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9.0 AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

9.1.1 New Fuel Storage

9.1.1.1 Design Bases

New fuel is stored in racks (Figure 9.1-1). Each rack is composed of individual vertical cells which can be fastened together in any number to form a module that can be firmly bolted to anchors in the floor of the new fuel storage pit. The new fuel storage racks are designed to include storage for 1/3 core for each unit at a center to center spacing of 21 inches. This spacing provides a minimum separation between adjacent fuel assemblies of 12 inches which is sufficient to maintain a subcritical array even in the event the building is flooded with unborated water. Space between storage positions is blocked to prevent insertion of fuel. All surfaces that come into contact with the fuel assemblies are made of annealed austenitic stainless steel, whereas the supporting structure may be painted carbon steel. A three inch drain is provided in the new fuel storage vault.

The racks are designed to withstand nominal operating loads as well as safe shutdown earthquake (SSE) and operating basis earthquake (OBE) seismic loads in accordance with Regulatory Guides 1.29 and 1.13.

The new fuel storage racks are located in the new fuel pit area which has a cover that protects the racks from dropped objects. Administrative controls are utilized when a section of the protective cover is removed for handling of the new fuel assemblies.

9.1.1.2 Facilities Description

The location of the new fuel storage vault is shown in Figures 1.2-3 and 1.2-8. The design of the new fuel storage racks is shown in Figure 9.1-1.

The new fuel storage vault is a reinforced concrete structure. This vault is a part of the Auxiliary Building, which is a Seismic Category I Structure (See Section 3.2).

The new fuel storage vault opens on to the Elevation 757 floor, but is normally covered by a series of hatches which are designed to withstand the effects of an OBE or SSE. These hatches are removed as necessary during handling of the new fuel.

9.1.1.3 Safety Evaluation

The center-to-center distance between new fuel assemblies is sufficient to assure $k_{eff} \leq 0.98$ when the new fuel storage area is dry or fogged (optimally moderated). For the fully flooded condition assuming cold, clean, unborated water, the value of k_{eff} is less than or equal to 0.95.

The new fuel assemblies are stored dry, the 21 inch center to center spacing ensuring an ever safe geometric array. Under these conditions, a criticality accident during refueling and storage is not considered credible.

Design of the storage racks is in accordance with Regulatory Guide 1.13 and 1.29 and ensures adequate safety under normal and postulated accidents.

Consideration of criticality safety analysis is discussed in Section 4.3.2.7.

9.1.2 Spent Fuel Storage

9.1.2.1 Design Bases

The spent fuel racks are designed in accordance with the following listed criteria:

1. The spent fuel storage racks were designed for storage of 1386 fuel assemblies. The design meets all the structural and seismic requirements of Category I equipment as defined by the NRC Position Paper dated April 14, 1978, on spent fuel storage and handling applications and the references listed in Table 9.1-3.

2. Burnup credit and fuel assembly placement controls are used to ensure the fuel array in the spent fuel racks is maintained subcritical assuming the array is fully flooded with nonborated water, the fuel is new with a maximum anticipated enrichment of 5.0 weight percent U-235 and the geometric array is the worst possible considering mechanical tolerances and abnormal conditions.

3. The spent fuel storage facility is designed to prevent severe natural phenomena, including missiles generated from high winds, from causing damage to the spent fuel. The spent fuel storage facility, including the spent fuel racks, is Seismic Category I.

4. The spent fuel storage racks are designed to withstand handling and normal operating loads and the maximum uplift forces generated by the fuel handling equipment.

5. A loss of pool cooling accident is not considered a credible accident because the pool cooling system is Seismic Category I and single failure proof.

6. The spent fuel storage racks are designed to withstand the impact of a dropped spent fuel assembly from the maximum lift height of the spent fuel pit bridge hoist.

7. The spent fuel storage facilities provide the capability for limiting the potential offsite exposures, in the event of significant release of radioactivity from the stored fuel, to well less than 10 CFR 100 guidelines.

9.1.2.2 Facilities Description

The spent fuel storage pool is a reinforced concrete structure with a stainless steel liner for leak tightness. This storage pool is a part of the Seismic Category I Auxiliary Building, and is shared between Units 1 and 2. Both the liner and pool walls are designed to withstand the effects of an OBE and SSE. The location of the spent fuel storage pool is shown on Figures 1.2-3 and 1.2-8. The storage rack configuration in the pool is shown on Figure 9.1-15. Typical storage racks are shown on Figure 9.1-16.

The spent fuel storage pool opens onto the Elevation 757 floor, and is protected by a guard rail which surrounds the pool. The depth of the pool is sufficient to allow some 26 feet of water shielding (nominally) above the spent fuel. This water depth ensures that the doses on the operating floor from stored spent fuel are negligibly small.

The spent fuel storage racks consist of stainless steel structures with cells or receptacles for nuclear fuel assemblies as they are used in a reactor. Twenty-four of these flux trap racks, provide 1386 storage positions in eighteen 7 x 8 cell array modules and six 7 x 9 cell array modules. Figure 9.1-15 shows the layout of the storage racks in the spent fuel pool. Each rack is supported by four pedestals (one rack has five pedestals) sitting on two-inch thick stainless steel bearing pads which spread the load on the pool floor.

9.1.2.3 Safety Evaluation

Design of these storage racks is in accordance with Regulatory Guide 1.13 and ensures a safe condition under normal and postulated accident conditions. The distance between spent fuel assemblies is maintained to ensure a $k_{eff} \leq 0.95$ even if unborated water is used to fill the spent fuel storage pool. Consideration of criticality safety analysis is discussed in Section 4.3.2.7.

The spent fuel racks are designed as free standing and are qualified as seismic Category I structures. The seismic design considered fully loaded racks in water at less than boiling temperature undergoing a SSE. Composite, dynamic simulations which modeled all racks in the pool were utilized to determine limiting loads and displacements for each rack in the pool, to establish limiting relative motion between racks, and to evaluate the potential for and the consequences of inter-rack and rack-wall phenomena in the entire assemblage of racks. The racks were also checked for OBE loads and found to be satisfactory. See section 3.8.4 for related pool structure information.

The racks can withstand the drop of a fuel assembly from its maximum supported height and the drop of tools used in the pool. The racks are also capable of withstanding accidental drops of the gates which cover the slots between the spent fuel pool and the transfer canal and cask loading pit from a height of eight feet above the top of the racks. Electrical and mechanical stops prevent the movement of heavy objects over the spent fuel pool including the shipping casks. The movement of the casks is restricted to areas away from the pool. The wall which separates the fuel storage area from the cask loading area has been designed to restrict damage to the cask loading area if a cask were dropped even in a tipped position in the cask loading area.

Loss of pool cooling and pool water events are discussed in Section 9.1.3. Radiation sources and protection for the pool water are discussed in Sections 12.2.1 and 12.3.2.2. Although the number of stored fuel assemblies is increased, the capacity of the pool water cleanup system is adequate to maintain radionuclide concentrations within design limits. Therefore no increase in personnel exposures is expected.

9.1.2.4 Materials

The materials used in the construction of the spent fuel racks are 304 stainless, CF-3M stainless and 17-4 PH stainless. The neutron poison material is a commercial product known as Boral and contains B_4C powder in a matrix.

The flux trap racks contain the following proven materials:

a. Poison inner can and outer tubes: 304 stainless steel, ASTM A-666-72 Grade B

b. Top and bottom grid castings: CF-3M, ASTM A-296-77

c. Threaded pedestal foot: 17-4 PH, ASTM A-564-66

In addition to the stainless steel material, the racks employ Boral, a patented product of AAR Brooks and Perkins, as the thermal neutron absorber material. Boral is a thermal neutron absorbing material consisting of finely divided particles of boron carbide (B_4C) uniformly distributed in type 1100 aluminum, pressed and sintered in a hot rolling process. Boron carbide is a compound having a high boron content in a physically stable and chemically inert form. The 1100 alloy aluminum is a light weight metal with high tensile strength which is protected from corrosion by a highly resistant oxide film. The two materials, boron carbide and aluminum, are chemically compatible and ideally suited for long term use in the radiation, thermal and chemical environment of a spent fuel pool.

9.1.3 Spent Fuel Pool Cooling and Cleanup System (SFPCCS)

The SFPCCS is designed to remove from the spent fuel pool water the decay heat generated by stored spent fuel assemblies. Additional functions of the SFPCCS are to clarify and purify the water in the spent fuel pool, transfer canal, and refueling water storage tanks (RWSTs). If a warning of flood above plant grade is received when the one with both reactor vessels are open or vented to the containment atmosphere, the SFPCCS will be modified as indicated in Section 2.4.14 to accomplish cooling the reactor core(s).

9.1.3.1 Design Bases

SFPCCS design parameters are given in Table 9.1-1.

9.1.3.1.1 Spent Fuel Pool Cooling

The SFPCCS is designed to remove the decay heat from the spent fuel assemblies stored in the pool and maintain acceptable pool temperatures following a full core discharge. The temperatures listed in Table 9.1-1 can be maintained for the various full core offload scenarios assuming the SFPCCS heat exchangers are supplied with component cooling water at its design flow and temperature. If it is necessary to remove a complete core after a normal refueling, the system can maintain the spent fuel pool water at or below 159.2°F in the worst case design basis single failure scenario.

The SFPCCS incorporates two trains of equipment (plus a spare pump capable of operation in either train). The flow through the pool provides sufficient mixing to ensure uniform water conditions throughout the pool. Under design basis Ultimate Heat Sink (UHS) temperatures and heat exchanger fouling conditions, the heat load in the spent fuel pool is limited to 28.1E+06 BTU/hr during refueling outages. Under more favorable conditions, up to 50.2E+06 BTU/hr may be accommodated. Cycle specific calculations may be performed prior to the start of a refueling outage to determine the exact heat removal capability of the SFPCCS using recent heat exchanger performance testing and anticipated UHS temperatures; otherwise, 28.1E+06 BTU/hr may not be exceeded. The rate of fuel transfer from the reactor to the SFP is controlled such that, with one (1) train of SFPCCS in service, the SFP temperature will remain below 151.2 °F. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation can be used to determine the time to begin core offload and the rate at which the core can be off loaded.

9.1.3.1.2 Spent Fuel Pool Dewatering Protection

System piping is arranged so that failure of any pipeline cannot drain the spent fuel pool below the water level required for radiation shielding. A water level of ten feet or more above the top of the stored spent fuel assemblies is maintained to limit direct gamma dose rate.

9.1.3.1.3 Water Purification

The system's demineralizer and filter are designed to provide adequate purification to permit unrestricted access to the spent fuel storage area for plant personnel and maintain optical clarity of the spent fuel pool water surface by use of the system's skimmers, strainer, and skimmer filter.

9.1.3.1.4 Flood Mode Cooling

Section 2.4.14 presents the design basis operation of the SFPCCS when it may be used for reactor core cooling during flooded plant conditions.

9.1.3.2 System Description

The SFPCCS, shown in Figure 9.1-3, consists of two cooling trains (plus a backup pump capable of operation in either train), a purification loop, and a separate skimmer loop. The electrical logic control diagrams for this system are shown in Figures 9.1-4 and 9.1-5.

The SFPCCS removes decay heat from fuel stored in the spent fuel pool. Spent fuel is placed in the pool during the refueling sequence and stored there until it is shipped offsite or the spent fuel assemblies may be placed in interim storage at WBN Independent Spent Fuel Storage Installation (ISFSI) (Section 9.1.6). The system normally handles the heat load from either a full core or 1/3 of a core freshly discharged from each reactor plus the decreasing heat load from previously discharged fuel. Heat is transferred from the SFPCCS through the heat exchangers to the component cooling system.

When the SFPCCS is in operation, water flows from the spent fuel pool to both spent fuel pool pump suctions, is pumped through the tube side of the heat exchangers, and is returned to the pool. Each pump's suction line, which is protected by a strainer, is located at an elevation four feet below the normal spent fuel pool water level, while the return line contains an anti-siphon hole near the surface of the water to prevent gravity drainage of the pool.

While the heat removal operation is in process, a portion of the spent fuel pool water may be diverted through a demineralizer and a filter to maintain spent fuel pool water clarity and purity. This purification loop is sufficient for removing fission products and other contaminants which may be introduced if a fuel assembly with defective cladding is transferred to the spent fuel pool.

The spent fuel pool demineralizer may be isolated, by manual valves, from the heat removal portion of the SFPCCS. By this means, the isolated demineralizer may be used in conjunction with a refueling water purification pump and filter to clean and purify the refueling water while spent fuel pool heat removal operations proceed. Connections are provided such that the refueling water may be pumped from either the RWST or the refueling cavity of either unit, through the demineralizer and filter, and discharged to the refueling cavity or RWST of either unit. Connections are also provided to allow cleanup of the water in the transfer canals. Water can be drawn from the canal, and is pumped by a refueling water purification pump through the spent fuel pool demineralizer and a refueling water purification filter before being returned to the transfer canal.

To further assist in maintaining spent fuel pool water clarity, the water surface is cleaned by a skimmer loop. Water is removed from the surface by the skimmers, pumped through a strainer and filter, and returned to the pool surface at three locations remote from the skimmers.

The spent fuel pool is filled with water that is at least 2000 ppm. Borated water may be supplied from the RWST via the refueling water purification pump connection, or by running a temporary line from the boric acid blender, located in the chemical and volume control system directly into the pool. Demineralized water can also be added for makeup purposes (i.e., to replace evaporative losses) through a connection in the recirculation return line.

The spent fuel pool water may be separated from the water in the transfer canal by a gate. The gate is installed so that the transfer canal may be drained to allow maintenance of the fuel transfer equipment. The water in the transfer canal is pumped via a refueling water purification pump (RWPP) to a RWST. The transfer canal will be refilled from the RWST by the RWPP when the maintenance is complete.

An alternate method when the transfer canal water is outside the chemistry limit for use in the RWST is to pump the transfer canal water to the chemical and volume control system (CVCS) holdup tank via the RWPP. The water will be pumped back to the transfer canal via the CVCS holdup tank recirculation pumps.

A description of the operation of the SFPCCS during flood mode operation is given in Section 2.4.14.

9.1.3.2.1 Component Description

Spent fuel pool cooling and cleanup system codes and classifications are given in Section 3.2. Equipment operating parameters are given in Table 9.1-2. System design parameters are given in Table 9.1-1.

Spent Fuel Pool Pumps

The two pumps are horizontal, centrifugal units. They circulate spent fuel pool water through the heat exchangers, demineralizer, and filter. The pumps are controlled manually from a local station. A third pump is installed to serve as a backup to either of the two pumps normally used for cooling the spent fuel pool water (refer to Section 2.4.14 and Section 9.1.3.3.1).

Spent Fuel Pool Skimmer Pump

This horizontal, centrifugal pump circulates surface water through a strainer and a filter and returns it to the pool.

Refueling Water Purification Pumps

These horizontal, centrifugal pumps are used to circulate water from the transfer canal, the refueling cavity and the RWST through the spent fuel pool demineralizer, and a refueling water purification filter. The pumps are operated manually from a local station.

Spent Fuel Pool Heat Exchangers

The spent fuel pool heat exchangers are of the shell and U-tube type with the tubes welded to the tube sheet. Component cooling water circulates through the shell, and spent fuel pool water circulates through the tubes.

Spent Fuel Pool Demineralizer

This flushable, mixed-bed demineralizer is designed to provide adequate fuel pool water purity for unrestricted access by plant personnel to the pool working area, and to maintain water visual clarity.

Spent Fuel Pool Filter

The spent fuel pool filter is designed to improve the pool water clarity by removing particles which obscure visibility.

Spent Fuel Pool Skimmer Filter

The spent fuel pool skimmer filter is used to remove particles which are not removed by the strainer.

Refueling Water Purification Filters

The refueling water purification filters are designed to improve the clarity of the refueling water in the refueling canal or in the RWST by removing particles which obscure visibility.

Spent Fuel Pool Strainer

A strainer is located in each spent-fuel pool pump suction line for removal of relatively large particles which might otherwise clog the spent fuel pool demineralizer or damage the spent fuel pool pumps.

Spent Fuel Pool Skimmer Strainer

The spent fuel pool skimmer strainer is designed to remove debris from the skimmer process stream.

Spent Fuel Pool Skimmers

Two spent fuel pool skimmers are provided to remove water from the spent fuel pool water surface in order to remove floating debris.

Valves

Manual stop valves are used to isolate equipment, and manual throttle valves provide flow control. Valves in contact with spent fuel pool water are of austenitic stainless steel or equivalent corrosion resistant material.

Piping

All piping in contact with spent fuel pool water is austenitic stainless steel. The piping is welded except where flanged connections are used to facilitate maintenance and access to shadowed fuel storage cells.

9.1.3.3 Safety Evaluation

9.1.3.3.1 Availability and Reliability

The SFPCCS is located in a Seismic Category I structure that is tornado missile protected. Active components of the cooling portion of the system are located above the design basis flood level in the Auxiliary Building (Section 2.4.14). The SFPCCS heat removal equipment is designed to remain functional for the design basis earthquake and within the required stress limits for the operational basis earthquake.

Electrical power is supplied from emergency power buses to each of the spent fuel pool pumps. Each pump is connected to these emergency power buses so that it receives power from a separate diesel generator set should offsite power be lost. The use of emergency power buses assures the operation of these pumps for open reactor cooling during plant flooding conditions. This manually controlled system may be shut down for limited periods of time for maintenance or replacement of malfunctioning components. The pool is sufficiently large that an extended period of time would be required for the water to heat up appreciably if cooling were interrupted (see Table 9.1-1). In the event of a failure of one spent fuel pool pump, the backup pump would be aligned and operated. In the event of loss of cooling to one spent fuel pool heat exchanger, cooling of the spent fuel pool water could be maintained by the remaining equipment; however, the reduced heat removal capacity would result in elevation of the spent fuel pool water equilibrium temperature to a higher, but acceptable, temperature.

In the event that cooling capability were lost for an extended period, the pool water temperature would approach boiling. At the maximum decay heat production rate, the water loss by vaporization would be about 102 gpm. A seismically qualified line is available from the common discharge of the refueling water purification pumps to the spent fuel pool cooling loop. All piping, valves, and pumps from the RWST to the common discharge of the refueling water purification pumps are seismically qualified. Other sources for makeup available are the demineralized water system and the fire protection system. A sufficient portion of the fire protection system is a Seismic Class I system. Fire hose stations located on seismic and non-seismic piping in the fire protection system are capable of supplying a sufficient quantity of makeup water.

9.1.3.3.2 Spent Fuel Pool Dewatering

The most serious failure of this system would be complete loss of water in the storage pool. To protect against this possibility, the spent fuel pool cooling suction connections enter near the normal water level such that it cannot be lowered appreciably by siphoning. The cooling water return line contains an anti-siphon hole to prevent draining of the pool. These design features assure that the pool cannot be drained below four feet of normal water level (normal water level in the spent fuel pool is approximately 26 feet above the top of the stored spent fuel).

The transfer canal has a drain connection in the bottom of the canal. The line runs upward, embedded in concrete, to a level about 13 feet below the normal pool surface. The line continues embedded, dropping below the bottom of the transfer canal. At the high point of the drain line, a siphon breaker line connects into the drain line, terminating in the canal above the normal pool surface. A valve in this line is locked open at all times except when the canal is to be drained. The transfer canal is isolated from the spent fuel pool with a sectionalizing gate during "Transfer Canal Dewatering", (draining operation). With this arrangement, if the transfer canal drain line ruptures, the pool level will not be affected. If the transfer canal drain line ruptures with the syphon valve open and the sectionalizing gate open, 13 feet of water will be above the fuel assemblies in the storage racks.

9.1.3.3.3 Pool and Fuel Temperatures

The cooling of the spent fuel assemblies stored within the storage racks has been analyzed for effective and adequate cooling under all postulated pool storage conditions.

Two discharge scenarios have been evaluated for both single and dual SFP cooling train operation. Case one considers a full core discharge while a second case considers a full core discharge following a normal refueling. Each case considers the accumulated decay heat of all previously discharged spent nuclear fuel assemblies stored in the SFP. Maximum bulk water temperatures for each core off load scenario are given in Table 9.1-1. Following unit shutdown, a decay time of approximately 33 days prior to the completion of core offload is required to maintain the total SFP decay heat below 28.1E+06 BTU/hr design basis limit.

For full core offload following a normal refueling outage (Emergency Offload), it is assumed that a unit is required to shutdown 36 days after a refueling outage on the opposite unit. Following shutdown, it is assumed that core offload will be completed after a 60 day decay time. Under these conditions, the maximum SFP decay heat will be less than 25.61E+06 BTU/hr, which is less than the normal refueling case. Specific guidance in the form of allowable spent fuel pool decay heat curves for better than design conditions of spent fuel pool heat exchanger fouling and shell side cooling temperatures has been developed. Decay heat curves are provided which allow outage specific variation in maximum spent fuel pool decay heat load based on known values of spent fuel pool heat exchanger fouling factors and component cooling system temperatures. Sufficient spent fuel pool cooling equipment is operated and the rate of fuel transfer is controlled to assure that the spent fuel pool temperature does not exceed 150°F during anticipated refueling activities. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation may be used to determine the time to begin core off load and the rate at which the core can be off loaded.

The maximum local water temperature and maximum local fuel temperature have been determined to evaluate the possibility of nucleate boiling on the surface of the fuel assemblies. Analysis has shown that for any scenario with at least one SFPCCS train available, localized boiling does not occur within the fuel racks. The decay heat flux of the rods is greatest at the fuel mid-height. Mid height fuel cladding temperatures of 208.2°F, 217.1°F, and 208.9°F have been calculated based on no blockage, partial blockage, and off-center placement of an assembly in a rack cell respectively. Local maximum water temperatures of 193.7°F, 204.1°F, and 195.2°F have been calculated for the no blockage, partial blockage, and off-center placement cases respectively. The local saturation temperature at the top of the racks (240.7°F) is greater than any calculated local water temperature, which precludes the possibility of nucleate boiling. Additionally, the local saturation temperature is greater than any calculated fuel cladding temperature, which would preclude the possibility of film boiling at the surface of the fuel rods.

The approach to localized boiling within the racks has been evaluated for highest allowable spent fuel decay heat load (50.21 Mbtu/hr) in Reference [1]. The conclusions of the evaluation indicate that greater than 6°F margin to localized boiling exist between the maximum calculated fuel clad temperature and the local saturation temperature even at the highest allowable heat load.

The total volume of water contained in the pool and cask pit area at the start of a loss of cooling scenario is 372,460 gallons. The expected water heat-up rates for a total loss of cooling capability accident for both a full core discharge and a full core discharge following a normal refueling are listed in Table 9.1-1.

9.1.3.3.4 Water Quality

Except for operation of this system in the flood mode of reactor cooling, only a very small amount of water is interchanged between the refueling canal and the spent fuel pool as fuel assemblies are transferred in the refueling process. Whenever a fuel assembly with defective cladding is transferred to the spent fuel pool, a small quantity of fission products may enter the spent fuel cooling water. The purification loop provided removes fission products and other contaminants from the water. Radioactivity concentrations in the spent fuel pool water are maintained at a level such that the dose rate at the surface of the pool is low enough to allow minimum-restricted access for plant personnel (refer to Section 12.3.2.2).

With the use of high purity water, it is expected that the racks and pool walls will not see any significant crud buildup.

9.1.3.3.5 Leakage Detection for the Spent Fuel Pool

Leakage detection is provided for the spent fuel pool (SFP) by leakage channels located on the back side of each welded joint of the floor and walls of the SFP steel liner. Leakage into these channels will drain to the perimeter leakage channels located at the bottom of the SFP. The leakage will then flow into the SFP drain pipe to a normally open manual gate valve. Visual detection of the leakage from the SFP may be witnessed as the leakage exits the manual valve and drips into a funnel. The leakage is then routed to the tritiated drain collector tank (TDCT) of the waste disposal system. In the event of excessive leakage, the manual gate valve may be closed to prevent further leakage. Similar type design of leakage channels and visual display of leakage are also provided for the fuel transfer canal and the cask loading area. Non qualified instrumentation are provided in the SFP and the TDCT with MCR low and local high level alarms, respectively.

9.1.3.4 Tests and Inspections

Active components of the SFPCCS are either in continuous or intermittent use during normal plant operation. Periodic visual inspection and preventive maintenance are conducted using normal industry practice.

9.1.3.5 Instrument Application

The instrumentation for the SFPCCS is discussed below. Alarms and indicators are provided as noted.

9.1.3.5.1 Temperature

Instrumentation is provided to measure the temperature of the water in the spent fuel pool and give local indication as well as annunciation in the control room when normal temperatures are exceeded.

Instrumentation is also provided to give local indication of the temperature of the spent fuel pool water as it leaves the heat exchangers.

9.1.3.5.2 Pressure

Instrumentation is provided to give local indication of the pressure at points upstream and downstream of each pump and filter.

9.1.3.5.3 Flow

Instrumentation is provided to give local indication of the flow leaving the spent fuel pool filter and in the main cooling loops.

9.1.3.5.4 Level

Instrumentation is provided which gives an alarm in the control room when the water level in the spent fuel pool reaches either the high or low level condition.

9.1.4 Fuel Handling System

9.1.4.1 Design Bases

The fuel handling system (FHS) consists of equipment and structures utilized for safely implementing refueling operation in accordance with requirements of General Design Criteria 61 and 62 of 10 CFR 50, Appendix A.

The following design bases apply to the FHS.

1. Fuel handling devices have provisions to avoid dropping or jamming of fuel assemblies during transfer operation.

2. Handling equipment has provisions to avoid dropping of fuel handling devices during the fuel transfer operation.

3. Handling equipment used to raise and lower spent fuel has a limited maximum lift height so that the minimum required depth of water shielding is maintained. See New Fuel Elevator description for use with spent fuel.

4. The Fuel Transfer System (FTS), where it penetrates the containment, has provisions to preserve the integrity of the containment pressure boundary.

5. Criticality during fuel handling operations is prevented by geometrically safe configuration of the fuel handling equipment.

6. Handling equipment will not fail in such a manner as to damage Seismic Category I equipment in the event of a safe shutdown earthquake.

7. The inertial loads imparted to the fuel assemblies or core components during handling operations are less than the loads which could cause damage.

8. Physical safety features are provided for personnel operating handling equipment.

9.1.4.2 System Description

The FHS consists of the equipment needed for the refueling operation on the reactor core. Basically this equipment is comprised of the reactor component hoisting equipment, fuel handling equipment and the FTS. The structures associated with the fuel handling equipment are the refueling cavity, the refueling canal, the transfer canal, the spent fuel storage pit, the cask loading area and the new fuel storage vault.

New fuel assemblies are received one or two per shipping container and moved one assembly at a time using the Auxiliary Building crane. The assemblies are temporarily stored in either the new fuel vault for dry storage or in the spent fuel pool as a staging area for the next refueling. When storage in the spent fuel pool is desired, assemblies are placed into the new fuel elevator and lowered into the transfer canal where normal spent fuel handling equipment is used to complete the movement into its storage location. New assemblies may be transferred directly from the shipping container or from the new fuel vault into the reactor core or spent fuel pool via the new fuel elevator and normal spent fuel handling equipment.

The fuel handling equipment is designed to handle the spent fuel under water from the time it leaves the reactor vessel until it is placed in a container for shipment from the site or the spent fuel assemblies may be placed in interim storage at WBN Independent Spent Fuel Storage Installation (ISFSI) (Section 9.1.6). Underwater transfer of spent fuel provides an effective, economic and transparent radiation shield, as well as a reliable cooling medium for removal of decay heat. The boric acid concentration in the water is sufficient to preclude criticality.

The associated fuel handling structures may be generally divided into three areas: the refueling cavity and refueling canal which are flooded only during plant shutdown for refueling, the spent fuel storage area which is kept full of water and is always accessible to operating personnel, and the new fuel storage vault which is separate and protected for dry storage. The refueling canal and the transfer canal are connected by a fuel transfer tube. This tube is fitted with a blind flange on the refueling canal end and a gate valve on the transfer canal end. The blind flange is in place except during refueling to ensure containment integrity. Fuel is carried through the tube on an underwater transfer car.

Fuel is moved between the reactor vessel and the refueling canal by the refueling machine. A rod cluster control changing fixture is located on the refueling canal wall and may be used for transferring control elements from one fuel assembly to another. The rod cluster control assembly (RCCA) change tool is used from the spent fuel pool bridge crane to transfer control elements from one assembly to another in the spent fuel pool.

The lifting arm at either end of the fuel transfer tube is used to pivot a fuel assembly. Before entering the transfer tube the lifting arm pivots a fuel assembly to the horizontal position for passage through the transfer tube. After the transfer car transports the fuel assembly through the transfer tube, the lifting arm at that end of the tube pivots the assembly to a vertical position so that it can be lifted out of the upender frame.

In the spent fuel storage area, spent fuel assemblies are moved about by the spent fuel pit bridge hoist. When lifting spent fuel assemblies, the hoist uses a long-handled tool to assure that sufficient radiation shielding is maintained. A shorter tool is used to handle new fuel assemblies with the Auxiliary Building crane, but the new fuel elevator must be used to lower the assembly to a depth at which the spent fuel pit bridge crane using the long-handled tool, can place the new fuel assembly into the upending device.

The new fuel elevator may be used to raise or lower an irradiated fuel assembly to facilitate maintenance activities under administrative controls that ensure sufficient radiation shielding is maintained.

Decay heat, generated by the spent fuel assemblies in the spent fuel pit, is removed by the spent fuel pool cooling system.

After a sufficient decay period, the fuel may be removed from the racks and loaded into a shipping ask for removal from the site or the spent fuel assemblies may be placed in interim storage at the WBN Independent Spent Fuel Storage Installation (ISFSI) (Section 9.1.6).

9.1.4.2.1 Refueling Procedure

The refueling operation follows a detailed procedure which provides a safe, efficient refueling operation. Reactor core alterations or handling of irradiated fuel are suspended during a tornado warning. Prior to initiating refueling operations the reactor coolant system is borated and cooled down to refueling shutdown conditions as specified in the Technical Specifications. Criticality protection for refueling operations, including a requirement for periodic checks of boron concentration, is specified in the Technical Specifications.

The following significant points are assured by the refueling procedure:

1. The refueling water and the reactor coolant contain the required concentration of boron. This concentration is sufficient to keep the core reactivity of $k_{eff} \leq 0.95$ during the refueling operations with all control rods inserted except the most reactive rod.

2. The water level in the refueling cavity is high enough to keep the radiation levels within acceptable limits when the fuel assemblies are being removed from the core.

The refueling operation is divided into four major phases. A general description of a typical refueling operation through the four phases is given below:

1. Phase I - Preparation

The reactor is shut down and cooled to refueling conditions with a final $k_{eff} \leq 0.95$ (all rods in except the most reactive rod). At this time, the coolant level in the reactor vessel is lowered to a point slightly below the vessel flange. Then the fuel transfer equipment is checked for proper operation. The refueling machine is checked for proper operation prior to or during Phase I.

2. Phase II - Reactor Disassembly

Missile shields are removed from around the reactor head, allowing all piping, supports, cables, air ducts, and insulation to be removed from the vessel head. The refueling cavity is then prepared for flooding by sealing off the reactor cavity, checking of the underwater lights, tools, and FTS, closing the refueling canal drain holes, and removing the blind flange from the fuel transfer tube. After the reactor vessel head has been detensioned, the vessel head is unseated and raised above the vessel flange. Water from the RWST is pumped into the reactor coolant system by the residual heat removal pumps. During reactor pressure vessel (RPV) head removal and lift, radiation levels are monitored and direct inspections are performed to detect potential rod cluster control assembly (RCCA) withdrawal. This inspection may be performed by monitoring the source range instrumentation for any unusual unexpected change during RPV head removal. The RPV head is raised to clear obstructions, and moved to the storage stand. The reactor cavity water level is raised to just above the vessel flange, leak inspections are initiated and the level is increased to cover the upper internals guide tubes. The cavity water level is raised to the normal refueling level. The control rod drive shafts are disconnected and, with the upper internals, are removed from the vessel. The fuel is now free from obstructions and the core is ready for refueling.

3. Phase III - Fuel Handling

The general fuel handling sequence for a full core off load is:

a. The refueling machine is placed over the first assembly to be removed.

b. The fuel assembly is lifted and moved into the upender.

c. The upender is then pivoted to the horizontal position by the lifting arm.

d. The fuel is moved through the fuel transfer tube to the transfer canal area by the transfer car.

e. The fuel assembly is pivoted to the vertical position by the lifting arm. The fuel assembly is lifted and moved by the spent fuel handling tool attached to the spent fuel pit bridge crane.

f. The fuel assembly is then placed into a spent fuel rack storage cell.

g. This sequence is repeated until all 193 fuel assemblies are removed from the core and placed into the spent fuel pit.

h. Fuel related components are then shuffled/removed from assemblies and placed into their proper locations. After fuel related components shuffles are completed, the fuel is loaded back into the core in the prescribed sequence by reversing the above steps.

4. Phase IV - Dry Cask Storage Operations

Dry cask storage operations are provided in WBN Independent Spent Fuel Storage Installation (ISFSI) (Section 9.1.6).

9.1.4.2.2 Component Description

Refueling Machine

The refueling machine (Figure 9.1-6) is a rectilinear bridge and trolley crane with a vertical mast extending down into the refueling water. The bridge spans the refueling cavity and runs on rails set into the edge of the refueling cavity. The bridge and trolley motions are used to position the vertical mast over a fuel assembly. A long tube with a pneumatic gripper on the end is lowered down out of the mast to grip the fuel assembly. The gripper tube is long enough so that the upper end is still contained in the mast when the gripper end contacts the fuel. A winch mounted on the trolley raises the gripper tube and fuel assembly up into the mast tube. The fuel is transported while inside the mast tube to its new position.

The refueling machine uses three AC servo motors to control bridge, trolley, and hoist motions. Boundaries, interlocks, and speeds are controlled by an industrial programmable logic controller.

All major controls for the refueling machine are mounted in a console on the trolley. The bridge and trolley are positioned in relation to a grid pattern referenced to the core by a series of redundant digital encoder systems.

The drives for the bridge, trolley and hoist are variable speed. The maximum speed for the bridge is approximately 60 fpm and the maximum speed for the trolley is approximately 40 fpm. The maximum speed for the hoist is approximately 40 fpm.

The refueling machine has two auxiliary monorail hoists, one on each side of the bridge upper structure.

Electrical interlocks and limit switches on the bridge and trolley drives prevent damage to the fuel assemblies. The hoist is also provided with redundant limit switches to prevent a fuel assembly from being raised above a safe shielding depth should the limit switch fail. In an emergency, the bridge, trolley, and hoist can be operated manually using a handwheel on the motor shaft to return the system to a safe configuration..

Portable underwater cameras are used, as required, during refueling operations and can permit viewing of all fuel assembly positions.

Spent Fuel Pit Bridge Crane

The spent fuel pit bridge crane (Figure 9.1-7) is a steel-mounted walkway spanning the spent fuel pit, which carries an electric monorail hoist on an overhead structure. The spent fuel pit bridge crane is used exclusively for handling fuel assemblies within the spent fuel pit and transfer canal by means of a long-handled tool suspended from the hoist. The hoist travel and tool length are designed to limit the maximum lift of a fuel assembly to a safe shielding depth.

The spent fuel bridge crane has two step magnetic controllers for the bridge and hoist. The bridge speeds are 11 and 33 fpm and the hoist speeds are 7 and 20 fpm. A hydraulic coupling is used in the bridge drive to limit starting acceleration.

The hoist pendent control is equipped with a load sensing device to indicate an overload in the up direction or an underload in the down direction to prevent damage to the fuel elements. The hoist trolley is hand operated by a chain drive.

New Fuel Elevator

The new fuel elevator (Figure 9.1-8) consists of a box-shaped elevator assembly with its top end open and sized to house one fuel assembly.

The new fuel elevator is used primarily to lower a new fuel assembly to the bottom of the fuel transfer canal where it is transported to the fuel transfer system by the spent fuel pit bridge hoist.

The new fuel elevator may also be used to raise and lower an irradiated fuel assembly to facilitate maintenance activities. Prior to placing an irradiated fuel assembly in the elevator, safety precautions will be implemented to limit the maximum lift of the fuel assembly to a safe shielding depth.

Fuel Transfer System

The fuel transfer system (Figure 9.1-9) includes a cable-driven transfer car that runs on tracks extending from the reactor cavity through the transfer tube into the transfer canal. At each end of the transfer tube are lifting arms. The upender in the refueling cavity receives a fuel assembly in the vertical position from the refueling machine.

The fuel assembly is then pivoted to a horizontal position with the lifting arm for passage through the transfer tube. The transfer car is positively connected to the drive train in the transfer canal. After passing through the tube, the fuel assembly is pivoted to a vertical position for removal to the spent fuel pit storage location via the spent fuel pit bridge crane.

During reactor operation, the transfer car is stored in the transfer canal. A blind flange is bolted on the refueling canal end of the transfer tube to seal the reactor containment. The terminus of the tube in the transfer canal is closed by a gate valve.

Rod Cluster Control (RCC) Changing Fixture

The RCC changing fixture is supplied for periodic RCC element inspections and for transfer of RCC elements from one fuel assembly to another in the event this operation is ever required (Figure 9.1-10). The major subassemblies which comprise the changing fixture are the frame and track structure, the carriage, the guide tube, the gripper, and the drive mechanism. The carriage is a moveable container supported by the frame and track structure. The tracks provide a guide for the four flanged carriage wheels and allows horizontal movement of the carriage during changing operation. The positioning stops on both the carriage and frame locate each of the three carriage compartments directly below the guide tube. Two of these compartments are designed to hold individual fuel assemblies while the third is made to support a single rod cluster control element. Situated above the carriage and mounted on the refueling canal wall is the guide tube. The guide tube provides for the guidance and proper orientation of the gripper and rod cluster control element as they are being raised and lowered. The gripper is a pneumatically actuated mechanism responsible for engaging the rod cluster control element. It has two flexure fingers which can be inserted into the top of the rod cluster control element when air pressure is applied to the gripper piston. Normally the fingers are locked in a radially extended position. Mounted on the operating deck is the drive mechanism assembly which consists of the manual carriage drive mechanism, the operating handle, the pneumatic selector valve for actuating the gripper piston, and the electric hoist for elevation control of the gripper.

Spent Fuel Assembly Handling Tool

The spent fuel assembly handling tool (Figure 9.1-11) is used to handle new and spent fuel assemblies in the spent fuel pit. It is a manually actuated tool, suspended from the spent fuel pit bridge crane, which uses four cam actuated latching fingers to grip the underside of the fuel assembly top nozzle. The operating handle to actuate the fingers is located at the top of the tool. When the fingers are latched, a pin is inserted into the operating handle which prevents the fingers from being accidentally unlatched during fuel handling operations.

New Fuel Assembly Handling Tool

The new fuel assembly handling tool (Figure 9.1-12) is used to lift and transfer fuel assemblies between the new fuel shipping containers, the new fuel storage racks, and/or the new fuel elevator. It is a manually actuated tool suspended from the Auxiliary Building crane which uses four cam actuated latching fingers to grip the underside of the fuel assembly top nozzle. The operating handles to actuate the fingers are located on the side of tool. When the fingers are latched, the safety screw is turned in to prevent the accidental unlatching of the fingers.

Reactor Vessel Head Lifting Device

The reactor vessel head lifting device consists of a welded and bolted structural steel frame with suitable rigging to enable lifting and storing the head during refueling operations. The lifting device is permanently attached to the reactor vessel head.

Reactor Internals Lifting Device

The reactor internals lifting device (Figure 9.1-13) is a structural steel frame. The frame is lowered onto the guide tube support plate of the internals, and is mechanically connected to the support plate by three bolts. Bushings on the frame engage guide studs in the vessel flange to provide guidance during removal and replacement of the internals package.

Reactor Vessel Stud Tensioner

The stud tensioners (Figure 9.1-14) are employed to secure the head closure joint at every refueling. The stud tensioner is a hydraulically operated device that uses oil as the working fluid. The device permits preloading and unloading of the reactor vessel closure studs at cold shutdown conditions. Stud tensioners minimize the time required for stud tensioning and detensioning operations. Three tensioners are provided and are applied simultaneously to three studs located 120 degrees apart. A single hydraulic pumping unit operates the tensioners, which are hydraulically connected. The studs are tensioned to their operational load in two steps to prevent high stresses in the flange region and unequal loadings in the studs. Relief valves on each tensioner prevent overtensioning of the studs due to excessive pressure.

9.1.4.3 Design Evaluation

9.1.4.3.1 Safe Handling

Design Criteria for the Refueling Machine

1. The primary design objective of the refueling machine is reliability. A conservative design approach is used for all load bearing parts. Throughout the design consideration is given to the fact that the machine spends long idle periods stored in an atmosphere of 80°F and high humidity. In general, the crane structure is considered in the Class AI, Standby Service, as defined by the Crane Manufacturers Association of American Specification No. 70.

2. Seismic design considerations are discussed in Section 9.1.4.3.2.

3. All components critical to the operation of the crane and parts which could fall into the reactor are positively restrained from loosening. Fasteners above water that cannot be lockwired or tack welded are coated with locking compound.

Industrial codes and standards used in the design of the fuel handling equipment are:

1. Refueling machine and fuel handling machine: Applicable sections of Crane Manufacturer Association of America Specification No. 70.

2. Structural: AISC, Part 5, 7th Edition

3. Electrical: Applicable standards and requirements of the IEEE Standard 279, National Electric Code, NFPA#70, and NEMA Standard MG 1 and shall be used in the design of all electrical equipment.

4. Materials: Materials conform to the specifications of the ASTM standard.

5. Safety: OSHA Standards 29 CFR 1910 and 29 CFR 1926, including load testing requirements, the requirements of Regulatory Guide 1.29, and General Design Criteria 61 and 62.

Refueling Machine

The refueling machine design includes the following provisions to ensure safe handling of fuel assemblies:

1. Electrical Interlocks

a. Bridge, Trolley and Hoist Drive Interlocks

Bridge, along with the trolley drives are interlocked with the hoist, using redundant interlocks to prevent simultaneous operation of the hoist with the bridge and/or trolley.

b. Bridge Trolley Drive - Gripper Tube Up

Bridge and trolley drive operation is prevented except when the gripper tube up position switches are actuated or during indexing operations. The interlock is redundant.

c. Gripper Interlock

An interlock is supplied which prevents the opening of a solenoid valve in the air line to the gripper except when zero suspended weight is indicated by a force gage. As backup protection for this interlock, the mechanical weight actuated lock in the gripper, prevents operation of the gripper under load even if air pressure is applied to the operating cylinder. This interlock is redundant.

d. Excessive Suspended Weight

Two redundant excessive suspended weight switches open the hoist drive circuit in the up direction when the loading is excessive based on the vendor recommendations. The interlock is redundant.

The hoist is also provided with a low-load safety circuit, which prevents down-travel of the hoist if the load cell weight is sufficiently reduced. This minimizes the possibility of fuel assembly damage if one fuel assembly were to be lowered on top of another fuel assembly. The low load safety circuit setpoint is established using vendor recommendations.

e. Hoist-Gripper Position Interlock

An interlock in the hoist drive circuit in the up direction permits the hoist to be operated only when either the open or closed indicating switch on the gripper is actuated. The hoist-gripper position interlock consists of two separate circuits that work in parallel so that one circuit must be closed for the hoist to operate. If one or both interlocking circuits fail in the closed position, an audible and visual alarm on the console is actuated.

2. Bridge and Trolley Hold-Down Devices

Both refueling machine bridge and trolley are horizontally restrained on the rails by two pairs of guide rollers, one pair at each wheel location on one truck only. The rollers are attached to the bridge truck and contact the vertical faces on either side of the rail to prevent horizontal movement. Vertical restraint is accomplished by anti-rotation bars located at each of the four wheels for both the bridge and trolley. The anti-rotation bars are bolted to the trucks and, for the bridge restraints, extended under the rail flange, while the trolley restraints extend beneath the top flange of the bridge girder which supports the trolley rail. Both horizontal and vertical restraints are adequately designed to withstand the forces and overturning moments resulting from the Safe Shutdown Earthquake.

3. Design Load

The structure which supports the fuel assembly is designed for a static load of 5500 pounds. The refueling machine hoist has a manufacturer's rated capacity of 4000 pounds but is capable of supporting a static load of 5000 pounds with a safety factor of 5.0, and has been evaluated to be capable of a 5500 lb. static load in an emergency. Under normal conditions, the working load of the hoist is 2500 pounds (the weight of a fuel assembly, approximately 1600 pounds, plus gripper tube which weighs less than 1000 pounds). During normal hoist operation, the overload setpoint limits the hoist load to a value well below the rated capacity of the hoist. This value is based on vendor recommendations. The maximum allowable emergency pullout load (total maximum load which can be applied using the handwheel without danger of over stressing the hoist and supporting structure) is 5500 pounds. The 5500 pound load is a static load to be applied with the handwheel only, and only under emergency conditions. A load sensing device allows the load to be measured, so the operator knows the load being imposed on the hoist when using the handwheel.

4. Main Hoist Braking System

The main hoist is equipped with two independent braking systems. A solenoid release, spring-set electric brake is mounted on the motor shaft. This brake operates in the normal manner to release upon application of current to the motor and set when current is interrupted. The second brake is a mechanically actuated load brake internal to the hoist gear box that sets if the load starts to overhaul the hoist. It is necessary to apply torque from the motor to raise or lower the load. In raising, this motor cams to brake open; in lowering, the motor slips the brake allowing the load to lower. This brake actuates upon loss of torque from the motor for any reason and is not dependent on any electrical circuits. The motor brake capacity is 100% of the rated hoist capacity of 4000 pounds. The mechanical brake has a capacity of 150% of the rated hoist capacity.

5. Fuel Assembly Support System

    The main hoist system is supplied with redundant paths of load support such that failure of any one component will not result in free fall of the fuel assembly. Two wire ropes are anchored to the winch drum and carried over independent sheaves to a load equalizing mechanism on the top of the gripper tube. In addition, supports for the sheaves and equalizing mechanism are backed up by passive restraints to pick up the load in the event of failure of this primary support. Each wire rope has a load rating 5 times the design load.

The gripper mechanism contains a spring actuated mechanical lock which prevents the gripper from opening unless the gripper is under a compressive load.

The gripper and hoist systems are routinely load tested to the requirements listed in the plant Technical Requirements Manual.

Fuel Transfer System

The following safety features are provided for in the fuel transfer system.

1. Transfer Car Permissive Switch

    The primary transfer car controls are located on the operating floor and some conditions in the containment may, therefore, not be visible to the operator. The transfer car controls include an e-stop function on the containment side transfer control console allowing a second operator in the containment to exercise some control over car movement if conditions visible to him warrant such control. Transfer car operation is possible only when both lifting arms are in the down position as indicated by the underwater proximity switches. A second set of underwater proximity switches monitor the full up position of each of the upenders. Control logic provides a second permissive condition as a backup for the transfer car lifting arm interlock. Assuming the upender is in the upright position in the containment and the lifting arm interlock circuit fails in the permissive condition, the operator on the operating floor still cannot operate the car because the logic prevents car motion if either upender is indicated as being full up, or if either upender is indicated as being in motion.

2. Lifting Arm - Transfer Car Position

    Lifting arm operation is permitted only when the transfer car is at the respective end of its travel. Transfer car position indication, limit sensing, and braking controls are displayed on the control panel. The backup lifting arm interlock, a mechanical latch device which is opened by the weight of the fuel container when in the horizontal position, has been abandoned.

3. Transfer Car - Valve Open

   Interlocks on the transfer tube valve permit transfer car operation only when the transfer tube valve position switch indicates the valve is fully open.

4. Transfer Car - Lifting Arm

   The transfer car lifting arm interlock is primarily designed to protect the equipment from overload and possible damage if an attempt is made to move the car when the upender is not in the horizontal position. The basic interlock is a position limit switch in the control circuit made up from a 150 pound load, cart in position, and cart in zone.

5. Lifting Arm - Refueling Machine

   The refueling canal lifting arm is interlocked with the refueling machine. Whenever the transfer car is located in the refueling canal, the lifting arm cannot be operated unless the refueling machine mast is in the fully retracted position or the refueling machine is not over the upender.

6. Lifting Arm - Spent Fuel Pit Bridge

   The transfer canal lifting arm is interlocked with the spent fuel pit bridge position and hoist. The lifting arm cannot be operated when the spent fuel pit bridge is over the lifting arm area and the hoist is not in the full up position or when the spent fuel pit bridge crane is in bypass mode.

Spent Fuel Pit Bridge

The spent fuel pit bridge includes the following safety features.

1. The spent fuel pit bridge controls are interlocked to prevent simultaneous operation of bridge drive and hoist.

2. Bridge drive operation is prevented except when the hoist is in the full up position unless in bypass mode which allows bridge slow speed when the hoist is not in the full up position.

3. An overload protection device is included on the load monitor to limit the uplift force. The overload is set and administratively controlled based on Westinghouse recommendations.

4. Restraining bars are provided on each track to prevent the bridge from overturning.

Fuel Handling Tools and Equipment

All fuel handling tools and equipment handled over an open reactor vessel are designed to prevent inadvertent decoupling from machine hooks (i.e., lifting rigs are pinned to the machine hook and safety latches are provided on hooks supporting tools).

Tools required for handling internal reactor components are designed with fail safe features that prevent disengagement of the component in the event of operating mechanism malfunction. These safety features apply to all tools which handle or service new or spent fuel or fuel related components.

9.1.4.3.2 Seismic Considerations

The safety classifications for all fuel handling and storage equipment are listed in Table 3.2-2. These safety classes provide criteria for the seismic design of the various components. Class 1 and Class 2 equipment is designed to withstand the forces of the OBE and SSE. For normal conditions plus OBE loadings, the resulting stresses are limited to allowable working stresses as defined in the ASME Code, Section III, Appendix XVII, Subarticle XVII-2200 for normal and upset conditions. For normal conditions plus SSE loadings, the stresses are limited to within the allowable values given by Subarticle XVII-2110 for critical parts of the equipment which are required to maintain the capability of the equipment to perform its safety function. Permanent deformation is allowed for the loading combination which includes the SSE to the extent that there is no loss of safety function. The Class 3 fuel handling and storage equipment satisfies the Class 1 and Class 2 criteria given above for the SSE. Consideration is given to the OBE only insofar as failure of the Class 3 equipment might adversely affect Class 1 or 2 equipment.

For non-nuclear safety equipment, design for the SSE is considered if failure might adversely affect a Safety Class 1, 2 or 3 component. Design for the OBE is considered if failure of the non-nuclear safety component might adversely affect a Safety Class 1 or 2 component.

9.1.4.3.3 Containment Pressure Boundary Integrity

The fuel transfer tube which connects the refueling cavity (inside the reactor containment) and the operating floor (outside the containment) is closed on the refueling cavity side by a blind flange when containment integrity is required, except during refueling operations. Two seals are located around the periphery of the blind flange with leak-check provisions between them.

9.1.4.3.4 Radiation Shielding

During all phases of spent fuel transfer, the gamma dose rate at the refueling bridge is 2.5 mr/hr or less. This is accomplished by maintaining a minimum of 9.9 feet of water above the active fuel region which correlates to 8 feet and 10.875 inches above the top of the fuel assembly during all handling operations.

The two fuel handling devices used to lift spent fuel assemblies are the refueling machine and the spent fuel pit bridge. The refueling machine contains positive stops which prevent the active fuel region of a fuel assembly from being raised to within a minimum of 9.9 feet of the water level in the refueling cavity. The hoist on the spent fuel pit bridge moves spent fuel assemblies with a long handled tool. Hoist travel and tool length likewise limit the maximum lift of the active fuel region of a fuel assembly to within a minimum of 9.9 feet of the water level in the spent fuel pit and transfer canal.

9.1.4.4 Tests and Inspections

As part of normal plant operations, the fuel handling equipment is inspected for operating conditions prior to each refueling and dry cask storage (Reference 9.1.6) operation. During the operational testing of this equipment, procedures are followed that will affirm the correct performance of the fuel handling system interlocks.

9.1.5 Tritium Producing Burnable Absorber Rods (TPBARs) Consolidation Activity (Unit 1 Only)

9.1.5.1 Design Bases

Equipment is installed in the Spent Fuel Pit (SFP) cask loading and set-down areas for consolidating up to 300 TPBARs into a consolidation canister. The loaded consolidation canisters will be stored in the existing fuel pool racks to await shipment to the DOE Tritium Extraction Facility.

The design basis applicable to the consolidation equipment is to consolidate TPBARs in a manner that ensures existing fuel handling equipment functional and design requirements are met. Functions which support this basis include requirements to meet existing seismic qualification, environmental compatibility, materials compatibility, NUREG-0612, and ALARA.

9.1.5.2 Facilities Description

The consolidation equipment performs its consolidation function in the SFP fuel cask loading pit, and is stored in the SFP cask set-down area below Elevation 757. Control cabinets, camera equipment, cables, etc, which contain combustible materials will be stored in an area that is acceptable from a fire loading standpoint. See UFSAR Figures 9.1-17, 9.1-18 and 9.1-19 respectively for a pictorial Consolidation Plan, Layout and Canister design.

The equipment and fixtures that will be submerged in the SFP have been fabricated of stainless steels or non-stainless materials compatible with borated water communicating with the RCS. The roller brake, cables, and rollers are made of materials known to withstand the hot borated water, and expected radiation environment without affecting the function of the plant systems.

TPBAR assemblies containing irradiated TPBARs are moved from the SFP to equipment contained in the SFP cask area for consolidation into canisters. Loaded TPBAR canisters will be moved under-water through the opening connecting the SFP cask loading area to designated fuel storage racks in the Spent Fuel Pool for storage. When ready for shipment, canisters containing irradiated TPBARs will be removed from the SFP storage rack, moved underwater to the SFP cask loading area, and loaded into a TPBAR Transport Cask for shipment to the Tritium Extraction Facility. Special fixtures and lifting devices will be used in conjunction with the existing bridge crane to facilitate movement of the loaded TPBAR canisters to and from their designated storage rack.

9.1.5.3 Safety Evaluation

a) Design of the consolidation equipment, cabinet and controls, appurtenances, supports, and framing is in accordance with Regulatory Guide 1.13 and 1.29, which ensures adequate safety under normal condition, postulated SSE and OBE, and accidents.

b) The equipment and fixtures that will be submerged in the SFP have been fabricated of stainless steels or other materials compatible with the hot, borated water, radiation environment and the stainless SFP liner in communication with RCS. This equipment will not affect operation of the plant, will not adversely affect the function of plant systems, and will have no adverse affect on safe shutdown or the safety of plant personnel or the public.

c) The TPBAR handling and consolidation equipment is designed and configured such that minimum water shielding in the Spent Fuel Pool and Cask Loading Pit is maintained to keep dose rates ALARA. Equipment, tools, and design features prevent inadvertently raising the TPBAR assemblies, loaded canisters, or post-consolidation baseplates above safe shielding depths.

d) The existing auxiliary building crane or bridge crane fuel handling equipment will be used, with new handling fixtures/devices as required to move the consolidation fixture and TPBAR canister within normal boundaries; thus ensuring that handling events are bounded by existing fuel handling safety and accident analyses.

e) Refer to the LAR for a description of TPBAR consolidation and safety analysis.

REFERENCES

1. Holtec Report No. HI-2002607, R0, “LOCA Temperature Analysis of the Watts Bar Spent Fuel Pool.”

2. LAR TVA-WBN-TS-00-015, “Watts Bar Nuclear Plant (WBN) – Unit 1 – Revision of Boron Concentration Limits and Reactor Core Limitations for Tritium Production Cores (TPCs) – Technical Specification (TS) Change No. TVA-WBN-TS-00-015” (T04010821812). (Unit 1 Only)

9.1.6 Independent Spent Fuel Storage Installation (ISFSI)

9.1.6.1 Regulatory Basis

Under 10 CFR 72.210, WBN is issued a general license for storage of spent fuel in an Independent Spent Fuel Storage Installation (ISFSI). An ISFSI is a complex that is designed and constructed for interim storage of spent nuclear fuel, solid reactor-related GTCC waste, and other radioactive materials associated with spent fuel and reactor-related GTCC waste storage. TVA selected HOLTEC International’s HI-STORM FW storage system for use at WBN’s ISFSI to maintain adequate on-site spent fuel storage capacity. Upon NRC approval of the Final Safety Analysis Report (FSAR) for the HI-STORM FW storage system, the NRC issued Certificate of Compliance (CoC) Docket No. 72-1032 and Safety Evaluation Report (SER) Docket No. 72-1032 for use of the HI-STORM FW system. As a General Licensee, WBN is authorized to use the HI-STORM FW storage system in accordance with:

- NUREG-1536, Standard Review Plan for Dry Cask Storage Systems
- CoC 72-1032, Containing:
    - Appendix A: Technical Specifications
    - Appendix B: Approved Contents and Design Features
- HOLTEC FSAR for the HI-STORM FW
- NRC Safety Evaluation Report: HI-STORM FW System
- 10 CFR 72, as applicable per 10 CFR 72.13
- WBN 10 CFR 72.212 Evaluation Report

9.1.6.2 System Description

The HI-STORM FW system used at WBN is comprised of stainless steel multi-purpose canister (MPC-37), a transfer cask (HI-TRAC VW), and a HI-STORM metal / concrete overpack. WBN implemented Holtec International’s HI-STORM FW Version XL overpack during the second ISFSI campaign. The FW Version XL is an alternative to the standard HI-STORM FW cask and features a more effective closure lid to further improve sky shine and vent outlet dose performance. The use of the term HI-STORM FW is considered synonymous with HI-STORM

FW Version XL throughout Chapter 9.1.6. The MPC fuel basket provides criticality control and can hold 37 PWR spent fuel assemblies or radioactive materials associated with spent fuel and reactor-related waste components. The outer shell, top lid, bottom baseplate, closure ring, and associated welds constitute the MPC-37 confinement boundary which precludes radioisotopes leakage into the environment, provides the heat transfer medium from the contents to the environment, and provides an inert environment to prevent corrosion of the stored fuel. The HI-TRAC VW hold the MPC-37 during spent fuel loading, processing, and unloading operations and provides ALARA for personnel in accordance with 10 CFR 20. The HI-TRAC VW is used to transfer the MPC-37 to and from the cask pit pool and the HI-STORM FW overpack for onsite storage in accordance with 10 CFR 72 or to an off-site shipment cask licensed under 10 CFR 71. The MPC-37 is stored inside the HI-STORM FW overpack for protection against extreme natural phenomena, tornado generated missiles, radiological shielding, and allows for the transfer of heat from the stored fuel to the environs. The WBN ISFSI is located within the existing owner controlled area, northwest of the Diesel Generator Building. The ISFSI storage pad (see Figure 2.4-40B sheet 6) is sufficient to store the 80 HI-STORM FW storage systems. In addition to the storage pad, the ISFSI is surrounded by protected fencing and monitored by various security systems.

Confinement of all radioactive materials in the HI-STORM FW system is provided by the MPC. The design of the HI-STORM FW MPC assures that there are no credible design basis events that would result in a radiological release to the environment. The HI-STORM FW overpack and HI-TRAC VW transfer cask are designed to provide physical protection to the MPC during normal, off-normal, and postulated accident conditions to assure that the integrity of the MPC is maintained. The dry inert atmosphere in the MPC and the passive heat removal capabilities of the HI-STORM FW also assure that the SNF assemblies remain protected from long-term degradation.

A detailed description of the HI-STORM FW storage system is provided in the HOLTEC HI-STORM FW FSAR (Report HI-2114830). Chapter 7 describes the HI-STORM FW confinement design and describes how the design satisfies the confinement requirements of 10CFR72. It also provides an evaluation of the MPC confinement boundary as it relates to the criteria contained in Interim Staff Guidance (ISG)–18 and applicable portions of ANSI N14.5-1997 as justification for reaching the determination that leakage from the confinement boundary is not credible and, therefore, a quantification of the consequence of leakage from the MPC is not required. This chapter is in general compliance with NUREG-1536.

9.1.6.3 Dry Cask Storage Operations

a. Holtec International HI-TRAC VW transfer cask and multi-purpose canister (MPC) are placed in a cask work area (CWA) on the auxiliary building refueling floor by the auxiliary building overhead crane with a lift yoke attached to the crane hook using site established safe load path.
b. Activities associated with the preparation of the transfer cask such as inspection, placing the MPC into the transfer cask, draining the neutron shield water jacket, partial filling of the MPC with borated water, installation of the inflatable annulus shield, etc. will be performed in the CWA.
c. After the transfer cask preparations are completed, the transfer cask and MPC are moved from the CWA to the cask stand in the shallow end of the cask loading area.
d. To prevent submerging the main hoist crane hook in the deep end of the cask loading area, a lift yoke extension will be installed between the crane hook and the lift yoke.

e. With these lifting devices in place, the transfer cask and MPC are moved from the shallow end of the cask loading area to the deep end cask stand. The cask support stand in the deep end of the cask loading area is ergonomically sized such that the top of the MPC is positioned approximately level with the top of the spent fuel pool fuel racks.
f. Underwater camera and surveillance will be used as needed to ensure placement of the transfer cask, verify lift yoke is engaged or disengaged, verify MPC lid placement, monitor fuel loading, etc.
g. The gate between the cask loading area and the spent fuel pit is not to be installed.
h. Using the spent fuel pit bridge, spent fuel assemblies are transferred from the spent fuel storage racks to the MPC wherein 10 CFR 72 regulation is in effect. After spent fuel assemblies are loaded, the MPC lid is placed on the MPC. Radiation monitoring may be performed prior to transfer cask and MPC breaching the pool surface.
i. Following verification of MPC lid placement, the transfer cask and loaded MPC are placed back on the shallow end shelf and the lift yoke extension removed. Note that the 10 CFR 50 Technical Specification (Reference LCO 3.7.13) requirement of maintaining 23 feet of water shielding no longer applies.
j. The upper portion of the transfer cask and loaded MPC is raised above the SFP water surface. After radiation dose rate measurements confirm that it is safe to continue, a relatively small amount of water is removed from the MPC to facilitate MPC lid welding. Radiological surveys and preliminary decontamination of the MPC lid and transfer cask are performed as the transfer cask continues to be raised until it has been removed from the SFP. The transfer cask and loaded MPC are placed back in the CWA where the next phase of decontamination of the transfer cask, disengagement of the annulus overpressure system, and MPC closure operation are performed.
k. After the MPC lid is seal welded, the MPC is hydrostatically tested, drained, dried and filled with helium.
l. The transfer cask and MPC are moved to the auxiliary building railroad bay where the MPC is transferred to the HI-STORM FW overpack.
m. The HI-STORM FW overpack is transported to the ISFSI and placed at a designated location.
n. If necessary, unloading operations are performed using similar methodology in reverse.

9.1.6.4 Evaluation of Reactor Power & ISFSI Facilities Interface Documents

Analyses used to demonstrate ISFSI compliance to 10 CFR 50 and 10 CFR 72 regulations are listed in Table 9.1-4. These analyses address SSCs that are shared or utilized to facilitate WBN 10 CFR 50 and 10 CFR 72 facilities. This section is not intended to be all inclusive of design features between the two facilities however, this listing provides examples of SSCs having design basis requirements in both the 10 CFR 50 and 10 CFR 72 regulations. The applicability of these regulations also includes the associated drawings and procedures of the commonly shared SSCs. Therefore, implementing a change, test, or experiment for these shared SSCs shall require a 10 CFR 50.59 review and a 10 CFR 72.48 review. This position demonstrates compliance with 10 CFR 50 Appendix A, GDC-5 and 10 CFR 72.122 paragraphs (d), (e), and (k) (4).

WBN

TABLE 9.1-1

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM
DESIGN PARAMETERS

Spent fuel pool storage capacity	1386 Assemblies
Spent fuel pool water volume	372,460[1] gallons
Nominal boron concentration of the spent fuel pool water	2,000 ppm

	Decay Heat [2] (MBtu/hr)	Maximum SFP Temperature (2-Train) (°F)	Maximum SFP Temperature (1-Train) (°F)	SFP Loss of Cooling Heatup Rate (°F/hr)	Boil-Off Time to 10′ Above Rack With No Makeup (hr)
Normal Full Core Discharge[3]	28.1	124.7	151.2	9.88	47.4
Emergency Offload[4]	25.6	129.3	159.2	8.40	55.1
Optimum (Better than Design) Conditions [5]	50.2	129.3	159.2	16.46	28.1

(1) Including cask pit area volume.

(2) Decay Heat in accordance with ANS Standard 5.1, "Decay Heat Power in Light Water Reactors," and USNRC Regulatory Guide 3.54, "Spent Fuel Heat Generation in an Independent Spent Fuel Pool Storage Installation."

(3) Stored legacy fuel assemblies, plus an additional full core (193 assemblies) discharged after 33 days decay time at design basis heat exchanger fouling conditions and Technical Specification Ultimate Heat Sink (UHS) temperatures. The normal refueling interval for WBN is 18 months, with refueling outages typically scheduled in the spring and fall.

(4) Stored legacy fuel assemblies, plus 96 assemblies discharged the previous refueling outage, decayed 96 days, plus an additional full core (193 assemblies) discharged after 60 days decay time. The SFP has been analyzed for a maximum water temperature of 159.2 °F.

(5) Considers better than design heat exchanger fouling and better than design UHS temperature.

TABLE 9.1-2 (Sheet 1 of 4)

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN AND OPERATING PARAMETERS

Spent Fuel Pool Pump	
Number	3
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	2300
Total developed head, ft	125
Material	Stainless Steel
Spent Fuel Pool Skimmer Pump	
Number	1
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	100
Total developed head, ft	50
Material	Stainless Steel
Refueling Water Purification Pump	
Number	2
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	200

TABLE 9.1-2 (Sheet 2 of 4)

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN AND OPERATING PARAMETERS

Total developed head, ft	170	
Material	Stainless Steel	
Spent Fuel Pool Heat Exchanger		
Number	2	
Design heat transfer, Btu/hr	11.94×10^6	
	Shell	Tube
Design pressure, psig	150	150
Design temperature, °F	200	200
Design flow lb/hr	1.49×10^6	1.14×10^6
Inlet temperature, °F	95	120
Outlet temperature, °F	103	109.5
Fluid circulated	Component Cooling Water	Spent Fuel Pool Water
Material	Carbon Steel	Stainless Steel
Spent Fuel Pool Demineralizer		
Number	1	
Design pressure, psig	300	
Design temperature, °F	250	
Design flow, gpm	100*	
Resin volume, ft^1	30	
Material	Stainless Steel	

*Flow may be increased to 180 gpm for refueling cavity and RWST cleanup.

TABLE 9.1-2 (Sheet 3 of 4)

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN AND OPERATING PARAMETERS

Spent Fuel Pool Filter	
Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Filtration requirement	98% retention of particles above 5 microns
Materials, vessel	Stainless Steel
Spent Fuel Pool Skimmer Filter	
Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm (Filter)	150
Rated flow, gpm (Pump)	100
Filtration requirement	98% retention of particles above 5 microns
Material, vessel	Stainless Steel
Refueling Water Purification Filter	
Number	2
Design pressure, psig	200
Design temperature, °F	250
Design flow, gpm	200

TABLE 9.1-2 (Sheet 4 of 4)

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN AND OPERATING PARAMETERS

Filtration requirement	98% retention of particles above 5 microns
Material, vessel	Stainless Steel
Spent Fuel Pool Strainer	
Number	2
Rated flow, gpm	2300
Perforation, inches	Approximately 0.2
Material	Stainless Steel
Spent Fuel Pool Skimmer Strainer	
Number	1
Rater flow, gpm	100
Design pressure, psig	50
Design temperature, °F	200
Perforation, inches	1/8
Material	Stainless Steel
Spent Fuel Pool Skimmers	
Number	2
Design flow, gpm	50
Piping and Valves	
Design pressure, psig	150
Design temperature, °F	200
Material	Stainless Steel

TABLE 9.1-3

BASIS FOR DESIGN CRITERIA OF THE
WATTS BAR NUCLEAR PLANT SPENT FUEL RACKS

ASME B&PV Code III, Subsection NF

AISC Manual of Steel Construction, Seventh Edition, 1970.

USNRC Standard Review Plan, Section 3.8.4, "Other Seismic Category I Structures".

USNRC Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis."

USNRC Regulatory Guide 1.29, "Seismic Design Classification".

USNRC Regulatory Guide 1.92, "Combining Model Responses and Spatial Components in Seismic Response Analysis".

OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications, dated April 14, 1978.

10 CFR Part 50, Appendix B, "Quality Assurance Criteria For Nuclear Power Plants and Fuel Reprocessing Plants".

TABLE 9.1-4
(Sheet 1 of 3)

10 CFR Part 50 Reactor Power & 10 CFR Part 72 ISFSI Facilities Interface Documents

CIVIL / STRUCTURAL CALCULATIONS

CDQ0000792013000357, HI-STORM FW Cask Handling Weights at WBN, HI-2135734, HI-STORM FW Cask Handling Weights at WBN

CDQ0006912014000556, Watts Bar Nuclear Plant Haul Path Design Calculations, Multiple HOLTEC Reports, HI-2135812, Watts Bar Plant ISFSI Haul Path Design Criteria

CDQ0006912014000558, Watts Bar Nuclear Plant ISFSI Haul Path - Underground Utility Evaluation , HI-2135818

CDQ0006912014000633, Dynamic Analysis of Loaded HI-STORM FW on LPT at Watts Bar, HI-2135883, Dynamic Analysis of Loaded HI-STORM FW on LPT at Watts Bar

CDQ0009992013000358, Time History Generation for Watts Bar, HI-2135731, Time History Generation for Watts Bar

CDQ0000792014000632, Calculation Package on the Seismic Stability Analysis of Watts Bar HI-STORM/HI-TRAC Stack Using NRC-Concurred Methodology, HI-2135902, Calculation Package on the Seismic Stability Analysis of Watts Bar HI-STORM/HI-TRAC Stack Using NRC Concurred Methodology

CDQ0000792014000660, Watts Bar Auxiliary Building Floor Structural Analysis, HI-2146106, Watts Bar

CDQ0000792014000634, WBN Auxiliary Building ISFSI Analysis for HI-TRAC & MPC:

HI-2135779, Kinematic Stability Analysis of the Loaded HITRAC VW on RFF and in CLP for WBN
HI-2135781, Seismic Stability Analysis of Empty MPC on the Refueling Floor
HI-2146331, Auxiliary Building Floor Structural Qualification Under Loaded HI-TRAC VW Configurations

CDQ0000792014000639, WBN Cask Loading Area ISFSI Analysis of HI-TRAC & Pedestal:

HI-2146229, Seismic Analysis of HI-TRAC VW of Cask Loading Area Shelf at EL, 731' at Watts Bar Plant
HI-2146299, Seismic Analysis of HI-TRAC VW on Freestanding Pedestal in Cask Loading Area at WBN
HI-2146417, Structural Evaluation of Pedestal in Cask Loading Area for HI-TRAC VW at WBN

CDQ0006912014000638, Watts Bar Nuclear Plant Haul Path-Rail Slab, HI-2146034, Watts Bar Nuclear Plant Haul Path-Rail Slab

TABLE 9.1-4
(Sheet 2 of 3)

10 CFR Part 50 Reactor Power & 10 CFR Part 72 ISFSI Facilities Interface Documents

CDQ0006912014000706, Analysis of the Lift Yoke Extension and Storage Bracket HI- 2156662 & HI-2156589

HI-2156662, Structural Analysis of the Watts Bar Lift Yoke Extension Storage Bracket
HI-2156589, Structural Analysis of the HI-TRAC Lift Yoke Extension for WBN

CDQ0000792015000712 Low Profile Transporter (LPT) Analysis HI-2146330, Low Profile Transporter (LPT) Analysis

CDQ0006912014000557, Watts Bar ISFSI Geotechnical Soil Parameters Recommendations Report, HI-2135638

CDQ0006912014000559, WBN Subgrade Modulus and Bearing Capacity for Heavy Haul Path, HI-2145966

CDQ0000792014000647, Vertical Cask Transporter Stability Analysis on the Haul Path and the ISFSI Pad at Watts Bar Nuclear Plant, HI-2146169

CDQ0000782015000761, Evaluation of Live Loads and Seismic Interaction Requirements for Dry Cask FHD Main Skid and FHD Chiller Skid, RRTI-2246-007

CDQ0006912014000560, Watts Bar Nuclear Plant Haul Path – Fabrication Pad, HI-2145996

CDQ0006912014000571, Liquefaction Analysis for Proposed WBN ISFSI Pad, HI-2135836

CDQ0006912014000572, Calculation Package of Seismic Analysis of WBN ISFSI Pad Using LS-DYNA, HI-2146101

CDQ0006912014000573, Structural Analysis of ISFSI Pad at WBN, HI-2146251

CDQ0009992015000754, Accidental Drop of a Spent Fuel Assembly During the course of MPC Loading Operations

NUCLEAR / MECHANICAL CALCULATIONS

EPMDBG092088, Spent Fuel Pool Cooling and Cleanup System (78) Operating Modes Calculation

MDQ0000782013000405, Environmental Conditions for Spent Fuel Pool Level Instrumentation during Extended Station Blackout Conditions

MDQ0000782015000732, WBN Aux Bldg-El. 757 Refueling Floor Temperature Transient (LOCA) During Dry Cask Storage Operations

MDQ0009992015000746, MPC CLOSURE TIME TO BOIL & THERMAL ANALYSIS

TABLE 9.1-4
(Sheet 3 of 3)

10 CFR Part 50 Reactor Power & 10 CFR Part 72 ISFSI Facilities Interface Documents

NDQ0000782015000757, SPENT FUEL POOL BORON CONCENTRATION ANALYSIS DURING DCS ACTIVITIES

NDQ0000782015000760, Thermal Response of the HI-STORM under Flood Condition and Design Basis for Post-Flood Restorative Measures

NDQ0000792015000729, WBN Site Boundary Normal and Off Normal Doses including ISFSI

NDQ0000792015000730, Comparison of the Dose Consequences between a Single Fuel Assembly FHA and a Dropped Loaded HI-TRAC VW/MPC-37 Cask

NDQ0000792015000731, Post-LOCA and Transient Response to Place MPC in Safe Condition during LOCA

NDQ0000792015000734, OCCUPATIONAL DOSE RATES AROUND THE HI-STORM FW SYSTEM FOR WBN, HI-2135814

NDQ0000792015000763, ISFSI and Haul Route Fire Hazards Analysis Calculation

NDQ0009992013000356, WBN ISFSI Compliance to 10CFR72.104 & 10CFR72.106 Criteria for Radioactive Materials in Direct Radiation, HI-2135709 & HI-2135760

NDQ0009992015000747, Alternate Cooling Water System (ACWS) Equipment Sizing Calculation

WBNAPS4004, Summary of Mild Environment Conditions for Watts Bar Nuclear Plant

WBNNAL3025, Normal Operating Dose for Equipment Outside the Shield Building

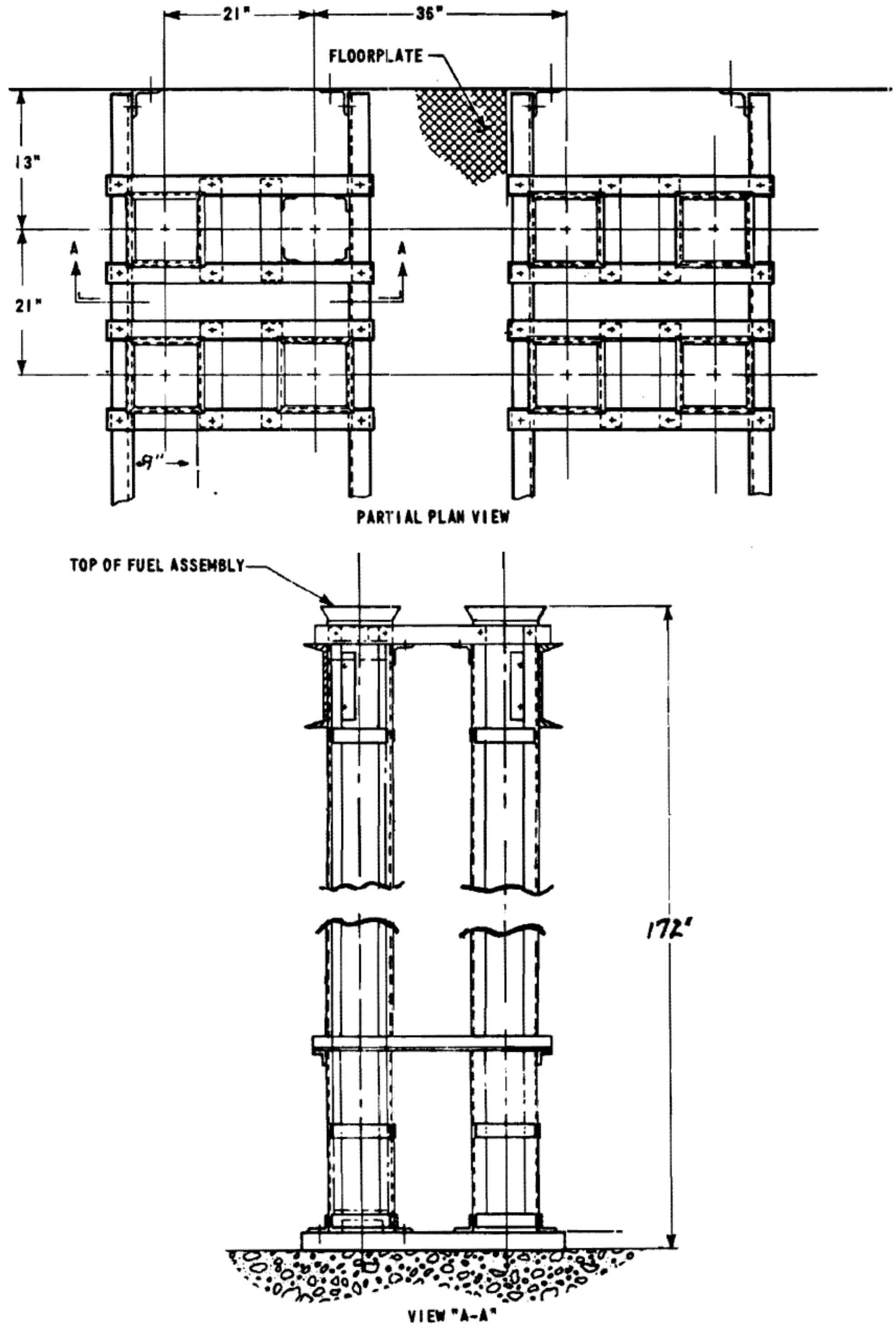
WBNTSR020, Safety Limit for the Spent Fuel Pool Radiation Monitors

WBNTSR075, Location Specific Radiation Dose to Area A6 to A10 and T to U, El. 757

WBNTSR090, Determine the Dose Rate at the Site Boundary due to Tanks in the Yard and ISFSI

WBNTSR104, Location Specific Radiation Dose to the Spent Fuel Pool Radiation Monitors

WBNTSR112, Shield Design Review and Equipment Qualification Study



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
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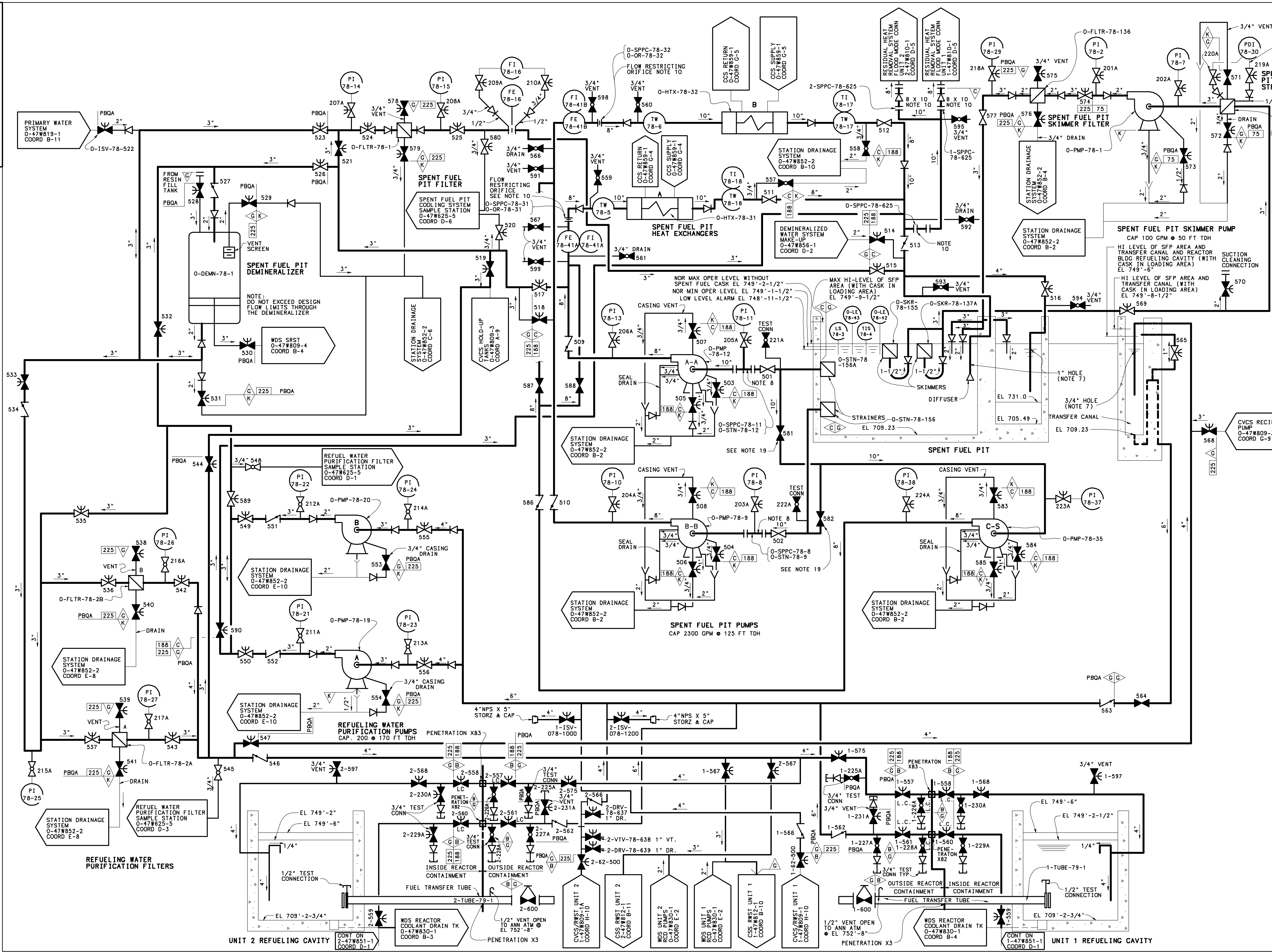
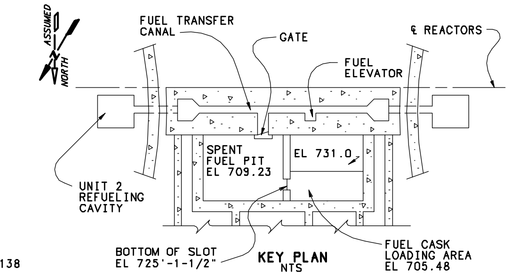
New Fuel
Storage Racks

FIGURE 9.1-1

FIGURE 9.1-2

DELETED





KEY PLAN
NTS

NOTES:

1. THIS FLOW DIAGRAM IS FOR UNIT 1 AND UNIT 2.
2. ALL VALVES ARE THE SAME SIZE AS THE PIPE UNLESS OTHERWISE NOTED.
3. UNIT 1 VALVES HAVE PREFIX "1". UNIT 2 VALVES HAVE PREFIX "2". VALVES WITH NO PREFIX NUMBER ARE COMMON TO BOTH UNITS. VALVES ARE SYS 78 (SFP) UNLESS NOTED BY A DIFFERENT SYS NO. LOCATED BETWEEN PREFIX AND VALVE NO.
4. FOR DEFINITION OF SYMBOLS OF "L.C." OR "L.O.", REFER TO MEMO B26850402001.
5. ALL PRESSURE, SAMPLE AND TEST CONNECTIONS ARE 3/4" UNLESS OTHERWISE NOTED.
6. TVA CLASSIFICATION OF THE PIPING SYSTEM IS DENOTED BY ⟨G|D⟩
7. LOCATE HOLE IN PIPE 2 FEET BELOW NORMAL WATER LEVEL.
8. TEMPORARY STRAINER IS PLACED IN THE SPOOL PIECE DURING INITIAL FLUSHING OPERATIONS. STRAINER MUST BE REMOVED BEFORE PLANT START-UP. TEST CONNECTION IS CONNECTED TO PRESSURE GAUGE DURING INITIAL FLUSHING.
9. SYSTEM DESIGN PARAMETERS ARE AS FOLLOWS:

SUB-SYSTEM	PRESSURE	TEMPERATURE
SPENT FUEL PIT COOLING	150 PSIG	200° F
SPENT FUEL PIT SKIMMER	150 PSIG	200° F
SPENT FUEL PIT SKIMMER STRAINER	50 PSIG	200° F
REFUELING WATER PURIFICATION	150 PSIG	200° F

10. SPOOL PIECES IN THIS LINE TO BE INSTALLED FOR OPEN REACTOR COOLING DURING FLOODS ABOVE PLANT GRADE ONLY. ORIFICES ARE TO BE REMOVED.
11. [188|225] INDICATES THE HYDROSTATIC TEST PRESSURE. CONST SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST. ASME CODE CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION.
12. CLASS G PIPING LABELED WITH PBQA IS ANALYZED FOR SEISMIC CAT. 1(L) PRESSURE BOUNDARY RETENTION & IS WITHIN THE SCOPE OF THE HYDROSTATIC QA PROGRAM (THE VALVE SEAT TERMINATES THE PBQA BOUNDARY). ALL REMAINING CLASS G PIPING IS SEISMICALLY SUPPORTED FOR POSITION RETENTION ONLY.
13. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS: (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION".) N3-78-4001 - - - - SPENT FUEL POOL COOLING AND CLEANING SYSTEM
14. FOR TVA CLASS C PIPING, ALL PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS AND TEST CONNECTIONS IS TVA CLASS K.
15. UNLESS OTHERWISE NOTED, ALL ROOT VALVES HAVE AN "A" SUFFIX IF NOT SHOWN IN THE ADDRESS.
16. NOT USED.
17. NOT USED.
18. NOT USED
19. EITHER VALVE 0-ISV-078-0581 OR 0-ISV-078-0582 SHOULD BE NORMALLY OPEN DURING NORMAL OPERATION OF THE SYSTEM, NOT BOTH.
20. VALVES DENOTED AS L.C. ARE LOCKED CLOSED DURING NORMAL PLANT OPERATION.

REFERENCE DRAWINGS:

TVA DRAWINGS:

- 47W454-SERIES ------ MECHANICAL FUEL POOL COOLING AND CLEANING SYSTEM
- 47W611-78-1 -------- LOGIC DIAGRAM
- 1-,2-47W610-78-1 --- CONTROL DIAGRAM
- 47BM454-SERIES ----- BILL OF MATERIAL
- WB-DC-40-29 -------- DESIGN CRITERIA FOR FLOOD PROTECTION PROVISIONS
- 2-47W855-101 ------- MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - FUEL POOL COOLING AND CLEANING SYSTEM

WESTINGHOUSE DRAWINGS:

- 113E794 ------ FLOW DIAGRAM, SPENT FUEL PIT COOLING SYSTEM
- 119DE52 ------ PROCESS FLOW DIAGRAM, SPENT FUEL PIT COOLING SYSTEM

UFSAR AMENDMENT 1

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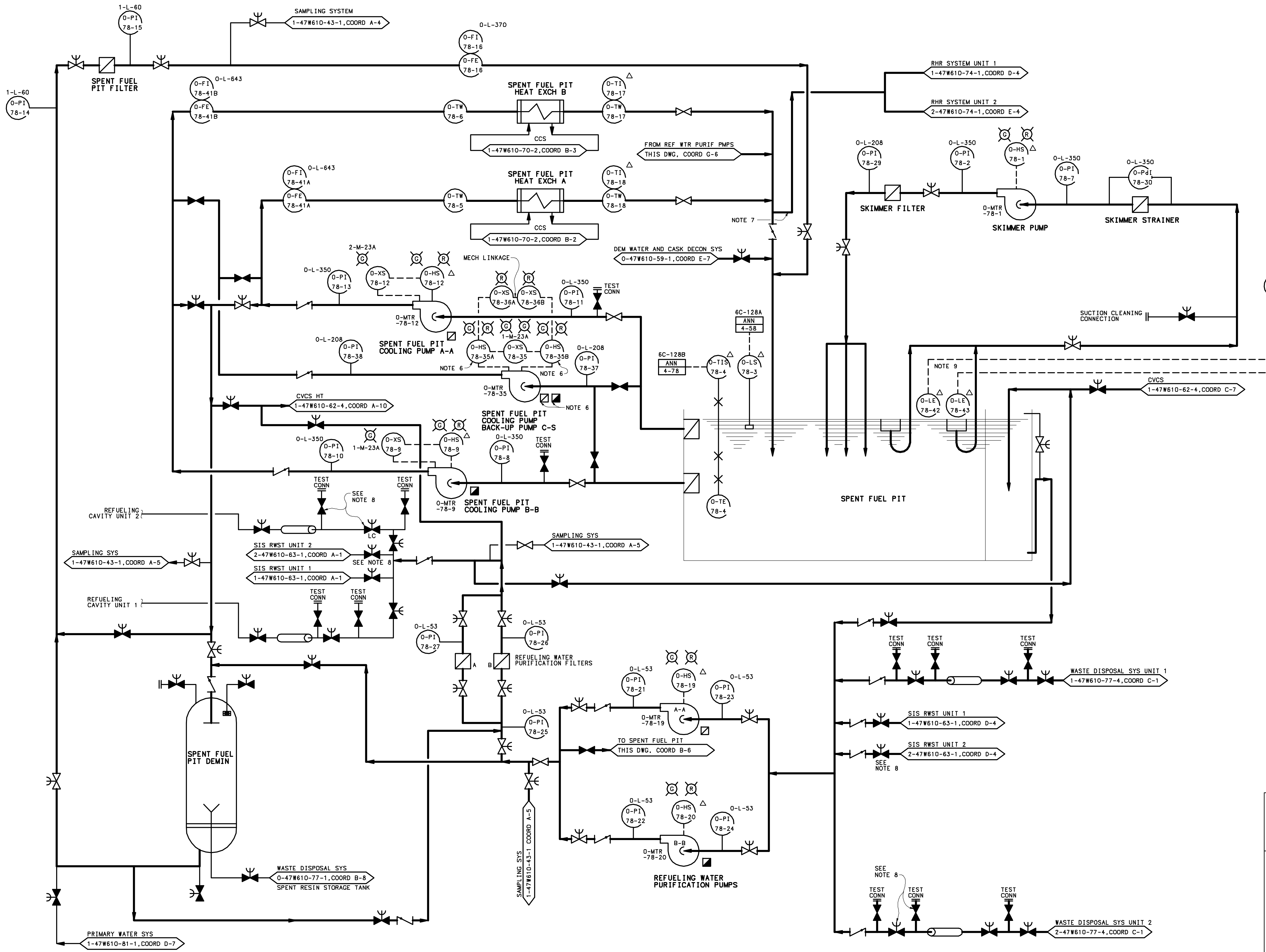
POWERHOUSE
UNITS 1 & 2
MECHANICAL-FLOW DIAGRAM
FUEL POOL COOLING
AND CLEANING SYSTEM
TVA DWG NO. 0-47W855-1 R2
FIGURE 9.1-3

CAD MAINTAINED DRAWING



NOTES:

1. THE SPENT FUEL PIT COOLING SYSTEM MAINTAINS THE NECESSARY TEMPERATURE OF THE WATER IN THE SPENT FUEL PIT AND CLARIFIES, PURIFIES, AND DEMINERALIZES THE WATER IN THE SPENT FUEL PIT, FUEL TRANSFER CANAL, AND REFUELING WATER STORAGE TANK. THE SURFACE OF THE WATER IS CLEANED OF FLOATING TRASH AND IMPURITIES BY A SKIMMER LOOP CONTAINING A SKIMMER PUMP, SKIMMER HEADS, A STRAINER, AND A FILTER.
2. THE SPENT FUEL PIT COOLING SYSTEM IS OPERATED WHEN THERE IS A NEED TO LOWER THE PIT WATER TEMPERATURE OR TO CLARIFY AND PURIFY THE PIT WATER. THESE OCCASIONS ARE DETERMINED BY THE AMOUNT OF FUEL IN THE PIT AND THE LENGTH OF TIME THE FUEL HAS BEEN IN THE PIT. COOLING WATER FOR THE HEAT EXCHANGER IS SUPPLIED FROM COMPONENT COOLING WATER.
3. THE DEMINERALIZER PORTION OF THE SPENT FUEL PIT COOLING SYSTEM MAY BE ISOLATED FROM THE HEAT REMOVAL PORTION OF THE SYSTEM BY PROPER VALVING AND USED TO PURIFY THE WATER IN THE REFUELING WATER STORAGE TANK.
4. PIPING AND INSTRUMENT SYMBOLS ARE SHOWN ON DRAWING 30B617-3R1 OF "MECHANICAL DESIGN STANDARDS."
5. THIS SYSTEM IS COMMON TO UNITS 1 AND 2, EXCEPT AS NOTED.
6. UNDER EMERGENCY CONDITIONS THE DEVICE MAY BE MANUALLY TRANSFERRED TO THE OPPOSITE POWER TRAIN.
7. TEMPORARY PIPING TIE-IN BETWEEN SFPCS AND RHRS WILL BECOME FUNCTIONAL WITH THE ADDITION OF SPOOL PIECES. THIS PIPING WILL OPERATE DURING OPEN REACTOR COOLING FOR FLOODS ABOVE PLANT GRADES, ONLY.
8. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08, CONTROL OF UNIT INTERFACES.
9. LEVEL LOOPS 0-LPL-78-42 AND -43 MAINTAIN PHYSICAL SEPARATION TO THE EXTENT PRACTICAL.

REFERENCE DRAWINGS:

0-47W611-78-1 ------------ LOGIC DIAGRAM
47W454 ------------------- PIPING
0-47W855-1 --------------- FLOW DIAGRAM

WESTINGHOUSE - 113E794 -------- SPENT FUEL PIT COOLING SYSTEM FLOW DIAGRAM

WATTS BAR
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POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
SPENT FUEL PIT COOL SYS
TVA DWG NO. 0-47W610-78-1 R1
FIGURE 9.1-4

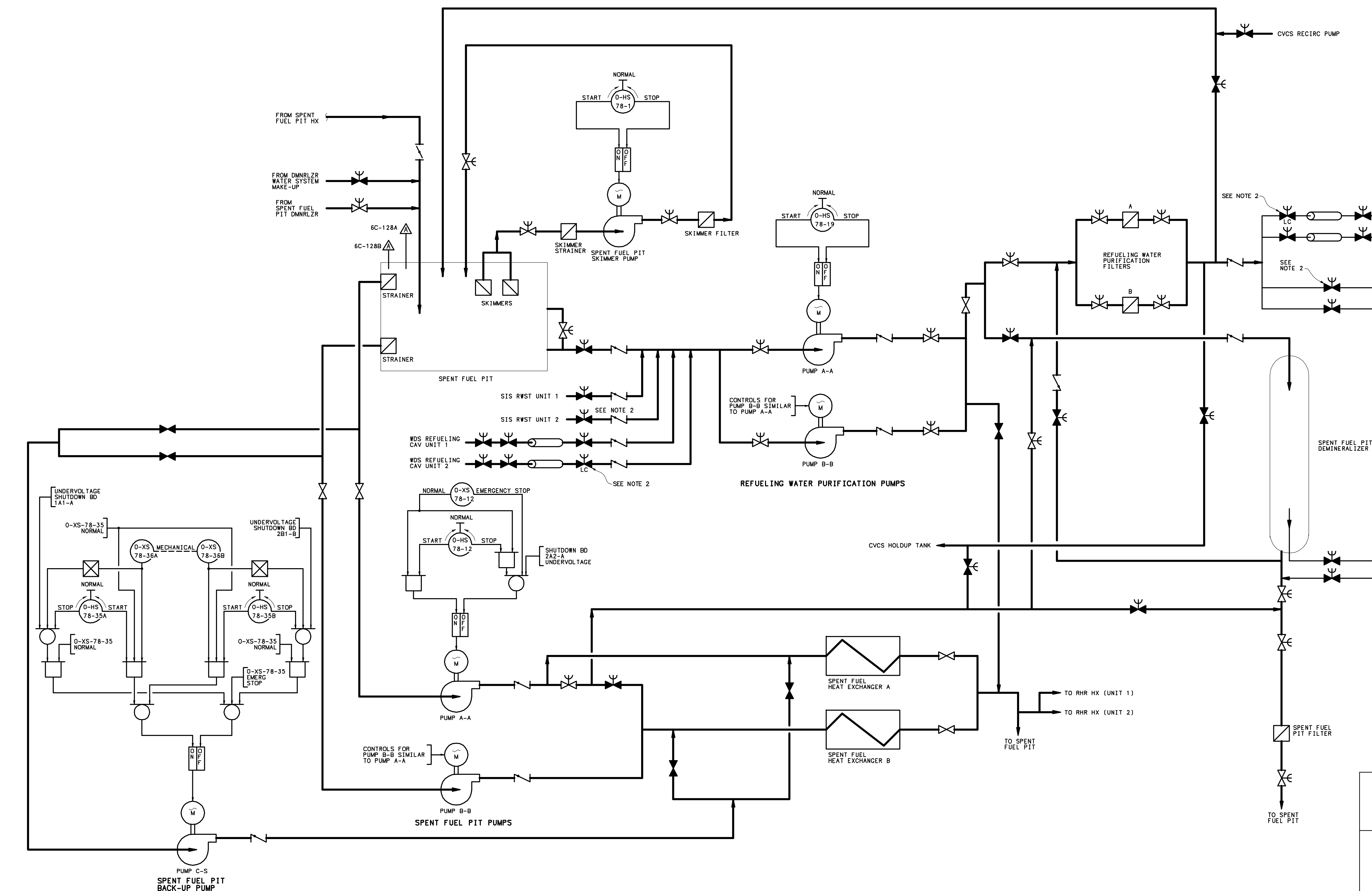
CAD MAINTAINED DRAWING

NOTES:

1. DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME.
2. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08, CONTROL OF UNIT INTERFACES.

REFERENCE DRAWINGS:

1-47W611-0-1-----------LOGIC INDEX
2-47W611-0-1-----------LOGIC INDEX
0-47W610-78-1----------CONTROL DIAGRAM



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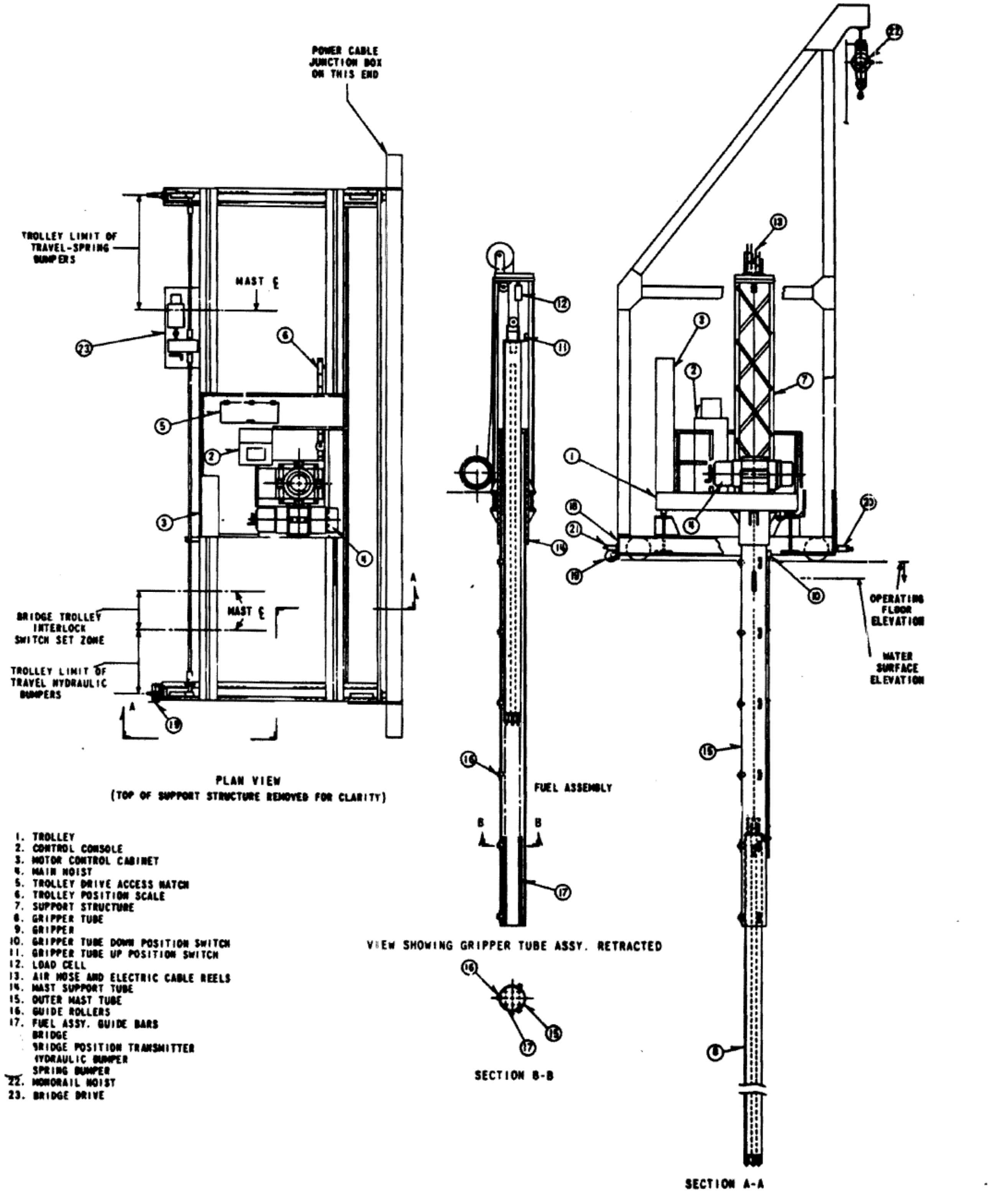
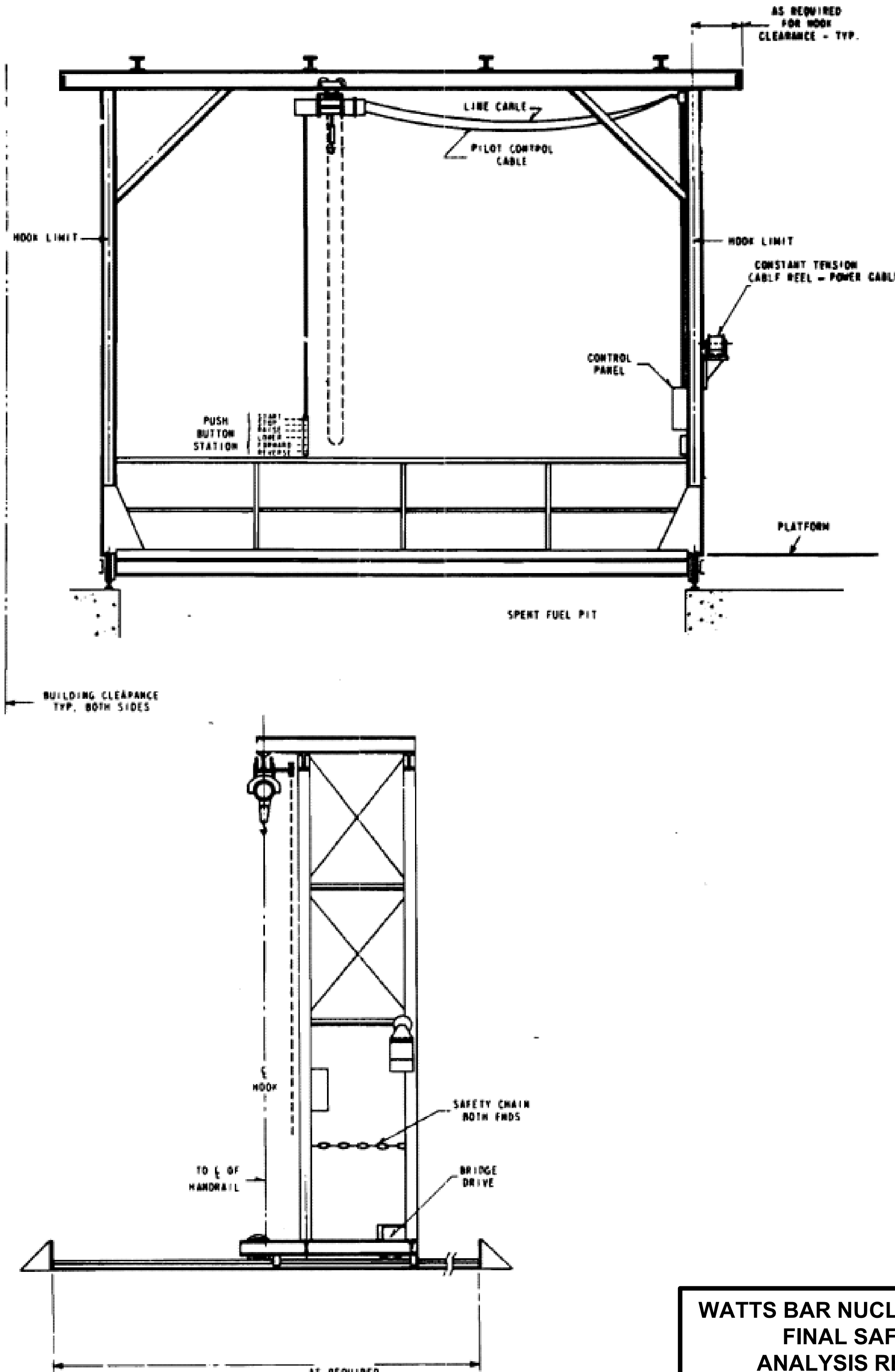
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
SPENT FUEL PIT COOLING SYSTEM
TVA DWG NO. 0-47W611-78-1 R1
FIGURE 9.1-5



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Typical Manipulator
Crane

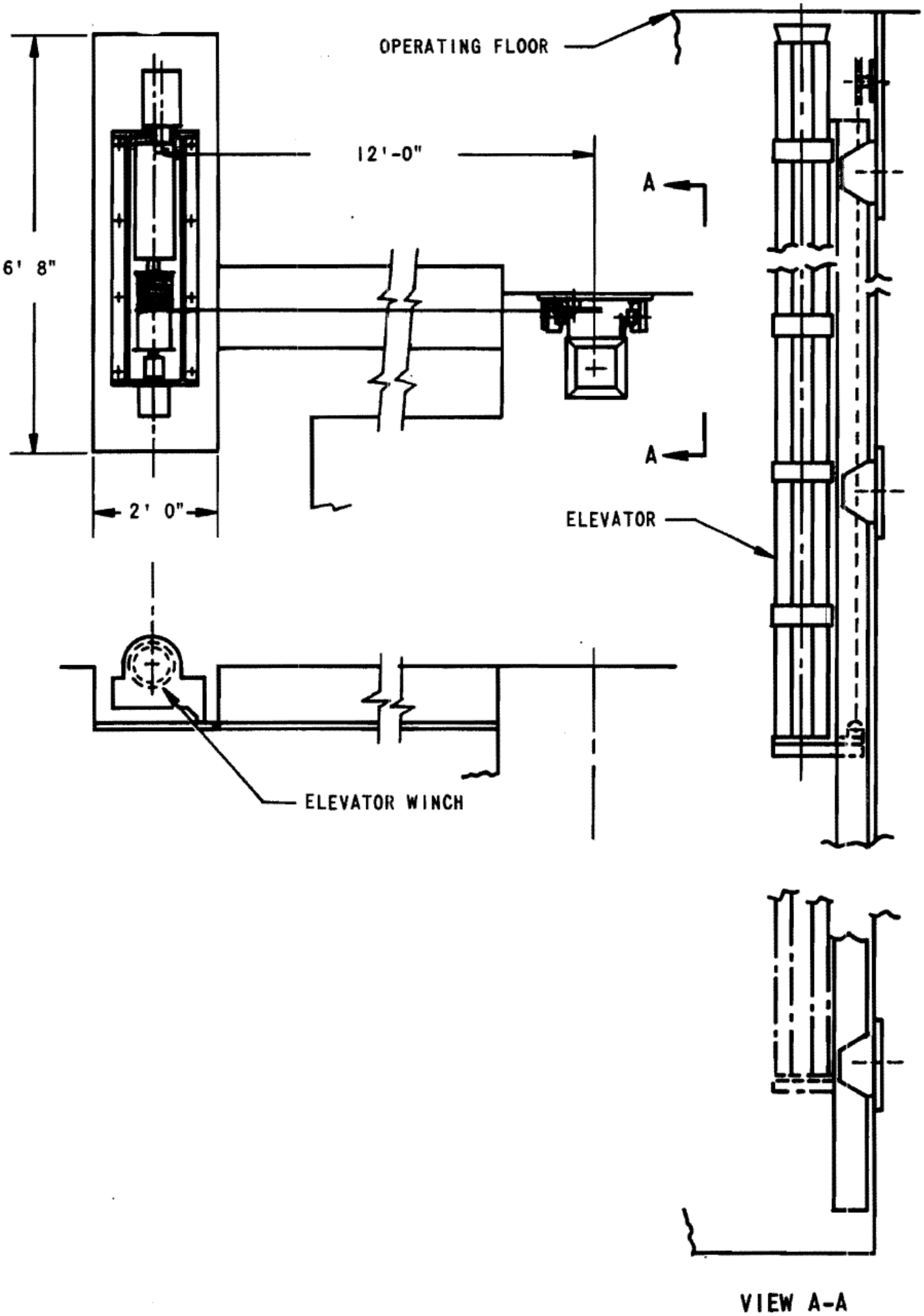
FIGURE 9.1-6



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Typical Spent Fuel
Pit Bridge

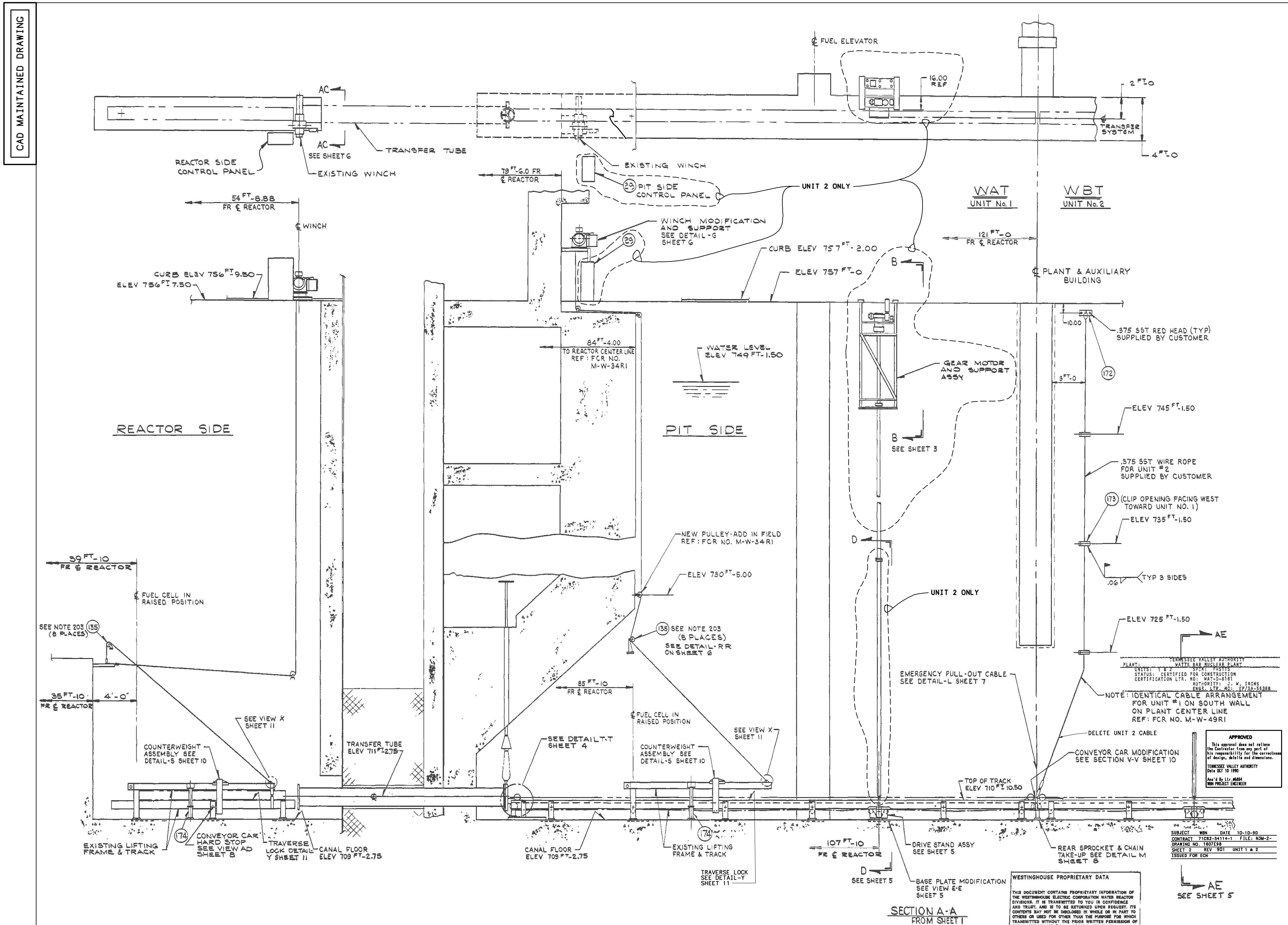
FIGURE 9.1-7



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

New Fuel
Elevator

FIGURE 9.1-8

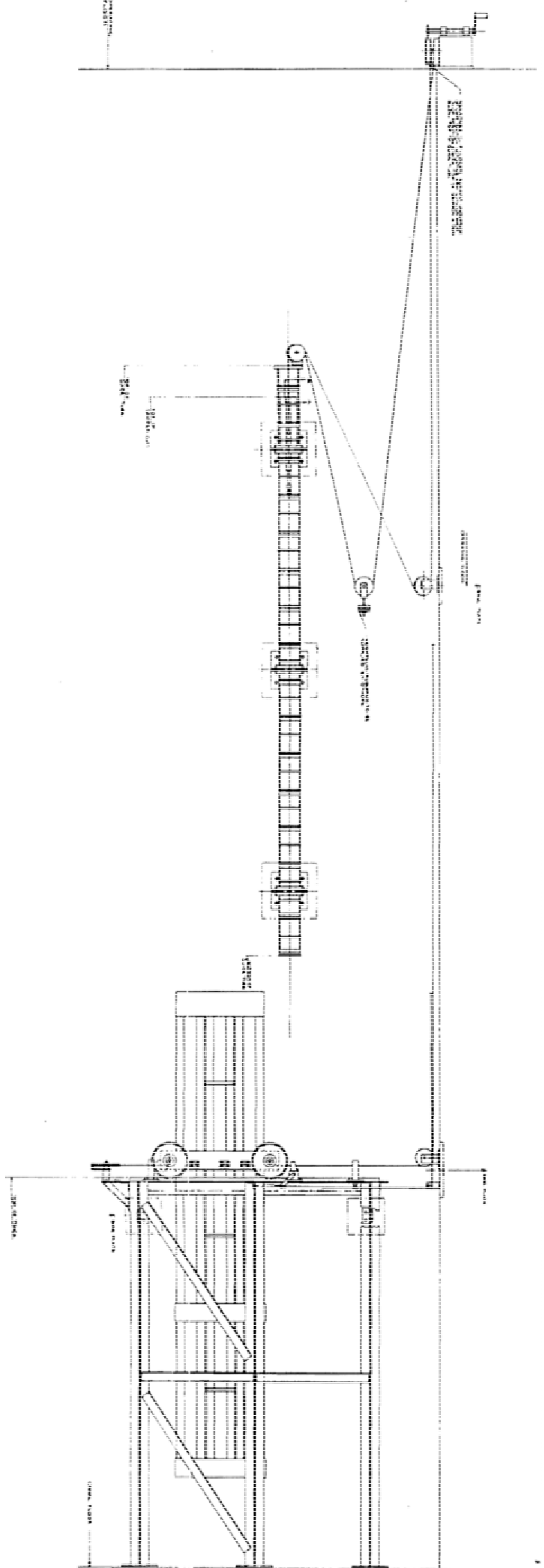


WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

FUEL TRANSFER SYSTEM ASSEMBLY
UNIT 1 SHOWN ABOUT ℄ AUX BLDG

DWG NO. 1607E98-2 R901

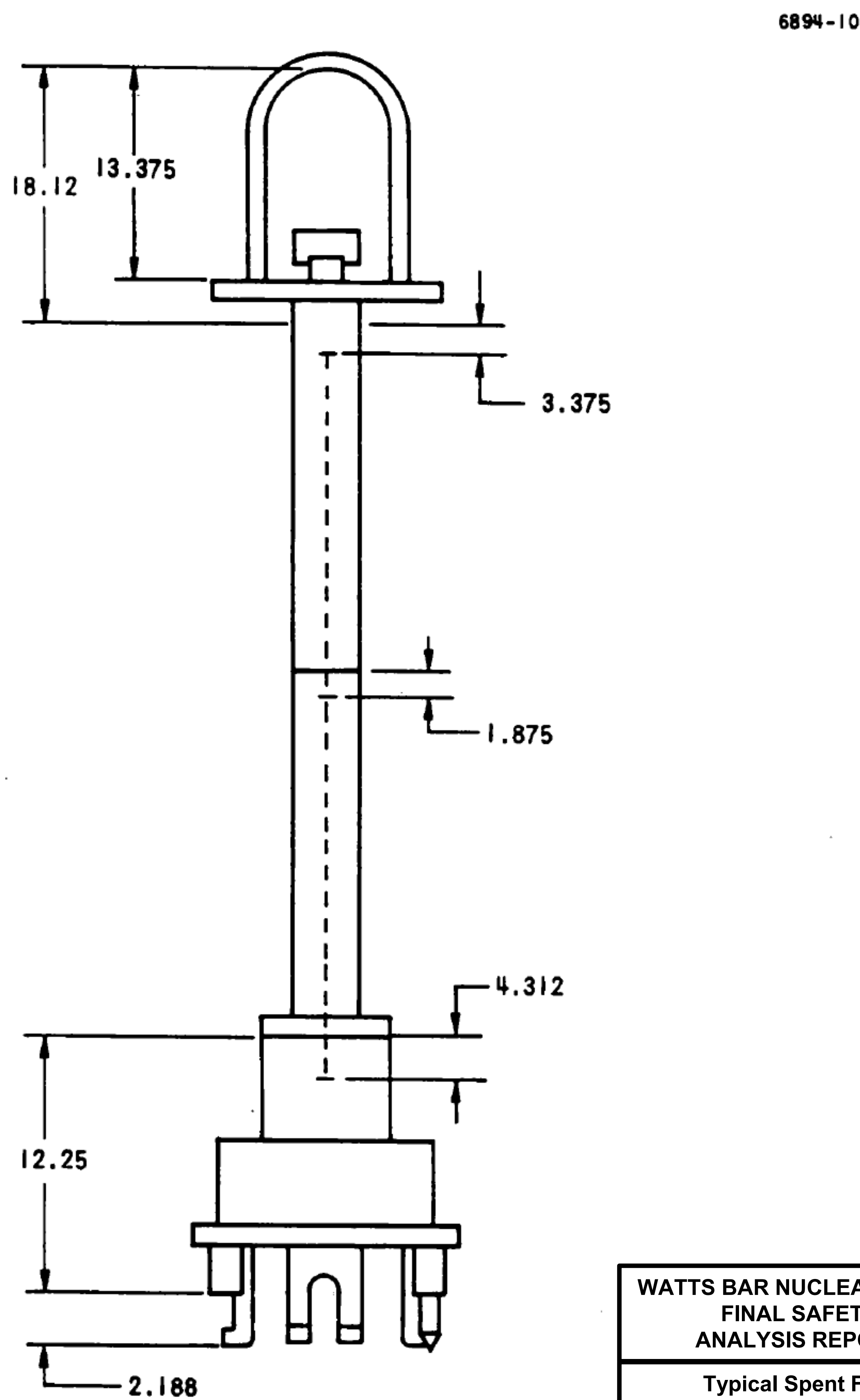
FIGURE 9.1-9



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Rod Cluster Control
Changing Fixture

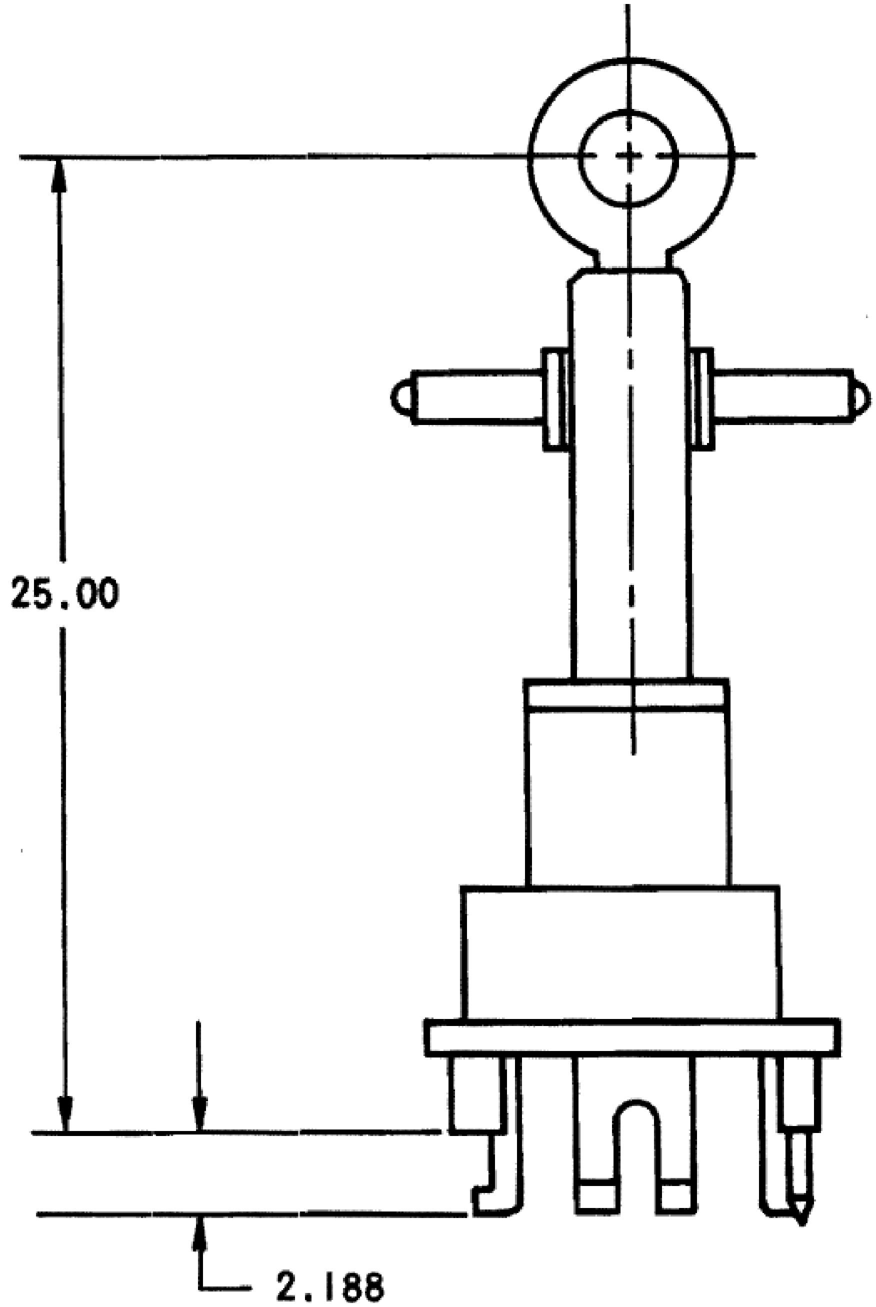
FIGURE 9.1-10



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Typical Spent Fuel
Handling Tool

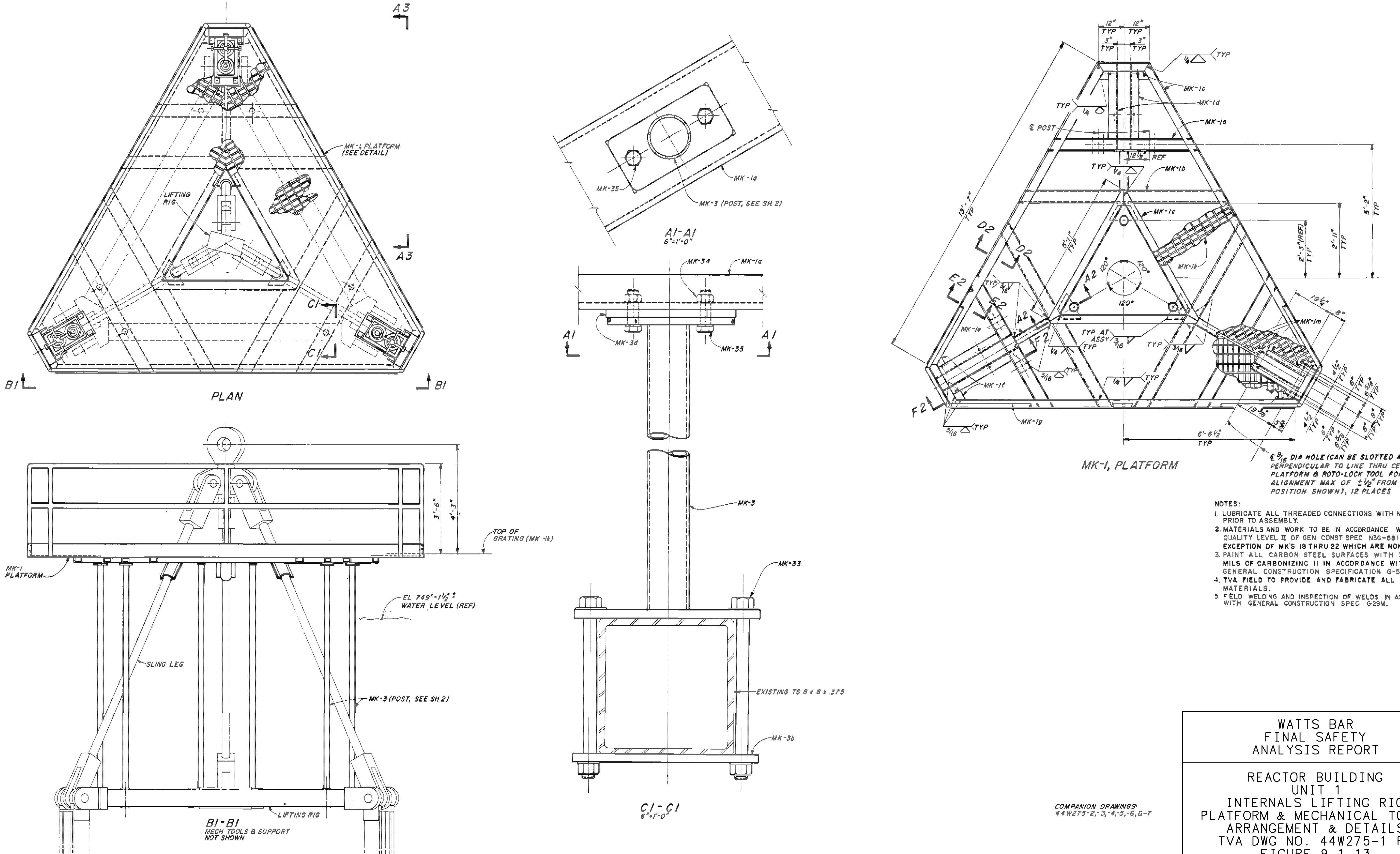
FIGURE 9.1-11



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Typical New Fuel
Handling Tool

FIGURE 9.1-12

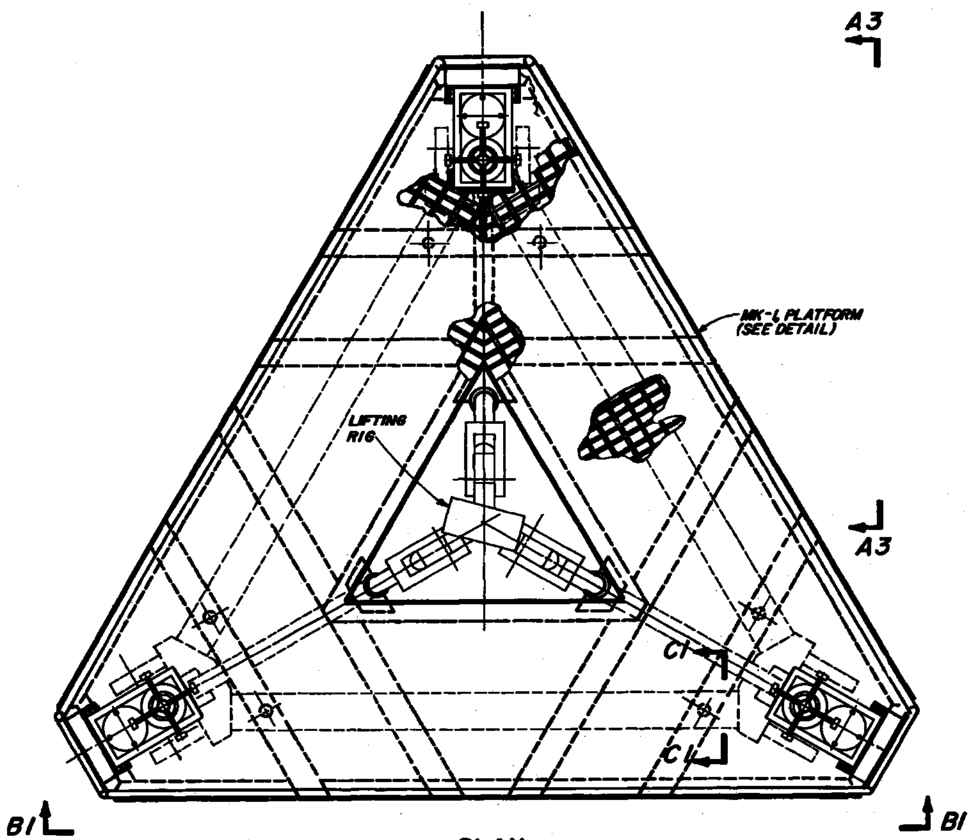


NOTES:

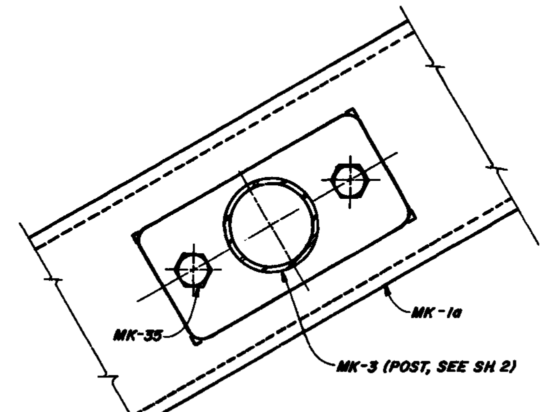
1. LUBRICATE ALL THREADED CONNECTIONS WITH NEOLUBE PRIOR TO ASSEMBLY.
2. MATERIALS AND WORK TO BE IN ACCORDANCE WITH QUALITY LEVEL II OF GEN CONST SPEC N3G-881 WITH EXCEPTION OF MK'S 18 THRU 22 WHICH ARE NON QA.
3. PAINT ALL CARBON STEEL SURFACES WITH 3-5 MILS OF CARBONIZINC II IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION G-55.
4. TVA FIELD TO PROVIDE AND FABRICATE ALL MATERIALS.
5. FIELD WELDING AND INSPECTION OF WELDS IN ACCORDANCE WITH GENERAL CONSTRUCTION SPEC G-29M.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

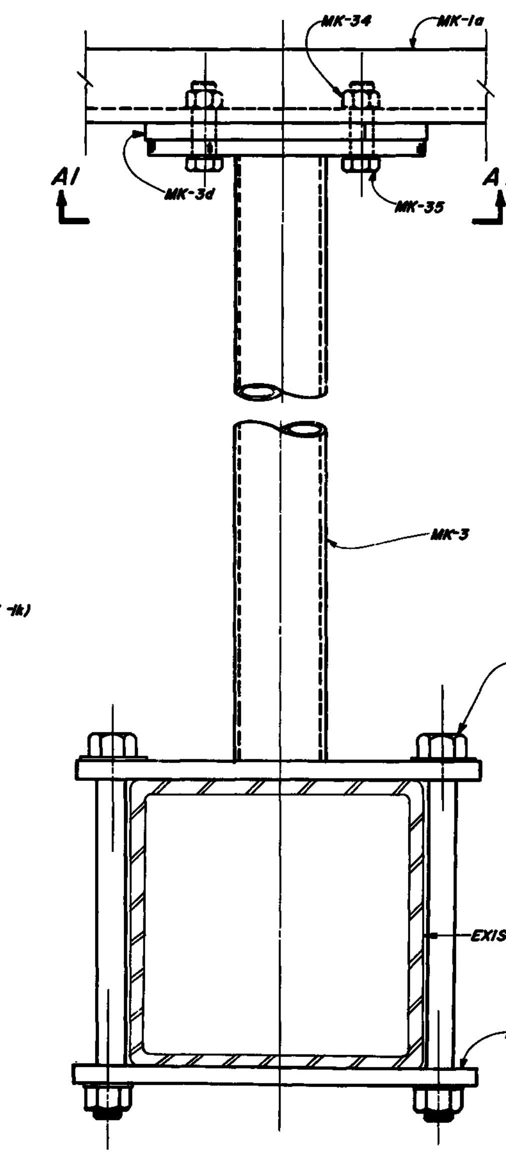
REACTOR BUILDING
UNIT 1
INTERNALS LIFTING RIG
PLATFORM & MECHANICAL TOOLS
ARRANGEMENT & DETAILS
TVA DWG NO. 44W275-1 RD
FIGURE 9.1-13



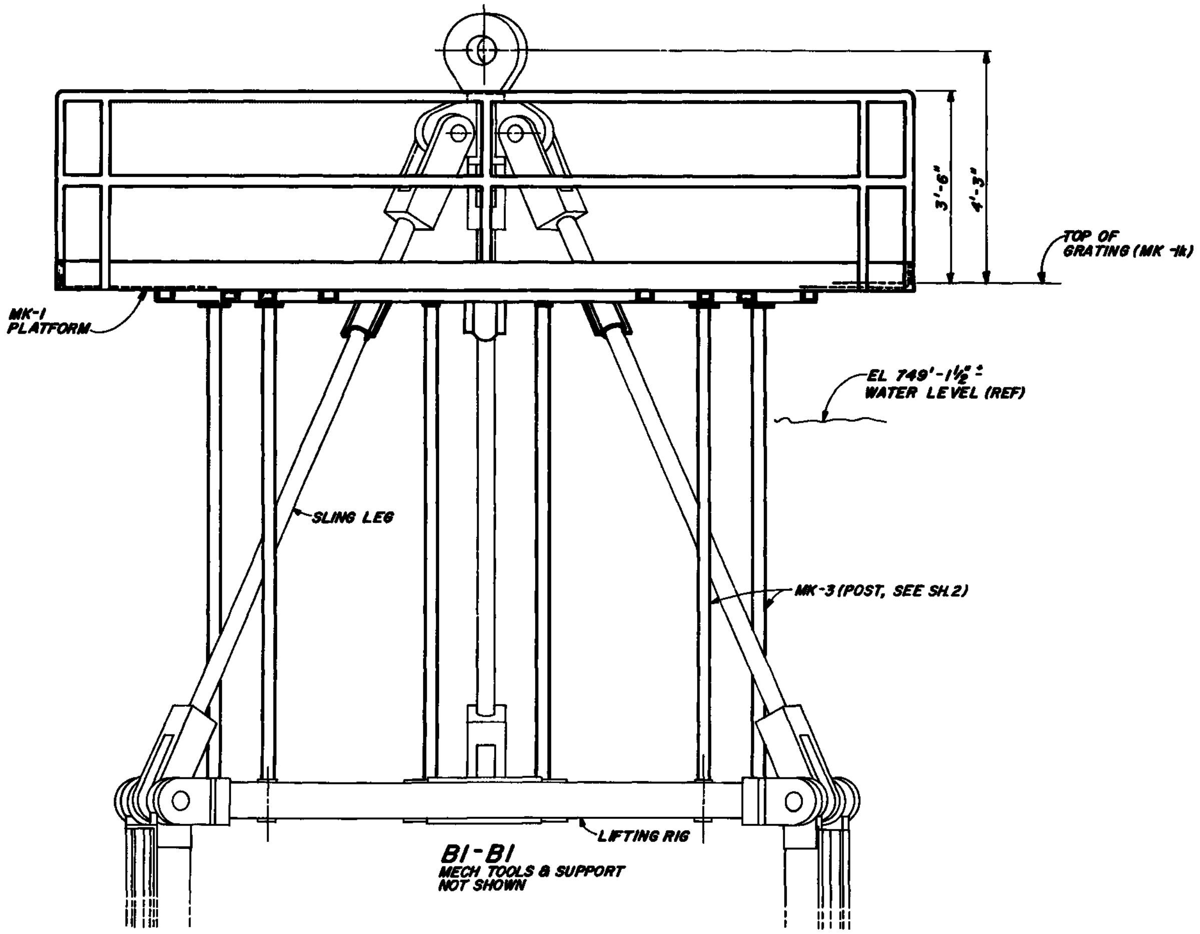
PLAN



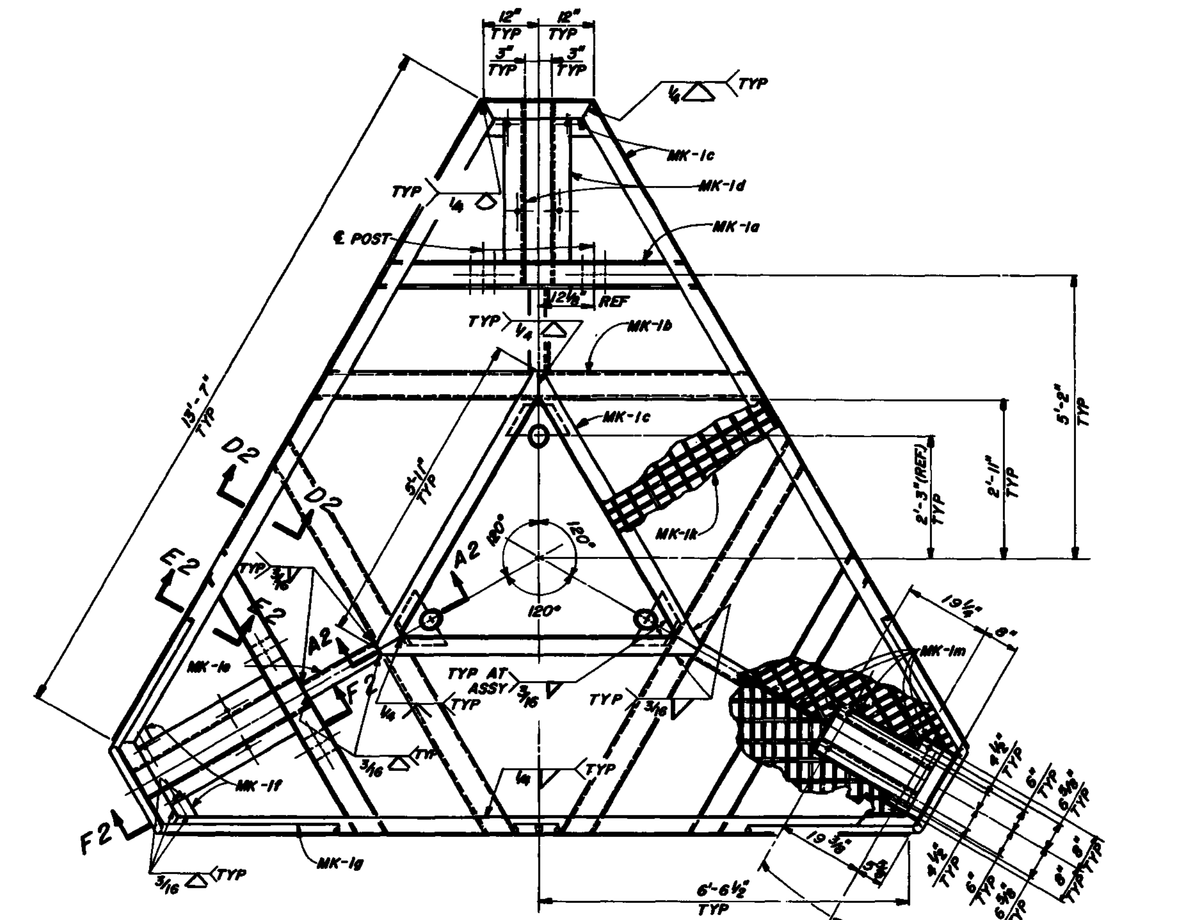
A1-A1
6"=1'-0"



C1-C1
6"=1'-0"



B1-B1
MECH TOOLS & SUPPORT NOT SHOWN



MK-1, PLATFORM

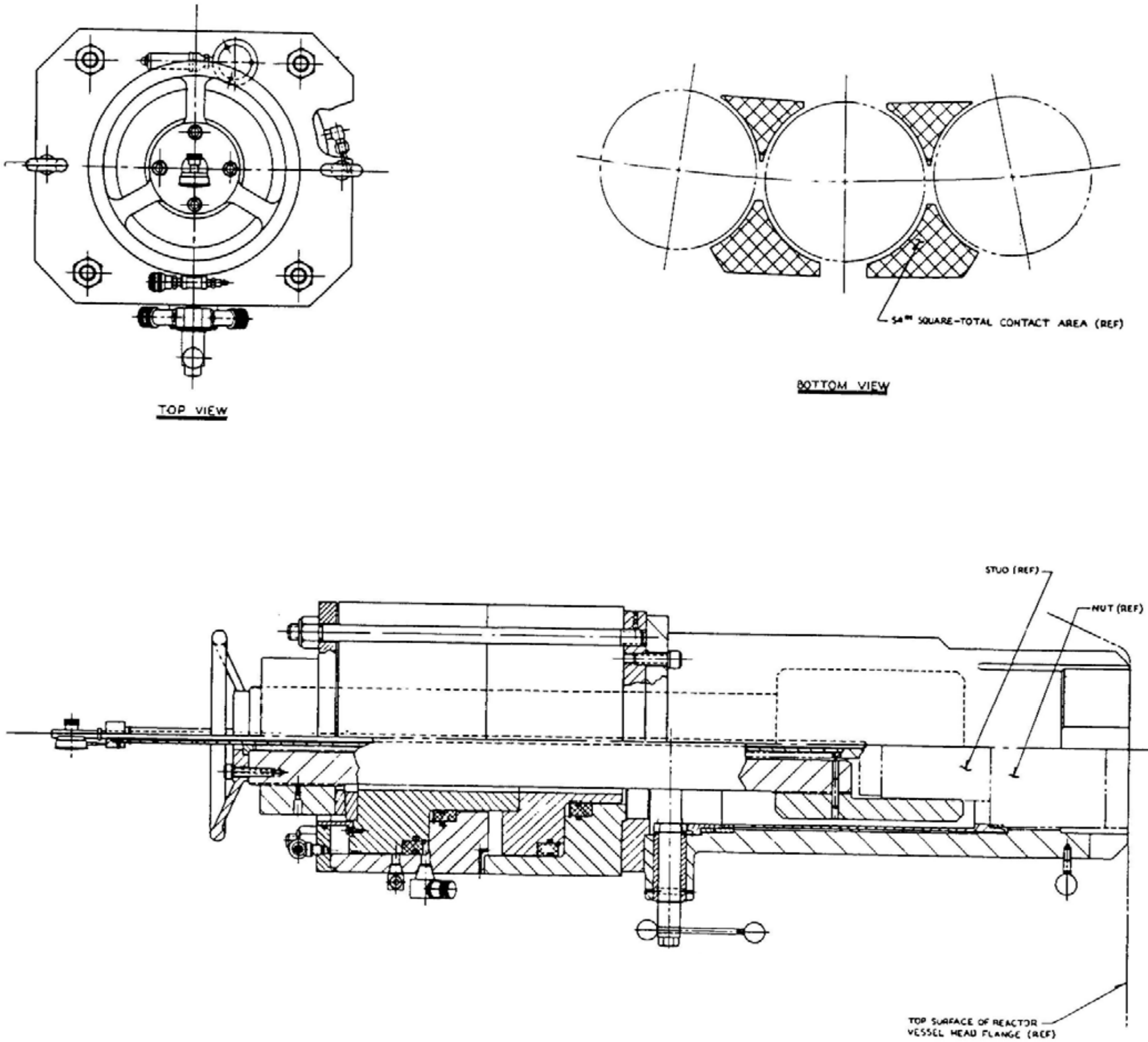
NOTES:

1. LUBRICATE ALL THREADED CONNECTIONS WITH NEOLUBE PRIOR TO ASSEMBLY.
2. MATERIALS AND WORK TO BE IN ACCORDANCE WITH QUALITY LEVEL II OF GEN CONST SPEC N3G-881 WITH EXCEPTION OF MK'S 18 THRU 22 WHICH ARE NON QA.
3. PAINT ALL CARBON STEEL SURFACES WITH 3-5 MILS OF CARBONIZINC II IN ACCORDANCE WITH GENERAL CONSTRUCTION SPECIFICATION G-55.
4. TVA FIELD TO PROVIDE AND FABRICATE ALL MATERIALS.
5. FIELD WELDING AND INSPECTION OF WELDS IN ACCORDANCE WITH GENERAL CONSTRUCTION SPEC G-29M.

COMPANION DRAWINGS:
2-44W275-2,-3,-4,-5,-6,&-7

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

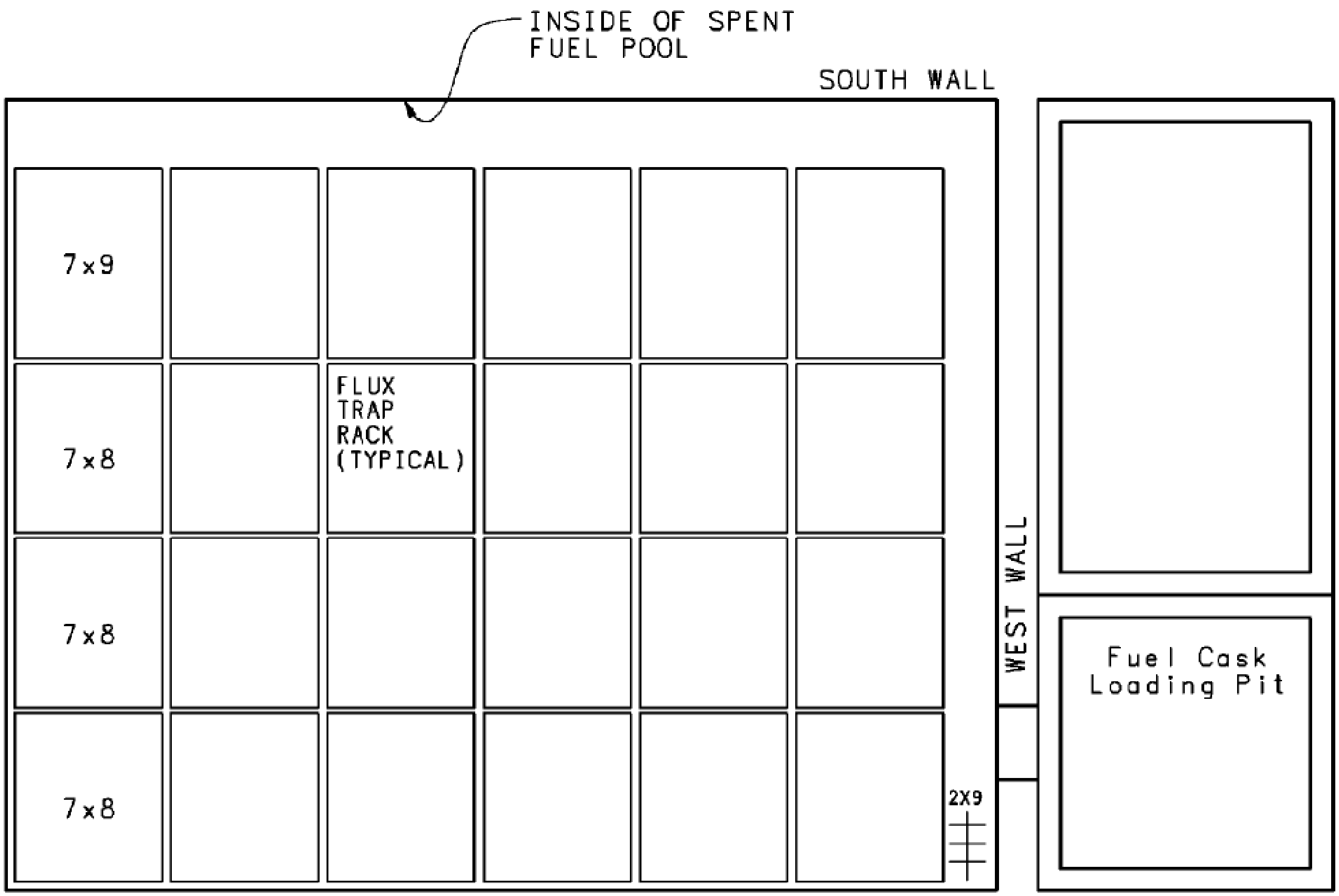
REACTOR BUILDING
UNIT 2
INTERNALS LIFTING RIG
PLATFORM & MECHANICAL TOOLS
ARRANGEMENT & DETAILS
TVA DWG NO. 2-44W275-1 R1
FIGURE 9.1-13(U2)



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Typical
Stud Tensioner

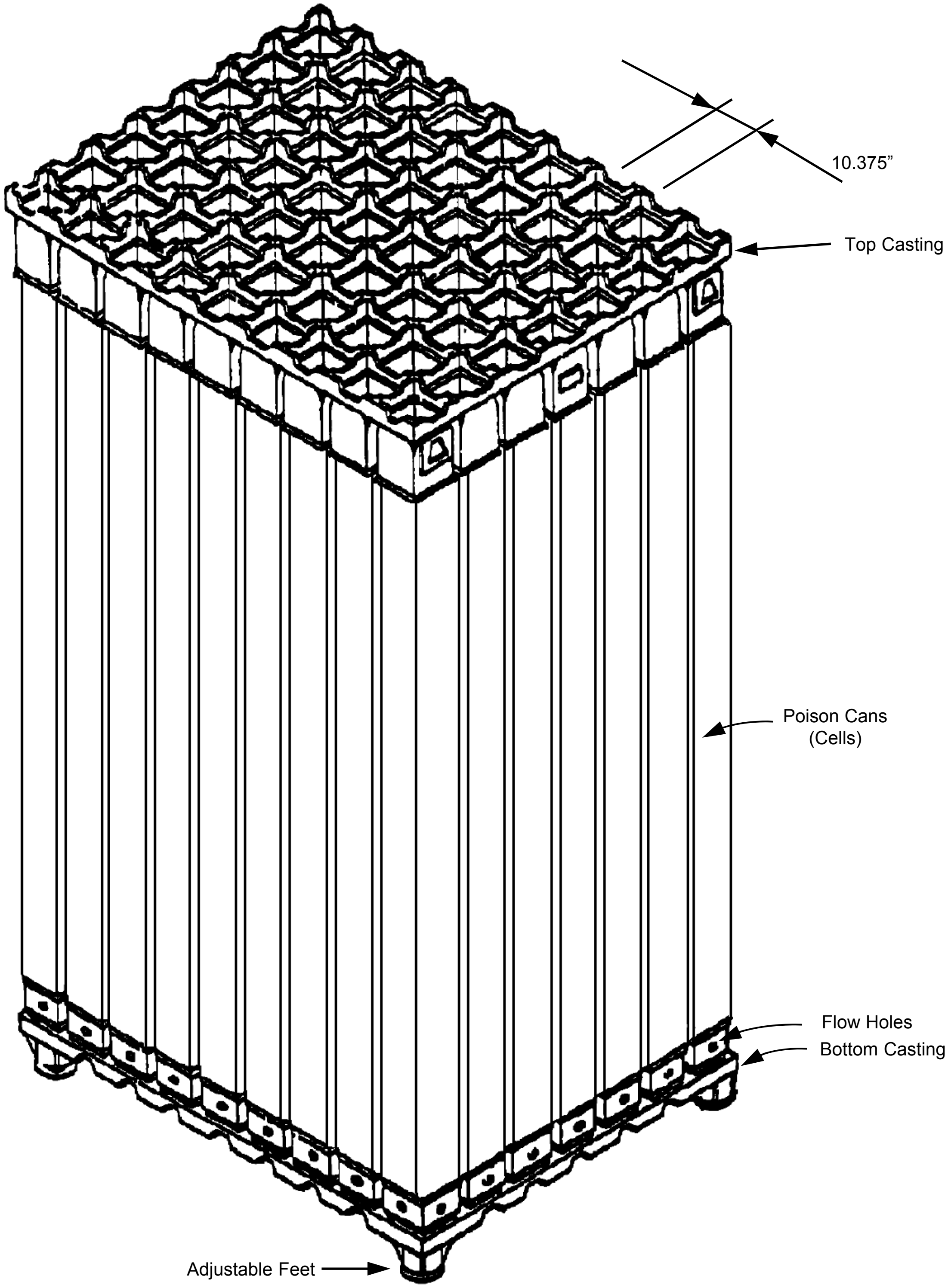
FIGURE 9.1-14



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Plan View of
Spent Fuel Pool

FIGURE 9.1-15

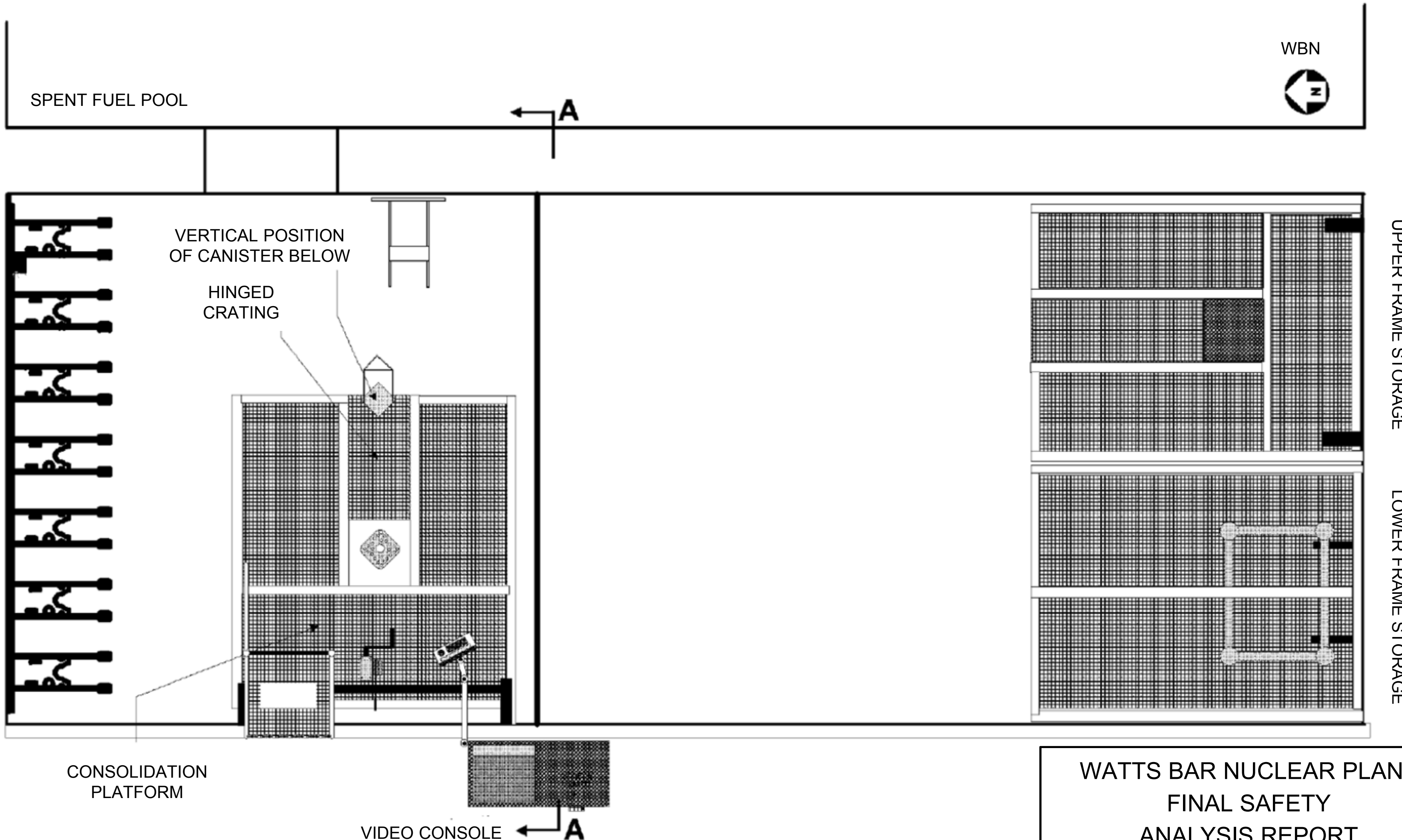


Racks may be 7 cells wide by 8 cells long or 7 cells by 9 cells.

WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT

Flux Trap Spent Fuel Storage Rack

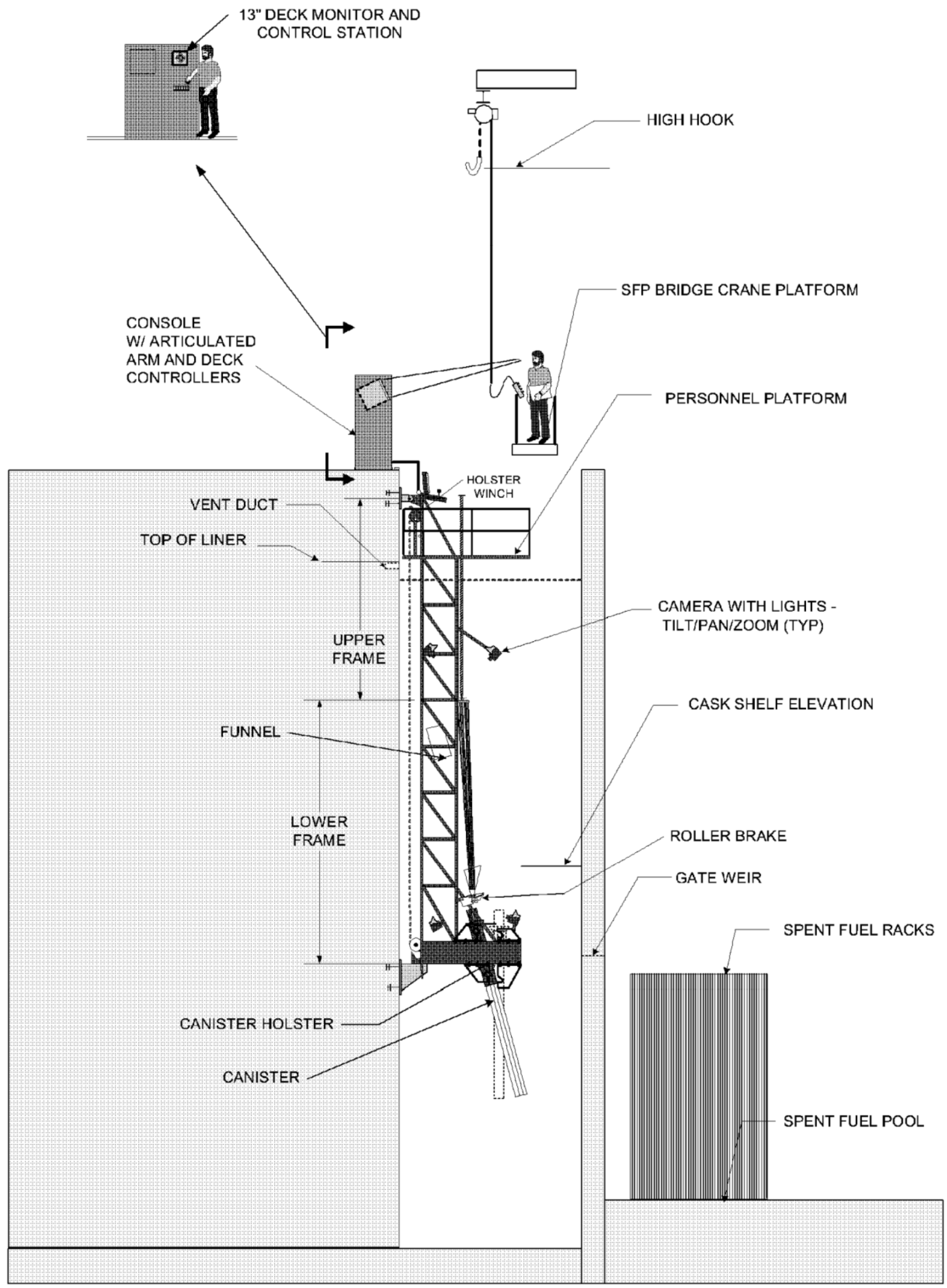
FIGURE 9.1-16



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Spent Fuel Pool Cask
Loading Area
TPBAR Consolidation Fixture
Layout Plan View

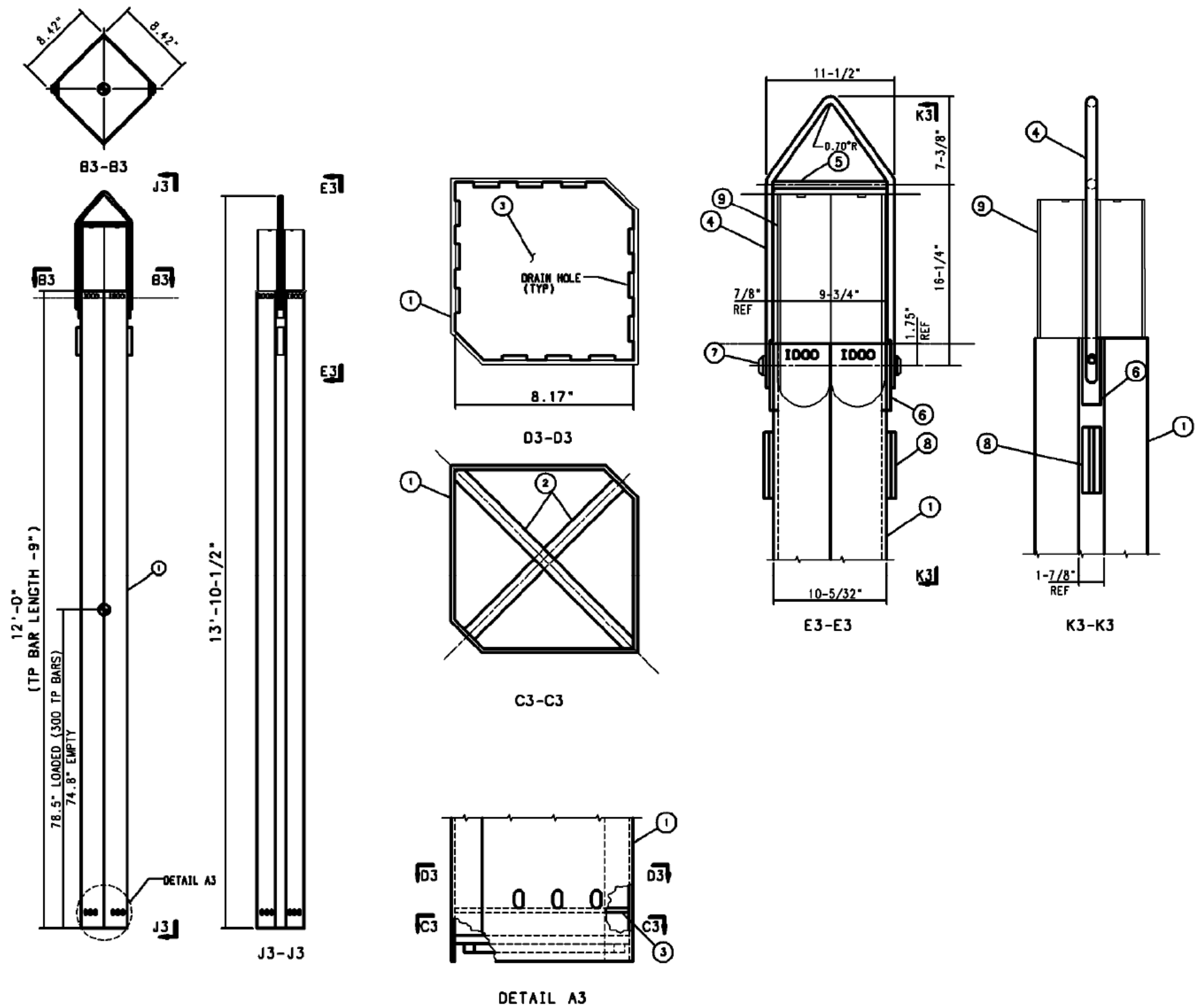
FIGURE 9.1-17



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Spent Fuel Pool Cask Loading Area TPBAR Consolidation Fixture Layout Elevation View

FIGURE 9.1-18



NOTES:

1. TOTAL DRY WEIGHT: 954 LB. (INCLUDING TOP INSERT AND 300 TPBARS). DRY WEIGHT EMPTY: 234 LB. TOP INSERT WEIGHT: 50 LB.

2. EACH CANISTER SHALL HAVE UNIQUE IDENTIFICATION CLEARLY DENOTED FOR FOUR LOCATIONS OF THE CANISTER AT THE TOP AS SHOWN (ID00). LETTERING IS TO BE A MINIMUM ¾" TALL ETCHED, ENGRAVED, OR STAMPED ON METAL.

3. DIMENSION ON THIS FIGURE ARE REFERENCE ONLY.

1 – CANISTER	6 – HINGE PLATE
2 – ENERGY TRANSFER BAR S	7 - HINGE PIN
3 – CANISTER BOTTOM PLATE	8 – LIFTING LUG
4 – LIFTING BAIL	9 – TOP INSERT
5 – BAIL CROSSMEMBER	

WATTS BAR NUCLEAR PLANT FINAL SAFETY ANALYSIS REPORT

TPBAR Consolidation Canister

FIGURE 9.1-19

9.2 WATER SYSTEMS

9.2.1 Essential Raw Cooling Water (ERCW)

9.2.1.1 Design Bases

The ERCW system is safety-related because it provides essential auxiliary support functions to the engineered safety features of the plant. The system is designed to supply cooling water to safety and non-safety-related equipment. Provisions are made to ensure a continuous flow of cooling water to those systems and components necessary for plant safety either during normal operation or under accident conditions. Sufficient redundancy of piping and components is provided to ensure that cooling is maintained to vital loads at all times.

9.2.1.2 System Description

The ERCW system consists of eight ERCW pumps, four traveling water screens, four screen wash pumps, four strainers located in the main intake pumping station, and associated piping and valves as shown in Figures 9.2-1 through 9.2-4B. The logic and control diagrams are presented in Figures 9.2-5 through 9.2-14A. The design data for pumps required for two-unit operation is shown in Table 9.2-1.

The eight ERCW pumps are mounted on the intake pumping station at Elevation 741.0 which is above the probable maximum flood level.

The ERCW system is designed to supply cooling water to the following components:

1. Component cooling heat exchangers***

2. Containment spray heat exchangers

3. Emergency diesel generators

4. Emergency makeup for component cooling system

5. Control Building air conditioning water chillers***

6. Auxiliary Building ventilation coolers (for ESF equipment)***

7. Containment ventilation coolers***

8. Air compressors***

9. Reactor coolant pump (RCP) motor coolers***

10. Control rod drive ventilation coolers***

11. Residual heat removal heat exchangers*

12. Shutdown board Rm Air conditioning water chillers***

13. Spent fuel pool heat exchangers*

14. Reactor coolant pump thermal barrier*

15. Ice machine refrigeration condenser*

16. Instrument room chillers***

17. Auxiliary feedwater**

18. Sample system (SS) heat exchangers*

19. Backup cooling water to the CCP 2A-A lube and gear oil cooler via the CCP 2A-A room cooler.

* Provided with ERCW only during flood above Elevation 728.0.
** Not a cooling load. ERCW discharge provides safety-related source for AFW only when preferred supply from the Condensate Storage Tank is unavailable.
*** Loads on the system during normal operation.

The intake pumping station is located approximately 800 feet from the reservoir at the end of the plant intake channel which provides direct communication with the main river channel for reservoir levels including loss of downstream dam. The intake pumping station is so designed that ERCW related equipment located therein will remain operable during the probable maximum flood.

Water for the ERCW system enters two separate sump areas of the pumping station through four traveling water screens, two for each sump, and two diver protection barriers, one for each sump (Figure 9.2-41). Four ERCW pumping units, on the same plant train, take suction from one of the sumps, and four more on the opposite plant train take suction from the other sump. One set of pumps and associated equipment is designated Train A, and the other Train B. These trains are redundant and are normally maintained separate and independent of each other. Each set of four pumps discharges into a common manifold, from which two separate headers (1A and 2A for Train A, 1B and 2B for Train B), each with its own automatic backwashing strainer, supply water to the various system users. Two ERCW headers associated with the same ERCW train (i.e., 1A/2A or 1B/2B) may be cross-connected to provide greater flexibility (e.g., for strainer maintenance).

Two paths are available for water discharge from the ERCW system. The normal path is to the cooling tower basins of the condenser circulating water system for use as makeup for evaporative losses. The alternate path is to the yard holding pond through yard ERCW standpipes and an ERCW overflow box. The alternate path is seismically qualified up to and including the ERCW overflow box.

The alignment of ERCW headers and system users is as follows:

1. Containment spray heat exchangers 1A, 1B, 2A, and 2B are supplied from ERCW headers 1A, 1B, 2A and 2B, respectively.

2. The normal supply for both Train A diesel generators is from header 1A, although a backup source from header 2B is also provided. The normal supply for both Train B diesel generators is from header 1B with a backup supply from header 2A.

3. The normal supply for component cooling heat exchangers A, B, and C is from ERCW header 2A, 2A, and 2B, respectively. However, interconnections between headers 1B and 2A, and between 1A and 2B have been incorporated to permit alternate supplies.

4. Each header provides ERCW to its corresponding Main Control Room and Control Building electrical board room air-conditioning chillers, the Auxiliary Building ventilation coolers for ESF equipment, the containment ventilation coolers, the RCP motor air coolers, the CRDM vent coolers, and the containment instrument room air conditioning water chillers (i.e., header 1A and 2A supply Train A equipment header 1B and 2B supply Train B equipment, etc.).

5. Headers 1A and 1B provide a normal and backup source of cooling water for the station air compressors. For the auxiliary control air compressors there is one compressor on Header 1A and one on Header 2B.

6. Under flood conditions, the ERCW system provides water to the spent fuel pool heat exchangers, reactor coolant pump thermal barrier, ice machine refrigeration condensers, and under certain conditions, residual heat removal heat exchangers and sample system heat exchangers (refer to Section 2.4.14) using spool piece inter-ties.

7. In the event of a need to supply ERCW to the auxiliary feedwater system, when the normal supply of water is not available from the condensate storage tank, discharge headers A and B automatically provide an emergency water supply to the motor-driven auxiliary feedwater pumps of the same train assignment as the header and to each unit's turbine driven auxiliary feedwater pump.

8. Connections are available in the A-Train ERCW supply and return headers for the lower compartment coolers that will allow chilled water from a non-safety related chiller to be used to provide additional cooling of the Reactor Building during outages.

9. Two RCP motor air coolers are supplied from ERCW Header 1A for Unit 1, 2A for Unit 2; and two are supplied from ERCW Header 1B for Unit 1 and 2B for Unit 2.

The supply headers are arranged and fitted with isolation valves such that a critical crack in either header can be isolated to ensure uninterrupted operation of the other header.

The operation of two pumps on the same plant train is normally sufficient to supply cooling water requirements for the plant for two-unit cooldown, refueling or post-accident operation, and two pumps per plant train will operate during the hypothetical combined accident and loss of normal power if all four diesel generators are in operation. In an accident, the safety injection signal automatically starts two pumps on each plant train, thus providing full redundancy.

Pump motors, traveling screen motors, screen wash pump motors, and backwashing strainer motors are supplied with power from normal and emergency sources, thereby ensuring a continuous flow of cooling water under all conditions. There are two independent power trains with two emergency diesel generators for each train, four of the eight ERCW pumps are assigned to Train A and four to Train B. Due to diesel generator capacity limits, an interlock prevents more than one ERCW pump from being automatically loaded onto any given diesel generator. Under certain scenarios when a diesel generator has excess capacity, this interlock may be manually bypassed and a second ERCW pump may be manually loaded onto the diesel generator. Two traveling screens, two screen wash pumps, and two strainers are assigned to the power train corresponding to that of the ERCW pumps which this equipment serves. The motor-operated valves in the ERCW system are generally supplied with emergency power from the train of diesel generators which corresponds to the pump supplying the header in which the valve is located.

The component cooling system (CCS) heat exchanger discharge by-pass valves incorporate special trim to suppress cavitation. Flow is directed through the by-pass lines at low and intermediate heat exchanger flow rates by opening the by-pass line and closing the main 24-inch motor-operated butterfly valve at the heat exchanger outlet. For conditions which require flow rates beyond the capacity of the anti-cavitation valve, the 24-inch butterfly valve is opened and the anti-cavitation valve closed. To minimize cavitation of the butterfly valves, a multi-holed orifice is located in each of the two CCS heat exchanger vertical discharge headers to increase the back pressure at the valves.

9.2.1.3 Safety Evaluation

The ERCW system is designed to prevent any postulated failure from curtailing normal plant operation or limiting the ability of the engineered safety features to perform their functions in the event of natural disasters or plant accidents. Sufficient pump capacity is provided for design cooling water flows under all conditions and the system is arranged in such a way that even a complete header loss can be isolated in a manner that does not jeopardize plant safety.

The ERCW system has eight pumps (four pumps per train). However, minimum combined safety requirements for the two units are met by only two ERCW pumps on the same plant train. There is one exception to this; see the discussion on compliance with GDC 5 later in this section. Sufficient redundancy, separation and independence of piping and components are provided to ensure that cooling is maintained to vital loads at all times despite the occurrence of a random single failure. A single active failure will not remove more than one supply train per unit (i.e., either headers 1A and 2A or headers 1B and 2B will always remain in service). The ERCW system is sufficiently independent so that a single active failure of any one component in one train will not preclude safe plant operations in either unit. A failure modes and effects analysis is presented in Table 9.2-2.

The safety-related portion of the ERCW system is designed such that total loss of either train, or the loss of offsite power and an entire plant shutdown power train will not prevent safe shutdown of either unit under any credible condition.

CCS Heat Exchanger C, which is shared between the two units, serves the train B engineered safety features for both units. During normal operation, the ERCW flow path to this heat exchanger will be through anti-cavitation bypass valve, FCV-67-144. A safety injection actuation signal in either unit or a loss of offsite power signal causes valve FCV-67-152 to automatically open to assure ERCW flow from header 2B. Depending on the event, the operator will then close FCV-67-144 and place FCV-67-152 in either Position A or B, as appropriate.

The Train A safeguards are capable of meeting the safety requirements independently of the Train B safeguards equipment. Depending on the event, the operator will place the 1(2)-FCV-67-146 valves in either Position A or B, as appropriate, then close the 1(2)-FCV-67-143 valves. The earliest that this action is required is 15 minutes. If minor adjustments in ERCW flow are required, the 1(2)-FCV-67-143 valve positions may be adjusted.

Under extreme flood conditions, the ERCW system provides a heat sink for required cooling systems, except the high pressure fire protection system water is used for steam generator feedwater for reactor cooling. The ERCW system is designed to continue operation during the postflood situation in which the loss of the downstream dam has also been assumed.

The ERCW system is designed to furnish a continuous supply of cooling water under normal conditions, as well as under the following extreme circumstances:

1. Tornado or other violent weather condition which might disrupt normal offsite power. The ERCW pumps are protected from tornadic winds and tornado-borne missiles, as described in Section 3.5, by a walled enclosure covered with a roof composed of structural steel wide-flanged I-beams. The walls and roof are designed to withstand the tornado wind loading and tornado-driven missile impact. In addition, the pumps on power train A are separated from those on train B by a wall on the pumping station deck. The traveling water screens and related screen wash pumps are also located within this protective structure. Yard piping (Class C) is protected by a minimum rock cover or concrete slabs where the minimum rock cover is not possible.

2. The ERCW pumps, intake pumping station traveling screens and screenwash pumps, and associated piping and structures remain operable during and after a safe shutdown earthquake which might destroy non-seismic structures and equipment and the main river dams upstream and downstream of the site. The components required for operation are designed either to Seismic Category I or I(L) - pressure boundary integrity requirements. The pumping station is designed to maintain direct communication with the main river channel at minimum possible water level resulting from loss of the downstream dams.

3. The design provides for the probable maximum flood with the coincident or subsequent loss of the upstream and/or downstream dams. To meet these conditions, the ERCW pumps, traveling screens, and screenwash pumps located in the intake pumping station are above the maximum possible flood level.

4. In the event of blockage of the non-qualified, normal discharge path, the alternative discharge path would be functional. In this event, the discharge water would flow through the ERCW standpipes and out of the ERCW overflow box. The ERCW overflow box is located in Area 2 which is described in Section 2.4.2.3. The flow from the overflow box will drain along the road, then across the perimeter road, flow west through a swale and across the low point in the access road. If the normal discharge path is blocked, no change in valve alignment or operator action is necessary to activate the alternate path. The alternate path is seismically qualified up to and including the ERCW overflow box. If the alternate path was in use and the non-qualified piping became blocked, the discharge water would flow out of the overflow box and drain away from the plant. Even with the maximum flow out of the overflow box, the water would not build up to reach the elevation of any of the entrances to safety-related buildings. For purposes of maintenance to the cooling towers, a valve is provided in each of the normal discharge headers so that the ERCW flow can be terminated to the cooling towers and diverted to the holding pond via the alternate discharge path.

Cooling water is supplied in an open cycle cooling mode to the various heat exchangers served by the ERCW pumps during all modes of plant operation. With normal offsite power sources available, water is normally supplied to both units by operating up to two ERCW pumps per train. More than 2 pumps may be operated during pump changeover, etc. The ERCW system provides the required flow necessary to dissipate the heat loads imposed under the design basis operating mode combination, i.e., one unit in LOCA and the other unit in hot standby, based on a maximum river temperature. The ERCW system is also capable of supporting a cooldown of the non-accident unit in accordance with GDC 5. Maximum ERCW supply temperature is 85°F and is consistent with the recommendations in Regulatory Guide 1.27. Minimum river temperature is 35°F.

ERCW is a versatile system capable of providing sufficient flow and heat removal for a variety of conditions in each unit. As examples,

1. During normal operations, the ERCW system can supply the highest flow / decay heat demand of one unit in Startup and the other in Hot Shutdown with a flow requirement of approximately 26,250 gpm and remove a heat demand of 241 MBtu/hr.

2. Under design basis accident conditions with offsite power available, the ERCW system can supply the highest flow / decay heat demand with one unit in Startup and the other in LOCA Recirculation with a flow requirement of approximately 32,750 gpm and remove a heat demand of 446 MBtu/hr.

3. Under design basis accident conditions with a LOOP coupled with a Loss of Train A, ERCW Train B can supply the highest flow / decay heat demand of one unit in Hot Shutdown and the other in LOCA-Recirculation with a flow requirement of approximately 21,850 gpm and remove a decay heat demand of 316 MBtu/hr.

4. Under design basis accident conditions with a LOOP coupled with a Loss of Train B, ERCW Train A can supply the highest flow / decay heat demand of one unit in Hot Shutdown and the other in LOCA-Recirculation with a flow requirement of approximately 22,400 gpm and remove a decay heat demand of 320 MBtu/hr.

The availability of water for the design basis condition on the ERCW system is based on one unit being in a LOCA and the other unit in hot standby and the following events occurring simultaneously:

1. Loss of offsite power.

2. Loss of downstream dam.

3. Loss of an emergency power train.

GDC 5 Compliance: The ERCW system has eight pumps (four pumps per train). Normally, during Loss of Offsite Power (LOOP) events, only four pumps (two pumps per train) may be loaded onto the four diesel generators (one per diesel generator). When both trains of ERCW are available, the four ERCW pumps are able to supply all required loads for all design basis events to support both units. When various events occur with a LOOP, and combined with a complete loss of one train of emergency power, then only two ERCW pumps are normally available. The two ERCW pumps are able to support the accident unit, the non-accident unit and the SFP for all design basis events except as described below.

Typically, if an accident occurs on one unit, the second unit will be brought to Mode 3 (Hot Standby), which for Watts Bar is the defined “Safe Shutdown” mode of operation. The non-accident unit will be held in Mode 3 until the accident unit can be stabilized and the core decay heat in the non-accident is within the capability of the RHR system. Calculations demonstrate that two ERCW pumps are sufficient to cope with the accident unit and bring the non-accident unit to Cold Shutdown within 72 hours. There is one scenario where two ERCW pumps do not have sufficient capacity to cope with both the accident and non-accident units. This scenario is described as follows:

- The non-accident unit has been shutdown within the previous 48 hours and is being cooled by RHR in either Mode 4 or Mode 5.

- The accident unit is in LOCA-Recirculation mode of operation

- LOOP

- Loss of one train of emergency power.

Under this scenario, a third ERCW pump is required. Diesel generator loading calculations indicate that the diesel generator associated with the non-accident unit has the capacity to support a second ERCW pump (approximately 805 horsepower). Manual bypass switches on the shutdown boards allow the interlocks, which prevent more than one ERCW pump to be loaded onto a diesel generator, to be over-ridden. The third ERCW pump must be manually started prior to placing the accident unit in LOCA Recirculation.

For these reasons, one of the following two GDC 5 related restrictions are imposed on the ERCW system following the shutdown of a unit:

1. A third ERCW pump must be available on each train of ERCW; or,

2. The shutdown unit must remain in Mode 3 for 48 hours prior to establishing RHR cooling.

Calculations indicate that there is sufficient ERCW capacity to maintain the SFP within its design basis temperatures for all scenarios. In certain cases, SFP cooling may be temporarily suspended while plant operators reconfigure plant systems to restore it. In order to preclude leakage of radioactivity from the containment, the supply lines to the upper containment coolers are provided with double isolation by use of a check valve and motor-operated valve. The supply lines to the lower containment cooler groups and the discharge lines are doubly protected by use of two motor-operated valves operated on separate power trains as shown in Figure 9.2-11.

Radiation detectors are installed in each ERCW discharge header at a point downstream of the last equipment discharge point. If an abnormal radiation level is detected in either ERCW discharge header, the radiation source is located and isolated.

9.2.1.4 Tests and Inspections

All system components are hydrostatically tested in accordance with the applicable industry code before station startup. The yard piping is hydrostatically tested in accordance with Section III of the ASME Code. Subsequent to closing out Section III activities, the yard piping was opened at a number of locations and a cement-mortar lining was applied as a replacement under the provisions of Section XI of the ASME Code. Section XI defines a replacement as a design change to improve equipment service. Welds at pipe access points were examined visually and by magnetic particle test, and vacuum box leak tested before application of mortar to the weld area. After completion of cement-mortar lining, the piping was tested to the ASME Section III hydrostatic test requirements. The exposed welds were examined in accordance with the requirements of ASME Section III. ASME Section III examination pressure was maintained until the total time at pressure was one hour or greater. Following return of the system to service and before fuel load a visual examination (VT-2) will be performed in accordance with ASME Section XI IWA-5244 for buried components.

This alternative to visual examination during ASME Section III hydrostatic pressure testing was approved by NRC Inspection Report No. 50-390/89-04 and 50-391/89-04 for ERCW piping having inaccessible welds.

9.2.1.5 Instrument Applications

9.2.1.5.1 General Description

ERCW instrumentation and controls (see Figures 9.2-10 through 9.2-14A) for equipment supplied for a particular ERCW main supply header are powered from the same electrical power source as the pumps which normally supply the water to that header. Therefore, loss of one power train would result in the loss of only the instrumentation and controls associated with that particular ERCW header. Motor-operated containment isolation valves are arranged and powered such that isolation may be accomplished utilizing either one of the available power trains. Backup controls (see Section 7.4) are provided for devices which are required for operation in the event of a main control room evacuation.

9.2.1.5.2 Pressure Instrumentation

Pressure transmitters are provided on each ERCW pump discharge line and main supply header for displaying pressures locally and in the main control room, as well as actuating main control room annunciators when pressure drops below the setpoint. Each screenwash pump is provided with a local pressure gauge on the pump discharge line. Pressure differential switches are connected across each pair of traveling screens in a forebay. High differential pressure starts both screen wash pumps in a forebay and causes annunciation in the Main Control Room. Since this operation uses non-essential control air/service air, a nonqualified system, the screenwash system is put in continuous operation within three hours after an earthquake, tornado, flood, loop, loss of upstream or downstream dam, or within 12 hours of a LOCA. Screen wash pump discharge pressure switches are utilized to start the traveling screen motor when screen wash pressure has been established. Local pressure gauges and differential switches are provided on each ERCW strainer to monitor strainer pressures and indicate status. Local pressure test points are provided on the ERCW inlet and outlet of the water chillers of each electric board room air conditioner and each main control room air conditioner.

9.2.1.5.3 Flow Instrumentation

Flow elements and transmitters are provided for each ERCW main supply header to display the flow rates. The ERCW flow rate through each containment spray heat exchanger is also displayed in the main control room. The ERCW flow rate through each CCS heat exchanger is also available in the main control room. Local flow indicators are provided for the flow rate through the emergency diesel engine heat exchangers, the flow rate inlet and discharge from each lower containment, RC pump motor, and control rod drive ventilation cooler group, each upper containment ventilation cooler, and ECCS pump room coolers. Flow elements are provided in the discharge lines of most other coolers and heat exchangers for use during testing and system balancing.

9.2.1.5.4 Temperature Instrumentation

ERCW pump motor winding and bearing temperatures are monitored by a plant computer system which provides recorded data capability. Local temperature indicators are provided for the discharge from each emergency diesel engine heat exchanger and for various other users. Temperature test wells are provided on the inlet of each air conditioner condensing unit and the discharge side of each component cooling system heat exchanger, containment spray heat exchanger, RC pump motor cooler, and control rod drive cooler. Temperature test wells are also provided in the inlet and discharge lines for most space coolers, room coolers, and in the main supply and return header.

9.2.1.5.5 Control Valves

The open and closed positions of the ERCW air operated and motor-operated valves are displayed in the main control room by means of lights incorporated either on the controlling hand switch or on a valve status light subpanel. Air operated temperature and flow control valves are designed to fail open on loss of electrical power and/or operating air, thereby providing maximum ERCW cooling flow to the equipment being supplied.

ERCW is regulated to each upper and lower containment and control rod drive ventilation cooler through a throttling action type valve controlled by a temperature indicating controller. Manual and/or automatic override to fully close the control valve is provided by means of a hand switch and/or logic signals (Figures 9.2-5 through 9.2-9).

ERCW is supplied to each air conditioner condensing unit through an automatic water regulating valve controlled by condenser pressure.

Each CCS heat exchanger incorporates a motor-operated butterfly valve in its main ERCW discharge line. Each valve may be placed in either of two intermediate, throttled positions in addition to the full open or closed positions. The desired position is selected manually from the control room for the particular plant operating condition. In addition, the heat exchanger C valve has automatic controls to open the valve to the low-flow intermediate position in response to a loss of offsite power signal or a safety injection signal in either unit. Such automatic controls are not required for heat exchangers A or B since their bypass valves are normally open, whereas the heat exchanger C valve may be normally closed.

The by-pass lines at the CCS heat exchangers discharges have a special motor- operated, anti-cavitation modulating valve to control ERCW flow rate through the associated CCS heat exchanger at low and intermediate flow rates. These anti-cavitation valves may be manually adjusted to the open, closed, and/or intermediate position to achieve desired CCS heat exchanger performance for various operating modes. Control switches are provided in the main control room. The valves are designed to ASME Section III, Class 3, with Class 1E motor operators.

ERCW is supplied to each additional cooler or heat exchanger through an on-off action type valve controlled by either a hand switch, a temperature switch, a manual valve, a logic signal, or various combinations of these.

9.2.1.6 Corrosion, Organic Fouling, and Environmental Qualification

Watts Bar Nuclear Plant (WBN) has a comprehensive chemical treatment program for treating raw water systems. This treatment is a major part of WBN Raw Water Corrosion Program. The chemical treatment is used to control corrosion in carbon steel and yellow metals, to control organic fouling, including slime, to minimize the effect of microbiologically induced corrosion (MIC) and inhibit growth of Asiatic clams.

The water used in the Essential Raw Cooling Water (ERCW), High Pressure Fire Protection (HPFP) and Raw Cooling Water (RCW) system is chemically treated. The chemical treatment program injects chemicals to the ERCW, RCW, and HPFP raw water systems at the Intake Pumping Station (IPS) pits such that any pump taking suction from these pits will introduce the chemicals into the system. This treatment includes oxidizing biocide, non-oxidizing biocide, phosphate, and zinc. The phosphate is used to sequester iron from existing corrosion products, the zinc is used to passivate the carbon steel surfaces, and the oxidizing and non-oxidizing biocide will control slime, clams, and MIC

The dead legs to the containment spray system (CSS) heat exchangers (Hxs) and auxiliary feedwater (AFW) Pumps have biocide/chemical treatment lines which permit flow through those lines on a continuous basis when required by procedure. In addition, the CSS Hxs and piping between the motor-operated supply and discharge isolation valves are filled with demineralized water treated for corrosion control. Connections are provided on the biocide/chemical treatment lines feeding the Train A Auxiliary Feedwater Pump dead legs to permit chemical treatment with demineralized water and biocides.

The ERCW piping to the diesel generators is treated during periods of train specific biocide injection by opening the associated diesel generator ERCW supply valve.

For the ERCW line to the CCS surge tank, the blind flange at the spool piece connection is provided with a flushing connection to facilitate chemical treatment of the piping. Other lines used to connect to CCS piping during flood mode operation would be treated in a similar manner. These lines are not connected to the CCS during the flushing operation.

Control of organic fouling and Asiatic clams is further enhanced by the use of strainers in the supply headers. Each supply header is provided with a strainer (auto-backwash type) capable of removing particles and organic matter larger than 1/32-inch diameter. The strainers are located in the Intake Pumping Station downstream of the ERCW pumps.

Normal system operation and maintenance is considered adequate to disperse chemicals in the instrument lines, drains, and vents in the ERCW system.

Allowances for the effects of corrosion on the structural integrity of this system were made by increasing the wall thickness of the pump pressure boundary, pipe, heat exchanger shells and tubes, and other system pressure retaining components. Measures have also been taken to compensate for the effects of corrosion on the flow passing capability of the system. The normally wetted portion of the buried supply and discharge headers have been lined in situ with cement mortar, most of the 2-inch and smaller diameter piping is stainless steel, and selected runs of larger piping in the Auxiliary and Turbine Buildings are stainless steel, and almost all of the piping in the Reactor Building is stainless steel.

To the extent to which they are exposed to atmospheric conditions, all pumps and valves are designed to operate under the most extreme climatic conditions that are expected to prevail in the southeastern United States. Operator actions are taken, as needed, to provide surveillance and compensatory measures, to ensure the ERCW pumps auxiliary piping do not freeze during extreme weather conditions.

9.2.1.7 Design Codes

The ERCW system components are designed to the codes listed in Table 3.2-2a.

9.2.2 Component Cooling System (CCS)

9.2.2.1 Design Bases

The CCS is designed for operation during all phases of plant operation and shutdown. The system serves to remove residual and sensible heat from the reactor coolant system via the residual heat removal system during plant cooldown; cool the spent fuel pool water and the letdown flow of the chemical and volume control system; provide cooling to dissipate waste heat from various plant components; and provide cooling for safeguard loads after an accident.

The systems served by the CCS are:

1. Reactor coolant system (RCS), Section 5.5.1
   Reactor coolant pumps (RCPs)
   a. RCP upper and lower oil coolers
   b. RCP thermal barrier heat exchangers.

2. Residual heat removal (RHR) system, Section 5.5.7
    a. RHR heat exchangers (Hxs)
    b RHR pump seal water Hx

3. Safety injection system (SIS), Section 6.3
    a. Safety injection pump lube oil coolers

4. Chemical and volume control system (CVCS), Section 9.3.4
    a. Letdown Hx
    b Excess letdown Hx
    c. Seal water Hx
    d. Centrifugal charging pump lube and gear oil coolers

5. Spent fuel pool cooling and cleanup system (SFPCCS), Section 9.1.3
    a. SFPCCS Hxs

6. Containment spray system (CSS), Section 6.2.2
    a. Containment spray pump oil Hx

7. Gaseous waste processing disposal system (GWPS), Section 11.3
    a. Waste gas compressor Hxs

8. Sampling system (SS), Section 11.4
    a. Sample Hxs
    b. Sample chiller package
    c. Post accident sampling (PAS) coolers (Unit 1 Only)

The CCS serves as an intermediate loop between systems 1 through 8, listed above, and the ERCW system. Heat from the listed systems is transferred by the CCS through the component cooling heat exchangers to the ERCW system, which is the heat sink for these heat loads. The intermediate loop provides a double barrier to reduce the possibility of leakage of radioactive water to the environment.

The CCS design is based on a maximum ERCW inlet temperature of 85°F. The ERCW supply from the river is designed to be available under all conditions. The design temperature places no undue limitations on normal plant operation. It affects the time required for plant cooldown and the number of component cooling heat exchangers in use during the various plant operations.

Since the CCS is required for post-accident removal of heat from the reactor, the CCS is designed such that no single active or passive failure can interrupt cooling water to both A and B Engineered Safety Feature (ESF) trains. One ESF train is capable of providing sufficient heat removal capability for maintaining safe reactor shutdown.

The CCS pumps, thermal barrier booster pumps and required motor-operated valves will be automatically transferred to auxiliary onsite power upon loss of offsite power.

9.2.2.2 System Description

The CCS, shown in Figures 9.2-16, 9.2-17, 9.2-18, and 9.2-19, consists of five CCS pumps, two thermal barrier booster pumps per unit, three heat exchangers, two surge tanks, one CCS pump seal water collection unit, and associated valves, piping and instrumentation serving both units. The coolers associated with the systems served by CCS (see Section 9.2.2.1) are not part of CCS but rather are included in the serviced systems. Such coolers are discussed more fully in the references listed in Section 9.2.2.1.

The logic and control diagrams for this system are presented in Figures 9.2-20, 9.2-20A, 9.2-21, 9.2-21A, 9.2-22, 9.2-22A, 9.2-23, 9.2-24, 9.2.25, and 9.2-25A.

The CCS design pressure and temperature are 150 psig and 200°F, respectively, except as noted below:

(i) The design pressure and temperature for piping from thermal barrier booster pumps (TBBPS) discharge to the first of redundant check valves in each thermal barrier supply line are 200 psig and 200°F, respectively.

(ii) From the first redundant check valve of each thermal barrier supply line to the outboard containment isolation valve on the thermal barrier return line, the design pressure and temperature are the same as the RCS design pressure and temperature which are 2485 psig and 650°F. This prevents overpressurization of this portion of the CCS piping in the event of thermal barrier leakage. A 3/4-inch check valve installed across the inboard containment isolation valve, incorporates a soft seat which is not designed for fluid temperatures above 300°F. In order for the temperature to exceed 300°F, reactor coolant must leak through the thermal barrier into the CCS. A thermal barrier tube rupture event will not degrade the soft seat since isolation would occur rapidly. In order to guard against leakage through the check valve, inspection and repair of the check valve seat will be performed whenever repairs for thermal barrier tube leakage are needed.

(iii) In order to maintain containment integrity during and after a LOCA, CCS piping between and including the containment isolation valves is designed for 250°F.

CCS is a supporting system to other safe shutdown systems. Two redundant trains per unit are available. For each unit, Train A consists of two available CCS pumps and the associated valves, piping, instrumentation and heat exchanger (Heat Exchanger A for Unit 1 and Heat Exchanger B for Unit 2). Train B is common for both units and consists of one CCS pump and the associated valves, piping, instrumentation and heat exchanger (Heat Exchanger C).

Each unit has a CCS pump (1A-A for Unit 1 and 2A-A for Unit 2) which is aligned to that unit's Train A header and which receives electrical power from Train A. Each unit has another CCS pump (1B-B for Unit 1 and 2B-B for Unit 2) which are normally aligned to that unit's Train A header, but which receives electrical power from Train B. These pumps (1B-B and 2B-B) can be manually re-aligned to the common Train B piping system. CCS pump C-S, which normally receives Train B electrical power while serving as the common Train B CCS pump, is capable of being powered from a Train A source.

During normal full power operation, with all CCS equipment available, CCS pumps 1AA and 1BB and Heat Exchanger A are aligned with Unit 1, Train 1A ESF and miscellaneous equipment. CCS pumps 2A-A and 2B-B and Heat Ex changer B are aligned with Unit 2 Train 2A ESF and miscellaneous equipment. CCS pump C-S and Heat Exchanger C are aligned with both Unit 1, Train 1B and Unit 2, Train 2B.

Although normally aligned as described above, the CCS pumps can be manually realigned to meet various abnormal operational and maintenance requirements. Either Train B CCS pump can be re-aligned to CCS HX C to either replace or supplement CCS pump C-S. CCS pump CS can be re-aligned to either CCS HX A or B to supplement the Train A CCS pump. For additional information, see the GDC 5 compliance discussion in Section 9.2.2.3.

CCS Heat Exchangers are subject to testing in accordance with Generic Letter 89-13, which requires cleaning and testing of the ERCW cooled CCS Heat Exchangers to verify the heat transfer capability.

Since CCS Heat Exchanger A supports the operability of CCS Train 1A, without a dual unit outage, long duration maintenance on CCS Heat Exchanger A requires a Unit 1 refueling outage. Specifically, Unit 1 shall be in an outage at least 96 hours following shutdown with no more than one train of RHR cooling required and two operable Train B CCS Pumps shall be aligned to CCS Train B through CCS Heat Exchanger C. This alignment maintains an operable Train B for both units without impacting Unit 2 Train A. In addition, CCS Train B can support Seal Water Heat Exchanger 1A, Waste Gas Compressor A, and Spent Fuel Pool Cooling Heat Exchanger A through the use of the CCS isolation valves between the outlet of CCS Heat Exchangers A and C. This maintains refueling loads normally aligned to CCS Train 1A and two trains of Spent Fuel Pool Cooling by utilizing Spent Fuel Pool Cooling Heat Exchangers A and B and Spent Fuel Pool Cooling Pump C-S.

Since CCS Heat Exchanger B supports the operability of CCS Train 2A, without a dual unit outage, long duration maintenance on CCS Heat Exchanger B requires a Unit 2 refueling outage. Specifically, Unit 2 shall be in an outage at least 96 hours following shutdown with no more than one train of RHR cooling required and two operable Train B CCS Pumps shall be aligned to CCS Train B through CCS Heat Exchanger C. This alignment maintains an operable Train B for both units without impacting Unit 1 Train A. In addition, CCS Train B can support Seal Water Heat Exchanger 2A, Waste Gas Compressor B, and Spent Fuel Pool Cooling Heat Exchanger B through the use of the CCS isolation valves between the outlet of CS Heat Exchangers B and C. This maintains refueling loads normally aligned to CCS Train 2A and two trains of Spent Fuel Pool Cooling by utilizing the normal Spent Fuel Pool Cooling Heat Exchanger and pump alignments.

Since CCS Heat Exchanger C supports the operability of both CCS Trains 1B and 2B, without a dual unit outage, long duration maintenance on CCS Heat Exchanger C requires a Unit 1 refueling outage and CCS Heat Exchanger A is needed to support CCS Train 2B operability. Specifically, Unit 1 shall be in an outage with no RHR cooling required (full core offload) and CCS Heat Exchanger A (aligned to ERCW Train 1B), CCS Pump 1B-B, and CCS Pump C-S shall be aligned to CCS Train 2B. These components ensure that Unit 2 maintains two operable independent CCS trains, thereby; ensuring that Unit 2 is capable of responding to any design basis event. In this cleaning alignment, CCS can support two trains of Spent Fuel Pool Cooling utilizing Spent Fuel Pool Cooling Heat Exchangers A and B and Spent Fuel Pool Cooling Pump C-S.

Train 1A and Train 2A equipment will provide all the cooling water necessary for the safe operation of Units 1 and 2, respectively. Train 1B/2B (common) supplies additional cooling capacity of both units during various operational modes. Train 1B/2B equipment has been sized to maintain plant safety in the event of Train A power loss.

Two surge tanks are located in the Auxiliary Building. Each surge tank is separated into two parts by a baffle, providing separate minimum surge volumes for each ESF cooling train.

Both units are served by two cooling system trains (A and B) serving ESF equipment, with train A also serving miscellaneous non-safety related components. Except for the RHR Hxs, excess letdown Hx, and PASS coolers (Unit 1 only), both trains of the safeguards equipment of both units served by the CCS are normally aligned and supplied with CCS water and will automatically continue to be supplied in a LOCA. In the event of an accident, nonsafety-related components are not required; therefore, CCS flow to these components may be manually isolated. The excess letdown heat exchanger is required only during startup and when normal letdown is lost, and is valved in at that time. Prior to switchover from injection to recirculation phase of safety injection it is necessary for the operator to open the CCS valves at the RHR heat exchangers of the accident unit in order to supply these heat exchangers with cooling water. This action is part of the switchover sequence specified in Section 6.3.2.2 and Table 6.3-3. The earliest time at which this operator action is required to be performed is 10 minutes. If an emergency power train is lost during an accident condition, no additional operator action is required for plant safety except for the following cases:

1. If Train A power is lost and if the non-accident unit is utilizing Train B RHR cooling, it will be necessary to adjust CCS flow to the non-accident unit RHR HX.

2. If SFPCCS HX A is inservice and if a LOCA occurs on Unit 1 concurrent with a LOOP and Loss of Train B, it will be necessary to isolate CCS flow to SFPCCS HX A.

3. If Train A power is lost, SFP cooling may be restored by using CCS pump 1BB to supply CCS flow through CCS HX A and SFPCCS HX A. (Note: This also requires the re-alignment of ERCW header 1B to CCS HX A.)

In the event of a design basis flood at WBN, the CCS pumps will be submerged since the maximum flood level will be above the CCS pumps. Since cooling must be maintained to certain CCS users during the flood, provisions have been made to interconnect the ERCW and CCS systems to supply ERCW to the following loads:

a. SFP heat exchangers,
b. RHR heat exchangers,
c. RCP thermal barriers,
d. Sample heat exchangers.

The interconnections are accomplished by installing spool pieces and opening normally-closed valves during flood mode preparation. The thermal barrier booster pumps are required to operate during flood mode and remain above the maximum flood. Some normally-open CCS valves will be closed during this phase to isolate nonessential equipment. The surge tanks shall be isolated upon ERCW interconnection to prevent potential overpressurization.

Provisions have been provided to reestablish CCS flow to the reactor coolant pump thermal barrier following a Phase B isolation signal. This action will protect the integrity of the seals in the event of passive failure of the chemical and volume control system seal injection flow to the reactor coolant pump seals.

The CCS water is circulated through the shell side of the CCS heat exchangers to the components using the cooling water and then back to the CCS pump suction. The surge tank for each unit is separated into two sections by a baffle. Each section is tied into the pump suction lines from safeguard trains. A single Train B Section may be isolated from the pump suction lines. This tank accommodates expansion and contraction of the system water due to temperature changes or leakage, and provides a continuous water supply until a small leak from the system can be isolated. Because the surge tank is normally vented to the building atmosphere, a radiation monitor is provided in each component cooling water heat exchanger

discharge line. These monitors actuate an alarm and close both surge tank vent valves when the radiation reaches a preset level above the normal background.

Cooling water is available to the components served by the system. The system is provided with adequate motor-operated-valves to permit realignment or isolation of equipment and cooling water headers by the control room operator. (Motor-operated valves are opened as necessary, to provide the RHR heat exchangers with cooling water during startup, cooldown, refueling, and LOCA.)

Normal system makeup is provided from the demineralized water system. Emergency makeup is provided from the ERCW system by installing a spool piece.

The component cooling water contains a corrosion inhibitor to protect the carbon steel piping. Corrosion inhibitor type is consistent with current water chemistry technology.

The design provides radiation monitors at each CCS heat exchanger outlet for the detection of radioactivity entering the system from the RCS and its associated auxiliary systems, and includes provisions for isolation of system components.

9.2.2.3 Components

The components for this system are located within the controlled environments of the Auxiliary Building and the Reactor Building and are designed to withstand the environmental occurrences within those structures such that the components will perform their design function(s). During flooding, connections are made to the ERCW system to maintain a cooling supply to the safeguard trains, since the CCS pumps will be inoperative.

The only safety-related CCS equipment subject to water spray damage includes the CCS pump motors, thermal barrier booster pump motors, and certain valve motors.

The motor-operated valves have totally enclosed, waterproof motors. The CCS pump motors have a NEMA weather-protected Type II enclosure. Drip-proof motors have been provided for the thermal barrier booster pumps.

CCS component design data is listed in Table 9.2-8.

9.2.2.3.1 Component Cooling Heat Exchangers

The three component cooling water heat exchangers are of the shell and tube type. ERCW circulates through the tubes while component cooling water circulates through the shell side. The shell is of carbon steel and the tubes are ASME SB-676 stainless steel (AL-6X).

9.2.2.3.2 Component Cooling Pumps

The five component cooling water pumps which circulate water through the component cooling loops are horizontal, centrifugal units of standard commercial construction. The pump motors receive electric power from normal or emergency sources. Each of the four normally assigned pumps is connected (2 per unit) to one of the four electric power trains. The fifth pump can be powered from either of two assigned electric power trains.

9.2.2.3.3 Thermal Barrier Booster Pumps

The two booster pumps (2 per unit) circulate cooling water through the reactor coolant pump thermal barriers. The booster pumps provide the additional head necessary to overcome high

head loss through the thermal barriers, and thereby allow the CCS pumps to operate at a lower total head, supplying the remaining component cooling loads at a lower operating pressure. One booster pump supplies the thermal barrier requirements (160 gpm) for each reactor unit. A second pump is assigned to provide 100% redundancy. The pumps are horizontal, centrifugal units of standard commercial construction. The pump motors receive electric power from Class 1E power systems, which are described in Chapter 8.

9.2.2.3.4 Component Cooling Surge Tanks

The two component cooling water surge tanks accommodate changes in component cooling water volume. Each unit is provided with one tank for unit separation. Each tank has an internal baffle divider to provide two separate surge volumes for safeguard train separation within each tank. This arrangement provides redundancy for a passive failure during recirculation following a loss-of-coolant accident.

9.2.2.3.5 Seal Leakage Return Unit

The seal leakage return unit (SLRU) consists of a tank and two pumps. The tank serves as a collection point for seal leakage from the CCS pumps. The SLRU pumps return this water to the CCS surge tanks. This unit is not a safety class item, because its only function is the collection of pump seal leakage.

9.2.2.3.6 Valves

Valves used in the component cooling system are standard commercial types of carbon steel construction, designed to minimize leakage. Self-actuated, spring-loaded relief valves are provided for lines and components that could be pressurized beyond their design pressure by improper operation or malfunction.

The relief valves protecting the reactor coolant pump thermal barriers and their associated piping are designed to relieve thermal expansion if the cooling line is isolated while the reactor coolant system is hot. The cooling water piping from the check valve upstream of the barrier to the last containment isolation valve downstream is designed for primary system pressure (see Section 9.2.2.2). If the thermal barrier tube ruptures, the cooling line is automatically isolated and the relief valve accommodates thermal expansion of the fluid in the isolated section (this condition will also exist after containment isolation). The valve set pressure equals the design pressure of that particular segment of piping as described below under piping. Discharged water is directed to the Reactor Building sump.

Cooling water to the RCP thermal barrier is made available to assure that there will be no mechanical damage to the pump. The cooling water supply and discharge lines to the RCP thermal barriers each contain two remote-operated valves in series: One valve operates on power train A, the other on train B. The redundant discharge valves assure the ability to isolate this circuit if a barrier leak is detected. Leak detection is accomplished by measuring thermal barrier supply and discharge cooling water flows.

The cooling water supply line to the excess letdown heat exchanger contains a motor-operated and a manual valve outside the containment wall. A pilot- operated, fail closed, pneumatic valve is provided in the return line outside containment. Both the motor-operated and pneumatic valves are normally closed except during startup, but also have automatic control signals to assure closure under containment isolation conditions. A relief valve is supplied on the cooling water line downstream of the excess letdown heat exchanger. It is sized for thermal expansion occurring when the CCS side is isolated and high temperature fluid continues to flow on the opposite side. If both sides of the heat exchanger are isolated, the relief valve is also sized to relieve any

leakage through the high pressure letdown inlet isolation valve and into the cooling water piping via a heat exchanger tube leak.

Except for the normally closed makeup line and equipment vent and drain lines, there are no normal connections between the component cooling water and other systems. The equipment vent and drain lines outside the containment have manual valves which are normally closed unless the equipment is being vented or drained for maintenance or repair.

Relief valves other than those on the CCS surge tank or excess letdown heat exchanger have been sized to relieve the volumetric expansion occurring if the exchanger CCS side is isolated and high temperature coolant flows through the opposite side. The set pressure equals the design pressure of the CCS side of the heat exchangers or the CCS piping whichever is less. Water from the relief valves is directed to the floor drains.

Relief valves on the component cooling surge tanks are sized to relieve the maximum flow rate of water which enters the surge tank following a tube rupture of the RHR heat exchanger, excess letdown heat exchanger, or letdown heat exchangers. The set pressure ensures the working pressure of the surge tank will not be exceeded. The discharge of those valves is directed to the floor drain collector tank.

The surge tank vent-overflow line, which is open to the Auxiliary Building atmosphere, is equipped with an air-operated valve that closes automatically if radiation is detected in the system. A vacuum breaker valve is also provided to prevent collapsing the tank in the event of a large loss of water in the system.

9.2.2.3.7 Piping

Component cooling water system piping is carbon steel, with welded joints and connections except flanges at components which might require removal for maintenance. CCS piping is standard weight except the portion of piping to reactor coolant pump thermal barriers which is Schedule 160 from the first of the redundant check valves to the last containment isolation valve or the return piping.

9.2.2.4 Safety Evaluation

The CCS is comprised of two independent trains (A&B) where the CCS Train B header and Heat Exchanger C serve both the Unit 1 and Unit 2 Train B engineered safeguards equipment. The Unit 1 Train A header and Heat Exchanger A serve Unit 1 miscellaneous equipment and Unit 1 Train A engineered safeguards equipment. The Unit 2 Train A header and Heat Exchanger B serve the Unit 2 miscellaneous equipment and Unit 2 Train A engineered safeguards equipment. Each train has the capability to provide the maximum cooling water requirement for the plant. These equipment trains are sufficiently independent to guarantee the availability of at least one train at any time. The system has been analyzed for "worst case" heat loads under combinations of maximum river water temperature, design basis accident conditions, normal cooldown requirements, power train failures. Design basis safe shutdown for WBN is the hot standby mode. The CCS is also capable of supporting a cooldown of the non-accident unit in accordance with GDC 5.

CCS is a versatile system capable of providing sufficient flow and heat removal for a variety of conditions in each unit. As examples:

1. During normal operation, the CCS can supply the highest flow demand of both units in Startup with a flow requirement of approximately 22,950 gpm and remove the highest heat removal demand of one unit in Hot Shutdown and the other unit in Cold Shutdown with a heat load of approximately 192.1 MBtu/hr.

2. Under design basis accident conditions with offsite power available, the CCS can supply the highest flow demand of one unit in Startup and the other unit in LOCA-Recirculation with a flow requirement of approximately 21,600 gpm and remove the highest heat removal demand of one unit in Cold Shutdown and the other in LOCA-Recirculation with a heat load of approximately 154.5 MBtu/hr.

3. Under design basis accident conditions with a LOOP coupled with a Loss of Train A, CCS Train B can supply the highest flow / head removal demand of one unit in Hot Shutdown and the other in LOCA- Recirculation with a flow requirement of approximately 10,200 gpm and a heat load of approximately of 145 MBtu/hr.

4. Under design basis accident conditions with a LOOP coupled with a Loss of Train B, CCS Train A can supply the highest flow / heat removal demand of one unit in Hot Shutdown and the other in LOCA- Recirculation with a flow requirement of approximately 15,800 gpm and a heat load of approximately 170 MBtu/hr.

Component cooling water pumps, heat exchangers, and most of the associated valves, piping, and instrumentation (except flow, pressure and temperature transmitters) are located outside the containment and are therefore available for maintenance and inspection during power operation. Maintenance on a pump or heat exchanger is practical while redundant equipment is in service, subject to limitations of the Technical Specifications.

Sufficient cooling capacity is provided to fulfill system requirements under normal and accident conditions. Adequate safety margins are included in the size and number of components to preclude the possibility of a component malfunction adversely affecting operation of safeguards equipment. Active system components considered vital to the cooling function are redundant; i.e., any single active or passive failure in the system will not prevent the system from performing its design function.

The component cooling water pumps are automatically placed on emergency power in the event of loss of offsite power; therefore, the minimum ESF requirements are met with regard to supply of component cooling water. Separate trains provide component cooling water to the engineered safety features. Each train services its safety related cooling loads associated with the same train. Should a single failure result in the loss of a train of equipment (A or B) the other train is available for handling all required heat loads.

GDC 5 Compliance: The CCS has five pumps (two for Train A, two for Train B and one swing pump). Diesel generator loading calculations accommodate a combined loading alignment of CCS pumps is able to support the accident unit, the non-accident unit and the SFP for all design basis events except as described below.

Typically, if an accident occurs on one unit, the second unit will be brought to Mode 3 (Hot Standby), which for Watts Bar is the defined "Safe Shutdown" mode of operation. The non-accident unit will be held in Mode 3 until the accident unit can be stabilized and the core decay heat in the non-accident is within the capability of the RHR system. Calculations demonstrate that the normal CCS alignment is sufficient to cope with both the accident and non-accident units. All Loss of Train A scenarios required the realignment of a second CCS Train B pump to CCS HX C (to supplement CCS pump CS) to bring the non-accident unit to Cold Shutdown within 72 hours. There is one Loss of Train A scenario where a second CCS Train B pump must be re-aligned to CCS HX C prior to entering the LOCA-Recirculation phase. This scenario is described as follows:

- The non-accident unit has been shutdown within the previous 48 hours and is being cooled by RHR in either Mode 4 or Mode 5.
- The accident unit is in LOCA-Recirculation mode of operation
- LOOP
- Loss of Train A.

Under this scenario, two CCS pumps must supply CCS HX C. There will be an additional operator manual action (accomplished in the MCR) prior to establishing LOCA-Recirculation to either verify that the two CCS pumps aligned to CCS HX C are running (or start the second CCS pump).

For these reasons, one of the following two GDC 5 related restrictions are imposed on the CCS following the shutdown of a unit:

1. Re-align one of the two CCS Train B pumps to CCS HX C prior to establishing RHR cooling on the shutdown unit; or,
2. The shutdown unit must remain in Mode 3 for 48 hours prior to establishing RHR cooling

Calculations indicate that there is sufficient CCS capacity to maintain the SFP within its design basis temperatures for all scenarios. In certain cases, SFP cooling may be temporarily suspended while plant operators reconfigure plant systems to restore it.

9.2.2.5 Leakage Provisions

To minimize the possibility of leakage from piping, valves, and equipment, welded joints are used wherever possible. Flanged joints are used only in sections or connections to components which require inspection and/or maintenance on a periodic basis, and for butterfly valves.

A seal leakage return unit is provided to collect seal leakage from the component cooling pumps and return it to the system via the CCS surge tanks. The return unit consists of one collection tank and two seal leakage return pumps. The pumps alternate operation to return equal seal leakage volume to each unit surge tank and are not normally in service.

The component cooling water could become contaminated with radioactive water due to one of the following conditions:

1. A leak in any heat exchanger tube in the CVCS, RHR system, sampling system, or the SFPCS.

2. A leaking cooling coil for the thermal barrier cooler on a reactor coolant pump.

3. Seal leakage from the RHR pump.

9.2.2.6 Incidental Control

If outleakage occurs anywhere in the system, detection is accomplished through a falling level in the surge tank, which will actuate a low level alarm in the control room. Leak detection and control is also provided for the sample heat exchanger and chiller package by the level alarms in the waste disposal system sump where any system leakage will be collected. Leak detection and control is also provided for the Train A side of either surge tank, which contains the Class G sample heat exchangers and chiller package, by both flow and level instrumentation as discussed in Sections 9.2.2.7.2 and 9.2.2.7.3. Inleakage is detected by a surge tank high level alarm. The leaking portion of the system is located by visual inspection, and is isolated. The backup train is then put into operation.

Since the system does not service any engineered safety feature component inside the containment following a LOCA, containment isolation valves on the component cooling lines entering and leaving the containment are automatically closed on high-high containment pressure signal (Phase B containment isolation) except isolation valves for the excess letdown heat exchanger which close on Phase A containment isolation signal.

9.2.2.7 Instrument Applications

9.2.2.7.1 General Description

The CCS, being a water to water heat transfer system, uses inputs of flow rate, level, pressure, and temperature for instrumentation. Electric power to the essential or safety-related transducers in the instrument loops is from the same train as the equipment being served. Loss of a power train would result in loss of only instrumentation and control for equipment that is being served by that particular power train. Control of the system is through air and motor-operated valves. (See Figures 9.2-16, 9.2-17, 9.2-18, and 9.2-19.)

9.2.2.7.2 Flow Instrumentation

Maintaining ample flow rates is essential to proper heat transfer; therefore, flow measurements are taken at the outlet of virtually all heat exchangers and displayed in the control room. In addition, flows entering the power-trained headers are measured and displayed locally. Differential flow instrumentation is also provided for the sample heat exchangers and chiller package, but for a different reason. These coolers, as well as portions of the CCS piping, are designed to TVA Class G and therefore may break under seismic loading. Consequently, to preclude loss of water inventory, this flow instrumentation has been provided to detect outleakage and to provide control signals to isolate the Class G piping from the remainder of the system by automatic closure of valves FCV-70-183 and FCV-70-215. Main control room annunciation of this condition has also been provided. See Figures 9.2-18, 9.2-21, and 9.2-24.

The thermal barrier lines use differential flow to isolate a thermal barrier leak from the rest of the CCS. Flow rates are measured in both the supply and return headers. The two are compared, and should a mismatch occur due to in-leakage, the line is isolated. This comparison is done in each power train so the isolation function is completely redundant. Annunciation and flow rates on the individual thermal barriers give the operator the required data for proper control.

9.2.2.7.3 Level Instrumentation

Surge tank level measurements are used to monitor and control the total amount of water in the system. Should there be leakage into the system, the level will rise and activate a high-level switch for annunciation in the control room. Level is displayed in both the main and auxiliary control rooms.

Leakage out of the system is detected by a low level switch that activates a valve to provide demineralized water makeup to the system. Low-low level switches have also been provided on both the Train A side and the Train B side of both surge tanks. A low-low level signal from the Train A side of either tank indicates a probable break or tube leak in the nonqualified sample cooler/chiller piping and causes automatic closure of valves to isolate the nonqualified portion of the piping system.

9.2.2.7.4 Pressure Instrumentation

Pressure measurement is essential for proper monitoring of pump performance. Local pressure indications are available for both suction and discharge of all essential pumps in the system. Local indication is also available for the main supply headers to various equipment. Pressure in the three discharge headers of the CCS pumps is displayed in the main control room and ACR. Discharge headers for trains 1A and 2A are annunciated in the MCR on low-pressure setting. Low header pressure in in one unit or 1B-B will automatically start the standby pump in that unit.. MCR annunciation is also given when an abnormally high pressure is sensed at the discharge of each CCS pump.

9.2.2.7.5 Temperature Instrumentation

Temperature can be monitored at the outlet of every heat exchanger or heat exchanger group. Temperature indication is provided in the main control room for the main return headers to the pumps and for the outlet of the CCS heat exchangers. Should temperatures at the outlet of the major heat exchangers become excessive, annunciation will occur in the MCR to alert the operator to take corrective action.

9.2.2.7.6 Valves

Most of the valves in the system are motor-operated, non-throttling, fail-as-is type valves. They are used mostly to isolate sections of the system. The motor-operated valves are power trained. Valve LCV-70-63 is an air operated, fail-closed, makeup water level control valve for the surge tank. Valve FCV-70-66 is an air-operated, fail-closed, vent valve for the surge tank. Valve FCV-70-85 is an air-operated, fail-closed, isolation valve on the return line from the excess letdown heat exchanger. Throttling valves are used for process control and are not actuated by safety systems.

9.2.2.7.7 Conclusion

Since the CCS is a safety buffer system between the radioactive primary water and the ERCW, appropriate instrumentation provides the necessary data and controls for the operator to ensure the functional safety of the system.

9.2.2.8 Malfunction Analysis

The CCS is sufficiently independent so that a single active failure of any one component will not preclude safe plant operations in either unit. A failure analysis is presented in Table 9.2-9.

This paragraph discusses the consequences of a loss of component cooling water to the RHR pump seal coolers and the indicators that are available to alert the operator of this loss. The RHR pumps were procured to be operable without cooling water being supplied to the seal coolers. A loss of component cooling water to the seal cooler, however, would result in higher seal unit temperature and consequently shorter seal lifetime but would not cause or require a rapid shutdown of the pumps. Indication of a loss of component cooling water to an RHR seal cooler would be available from several sources. The component cooling lines serving the coolers are each provided with a flow element downstream of the cooler. Flow indication and alarm is provided in the main control room from each of the flow elements. The instrumentation discussed above is illustrated in Figures 9.2-21 and 9.2-22. Additionally, there is a temperature sensor in each RHR seal piping loop which will alarm in the MCR on high seal fluid temperature. A loss of component cooling water flow to one of the RHR seal coolers would not affect the redundant RHR pump.

9.2.2.9 Tests and Inspections

All systems piping and components were hydrostatically tested and CCS operability verified prior to station startup. Virtually all CCS components outside the containment are accessible for periodic inspection during operation. The position of system valves and automatic start of the CCS pumps on a safety injection signal are verified periodically.

9.2.2.10 Codes and Classification

Piping and components of the CCS are designed to the applicable codes and standards listed in Table 9.2-10.

The entire system is TVA Class C with the following exceptions:

1. Containment penetrations and associated containment isolation valves are TVA Class B.

2. The excess letdown heat exchanger piping inside containment is TVA Class B.

3. The sample cooler/chiller piping and valves between FCV-70-215 and FCV-70-183 is TVA Class G.

4. The CCS pump seal leakage collection tank is TVA Class L. The associated drain piping, valves, and seal leakage return pumps are TVA Class G from the collection point to the pumps outlet check valves 1-70-535 and 2-70-535.

5. The piping between valve 1-ISV-70-775, and the pipe cap and the piping between valve 1-ISV-70-777 and the pipe cap are TVA Class G.

9.2.3 Demineralized Water Makeup System

The demineralized water makeup system is a common system.

9.2.3.1 Design Bases

The system is designed to supply the requirements for high purity water for makeup to the steam generators, the primary water system, and the demineralized water system for cask decontamination, cleaning, flushing, and makeup for miscellaneous services.

9.2.3.2 System Description

The system consists of the following two sub-systems: a vendor-supplied water purification system, and the demineralized water storage and distribution system.

Flow diagrams are shown in Figures 9.2-26, 9.2-27 and 9.2-28.

The vendor supplied water purification system has been designed to comply with the aspects of the plant. The system takes raw water from an existing header. The raw water is filtered for suspended solids removal. Water is then normally passed through a reverse osmosis (RO) system designed to remove dissolved solids and organics. RO effluent is then passed through a process designed to remove CO_2 from the water. Water from this process is then deoxygenated as necessary. Water from the deoxygenation system then flows through a demineralizer for final polishing.

Water not meeting the specification is automatically recycled either to the RO influent or the demineralizer influent, depending on the parameter that is out of specification. In-line analyzers continuously monitor the effluent quality. Once the effluent is in specification, it is pumped to the 500,000 gallon demineralized water storage tank to the plant demineralized water storage and distribution system.

The demineralized water storage and distribution system consists of a 10,000 gallon demineralized water head tank, a 15,000 gallon cask decontamination head tank, main piping loop and supply headers. The loop supplies water for various services as shown in Figure 9.2-28. The services include emergency showers, eye wash stations, water for cask washdown room, fuel transfer canals and makeup water for various system tanks and equipment.

The main piping loop is supplied from the demineralized water head tank. Makeup water for the condensate storage tanks (CST) is supplied from either the demineralized water storage or from the water purification system. Washdown water for the cask washdown room is supplied from the cask decontamination head tank. Makeup for the primary water storage tanks is supplied directly from the loop.

Storage tanks and system principal piping are aluminum except piping inside reactor containment which is stainless steel. Piping is TVA Class H except reactor containment isolation valves and connecting piping which are TVA Class B, and piping in the Reactor Building which is TVA Class G.

9.2.3.3 Safety Evaluation

The demineralized water makeup system is not required for maintenance of plant safety in the event of an accident and is not a part of the engineered safety systems; therefore, the reactor containment isolation valves and the piping connecting the valves are the only portions of this system which have a nuclear safety class designation in accordance with TVA Classification B.

Pipe hangers and supports in the Control Building, Auxiliary Building, and Reactor Buildings are designed for seismic loading to prevent damage to adjacent safety related equipment necessary for the safe shutdown of the plant.

9.2.3.4 Test and Inspection

Prior to startup piping and equipment were tested. After startup routine visual inspection of the system components and instrumentation is adequate to verify system operability.

9.2.3.5 Instrumentation Applications

Instrumentation is provided to maintain storage tank levels. The water purification system effluent is provided with a finished water monitor and alarm.

A flow control valve in the demineralized water supply line maybe set to close when the demineralized water head tank level rises above the setpoint.

The cask decontamination head tank fills by gravity through a level seeking connection from the demineralized water system. Flow is controlled by a restrictive orifice and check valve.

High and low level switches annunciate both tank levels in the control room.

9.2.4 Potable and Sanitary Water Systems

9.2.4.1 Potable Water System

9.2.4.1.1 System Description

Potable water for this project is purchased from a water supply system operated by Watts Bar Utility District.

Potable water from the supply system enters the plant site through a water meter and a backflow prevention valve and is routed to two storage tanks in the Turbine Building. Most potable water used on site is taken from the outlets of these tanks in order to keep the stored water fresh and maintain adequate chlorine residual. Some of the more remote facilities are supplied directly from the main supply line. Pressure reducing valves are used where required. The main supply line and the return lines from the storage tanks supply the yard distribution system which conveys potable water to the various buildings and to other points of usage. Concrete backing is poured where lines change direction or dead end. The materials used for pipelines of the potable water system are in compliance with the Standard Plumbing Code.

Plumbing fixtures, water coolers, water heaters, eyewash equipment, and emergency shower equipment are supplied with potable water. Some eyewash and emergency shower equipment are also supplied water from the demineralized water system. Applicable laboratory, hospital, kitchen, and laundry equipment are also supplied. Hose bibs and service outlets receive potable water where raw water is not readily available or where water cleaner than raw water is needed. There are no potable water lines in the Reactor Building.

Hard-drawn copper tubing and solder joint fittings or galvanized steel pipe and galvanized malleable iron fittings are normally used on water lines in the buildings. Potable water lines are normally sized to limit fluid velocities to a maximum of seven to eight feet per second.

Flow diagrams are as shown on Figures 9.2-29A, 9.2-29B, 9.2-29C, and 9.2-29D.

9.2.4.1.2 Safety Evaluation

Potable water is not essential for the normal operation or the safe shutdown of the nuclear reactors. An adequate supply is important, however, to operate emergency eyewash and shower equipment, to wash contaminated clothing, to provide drinking water, and to carry away human waste. Interruptions in supply are minimized by storage in the two tanks in the Turbine Building.

The potable water system is not cross-connected with any radioactive system. Contamination protection is by the air gap normal to plumbing fixtures. Backflow preventers and vacuum breakers are provided throughout the plant to protect the potable water system from contamination due to backflow from contaminating sources. A reduced pressure backflow preventer is also installed in the main supply line to the plant to prevent any possible onsite contamination of the system from spreading offsite.

9.2.4.1.3 Tests and Inspections

All parts of the potable water systems are tested and inspected for leaks. Fixtures are accessible for inspection during normal operation.

When repairs or additions are made, potable water quality and treatment is monitored in accordance with the requirements of the Tennessee Department of Public Health.

9.2.4.1.4 Instrumentation Applications

Water level in the two storage tanks is controlled by a flow control valve operated by level switches. Level switches also actuate a local alarm.

Potable water flow entering the nuclear plant site is recorded by a conventional water meter.

9.2.4.2 Sanitary Water System

9.2.4.2.1 Design Bases

The maximum quantity of sanitary waste to be handled, treated, and disposed of is approximately 120,000 gallons per day. The average for normal operation is approximately 100,000 gallons per day. These quantities differ from potable water usage quantities because some potable water drains to other systems. See Sections 9.2.4.2.2 and 9.2.4.2.3.

Sanitary waste is pumped to the Spring City Sewage Treatment Facility under contract with the Spring City Waterworks. The contractual agreement provides for processing waste at a capacity of up to 100,000 gallons per day. Processing is performed by the contractor in compliance with all current Local, State and Federal guidelines prior to waste water being discharged to the river. The contract allows TVA the right to access and structurally modify piping for the purpose of inspection or surveillance as needed for compliance with NRC requirements.

9.2.4.2.2 System Description

Sanitary waste is collected in individual sanitary waste systems for those buildings which have sanitary facilities and conveyed into the plant yard sewage system, except as noted below and in Section 9.2.4.2.3.

The environmental data station, located far from the main plant, has its own septic tank and drain field.

In general, for building sanitary waste systems, the embedded lines and fittings are extra heavy cast-iron soil pipe, bell and spigot with neoprene gaskets. Exposed lines are galvanized steel and the fittings are the black cast-iron drainage type. Vent lines are galvanized steel and fittings are galvanized malleable iron.

The sanitary waste from most buildings flows by gravity into the yard sewage system. Some buildings, which have sanitary facilities on the lower levels, also have sewage ejectors.

The Turbine Building sanitary waste lines are run to the lower floor, which is below grade, collected in a sewage basin system that contains duplex grinder pumps and pumped to the yard system.

The Service Building sanitary waste is collected and pumped by a similar system.

Control Building sanitary waste lines flow by gravity to the Service Building sewage basin system.

The yard sewage system consists of a number of buried gravity flow and pressurized sewers, a number of lift stations and a sewage treatment plant. Gravity flow sewers are provided with precast manholes.

Gravity flow sewers are normally of cast iron soil pipe, vitrified clay, or polyvinyl chloride (PVC) construction. Pressurized sewers are PVC.

A lift station unit is provided in the yard at the Diesel Generator Building, consisting of a collection basin, two grinder pumps and associated controls.

Similar units are provided at the additional makeup water treatment plant and for the field services facility. These are duplex units with centrifugal sewage pumps located in a concrete basin. A lift station is also provided in the yard near the Office Building to deliver the sanitary waste to the treatment plant. The lift station sends the waste to a connection in the construction sewer system and then offsite to the contracted waste processor.

9.2.4.2.3 Safety Evaluation

The sanitary water system does not receive radioactive waste. Drainage from other plumbing equipment with the potential of receiving radioactive waste is as follows:

a. AUXILIARY BUILDING

Radiochemical Laboratory

1. Fume hood cup sink drains to the tritiated drain collector tank (TDCT).
2 Hospital-type sink and an eyewash drain to the laundry tank.
3. Fume hood cup sinks and one counter cup sink drain to the chemical drain tank.
4. Counter sinks drain to the floor drain collector tank (FDCT).

Titration Room
1. Fume hood cup sink drains to the chemical drain tank.
2. Counter sink drains to the FDCT.
3. Counter sinks drain to the Turbine Building station sump.

Hot Instrument Shop
1. Sink drains to the chemical drain tank.

125V Vital Battery Rooms, 1-4
1. Sinks and eyewashes drain to the Turbine Building station sump.

b. SERVICE BUILDING

Health Physics Laboratory
1. Counter sink drains to the laundry and hot shower tank.

Personnel Decontamination Room
1. The hot shower drains to the laundry and hot shower tank.

Instrument Shop
1. Counter sinks and one service sink drain to the laundry and hot shower tank.

Hot Shop Area
1. Emergency shower drains to the FDCT in the Auxiliary Building.
2. One decontamination shower and one sink drain to the laundry and hot shower tank.

Details of these drains and tanks are discussed in Section 9.3.3.

9.2.4.2.4 Tests And Inspections

Chlorinated effluent will be monitored in accordance with the requirements of the NPDES Permit.

9.2.4.2.5 Instrumentation Applications

A float-operated switch on each sewage pump in the plant will start the pump and force accumulated sewage into the yard sewer system.

The grinder pump lift stations in the yard have integral float or pressure switch control and alarm systems.

9.2.5 Ultimate Heat Sink

9.2.5.1 General Description

The ultimate heat sink (subsequently referred to as 'sink') for a nuclear plant is that complex of water sources and associated retaining structures used to remove waste heat from the plant during all normal, shutdown, and accident plant conditions. The sink is designed to perform one principal safety function throughout the plant's life: dissipation of residual heat after an accident.

The sink is comprised of a single water source, the Tennessee River, including the complex of TVA-controlled dams upstream of the plant intake, TVA's Chickamauga Dam (the nearest downstream dam), and the plant intake channel.

In normal operation, cooling water (approximately 85°F maximum) will flow from Chickamauga Reservoir through the plant intake channel to the intake pumping station. The intake channel is located on the inside of a bend in the river about 2 miles downstream of Watts Bar Dam. The intake channel extends about 800 feet from the edge of the reservoir through the flood plain along a line approximately perpendicular to the river flow, with the bottom at sufficient depth to ensure direct flow from the main river channel to the pumping station during all low water levels. A floating pontoon type structure is provided across the channel to serve as a barrier and discourage direct approach to the pumping station from the reservoir. The barrier is designed to make it virtually impossible to sink; however, if it were to sink, it could not block the channel to the extent of preventing the required flow from reaching the station.

Water is pumped to the plant by the ERCW and raw cooling water pumps (described in Sections 9.2.1 and 9.2.8, respectively), and in certain events, the fire protection pumps housed in the Seismic Category I intake pumping station. The station design assures protection of the safety-related ERCW pumps and fire protection pumps from the design basis flood. The ERCW pumps and fire protection pumps are capable of functioning under any plant design basis condition including a SSE plus loss of downstream dam and a LOCA. The ERCW system description and performance capabilities are discussed in detail in Section 9.2.1.

9.2.5.2 Design Bases

The sink for Watts Bar Nuclear Plant is designed to comply with the following regulatory positions in Regulatory Guide 1.27, Revision 1, March 1974.

1. The ultimate heat sink is capable of providing sufficient cooling for at least 30 days (a) to permit simultaneous safe shutdown and cooldown of all nuclear reactor units and maintain them in a safe shutdown condition, and (b) in the event of an accident in one unit, to limit the effects of that accident safely, to permit simultaneous and safe shutdown of the remaining unit, and maintain them in a safe shutdown condition. Procedures for assuring a continued capability after 30 days are available.

2. The ultimate heat sink is capable of withstanding, without loss of the capability specified in regulatory position 1 above, the effects of (a) the most severe natural phenomena associated with this location taken individually, (b) the site related events that historically have occurred or that may occur during the plant lifetime, (c) reasonably probable combinations of less severe natural phenomena and/or site related events, and (d) a single failure of man-made structural features.

3. The ultimate heat sink consists of one source of water, with the capability to perform the safety functions specified in regulatory position 1, above. It can be demonstrated that there is an extremely low probability of losing the capability of the single source. There is one canal connecting the source with the intake structures of the nuclear power units. It can be demonstrated that there is an extremely low probability that the single canal can fail entirely as a result of natural phenomena. The water source and associated canal are highly reliable and can be protected such that a complete failure cannot happen.

4. The Technical Specifications for the plant include actions to be taken in the event that conditions threaten partial loss of the capability of the ultimate heat sink or it temporarily does not satisfy regulatory positions 1 and 3, above, during operation.

9.2.5.3 Safety Evaluation

This safety evaluation is sectionalized to correspond with the points of the preceding regulatory positions.

1. The cooling water requirements for the most demanding accident shutdown and cooldown of the plant's reactors are presented in Section 9.2.1. The adequacy of the Tennessee River to provide this amount of water, and therefore to satisfy regulatory position 1, is confirmed in Sections 2.4.11.1, 2.4.11.3, and 2.4.11.5.

2. Under the most adverse events expected at the site or a reasonable combination of less severe events and any single failure of a man-made feature, the sink is designed to retain its capability to perform the specified safety functions. The most severe natural phenomena (including flood, drought, tornado, wind, and earthquake) that might conceivably occur at this site are thoroughly discussed in Chapter 2.

As stated previously, the ERCW pumps are protected from the design basis flood including the effects of wind waves, and therefore will be capable of functioning in all flood conditions up to and including the design basis flood. The intake channel extends from the pumping station into the reservoir to the original river bed and is dredged down to elevation 660 to provide free access to the river under low flow conditions described in Section 2.4.11. Both the normally exposed and submerged portions of the channel are dredged to sufficient width, riprapped on the sides, and seismically qualified (as discussed in Section 2.5) to eliminate the possibility of channel blockage due to an earth or mud slide. The channel will be monitored and dredged as required to maintain free access to the river. Therefore, adequate water will be available to the ERCW pumps at all times and for all events including the loss of downstream dam for any reason. Since the intake channel is seismically qualified, the unlikely occurrence of the SSE could significantly affect the sink only by causing failure of the non-Category I downstream dam and/or upstream dams. For the resulting low and/or high reservoir event, water will be available to the intake at all times. A seismically induced disturbance of the rock surfaces could only block a small percentage of the intake channel due to its high conservative width.

A tornado cannot disrupt the ERCW water supply to the intake station.

Protection of the intake channel and station against blockage or impact by river traffic is afforded by its location. For all conditions of river navigation (up to water level 698 which corresponds to the 40 year flood level in Watts Bar Dam tail waters at which lock operation ceases), the grade elevation of the river flood plain through which the channel passes is such that even when the flood plain is submerged, sufficient depth will not exist for passage of any major river vessel. In addition, due to the close proximity of the upstream dam, the possibility of a barge being accidentally released upstream and reaching the plant site would be extremely remote. However, if such an incident does occur, the barge will be carried away from and past the intake channel and station by the high velocity water passing the plant on the outside of the river bend on the opposite side of the reservoir.

For lake levels which would provide sufficient water depth for a barge to approach the intake station, it is not considered credible that serious damage would be incurred. The intake station would be in relatively stagnant, shallow water approximately 800 feet from the main river channel, and would be a relatively small target.

TVA regulation of the Tennessee River is such that drought will not jeopardize the sink's capability required in regulatory position 1; this is historically confirmed by the data in Section 2.4.11.3 (historical information).

The most severe combination of events considered credible to occur would be the simultaneous occurrence of a loss-of-coolant accident in one unit and hot standby of the other, loss of offsite power, and loss of upstream and/or downstream dams either individually or concurrently. Under this extreme situation, the sink retains the capability required by regulatory position 1.

Section 9.2.1.3 states that the ERCW system provides the required flow to remove the design basis heat load necessary to maintain the plant in a safe condition. As noted in Section 9.2.2.4, a calculation has been performed that shows there is sufficient ERCW and CCS capability to bring the non-accident unit to cold shutdown within 72 hours from entry into the Hot Standby mode to demonstrate compliance with GDC-5. Section 2.4.11.3 shows that the minimum available flow from the Tennessee River will be well in excess of this requirement.

3. The Tennessee River is the common supply for all plant cooling water requirements. Total interruption of this supply is incredible. Additionally, the integrity of the river's dams is not essential for safe reactor shutdown and cooldown. While only a single channel is provided to convey water from the river to the intake station, total failure is considered incredible due to the location, maintenance, and seismic qualification of the channel.

4. The limiting conditions and surveillance requirements for the ERCW system are given in the Technical Specifications. The limiting conditions for the plant's flood protection program are stated in the Technical Requirements Manual.

9.2.5.4 Instrumentation Application

This requirement is not applicable to the ultimate heat sink at WBNP.

9.2.6 Condensate Storage Facilities

The condensate storage facilities store and supply treated water for: (1) initial charging of the secondary system, (2) makeup water when the water treatment plant is being regenerated or is out of service, (3) replacement of water lost by safety valve or relief valve operation, and (4) the preferred source of an adequate quantity of feed quality water for emergency cooling (auxiliary feedwater system).

9.2.6.1 Design Bases

The condensate storage facilities are designed to serve as a receiver of water from the main condenser high level dump and to provide treated water for makeup to the main condenser while reserving a minimum amount for the auxiliary feedwater system. This amount is required to hold the plant for two hours after a design basis event and 5 hours to cool RCS from no-load hot standby at 50°F per hour to the point at which the residual heat removal system can take over.

When the CSTs are intact and offsite power is available, the inventory available in the CSTs plus makeup from the additional make-up water treatment plant and the demineralized water storage tank (FSAR Section 10.4), is capable of supplying clean water to support maintaining the plant on auxiliary feedwater for longer than seven hours without the need to transfer the AFW pump suction to ERCW. No credit is taken for this additional water in the design and safety evaluations of condensate storage or AFW.

The condensate storage tanks are not an engineered safety feature and are not seismically qualified. The supply from the additional make-up water treatment plant and the demineralized water storage tank and associated piping are not engineered safety features and are not seismically qualified. The storage tanks supply the preferred source of water to the auxiliary feedwater system, but the engineered safety feature source is the ERCW System (Safety Class 2b).

9.2.6.2 System Description

The condensate facility, shown in Figure 10.4-7, consists of one condensate transfer pump and two condensate storage tanks connected in parallel (one tank for each unit) and associated piping, controls, and instrumentation. The tanks are located in the plant yard adjacent to the east wall of the Turbine Building.

The auxiliary feedwater pumps take suction directly from the condensate storage tanks to supply treated water for cooldown of the reactor coolant system. A minimum of 200,000 gallons in each tank is reserved for the auxiliary feedwater system. This quantity is assured by means of standpipes through which other systems are supplied.

Makeup to the condenser is supplied by gravity flow from the tanks while reject water from the condenser flows to the tanks through the hotwell pumps. Makeup of deareated and demineralized water to the condensate storage tanks can be from the water treatment plant or the 500,000 gallon demineralized water storage tank. The tanks are equipped with a level control system which will indicate the tank volumes.

The condensate storage tanks are constructed from ASTM A283 Grade C carbon steel plate to AWWA Standard D100. The inside has a coating of epoxy-phenolic resin to prevent corrosion. Each tank has a capacity of 385,000 gallons with an overflow at 395,000 gallons.

Air removal (nitrogen purging) connections have been added to each of the condensate storage tanks. Low pressure nitrogen is introduced into the bottom of each condensate storage tanks through a multi-nozzled distribution header. The nitrogen is bubbled through the stored condensate and then is released to the atmosphere. Through this process dissolved oxygen content of the condensate storage tank water is reduced to and maintained at acceptable levels during periods of time when water in the tank is not exchanged with water in the steam cycle.

The condensate transfer pump (CTP) is an electric motor driven pump designed to deliver 1000 gpm at 55 feet total head. The main purpose of the condensate transfer pump is for the transfer of water from one tank to the other.

9.2.6.3 Safety Evaluation

The condensate storage tanks are the preferred source of clean water supply for the auxiliary feedwater pumps and a storage reservoir for secondary system water. The tanks are not an engineered safety feature. The engineered safety feature water source for the auxiliary feedwater system is the ERCW system (Safety Class 2b). Either tank is isolable, but auxiliary feedwater for either unit can be obtained from both tanks. This will be done only if necessary since each condensate storage tank normally contains auxiliary feedwater for just one unit.

The ERCW system pool quality feedwater will be used during events when safety is the prime consideration and steam generator cleanliness is of secondary importance.

Piping connected to the condensate storage tanks is routed through a heated tunnel under the tanks. Ice formation in the tanks during a period of prolonged low temperatures can be prevented, if necessary, by recirculation of water through the condensate transfer pump. The tank can accommodate water whose temperature is in the range of 40°F to 130°F. The AFW piping can accommodate water whose temperature is in the range of 40°F to 130°F.

The water in the condensate storage tanks is not normally radioactive. However, in the event of primary-to-secondary leakage due to a steam generator tube leak, it is possible for the condensate and feedwater system to become radioactively contaminated. The water in the condensate storage tanks can become contaminated by rejected water from the main condenser in situations where the secondary system is contaminated. The maximum level of contamination in the tanks can be conservatively estimated to be comparable to that of the main condenser. (Section 10.4.1)

Each condensate storage tank has an overflow level at 395,000 gallons. The overflow lines terminate beside the tanks just above ground level. A tank overflow or rupture would allow the water to be drained to the Turbine Building sump or to the river by way of the holding pond. The radiological consequences of this are less than other postulated accidents discussed in Chapter 15.

Tank repairs necessitated by damage or leaks can be made after closing tank isolation valves in the interconnecting headers, and transferring water from the defective tank to the other storage tank using the condensate transfer pump. Excess water can be drained to waste through normally locked closed tank drain valves which lead to the yard drainage system.

9.2.6.4 Test and Inspections

The condensate storage tanks are tested during the preoperational test program for both the condensate system and the auxiliary feedwater system. Periodic visual inspections are performed in accordance with plant procedure to ensure integrity of the tank.

Preoperational test requirements are given in Chapter 14.

9.2.6.5 Instrument Applications

The level in each storage tank is indicated on the main control board and on a local panel in the area of the transfer pump. The level signal received from an electronic level transmitter provides the signal for the annunciation in the main control room of low-low CST water level. Each tank is also equipped with side mounted displacement type level switches which provide signals for annunciation in the main control room of high-low CST water levels. The set points for these switches are set to alarm at points that are different from the low-low setpoint of the electronic level transmitter. Therefore, the electronic transmitter low-low setpoint is a backup for the displacement switch low level setpoint. Continuous tank level indication is provided locally and in the main control room for each tank.

9.2.7 Refueling Water Storage Tank

The refueling water storage tank (RWST) fulfills two basic requirements:

1. It provides an adequate supply of borated water (boron concentration of minimum 3100 ppm) for use during refueling operations.

2. It provides an adequate supply of borated water (boron concentration of minimum 3100 ppm) to the two charging pumps (CVCS), the two safety injection system (SIS) pumps, the two residual heat removal (RHR) pumps, and the two containment spray (CSS) pumps in the event of a loss-of-coolant accident (LOCA). During normal power operation, RWST water is valved to the suction of the SIS pumps, RHR pumps, and the CSS pumps. The suction of the CVCS pumps is automatically valved to the RWST by a safety injection signal.

The following criteria are used to fulfill the above requirements; the size of the RWST is sufficient to contain the largest of the following:

a. The amount of water required to fill the refueling cavity and fuel transfer tubes (350,000 gallons).

b. The amount of water, in addition to that in the SIS accumulator tanks, RCS inventory, and ice melt, necessary to establish the emergency cooling recirculation mode following a LOCA (i.e., the depth of water provided in the Reactor Building will be sufficient to provide free flow to the containment sump and to provide adequate suction head for the CVCS, SIS, RHR, and CSS pumps), including holdup or unavailable water (reactor cavity, containment atmosphere, water remaining in the RWST).

c. The amount of water necessary to supply the CVCS, SIS, RHR, and CSS for a period of time (10 minutes or more) sufficient to allow the operator to properly assess the situation and establish the recirculation mode following a LOCA.

The design parameters of the RWST are as follows:

Quantity	1
Design pressure	atmospheric
Normal operating pressure	atmospheric
Tank design temperature	200°F
Operating temperature, °F (water-min)	60°F
Volume, gal (to overflow)	380,000
Minimum operating volume, gal	370,000
Boron concentration, ppm (nominal)	3,200
Outside diameter, ft	43-1/2
Straight Side height, ft	38
Material of construction	Austenitic stainless steel
Number of heaters	4
Capacity of each heater, kW	12

The RWST instrumentation is discussed in Chapter 7. Overflow routing is discussed in Section 11.2.

The vent is at the top of the RWST and covered by a rain hood. A protective screen having ¾-inch openings and an effective area almost three times the cross sectional area of the 28-inch vent stack is fitted over windows near the top of the 28-inch stack but beneath and inside the rain hood. This screen guards against intrusion of foreign objects, yet is sufficiently open to minimize vent plugging by ice buildup. Additionally, to prevent freezing, the exterior surfaces of the vent stack and rain hood will be insulated with 3-inches of external grade insulation, suitably supported. Since the vent is located at the top of the RWST, and is approximately 44 feet from ground level, it is clear of normal debris (plastic sheets, paper, etc.), but further assurance is afforded by the shielding of the screen by the rain hood, and the large screen area.

The RWST's vortex nozzle assemblies were not radiographed. ASME Section III, Subsection NC, paragraph NC-5282.6 (1974 Edition, and Winter 1975 Addenda) requires butt joints in atmospheric storage tanks be fully radiographed.

TVA has issued CAQRs WBP890317 and WBP890318, for Units 1 & 2, respectively, for documentation of the problem. Calculation WBP-MTB-001 documents the basis for the acceptability of these welds.

9.2.7.1 ECCS Pumps Net Positive Suction Head (NPSH)

The straight side height of the RWST is 38 feet, and the overflow pipe inlet is 411 inches above the bottom of the tank, which is at Elevation 729.17. The outside diameter is 43.5 feet, with a capacity of 925 gal/in of depth. The normal fill is 375,000 gallons. The minimum operating level is 370,000 gallons. Makeup will be made should the level drop to the minimum operating level. Further emergency condition data is tabulated below:

Unit 1

Pump	Pump Centerline Elevation, ft	Minimum RWST Water Level Used in NPSH Analysis
RHRS	678.59	0"
CVCS	695.92	0"
SIS	694.60	0"
CSS	679.00	0"

Unit 2

Pump	Pump Centerline Elevation, ft	Minimum RWST Water Level Used in NPSH Analysis
RHRS	679.7	731.8 (low-low)
CCP	695.92	731.8 (low-low)
SIP	695	731.8 (low-low)
CSP	679.00	731.8 (low-low)

Using the minimum RWST volume of 370,000 gallons at the start of ECCS pumping, sufficient water will have been pumped into the Reactor Building in just over 10 minutes (maximum flowrates), to cause the low level auto switchover alarm to be actuated signaling the switchover sequencing. The switchover sequence from injection to recirculation mode is completed in accordance with Table 6.3-3.

The RHR pumps are automatically aligned to the containment sump. The ECCS and CS pumps have injected approximately 224,000 gallons of water into the Reactor Building at this time. The low-low level alarm is actuated after approximately 320,000 gallons have been injected, signaling the operator to shut off the CSS pumps. These are the last pumps to be shut down after all pumps have been switched to recirculation modes.

See Sections 6.2.2.2, 6.3.2.14, and Table 6.3-12 for additional discussion on NPSH of ECCS pumps.

Analysis of RHR and containment spray pump NPSH considers the effects of the sump with its Strainer Assemblies and all associated suction piping and valves. Assumptions made in the analysis are conservative and include:

(1) water temperature, 190°F
(2) normal containment atmospheric pressure
(3) all pumps operating at maximum rated flow and
(4) Containment sump level at top of RHR Sump Strainer Assembly.

The total head loss across the Strainer Assemblies includes losses associated with the Strainer Assemblies, the plenum box and all possible debris loading combinations. Adequate NPSH margin ensures that the ECCS and CSS pumps will operate as designed in accordance with NRC Generic Letter 2004-02.

Based on the above, the ECCS and CSS pumps NPSH data is tabulated in Table 6.3-12.

All of the ECCS pumps will be preoperationally tested under conditions that simulate limiting design basis conditions. Where accident limits can be more extreme than test conditions, calculations and/or extrapolations are made from the test data to show that the system performance will be satisfactory under accident conditions. For instance, all ECCS pumps are to be started and operated at maximum possible flow from the RWST into an open reactor vessel. Suction pressure data is taken and then corrected to reflect any difference between the level in the RSWT at the point where data is taken and the lowest level to exist in the tank under accident conditions. This number is then compared to required NPSH conditions to assure that acceptable margin exists. The containment spray pumps are also run during this test to determine their effect on the NPSH conditions at the ECCS pumps.

To verify acceptable discharge piping losses, each ECCS pump will be run individually at its maximum flow into an open reactor vessel. The safety injection and centrifugal charging pump flows will be limited and balanced through the use of manual valves in the injection lines going to the separate reactor coolant loops. Hence, these discharge line losses are set during the preoperational tests. The RHR pump discharge line losses are determined entirely by the installed piping system. The ECCS pump flowrates achieved during preoperational testing were evaluated to determine actual system resistance and the system resistance was confirmed to be acceptable. (Reference : Westinghouse Letters WBT-D-5007, dated August 21, 2014; WBT-D-5096, dated October 24, 2014; and WBT-D-5142, dated December 4, 2014)

All of the ECCS pumps are determined to be running in conformance with manufacturers test curves for total developed head. Test points for total developed head are also compared and determined to exceed the performance curves assumed in the ECCS analysis.

[*Historical Information* - A 1:4 scale model study which demonstrates the acceptability of the revised sump, sump screen, and trash rack design has been performed. The report of the model study, and an NPSH evaluation were submitted by letter from J. E. Gilleland to S. A. Varga, dated May 23, 1979.]

9.2.8 Raw Cooling Water System

9.2.8.1 Design Bases

The raw cooling water (RCW) system is designed to achieve the following objectives:

1. Provide cooling water to the turbine-generator auxiliary equipment and miscellaneous cooling equipment within the Turbine Building.

2. Serve as primary nonqualified source of cooling water for the ice condenser system.

3. Provide cooling water to nonessential air conditioning equipment within the Auxiliary Building.

4. Serve as a source for filling and maintaining pressurization of the raw service water (RSW) system.

5. Serve as a source of makeup water to the condenser circulating water system.

6. Provide raw water makeup to water treatment plant.

9.2.8.2 System Description

The flow, logic and control diagrams for this system are shown on Figures 9.2-32 through 9.2-39.

The RCW system is a non-safety related, shared system. Water is supplied by eight electric motor driven pumps located in the plant intake pumping station. The design data for these pumps is given in Table 9.2-11. Maximum normal system flow requirements for the two WBN units provided by the combination of (a) six of the eight RCW pumps located in the intake pumping station (b) one of the two booster pumps located in the Turbine Building for the RCW service to equipment in the Auxiliary Building and the Additional Equipment Buildings. The seventh and eighth RCW pumps located in the intake pumping station are spares. The second booster pump in the RCW line to the Auxiliary Building is a spare.

Water is supplied to the Turbine Building through two sectional legs of a single loop header. In the Turbine Building, the water is filtered to 1/32-inch particle size by four automatic backwashing strainers common to both units. Each strainer is designed to handle 1/3 of the maximum normal flow of both units.

After being strained, the water is directed to two loop headers within the Turbine Building, one for each unit. Water is then distributed from each loop header to the following equipment within the Turbine Building:

1. Generator stator heat exchangers
2. Generator hydrogen heat exchangers
3. Generator exciter heat exchangers
4. Generator main bus heat exchangers
5. Generator seal oil heat exchanger
6. Main turbine oil heat exchanges
7. Turbine electro-hydraulic control fluid heat exchangers
8. Feedwater pump turbine oil heat exchanger
9. Condenser vacuum pump coolers
10. Condensate booster pump heat exchangers
11. No. 3 and No. 7 heater drain tank pump heat exchangers
12. Turbine Building ventilation coolers

13. Sample heat exchangers

14. Standby main feedwater pump heat exchanger

15. Heat exchangers 90-120 for radiation monitoring

16. Auxiliary Boiler System Blowdown Tank

17. Condensate Demineralizer Air Compressor

In addition, the system supplies raw water upon demand to the raw service water system and makeup to the water treatment plant from either unit.

The raw service water (RSW) system supplies water requirements for various air-conditioning loads and for maintenance, cleaning, and other miscellaneous, intermittent purposes throughout the Turbine, Service, and Office Buildings and plant yard.

The RCW discharge from the heat exchangers and coolers located in the Turbine Building, with the exception of the sample heat exchangers which discharge to plant drainage, is directed to the cold water outlet flume of the condenser circulating water (CCW) cooling tower corresponding to the same unit. However, the Unit 1 RCW flow can be discharged into either the Unit 1 CCW cold water outlet flume, or the Unit 2 CCW cold water outlet flume to allow work to be performed on the CCW system while still maintaining RCW flow. Similarly, the Unit 2 RCW flow can be discharged into either the Unit 2 CCW cold water outlet flume or the Unit 1 CCW cold water outlet flume to allow work to be performed on the CCW system while still maintaining RCW flow. As described in Section 10.4.5 this RCW discharge serves as a portion of the makeup water to the CCW system. A siphon break is provided on the RCW discharge of each unit to prevent flooding of the powerhouse by backflow of water from the CCW system in the event of a rupture of the RCW header within the buildings.

Since the flow through major components within the RCW system is varied by temperature control valves which monitor the process side temperature in order to maintain a constant temperature of the cooled systems, the total system flow is decreased in the winter when the river temperature decreases. Subsequently, fewer than six pumps operate and less flow is available for CCW cooling tower makeup water. Therefore, to enable the RCW system to be utilized to the fullest extent as a makeup source to the CCW system, a bypass line with modulating valve is provided from the RCW supply to RCW discharge headers. This line permits that portion of the RCW system flow in excess of the RCW component requirements to bypass the Turbine Building and serve as additional makeup water to the CCW system on demand.

A connection to the Turbine Building loop header of both units provides a nonessential source of water to various equipment within the Auxiliary and Additional Equipment Buildings. This equipment includes the following:

1. Auxiliary Building general ventilation system and coolers (nonsafety- related equipment)

2. Additional Equipment Building ventilation coolers (for nonsafety-related equipment)

3. Ice condenser system heat exchangers

4. Post-operational chemical cleaning equipment

The non-seismically qualified portion of the RCW supply line from the Turbine Building to the Auxiliary Building includes two in-parallel booster pumps. The booster pumps are (i) located in the Turbine Building, (ii) locally controlled, and (iii) powered by non-safety-related electric power supplies. The same non-seismically qualified portion of the RCW supply line from the Turbine Building to the Auxiliary Building includes a bypass from the flow path of the installed booster pumps. Operation of one of the two booster pumps supports the nonessential source of water to the Auxiliary and Additional Equipment Building during operation of both WBN units.

Since the RCW system is not designed to remain operational for a flood level in excess of plant grade (Elevation 728.0), provisions are made in the Auxiliary Building for an intertie with the ERCW supply which is to be installed as part of the plant flood preparations (refer to Sections 2.4.14 and 9.2.1) in order to supply flow to the ice condenser system heat exchangers. The flow through the ice condenser system is always discharged to the holding pond, whether supplied from RCW or ERCW. The ERCW intertie is used in flood conditions to maintain a cooling water supply to the ice machine refrigeration condensers. Refer to Section 6.7 for a detailed description of the ice condenser system.

For control of organic fouling, including slime and Asiatic clam infestation, see Section 9.2.1.6. Strainers in the supply headers and periodic backflushing of the strainers curtail large clams from entering the plant. Chemical treatment of the RCW is necessary during the clam spawning season to control Asiatic clam growth, which is approximately May to October.

9.2.8.3 Safety Evaluation

Since this system has no safety-related functions, it is not required to be designed to remain operable through an earthquake, tornado, flood-above- plant-grade, or other such natural phenomena. The RCW system is designed such that none of its components can adversely affect the function of any safety-related system.

Within the intake pumping station, the RCW pumps and piping are located in a completely separate area from any safety-related equipment. The RCW piping in the electrical equipment room is supported to the extent required to prevent falling on safety-related cables and cable trays (pressure boundary integrity is not required). Within the Turbine Building, the RCW booster pumps for the RCW supply line from the Turbine Building to the Auxiliary Building are separated from any safety-related equipment.

The RCW system piping within the Auxiliary and Additional Equipment Buildings is seismically qualified (Seismic Category I(L)) to the extent required to ensure that a safe shutdown earthquake in combination with normal operating conditions will not cause flooding, water impingement, or damage due to falling on safety related equipment. This degree of seismic qualification is accomplished by supporting the piping in all areas so as to prevent its falling. In areas where safety-related equipment is located, either further support is provided to ensure the integrity of the RCW piping pressure boundary, or the safety-related equipment is sealed or shielded from water spray.

An isolation valve is provided in the seismically qualified (Seismic Cat (IL)) portion of the RCW supply line from the Turbine Building to the Auxiliary Building. This prevents the loss of water from the ERCW system to the nonqualified portion of the RCW system whenever the flood mode intertie to the ERCW system is made.

9.2.8.4 Tests and Inspection

The RCW system is hydrostatically or in-service leak tested and performance tested prior to plant operation to ensure adequacy of the system to meet the operational requirements. Once the plant is operational, routine visual inspection of all the system components is sufficient to verify functionability. A diver protection barrier is installed in the pump bay to facilitate the inspection of the RCW pumps.

REFERENCES

None.

TABLE 9.2-1

ESSENTIAL RAW COOLING WATER SYSTEM
PUMP DESIGN DATA

Essential Raw Cooling Water Pumps	
Quantity	8
Type	Vertical, wet pit centrifugal type
Rated capacity, gpm (each)	11,800
Rated head, ft	230
Motor horsepower, hp (each)	800
Submergence required, ft	5.25
Submergence available (minimum), ft	11.87
Screen Wash Pumps	
Quantity	4
Type	Vertical turbine
Rated capacity, gpm (each)	270
Rated head, ft	350
Motor horsepower, hp (each)	40
NPSH required, ft	10.35
NPSH available (minimum), ft	42.35
Traveling Water Screens	
Quantity	4
Motor Horsepower, hp (each)	3

TABLE 9.2-2 (Sheet 1 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1.	ERCW Pumps A-A B-A C-A D-A E-B F-B G-B H-B	Operate.	Any one pump either fails to start or stops operating.	Electrical or mechanical failure.	Status lights 0-HS-67-28A, 32A, 36A, 40A, 47A, 51A, 55A, 59A, respectively, and low header pressure alarms in MCR	None. Any two of four pumps on either Train A or Train B are capable of providing full ERCW flow.	None.	Two ERCW pumps can only support the LOCA unit and the non-accident unit being cooled by RHR after it has been shutdown for 48 hours. During the first 48 hours, if the non-accident(shutdown) unit requires RHR cooling a third ERCW pump is required. For this case, the FMEA becomes three of four pumps on either Train A or B are capable of providing full ERCW flow.
2.	Screen Wash Pumps 1A-A 2A-A 1B-B 2B-B	Operate.	Any one either fails to start or stops operating.	Electrical or mechanical failure.	Status lights 1-HS-67-431A, 2-HS-67-437A, 1-HS-67-440A, 2-HS-67-447A, respectively.	None. Any one of the two screens for either Train A or Train B intakes is capable of screening full ERCW flow.	None.	
3.	Traveling Water Screen	Operate. Start automatically	Any one either fails to start or	Electrical or mechanical	Motor indication 1-XI-67-434, 445,	None. Any one of the two screens	None.	

TABLE 9.2-2 (Sheet 2 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	1A-A 1B-B 2A-A 2B-B	on high pressure in wash line.	stops operating.	failure.	2-XI-67-439, 451, respectively.	on either train A or Train B intake is capable of screening full ERCW flow.		
4.	ERCW Pump Disch Check Valves 0-67-503A 0-67-503B 0-67-503C 0-67-503D 0-67-503E 0-67-503F 0-67-503G 0-67-503H	Open to provide flow path when respective pump starts.	Fails to open.	Mechanically stuck closed.	High pressure alarms in MCR.	None. Any other two of the remaining three pumps in the affected train or any two of the four pumps in the other train can be started.	None	
		Close to pre-vent backflow when respective pump stops.	Fails to close.	Mechanically stuck open.	Low flow alarms and low pressure alarm in MCR.	None. Respective pump train discharge valves 1,2-FCV-67-22 in Train A or 1,2-FCV-67-24 in Train B can be closed to isolate affected pump train from supply headers and supply ERCW from other pump train.	None.	
5.	ERCW Pump Disch Hdr Butterfly Valves. 1-FCV-67-22 1-FCV-67-24 2-FCV-67-22	ERCW flow path to headers 1A, 1B, 2A, 2B, respectively.	Any one of four closes.	Inadvertent actuation or mechanical failure.	Low flow alarms in MCR.	None. Three of four headers are available to ensure either headers 1A and 2A or headers 1B and 2B will be in service to meet all plant requirements.	None.	Administratively locked in open position with breakers open.

TABLE 9.2-2 (Sheet 3 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2-FCV-67-24							
6.	DG 1A-A Clr Inlet B'fly Valve 1-FCV-67-66	ERCW supply flow path from header 1A	Valve fails to fully open or recloses.	Electrical or mechanical failure Inadvertent actuation or mechanical failure.	Status lights 1-HS-67-66A	Inability to provide required cooling flow to diesel generator.	None. The remaining three diesel generators are available to supply required emergency power.	
7.	DG 2A-A Clr Inlet B'fly Valve 2-FCV-67-66	ERCW supply flow path from header 1A	Valve fails to fully open or recloses.	Electrical or mechanical failure. Inadvertent actuation or mechanical failure.	Status lights 2-HS-67-66A	Inability to provide required cooling flow to diesel generator.	None. The remaining three diesel generators are available to supply required emergency power.	
8.	DG 1B-B Clr Inlet B'fly Valve 1-FCV-67-67	ERCW supply flow path from header 1B	Valve fails to fully open or recloses.	Electrical or mechanical failure Inadvertent actuation or mechanical failure.	Status lights 1-HS-67-67A	Inability to provide required cooling flow to diesel generator.	None. The remaining three diesel generators are available to supply required emergency power.	
9.	DG 2B-B Clr Inlet Butterfly Valve 2-FCV-67-67	ERCW supply flow path from header 1B	Valve fails to fully open or recloses.	Electrical or mechanical failure. Inadvertent actuation or mechanical	Status lights 2-HS-67-67A	Inability to provide required cooling flow to diesel generator.	None. The remaining three diesel generators are available to supply required	

TABLE 9.2-2 (Sheet 4 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				failure.			emergency power.	
10.*	ADG Clr Inlet B'fly Valves 1-FCV-67-72-S 2-FCV-67-73-S	ERCW supply flow path from headers 2A/2B and 1A/1B respectively.	Either one of two fails to fully open or recloses.	Electrical or mechanical failure. Inadvertent actuation or mechanical failure.	Status lights 1-HS-67-72A, 2-HS-67-73A, respectively.	None. Each valve provides full flow capability.	None.	*The ADG is not operable however, this wording is retained for historical purpose.
11.	DG 1A-A Clr Inlet Check Valves 1-67-508A	ERCW supply flow path from header 1A backflow protection.	Fails to open or Fails to close on reverse flow.	Mechanical failure or stuck closed.	No direct MCR indications available.	If the valve fails to open, flow to the DG jacket water heat exchangers would be isolated. If a failure occurred, the opposite train diesel would be available, or flow from the opposite train ERCW supply Header 2B could be provided under the abnormal operating procedures.	None.	

TABLE 9.2-2 (Sheet 5 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				Mechanical failures or stuck open.		None. Reverse flow would only occur on loss of ERCW supply Header 1A, if the opposite ERCW supply Header 2B had been placed in service. The loss of 1A would be the single failure, in which case failure of this valve need not be postulated. Header realignment would be implemented by abnormal operating procedures.		
	DG 1A-A Clr Inlet Check Valves 1-67-513A	Alternate ERCW supply flow path from header 2B, backflow protection.	Fails to open Or	Mechanical failure or stuck open.	No direct MCR indications available.	The backup supply flow from ERCW supply header 2B would be unavailable. This supply is only placed in service under abnormal plant operating procedures when the normal supply from ERCW supply header 1A is unavailable.	None.	

TABLE 9.2-2 (Sheet 6 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failures or stuck closed.		None, under normal plant operating conditions flow through this line is isolated by valve 1-FCV-67-068-A. Therefore, the failure of the check valve to close has no effect on the system.		
12.	DG 2A-A Clr Inlet Check Valves 2-67-508A	ERCW supply flow path from header 1A backflow protection.	Fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available.	If the valve fails to open, flow to the DG jacket water heat exchangers would be isolated. If a failure occurred, the opposite train diesel would be available or flow from the opposite train ERCW supply header 2B could be provided under the abnormal operating procedures.	None.	

TABLE 9.2-2 (Sheet 7 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failures or stuck open.		None. Reverse flow would only occur on loss of ERCW supply Header 1A, if the opposite ERCW supply Header 2B had been placed in service. The loss of Header 1A would be the single failure, in which case failure of this valve need not be postulated.. Header realignment would be implemented by abnormal operating procedures.		
	DG 2A-A Clr Inlet Check Valves 2-67-513A	Alternate ERCW supply flow path from header 2B, backflow protection.	Fails to open. or	Mechanical failure or stuck closed.	No direct MCR indications available	The back-up supply flow from ERCW supply Header 2B would be unavailable. This supply is only placed 9in service under abnormal plant operating procedures when the normal supply from ERCW supply header 1A is unavailable..	None.	

TABLE 9.2-2 (Sheet 8 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow	Mechanical failures or stuck open.		None, under normal plant operating conditions flow through this line is isolated by valve 2-FCV-67-068-A. Therefore, the failure of the check valve to close has no effect on the ERCW system		
13.	DG 1B-B Clr Inlet Check Valves 1-67-508B	ERCW supply flow path from header 1B, backflow protection.	Fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available.	If the valve fails to open, flow to the DG jacket water heat exchangers would be isolated. If a failure occurred, the opposite train diesel would be available or flow from the opposite train ERCW supply header 2A could be provided under the abnormal operating procedures.	None.	

TABLE 9.2-2 (Sheet 9 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failures or stuck open.		None. Reverse flow would only occur on loss of ERCW supply Header 1B, if the opposite ERCW supply Header 2A had been placed in service. The loss of Header 1B would be the single failure, in which case failure of this valve need not be postulated.. Header realignment would be implemented by abnormal operating procedures.		
	DG 1B-B Clr Inlet Check Valves 1-67-513B	Alternate ERCW supply flow path from Header 2A, backflow protection	Fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available	The back-up supply flow from ERCW supply Header 2A would be unavailable. This supply is only placed in service under abnormal plant operating procedures when the normal supply from ERCW supply Header 1B is unavailable.	None.	

TABLE 9.2-2 (Sheet 10 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failures or stuck open.		None, under normal plant operating conditions flow through this line is isolated by valve 1-FCV-67-065-B. Therefore, the failure of the check valve to close has no effect on the ERCW system.		
14.	DG 2B-B Clr Inlet Check Valves 2-67-508B	ERCW supply flow path from Header 1B backflow protection.	Fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available.	If the valve fails to open, flow to the DG jacket water heat exchanger would be isolated. If a failure occurred, the opposite train diesel would be available, or flow from the opposite train ERCW supply Header 2A could be provided under the abnormal operating procedures.	None.	

TABLE 9.2-2 (Sheet 11 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failure or stuck open.		None. Reverse flow would only occur on loss of ERCW supply Header 1B, if the opposite ERCW supply Header 2A had been placed in service. The loss of Header 1B would be the single failure, in which case failure of this valve need not be postulated. Header realignment would be implemented by abnormal operating procedures.		
	DG 2B-B Clr Inlet Check Valve 2-67-513B	Alternate ERCW supply flow path from Header 2A backflow protection.	Fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available.	The back-up supply flow from ERCW supply header 2A would be unavailable. This supply is only placed in service under abnormal plant operating procedures when the normal supply from ERCW supply header 1B is unavailable.	None.	

TABLE 9.2-2 (Sheet 12 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failure or stuck open.		None, under normal plant operation conditions, flow through this line is isolated by valve 2-FCV-067-0065-B. Therefore, the failure of the check valve to close has no affect on the ERCW system.		
15.	DELETED							
16.	DELETED							
17.	Screen Wash Pump Disch Check Valves 1-67-940A 2-67-935B	Pump 1A-A and 2B-B discharge flow path to screens 1A-A and 2B-B, respectively, backflow protection when cross connect is open.	Either one of two fails to open or	Mechanical failure or stuck closed.	Pump ON indicated by position of hand switch 1, 2-HS-67-431A, 447, respectively, and screen motors NOT ON by status indicating light 1, 2-XI-61-434, 451, respectively, indicates pressure switch 1, 2-PS-67-434, 451, respectively, did not reach setpoint and allow screen motor to run.	None. Pumps 2A-A and 1B-B and screens 2A-A and 1B-B, respectively, provide full capacity backup.	None.	

TABLE 9.2-2 (Sheet 13 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close on reverse flow.	Mechanical failure or stuck open.	No direct MCR indications available.			
18.	Main Discharge Hdr A, B B'fly Valves FCV-67-360 FCV-67-362	ERCW to Cooling Tower 2 and 1 basin isolation, respectively.	Either one of two fails to close or reopens.	Electrical or mechanical failure. Inadvertent actuation or electrical failure.	Status Lights 0-HS-67-360A, 362A, respectively.	None. Alternate route to emergency pond thru overflow weir is always open without any obstruction for water discharge.	None.	
19.	ERCW Pump Discharge Strainers 1 A-A 1 B-B 2 A-A 2 B-B	Operate.	Any one of four fails to start or stops operating.	Electrical or mechanical failure.	High differential pressure alarms in MCR.	None. Both strainers on either Train A or B pump discharges are capable of full ERCW flow capacity. Shut down affected header and operate on other train.	None.	
20.	Screen Wash Pump 1 B-B, 2 B-B, 1A-A, 2 A-A Prelube Check	Open to provide flow path to flush pump bearings.	Any one of four fails to open or	Mechanical failure or stuck closed.	No direct MCR indications available.	None. Either one of two pump and screen sets in each train is capable of screening full ERCW flow.	None.	

TABLE 9.2-2 (Sheet 14 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Valves 1-67-934B 2-67-934B 1-67-938A 2-67-938A	Close to prevent backflow.	Fails to close on reverse flow.	Mechanical failure or stuck open.		None. Shut down pump with failed valve and operate other pump/screen set in train.		
21.	DELETED							
22.	ERCW Pump Prelube Check Valves 0-67-507A 0-67-507B 0-67-507C 0-67-507D 0-67-507E 0-67-507F 0-67-507G 0-67-507H	Open to provide flush path to flush bearings of pumps A-A, B-A, C-A, D-A, E-B, F-B, G-B, H-B, respectively, to prolong life of the bearings and stuffing box.	Any one of eight fails to open or	Mechanical failure or stuck closed.	High bearing temp logs T3110A and T3111A for A and C, T3112A and T3113A for B and D, T3114A and 3115A for E and G, T3116A and T3117A for F and H.	None. Operate pumps on unaffected train.	None.	
			Any one of eight fails to close on reverse flow	Mechanical failure or stuck open.	No direct MCR indications available.	None. Operate pumps on unaffected train.	None.	
23.	ERCW Vac Brkr (Air Release Valves) 0-67-502A 0-67-502B	Close when Pumps A-A, B-A, C-A, D-A, E-B, F-B, G-B, H-B, respectively, are started and air is evacuated from	Any one of eight valves fails to close.	Mechanical failure or stuck open.	No direct MCR indications available.	None. Two of four pumps on each Train A or B can furnish full ERCW flow.	None.	

TABLE 9.2-2 (Sheet 15 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	0-67-502C 0-67-502D 0-67-502E 0-67-502F 0-67-502G 0-67-502H	pump discharge column. Open when respective pump is stopped to break vacuum in column.	Any one of eight valves fails to open.	Mechanical failure or stuck closed.		None. Two of four pumps in each Train A or B can furnish full ERCW flow.	None.	
24.	Strainer Flush Valves 1-FCV-67-9B 2-FCV-67-9B 1-FCV-67-10B 2-FCV-67-10B	Cycle intermittently to provide ERCW flow to flush strainer 1A-A, 2A-A, 1B-B, 2B-B, respectively.	Any one of four fails to operate correctly.	Electrical or mechanical failure.	High differential pressure alarms in MCR.	None. Respective strainer will clog reducing flow to Header 1A, 2A, 1B, 2B, respectively. Either one of two header sets of 1A and 2A or 1B and 2B above can furnish full ERCW flow.	None.	
25.	Strainer Backwash Valves 1-FCV-67-9A 2-FCV-67-9A 1-FCV-67-10A 2-FCV-67-10A	Cycle intermittently to provide ERCW flow to backwash strainer 1A-A, 2A-A, 1B-B, 2B-B, respectively.	Any one of four fails to operate correctly.	Electrical or mechanical failure.	High differential pressure alarms in MCR.	None. Respective strainer will clog reducing ERCW flow to Header 1A, 2A, 1B, 2B, respectively. Either one of two header sets of 1A and 2A or 1B and 2B alone can furnish full ERCW flow.	None.	
26.	Aux. Bldg. Supply Header Section Valves 1-FCV-67-81	ERCW supply flow path to Aux. Bldg. for headers 1A, 1B, 2A, 2B,	Any one of four fails closed.	Mechanical failure.	No direct MCR indication available. See remarks.	None. Interrupt ERCW supply to Aux. Bldg. via respective header.	None.	Administratively locked in open position with breaker open.

TABLE 9.2-2 (Sheet 16 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	1-FCV-67-82 2-FCV-67-81 2-FCV-67-82	respectively.				Either one of two header sets of 1A and 2A or 1B and 2B can furnish full ERCW flow.		
27.	Header 1B and 2A Section Valves 1-FCV-67-223 2-FCV-67-223	Remain open to provide flow to CCS HX A from Header 2A.	Either FCV fails closed.	Mechanical failure.	High temperature alarm form 0-M-278.	Interrupts ERCW cooling to CCS HX A.	None. Train B CCS components, cooled by HX- C, provide backup for all safety related loads.	
28.	CCS HX A Inlet B'fly 1-FCV-67-478	Remain open to supply CCS HX A from header 2A.	Fails closed.	Mechanical failure.	High temperature alarm form 0-M-278.	Interrupts ERCW cooling a CCS HX A. ERCW flow provided to redundant CCS HX C by Train B via Header 2B.	None. Train B CCS components, cooled by HX- C provide backup for all safety-related loads.	Administratively locked in open position with breaker open.
29.	CCS HX A Outlet B'fly and Bypass 1-FCV-67-146 1-FCV-67-143	Remain closed, or open to control ERCW flow through HX.	Either one does not operate properly.	Electrical or mechanical failure.	Flow indicator 2-FI-67-222.	Depending on failure position of valves, disrupts system balance or interrupts proper flow to HX. ERCW flow provided to redundant CCS HX C by Train B via Header 2B.	None. CCS HX C provides 100% backup service.	
30.	CCS HX B Outlet B'fly and Bypass	Remains closed, or open to control ERCW flow through HX.	Either one does not operate properly.	Electrical or mechanical failure.	Flow indicator 2-FI-67-222.	Depending on failure position of valves, disrupts system balance or interrupts proper flow to HX.	None. CCS HX C provides 100% backup service.	

TABLE 9.2-2 (Sheet 17 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2-FCV-67-146 2-FCV-67-143					ERCW flow provided to redundant CCS HX C by Train B via Header 2B.		
31.	CCS HX C Inlet Bfly's 1-FCV-67-147 2-FCV-67-147	(1) isolates Header 1A from 2B.	None for (1). See remarks.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Administratively locked in closed and open position, respectively, with breakers open.
		(2) provides ERCW flow path from Header B.	(2) fails closed.	Mechanical failure due to disc-stem slip.	Flow indicator 1-FI-67-226.	None.	None. CCS HX A & B (Train A) provides 100% service.	
32.	CCS HX C Outlet Bfly's and Bypass	Remain closed, or open to control flow through HX.	Either -152 or -144 does not operate properly.	Electrical or mechanical failure.	Change in flow indication on 0-FI-67-226	None.	None.	CCS HX C is back-up for CCS HX A and B. A failure related to HX A or B precludes a second failure related to HX C.
	0-FCV-67-152 0-FCV-67-151	Remain Closed.	None. See remarks.	Not applicable.	Not applicable.	None.	None.	Valve -151 is locked closed with breaker removed
	0-FCV-67-144	Same as for 0-FCV-67-152				None.	None.	

TABLE 9.2-2 (Sheet 18 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
33.	CSS HX 1A, 1B & 2A, 2B Inlet Bfly's 1-FCV-67-125 & 2-FCV-67-125 1-FCV-67-123 & 2-FCV-67-123	Open to provide ERCW flow.	Either one (for the affected unit) fails to open or Recloses.	Electrical or mechanical failure. Mechanical failure or inadvertent actuation.	Status lights 1 & 2-HS-67-125A, 123A, respectively, and flow indicators 1 & 2-FI-67-136, 122, respectively.	None.	None. Only one of two HXs (each unit) required for safe shutdown.	
34.	CCS HX 1A, 1B & 2A, 2B Outlet Bfly's 1-FCV-67-126 & 2-FCV-67-126 1-FCV-67-124 & 2-FCV-67-124	Open to provide ERCW flow.	Either one fails (for the affected unit) to open or Recloses.	Electrical or mechanical failure. Electrical or mechanical failure or inadvertent actuation.	Status lights 1 & 2-HS-67-126A, 124A, respectively, and flow indicators 1 & 2-FI-67-136, 122, respectively.	None.	None. Only one of two HXs (each unit) required for safe shutdown.	
35.	Shutdown BD RM A/C Wtr Chiller A-A, B-B Outlet 1-TCV-67-158 2-TCV-67-158	Remain open to provide ERCW flow to Chillers A-A, B-B, respectively.	Either one of two fails closed.	Mechanical failure or inadvertent actuation.	No direct MCR indication available.	None.	None. Either one of two chillers provides 100% cooling.	
36.	Train 1A, 2A A/C Equip and Service Air Compressor Supply B'fly 1-FCV-67-127 2-FCV-67-127	Remain open to provide ERCW flow to Train 1A and 2A A/C equipment and SA compressor, respectively.	Either one of two fails closed.	Mechanical failure by disc stem slippage.	No direct MCR indication available.	None.	None. Either one of two trains 1A or 1B provides 100% cooling.	Administratively locked in open position with breaker open.

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
37.	Train 1B, 2B A/C Equip and Service Air Compressor Supply B'fly 1-FCV-67-128 2-FCV-67-128	Remain open to provide ERCW flow to Train 1B and 2B A/C equipment and SA compressor, respectively.	Either one of two fails closed.	Mechanical failure by disc stem slippage.	No direct MCR indication available.	None.	None. Either one of two trains 1A or 1B provides 100% cooling.	Administratively locked in open position with breaker open.
38.	Instr Rm Wtr Chlrs 1A, 1B & 2A, 2B Inlet 1-TCV-67-115 & 2-TCV-67-115 1-TCV-67-118 & 2-TCV-67-118	Modulate to provide ERCW flow to Chillers 1A, 2A, 1B, 2B respectively.	Either one of two (for the affected unit) fails to close.	Electrical or mechanical failure or inadvertent actuation.	No direct MCR indication available.	None. Either one of two coolers provides 100% service.	None.	Instr Rm coolers not required for safe shutdown
39.	Upper Containment Vent Clrs 1A, 1C, 1B, 1D & 2A, 2C, 2B 2D Supply Control Valves 1-TCV-67-129 1-TCV-67-132 1-TCV-67-137 1-TCV-67-140 2-TCV-67-129 2-TCV-67-132 2-TCV-67-137	Piping system integrity.	Not applicable. See remarks.	Not applicable.	Status lights 1-ZS-67-129, 132, 137, 140, &2-ZS-67-129, 132, 137, 140, respectively.	None.	None.	ERCW flow to containment will be isolated.

TABLE 9.2-2 (Sheet 20 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2-TCV-67-140 respectively							
40.	Upper Containment Vent Clrs 1A, 1C, 1B, 1D & 2A, 2C, 2B, 2D Supply Cont Isol Valves 1-FCV-67-130 (Penet X-69) 1-FCV-67-133 (Penet X-75) 1-FCV-67-138 (Penet X-74) 1-FCV-67-141 (Penet X-68) 2-FCV-67-130 (Penet X-69) 2-FCV-67-133 (Penet X-75) 2-FCV-67-138 (Penet X-74) 2-FCV-67-141 (Pent X-68)	Close for containment isolation.	Fails to close or Reopens.	Mechanical or electrical failure. Mechanical failure or inadvertent actuation.	Status lights 1 & 2-HS-67-130, 133, 138, 141, respectively.	None. Check valves 580A, 580C, 580B, 580D, respectively, provide containment isolation backup.	None.	
41.	Upper Containment Vent Clrs 1A, 1C, 1B & 1D & 2A, 2C, 2B,	Close to provide containment isolation backup for valves	Any one of four (for the affected unit) fails to close.	Mechanical failure or stuck open.	No direct MCR indication available.	None. Containment isolation valves fulfill containment isolation function.	None.	

TABLE 9.2-2 (Sheet 21 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2D Supply Cont Iso Check Valves 1-67-580A (Penet X-69) 1-67-580C (Penet X-75) 1-67-580B (Penet X-74) 1-67-580D (Penet X-68) 2-67-580A (Penet X-69) 2-67-580C (Penet X-75) 2-67-580B (Penet X-74) 2-67-580D (Penet X-68)	1-FCV-67-130, 133, 138, 141, 2-FCV-67-130, 133, 138, 141 respectively.						
42.	Upper Containment Vent Coolers 1A, 1C, 1B, 1D &2A, 2C, 2B, 2D Return	Close for containment isolation.	Any one of four (for the affected unit) fails to close or	Electrical or mechanical failure.	Status lights 1 & 2-HS-67-295A, 296A, 297A, 298A, respectively.	None. Outboard containment isolation valves 1 & 2-FCV-67-131, 134, 139, 142,	None.	

TABLE 9.2-2 (Sheet 22 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Inboard Cont Iso Valves 1-FCV-67-295 (Penet X-73) 1-FCV-67-296 (Penet X-71) 1-FCV-67-297 (Penet X-70) 1-FCV-67-298 (Penet X-72) 2-FCV-67-295 (Penet X-73) 2-FCV-67-296 (Penet X-71) 2-FCV-67-297 (Penet X-70) 2-FCV-67-298 (Penet X-72)		Reopens.	Mechanical failure or inadvertent actuation.		respectively, provide backup isolation.		
43.	Upper Containment Vent Clrs 1A, 1C, 1B & 1D & 2A, 2C, 2B,	Close to provide containment isolation backup for valves 1-FCV-67-131, 134, 139, 142, & 2-FCV-67-131,	Any one of four (for the affected unit) fails to close. See remarks.	Mechanical failure or stuck open.	No direct MCR indication available.	None. Respective containment isolation valves fulfill isolation function.	None.	Primary function is thermal pressure relief of liquid trapped between isolation valves. Failure to open is not considered credible.

TABLE 9.2-2 (Sheet 23 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2D Return Pressure Relief Cont Iso Check Valves 1-67-585A (Penet X-73) 1-67-585C (Penet X-71) 1-67-585B (Penet X-70) 1-67-585D (Penet X-72) 2-67-585A (Penet X-73) 2-67-585C (Penet X-71) 2-67-585B (Penet X-70) 2-67-585D (Penet X-72)	134, 139, 141 respectively.						

TABLE 9.2-2 (Sheet 24 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
44.	Upper Containment Vent Clr 1A, 1C, 1B, 1D & 2A, 2C, 2B, 2D Return Outboard Cont Iso Valves 1-FCV-67-131 (Penet X-73) 1-FCV-67-134 (Penet X-71) 1-FCV-67-139 (Penet X-70) 1-FCV-67-142 (Penet X-72) 2-FCV-67-131 (Penet X-73) 2-FCV-67-134 (Penet X-71) 2-FCV-67-139 (Penet X-70) 2-FCV-67-142 (Penet X-72)	Close for containment isolation.	Any one of four fails to close or	Electrical or mechanical failure.	Status lights 1 & 2-HS-67-131A, 134A, 139A, 142A, respectively.	None. Inboard containment isolation valves 1 & 2-FCV-67-295, 296, 297, 298 and check valves 585A, 585C, 585B, 585D, respectively, provide backup isolation.	None.	
			reopens.	Mechanical failure or inadvertent actuation.				

TABLE 9.2-2 (Sheet 25 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
45.	Lower Containment Vent Clr 1A, 1C, 1B, 1D & 2A, 2C, 2B, 2D Supply Outboard Cont Iso Valves 1-FCV-67-83 (Penet X-58A) 1-FCV-67-91 (Penet X-62A) 1-FCV-67-99 (Penet X-60A) 1-FCV-67-107 (Penet X-56A) 2-FCV-67-83 (Penet X-58A) 2-FCV-67-91 (Penet X-62A) 2-FCV-67-99 (Penet X-60A) 2-FCV-67-107 (Penet X-56A)	Close for containment isolation.	Any one of four (for the affected unit) fails to close or	Electrical or mechanical failure.	Status lights 1-HS-67-83A, 91A, 99A, 107A, &2-HS-67-83A, 91A, 99A, 107A,respectively.	None. Check Valves 562A, 562C, 562B, 562D, and isolation valve 1 & 2-FCV-67-113, respectively, provide isolation backup. Manual actions are required to isolate the line upstream of valve 1 & 2-FCV-67-107. See Remarks.	None.	The line downstream of 1 & 2-FCV-67-113 and 1054D in containment is not protected from an HELB. With a single failure of 1 or 2-FCV-67-107, manual isolation using upstream valve 1 or 2-ISV-67-523B is required.
			reopens.	Mechanical failure or inadvertent actuation.				

TABLE 9.2-2 (Sheet 26 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
46.	Lower Containment Vent Clr 1A, 1C, 1B, 1D & 2A, 2C, 2B, 2D Supply Inboard Cont Iso Valves 1-FCV-67-89 (Penet X-58A) 1-FCV-67-97 (Penet X-62A) 1-FCV-67-105 (Penet X-60A) 1-FCV-67-113 (Penet X-56A) 2-FCV-67-89 (Penet X-58A) 2-FCV-67-97 (Penet X-62A) 2-FCV-67-105 (Penet X-60A) 2-FCV-67-113 (Penet X-56A)	Close for containment isolation.	Any one of four (for the affected unit) fails to close or	Electrical or mechanical failure.	Status lights 1 & 2-HS-67-89A, 97A, 105A, 113A, respectively.	None. Valves 1 & 2-FCV-67-83, 91, 99, 107, respectively, provide backup isolation function.	None.	
			reopens.	Mechanical failure or inadvertent actuation.				

TABLE 9.2-2 (Sheet 27 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
47a.	Lower Containment Vent Clr 1A, 1C, 1B, 1D Supply Pressure Relief Cont Iso Valves 1-67-1060A 1-67-1060B 1-67-1060C 1-67-1060D	Close for containment isolation.	Anyone of four fails to close.	Mechanical failure or stuck open.	No direct MCR indication available.	None. Respective containment isolation valve will fulfill isolation function.	None.	Primary function is thermal pressure relief of liquid trapped between isolation valves. Failure to open is not considered credible.
			Any one of four fails to open.	Mechanical Failure	None.	Single Failure	If respective containment isolation valves close and are leak tight, a line failure could occur between the two isolation valves. See remarks.	Containment integrity is maintained because the break would occur between the two leak tight FCVs.
47b.	Lower Containment Vent Clrs 2A, 2C, 2B, 2D Supply Pressure Relief Cont Iso Valves 2-CKV-67-1054A, 2-CKV-67-1054C, 2-CKV -67-1054B, 2-CKV -67-1054D	Close to provide backup containment isolation for valves 2-FCV-67-83, -91, -99 & -107 respectively. See remarks.	Any one of four fails to close.	Mechanical Failure or stuck open	No direct MCR indication available	None. Respective containment isolation valve will fulfill isolation function.	None	Primary function is thermal pressure relief of liquid trapped between isolation valves. Failure to open is not considered credible.
48.	Lower Containment Vent Clrs 1A, 1C, 1B, 1D & 2A, 2C, 2B,	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment

TABLE 9.2-2 (Sheet 28 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2D Temperature Control Valves 1-TCV-67-84 1-TCV-67-92 1-TCV-67-100 1-TCV-67-108 2-TCV-67-84 2-TCV-67-92 2-TCV-67-100 2-TCV-67-108							isolation valves.
49	Unit 1 RC Pump Motor 1, 3, 2, 4 Clrs and Unit 2 RC Pump Motor 1, 3, 2, 4 Clrs Temperature Control Valves 1-TCV-67-86 1-TCV-67-94 1-TCV-67-102 1-TCV-67-110 2-TCV-67-86 2-TCV-67-94 2-TCV-67-102 2-TCV-67-110	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment isolation valves.

TABLE 9.2-2 (Sheet 29 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
50.	Control Rod Drive Units 1A, 1C, 1B, 1D 2A, 2C, 2B, 2D Temperature Control Valves 1-TCV-67-85 1-TCV-67-93 1-TCV-67-101 1-TCV-67-109 2-TCV-67-85 2-TCV-67-93 2-TCV-67-101 2-TCV-67-109	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment isolation valves.
51.	Lower Containment Vent Clrs 1A, 1C, 1B, 1D Check Valves 1-67-565A 1-67-565C 1-67-565B 1-67-565D	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment isolation valves.
52.	RC Pump Motor Unit 1 1, 3, 2, 4 & Unit 2 1, 3, 2, 4 Clrs	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment

TABLE 9.2-2 (Sheet 30 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Check Valves 1-67-571A 1-67-571C 1-67-571B 1-67-571D 2-67-571A 2-67-571C 2-67-571B 2-67-571D							isolation valves.
53.	Control Rod Drive Vent Clrs 1A, 1C, 1B, 1D, 2A, 2C, 2B, 2D Check Valves 1-67-568A 1-67-568C 1-67-568B 1-67-568D 2-67-568A 2-67-568C 2-67-568B 2-67-568D	None.	Not applicable.	Not applicable.	Not applicable.	None.	None.	These valves are isolated from ERCW flow by containment isolation valves.
54.	Lower Containment Vent	Close for containment	Any one of four (for the affected	Electrical or mechanical	Status lights 1 & 2-HS-67-87A,	None. Valves 1 & 2-FCV-67-88,	None.	

TABLE 9.2-2 (Sheet 31 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Clrs 1A, 1C, 1B, 1D, 2A, 2C, 2B, 2D Return Inboard Cont Iso Valves 1-FCV-67-87 (Penet X-59A) 1-FCV-67-95 (Penet X-63A) 1-FCV-67-103 (Penet X-61A) 1-FCV-67-111 (Penet X-57A) 2-FCV-67-87 (Penet X-59A) 2-FCV-67-95 (Penet X-63A) 2-FCV-67-103 (Penet X-61A) 2-FCV-67-111 (Penet X-57A)	isolation.	unit) fails to close or reopens.	failure. Mechanical failure or inadvertent actuation.	95A, 103A, 111A, respectively.	96, 104, 112, respectively, provide backup isolation function.		
55.	Lower Containment Vent Clrs	Close for containment isolation backup	Any one of four (for the affected unit) fails open.	Mechanical failure or stuck open.	No direct MCR indication available.	None. Containment isolation valves fulfill isolation function.	None.	

TABLE 9.2-2 (Sheet 32 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	1A, 1C, 1B, 1D 2A, 2C, 2B, 2D Return Pressure Relief Cont Iso Check Valves 575A (Penet X-59A) 575C (Penet X-63A) 575B (Penet X-61A) 575D (Penet X-57A)	for valves 1 & 2-FCV-67-88, 96, 104, 112, respectively.						
56.	Lower Containment Vent Clrs 1A, 1C, 1B, 1D 2A, 2C, 2B, 2D Return Outboard Cont Iso Valves 1-FCV-67-88 (Penet X-59A) 1-FCV-67-96 (Penet X-63A) 1-FCV-67-104	Close for containment isolation.	Any one of four (for the affected unit) fails to close or	Electrical or mechanical failure.	Status lights 1 & 2-HS-67-88A, 96A, 104A, 112A, respectively.	None. Inboard containment isolation valves 1 & 2-FCV-67-87, 95, 103, 111 and check valves 575A, 575C, 575B, 575D, respectively, provide backup isolation.	None.	

TABLE 9.2-2 (Sheet 33 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	(Penet X-61A) 1-FCV-67-112 (Penet X-57A) 2-FCV-67-88 (Penet X-59A) 2-FCV-67-96 (Penet X-63A) 2-FCV-67-104 (Penet X-61A) 2-FCV-67-112 (Penet X-57A)		reopens.	Mechanical failure or inadvertent actuation.				
57.	Spent Fuel Pit Pump & TB Booster Pump Space Clr 1A, 1B Supply Valves 1-FCV-67-213 1-FCV-67-215	Open for ERCW flow to Coolers 1A, 1B, respectively.	Either one of two fails to open or	Electrical or mechanical failure.	Status lights 1-ZS-67-213A, 215A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% service.	
			Either one of two recloses.	Mechanical failure or inadvertent actuation.				
58.	CCS Pump & Aux FW Pump Space Clr 1A, 1B Supply Valves	Open for ERCW flow to Coolers 1A, 1B,	Either one of two fails to open or	Electrical or mechanical failure	Status lights 1-ZS-67-162A, 164A, respectively. No indication for	None.	None. Either one of two coolers provides 100%	

TABLE 9.2-2 (Sheet 34 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	1-FCV-67-162 1-FCV-67-164	respectively.	Either one of two recloses.	Mechanical failure or inadvertent actuation	disc-stem connection failure.		service.	
59.	Centrif Charging Pump Rm Clr 1A, 1B Supply Valves 1-FCV-67-168 1-FCV-67-170 2-FCV-67-168 2-FCV-67-170	ERCW flow to Coolers 1A, 1B, 2A, 2B respectively.	Either one of two (for the affected unit) closes.	Mechanical failure or inadvertent actuation.	Status lights 1 & 2-ZS-67-168A, 170A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% service.	Administratively locked open with power to their FSV's removed.
60.	Recip Charging Pump Rm Clr 1C Supply Valves 1-FCV-67-172 2-FCV-67-172	None.	None. See remarks.	Not applicable.	Not applicable.	None.	None.	During DBE does not effect ERCW safety function.
61.	SIS Pump RM Clr 1A, 1B, 2A, 2B Supply Valves 1-FCV-67-176 1-FCV-67-182 2-FCV-67-176 2-FCV-67-182	Open for ERCW flow to Coolers 1A, 1B, 2A, 2B respectively.	Either one of two (for the affected unit) fails to open or Either one of two recloses.	Electrical or mechanical failure. Mechanical failure or inadvertent actuation.	Status lights 1 & 2-ZS-67-176A, 182A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provide 100% service.	

TABLE 9.2-2 (Sheet 35 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
62.	CS Pump Rm Clr 1A-A, 1B-B, 2A-A, 2B-B Supply Valves 1-FCV-67-184 1-FCV-67-186 2-FCV-67-184 2-FCV-67-186	Open for ERCW flow to Coolers 1A, 1B, 2A, 2Brespectively.	Either one of two (for the affected unit) fails to open	Electrical or mechanical failure.	Status lights 1 & 2-ZS-67-184A, 186A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provide 100% service.	
			or					
			Either one of two recloses	Mechanical failure or inadvertent actuation.				
63.	RHR Pump Rm Clr 1A-A, 1B-B 2A-A, 2B-B Supply Valves 1-FCV-67-188 1-FCV-67-190 2-FCV-67-188 2-FCV-67-190	ERCW flow path to Coolers 1A-A, 1B-B, 2A-A, 2B-B respectively.	Either one of two(for the affected Unit) closes.	Mechanical failure or inadvertent actuation.	Status lights 1 & 2-ZS-67-188A, 190A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two (each unit) coolers provide 100% service.	Administratively locked open with power to their FSV's removed.
64.	Penet Rm Elev 692 ft Crs 1A1, 1B1, 2A1, 2B1 Supply Valves 1-FCV-67-346 1-FCV-67-348 2-FCV-67-346 2-FCV-67-348	Open for ERCW flow to Coolers 1A1, 1B1, 2A1, 2B1respectively.	Either one of two (for the affected unit) fails to open	Electrical or mechanical failure.	Status lights 1 & 2-ZS-67-346A, 348A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two (each unit) coolers provide 100% service.	
			or					
			Either one of two recloses.	Mechanical failure or inadvertent actuation.				

TABLE 9.2-2 (Sheet 36 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
65.	Penet Rm Elev 713 ft Clrs 1A2, 1B2, 2A2, 2B2 Supply Valves 1-FCV-67-350 1-FCV-67-352 2-FCV-67-350 2-FCV-67-352	Open for ERCW flow to Coolers 1A2, 1B2, 2A2, 2B2 respectively.	Either one of two (for the affected unit)fails to open or	Electrical or mechanical failure.	Status lights 1-ZS-67-350A, 352A, 2-ZS-67-350A, 352A respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% service.	
			Either one of two recloses.	Mechanical failure or inadvertent actuation.				
66.	Penet Rm Elev 737 ft Clrs 1A3, 1B3, 2A3, 2B3 Supply Valves 1-FCV-67-354 1-FCV-67-356 2-FCV-67-354 2-FCV-67-356	Open for ERCW flow to Coolers 1A3, 1B3, 2A3, 2B3, respectively.	Either one of four fails to open or	Electrical or mechanical failure.	Status lights 1-ZS-67-354A, 356A, 2-ZS-67-354A, 356A, respectively. No indication for disc-stem connection failure.	None.	None. Either pair of coolers 1A3 and 2A3 or 1B3 and 2B3 provide 100% service.	
			Either one of four recloses.	Mechanical failure or inadvertent actuation.				
67.	Pipe Chase Clr 1A, 1B, 2A, 2B Supply Valves 1-FCV-67-342 1-FCV-67-344 2-FCV-67-342 2-FCV-67-344	Open for ERCW flow to Coolers 1A, 1B, 2A, 2B respectively.	Either one of two (for the affected unit) fails to open or	Electrical or mechanical failure.	Status lights 1 & 2-ZS-67-342A, 344A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% required capacity.	
			Either one of two recloses.	Mechanical failure or inadvertent actuation.				

TABLE 9.2-2 (Sheet 37 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
68.	Emerg Gas treatment Rm Clr 2A, 2B Supply Valves 2-FCV-67-336 2-FCV-67-338	Open for ERCW flow to Coolers 2A, 2B, respectively.	Either one of two fails to open or Either one of two recloses.	Electrical or mechanical failure. Mechanical failure or inadvertent actuation.	Status lights 1 & 2-ZS-67-336A, 338A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% required capacity.	
69.	BA Transf Pump & Aux FW Pump Space Clr 2A, 2B Supply Valves 2-FCV-67-217 2-FCV-67-219	Open for ERCW flow to Coolers 2A, 2B, respectively.	Either one of two fails to open or Either one of two recloses.	Electrical or mechanical failure. Mechanical failure or inadvertent actuation.	Status lights 1-ZS-67-217A, 219A, respectively. No indication for disc-stem connection failure.	None.	None. Either one of two coolers provides 100% required capacity.	
70.	TB Supply Header 1A, 1B, Iso F'fly 0-FCV-67-205	Close on high flow and low pressure to isolate non-essential portion of ERCW system piping.	Either one of two fails to close or Either one of two reopens.	Electrical or mechanical failure. Mechanical failure or inadvertent actuation.	Status lights 0-HS-67-205A, 208A, respectively.	None. Shut down train with failed valve. Operate other train.	None.	
71.	Header 1B to CCS HX A Supply Bfly Valve 1-FCV-67-458-A	Remain closed	Fails open.	Electrical or Mechanical failure or inadvertent actuation.	1-FI-67-222 flow indication.	Interrupts flow to CCS HX A & B. ERCW flow provided to CCS HX C via Header 2B.	None. CCS HX C Provides 100% backup service.	Locked closed with breaker removed.
72.	Emergency Power to Train A, B	Provide power to Train A, B ERCW	Either one of two fails.	Diesel generator mechanical	MCR Indications.	Loss of ERCW system Train A or B,	None. Other train has 100%	Only one of two Trains A or B

TABLE 9.2-2 (Sheet 38 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		system pumps, screens, strainer motors and valve actuators, respectively.		failure or shutdown board failure.		respectively.	ERCW System capability.	required to mitigate DBE.
73.	Passive failure of any one piping system pressure boundary component (i.e., valve body, disc, pump casing. HX tube or shell, etc.) in either train A or B.	Pressure boundary integrity.	Ruptures, leakage, component pressure boundary breaches, etc.	Mechanical failures.	No direct MCR indication available, however various process parameters such as temperature, pressure, flow, etc., will permit monitoring of system performance.	System capability for respective train diminished.	None. Other train has 100% ERCW system capability.	Only one of two Trains A or B required to mitigate DBE.
73a.	Electrical failure of ERCW Train 1B and 2B. ERCW Train 1B ERCW Train 2B	Normal supply to ESF equipment Normal supply to CCS HX C	Cable Tray malfunction	Fire, missile electrical malfunction	High temperature alarm from 0-M-27B	Lose ERCW Train B	None. NO cooling will be provided to CCS HX C, however both CCS HX A and B are available from ERCW Header 2A for cooling Unit 1 and 2, respectively.	CCS HXs A and B are not affected. Thus, they are available and provide 100% cooling capacity.
74.	Electric Board Room A/C Condensers A-A and B-B discharge temperature control valves 0-	Throttles ERCW flow to EBR Bd. Rm. A/C Condensers A-A & B-B	Either valve fails open or	Mechanical failure.	Local indication at EBR chiller skid on low refrigerant suction pressure or low compressor oil pressure. See Remark 1.	None for ERCW. For HVAC, loss of associated EBR chilled water train. Eventual shutdown of associated EBR AHUs upon	None. Standby chilled water train is 100% redundant.	1) MCR annunciation of EBR Air conditioning safety train switchover to standby HVAC/chilled water train due to eventual

TABLE 9.2-2 (Sheet 39 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	TCV-67-1050- A 0-TCV-67-1052-B					switchover to redundant train. None for ERCW. For HVAC, potential loss of associated EBR chilled water train.		temperature increase in conditioned EBR spaces
			fails closed or		Local indication at EBR chiller skid on high refrigerant pressure. See Remark 1.			(2) May behave similar to either fail open or fail closed.
			fails to modulate.		Possible local indication at EBR chiller skid dependent upon severity of condition. See Remark 2.			
75.	Main Control Room A/C condensers A-A & B-B discharge Temperature control valves. 0-TCV-67-1051-A 0-TCV-67-1053-B	Throttles ERCW flow to MCR A/C Condensers A-A & B-B	Either valve fails open or	Mechanical failure.	Local indication at MCR chiller skid on low refrigerant suction pressure or low compressor oil pressure.	None for ERCW. For HVAC, loss of associated MCR chilled water train. Eventual shutdown of associated MCR AHUs upon switchover to redundant train.	None. Standby chilled water train is 100% redundant.	1) MCR annunciation of MCR Air conditioning safety train switchover to standby HVAC/chilled water train due to eventual temperature increase in conditioned MCR spaces.
			fails closed		See Remark 1			

TABLE 9.2-2 (Sheet 40 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			or fails to modulate.		Local indication at MCR chiller skid on high refrigerant pressure. See Remark 1. Possible local indication at MCR chiller skid dependent upon severity of condition. See Remark 2.	None for ERCW. For HVAC potential loss of associated MR chilled water train.		2)May behave similar to either fail open or fail closed.
76.	Auxiliary Control AIr Compressors A & B cooling water supply solenoid cutoff valves. 0-FSV-67-1221-A and 0-FSV-67-1223B	Open for ERCW flow to the ACAC A & B cylinder jackets and after coolers. Valves close when compressors are not running.	Either valves fails open or	Electrical or Mechanical failure.	None. Higher than normal discharger air temperature local indication of 0-TI-32-65 or -92 and high temperature alarm via 0-TS-32-64 or -91 if affected ACAC is running.	See Remarks.	None.	If idle for long periods, potential damage to internal components of affected ACAC due to rust resulting from condensation.
			fails closed	Mechanical failure or inadvertent operation.		Potential loss of affected ACAC due to overheating.	None. Other train available to provide safe shutdown.	
77.	Auxiliary Control Air Compressors A and B cooling water supply pressure control valves. 0-PCV-67-1222	Reduces ERCW pressure to the ACAC A and B cylinder jackets and after coolers.	Either valve fails open or	Mechanical failures.	Visible discharge flow from relief valve 0-RFV-67-971 or -672 if affected ACAC is running.	None.	None.	

TABLE 9.2-2 (Sheet 41 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	and 0-PCV-67-1224		fails closed.		Higher than normal discharge air temperature local indication on 0-TI-32-65 or -92 and high temperature alarm via 0-TS-32-64 or -91 if affected ACAC is running.	Potential loss of affected ACAC due to overheating.	None. Other train available to provide safe shutdown.	
78.	Auxiliary Control Air Compressors A and B cooling water supply pressure control valves. 0-PCV-67-1222A and 0-PCV-67-1224A	Throttles ERCW flow to ACAC A and B cylinder jackets.	Either valve fails open or	Mechanical failure.	Lower than normal local temperature indication on 0-TI-32-65 or -92 if affected ACAC is running.	None.	None.	
			fails closed.		Higher than normal discharge air temperature local indication on 0-TI-32-65 or -92 and high temperature alarm via 0-TS-32-64 or -91 if affected ACAC is running.	Potential loss of affected ACAC due to overheating.	None. Other train available to provide safe shutdown.	
79.	Auxiliary Control Air Compressors A and B cooling water supply pressure control valves.	Throttles ERCW flow to ACAC A and B after coolers.	Either valve fails open or	Mechanical failure.	Lower than normal discharge air temperature local indication o n0-TI-32-65 or -92 if affected ACAC is running.	None.	None.	

TABLE 9.2-2 (Sheet 42 of 42)

ESSENTIAL RAW COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

Item	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	0-TCV-67-1222B and 0-TCV-67-1224B		fails closed.		Higher than normal discharge air temperature local indication of 0-TI-32-65 or -92 if affected ACAC is running.	Potential overheating and loss of air dryers downstream of affected ACAC due to high discharge air temperature.	None. Other train available to provide safe shutdown.	
80.	ERCW Header Cross-Tie Isolation Valves 1-ISV-67-1117 2-ISV-67-1119 1-ISV-67-1118 2-ISV-67-1120	Manual butterfly valves normally closed.	Fails to open.	Mechanically stuck closed.	Low flow alarms 1-FA-67-61, 62	None. Three of four strainers are available to insure either headers 1A and 2A or headers 1B and 2B will be in service to meet plant requirements.	None.	Closed with hand wheel attached.
		Provides ERCW flow path in the event of a strainer malfunction or outage on a given train.	One closes while crosstie is in operation.	Inadvertent closure or mechanical failure.	2-FA-67-61, 62 respectively.	None. Three of four strainers are available to insure either headers 1A and 2A or headers 1B and 2B will be in service to meet plant requirements.	None.	Must put another ERCW train in service to serve isolated unit header.

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TABLE 9.2-3

MOVED TO TABLE 6.3-12

TABLES 9.2-4, 5, 6, and 7

DELETED

TABLE 9.2-8 (Sheet 1 of 2)

COMPONENT COOLING SYSTEM
COMPONENT DESIGN DATA

Component Cooling Pumps (Note 1)	
Quantity	5
Type	Horizontal centrifugal
Rated capacity, gpm, each	6000 gpm*
Rated head, ft water	190*
Motor horsepower, hp	350
Casing material	Cast steel
Design pressure, psig	150
Design temperature, °F	200
Thermal Barrier Booster Pumps	
Quantity	2
Type	Horizontal centrifugal
Rated Capacity, gpm, each	160*
Rated head, ft water	130*
Motor horsepower, hp	10
Casing material	Cast steel (SS 316)
Design pressure, psig	200
Design temperature, °F	200
Surge Tanks	
Number	2
Design pressure	
Internal, psig	33 psig
External, psig	vacuum breaker provided
Design temperature, °F	200
Total volume, gal	12,000
Normal water volume, gal	6,900 (minimum)
Fluid	Component cooling water (Demineralized Water)
Material	Carbon steel

TABLE 9.2-8 (Sheet 2 of 2)

COMPONENT COOLING SYSTEM
COMPONENT DESIGN DATA

Heat Exchangers	
Quantity	3
Type	Shell and tube
Heat transferred, BTU/hr, each; normal operating condition Unit 1	64.3×10^6
Shell side (component cooling water) Inlet temperature, °F	109.3
Outlet temperature, °F	95.0
Flow rate, lb/hr	4.5×10^6
Design temperature, °F	200
Design pressure, psig	150
Shell material	ASME SA 516 Grade 70
Tube side (essential raw cooling water)	
Inlet temperature, °F	85
Outlet temperature, °F	95.7
Seal Leakage Collection Station	
Quantity	1 Tank w/ 2 pumps
Pump type	Regenerative turbine (horizontal)
Rated capacity, gpm, each	10
Rated head, ft water	150
Motor horsepower, hp	1.5
Pump casing material	Cast iron
Tank capacity, gal	180
Tank material	Carbon steel
Design pressure, psig	150
Design temperature, °F	200

*During preoperational testing of the component cooling system (CCS) pumps and thermal barrier booster pumps, the pumps did not meet vendor pump performance curves. This was due mainly to the instrument inaccuracies factored into both the flow and head measurements for the data points. A review of the CCS hydraulic losses calculation has determined that even with the instrument inaccuracies factored in, the CCS pumps will still exceed the CCS hydraulic performance requirements on the pumps.

Note 1 (Unit 2 Only): The rated capacity of 6000 gpm at 190 feet of head provided in this table are the original design point for the Component Cooling Pumps. However, each pump is capable of providing a flow of 8650 gpm at 128.4 feet of head.

TABLE 9.2-9 (Sheet 1 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
A	CONTAINMENT ISOLATION							
A-1	1-FCV-70-85	Containment Isolation Penetration No. X-35	Fails to close	Mechanical failure	1-HS-70-85A status lights	Single failure	None. Inside containment is a closed system	Containment integrity is maintained. Valve is normally closed.
2A-1	2-FCV-70-85	Containment Isolation Penetration No. X-35	Fails to close	Mechanical failure	2-HS-70-85A status lights	Single failure	None. Inside containment is a closed system	Containment integrity is maintained. Valve is normally closed.
A-2	1-FCV-70-143	Containment Isolation Penetration No. X-53	Fails to close	Power supply, electric or mechanical failure	1-HS-70-143A status lights	Single failure	None. Inside containment is a closed system	Containment integrity is maintained. Valve is normally closed.
2A-2	-FCV-70-143	Containment Isolation Penetration No. X-53	Fails to close	Power supply, electric or mechanical failure	2-HS-70-143A status lights	Single failure	None. Inside containment is a closed system	Containment integrity is maintained. Valve is normally closed.
A-3	1-RFV-70-703	Relieve high pressure in piping to and from Excess Letdown HX inside containment due to tube leakage or failure of CVCS isolation valves	See "Effect On System" Column	Mechanical failure	None	None. Tube leakage or CVCS iso. valve failure constitutes the single failure. 1-RFV-70-703 will lift on overpressure	None	None
2A-3	2-RFV-70-703	Relieve high pressure in piping to and	See "Effect On System" Column	Mechanical failure	None	None. Tube leakage or CVCS iso.	None	None

TABLE 9.2-9 (Sheet 2 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		from Excess Letdown HX inside containment due to tube leakage or failure of CVCS isolation valves				valve failure constitutes the single failure. 2-RFV-70-703 will lift on overpressure		
A-4	1-FCV-70-87	Containment Isolation Penetration No. X-50A	Fails to close	Power supply, electric or mechanical failure	1-HS-70-87A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-90	Containment integrity is maintained. Valve is normally closed.
2A-4	2-FCV-70-87	Containment Isolation Penetration No. X-50A	Fails to close	Power supply, electric or mechanical failure	2-HS-70-87A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-90	Containment integrity is maintained. Valve is normally closed.
A-5	1-FCV-70-90	Containment Isolation Penetration No. X-50A	Fails to close	Power supply, electric or mechanical failure	1-HS-70-90A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-87 & 1-RFV-70-687	Containment integrity is maintained
2A-5	2-FCV-70-90	Containment Isolation Penetration No. X-50A	Fails to close	Power supply, electric or mechanical failure	2-HS-70-90A status lights	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-87	Containment integrity is maintained

TABLE 9.2-9 (Sheet 3 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
A-6	1-RFV-70-687	Containment Isolation Penetration No. X-50A	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by valve 1-FCV-70-90	Containment integrity is maintained (See Note 1).
			Fails to Open	Mechanical Failure	None	Single Failure	If isolation valves 1-FCV-70-87 and 1-FCV-70-90 close and are leak tight, a line failure could occur between the two isolation valves. See Remarks	
2A-6	2-CKV-70-687	Containment Isolation Penetration No. X-50A	Fails to Close	Mechanical Failure	None	Single Failure	None, isolation will be achieved by redundant valve 2-FCV-70-90.	Containment integrity is maintained (See Note 1)
A-7	1-FCV-70-89	Containment Isolation Penetration No. X-29	Fails to close	Power supply, electric or mechanical failure	1-HS-70-89A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-92 & 1-RFV-70-698	Containment integrity is maintained.
2A-7	2-FCV-70-89	Containment Isolation Penetration No. X-29	Fails to close	Power supply, electric or mechanical failure	2-HS-70-89A status lights	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-	Containment integrity is maintained.

TABLE 9.2-9 (Sheet 4 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
							70-92	
A-8	1-FCV-70-92	Containment Isolation Penetration No. X-29	Fails to close	Power supply, electric or mechanical failure	1-HS-70-92A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-89	Containment integrity is maintained.
2A-8	2-FCV-70-92	Containment Isolation Penetration No. X-29	Fails to close	Power supply, electric or mechanical failure	2-HS-70-92A status lights	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-89 and manual isolation of a downstream valve. See Remarks.	The line inside containment upstream of 2-FCV-70-89 is not protected from a HELB. Thermal relief check valve 2-CKV-70-698 around 2-FCV-70-89 will allow backflow into containment. Action is required to manually isolate valve 2-ISV-70-700 downstream of 2-FCV-70-92.
A-9	1-RFV-70-698	Containment Isolation Penetration No. X-29	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-89	Containment integrity is maintained (See Note 1).

TABLE 9.2-9 (Sheet 5 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Fails to open	Mechanical Failure	None	Single failure	If isolation valves 1-FCV-70-89 and 1-FCV-70-92 close and are leak tight, a line failure could occur between the two isolation valves. See Remarks.	Containment integrity is maintained because the break would occur between the two leak tight FCVs.
2A-9	2-CKV-70-698	Containment Isolation Penetration No. X-29	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-89	Containment integrity is maintained (See Note 1).
A-10	1-FCV-70-100	Containment Isolation Penetration No. X-52	Fails to close	Power supply, electric or mechanical failure	1-HS-70-100A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-140 & 1-RFV-70-790	Containment integrity is maintained.
2A-10	2-FCV-70-100	Containment Isolation Penetration No. X-52	Fails to close	Power supply, electric or mechanical failure	2-HS-70-100A status lights	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-140	Containment integrity is maintained.

TABLE 9.2-9 (Sheet 6 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
A-11	1-FCV-70-140	Containment Isolation Penetration No. X-52	Fails to close	Power supply, electric or mechanical failure	1-HS-70-140A status lights	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-100.	Containment integrity is maintained.
2A-11	2-FCV-70-140	Containment Isolation Penetration No. X-52	Fails to close	Power supply, electric or mechanical failure	2-HS-70-140A status lights	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-100 and manual isolation of an upstream valve. See Remarks.	The line inside containment downstream of 2-FCV-70-100 is not protected from a HELB. Thermal relief check valve 2-CKV-70-790 around 2-FCV-70-100 will allow flow to enter containment. Action is required to manually isolate valve 2-ISV-70-516 upstream of 2-FCV-70-140.
A-12	1-RFV-70-790	Containment Isolation Penetration No. X-52	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by valve 1-FCV-70-100	Containment integrity is maintained (See Note 1)
			Fails to open	Mechanical Failure	None	Single failure	If isolation valves 1-FCV-70-100 and 1-FCV-70-140 close and are	Containment integrity is maintained because the break would occur between the two leak tight

TABLE 9.2-9 (Sheet 7 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
							leak tight, a line failure could occur between the two isolation valves. See Remarks.	FCVs.
2A-12	2-CKV-70-790	Containment Isolation Penetration No. X-52	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by valve 2-FCV-70-140	Containment integrity is maintained (See Note 1)
A-13	1-FCV-70-133	Prevention of inleakage of unborated CCS water into containment	Fails to close	Power supply, electric or mechanical failure	1-HS-70-133A status lights	Single failure	None. Inleakage prevention will be achieved by redundant valve 1-FCV-70-134	None
2A-13	2-FCV-70-133	Prevention of inleakage of unborated CCS water into containment	Fails to close	Power supply, electric or mechanical failure	2-HS-70-133A status lights	Single failure	None. Inleakage prevention will be achieved by redundant valve 2-FCV-70-134	None
A-14	1-FCV-70-134	Containment Isolation Penetration No. X-50B and	Fails to close	Power supply, electric or mechanical failure	1-HS-70-134A status lights	Single failure for both functions	None. Isolation will be maintained by redundant valve 1-CKV-	Containment integrity is maintained

TABLE 9.2-9 (Sheet 8 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		prevention of inleakage of unborated CCS water into containment					70-679 and inleakage prevention will be achieved by redundant valve 1-FCV-70-133.	
2A-14	2-FCV-70-134	Containment Isolation Penetration No. X-50B and prevention of inleakage of unborated CCS water into containment	Fails to close	Power supply, electric or mechanical failure	2-HS-70-134A status lights	Single failure for both functions	None. Isolation will be maintained by redundant valve 2-CKV-70-679 and inleakage prevention will be achieved by redundant valve 2-FCV-70-133.	Containment integrity is maintained
A-15	1-CKV-70-679	Containment Isolation Penetration No. X-50B	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant valve 1-FCV-70-134	Containment integrity is maintained
2A-15	2-CKV-70-679	Containment Isolation Penetration No. X-50B	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant valve 2-FCV-70-134	Containment integrity is maintained

TABLE 9.2-9 (Sheet 9 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
A-16	1-RFV-70-835	Over pressure protection of L.P. piping of CCS supply to RCP thermal barrier HX.	Fails closed	Mechanical failure	Flow transmitters 1-FT-70-95, -105, -115, -124, -81B, or -81E (any one or combination)	None. Tube leakage or CVCS isolation valve failure constitutes the single failure (failure of this valve need not be considered).	None	If this valve failed open, containment integrity is still ensured because leakage is into containment. If the valve failed closed and the system did overpressurize, again leakage is into containment. Leakage into

TABLE 9.2-9 (Sheet 10 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Fails Open			None, inleakage isolated by FCVs (see remarks)		
2A-16	2-RFV-70-835	Over pressure protection of L.P. piping of CCS supply to RCP thermal barrier HX.	Fails closed	Mechanical failure	Flow transmitters 2-FT-70-95, -105, -115, -124, -81B, or -81E (any one or combination)	None. Tube leakage or CVCS isolation valve failure constitutes the single failure (failure of this valve need not be considered).	None	If this valve failed open, containment integrity is still ensured because leakage is into containment. If the valve failed closed and the system did overpressurize, again leakage is into containment. Leakage into containment would be limited by closure of either 2-FCV-70-133 or -134 and -87 (with 2-CKV-70-687) or -90.
			Fails Open			None, inleakage isolated by FCVs (see remarks)		

TABLE 9.2-9 (Sheet 11 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
B	COOLING WATER TO EQUIPMENT FOR SAFE SHUTDOWN							
B-1	1-FCV-70-153	Supply water to RHR HX 1B-B	Fails Closed	Power supply, mechanical or electrical failure	Alarm with 1-HS-70-153A status lights or low flow alarm if stem or disc separation.	Supply to HX 1B-B is lost. Supply to HX 2B-B is Unchanged.	None. Redundant RHR HX 1A-A will provide heat removal capability	Safe shutdown function is achieved with one HX. (A Train)
			Fails Open			Supply to HX 1B-B increases and supply to 2B-B remains unchanged.		
			Fails Throttled			Supply to either HX 1B-B and 2B-B remains unchanged.		
2B-1	2-FCV-70-153	Supply water to RHR HX 2B-B	Fails Closed	Power supply, mechanical or electrical failure	Alarm with 2-HS-70-153A status lights or low flow alarm if stem or disc separation.	Supply to HX 2B-B is lost. Supply to 1B-B remains unchanged.	None. Redundant RHR HX 2A-A will provide heat removal capability	Safe shutdown function is achieved with one HX. (A Train)

TABLE 9.2-9 (Sheet 12 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Fails Open			Supply to HX 2B-B increases and supply to 1B-B remains unchanged.		
			Fails Throttled			Supply to either HX 2B-B and 1B-B remains unchanged.		
B-2	1-FCV-70-156	Supply water to RHR HX 1A-A	Fails to open	Power supply, mechanical or electrical failure	Alarm with 1-HS-70-156A status lights or low flow alarm if stem or disc separation	Supply to HX 1A-A is stopped	None. Redundant RHR HX 1B-B will provide heat removal capability	Safe shutdown function is achieved with one HX
2B-2	2-FCV-70-156	Supply water to RHR HX 2A-A	Fails to open	Power supply, mechanical or electrical failure	Alarm with 2-HS-70-156A status lights or low flow alarm if stem or disc separation	Supply to HX 2A-A is stopped	None. Redundant RHR HX 2B-B will provide heat removal capability	Safe shutdown function is achieved with one HX
B-3	0-FCV-70-194	Supply water to Spent Fuel Pit HX-B	Fails to open	Power supply, mechanical or electrical failure	0-HS-70-194A status lights or low flow alarm if stem or disc separation	Supply to HX B is stopped	None, 0-FCV-70-197 will supply water to redundant Spent Fuel Pit HX A.	Safe shutdown function is achieved with one HX

TABLE 9.2-9 (Sheet 13 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
B-4	0-FCV-70-197	Supply water to Spent Fuel Pit HX-A	Fails to open	Power supply, mechanical or electrical failure	0-HS-70-197A status lights or low flow alarm if stem or disc separation	Supply to HX A is stopped	None, 0-FCV-70-194 will supply water to redundant Spent Fuel Pit HX B.	Safe shutdown function is achieved with one HX
C	CCS PUMPS							
C-1	CCS Pump 1A-A (1-PMP-70-46)	Supply water to Train 1A	Fails to operate	Power supply, electrical or mechanical failure	1-HS-70-46A status lights low header. pressure alarm	Flow from Pump 1A-A is lost	None. Redundant CCS Pump 1B-B will start on low pressure	Safe shutdown function is achieved from redundant pump
C-2	CCS Pump 1B-B (1-PMP-70-38)	Supply water to Train 1A	Pump Fails to operate	Power supply, electrical or mechanical failure	1-HS-70-38A status lights low header. pressure	Flow from Pump 1B-B is lost	None. Redundant CCS Pump 1A-A will start on low pressure	Safe shutdown function is achieved from redundant pump
			Pump Fails to operate	Power supply, electrical or mechanical failure	1-HS-70-38A status lights low header. pressure	Flow from Pump 1B-B is lost	None. Redundant CCS Trains 1A & 2A will continue to support CCS safety function (See Note 2).	Safe shutdown function capability is available from CCS Trains 1A and 2A.
C-3	CCS Pump C-S (0-PMP-70-51)	Supply water to Train 1B/2B	Pump Fails to operate	Power supply, electrical or mechanical failure	1-HS-70-51A status lights	Flow from Pump C-S is lost	None. Redundant CCS Pump 1B-B can supply water to Train B.	Safe shutdown function is achieved from redundant pump
2C-3A	Pump 2B-B (2-PMP-70-	Supply water to Train 2A	Pump Fails to Operate	Power supply, electrical or mechanical	1-HS-7-033A status lights, low header	Flow from 1B-B is lost	None, redundant CCS Pump 2A-A will	Safe shutdown function is achieved from redundant

TABLE 9.2-9 (Sheet 14 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	33)			failure	pressure alarm		start on low pressure.	pump.
		Supply water to CCS Train 1B/2B as replacement or supplement for CCS pump C-S	Pump Fails to Operate	Power Supply, electrical or mechanical failure	2-HS-70-33A status lights, low header pressure alarm	Flow from 2B-B is lost	None, redundant CCS Trains 1A & 2A will continue to support CCS safety function (See Note 2).	Safe shutdown function capability is available from CS Trains 1A and 2A.
2C-3B	Pump 2A-A (2-PMP-70-59)	Supply water to Train 2A	Pump Fails to Operate	Power supply, electrical or mechanical Failure	2-HS-70-59A status lights, low header pressure alarm	Flow form 2A-A is lost	None, redundant CS Pump 2B-B will start on low pressure.	Safe shutdown function is achieved from redundant pump.
C-4	1-CKV-70-504A	Prevent backflow to CCS Pump 1A-A when pump is not operating	Fails to close	Mechanical failure	Low header. press alarm	Train A header pressure may be low	None. Manual isolation valve 1-ISV-70-505A will be closed. Pump 1B-B or C-S will continue to operate.	Safe shutdown function is not affected.
C-5	1-CKV-70-504B	Prevent backflow to CCS Pump 1B-B when pump is not operating	Fails to close	Mechanical failure	Low header. pressure alarm	Train A header pressure may be low	None. Manual isolation valve 1-ISV-70-505B will be closed. Pump 1A-A or C-S will continue to operate.	Shutdown function is not affected
C-6	0-CKV-70-504	Prevent backflow to	Fails to close	Mechanical failure	None	Train B header	None. Manual isolation valve	Shutdown function is not affected.

TABLE 9.2-9 (Sheet 15 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		CCS Pump C-S when pump is not operating				pressure may be low	0-ISV-70-505 will be closed. Pump 1A-A2A-A or 1B-B/2B-B will continue to operate.	
2C-6A	0-CKV-70-504A	Prevent backflow to CCS Pump 2A-A when pump is not operating	Fails to close	Mechanical failure	Low header pressure alarm	Train A header pressure may be low	None. Manual isolation valve 2-ISV-70-505A will be closed. Pump 2B-B or C-S will continue to operate.	Shutdown function is not affected.
C-7	2-CKV-70-504B	Prevent backflow to CCS Pump 2B-B when pump is not operating	Fails to close	Mechanical failure	Low header pressure alarm	Train A header may be low	None. Manual isolation valve 2-ISV-70-505B will be closed. Pump 2A-A or C-S will continue to operate.	Safe Shutdown function is not affected.
D	SAFETY/NONSAFETY ISOLATION							
D-1	1-FCV-70-183	Isolate break in class ‘G’ piping. to Sample HXs and Chiller on high flow differential from 1-FE-70-215A and B and/or low Surge Tank. level at 1-LT-	Fails to close	Power supply, electrical or mechanical failure	1-HS-70-183A status lights low level alarm	Loss of inventory from Train 1A portion of the Surge Tank	None. Train 1B portion of a Surge Tank is still intact, supporting Train B of CCS	Safe shutdown is achieved by redundant Train B.

TABLE 9.2-9 (Sheet 16 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		70-63						
2D-1	2-FCV-70-183	Isolate break in class ‘G’ piping. to Sample HXs and Chiller on high flow differential from 2-FE-70-215A and B and/or low Surge Tank. level at 2-LT-70-63	Fails to close	Power supply, electrical or mechanical failure	2-HS-70-183A status lights low level alarm	Loss of inventory from Train 1A portion of the Surge Tank	None. Train 2B portion of a Surge Tank is still intact, supporting Train B of CCS	Safe shutdown is achieved by redundant Train B.
D-2	1-FCV-70-215	Isolate break in class ‘G’ piping. to Sample HX's and Chiller on signal that valve 1-FCV-70-183 has closed.	Fails to close	Power supply, electrical or mechanical failure	Low level alarm	Potential loss of inventory from train 1A portion of the Surge Tank	None. Train 1B portion of the Surge Tank is still intact, supporting Train B of CCS	Safe shutdown is achieved by redundant Train B.
2D-2	2-FCV-70-215	Isolate break in class ‘G’ piping. to Sample HX's and Chiller on signal that valve 2-FCV-70-183 has closed.	Fails to close	Power supply, electrical or mechanical failure	Low level alarm	Potential loss of inventory from train 2A portion of the Surge Tank	None. Train 2B portion of the Surge Tank is still intact, supporting Train B of CCS	Safe shutdown is achieved by redundant Train B.
E	HIGH PRESSURE PIPING ISOLATION							

TABLE 9.2-9 (Sheet 17 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
E-1	1-CKV-70-681A	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-682A	None
2E-1	2-CKV-70-681A	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-682A	None
E-2	1-CKV-70-682A	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-681A	None
2E-2	2-CKV-70-682A	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-681A	None
E-3	1-CKV-70-681B	Prevent backflow of high pressure RCS fluid into low pressure	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-682B	None

TABLE 9.2-9 (Sheet 18 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		CCS Piping (See Note 4)						
2E-3	2-CKV-70-681B	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-682B	None
E-4	1-CKV-70-682B	Prevent backflow of high pressure RCS fluid into low pressure CCS piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-681B	None
2E-4	2-CKV-70-682B	Prevent backflow of high pressure RCS fluid into low pressure CCS piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-681B	None
E-5	1-CKV-70-681C	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-682C	None
2E-5	2-CKV-70-681C	Prevent backflow of high pressure	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant	None

TABLE 9.2-9 (Sheet 19 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		RCS fluid into low pressure CCS Piping (See Note 4)					check valve 2-CKV-70-682C	
E-6	1-CKV-70-682C	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-681C	None
2E-6	2-CKV-70-682C	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-681C	None
E-7	1-CKV-70-681D	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-682D	None
2E-7	2-CKV-70-681D	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-682D	None

TABLE 9.2-9 (Sheet 20 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
E-8	1-CKV-70-682D	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 1-CKV-70-681D	None
2E-8	2-CKV-70-682D	Prevent backflow of high pressure RCS fluid into low pressure CCS Piping (See Note 4)	Fails to close	Mechanical failure	None	Single failure	None. Isolation will be achieved by redundant check valve 2-CKV-70-681D	None
F	SURGE TANK MAKE-UP							
F-1	1-LCV-70-63	Isolate Surge Tank upon demineralized water line break	Fails to close	Mechanical failure	1-HS-70-63A status lights high level alarm.	Single failure	None. Backflow will be prevented by valve 1-CKV-70-541	Failure to close without a Demineralized. Water line break occurring would result in tank overflow to LWDS which would not affect safe shutdown function.
		Provide make-up to CCS Surge Tank	Fails to Open	Pneumatic or Mechanical Failure	1-HS-70-63A status lights high level alarm.	Make-up to Surge Tank is lost.	None, CCS Pump C-S may take suction from Train 2B portion of Unit 2 Surge Tank.	Upon a failure to open, if closed, the opposite units B Train CCS Surge Tank Outlet Isolation Valve (1, 2-ISV-70-544B) shall be opened.

TABLE 9.2-9 (Sheet 21 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
2F-1	2-LCV-70-63	Isolate Surge Tank upon demineralized water line break	Fails to close	Mechanical failure	2-HS-70-63A status lights high level alarm.	Single failure	None. Backflow will be prevented by valve 2-CKV-70-541	Failure to close without a Demineralized. Water line break occurring would result in tank overflow to LWDS which would not affect safe shutdown function.
		Provide make-up to CCS Surge Tank	Fails to Open	Pneumatic or Mechanical Failure	2-HS-70-63A status lights high level alarm.	Make-up to Surge Tank is lost.	None, CCS Pump C-S may take suction from Train 1B portion of Unit 1 Surge Tank.	Upon a failure to open, if closed, the opposite units B Train CCS Surge Tank Outlet Isolation Valve (1, 2-ISV-70-544B) shall be opened.
F-2	1-CKV-70-541	Prevent backflow of water from Surge Tank	Fails to close	Mechanical failure	None	Single failure	None. Backflow will be prevented by valve 1-LCV-70-63	None
2F-2	2-CKV-70-541	Prevent backflow of water from Surge Tank	Fails to close	Mechanical failure	None	Single failure	None. Backflow will be prevented by valve 2-LCV-70-63	None
G	SURGE TANK RADIATION RELEASE							
G-1	1-FCV-70-66	Surge Tank Vent to isolate tank	See 'Effect on System' column	Mechanical failure	1-HS-70-66A status lights	None. Radiation detected in	None	None

TABLE 9.2-9 (Sheet 22 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		when radiation detected in system				system caused by tube break constitutes the single failure 1-FCV-70-66 will close on detection of radiation.		
		Surge Tank vent to atmosphere	Fails to open	Pneumatic or mechanical failure	1-HS-70-66A status lights	Surge tank may be pressurized. However, Relief Valve 1-RFV-70-538 protects the CCS from overpressure	None	
2G-2	2-FCV-70-66	Surge Tank Vent to isolate tank when radiation detected in system	See 'Effect on System' column	Mechanical failure	2-HS-70-66A status lights	None. Radiation detected in system caused by tube break constitutes the single failure 2-FCV-70-66 will close on detection of radiation.	None	None
		Surge Tank	Fails to open	Pneumatic or	2-HS-70-66A	Surge tank	None	

TABLE 9.2-9 (Sheet 23 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		vent to atmosphere		mechanical failure	status lights	may be pressurized. However, Relief Valve 2-RFV-70-538 protects the CCS from overpressure		
G-3	1-RFV-70-538	Relieve overpressure in the Surge Tank	See 'Effect On System' column	Mechanical failure	None	None. Over-pressurization in system caused by tube break constitutes the single failure. 1-RFV-70-538 will relieve over-pressure in the Surge Tank.	None	None
2G-4	2-RFV-70-538	Relieve over-pressure in the Surge Tank	See ‘Effect on System’ column.	Mechanical Failure	None	None, over-pressureization in system caused by tube break constitutes the single failure. 2-RFV-70-538 will relieve over-	None	None

TABLE 9.2-9 (Sheet 24 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
						pressure in the Surge Tank.		
G-5	CCS Equipment Various coolers	Varies	Passive failure tube leak	Mechanical failure	High level alarm or high radiation alarm	Potential radiation present in the system and/or increase in system volume.	None. The Surge Tank Vent valve 1-FCV-70-66 will close, preventing radiation release to atmosphere	None
2G-5	CCS Equipment Various coolers	Varies	Passive failure tube leak	Mechanical failure	High level alarm or high radiation alarm	Potential radiation present in the system and/or increase in system volume.	None. The Surge Tank Vent valve 2-FCV-70-66 will close, preventing radiation release to atmosphere	None
G-6	1-RFV-70-539	Vacuum Relief for CCS Surge Tank A	Failure to open	Mechanical failure	Decrease in water level in Tank B (Unit 2).	None	None, reduced pressure in surge tank will result in water from Tank B being drawn into Tank A to equalize the pressure. If pressure in	System out-leakage concurrent with the closure of companion valve 1, 2-FCV-70-66 would be the initiator for pulling a vacuum on the CCS Surge Tanks. All out-leakage is bounded by the largest break in the Moderate

TABLE 9.2-9 (Sheet 25 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
							Tank B drops below the setpoint, 2-RFV-70-539 will open.	Energy Line Break Calculation, WBNOSG4099. Since the CCS Line breaks are described as capable of being isolation within 60 minutes of the initiating event and a passive failure of a component is not assumed within 24 hours following the initiating event, the failure of the vacuum relief is not credible during the bounding event.
2G-7	2-RFV-70-539	Vacuum Relief for CCS Surge Tank B	Failure to open	Mechanical failure	Decrease in water level in Tank A (Unit 1).	None	None, reduced pressure in surge tank will result in water from Tank A being drawn into Tank B to equalize the pressure. If pressure in Tank A drops below the setpoint, 1-RFV-70-539 will open.	System out-leakage concurrent with the closure of companion valve 1, 2-FCV-70-66 would be the initiator for pulling a vacuum on the CCS Surge Tanks. All out-leakage is bounded by the largest break in the Moderate Energy Line Break Calculation, WBNOSG4099. Since the CCS Line breaks are described as capable of being isolation within 60

TABLE 9.2-9 (Sheet 26 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								minutes of the initiating event and a passive failure of a component is not assumed within 24 hours following the initiating event, the failure of the vacuum relief is not credible during the bounding event.
H	EMERGENCY POWER							
H-1	Emergency Power to Train A	Provide power to pump A motor and all MOVs in Train A	Fails	Diesel generator shutdown board 1A-A failure	Control room indication	CCS Train A is lost	None. Two 100% capacity trains are provided.	Only one train is required to mitigate accident consequences. Equipment realignments are required.
H-2	Emergency Power to Train B	Provide power to pump B motor and all MOVs in Train B	Fails	Diesel generator shutdown board 1B-B failure	Control room indication	CCS Train B is lost	None, two 100% capacity trains are provided.	Only one train is required to mitigate accident consequences. Equipment realignments are required.
I	PASSIVE FAILURE							
I-1	Piping System (Valve body, disc, pump casing, HX shell, etc.)	Varies	Ruptures, leakages disc separation, etc.	Mechanical failure	Various process parameters; pressure, temperature, flow, etc.	System capability diminished	None, two 100% capacity trains are provided.	Only one train is required to mitigate the accident consequences.

TABLE 9.2-9 (Sheet 27 of 27)

COMPONENT COOLING WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

ITEM NO.	COMPONENT	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
NOTE 1: Primary function of the valve is to relieve pressure generated by expanding liquid trapped between isolation valves. Failure of a check valve to open is not considered to be credible.								
NOTE 2 If CCS Pump 1B-B is used to supply water to Train 1B/2B, opening of locked closed valves 1-FCV-70-26, 27, 64 & 74 and closing of locked open valve 1-FCV-70-34 will be required.								
NOTE 3 If CCS Pump 2B-B is used to supply water to Train 1B/2B, opening of locked closed valves 2-FCV-70-28, 29, 76 & 78 and closing of locked open valve 2-FCV-70-39 will be required.								
NOTE 4: This evaluation is based on the assumption that RCP thermal barrier tube break has occurred causing the high pressure RCS to pressurize the low pressure CCS.								

TABLE 9.2-10

COMPONENT COOLING SYSTEM CODE REQUIREMENTS

	TVA Class [1]	Design Code
Heat exchangers	C	ASME III, Class 3
Surge Tanks	C	ASME III, Class 3
Pumps	C	ASME III, Class 3
System piping	B&C	ASME III, Class 2 and Class 3
Valves	B&C	ASME III, Class 2 and Class 3
Seal leakage return unit (Excluding Pumps)	L	Unclassified
Piping to sample heat exchangers and sample chiller package	C&G	ASME III, Class 3 and ANSI B31.1
Seal leakage return pumps	G	Manufacturer's Standards
Sample Cooler/Chiller piping and valves	G	ANSI B31.1

[1] TVA classes are defined in Section 3.2

TABLE 9.2-11

RAW COOLING WATER SYSTEM PUMP DESIGN DATA

Number of Pumps	8
Type	Vertical Turbine
Rated Capacity (gpm)	5135

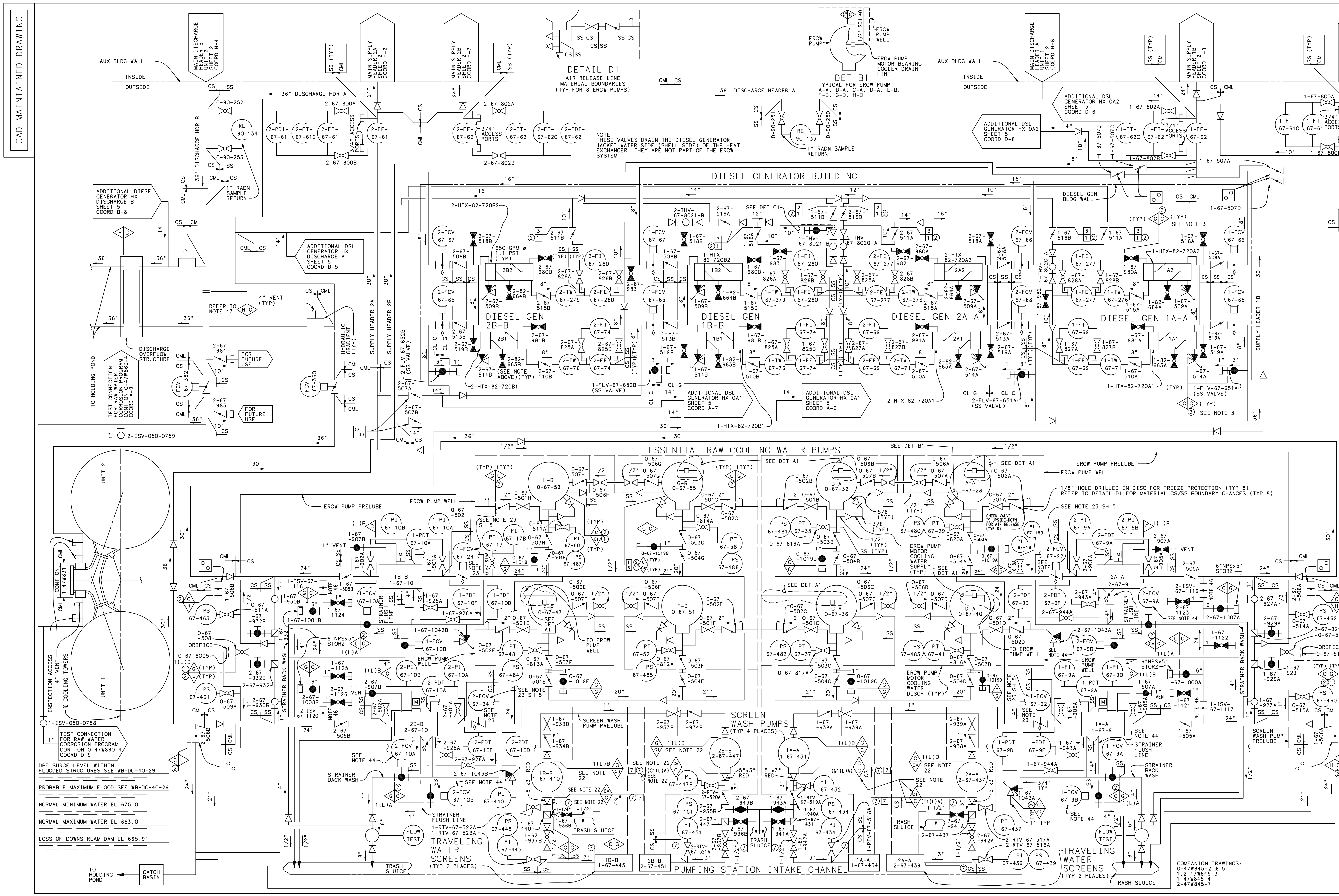
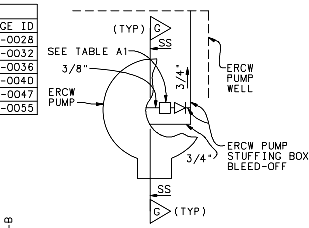


TABLE A1	
ERCW PUMP	FLOW GAGE ID
A-A	0-FG-067-0028
B-A	0-FG-067-0032
C-A	0-FG-067-0036
D-A	0-FG-067-0040
E-B	0-FG-067-0047
G-B	0-FG-067-0055



DETAIL A1
TYPICAL FOR ERCW PUMP
A-A, B-A, C-A, D-A, E-B, G-B

NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
2. EXPLANATION OF VALVE AND INSTRUMENT NUMBERS.

INSTRUMENT NO.	1- (UNIT)	FE- (TYPE)	67- (SYSTEM)	100 (INSTRUMENT NO.)
VALVE NO.	1- (UNIT)	FCV- (FUNCTION)	67- (SYSTEM)	100 (VALVE NO.)

3. SOURCE NOTE NCR SWP79-W-3 REPORT.
4. MAIN PROCESS SYSTEM VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
5. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
6. ALL PIPING AND VALVES ARE TVA CLASS B FOR CONTAINMENT ISOLATION AND REMAINDER OF SYSTEM PIPING AND VALVES TVA CLASS C, EXCEPT AS NOTED ON DIAGRAM. INSTRUMENT TAKEOFFS ARE SAME CLASS AS HEADERS THROUGH FIRST VALVE.
7. ALL TEST CONNECTIONS (TC) AND TEST VENT CONNECTIONS (TV) ARE 1/2" UNLESS OTHERWISE NOTED.
8. PIPING DESIGN TEMPERATURE IS 130°F.
9. FOR VALVE MARKER TAG LIST SEE WATTS BAR MECHANICAL VALVE PROGRAM RPT-009 & 010.
10. [1|3] THIS SYMBOL DENOTES A DESIGN PRESSURE BOUNDARY: 1=160 PSIG; 2=50 PSIG; 3=35 PSIG; 4=150 PSIG; 5=80 PSIG; 6=100 PSIG; 7=220 PSIG; 8=75 PSIG; 9=145 PSIG.
11. ⟨C|G⟩ DENOTES TVA CLASS BOUNDARIES. THE ACTUAL POINT OF PIPING CLASS INSTALLATION IS DENOTED ON 47W450, 37W206 AND 17W302 DRAWING SERIES AND WILL NOT BE LESS THAN DENOTED ON 1-, 2-47W845 SERIES.
12. (2)(1) DENOTES THE HYDROSTATIC TEST PRESSURE. CONSTRUCTION SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENT TO THE HYDROSTATIC TEST. ASME CODE CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN-DES APPROVES THEIR APPLICATION. PRESSURE BOUNDARIES ARE AT THE VALVE SEAT EVEN THOUGH THEY MAY BE SHOWN AT THE VALVE WELD. UNLESS OTHERWISE NOTED, DISCHARGE PIPING OPEN TO THE ATMOSPHERE DOWNSTREAM OF THE LAST ISOLATION VALVE IS EXEMPT FROM HYDROSTATIC TESTING IN ACCORDANCE WITH ASME CODE CASE N-240. 1=240 PSIG, 2=200 PSIG, 3=75 PSIG, 4=62.5 PSIG, 5=30 PSIG, 6=43.75 PSIG, 7=330 PSIG, 8=112.5 PSIG. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
13. THE COOLERS, CHILLERS AND ASSOCIATED EQUIPMENT IN THE AUXILIARY BUILDING ARE QUALIFIED AS SEISMIC CATEGORY 1, PER WB-DC-40-31.2 OR SEISMIC CATEGORY 1(L) PER WB-DC-40-31.13 , TO MAINTAIN THE ERCW PRESSURE BOUNDARY DURING AND AFTER A SAFE SHUTDOWN EARTHQUAKE (SSE). ALL PRIMARY SAFETY-RELATED COOLERS ARE QUALIFIED AS SEISMIC CATEGORY 1 PER WB-DC-40-36.1. (C✱) ON THESE DRAWINGS INDICATES THE DESIGNATION "VENDOR SUPPLIED SAFETY RELATED EQUIPMENT PACKAGES" WHICH MEET THE REQUIREMENTS DEFINED ON 47B21-1 & -1A. THE ERCW DRAIN LINES ASSOCIATED WITH THE MAIN CONTROL ROOM AND ELECTRIC BOARD ROOM CHILLERS FROM THE CHILLER THROUGH THE DRAIN VALVES WERE ORIGINALLY PROVIDED AND INSTALLED AS CLASS M BUT SHOULD BE CONSIDERED C* FOR FUTURE REPLACEMENT WITH TVA CLASS C MATERIAL. (Y) INDICATES SEISMIC CATEGORY 1 (L)B WITHOUT PRESSURE BOUNDARY RETENTION.
14. DENOTES A PIPE MATERIAL BOUNDARY:
    CS = CARBON STEEL
    SS = STAINLESS STEEL
    CML = CS WITH CEMENT MORTAR LINING

NOTES CONTINUED ON SHEET 5

REFERENCE DRAWINGS:
47B601-67 SERIES --- INSTRUMENT TABULATION
30B617 ------------- INSTRUMENT SYMBOLS
47W450 SERIES ------ ERCW PIPING
37W206 SERIES ------ INTAKE PUMPING STATION PIPING
17W302 SERIES ------ YARD PIPING

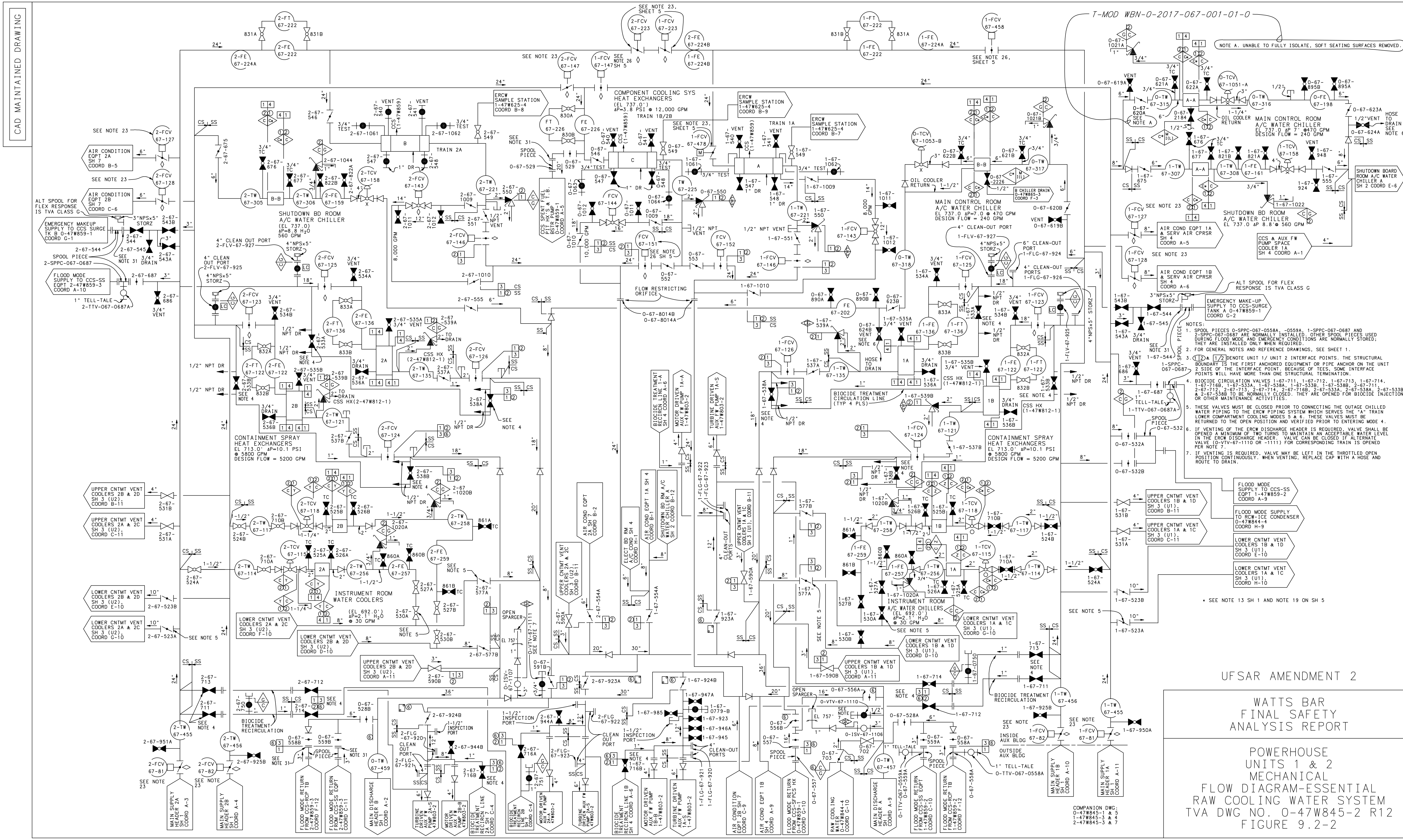
1-47W800-1 ----------- FLOW DIAGRAM-GENERAL PLANT SYSTEMS
1-47W844-3 ----------- FLOW DIAGRAM-RAW COOLING WATER
1-47W803-2 ----------- FLOW DIAGRAM-FEEDWATER
1-47W859-1 THRU 3 ---- FLOW DIAGRAM-COMPONENT COOLING SYSTEM
1-47W850 SERIES ------ FLOW DIAGRAM-FIRE PROTECTION AND RAW SERVICE WATER
1-47W610-67 SERIES --- CONTROL DIAGRAM
47W611-67 SERIES --- LOGIC DIAGRAM
17W586, 17W585 ----- PIPING-DIESEL GENERATOR BUILDING

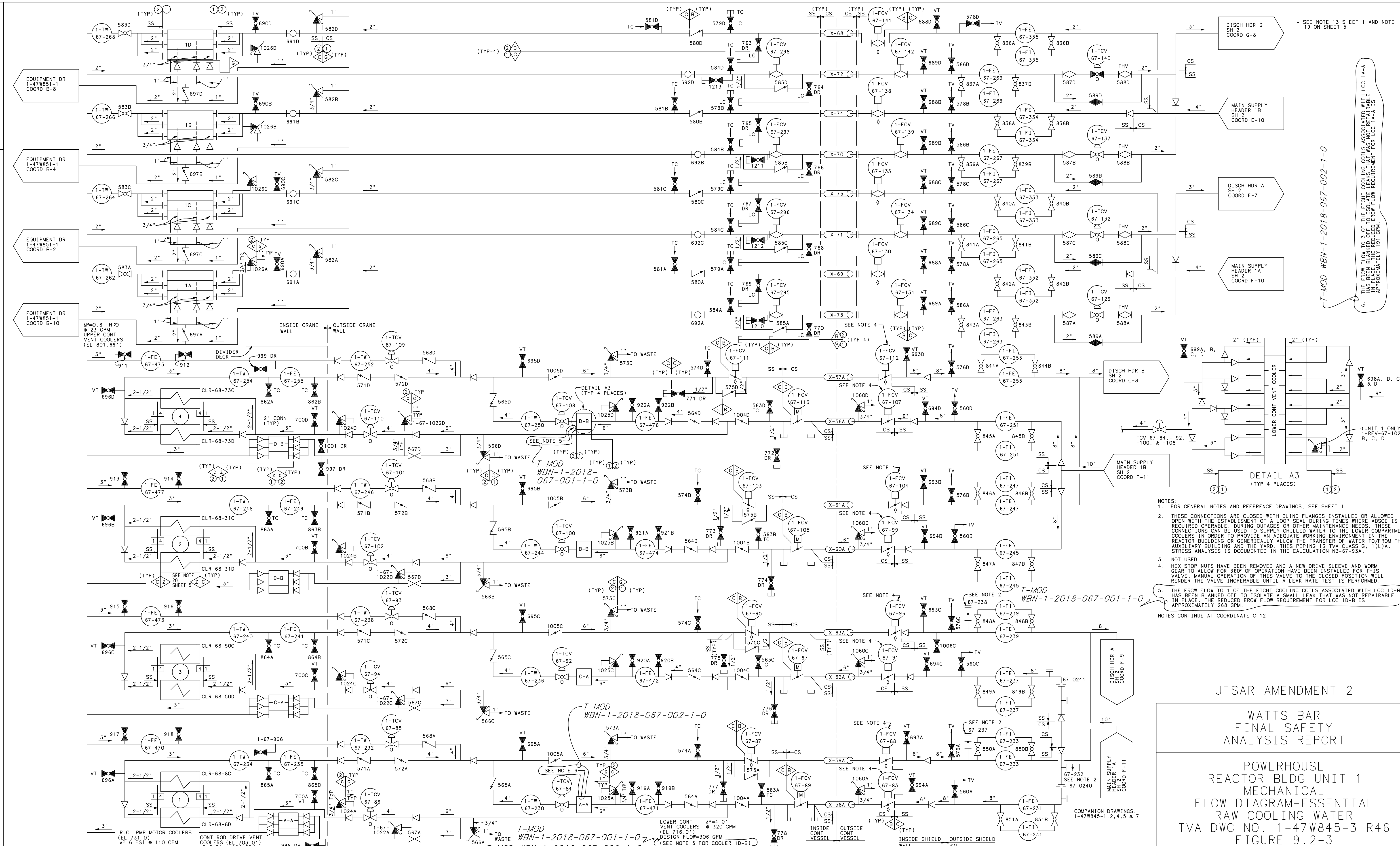
DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
WB-DC-20-20 ---------- TRAVELING WATER SCREENS FOR WATER SUPPLY INTAKE PUMPING STATION
N3-67-4002 ----------- ESSENTIAL RAW COOLING WATER
37W845-100 SERIES----- STRESS ANALYSIS PROBLEM BOUNDARY
47W845-100 SERIES----- STRESS ANALYSIS PROBLEM BOUNDARY

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

IPS, YARD, DGB
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM-ESSENTIAL
RAW COOLING WATER SYSTEM
TVA DWG NO. 0-47W845-1 R9
FIGURE 9.2-1


CAD MAINTAINED DRAWING
T-MOD WBN-0-2017-067-001-01-0
NOTE A. UNABLE TO FULLY ISOLATE, SOFT SEATING SURFACES REMOVED.
NOTES:
1. SPOOL PIECES 0-SPPC-067-0558A, -0559A, 1-SPPC-067-0687 AND 2-SPPC-067-0687 ARE NORMALLY INSTALLED. OTHER SPOOL PIECES USED DURING FLOOD MODE AND EMERGENCY CONDITIONS ARE NORMALLY STORED; THEY ARE INSTALLED ONLY WHEN REQUIRED.
2. FOR GENERAL NOTES AND REFERENCE DRAWINGS, SEE SHEET 1.
3. (1|2) & [1/2] DENOTE UNIT 1/ UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
4. BIOCIDE CIRCULATION VALVES 1-67-711, 1-67-712, 1-67-713, 1-67-714, 1-67-716B, 1-67-533A, 1-67-538A, 1-67-533B, 1-67-538B, 2-67-711, 2-67-712, 2-67-713, 2-67-714, 2-67-716B, 2-67-533A, 2-67-538A, 2-67-533B, & 2-67-538B TO BE NORMALLY CLOSED. THEY ARE OPENED FOR BIOCIDE INJECTION OR OTHER MAINTENANCE ACTIVITIES.
5. THESE VALVES MUST BE CLOSED PRIOR TO CONNECTING THE OUTAGE CHILLED WATER PIPING TO THE ERCW PIPING SYSTEM WHICH SERVES THE "A" TRAIN LOWER COMPARTMENT COOLING MODES 5 & 6. THESE VALVES MUST BE RETURNED TO THE OPEN POSITION AND VERIFIED PRIOR TO ENTERING MODE 4.
6. IF VENTING OF THE ERCW DISCHARGE HEADER IS REQUIRED, VALVE SHALL BE OPENED A MINIMUM OF TWO TURNS TO MAINTAIN AN ACCEPTABLE WATER LEVEL IN THE ERCW DISCHARGE HEADER. VALVE CAN BE CLOSED IF ALTERNATE VALVE (0-VTV-67-1110 OR -1111) FOR CORRESPONDING TRAIN IS OPENED PER NOTE 7.
7. IF VENTING IS REQUIRED, VALVE MAY BE LEFT IN THE THROTTLED OPEN POSITION CONTINUOUSLY. WHEN VENTING, REPLACE CAP WITH A HOSE AND ROUTE TO DRAIN.
• SEE NOTE 13 SH 1 AND NOTE 19 ON SH 5
COMPANION DWG:
0-47W845-1 & 5
1-47W845-3 & 4
2-47W845-3 & 7
UFSAR AMENDMENT 2
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT
POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM-ESSENTIAL
RAW COOLING WATER SYSTEM
TVA DWG NO. 0-47W845-2 R12
FIGURE 9.2-2



NOTES:

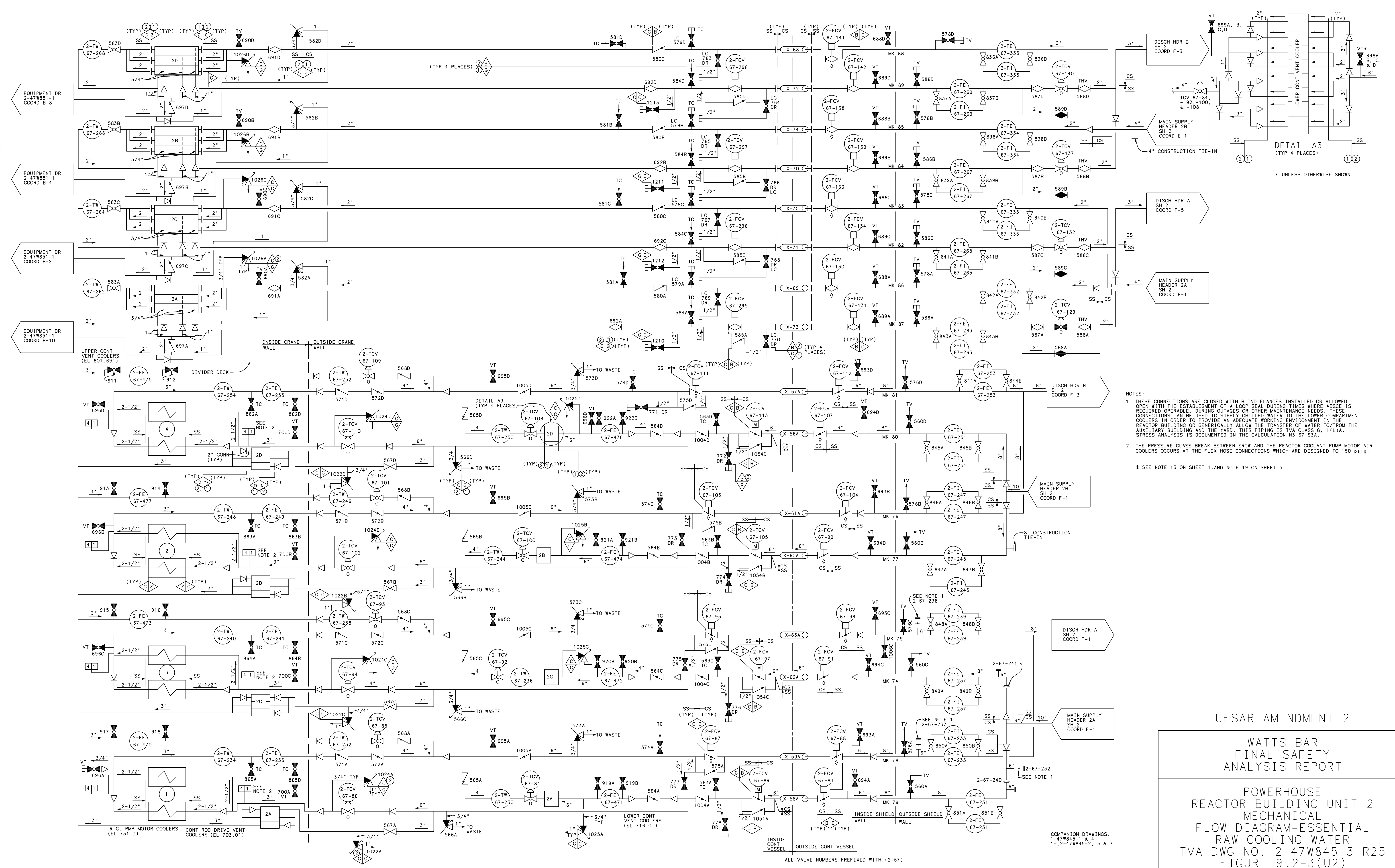
1. FOR GENERAL NOTES AND REFERENCE DRAWINGS, SEE SHEET 1.
2. THESE CONNECTIONS ARE CLOSED WITH BLIND FLANGES INSTALLED OR ALLOWED OPEN WITH THE ESTABLISMENT OF A LOOP SEAL DURING TIMES WHERE ABSCE IS REQUIRED OPERABLE. DURING OUTAGES OR OTHER MAINTENANCE NEEDS, THESE CONNECTIONS CAN BE USED TO SUPPLY CHILLED WATER TO THE LOWER COMPARTMENT COOLERS IN ORDER TO PROVIDE AN ADEQUATE WORKING ENVIRONMENT IN THE REACTOR BUILDING OR GENERICALLY ALLOW THE TRANSFER OF WATER TO/FROM THE AUXILIARY BUILDING AND THE YARD. THIS PIPING IS TVA CLASS G, 1(L)A. STRESS ANALYSIS IS DOCUMENTED IN THE CALCULATION N3-67-93A.
3. NOT USED.
4. HEX STOP NUTS HAVE BEEN REMOVED AND A NEW DRIVE SLEEVE AND WORM GEAR TO ALLOW FOR 360° OF OPERATION HAVE BEEN INSTALLED FOR THIS VALVE. MANUAL OPERATION OF THIS VALVE TO THE CLOSED POSITION WILL RENDER THE VALVE INOPERABLE UNTIL A LEAK RATE TEST IS PERFORMED.
5. THE ERCW FLOW TO 1 OF THE EIGHT COOLING COILS ASSOCIATED WITH LCC 1D-B HAS BEEN BLANKED OFF TO ISOLATE A SMALL LEAK THAT WAS NOT REPAIRABLE IN PLACE. THE REDUCED ERCW FLOW REQUIREMENT FOR LCC 1D-B IS APPROXIMATELY 268 GPM.

NOTES CONTINUE AT COORDINATE C-12

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
REACTOR BLDG UNIT 1
MECHANICAL
FLOW DIAGRAM-ESSENTIAL
RAW COOLING WATER
TVA DWG NO. 1-47W845-3 R46
FIGURE 9.2-3



NOTES:

1. THESE CONNECTIONS ARE CLOSED WITH BLIND FLANGES INSTALLED OR ALLOWED OPEN WITH THE ESTABLISMENT OF A LOOP SEAL DURING TIMES WHERE ABSCE IS REQUIRED OPERABLE. DURING OUTAGES OR OTHER MAINTENANCE NEEDS, THESE CONNECTIONS CAN BE USED TO SUPPLY CHILLED WATER TO THE LOWER COMPARTMENT COOLERS IN ORDER TO PROVIDE AN ADEQUATE WORKING ENVIRONMENT IN THE REACTOR BUILDING OR GENERICALLY ALLOW THE TRANSFER OF WATER TO/FROM THE AUXILIARY BUILDING AND THE YARD. THIS PIPING IS TVA CLASS G, 1(L)A. STRESS ANALYSIS IS DOCUMENTED IN THE CALCULATION N3-67-93A.

2. THE PRESSURE CLASS BREAK BETWEEN ERCW AND THE REACTOR COOLANT PUMP MOTOR AIR COOLERS OCCURS AT THE FLEX HOSE CONNECTIONS WHICH ARE DESIGNED TO 150 psig.

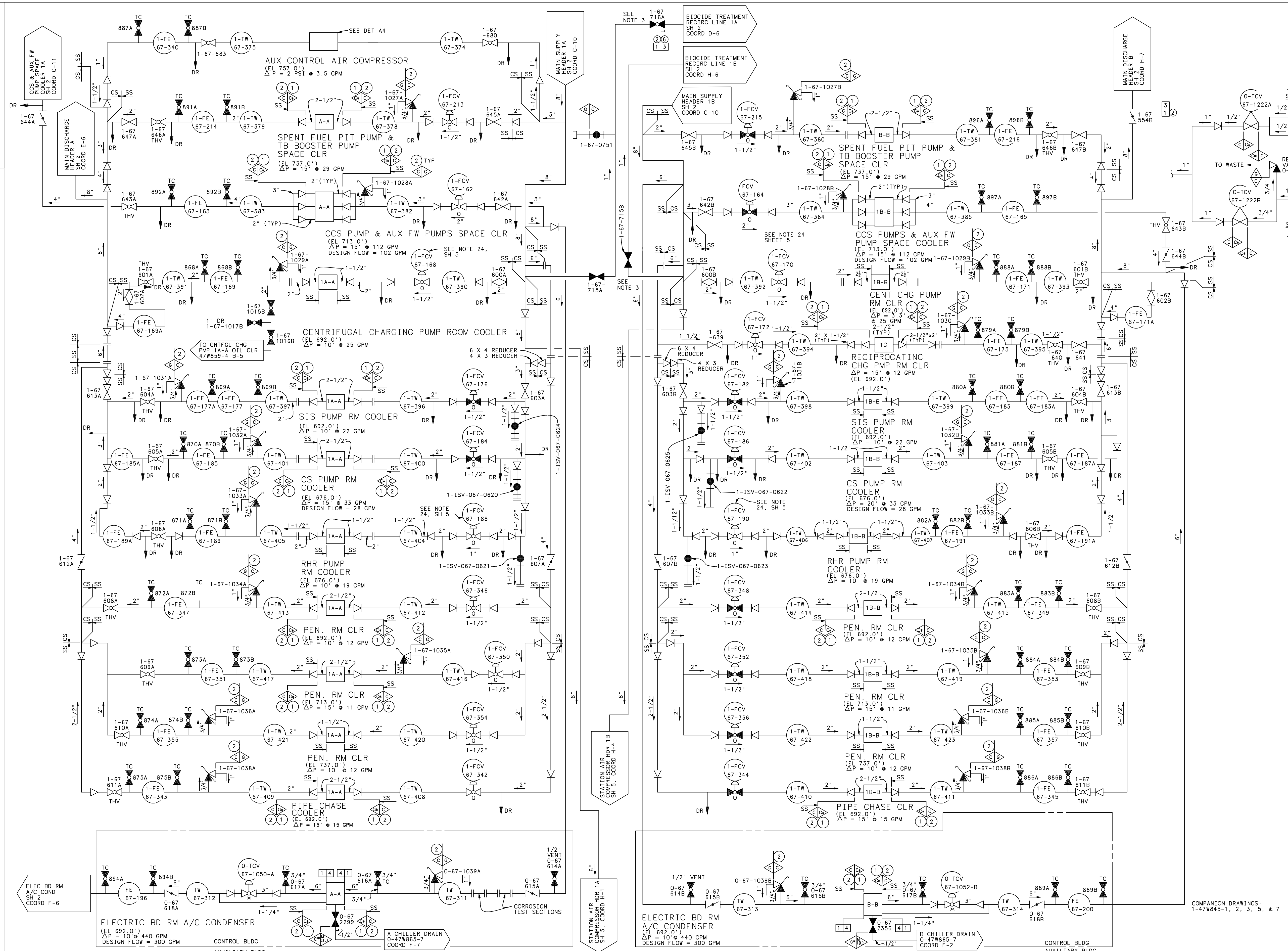
* SEE NOTE 13 ON SHEET 1,AND NOTE 19 ON SHEET 5.

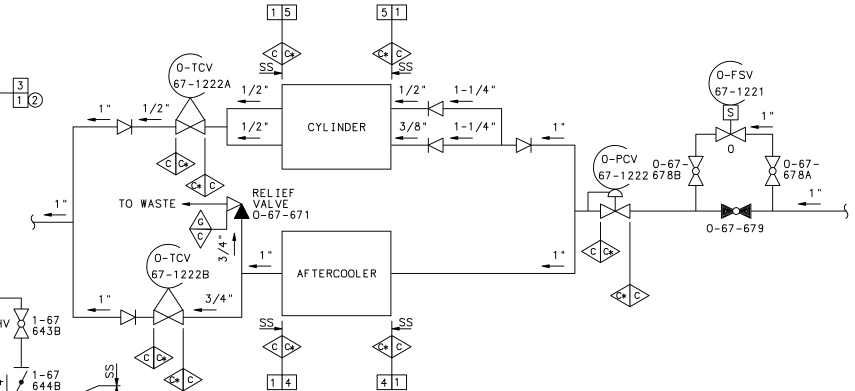
COMPANION DRAWINGS:
1-47W845-1 & 4
1-,2-47W845-2, 5 & 7

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
REACTOR BUILDING UNIT 2
MECHANICAL
FLOW DIAGRAM-ESSENTIAL
RAW COOLING WATER
TVA DWG NO. 2-47W845-3 R25
FIGURE 9.2-3(U2)





AUXILIARY CONTROL AIR COMPRESSOR A
DETAIL A4
(EL 757.0)

NOTE:

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS, SEE SHEET 1.
2. NOT USED.
3. BIOCIDE CIRCULATION VALVES 1-67-715A, 1-67-716A, & 1-67-715B TO BE NORMALLY CLOSED. THEY ARE OPENED FOR BIOCIDE INJECTION OR OTHER MAINTENANCE ACTIVITIES.

* SEE NOTE 13 SH 1 AND NOTE 19 ON SH 5.

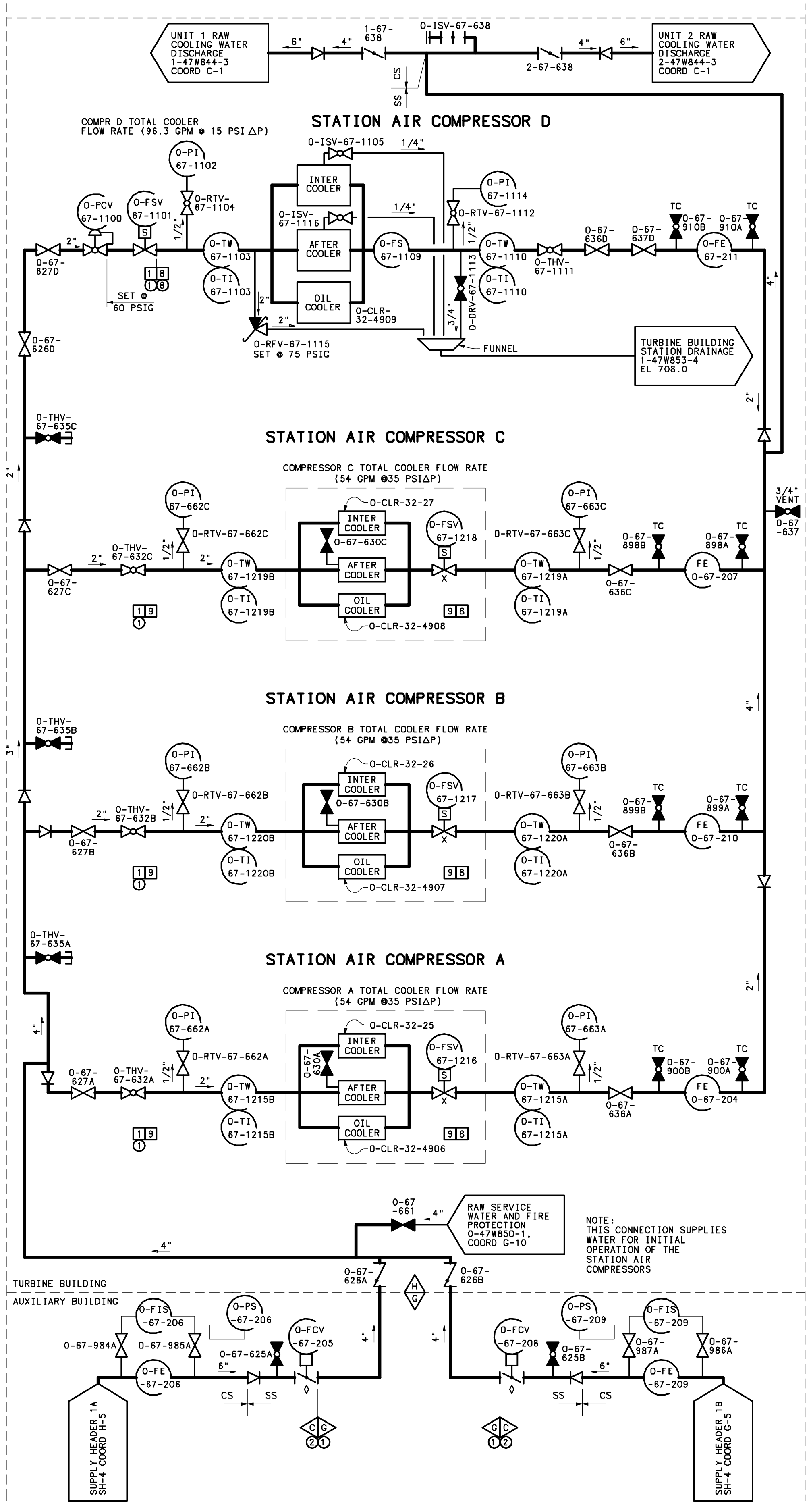
COMPANION DRAWINGS:
1-47W845-1, 2, 3, 5, & 7

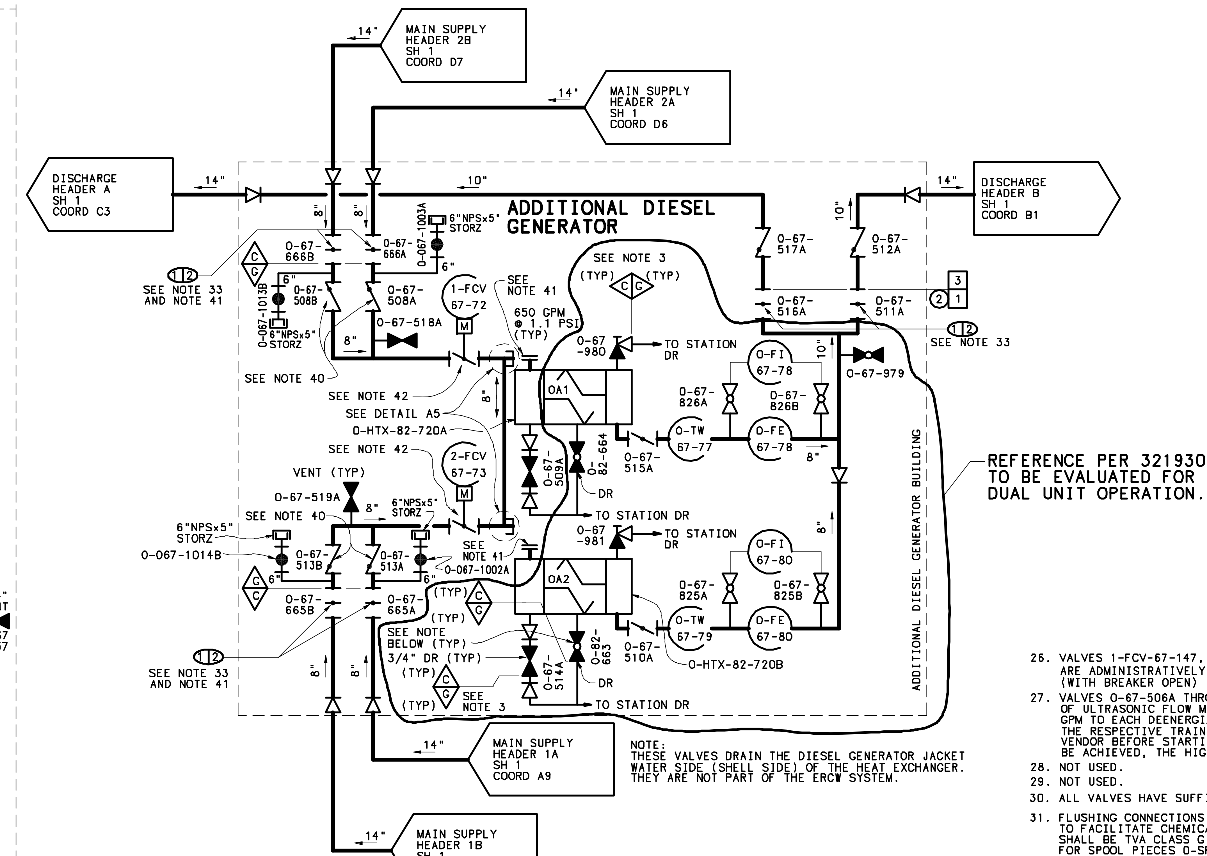
UFSAR AMENDMENT 2

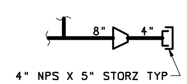
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUX & CONTROL BLDG UNIT 1
MECHANICAL
FLOW DIAGRAM - ESSENTIAL
RAW COOLING WATER
TVA DWG NO. 1-47W845-4 R46
FIGURE 9.2-4

CAD MAINTAINED DRAWING







DETAIL A5
TYP

TABLE 1
APPENDIX R AND ENVIRONMENTAL QUALIFICATION VALVES

VALVE	APPENDIX R POSITION (SEE NOTE)	COMMENTS	REF NOTES
0-FCV-67-0151-A	POWER DISCONNECTED - CLOSED	VALVE DOES NOT REQUIRE POSITION CHANGE.	26
1-FCV-67-0022-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0024-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0081-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0082-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0127-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0128-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
1-FCV-67-0147-A	POWER DISCONNECTED - CLOSED	DO NOT CHANGE, REALIGNS FLOW TO CCS HX	26
1-FCV-67-0168-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	24
1-FCV-67-0170-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	24
1-FCV-67-0188-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	24
1-FCV-67-0190-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	24
1-FCV-67-0223-A	POWER DISCONNECTED - OPEN	DO NOT CHANGE, REALIGNS FLOW TO CCS HX	23
1-FCV-67-0458-A	POWER DISCONNECTED - CLOSED	DO NOT CHANGE, REALIGNS FLOW TO CCS HX	26
1-FCV-67-0478-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0022-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0024-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0081-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0082-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0126-A	POWER DISCONNECTED - CLOSED	DO NOT OPEN, U1/U2 INTERFACE.	26, 28
2-FCV-67-0147-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	23
2-FCV-67-0223-A	POWER DISCONNECTED - OPEN	DO NOT CHANGE, REALIGNS FLOW TO CCS HX	23
1-FCV-67-0066-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	37
1-FCV-67-0067-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	37
1-FCV-67-0146-A	POWER DISCONNECTED - CLOSED	MAY BE OPENED DURING UNIT COOLDOWN, MODES 4,5,6	26
2-FCV-67-0066-A	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	37
2-FCV-67-0067-B	POWER DISCONNECTED - OPEN	CLOSE FOR ISOLATION OF HEADER ONLY.	37
2-FCV-67-0123-B	POWER DISCONNECTED - CLOSED	DO NOT OPEN, U1/U2 INTERFACE.	26, 28
2-FCV-67-0124-B	POWER DISCONNECTED - CLOSED	DO NOT OPEN, U1/U2 INTERFACE.	26, 28
2-FCV-67-0125-A	POWER DISCONNECTED - CLOSED	DO NOT OPEN, U1/U2 INTERFACE.	26,28
2-FCV-67-0143-A	POWER DISCONNECTED - THROTTLED	THROTTLED POSITION REQUIRED FOR FLOW BALANCE.	32
2-FCV-67-0146-A	POWER DISCONNECTED - CLOSED	NOT NEEDED FOR UNIT 1 ONLY OPERATION.	32

NOTE:
POWER DISCONNECTED MEANS THE ASSOCIATED BREAKER IS OPEN.

NOTES CONTINUED:

15. THE FAILURE POSITION FOR NON-MANUALLY OPERATED VALVES IS SHOWN AS BELOW:
O = OPENS WHEN IT FAILS
X = CLOSES WHEN IT FAILS
<> = STAYS AS IS WHEN IT FAILS

16. ALL CLASS G PIPING IS SEISMICALLY SUPPORTED TO MAINTAIN PRESSURE BOUNDARY AND THE HYDROSTATIC TEST IS WITHIN THE QA PROGRAM EXCEPT FOR PIPING ON THE DISCHARGE SIDE OF DRAIN AND VENT VALVES AND RELIEF VALVES WHICH DISCHARGE TO THE ATMOSPHERE. SINCE THESE PIPES DISCHARGE ATMOSPHERIC PRESSURE, NO HYDROSTATIC TESTING OF THESE LINES IS NEEDED. (SEE NOTE 22)

17. [o o] THIS SYMBOL DENOTES THOSE VALVES WHICH HAVE A LOCKING DEVICE SO VALVES CAN BE LOCKED IN THEIR PROPER POSITION.

18. ALL INSTRUMENTATION SENSE LINES AND VALVES SHALL BE OF STAINLESS STEEL.

19. THE HVAC COOLERS/CHILLERS SUPPLIED BY ERCW WHICH ARE DESIGNATED AS TVA CLASS Y ARE SEISMIC CATEGORY 1(L)B WITHOUT PRESSURE BOUNDARY INTEGRITY.

20. THE ERCW SUPPLIED COOLERS WHICH ARE DESIGNATED AS TVA CLASS Z ARE SEISMIC CATEGORY 1(L)A WITH PRESSURE BOUNDARY INTEGRITY.

21. FLOW DIRECTION FOR NORMALLY CLOSED VENT, DRAIN, RELIEF AND TEST VALVES SHALL BE OUTWARD FROM THE SYSTEM UNLESS OTHERWISE SPECIFIED. WHEN DISCHARGE IS TO ATMOSPHERE, PIPING DOWNSTREAM OF THESE VALVES SHALL BE CLASS G, UNLESS OTHERWISE SPECIFIED.

22. THE ESSENTIAL RAW COOLING WATER SCREEN WASH PUMPS 1A-A, 2A-A, 1B-B, 2B-B AND THE ASSOCIATED DISCHARGE PIPING (1(L)A) ARE REQUIRED TO MAINTAIN PRESSURE BOUNDARY INTEGRITY. ANY MODIFICATIONS OR REPAIR TO THE SCREEN WASH PUMPS, PIPING, OR VALVES AFTER JUNE 17, 1995 SHALL BE MADE TO THE REQUIREMENTS OF TVA CLASS C. THE PRELUBE PIPING TO THESE PUMPS IS NOT REQUIRED TO MAINTAIN PRESSURE BOUNDARY INTEGRITY (1(L)B). (SOURCE NOTES 55E NCR WBN MEB 8408 AND WBPER950260).

23. VALVES 1 & 2-FCV-67-22, 1 & 2-FCV-67-24, 1-FCV-67-127, 1-FCV-67-128, 1 & 2-FCV-67-81, 1 & 2-FCV-67-82, 2-FCV-67-147, 1 & 2-FCV-67-223, AND 1-FCV-67-478 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION (WITH BREAKER OPEN) (APPENDIX R). HEADERS 1A & 2A MAY BE CROSS-CONNECTED FOR STRAINER MAINTENANCE DURING ERCW OPERATION (UNIT 1 ONLY) BY OPENING BOTH CROSS-CONNECT VALVES 1-ISV-67-1117 AND 2-ISV-67-1119 BEFORE CLOSING EITHER 1- OR 2-FCV-67-22. EITHER 1- OR 2-FCV-67-22, WHICHEVER IS REQUIRED TO SUPPORT THE OPERATING STRAINER, SHALL REMAIN IN THE OPEN POSITION AS REQUIRED ABOVE. HEADERS 1B & 2B MAY BE CROSS-CONNECTED FOR STRAINER MAINTENANCE DURING ERCW OPERATION (UNIT 1 ONLY) BY OPENING BOTH CROSS-CONNECT VALVES 1-ISV-67-1118 AND 2-ISV-67-1120 BEFORE CLOSING EITHER 1- OR 2-FCV-67-24. EITHER 1- OR 2-FCV-67-24, WHICHEVER IS REQUIRED TO SUPPORT THE OPERATING STRAINER, SHALL REMAIN IN THE OPEN POSITION AS REQUIRED ABOVE. REFER TO TABLE 1. VALVES 2-FCV-67-127 AND 2-FCV-67-128 ARE ADMINISTRATIVELY LOCKED OPEN (WITH BREAKER OPEN) (NOT APPENDIX R).

24. VALVES 1 & 2-FSV-67-170-B, FSV-67-168A, FSV-67-188A & FSV-67-190B (WHICH ARE ASSOCIATED WITH FCV'S OF SAME NUMBERS) HAVE BEEN ELECTRICALLY DISCONNECTED AT THE MOTOR CONTROL CENTER DUE TO APPENDIX R INTERACTION. REFER TO TABLE 1.

25. VALVE 2-ISV-67-537A IS A LAYUP BOUNDARY. VALVE IS CLOSED AND IT'S HANDWHEEL IS REMOVED. VALVE HAS BEEN FITTED WITH A 1/16-INCH RED RUBBER GASKET, FULL SHEET WHICH IS INSTALLED ON THE SIDE NEAR TO THE CSS HX. THE SPACE BETWEEN THE GASKET AND THE VALVE DISC IS FILLED WITH A CASTING MADE OF SYLGARD 170 A & B SILICONE ELASTOMER. PRIOR TO UNIT -2 FUEL LOAD, FULL FUNCTION OF THIS VALVE WILL BE RESTORED. REFERENCE DCN P-05632.

26. VALVES 1-FCV-67-147, 0-FCV-67-151 AND 1-FCV-67-458-A ARE ADMINISTRATIVELY LOCKED IN THE CLOSED POSITION. (WITH BREAKER OPEN) (APPENDIX R) REFER TO TABLE 1.

27. VALVES 0-67-506A THROUGH H ARE TO BE ADJUSTED, THROUGH THE USE OF ULTRASONIC FLOW METERS, TO SUPPLY THE DESIRED PRELUBE FLOW OF 2 GPM TO EACH DEENERGIZED ERCW PUMP WITH ONE PUMP RUNNING IN THE RESPECTIVE TRAIN. A MINIMUM OF 1/2 GPM IS REQUIRED BY THE VENDOR BEFORE STARTING AN ERCW PUMP. IF A FLOW OF 2 GPM CANNOT BE ACHIEVED, THE HIGHEST VALUE ABOVE .5 GPM SHOULD BE USED.

28. NOT USED.

29. NOT USED.

30. ALL VALVES HAVE SUFFIX "A" UNLESS OTHERWISE NOTED.

31. FLUSHING CONNECTIONS ARE ADDED TO THE BLIND FLANGES TO FACILITATE CHEMICAL FLUSHING. THESE FLUSHING CONNECTIONS SHALL BE TVA CLASS G.
FOR SPOOL PIECES 0-SPPC-67-0558B AND 0-SPPC-67-0559B, FLUSHING CONNECTIONS ARE ADDED TO THE BOTTOM OF THE SPOOL PIECES TO FACILITATE CHEMICAL FLUSHING. THERE IS A 1" CAP WITH A 3/16" HOLE IN THE CENTER THAT MUST REMAIN ON THE 1" DRAIN LINES WHEN TESTING IS NOT IN PROGRESS

32. NOT USED.

33. VALVES 0-67-511A, -516A, -665A, -665B, -666A AND -666B ARE U1/U2 INTERFACE POINTS. VALVES ARE ADMINISTRATIVELY LOCKED IN THE CLOSED POSITION WITH HANDWHEEL LEFT IN PLACE.

34. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

35. THIS VALVE IS A UNIT 1/2 INTERFACE POINT AND MUST BE CLOSED WITH THE HANDWHEEL REMOVED. IF VALVE HAS UNACCEPTABLE SEAT LEAKAGE, THE VALVE SHALL BE FITTED WITH A 1/16 INCH RED RUBBER GASKET FULL SHEET WHICH EXTENDS OVER THE UNIT 1 SIDE OF THE VALVE DISC. THE SPACE BETWEEN THE GASKET AND DISC SHALL BE FILLED WITH A CASTING MADE OF SYLGARD 170 A & B SILICONE ELASTOMER.

36. THE DISC ON THESE VALVES IS MADE OF AUSTENITIC GRAY IRON, WHICH IS NOT SUITABLE FOR RAW WATER SERVICE. REPAIR OR REPLACEMENT OF THESE VALVES REQUIRES THE USE OF MATERIALS WHICH ARE NOT INCOMPATIBLE WITH RAW WATER SERVICE. SPECIFICALLY PROHIBITED ARE AUSTENITIC GRAY IRON, C95400 ALUMINUM BRONZE NOT PROPERLY HEAT TREATED, OR OTHER MATERIALS NOT COMPATIBLE WITH RAW WATER OR COMPATIBLE ONLY WHEN IN THE PROPER HEAT TREATED CONDITION (UNLESS THE PROPER HEAT TREATMENT IS SPECIFIED IN THE PROCUREMENT DOCUMENT).

37. VALVES ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION (MCC BREAKER OPEN) TO ENSURE FLOW TO THE DIESEL GENERATORS, AND FOR APPENDIX R CONCERNS.

38. THE SET PRESSURE (WITH NO BACK PRESSURE) FOR THE FOLLOWING ERCW RELIEF VALVES IS LISTED BELOW:

0-RFV-67-1021A-A	150 PSIG	0-RFV-67-1021B-B	150 PSIG
0-RFV-67-1039A-A	150 PSIG	0-RFV-67-1039B-B	150 PSIG
1-RFV-67-1020A-A	150 PSIG	1-RFV-67-1020B-B	150 PSIG
1-RFV-67-1022-A	150 PSIG	1-RFV-67-1022A-A	160 PSIG
1-RFV-67-1022B-B	160 PSIG	1-RFV-67-1022C-A	160 PSIG
1-RFV-67-1022D-B	160 PSIG	1-RFV-67-1024A-A	150 PSIG
1-RFV-67-1024B-B	150 PSIG	1-RFV-67-1024C-A	150 PSIG
1-RFV-67-1024D-B	150 PSIG	1-RFV-67-1025A-A	160 PSIG
1-RFV-67-1025B-B	160 PSIG	1-RFV-67-1025C-A	160 PSIG
1-RFV-67-1025D-B	160 PSIG	1-RFV-67-1026A-A	160 PSIG
1-RFV-67-1026B-B	160 PSIG	1-RFV-67-1026C-A	160 PSIG
1-RFV-67-1026D-B	160 PSIG	1-RFV-67-1027A-A	160 PSIG
1-RFV-67-1027B-B	160 PSIG	1-RFV-67-1028A-A	160 PSIG
1-RFV-67-1028B-B	160 PSIG	1-RFV-67-1029A-A	160 PSIG
1-RFV-67-1029B-B	160 PSIG	1-RFV-67-1030-B	160 PSIG
1-RFV-67-1031A-A	160 PSIG	1-RFV-67-1031B-B	160 PSIG
1-RFV-67-1032A-A	160 PSIG	1-RFV-67-1032B-B	160 PSIG
1-RFV-67-1033A-A	160 PSIG	1-RFV-67-1033B-B	160 PSIG
1-RFV-67-1034A-A	160 PSIG	1-RFV-67-1034B-B	160 PSIG
1-RFV-67-1035A-A	160 PSIG	1-RFV-67-1035B-B	160 PSIG
1-RFV-67-1036A-A	160 PSIG	1-RFV-67-1036B-B	160 PSIG
1-RFV-67-1038A-A	160 PSIG	1-RFV-67-1038B-B	160 PSIG
1-RFV-67-1042A-A	160 PSIG	1-RFV-67-1042B-B	160 PSIG
2-RFV-67-1037A-A	160 PSIG	2-RFV-67-1037B-B	160 PSIG
2-RFV-67-1040A-A	160 PSIG	2-RFV-67-1040B-B	160 PSIG
2-RFV-67-1041A-A	160 PSIG	2-RFV-67-1041B-B	160 PSIG
2-RFV-67-1043A-A	160 PSIG	2-RFV-67-1043B-B	160 PSIG
2-RFV-67-1044-B	150 PSIG	0-RFV-67-0550-B	160 PSIG
0-RFV-67-0671-A	80 PSIG	0-RFV-67-0672-A	80 PSIG
1-RFV-67-0509A-A	160 PSIG	1-RFV-67-0509B-B	160 PSIG
1-RFV-67-0514A-A	160 PSIG	1-RFV-67-0514B-B	160 PSIG
1-RFV-67-0539A-A	150 PSIG	1-RFV-67-0539B-B	150 PSIG
1-RFV-67-0550	160 PSIG	1-RFV-67-0566A-A	160 PSIG
1-RFV-67-0566B-B	160 PSIG	1-RFV-67-0566C-A	160 PSIG
1-RFV-67-0566D-B	160 PSIG	1-RFV-67-0573A-A	160 PSIG
1-RFV-67-0573B-B	160 PSIG	1-RFV-67-0573C-A	160 PSIG
1-RFV-67-0573D-B	160 PSIG	1-RFV-67-0582A-A	160 PSIG
1-RFV-67-0582B-B	160 PSIG	1-RFV-67-0582C-A	160 PSIG
1-RFV-67-0582D-B	160 PSIG	2-RFV-67-0509A-A	160 PSIG
2-RFV-67-0509B-B	160 PSIG	2-RFV-67-0514A-A	160 PSIG
2-RFV-67-0514B-B	160 PSIG	2-RFV-67-0550-A	160 PSIG

NOTE 38 CONT:

2-RFV-67-1020A-A	150 PSIG	2-RFV-1020-B-A	150 PSIG
2-RFV-67-1022-A	160 PSIG	2-RFV-1022-B	160 PSIG
2-RFV-67-1022-C	160 PSIG	2-RFV-1022-D	160 PSIG
2-RFV-67-1024-A	150 PSIG	2-RFV-1024-B	150 PSIG
2-RFV-67-1024-C	150 PSIG	2-RFV-1024-D	150 PSIG
2-RFV-67-1026-A	160 PSIG	2-RFV-1026-B	160 PSIG
2-RFV-67-1026-C	160 PSIG	2-RFV-1026-D	160 PSIG
2-RFV-67-1029-A-A	160 PSIG	2-RFV-1029-B-B	160 PSIG
2-RFV-67-1031-A	160 PSIG	2-RFV-1031-B	160 PSIG
2-RFV-67-1032-A	160 PSIG	2-RFV-1032-B	160 PSIG
2-RFV-67-1033-A	160 PSIG	2-RFV-1033-B	160 PSIG
2-RFV-67-1034-A	160 PSIG	2-RFV-1034-B	160 PSIG
2-RFV-67-1035-A	160 PSIG	2-RFV-1035-B	160 PSIG
2-RFV-67-1038-A	160 PSIG	2-RFV-1038-B	160 PSIG
2-RFV-67-566-A	160 PSIG	2-RFV-566-B	160 PSIG
2-RFV-67-566-C	160 PSIG	2-RFV-566-D	160 PSIG
2-RFV-67-573-A	160 PSIG	2-RFV-573-B	160 PSIG
2-RFV-67-573-C	160 PSIG	2-RFV-573-D	160 PSIG
2-RFV-67-582-A	160 PSIG	2-RFV-582-B	160 PSIG
2-RFV-67-582-C	160 PSIG	2-RFV-582-D	160 PSIG
2-RFV-67-539-A	150 PSIG	2-RFV-539-B	150 PSIG
2-RFV-67-1025A	160 PSIG	2-RFV-67-1025C	160 PSIG
2-RFV-67-1025B	160 PSIG	2-RFV-67-1025D	160 PSIG

39. AUXILIARY BUILDING SECONDARY CONTAINMENT ENCLOSURE (ABSCE) MUST BE CONSIDERED WHENEVER SYSTEM BREACH WILL OCCUR IN NORTH/SOUTH VALVE ROOMS (A10 & A11). BEFORE PERFORMING ANY MODIFICATION/MAINTENANCE ACTIVITIES IN ROOMS A10 & A11 ENSURE APPROPRIATE PRECAUTIONS ARE TAKEN TO MAINTAIN ABSCE BOUNDARY.

40. CHECK VALVES 0-67-508A, 0-67-508B, 0-67-513A AND 0-67-513B HAVE HAD THE INTERNALS REMOVED TO PERMIT REVERSE FLOW WHEN REQUIRED.

41. HEAT EXCHANGERS OA1 AND OA2 HAVE BEEN DISCONNECTED FROM THE 8" SUPPLY PIPING AND THE HEAT EXCHANGER INLETS HAVE BEEN BLIND FLANGED. THESE BLIND FLANGES ARE NOT TO BE REMOVED FROM THE HEAT EXCHANGERS WITHOUT PRIOR ENGINEERING APPROVAL. THE INTERFACE POINTS REMAIN AS PREVIOUSLY ESTABLISHED AND ALLOWS CONFIGURATION CONTROL OF THE CLASS G PIPING EVEN THOUGH IT WILL NOT BE USED DURING NORMAL MODES OF UNIT 1 OPERATION. THE CLASS G PIPING AND COMPONENTS ARE REQUIRED FOR U1 OPERATION FOR CONVENIENCE AND CAN NOT BE REMOVED.

42. 1-FCV-67-72 AND 2-FCV-67-73 ARE POSITIONED OPEN AND POWER REMAINS REMOVED. ONLY THE OPEN FLOW PATH THROUGH THE VALVE IS MAINTAINED WITHIN CONFIGURATION CONTROL.

43. NOTE USED.

44. HEX STOP NUTS HAVE BEEN REMOVED AND A NEW DRIVE SLEEVE AND WORM GEAR TO ALLOW FOR 360° OF OPERATION HAVE BEEN INSTALLED FOR THIS VALVE.

45. WBN IS IN THE PROCESS OF QUALIFYING LOWER COMPARTMENT COOLER COILS AS SEISMIC I AND RE-RATING TO A NEW PRESSURE/TEMPERATURE. COILS WILL HAVE ADDITIONAL TAG ADDED WHEN RE-RATING IS COMPLETE. THIS WILL ELIMINATE THE NEED TO CUT-OUT AND REMAKE FLANGE TO PIPE WELDS. WHEN THIS QUALIFICATION IS COMPLETED, MAKE AND DOCUMENT THE WELDS AS SECTION III CLASS 3 (TVA CLASS C).

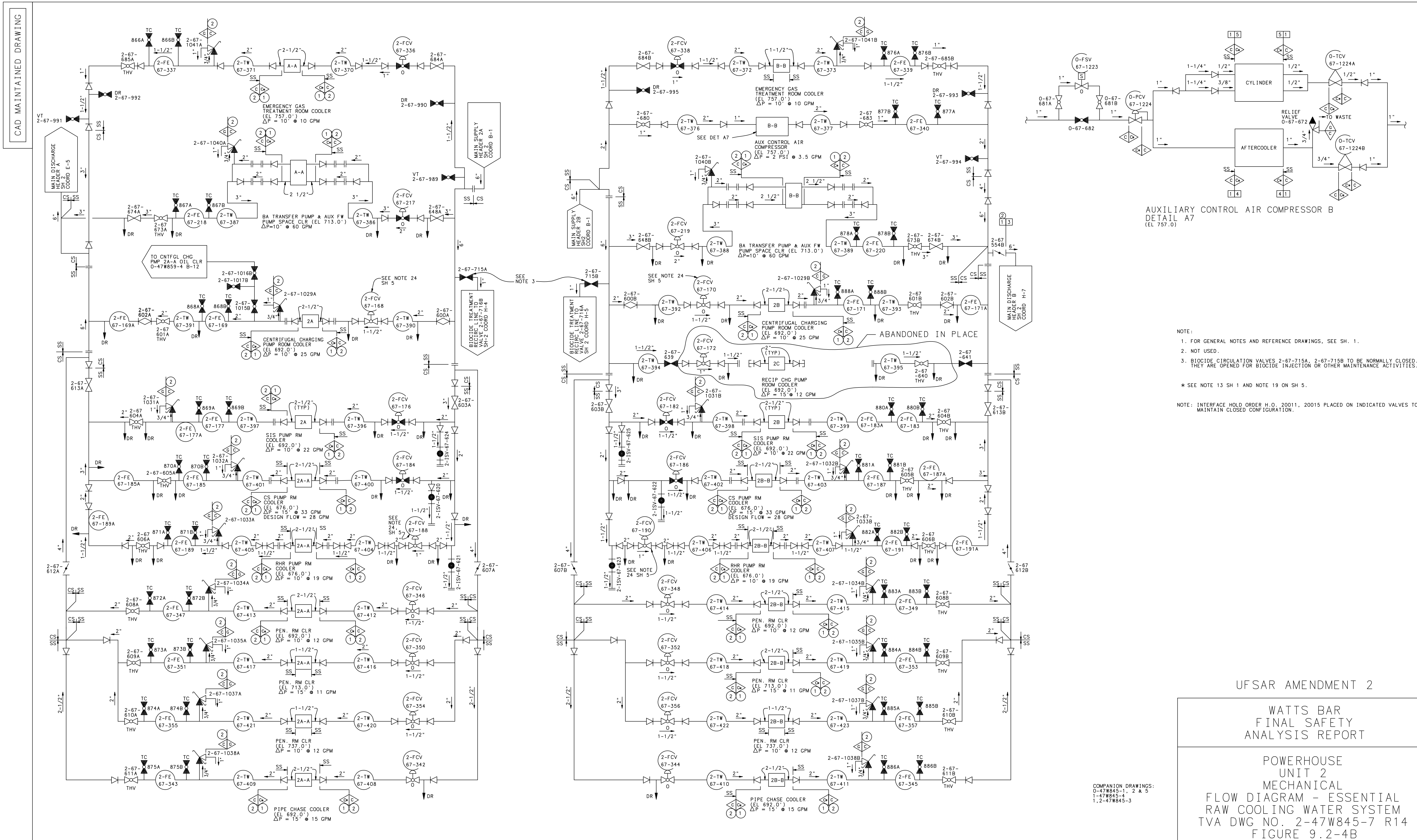
46. VALVES 1-ISV-67-1117, 1-ISV-67-1118, 2-ISV-67-1119, AND 2-ISV-67-1120, CAN BE OPENED BY OPERATIONS TO CROSS-TIE THE 1A & 2A HEADERS AND THE 1B & 2B HEADERS TO REDUCE STRAINER DIFFERENTIAL PRESSURE.

47. THE PIPING BETWEEN THE STANDPIPES (HYDRAULIC GRADIENTS) AND THE VALVE BOXES 1 AND 2 (CONTAINING VALVES 0-FCV-067-0360 AND -0362) HAS BEEN QUALIFIED FOR PRESSURE BOUNDARY RETENTION (REF. N3-67-4002).

COMPANION DRAWINGS:
0-47W845-1,2
1,2-47W845-3
1-47W845-4
2-47W845-7

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
TURBINE BUILDING UNIT 1 & 2
MECHANICAL
FLOW DIAGRAM-ESSENTIAL
RAW COOLING WATER SYSTEM
TVA DWG NO. 0-47W845-5 R0
FIGURE 9.2-4A



NOTE:

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS, SEE SH. 1.
2. NOT USED.
3. BIOCIDE CIRCULATION VALVES 2-67-715A, 2-67-715B TO BE NORMALLY CLOSED. THEY ARE OPENED FOR BIOCIDE INJECTION OR OTHER MAINTENANCE ACTIVITIES.

* SEE NOTE 13 SH 1 AND NOTE 19 ON SH 5.

NOTE: INTERFACE HOLD ORDER H.O. 20011, 20015 PLACED ON INDICATED VALVES TO MAINTAIN CLOSED CONFIGURATION.

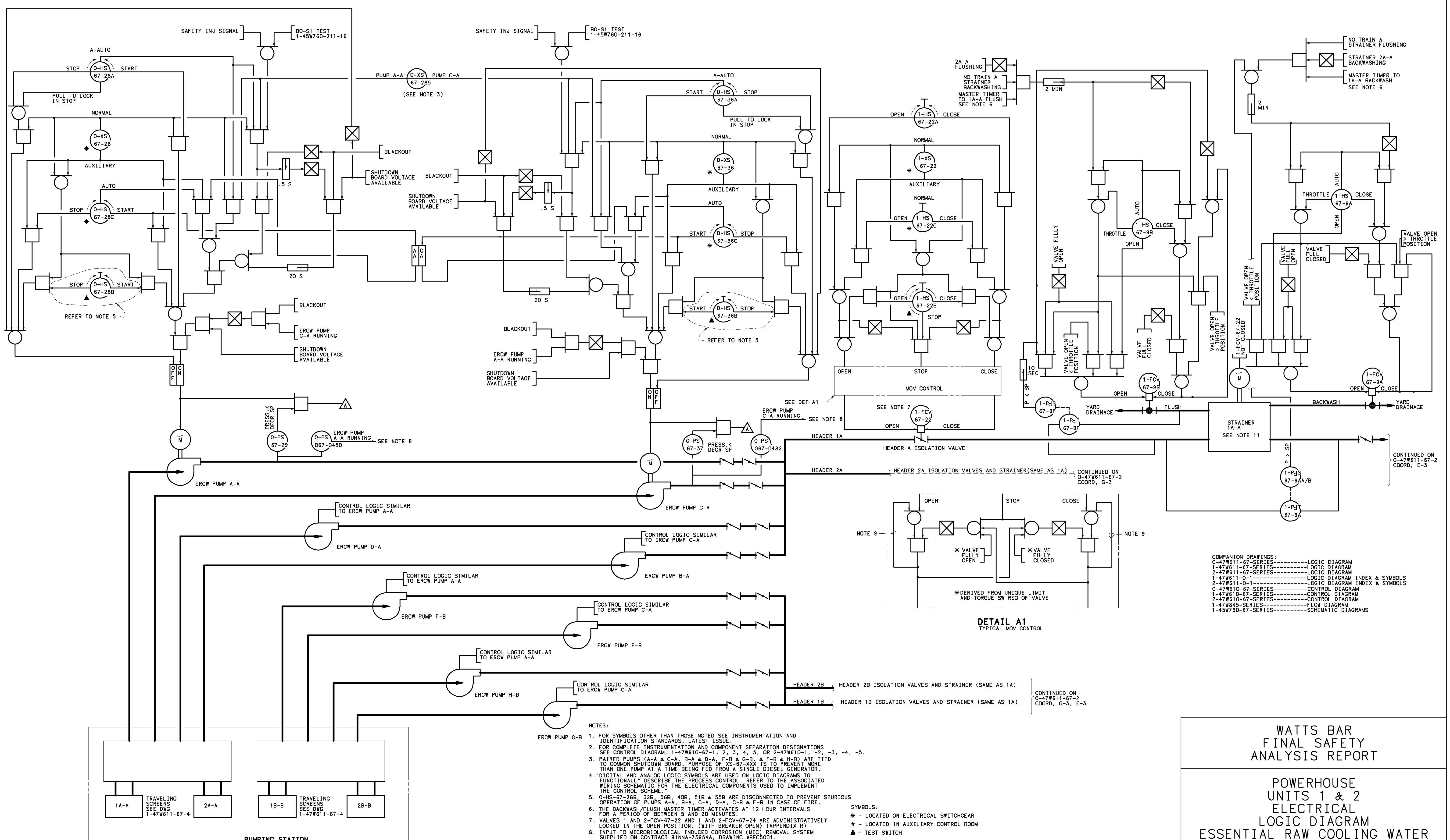
COMPANION DRAWINGS:
0-47W845-1, 2 & 5
1-47W845-4
1,2-47W845-3

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
MECHANICAL
FLOW DIAGRAM - ESSENTIAL
RAW COOLING WATER SYSTEM
TVA DWG NO. 2-47W845-7 R14
FIGURE 9.2-4B

CAD MAINTAINED DRAWING



COMPANION DRAWINGS:
0-47W611-67-SERIES-----------LOGIC DIAGRAM
1-47W611-67-SERIES-----------LOGIC DIAGRAM
2-47W611-67-SERIES-----------LOGIC DIAGRAM
1-47W611-0-1-----------------LOGIC DIAGRAM INDEX & SYMBOLS
2-47W611-0-1-----------------LOGIC DIAGRAM INDEX & SYMBOLS
0-47W610-67-SERIES-----------CONTROL DIAGRAM
1-47W610-67-SERIES-----------CONTROL DIAGRAM
2-47W610-67-SERIES-----------CONTROL DIAGRAM
1-47W845-SERIES--------------FLOW DIAGRAM
1-45W760-67-SERIES-----------SCHEMATIC DIAGRAMS

NOTES:

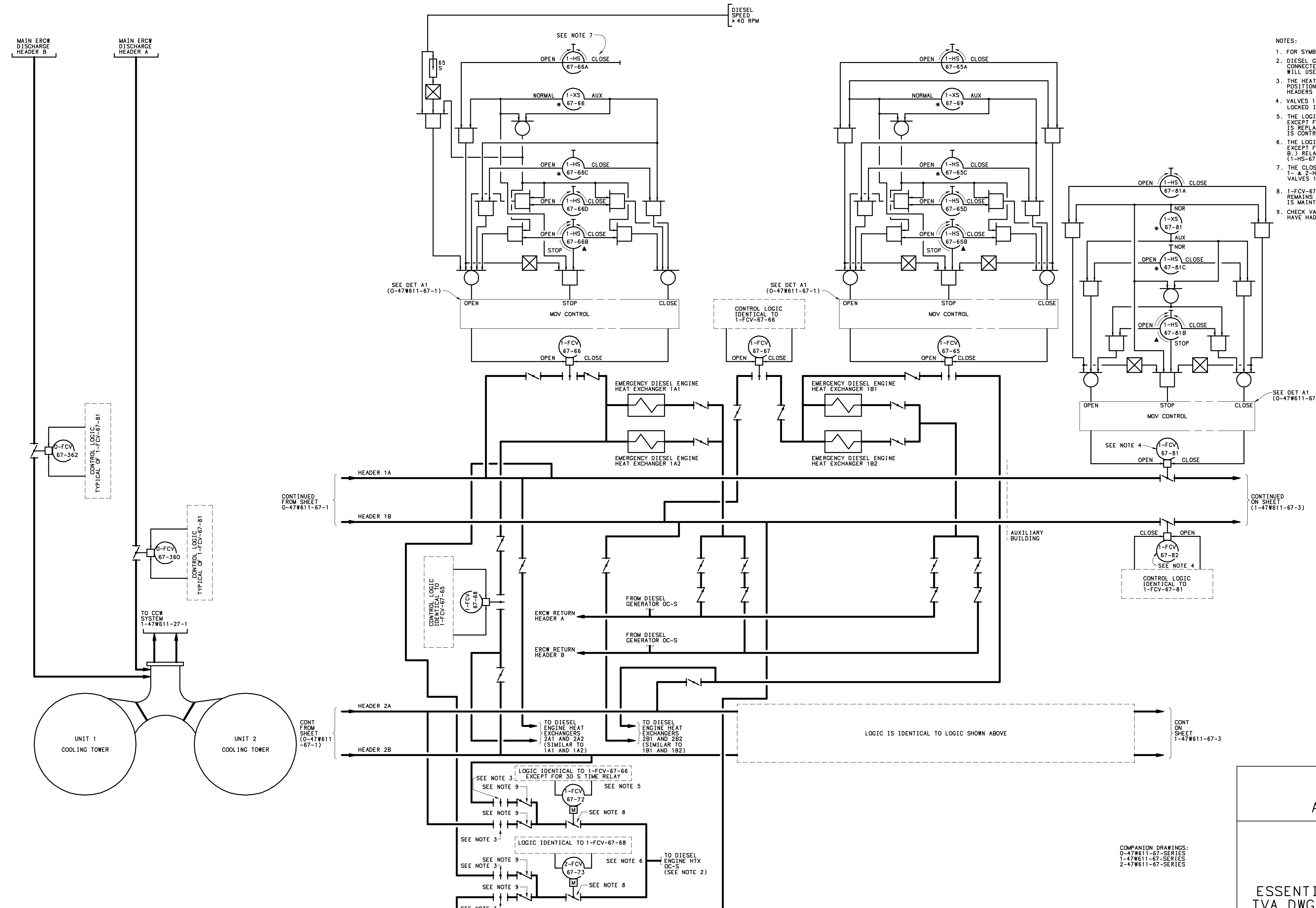
1. FOR SYMBOLS OTHER THAN THOSE NOTED SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAM, 1-47W610-67-1, 2, 3, 4, 5, OR 2-47W610-1, -2, -3, -4, -5.
3. PAIRED PUMPS (A-A & C-A, B-A & D-A, E-B & G-B, & F-B & H-B) ARE TIED TO COMMON SHUTDOWN BOARD, PURPOSE OF XS-67-XXX IS TO PREVENT MORE THAN ONE PUMP AT A TIME BEING FED FROM A SINGLE DIESEL GENERATOR.
4. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
5. 0-HS-67-28B, 32B, 36B, 40B, 51B & 55B ARE DISCONNECTED TO PREVENT SPURIOUS OPERATION OF PUMPS A-A, B-A, C-A, D-A, G-B & F-B IN CASE OF FIRE.
6. THE BACKWASH/FLUSH MASTER TIMER ACTIVATES AT 12 HOUR INTERVALS FOR A PERIOD OF BETWEEN 5 AND 20 MINUTES.
7. VALVES 1 AND 2-FCV-67-22 AND 1 AND 2-FCV-67-24 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R)
8. INPUT TO MICROBIOLOGICAL INDUCED CORROSION (MIC) REMOVAL SYSTEM SUPPLIED ON CONTRACT 91NNA-75954A, DRAWING #BEC5001.
9. SEAL-IN NOT FOR 1-FCV-67-143, 2-FCV-67-143 & 0-FCV-67-144.
10.
11. DURING CROSS TIE OPERATION, STRAINER WILL BE RUN IN CONTINUOUS BACKWASH.

SYMBOLS:
* - LOCATED ON ELECTRICAL SWITCHGEAR
# - LOCATED IN AUXILIARY CONTROL ROOM
▲ - TEST SWITCH

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 0-47W611-67-1 R2
FIGURE 9.2-5

CAD MAINTAINED DRAWING



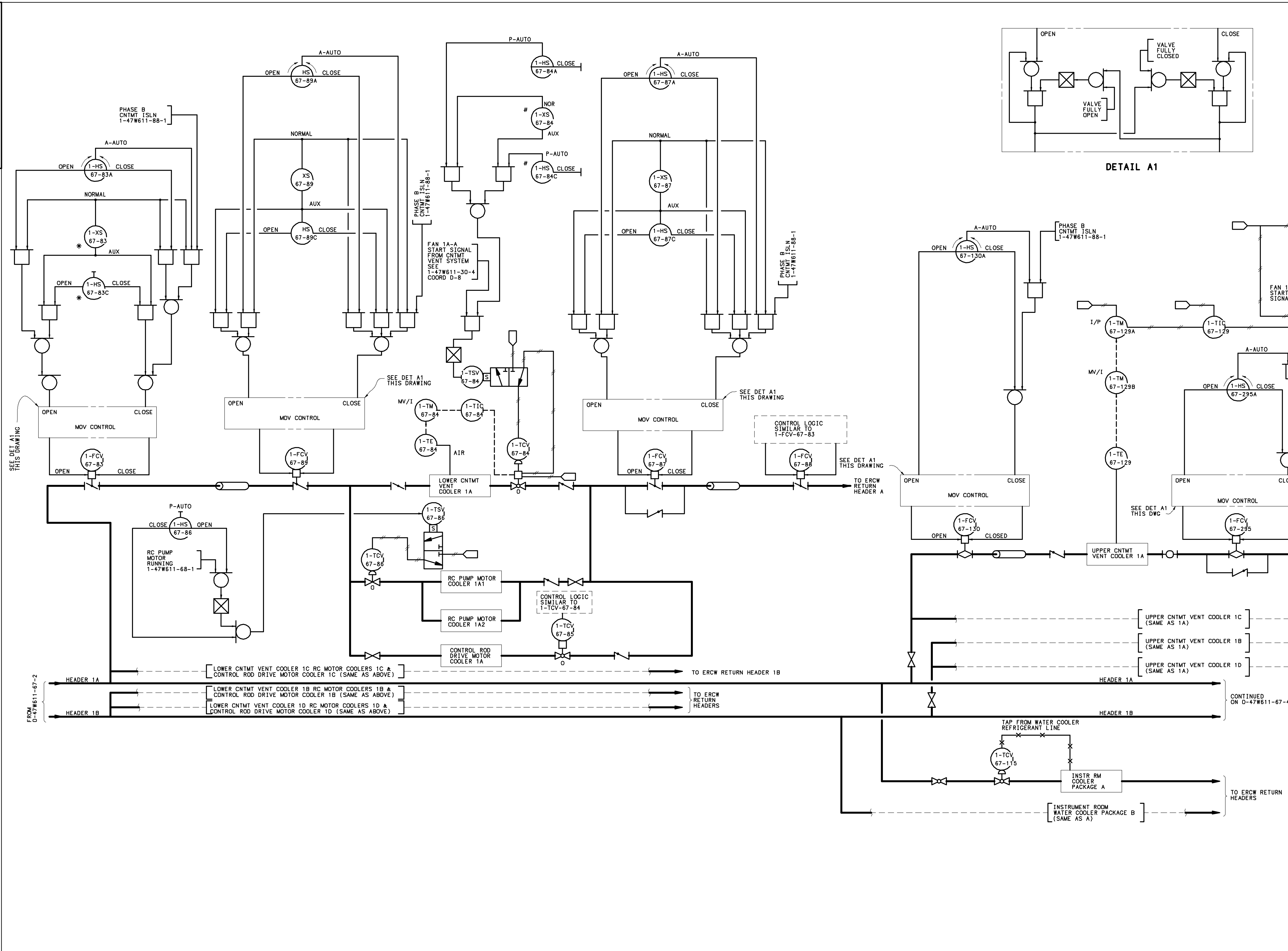
NOTES:

1. FOR SYMBOLS AND GENERAL NOTES, SEE O-47W611-67-1.
2. DIESEL GENERATOR OC-S IS A SPARE DIESEL THAT CAN BE CONNECTED TO REPLACE ANY OF THE OTHER DIESELS. OC-S WILL USE THE MCR CONTROLS OF THE DIESEL REPLACED.
3. THE HEAT EXCHANGER INLET MANUAL VALVES ARE TO BE POSITIONED TO ALIGN DIESEL OC-S TO THE SAME TRAIN HEADERS AS THE DIESEL BEING REPLACED.
4. VALVES 1 & 2-FCV-67-81, 1 & 2-FCV-67-82 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R).
5. THE LOGIC FOR 1-FCV-67-72 IS IDENTICAL TO 1-FCV-67-66 EXCEPT FOR A.) TIMER OLR IS 30 SECONDS, B.) 1-HS-67-66C IS REPLACED BY 1-HS-67-72A AND C.) RELAY CONTACT RO2 IS CONTROLLED BY 1-HS-67-66A. (1-HS-67-72A DOES NOT EXIST).
6. THE LOGIC FOR 2-FCV-67-73 IS IDENTICAL TO 1-FCV-67-68 EXCEPT FOR A.) 1-HS-67-68C IS REPLACED BY 2-HS-67-73A AND B.) RELAY CONTACTS RO1/RC1 ARE CONTOLLED BY 1-HS-67-68A (1-HS-67-73A DOES NOT EXIST).
7. THE CLOSING CIRCUIT OF MCR HAND SWITCHES 1- & 2-HS-67-66A AND 1- & 2-HS-67-67A ARE DELETED TO PREVENT SPURIOUS CLOSING OF VALVES 1- & 2-FCV-67-66 AND 1- & 2-FCV-67-67 IN CASE OF FIRE.
8. 1-FCV-67-72 AND 2-FCV-67-73 ARE POSITIONED OPEN AND POWER REMAINS REMOVED. ONLY THE OPEN FLOW PATH THROUGH THE VALVE IS MAINTAINED WITHIN CONFIGURATION CONTROL.
9. CHECK VALVES O-67-508A, O-67-508B, O-67-513A AND O-67-513B HAVE HAD THE INTERNALS REMOVED.

COMPANION DRAWINGS:
O-47W611-67-SERIES
1-47W611-67-SERIES
2-47W611-67-SERIES

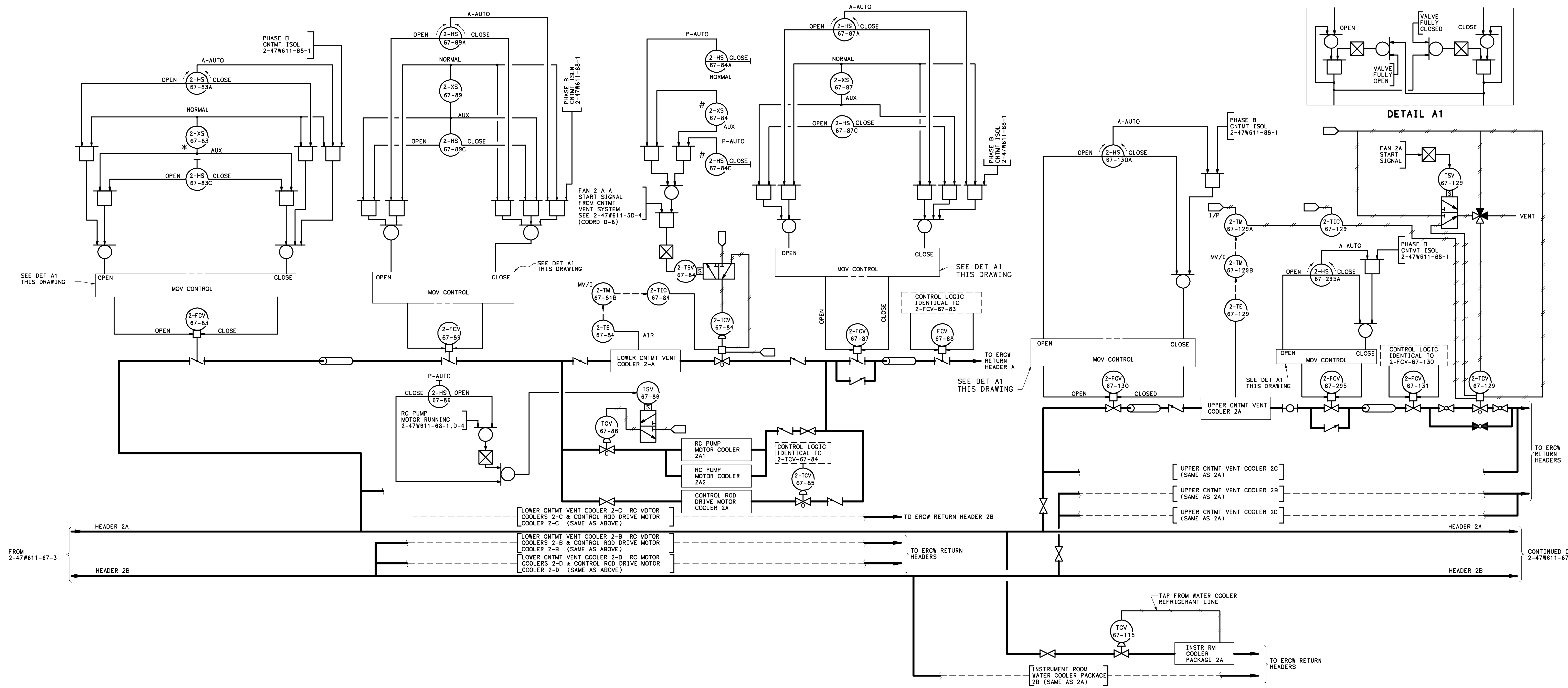
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. O-47W611-67-2 RO
FIGURE 9.2-6



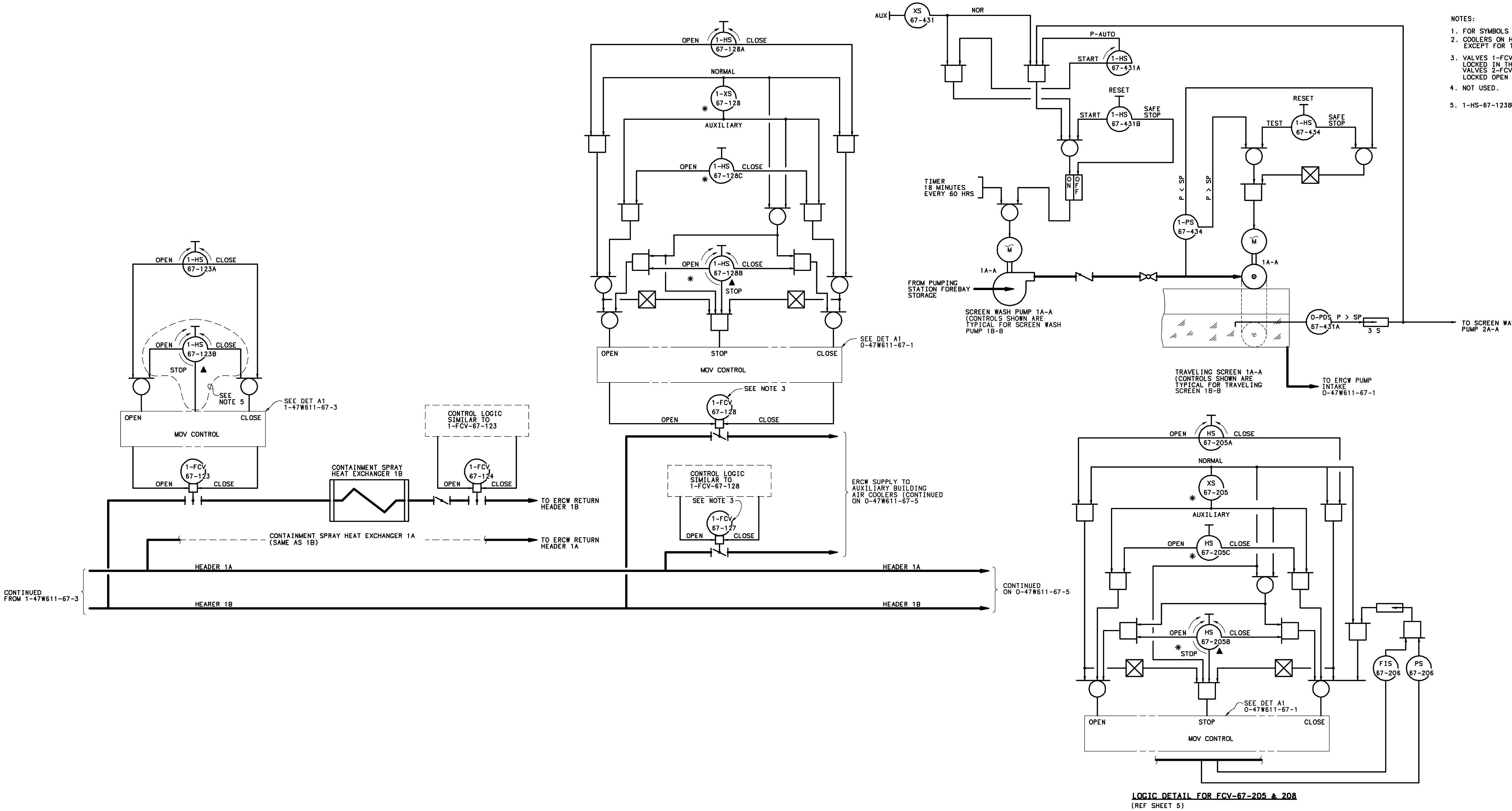
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 1-47W611-67-3 R6
FIGURE 9.2-7



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 2-47W611-67-3 R10
FIGURE 9.2-7(U2)

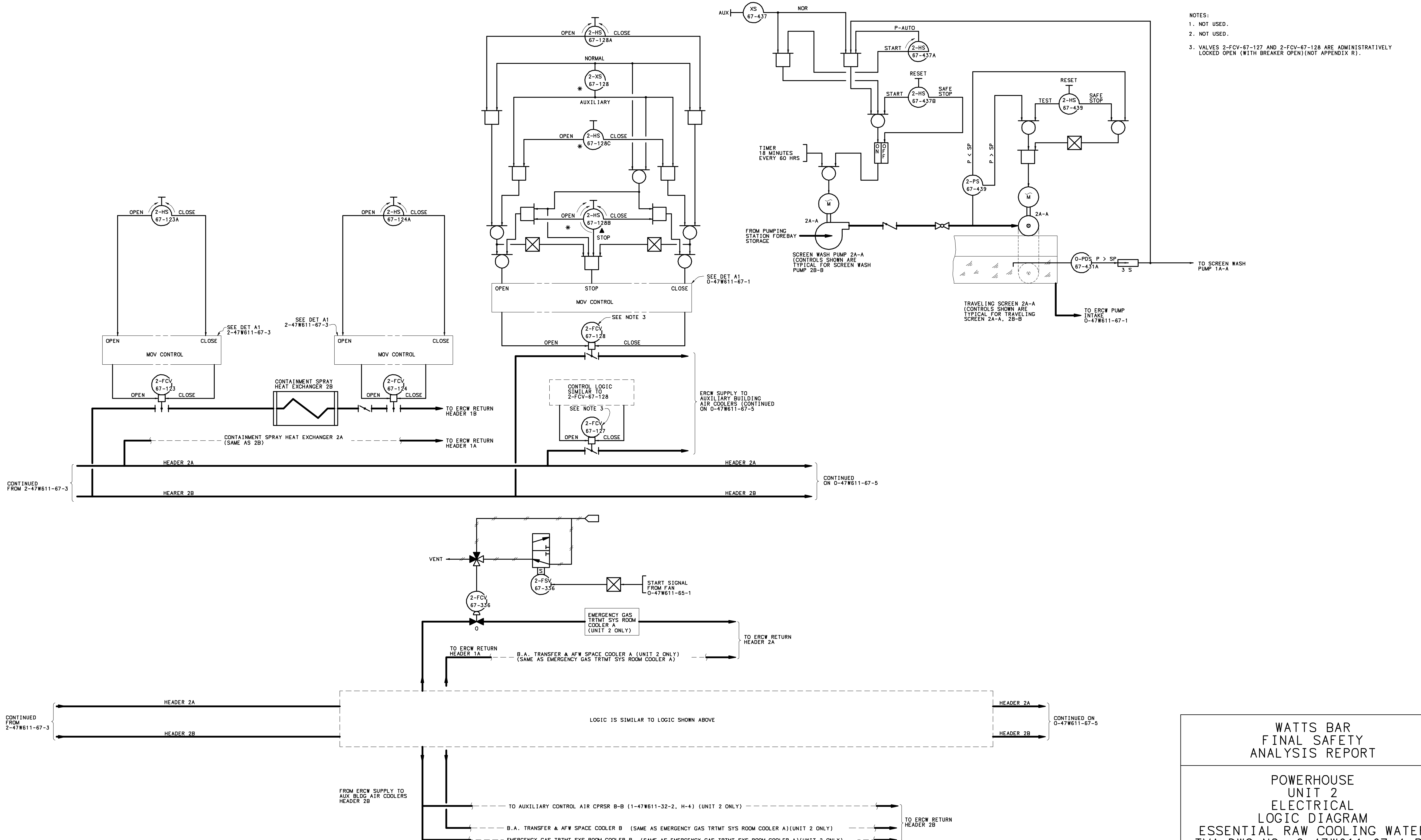


NOTES:

1. FOR SYMBOLS AND GENERAL NOTES, SEE 1-47W611-67-1.
2. COOLERS ON HEADERS 2A & 2B ARE SAME AS THOSE ON HEADERS 1A & 1B EXCEPT FOR THE UNIT 2 ONLY COOLERS.
3. VALVES 1-FCV-67-127 AND 1-FCV-67-128 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION (WITH BREAKER OPEN)(APPENDIX R). VALVES 2-FCV-67-127 AND 2-FCV-67-128 ARE ADMINISTRATIVELY LOCKED OPEN (WITH BREAKER OPEN)(NOT APPENDIX R).
4. NOT USED.
5. 1-HS-67-123B HAS BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

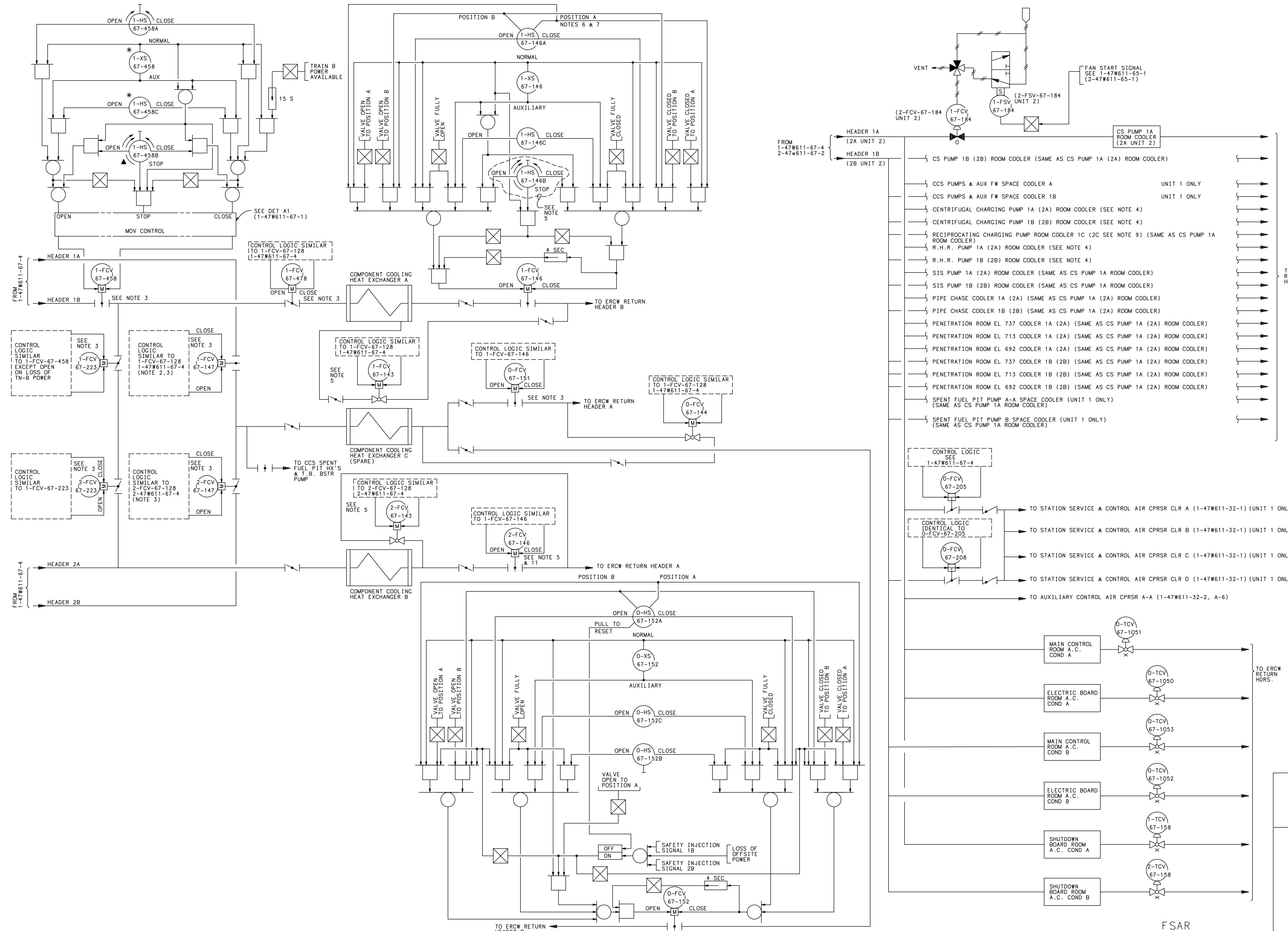
POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 1-47W611-67-4 R10
FIGURE 9.2-8



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 2-47W611-67-4 R4
FIGURE 9.2-8(U2)

CAD MAINTAINED DRAWING



NOTE:

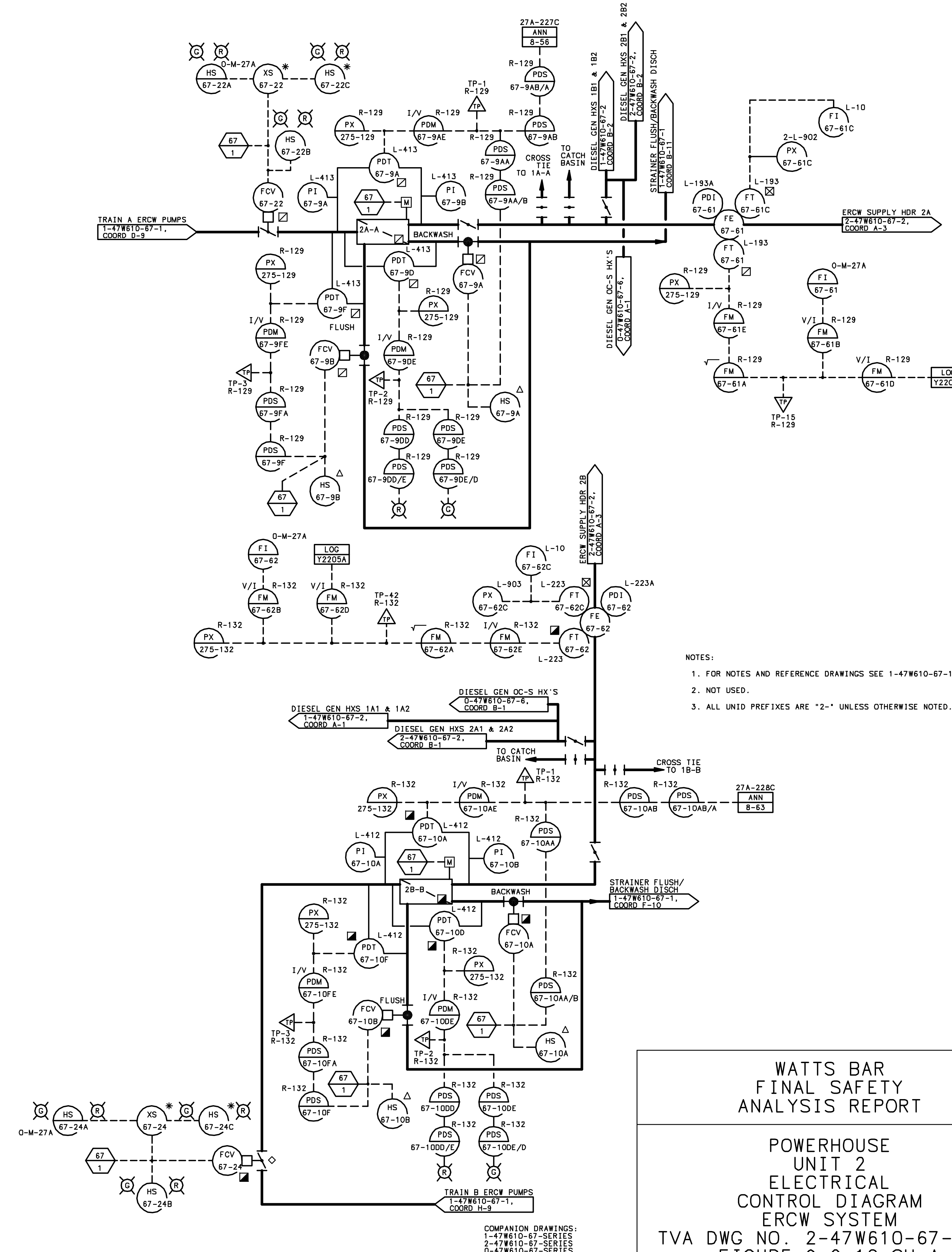
1. FOR SYMBOLS AND GENERAL NOTES SEE 0-47W611-67-1.
2. SEE ALSO 0-47W611-13-1.
3. VALVES 0-FCV-67-151, 1-FCV-67-147 AND 1-FCV-67-458 ARE ADMINISTRATIVELY LOCKED IN CLOSED POSITION AND VALVES ADMINISTRATIVELY 2-FCV-67-147, 1 & 2-FCV-67-223 AND 1-FCV-67-478 ARE LOCKED IN OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R).
4. 1 & 2-FSV-67-168, 170, 188 & 190 HAVE BEEN ELECTRICALLY DISCONNECTED AT THE MOTOR CONTROL CENTER DUE TO APPENDIX R INTERACTION.
5. 1-HS-67-143B, 2-HS-67-143B, 1-HS-67-146B, AND 2-HS-67-146B HAVE BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.
6. POSITION A: TO BE DETERMINED BY FLOW BALANCE TEST.
7. POSITION B: TO BE DETERMINED BY FLOW BALANCE TEST.
8. NOT USED.
9. ABANDONED IN PLACE FOR RECIPROCATING CHARGING PUMP ROOM COOLER 2C.

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
ESSENTIAL RAW COOLING WATER
TVA DWG NO. 0-47W611-67-5 R2
FIGURE 9.2-9

CAD MAINTAINED DRAWING



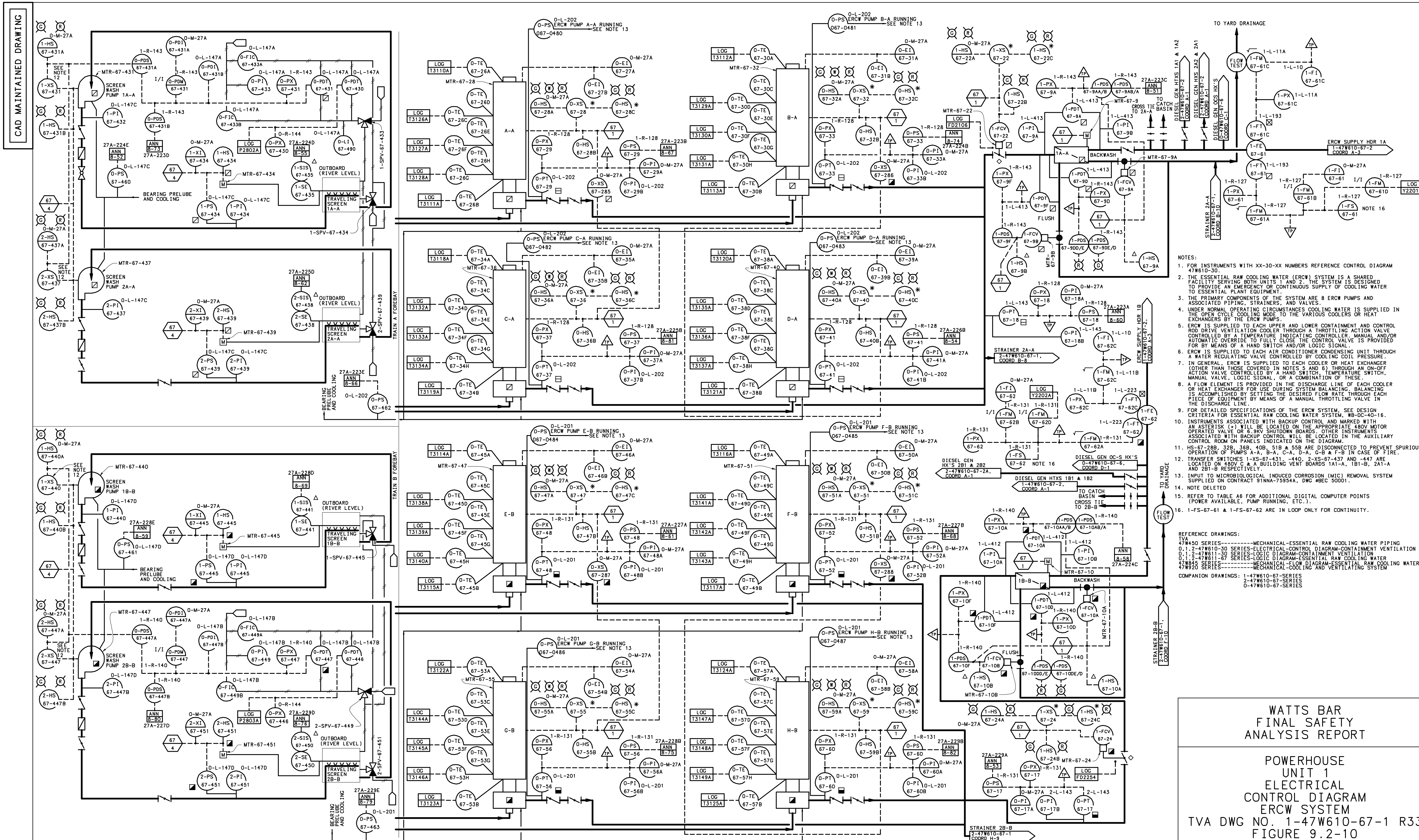
NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS SEE 1-47W610-67-1.
2. NOT USED.
3. ALL UNID PREFIXES ARE "2-" UNLESS OTHERWISE NOTED.

COMPANION DRAWINGS:
1-47W610-67-SERIES
2-47W610-67-SERIES
0-47W610-67-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 2-47W610-67-1 R6
FIGURE 9.2-10 SH A



NOTES:

1. FOR INSTRUMENTS WITH XX-30-XX NUMBERS REFERENCE CONTROL DIAGRAM 47W610-30.
2. THE ESSENTIAL RAW COOLING WATER (ERCW) SYSTEM IS A SHARED FACILITY SERVING BOTH UNITS 1 AND 2. THE SYSTEM IS DESIGNED TO PROVIDE AN EMERGENCY OR CONTINUOUS SUPPLY OF COOLING WATER TO ESSENTIAL PLANT EQUIPMENT.
3. THE PRIMARY COMPONENTS OF THE SYSTEM ARE 8 ERCW PUMPS AND ASSOCIATED PIPING, STRAINERS, AND VALVES.
4. UNDER NORMAL OPERATING CIRCUMSTANCES COOLING WATER IS SUPPLIED IN THE OPEN CYCLE COOLING MODE TO THE VARIOUS COOLERS OR HEAT EXCHANGERS BY THE ERCW PUMPS.
5. ERCW IS SUPPLIED TO EACH UPPER AND LOWER CONTAINMENT AND CONTROL ROD DRIVE VENTILATION COOLER THROUGH A THROTTLING ACTION VALVE CONTROLLED BY A TEMPERATURE INDICATING CONTROLLER. MANUAL AND/OR AUTOMATIC OVERRIDE TO FULLY CLOSE THE CONTROL VALVE IS PROVIDED FOR BY MEANS OF A HAND SWITCH AND/OR LOGIC SIGNAL.
6. ERCW IS SUPPLIED TO EACH AIR CONDITIONER CONDENSING UNIT THROUGH A WATER REGULATING VALVE CONTROLLED BY COOLING COIL PRESSURE.
7. IN GENERAL, ERCW IS SUPPLIED TO EACH COOLER OR HEAT EXCHANGER (OTHER THAN THOSE COVERED IN NOTES 5 AND 6) THROUGH AN ON-OFF ACTION VALVE CONTROLLED BY A HAND SWITCH, TEMPERATURE SWITCH, MANUAL VALVE, LOGIC SIGNAL, OR A COMBINATION OF THESE.
8. A FLOW ELEMENT IS PROVIDED IN THE DISCHARGE LINE OF EACH COOLER OR HEAT EXCHANGER FOR USE DURING SYSTEM BALANCING. BALANCING IS ACCOMPLISHED BY SETTING THE DESIRED FLOW RATE THROUGH EACH PIECE OF EQUIPMENT BY MEANS OF A MANUAL THROTTLING VALVE IN THE DISCHARGE LINE.
9. FOR DETAILED SPECIFICATIONS OF THE ERCW SYSTEM, SEE DESIGN CRITERIA FOR ESSENTIAL RAW COOLING WATER SYSTEM, WB-DC-40-16.
10. INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL AND MARKED WITH AN ASTERISK (*) WILL BE LOCATED ON THE APPROPRIATE 480V MOTOR OPERATED VALVE OR 6.9KV SHUTDOWN BOARDS. OTHER INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL WILL BE LOCATED IN THE AUXILIARY CONTROL ROOM ON PANELS INDICATED ON THE DIAGRAM.
11. HS-67-28B, 32B, 36B, 40B, 51B & 55B ARE DISCONNECTED TO PREVENT SPURIOUS OPERATION OF PUMPS A-A, B-A, C-A, D-A, G-B & F-B IN CASE OF FIRE.
12. TRANSFER SWITCHES 1-XS-67-431, -440, 2-XS-67-437 AND -447 ARE LOCATED ON 480V C & A BUILDING VENT BOARDS 1A1-A, 1B1-B, 2A1-A AND 2B1-B RESPECTIVELY.
13. INPUT TO MICROBIOLOGICAL INDUCED CORROSION (MIC) REMOVAL SYSTEM SUPPLIED ON CONTRACT 91NNA-75954A, DWG #BEC 50001.
14. NOTE DELETED
15. REFER TO TABLE A6 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
16. 1-FS-67-61 & 1-FS-67-62 ARE IN LOOP ONLY FOR CONTINUITY.

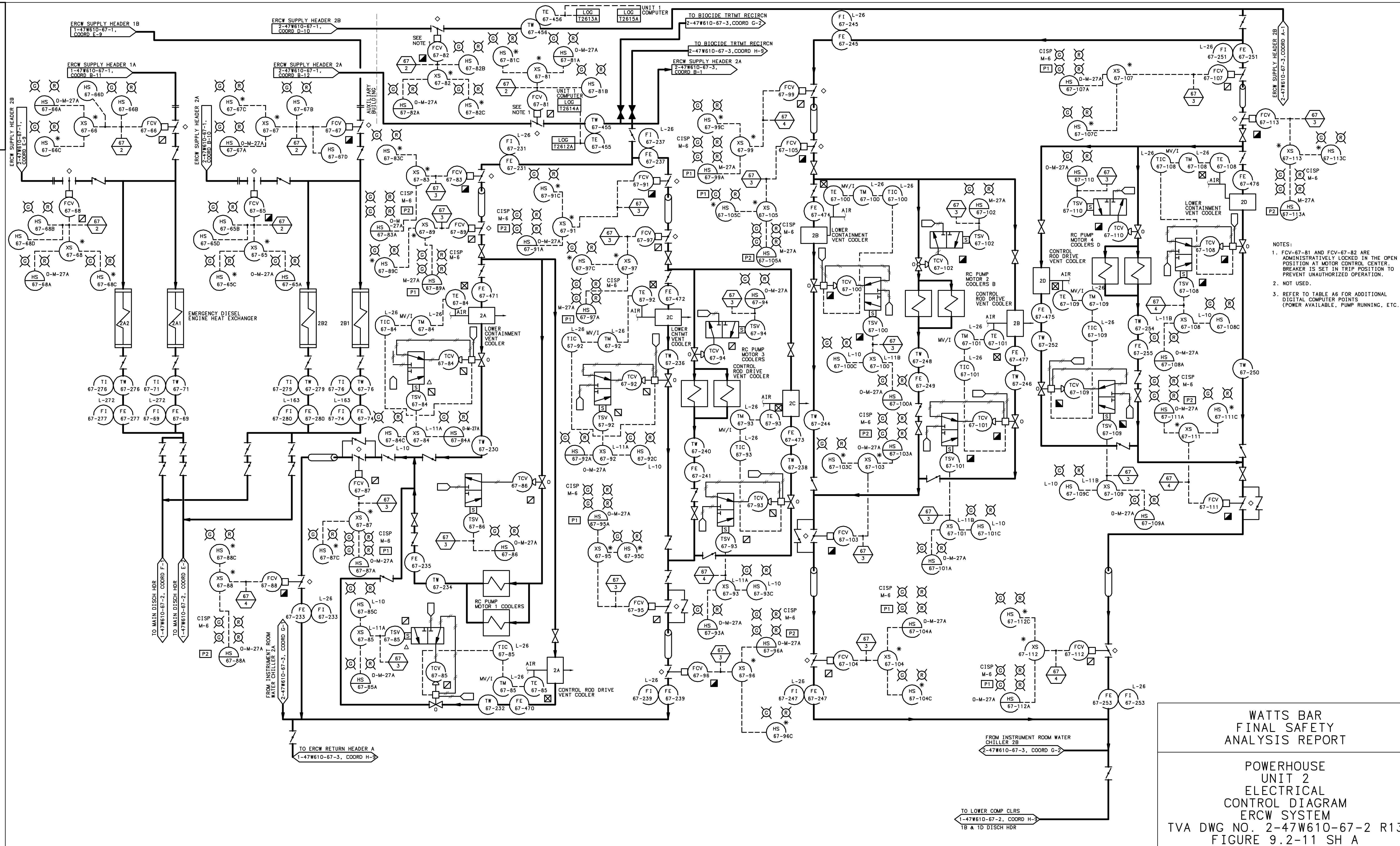
REFERENCE DRAWINGS:
TVA
47W450 SERIES----------MECHANICAL-ESSENTIAL RAW COOLING WATER PIPING
0,1,2-47W610-30 SERIES-ELECTRICAL-CONTROL DIAGRAM-CONTAINMENT VENTILATION
0,1,2-47W611-30 SERIES-LOGIC DIAGRAM-CONTAINMENT VENTILATION
0,1,2-47W611-67 SERIES-LOGIC DIAGRAM-ESSENTIAL RAW COOLING WATER
47W845 SERIES----------MECHANICAL-FLOW DIAGRAM-ESSENTIAL RAW COOLING WATER
47W920 SERIES----------MECHANICAL-COOLING AND VENTILATING SYSTEM

COMPANION DRAWINGS: 1-47W610-67-SERIES
2-47W610-67-SERIES
0-47W610-67-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 1-47W610-67-1 R33
FIGURE 9.2-10

CAD MAINTAINED DRAWING

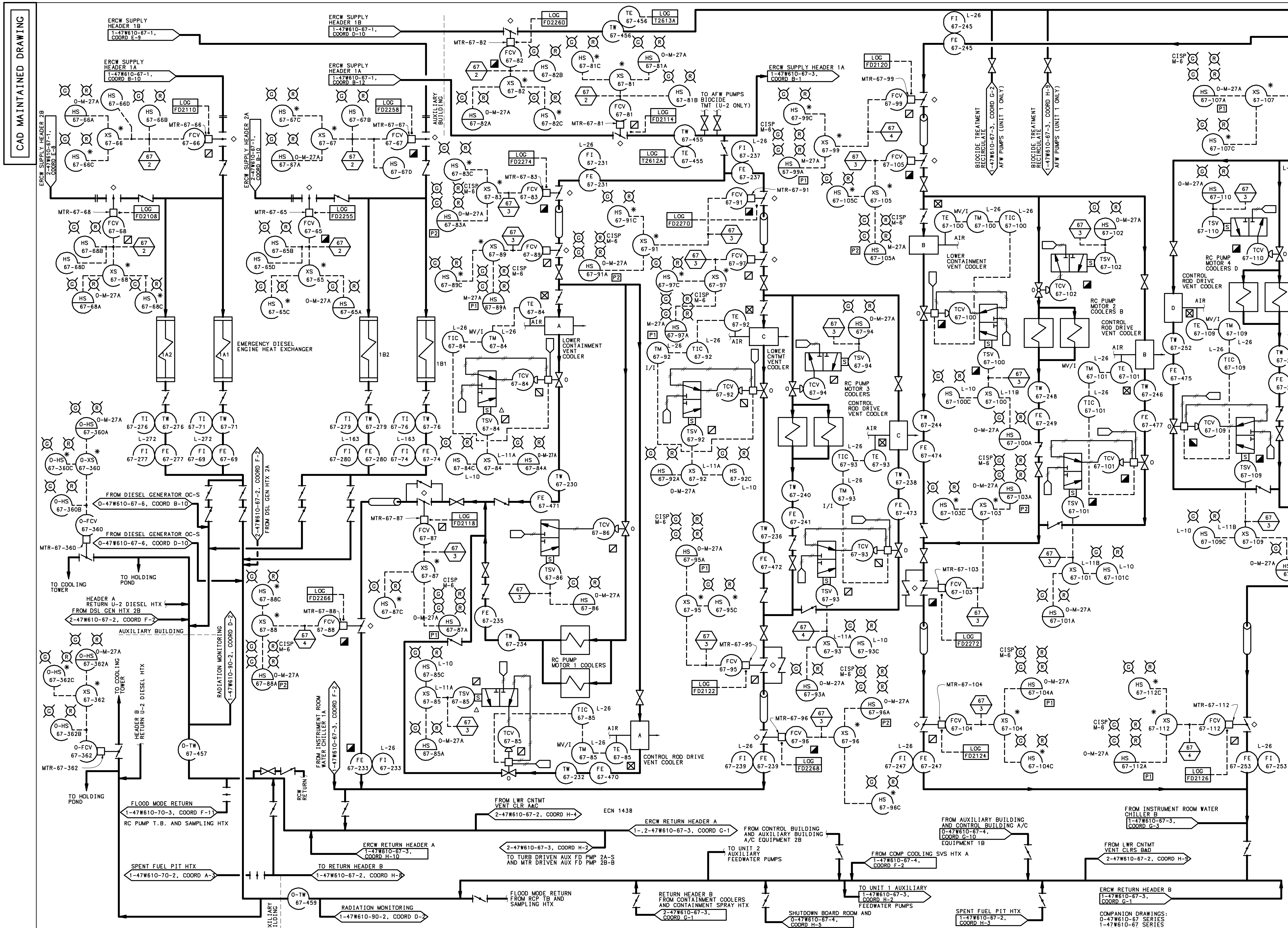


NOTES:

1. FCV-67-81 AND FCV-67-82 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION AT MOTOR CONTROL CENTER. BREAKER IS SET IN TRIP POSITION TO PREVENT UNAUTHORIZED OPERATION.
2. NOT USED.
3. REFER TO TABLE A6 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 2-47W610-67-2 R13
FIGURE 9.2-11 SH A

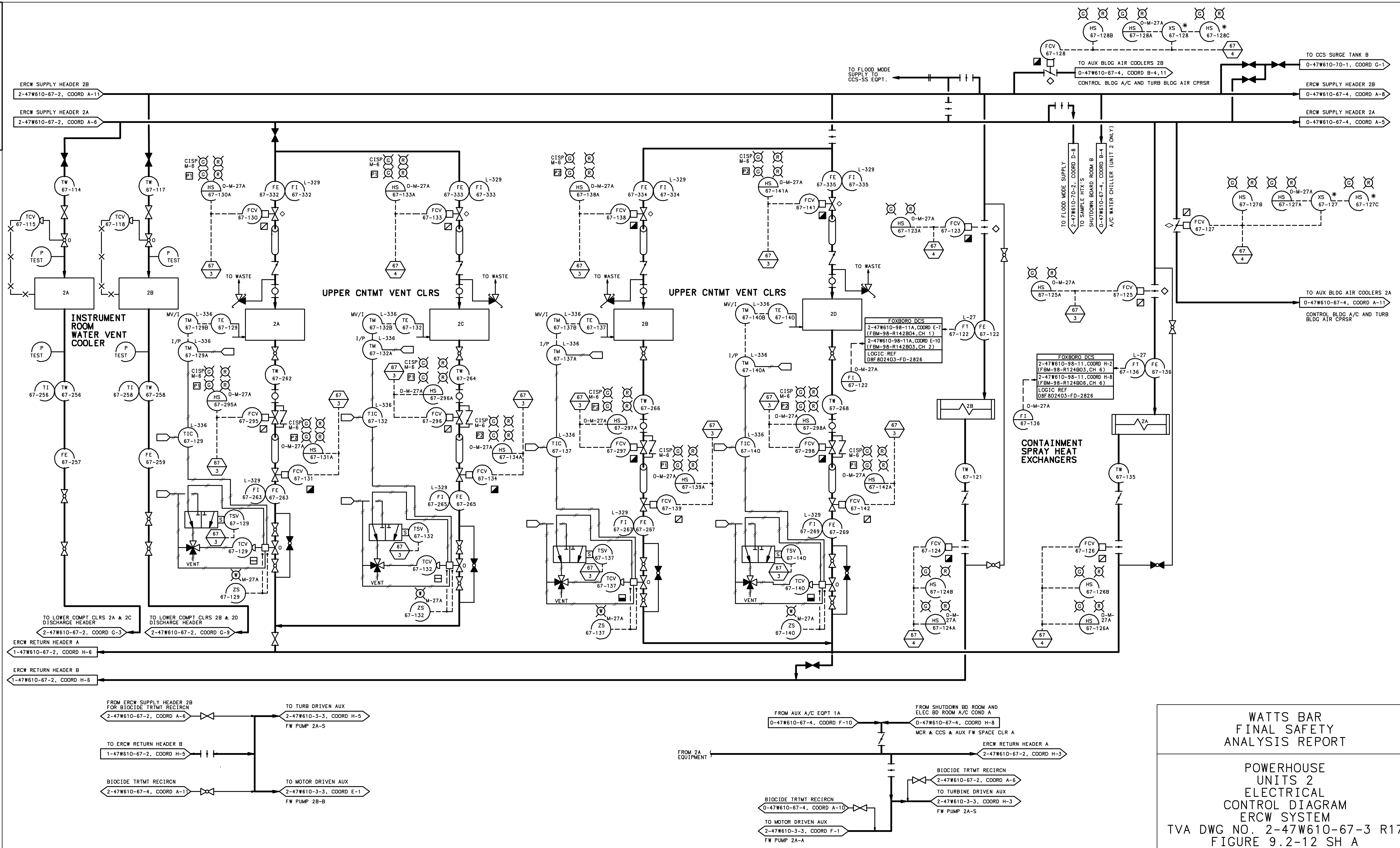


NOTES:

1. REFER TO TABLE A6 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

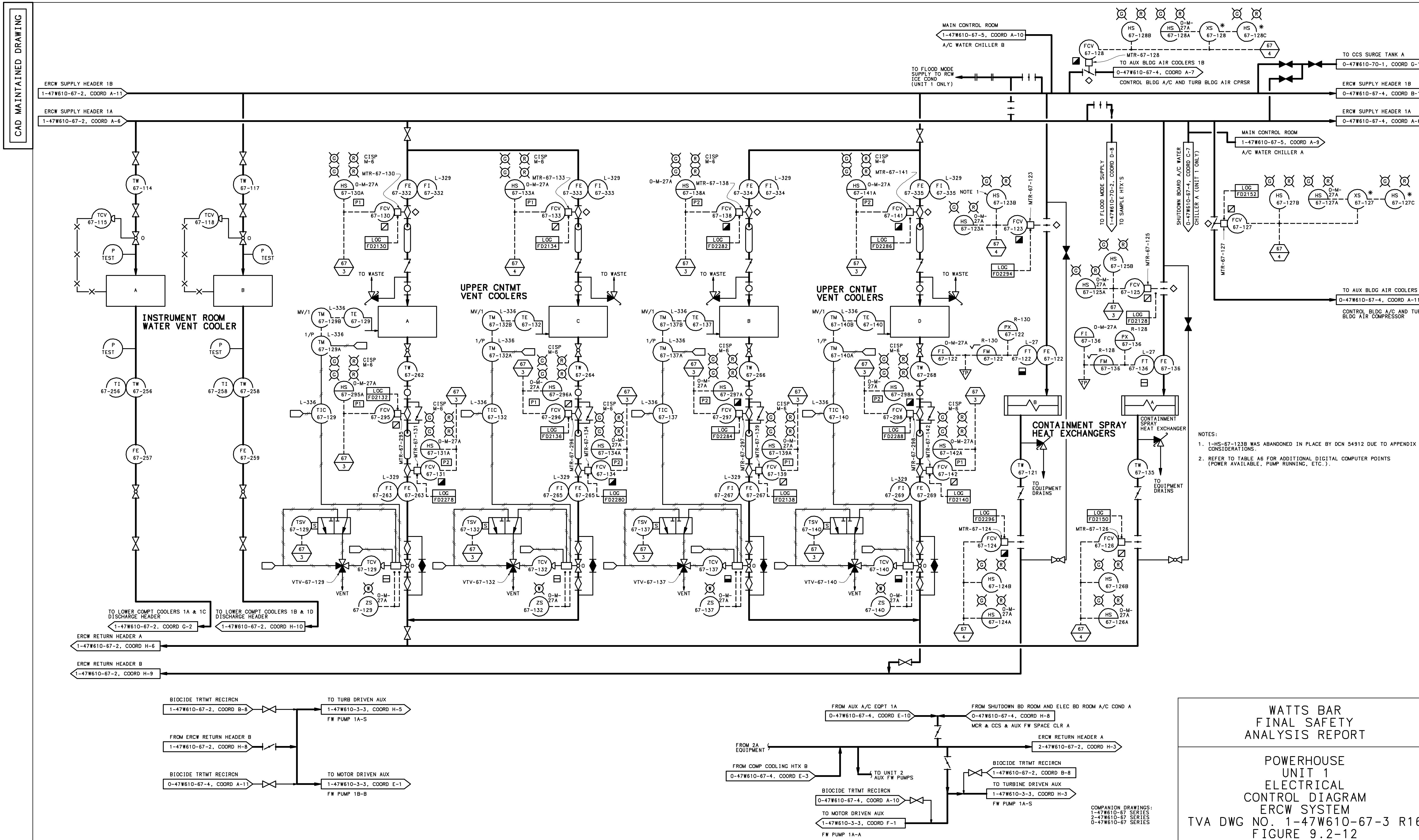
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 1-47W610-67-2 R22
FIGURE 9.2-11



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 2
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 2-47W610-67-3 R17
FIGURE 9.2-12 SH A

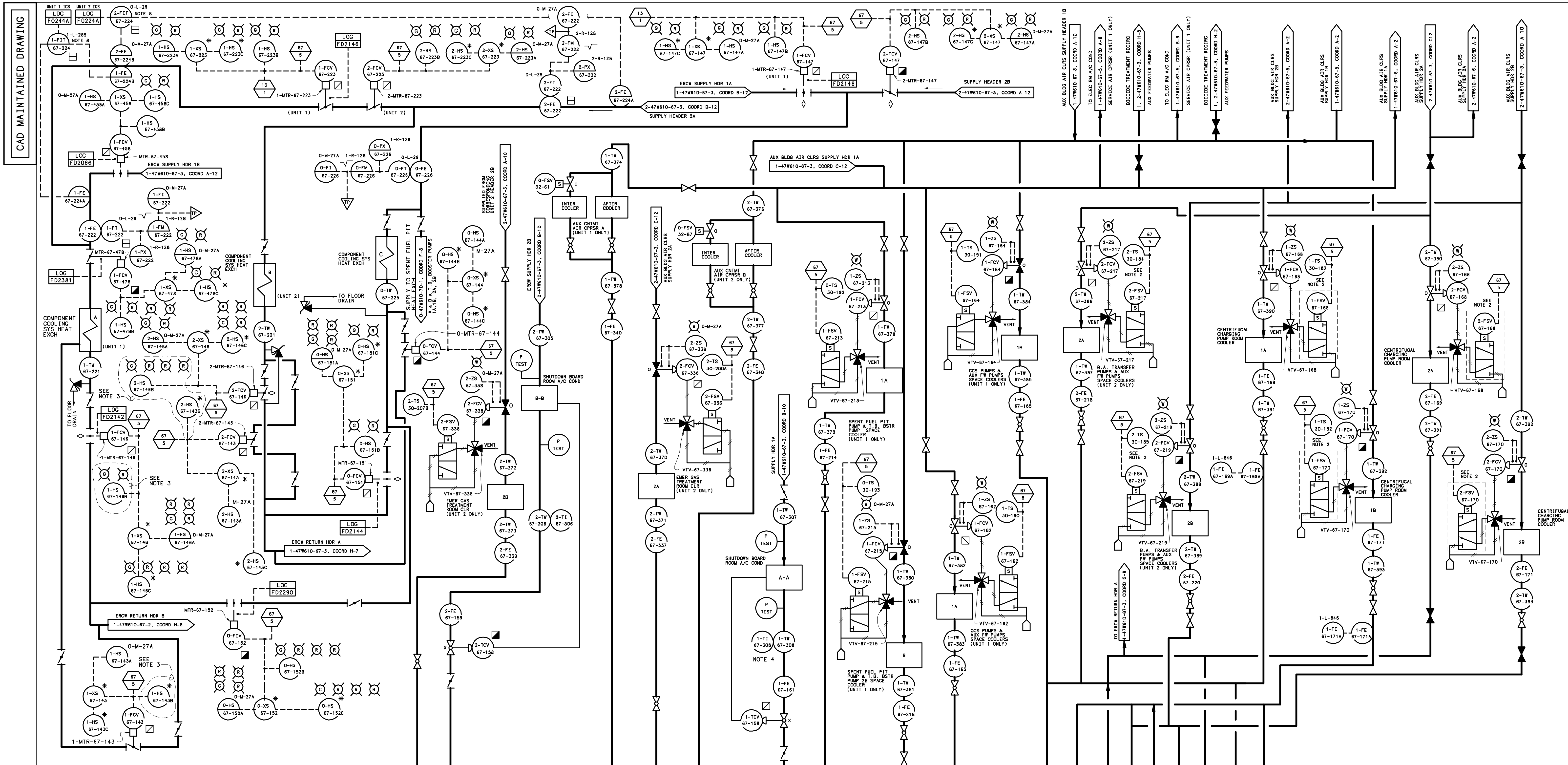


NOTES:

1. 1-HS-67-123B WAS ABANDONED IN PLACE BY DCN 54912 DUE TO APPENDIX R CONSIDERATIONS.
2. REFER TO TABLE A6 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 1-47W610-67-3 R16
FIGURE 9.2-12

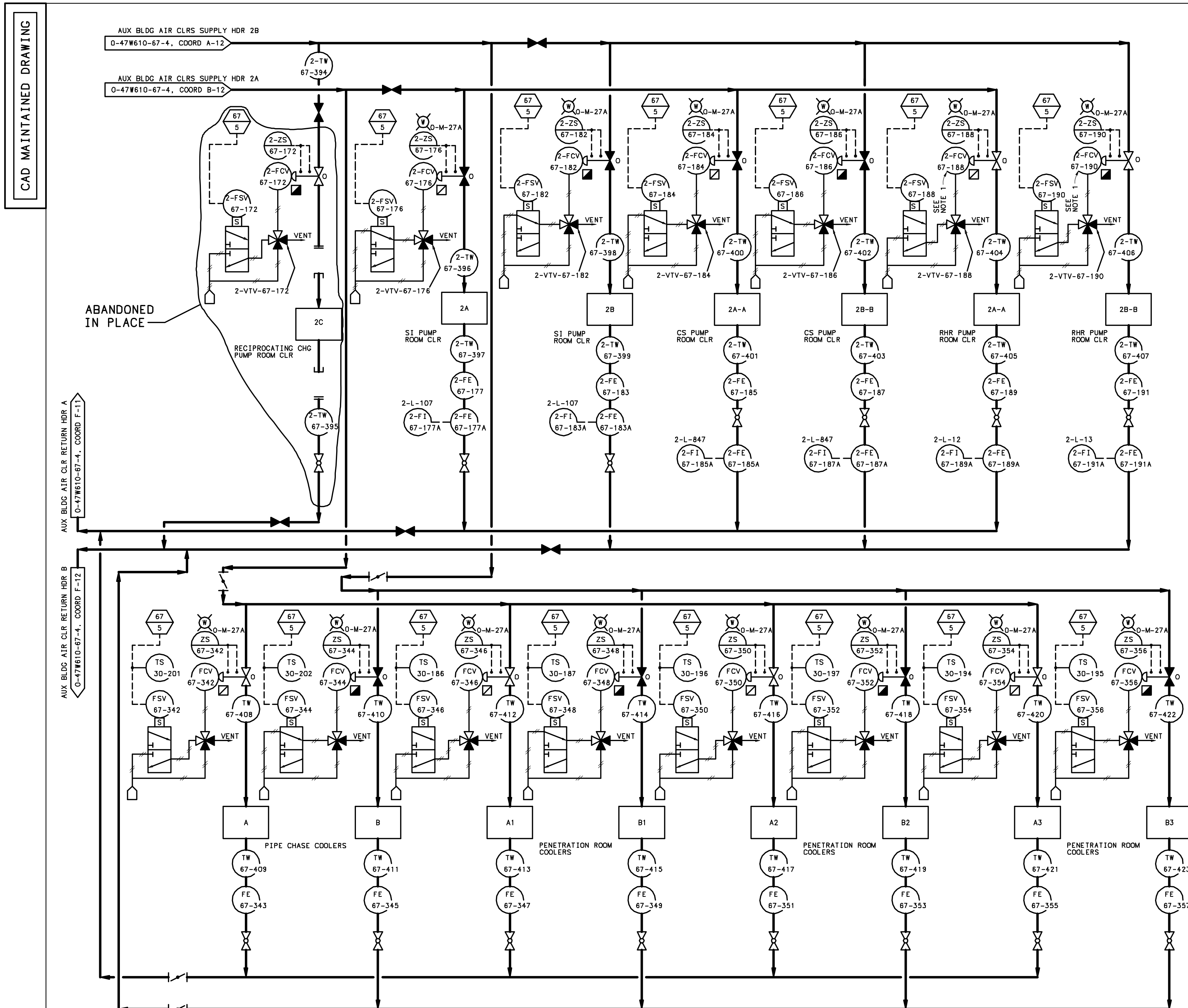


NOTES:

1. NOT USED
2. 1 AND 2-FSV-67-168 AND 1 AND 2-FSV-67-170 HAVE BEEN ELECTRICALLY DISCONNECTED AT THE MOTOR CONTROL CENTER DUE TO APPENDIX R INTERACTION.
3. 1-HS-67-143B, 2-HS-67-143B, 1-HS-67-146B, AND 2-HS-67-146B HAVE BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.
4. 1-TI-67-308 IS DAMAGED AND INACCESSIBLE AND HAS BEEN ABANDONED IN PLACE.
5. NOT USED
6. REFER TO TABLE A6 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
7. NOT USED.
8. 1-FE-67-224A, -224B, 2-FE-67-224A, AND -224B PROVIDE BIDIRECTIONAL FLOW MEASUREMENT. FLOWMETER 1-FIT-67-224 IS CONFIGURED TO DISPLAY AND OUTPUT THE SUM OF THE FLOW MEASURED BY SENSORS (FE). FLOWMETER 2-FIT-67-224 IS CONFIGURED TO DISPLAY AND OUTPUT THE MEASUREMENT OF 2-FE-67-224A MINUS 2-FE-57-224B.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

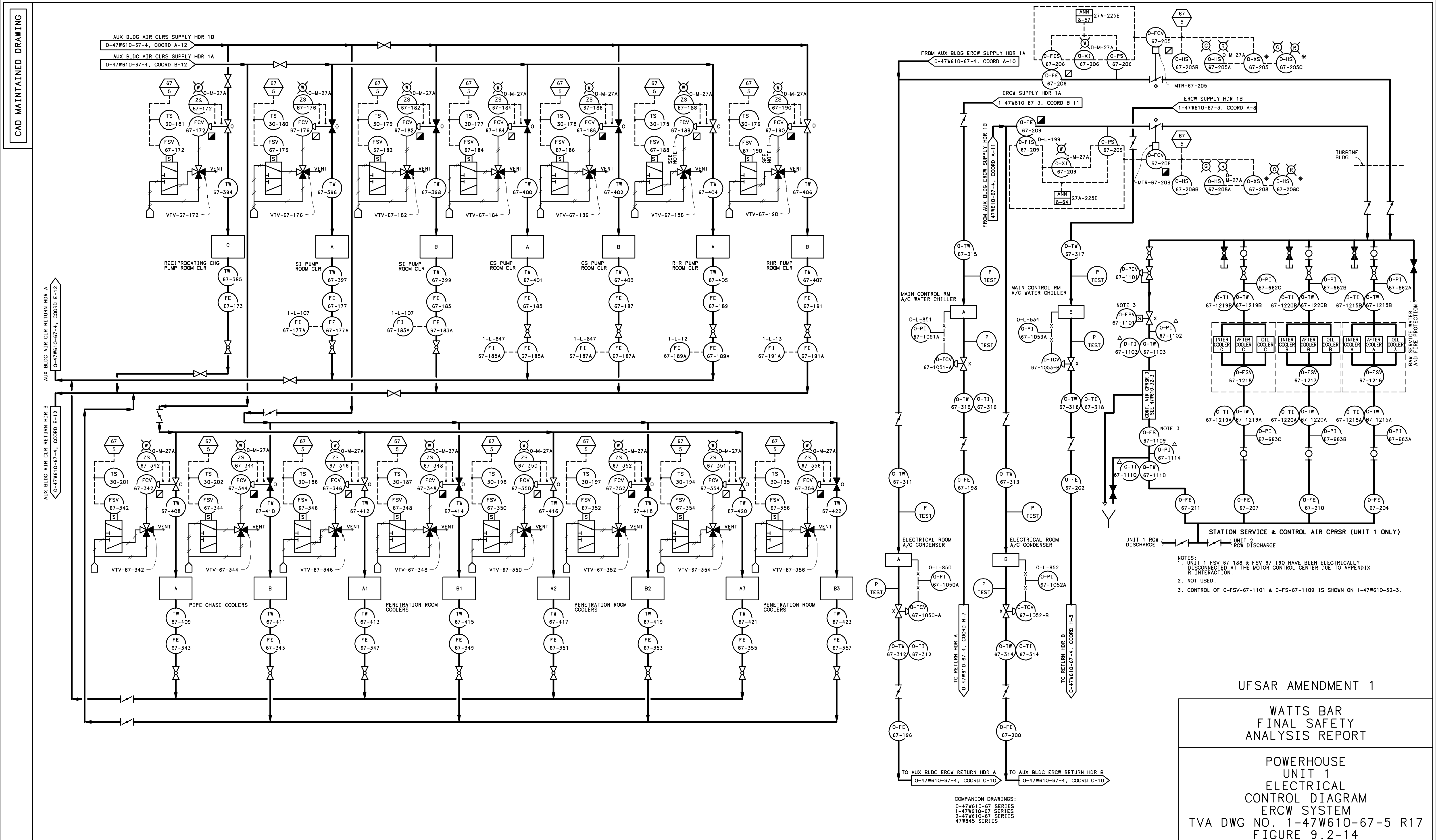
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 0-47W610-67-4 R1
FIGURE 9.2-13



NOTES:
1. 2-FSV-67-188 & 2-FSV-67-190 HAVE BEEN ELECTRICALLY DISCONNECTED AT THE MOTOR CONTROL CENTER DUE TO APPENDIX R INTERACTION.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 2-47W610-67-5 R10
FIGURE 9.2-14 SH A



UFSAR AMENDMENT 1

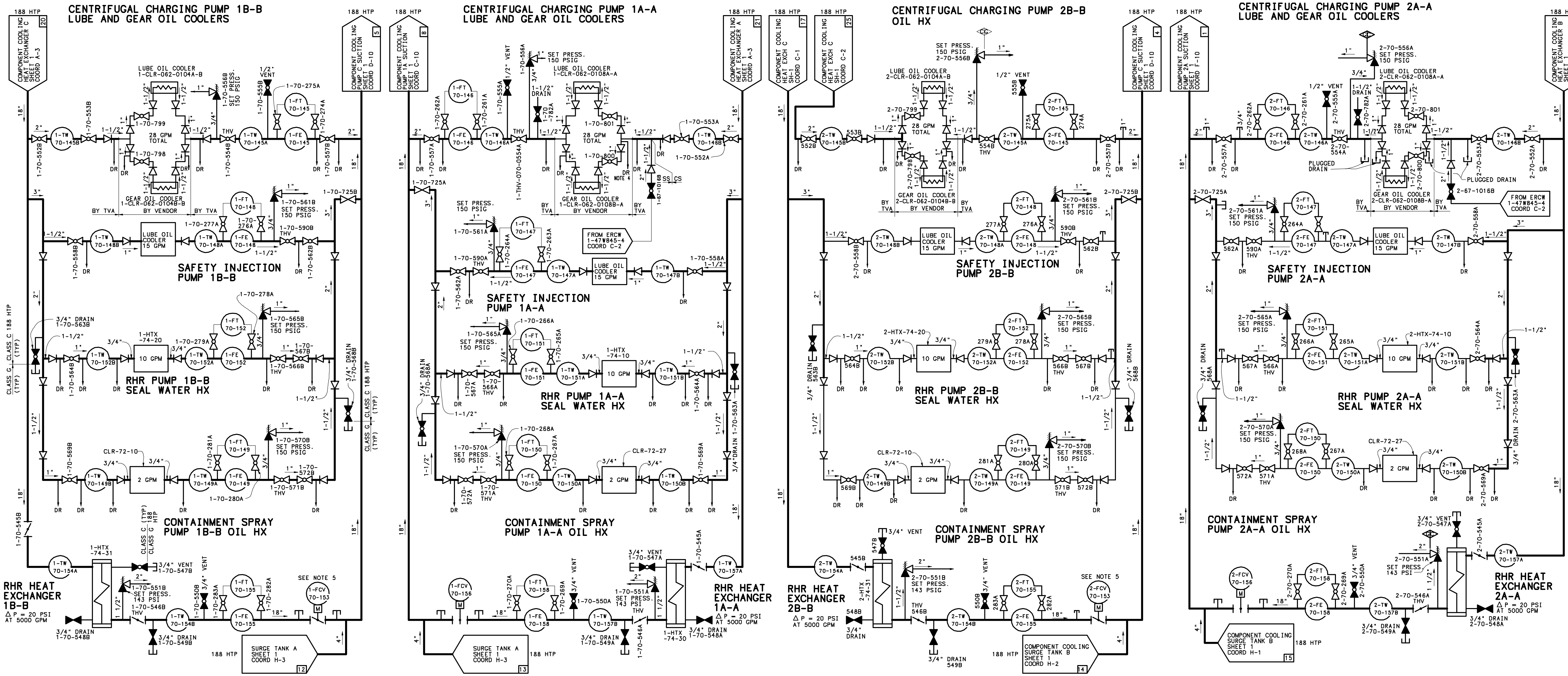
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
ERCW SYSTEM
TVA DWG NO. 1-47W610-67-5 R17
FIGURE 9.2-14

FIGURE 9.2-15

DELETED

CAD MAINTAINED DRAWING



NOTES:

1. NOT USED
2. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
3. NOT USED.
4. AUXILIARY ADAPTER MAY BE ADDED TO SUPPLY COOLING WATER FROM THE HPFP HOSE STATION.
5. VALVE POSITIONED AS NECESSARY TO BE THROTTLED , FULL OPEN, OR FULL CLOSED TO MAINTAIN REQUIRED CCS TRAIN B FLOW PATH. IF CONTINUOUSLY THROTTLED, VALVE POSITION IS TO BE SET SUCH THAT FLOW, AS INDICATED WITH FE-70-155, READS NO LESS THAN 2890 GPM. A FLOW OF 2,725 GPM IS ALLOWED DURING INFREQUENT OPERATION SUCH AS DURING CCS STARTUP TESTING OR DBE (WHEN NON-ACCIDENT UNIT IS IN REFUELING OR COLD SHUTDOWN MODE, IN CONJUNCTION WITH A LOOP AND LOSS OF TRAIN A).

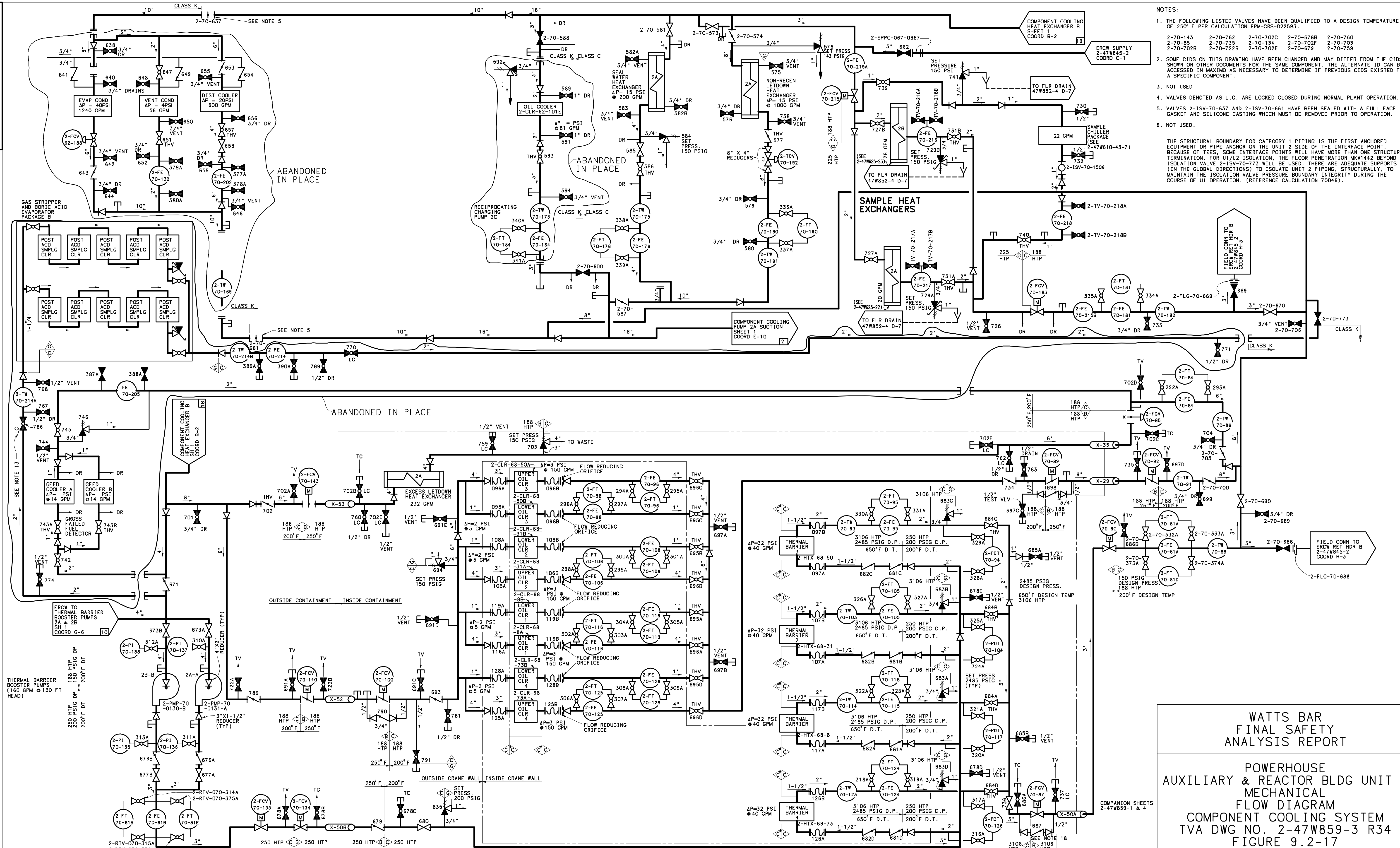
COMPANION DRAWINGS:

0-47W859-1, 1-47W859-2 & 2-47W859-3

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY BUILDING UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 0-47W859-4 R1
FIGURE 9.2-16

CAD MAINTAINED DRAWING



NOTES:

1. THE FOLLOWING LISTED VALVES HAVE BEEN QUALIFIED TO A DESIGN TEMPERATURE OF 250° F PER CALCULATION EPM-GRS-022593.

2-70-143	2-70-762	2-70-702C	2-70-678B	2-70-760
2-70-85	2-70-735	2-70-134	2-70-702F	2-70-703
2-70-702B	2-70-722B	2-70-702E	2-70-679	2-70-759

2. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

3. NOT USED

4. VALVES DENOTED AS L.C. ARE LOCKED CLOSED DURING NORMAL PLANT OPERATION.

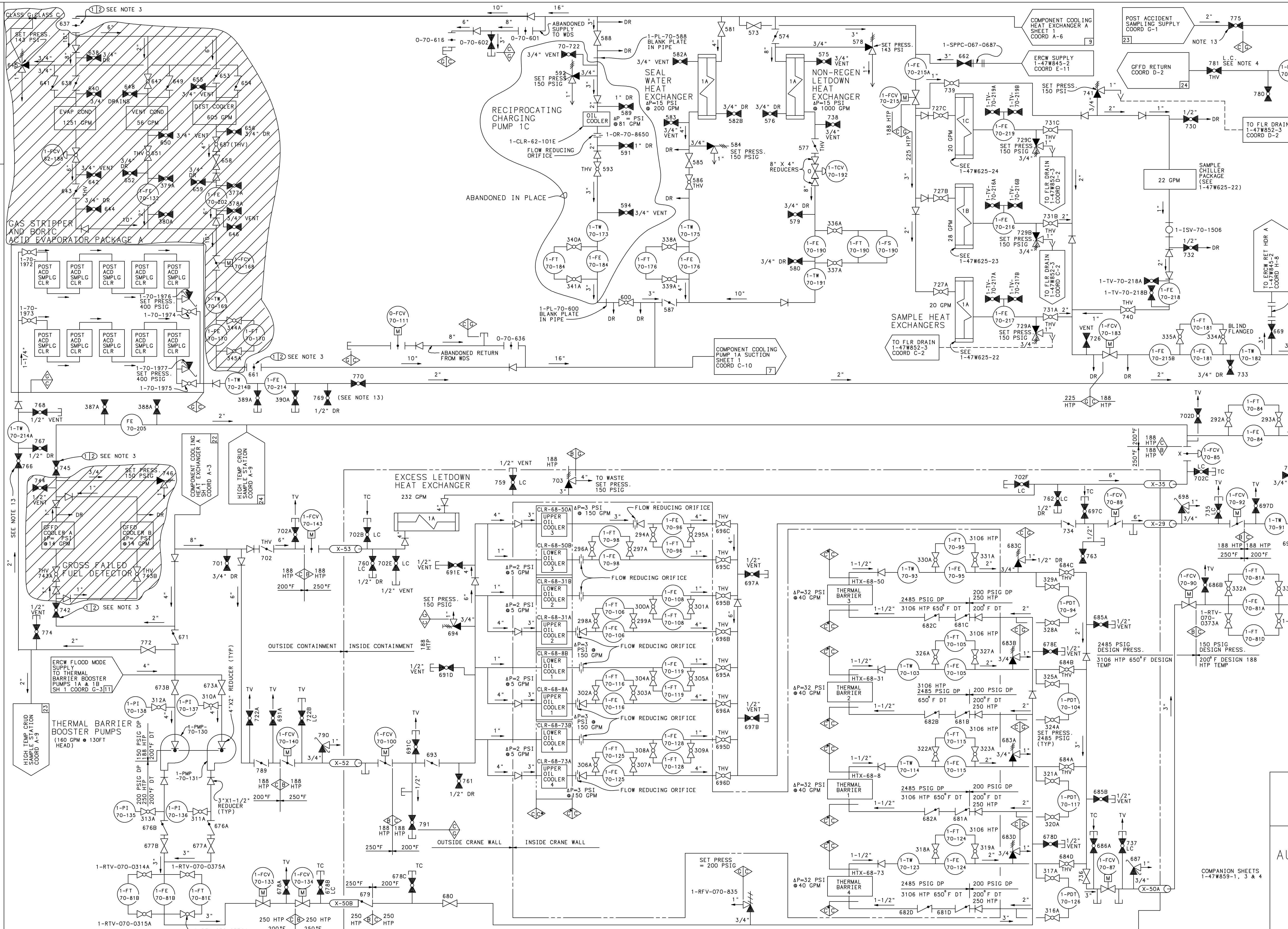
5. VALVES 2-ISV-70-637 AND 2-ISV-70-661 HAVE BEEN SEALED WITH A FULL FACE GASKET AND SILICONE CASTING WHICH MUST BE REMOVED PRIOR TO OPERATION.

6. NOT USED.

THE STRUCTURAL BOUNDARY FOR CATEGORY 1 PIPING IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION. FOR U1/U2 ISOLATION, THE FLOOR PENETRATION MK#1442 BEYOND ISOLATION VALVE 2-ISV-70-773 WILL BE USED. THERE ARE ADEQUATE SUPPORTS (IN THE GLOBAL DIRECTIONS) TO ISOLATE UNIT 2 PIPING, STRUCTURALLY, TO MAINTAIN THE ISOLATION VALVE PRESSURE BOUNDARY INTEGRITY DURING THE COURSE OF U1 OPERATION. (REFERENCE CALCULATION 70046).

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY & REACTOR BLDG UNIT 2
MECHANICAL
FLOW DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 2-47W859-3 R34
FIGURE 9.2-17



NOTES:

1. THE FOLLOWING LISTED VALVES HAVE BEEN QUALIFIED TO A DESIGN TEMPERATURE OF 250°F PER CALCULATION EPM-GRS-022593:

1-70-143	1-70-735
1-70-85	1-70-92
1-70-702B	1-70-140
1-70-702C	1-70-722B
1-70-702F	1-70-100
1-70-760	1-70-134
1-70-759	1-70-678B
1-70-762	1-70-679
1-70-89	1-70-703

2. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

3. VALVES MARKED WITH (1|2) ARE SAFETY RELATED UNIT 1/ UNIT 2 INTERFACE POINTS AND MUST BE LOCKED CLOSED. VALVES 1-ISV-70-637, AND 1-ISV-70-661 HAVE BEEN SEALED WITH A FULL FACE GASKET AND SILICONE CASTING WHICH MUST BE REMOVED PRIOR TO UNIT 2 OPERATION. THESE VALVES ARE TO BE CLOSED WITH THE HANDWHEELS REMOVED.

4. VALVES DENOTED AS L.C. ARE LOCKED CLOSED DURING NORMAL PLANT OPERATION.

COMPANION SHEETS 1-47W859-1, 3 & 4

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUXILIARY & REACTOR BLDG UNIT 1
MECHANICAL
FLOW DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 1-47W859-2 R43
FIGURE 9.2-18

CAD MAINTAINED DRAWING

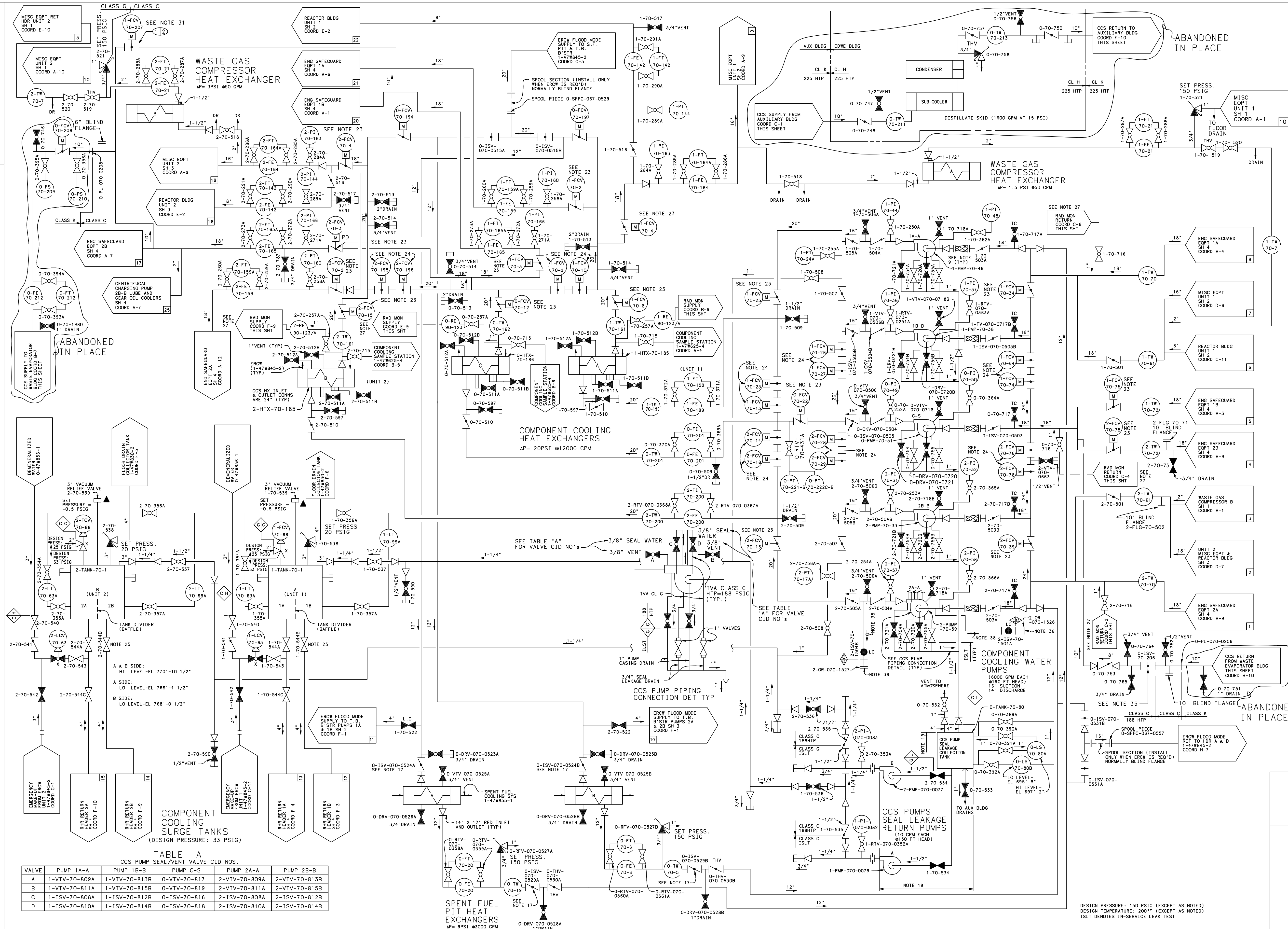


TABLE A

CCS PUMP SEAL/VENT VALVE CID NOS.

VALVE	PUMP 1A-A	PUMP 1B-B	PUMP C-S	PUMP 2A-A	PUMP 2B-B
A	1-VTV-70-809A	1-VTV-70-813B	0-VTV-70-817	2-VTV-70-809A	2-VTV-70-813B
B	1-VTV-70-811A	1-VTV-70-815B	0-VTV-70-819	2-VTV-70-811A	2-VTV-70-815B
C	1-ISV-70-808A	1-ISV-70-812B	0-ISV-70-816	2-ISV-70-808A	2-ISV-70-812B
D	1-ISV-70-810A	1-ISV-70-814B	0-ISV-70-818	2-ISV-70-810A	2-ISV-70-814B

DESIGN PRESSURE: 150 PSIG (EXCEPT AS NOTED)
DESIGN TEMPERATURE: 200°F (EXCEPT AS NOTED)
ISLT DENOTES IN-SERVICE LEAK TEST

COMPANION DRAWINGS: 1-47W859-2, 2-47W859-3 & 0-47W859-4

NOTES:

1. ALL VALVES ARE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
2. EXPLANATION OF VALVE AND INSTRUMENT NUMBERS:

INSTRUMENT NO.	1 (UNIT)	PCV (TYPE)	70 (SYSTEM)	100 (INSTRUMENT NO.)
VALVE NO.	1 (UNIT)	70 (SYSTEM)	100 (VALVE NO.)	

3. ALL VALVE AND INSTRUMENT NUMBERS ON A UNIT BASIS ARE PREFIXED WITH THE UNIT NUMBER I.E.,(1-) FOR UNIT 1 AND (2-) FOR UNIT 2. INSTRUMENTS AND VALVES COMMON TO BOTH UNITS PREFIXED WITH (0-).
4. MAIN PROCESS SYSTEM VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
5. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
6. ALL PIPING AND VALVES FOR CONTAINMENT ISOLATION ARE TVA CLASS B, THE REMAINDER OF SYSTEM PIPING AND VALVES ARE TVA CLASS C,G,H AND AS NOTED INSTRUMENT TAKEOFFS THRU THE FIRST VALVE ARE THE SAME TVA CLASS AS THE PROCESS PIPING.
7. ALL VALVE NUMBERS ON SHEET 2 ARE TO BE PREFIXED WITH 1-70 AND SHEET 3 WITH 2-70 UNLESS OTHERWISE SPECIFIED.
8. VALVES WITH AN "THV" ARE USED TO BALANCE SYSTEM FLOWS TO THE EQUIPMENT SERVICED.
9. STRAINERS ARE TO BE INSTALLED FOR USE DURING SYSTEM CLEAN UP AND REMOVED BEFORE NORMAL OPERATION BEGINS.
10. THE COMPONENT COOLING SYSTEM DESIGN PRESSURE IS 150 PSIG AND THE DESIGN TEMPERATURE IS 200°F, UNLESS OTHERWISE NOTED.
11. HTP-INDICATES THE HYDROSTATIC TEST PRESSURE-(PSIG) CONST SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST ASME CODE CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
12. ALL CLASS G PIPING IS SEISMICALLY SUPPORTED. HOWEVER THE HYDROSTATIC TEST IS NOT WITHIN THE QA PROGRAM. ALL CLASS H PIPING IN THE CDWE BUILDING IS SUPPORTED WITH 47A059 TYPICALS AND THE PRESSURE BOUNDARY IS NOT WITHIN THE QA PROGRAM. ALL PIPING DOWNSTREAM OF TEST, RELIEF, VENT, OR DRAIN VALVES WHICH OPEN TO ATMOSPHERE IS TVA PIPING CLASS G UNLESS OTHERWISE NOTED, AND IS NOT WITHIN THE PRESSURE BOUNDARY QA PROGRAM.
13. VALVES ARE TO REMAIN LOCKED CLOSED EXCEPT DURING SAMPLING OPERATIONS.
14. FOR CLASS C* DEFINITION, SEE CLASS C NOTE 4 ON 47B21-1.
15. FLOW CONTROL VALVES (FCV) MARKED WITH "PD" ARE ADMINISTRATIVELY LOCKED IN THE OPEN/CLOSED POSITION (SHOWN ON FLOW DIAGRAM) AT MOTOR CONTROL CENTER DUE TO APPENDIX R INTERACTION. BREAKERS ARE SET IN THE TRIP POSITION TO PREVENT UNAUTHORIZED OPERATION.
16. FOR DEFINITION OF SYMBOLS OF "LC." OR "LO", REFER TO MEMO B26850402001.
17. VALVES 0-ISV-70-524A, 524B, 529A AND 529B AT THE SPENT FUEL PIT HX CAN BE PARTIALLY OPEN TO ASSIST THE THVs IN THROTTLING TO MAINTAIN SYSTEM FLOW BALANCE AND MINIMIZE NOISE.
18. THE MAXIMUM OPERATING TEMPERATURE OF THE SOFT SEATS IS 300F. HOWEVER, BECAUSE VALVE 2-CKV-70-687 IS LOCATED ON THE THERMAL BARRIER, THE FLUID TEMPERATURE IN THE HEADER COULD EXCEED 300F IN THE EVENT OF A THERMAL BARRIER LEAK. SHOULD THIS EVENT OCCUR, MAINTENANCE SHALL BE PERFORMED.
19. THIS VENDOR SUPPLIED SKID MOUNTED EQUIPMENT HAS BEEN DETERMINED TO BE ACCEPTABLE FOR USE WITH THE DESIGN PARAMETERS OUTLINED IN NOTE 10. SEE CALCULATION NO. EPM-MJD-051289 / WBN-70-D053 / MEB-WBN-70, REV. 0. REFERENCE DRAWING 1-821338-104
20. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
    N3-70-4002- - - - -COMPONENT COOLING SYSTEM DESCRIPTION
21. VALVES 2-ISV-70-516, -574, -587, -705, AND 2-FCV-70-92 HAVE BEEN FITTED WITH A 1/16 INCH THICK NEOPRENE RUBBER GASKET FULL SHEET WHICH EXTENDS OVER THE UNIT 1 SIDE OF THE VALVE DISC. THE SPACE BETWEEN THE GASKET AND THE VALVE DISC IS FILLED WITH A CASTING MADE OF SYLGARD 170 A & B SILICONE ELASTOMER. PRIOR TO UNIT 2 FUEL LOAD FULL FUNCTION OF THESE VALVES WILL BE RESTORED, REFERENCE DCN P-05634.
22. TEMPORARY CONDITION FOR VALVE UNTIL UNIT 2 OPERATION.
23. VALVE IS ADMINISTRATIVELY LOCKED IN THE OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R)
24. VALVE IS ADMINISTRATIVELY LOCKED IN THE CLOSED POSITION. (WITH BREAKER OPEN) (APPENDIX R)
25. THE PREFERRED ALIGNMENT FOR ISOLATION VALVES 1,2-ISV-70-544B IS OPEN. EITHER ISOLATION VALVE 1-ISV-70-544B OR 2-ISV-70-544B MAY BE CLOSED DURING MODES 1-6. ONE OF THE TWO VALVES MUST ALWAYS REMAIN OPEN DURING MODES 1-6. THE CLOSED VALVE MUST BE OPENED IF EMERGENCY SURGE TANK MAKEUP WATER IS REQUIRED FROM ERCW.
26. NOT USED
27. TYPICAL CONTROLS FOR CCS LIQUID EFFLUENT (RADIATION) MONITORS 0, 1, 2-RE-90-123 ARE DEPICTED ON 1-47W610-90-2.
29. VALVE IS ADMINISTRATIVELY LOCKED IN CLOSED POSITION. (APPENDIX R)
30. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
31. VALVES MARKED WITH (1|2) ARE SAFETY RELATED UNIT 1/UNIT 2 INTERFACE POINTS AND MUST BE LOCKED CLOSED. 1-FCV-70-207 HAS BEEN SEALED WITH A FULL FACE GASKET AND SILICONE CASTING WHICH MUST BE REMOVED PRIOR TO ITS USE.
32. THIS SYMBOL ▲ INDICATES THE COMPONENT MAY BE REPLACED WITH A COMMERCIAL GRADE ITEM IN AN ASME SECTION III SYSTEM IN ACCORDANCE WITH NRC GENERIC LETTER 89-09.
33. VALVE IS ADMINISTRATIVELY LOCKED IN THE OPEN POSITION, WITH BREAKER OPEN (NOT FOR APPENDIX R).
34. NOT USED.
35. CABLES TO THE FORMER MOTOR ACTUATOR FOR 0-ISV-70-206 ARE DISCONNECTED COILED, AND TAPED.
36. TEMPORARY HOSE TO BE CONNECTED AT THIS FITTING DURING FILTERING ACTIVITIES WITH FILTER SKID 0-FLTR-70-1511.
37. LC DENOTES A VALVE THAT IS IN THE LOCKED CLOSED POSITION.
38. THE FLOW DIRECTION ARROWS ONLY APPLY WHEN THE FILTER IS IN OPERATION.

REFERENCE DRAWINGS:

47W464 SERIES- - - - - -COMPONENT COOLING SYSTEM PIPING
1-47W800-1 - - - - - - - -GENERAL PLANT SYSTEM FLOW DIAGRAM
1-47W610-70-1,2,& 3- - -COMPONENT COOLING SYSTEM CONTROL DIAGRAM
47W611-70-1,2,& 3- - - -COMPONENT COOLING SYSTEM LOGIC DIAGRAM
47B601-70 SERIES - - - -SERIES INSTRUMENT TABULATION
47W859-100 SERIES- - - -STRESS ANALYSIS PROBLEM BOUNDARY
1-47W610-90-2- - - - - -RADIATION MONITORING SYSTEM CONTROL DIAGRAM

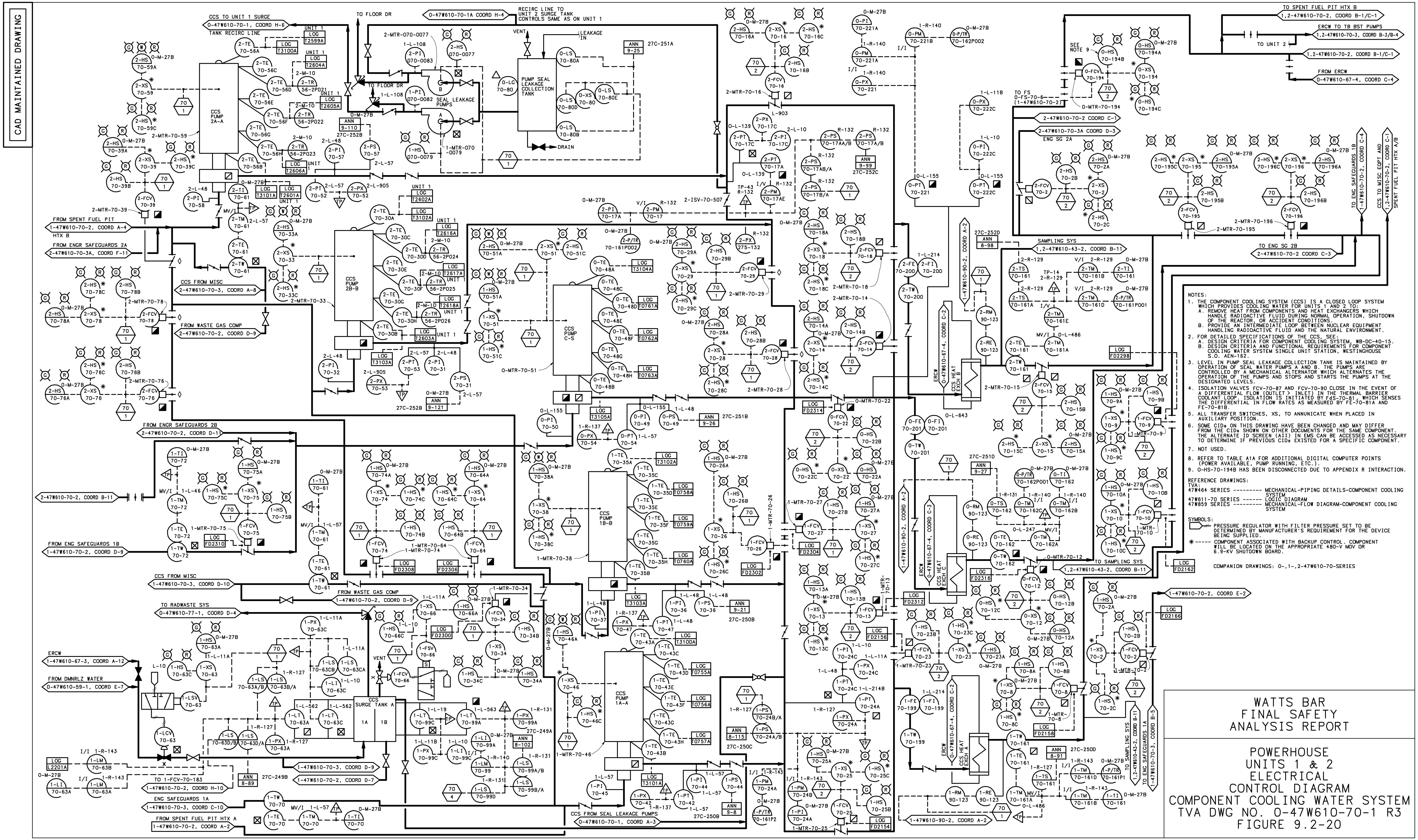
LEGEND:

- - - - - 1/2" NPT PLUG OR CAP TYPE DRAIN
TC - - - - - - - - - - 1/2" TEST CONNECTION
TV - - - - - - - - - - 1/2" TEST VENT
INDICATES MATCH NUMBER
1-FCV 70-75 M PD--SEE NOTE 15
- CLEAN UP STRAINER (SEE NOTE 9)

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
AUX BLDG UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 0-47W859-1 R7
FIGURE 9.2-19



NOTES:

1. THE COMPONENT COOLING SYSTEM (CCS) IS A CLOSED LOOP SYSTEM WHICH PROVIDES COOLING WATER FOR UNITS 1 AND 2 TO:
   A. REMOVE HEAT FROM COMPONENTS AND HEAT EXCHANGERS WHICH HANDLE RADIOACTIVE FLUID DURING NORMAL OPERATION, SHUTDOWN OF THE REACTOR, OR ACCIDENT CONDITIONS.
   B. PROVIDE AN INTERMEDIATE LOOP BETWEEN NUCLEAR EQUIPMENT HANDLING RADIOACTIVE FLUID AND THE NATURAL ENVIRONMENT.
2. FOR DETAILED SPECIFICATIONS OF THE CCS, SEE:
   A. DESIGN CRITERIA FOR COMPONENT COOLING SYSTEM, WB-DC-40-15.
   B. DESIGN CRITERIA AND FUNCTIONAL REQUIREMENTS FOR COMPONENT COOLING WATER SYSTEM SINGLE UNIT STATION, WESTINGHOUSE S.O. AEN-162.
3. LEVEL IN PUMP SEAL LEAKAGE COLLECTION TANK IS MAINTAINED BY OPERATION OF SEAL WATER PUMPS A AND B. THE PUMPS ARE CONTROLLED BY A MECHANICAL ALTERNATOR WHICH ALTERNATES THE OPERATION OF THE PUMPS AND STOPS AND STARTS THE PUMPS AT THE DESIGNATED LEVELS.
4. ISOLATION VALVES FCV-70-87 AND FCV-70-90 CLOSE IN THE EVENT OF A DIFFERENTIAL FLOW (OUTLET > INLET) IN THE THERMAL BARRIER COOLANT LOOP. ISOLATION IS INITIATED BY FdS-70-81, WHICH SENSES THE DIFFERENTIAL IN FLOW RATES AS MEASURED BY FE-70-81A AND FE-70-81B.
5. ALL TRANSFER SWITCHES, XS, TO ANNUNICATE WHEN PLACED IN AUXILIARY POSITION.
6. SOME CIDs ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDs SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDs EXISTED FOR A SPECIFIC COMPONENT.
7. NOT USED.
8. REFER TO TABLE A1A FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
9. 0-HS-70-194B HAS BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.

REFERENCE DRAWINGS:
TVA:
47W464 SERIES --------- MECHANICAL-PIPING DETAILS-COMPONENT COOLING SYSTEM
47W611-70 SERIES ------ LOGIC DIAGRAM
47W859 SERIES --------- MECHANICAL-FLOW DIAGRAM-COMPONENT COOLING SYSTEM

SYMBOLS:
PRESSURE REGULATOR WITH FILTER PRESSURE SET TO BE DETERMINED BY MANUFACTURER'S REQUIREMENT FOR THE DEVICE BEING SUPPLIED.
* ----- COMPONENT ASSOCIATED WITH BACKUP CONTROL. COMPONENT WILL BE LOCATED ON THE APPROPRIATE 480-V MOV OR 6.9-KV SHUTDOWN BOARD.

COMPANION DRAWINGS: 0-,1-,2-47W610-70-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

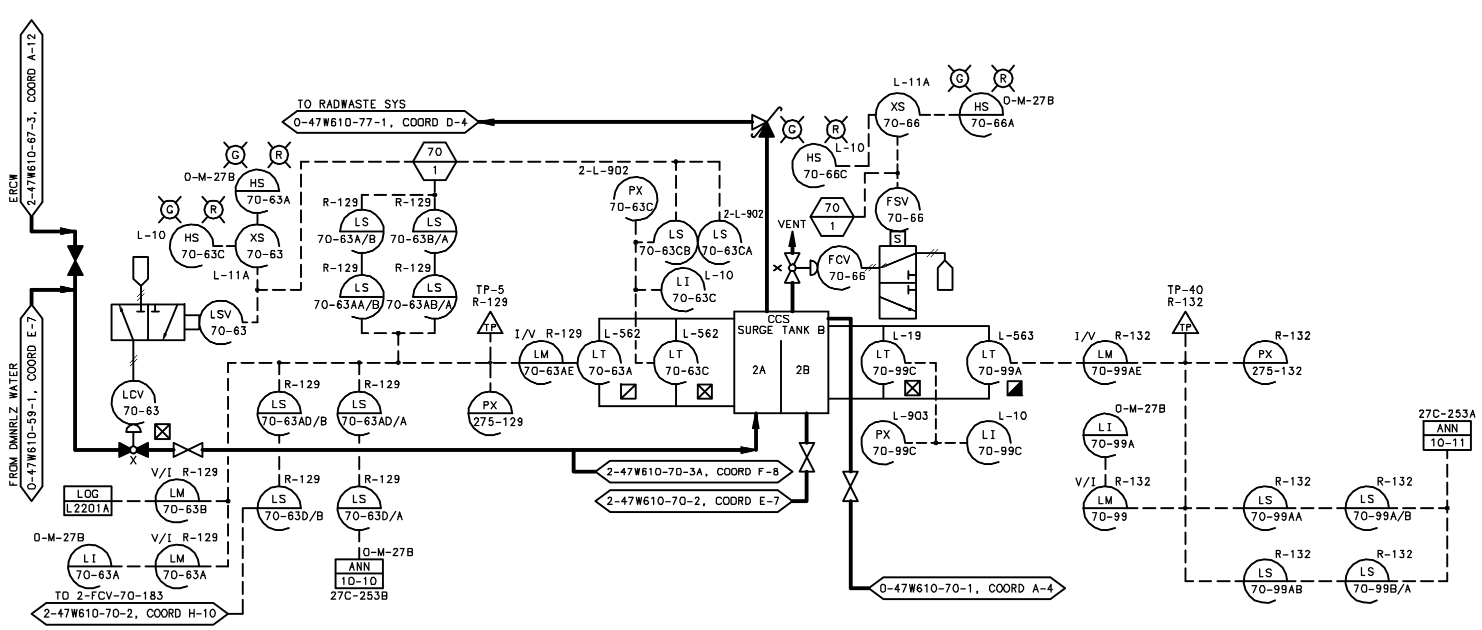
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYSTEM
TVA DWG NO. 0-47W610-70-1 R3
FIGURE 9.2-20

TABLE A1A
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION	INSTRUMENT ID	POINT ID	DESCRIPTION
0-BKR-070-0051	XD2101	CCS PMP C POWER SOURCE	1-FCV-070-0089	FD2329	RCP OIL CLR RET CNTMT ISO VLV
1-FCV-070-0002	FD2165	RHR HX A HDR INLET VLV	1-FCV-070-0090	FD2177	RCP THRM BAR RET CNTMT ISO VLV
1-FCV-070-0003	FD2389	RHR HX B HDR INLET VLV	1-FCV-070-0092	FD2175	RCP OIL CLR RET CNTMT ISO VLV
1-FCV-070-0004	FD2163	MISC EQPT HDR INLET VLV	1-FCV-070-0133	FD2171	RCP THRM BAR BSTR PMP DISH VLV
1-FCV-070-0008	FD2157	CCS HX A OUTLET VLV	1-FCV-070-0134	FD2325	RCP THRM BAR CNTMT ISO VLV
1-FCV-070-0009	FD2319	CCS HX A & C OUTLET ISO VLV	1-FCV-070-0140	FD2323	RCP OIL CLR HDR CNTMT ISO VLV
1-FCV-070-0010	FD2161	CCS HX A & C OUTLET ISO VLV	1-FCV-070-0143	FD2173	EXCESS LTDN HX CONT INLET ISV
0-FCV-070-0012	FD2315	CCS HX C OUTLET VLV	1-FCV-070-0153	FD2321	RHR HX B-B OUTLET VLV
1-FCV-070-0013	FD2311	CCS HX A & C INLET ISO VLV	1-FCV-070-0156	FD2167	RHR HX A-A OUTLET VLV
0-FCV-070-0022	FD2313	CCS HX C INLET VLV	0-FCV-070-0194	FD2317	SFPCS HX B SUP HDR ISO VLV
1-FCV-070-0023	FD2155	CCS HX A & C INLET ISO VLV	0-FCV-070-0197	FD2159	SFPCS HX A SUP HDR ISO VLV
1-FCV-070-0025	FD2153	CCS HX A INLET VLV	1-HS-070-0038A	HD2059	CCS TR-B HS-38A, 2-HS-70-51A
1-FCV-070-0026	FD2301	CCS PMPS A-A&B-B TO C-S OUT ISV	1-HS-070-0046A	HD2027	CCS TR-A HS-46A
1-FCV-070-0027	FD2303	CCS PMPS A-A&B-B TO C-S OUT ISV	1-HS-070-0051A	HD4001	CCS PUMP C-S TR-A HS-51A
1-FCV-070-0034	FD2299	CCS PMPS A-A TO B-B ISO VLV	1-PMP-070-0038	XD2086	CCS PUMP 1B-B
1-FCV-070-0064	FD2305	CCS PMPS A-A&B-B TO C-S XTIE	1-PMP-070-0038	XD2085	CCS PUMP 1B-B
1-FCV-070-0074	FD2307	CCS PMPS A-A&B-B TO C-S XTIE	1-PMP-070-0046	XD2035	CCS PUMP 1A-A
1-FCV-070-0075	FD2309	RHR HX B RET HDR ISO VLV	1-PMP-070-0046	XD2106	CCS PUMP 1A-A
1-FCV-070-0085	FD4001	CCS EXCESS LTDN HX OUTLET VLV	0-PMP-070-0051	XD2089	CCS PUMP C (NOR FDR)
1-FCV-070-0087	FD2327	RCP THRM BAR RET CNTMT ISO VLV	0-PMP-070-0051	XD2039	CCS PUMP C (ALT FDR)
			0-PMP-070-0051	XD2038	CCS PUMP C (ALT FDR)
			0-PMP-070-0051	XD2087	CCS PUMP C (NOR FDR)

SEE SHEETS 1, 2, 3 & DWG 45W749-4A FOR ASSOCIATED INSTRUMENTATION

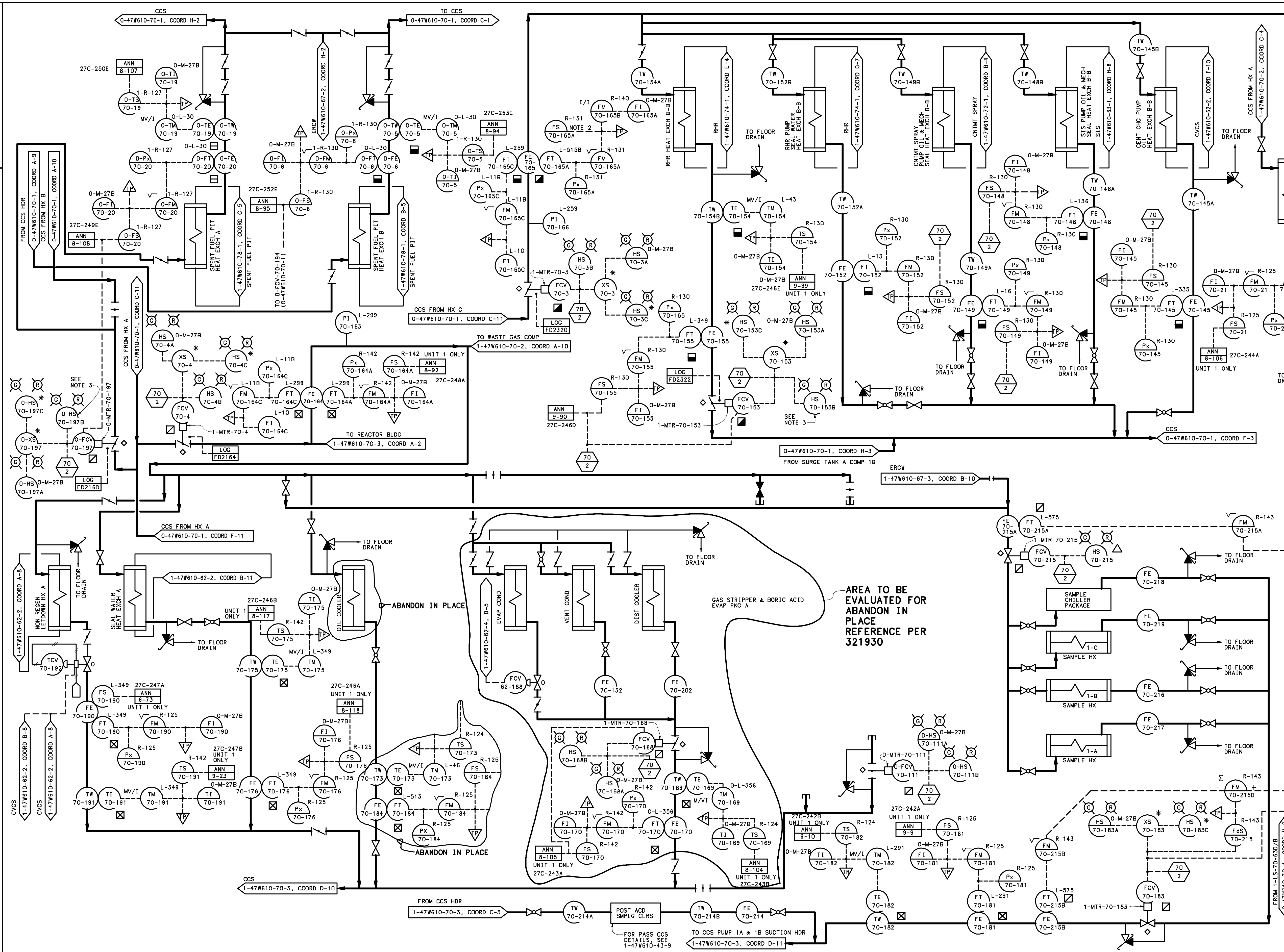
NOTES:
1. FOR NOTES, REFERENCE, COMPANION DWGS, AND SYMBOLS SEE 0-47W610-70-1.



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYSTEM
TVA DWG NO. 0-47W610-70-1A R4
FIGURE 9.2-20A

CAD MAINTAINED DRAWING



NOTES:

1. REFER TO TABLE A1A FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
2. 1-FS-70-165A IS IN LOOP ONLY FOR CONTINUITY.
3. 0-HS-70-197B AND 1-HS-70-153B HAVE BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYSTEM
TVA DWG NO. 1-47W610-70-2 R35
FIGURE 9.2-21

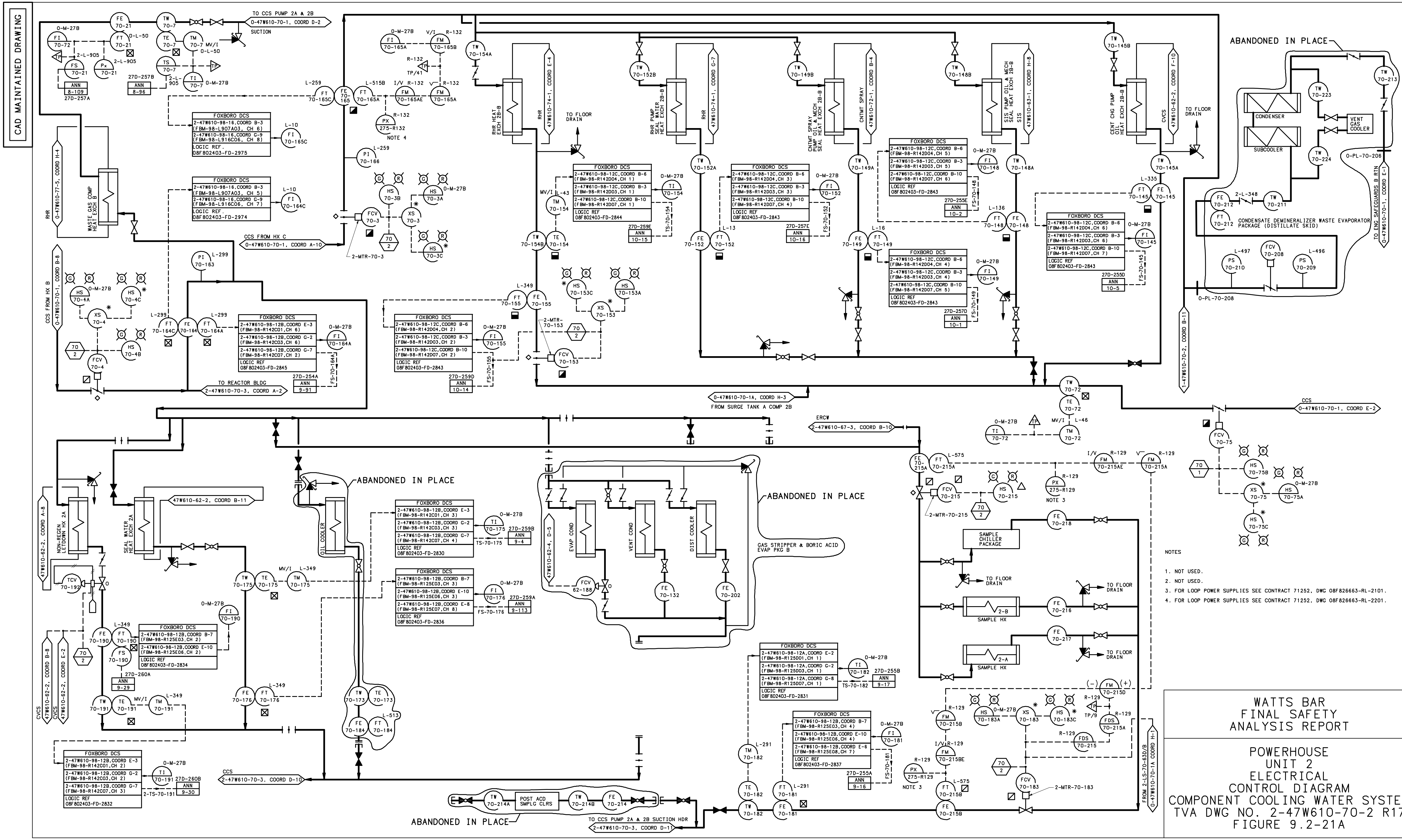
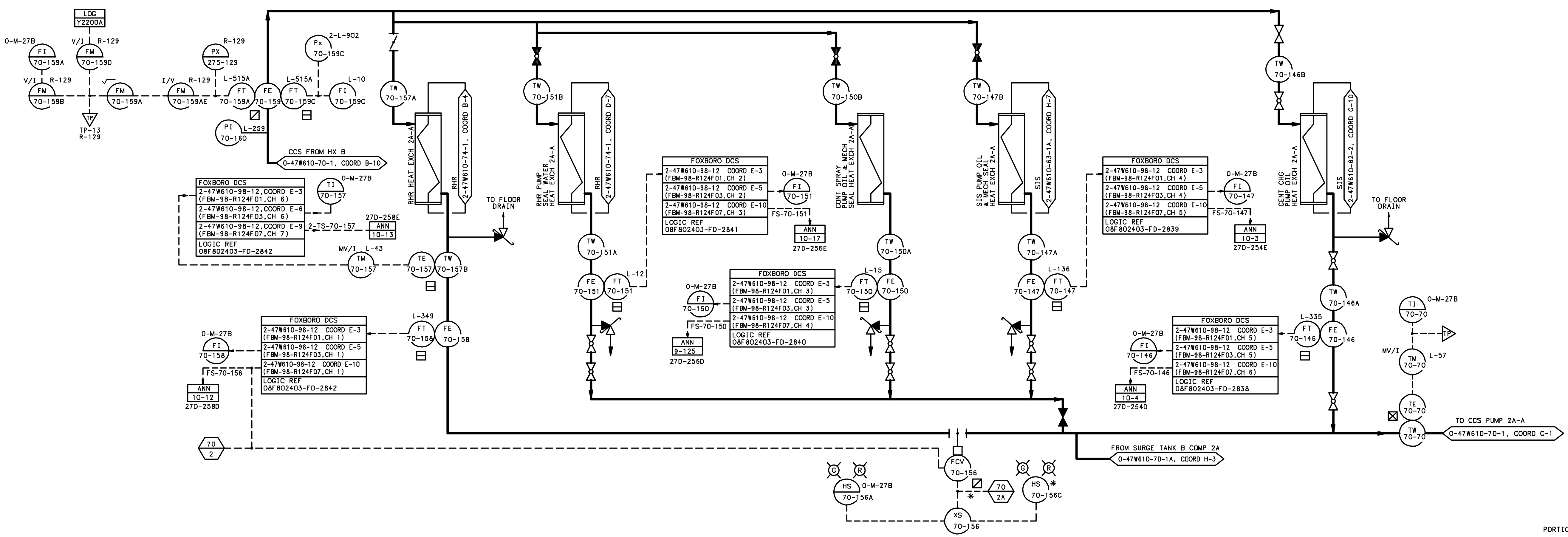


FIGURE 9.2-21A

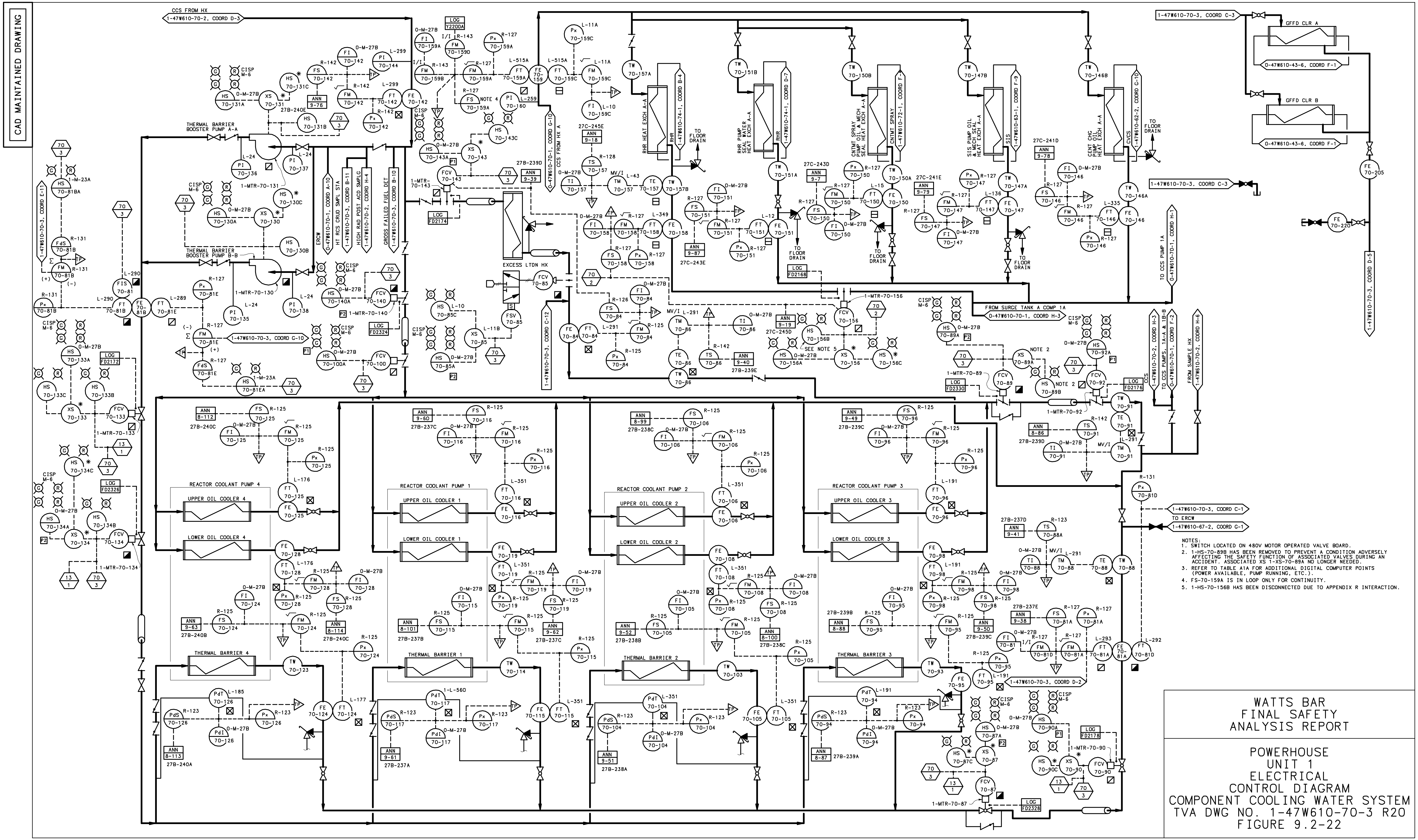
CAD MAINTAINED DRAWING



THIS DRAWING HAS BEEN DIVIDED AND PORTIONS OF THE DRAWING ARE ON 2-47W610-70-3.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

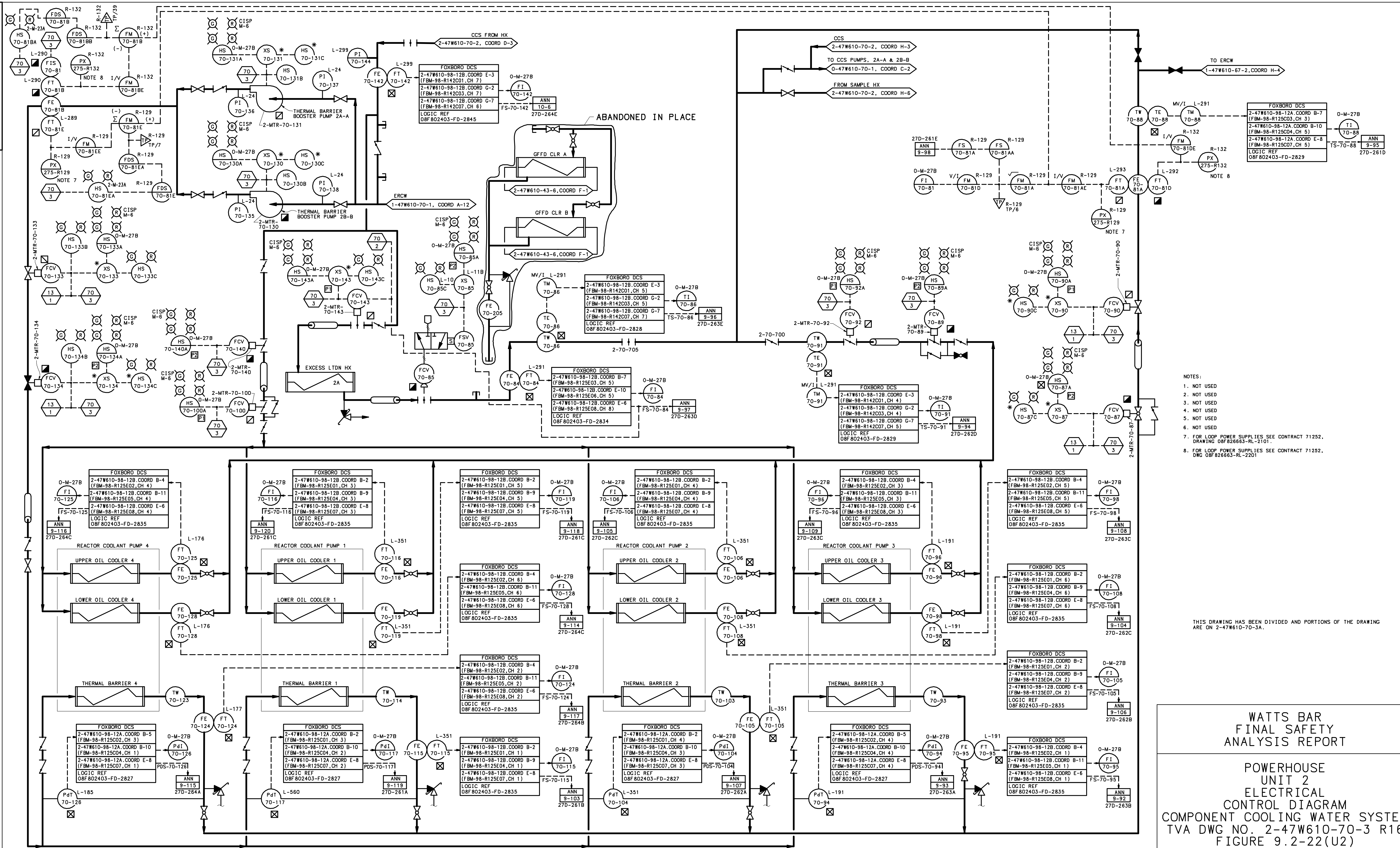
POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYS
TVA DWG NO. 2-47W610-70-3A R11
FIGURE 9.2-22 SH A



NOTES:
1. SWITCH LOCATED ON 480V MOTOR OPERATED VALVE BOARD.
2. 1-HS-70-89B HAS BEEN REMOVED TO PREVENT A CONDITION ADVERSELY AFFECTING THE SAFETY FUNCTION OF ASSOCIATED VALVES DURING AN ACCIDENT. ASSOCIATED XS 1-XS-70-89A NO LONGER NEEDED.
3. REFER TO TABLE A1A FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
4. FS-70-159A IS IN LOOP ONLY FOR CONTINUITY.
5. 1-HS-70-156B HAS BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

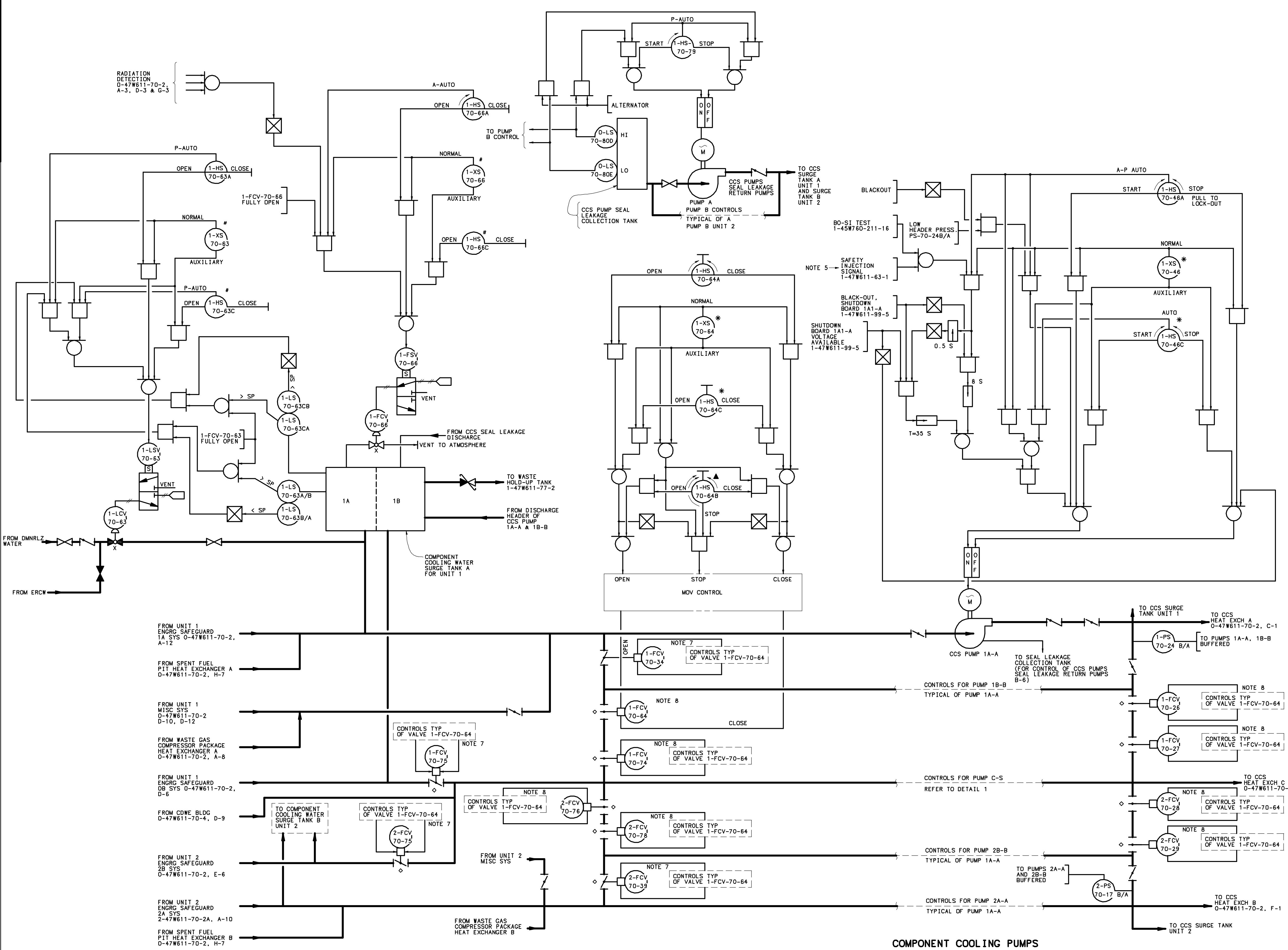
POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYSTEM
TVA DWG NO. 1-47W610-70-3 R20
FIGURE 9.2-22



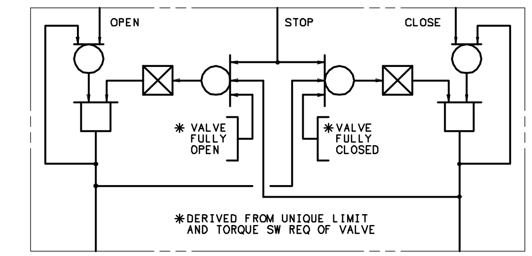
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
COMPONENT COOLING WATER SYSTEM
TVA DWG NO. 2-47W610-70-3 R16
FIGURE 9.2-22(U2)

CAD MAINTAINED DRAWING



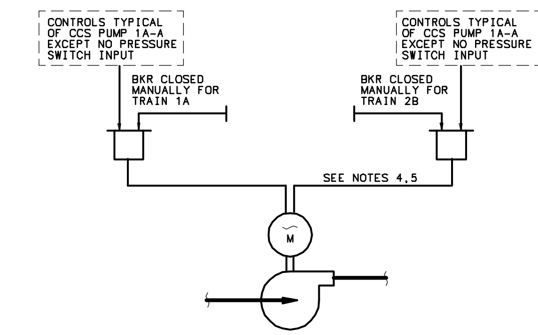
COMPONENT COOLING PUMPS



TYPICAL MOV CONTROL

REFERENCE DRAWINGS:

1-47W611-0-1-------------LOGIC DIAGRAM INDEX & SYMBOLS
2-47W611-0-1-------------LOGIC DIAGRAM INDEX & SYMBOLS
1-47W610-70 SERIES---------CONTROL DIAGRAM
0-47W610-70-SERIES---------CONTROL DIAGRAM
2-47W610-70-SERIES---------CONTROL DIAGRAM
0-47W859-1-----------------FLOW DIAGRAM
1-47W859-2-----------------FLOW DIAGRAM



DETAIL 1

NOTES:

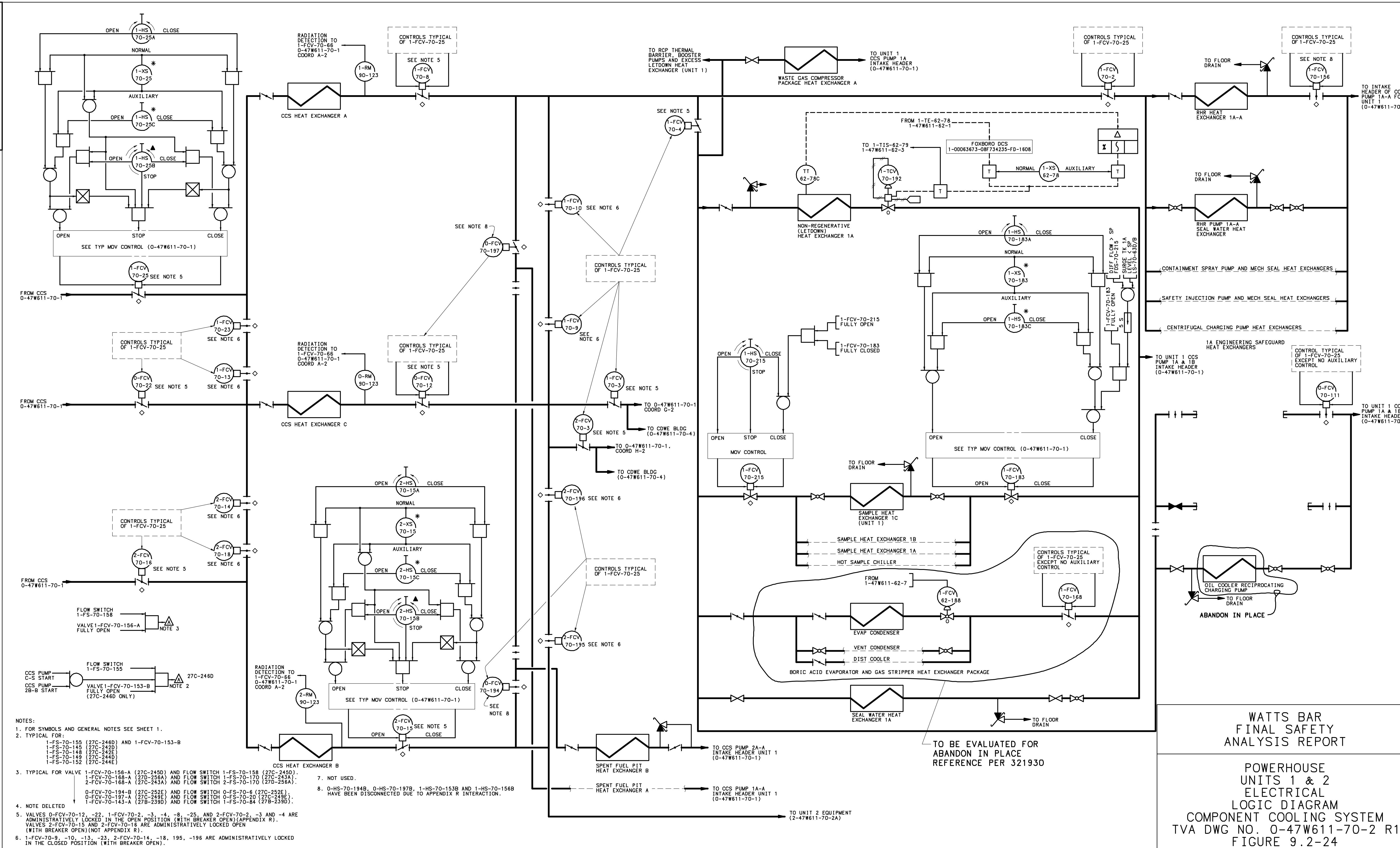
1. FOR SYMBOLS OTHER THAN THOSE NOTED ABOVE SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPERATION DESIGNATIONS SEE CONTROL DIAGRAM, 47W610-70 SERIES.
3. LOGIC SHOWN FOR UNIT 1, TYPICAL FOR UNIT 2 EXCEPT AS NOTED.
4. POWERED BY TRAIN 2B NORMALLY.
5. C-S PUMP WILL START ON SAFETY INJECTION SIGNAL FROM UNIT 1 OR UNIT 2. PUMPS 1A-A AND 1B-B START ON A UNIT 1 SI SIGNAL. PUMPS 2A-A AND 2B-B START ON A UNIT 2 SI SIGNAL. THE UNIT 2 SI SIGNALS ARE CONTROLLED BY PROCEDURE 0-TI-12.08, CONTROL OF UNIT INTERFACES.
6. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
7. VALVES 1-FCV-70-34, 2-FCV-70-39, AND 1 & 2-FCV-70-75 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R)
8. VALVES 1-FCV-70-26, 1-FCV-70-27, 1-FCV-70-64 1-FCV-70-74, 2-FCV-70-28, 2-FCV-70-29, 2-FCV-70-76 AND 2-FCV-70-78 ARE ADMINISTRATIVELY LOCKED IN THE CLOSED POSITION. (WITH BREAKER OPEN) (APPENDIX R)
9. NOT USED.
10. SOME CIDs ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDs SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDs EXISTED FOR A SPECIFIC COMPONENT.

COMPANION DRAWINGS:

0-47W611-70-SERIES-------LOGIC DIAGRAM
1-47W611-70-SERIES-------LOGIC DIAGRAM
2-47W611-70-SERIES-------LOGIC DIAGRAM

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 0-47W611-70-1 R1
FIGURE 9.2-23

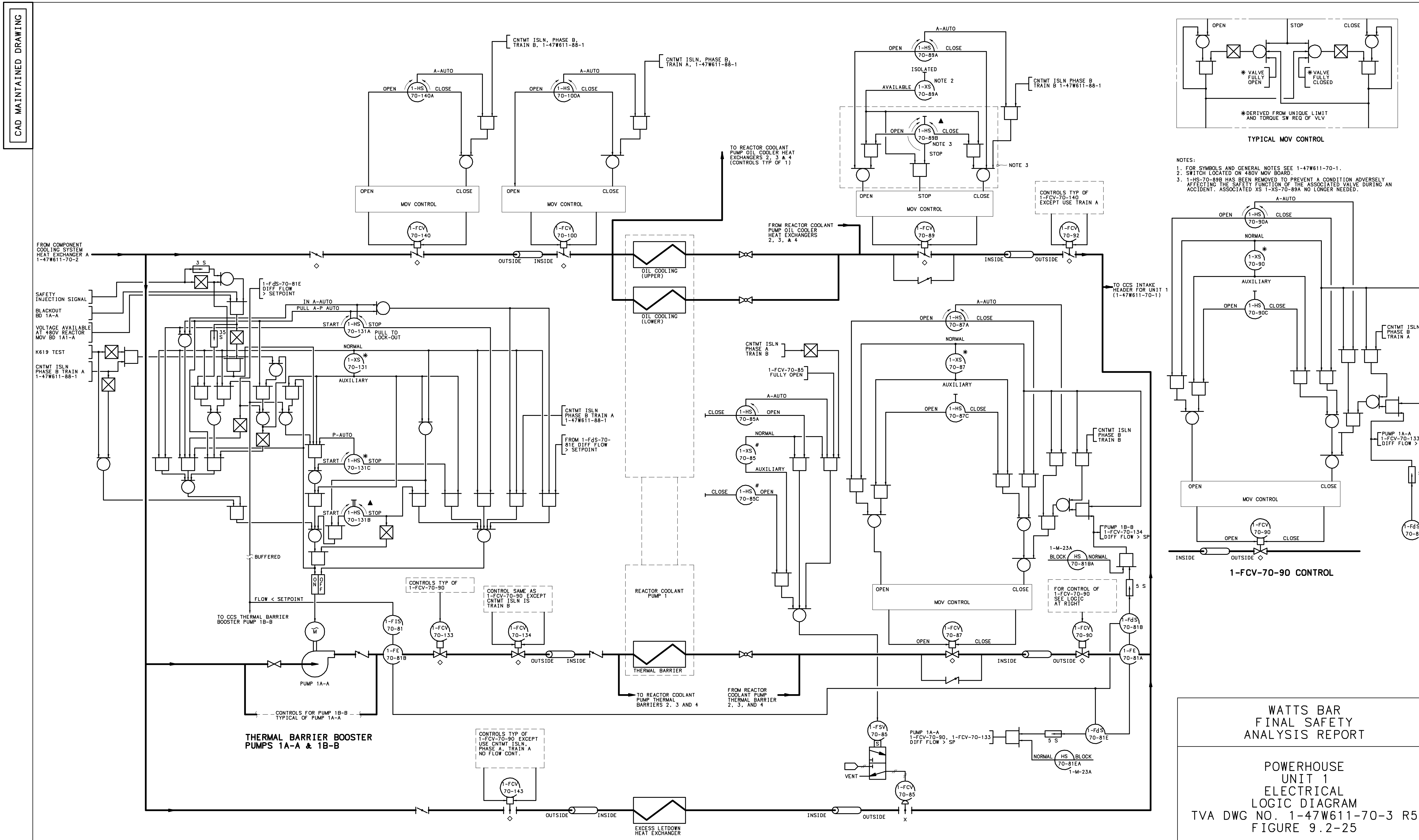


NOTES:

1. FOR SYMBOLS AND GENERAL NOTES SEE SHEET 1.
2. TYPICAL FOR:
   - 1-FS-70-155 (27C-246D) AND 1-FCV-70-153-B
   - 1-FS-70-145 (27C-242D)
   - 1-FS-70-148 (27C-242E)
   - 1-FS-70-149 (27C-244D)
   - 1-FS-70-152 (27C-244E)
3. TYPICAL FOR VALVE 1-FCV-70-156-A (27C-245D) AND FLOW SWITCH 1-FS-70-158 (27C-245D).
   1-FCV-70-168-A (27D-256A) AND FLOW SWITCH 1-FS-70-170 (27C-243A).
   2-FCV-70-168-A (27C-243A) AND FLOW SWITCH 2-FS-70-170 (27D-256A).
   0-FCV-70-194-B (27C-252E) AND FLOW SWITCH 0-FS-70-6 (27C-252E).
   0-FCV-70-197-A (27C-249E) AND FLOW SWITCH 0-FS-70-20 (27C-249E).
   1-FCV-70-143-A (27B-239D) AND FLOW SWITCH 1-FS-70-84 (27B-239D).
4. NOTE DELETED
5. VALVES 0-FCV-70-12, -22, 1-FCV-70-2, -3, -4, -8, -25, AND 2-FCV-70-2, -3 AND -4 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION (WITH BREAKER OPEN)(APPENDIX R). VALVES 2-FCV-70-15 AND 2-FCV-70-16 ARE ADMINISTRATIVELY LOCKED OPEN (WITH BREAKER OPEN)(NOT APPENDIX R).
6. 1-FCV-70-9, -10, -13, -23, 2-FCV-70-14, -18, 195, -196 ARE ADMINISTRATIVELY LOCKED IN THE CLOSED POSITION (WITH BREAKER OPEN).
7. NOT USED.
8. 0-HS-70-194B, 0-HS-70-197B, 1-HS-70-153B AND 1-HS-70-156B HAVE BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

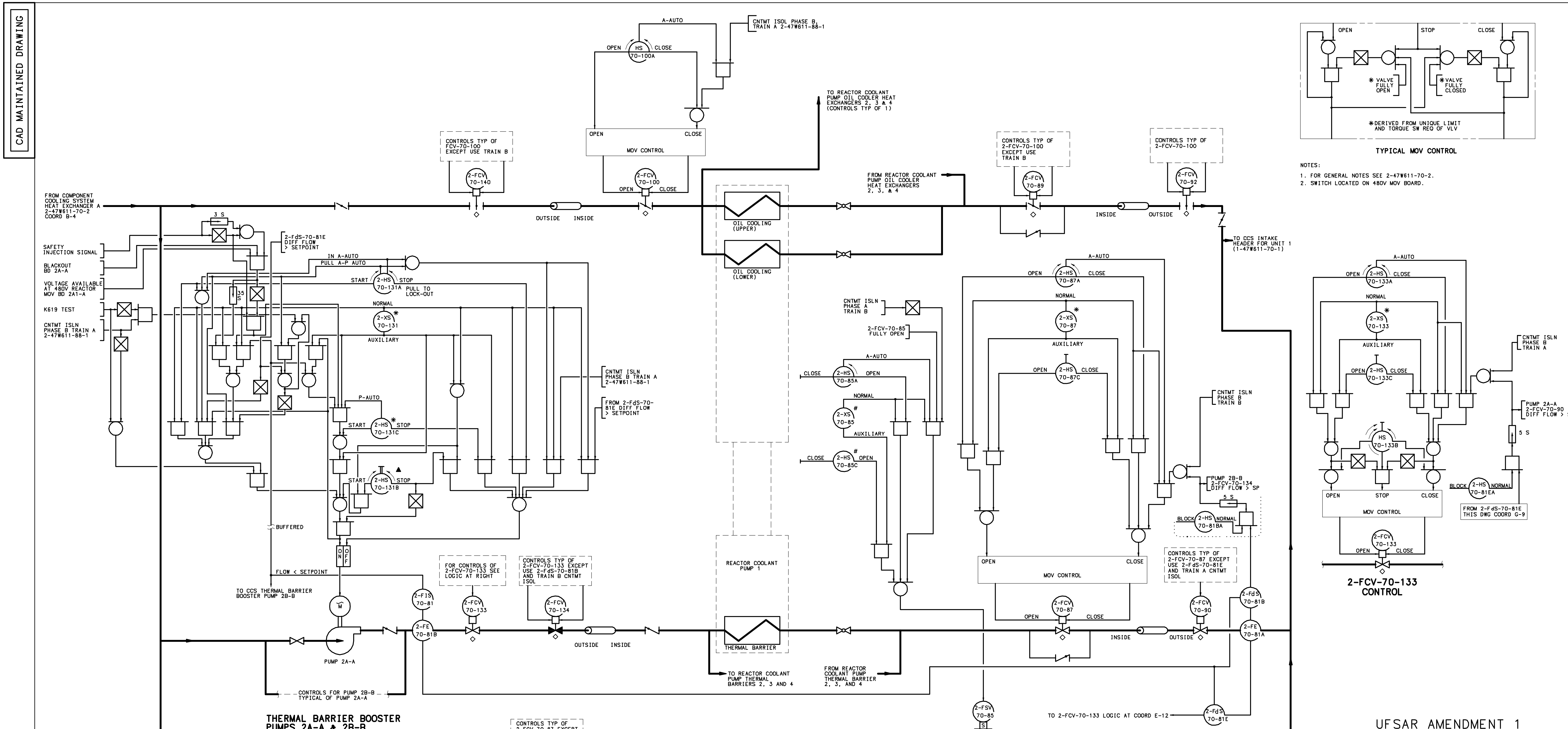
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 0-47W611-70-2 R1
FIGURE 9.2-24



WATTS BAR FINAL SAFETY ANALYSIS REPORT

POWERHOUSE UNIT 1 ELECTRICAL LOGIC DIAGRAM TVA DWG NO. 1-47W611-70-3 R5

FIGURE 9.2-25

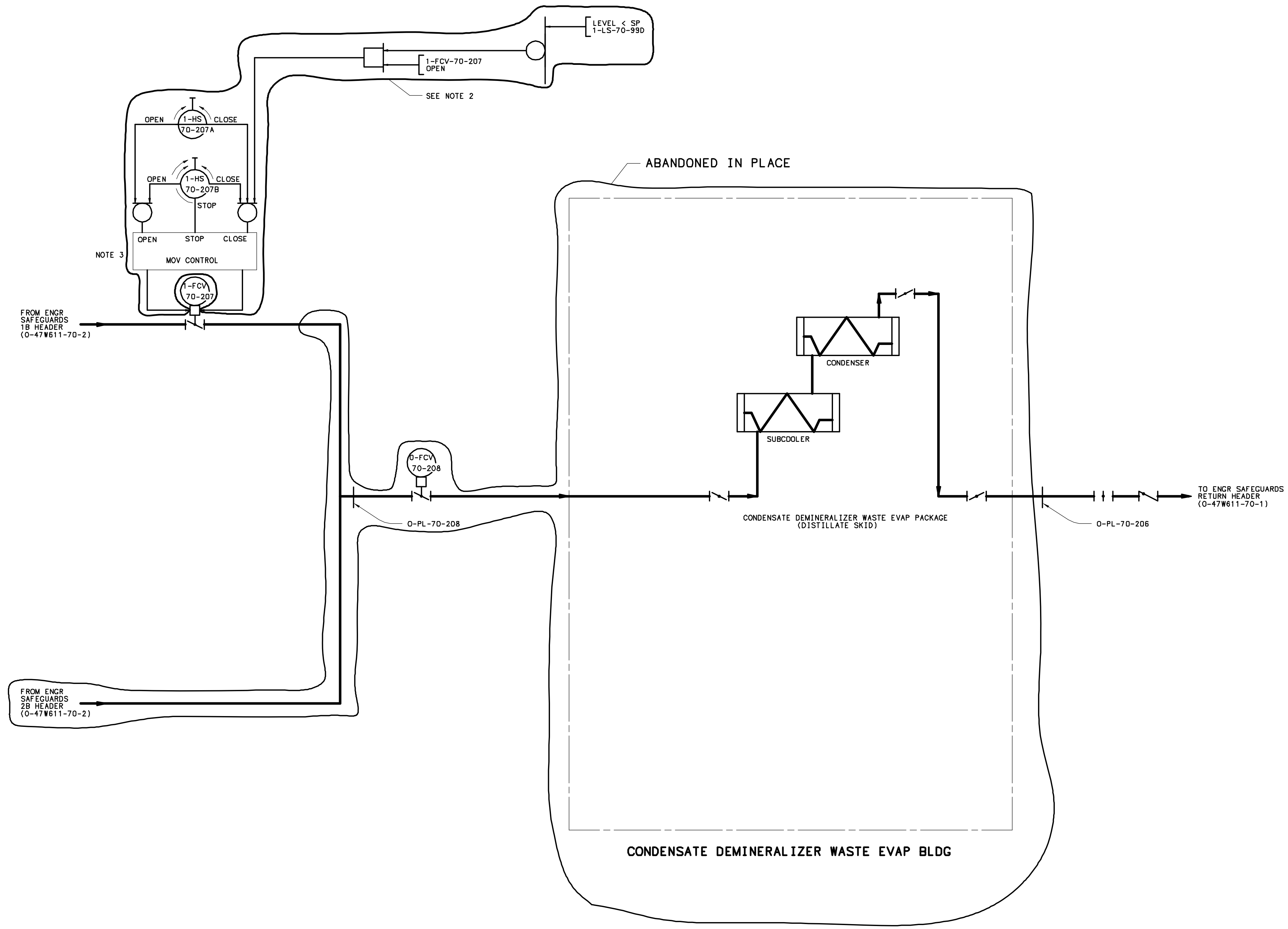


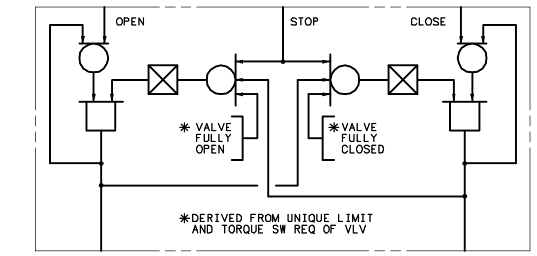
UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 2-47W611-70-3 R12
FIGURE 9.2-25(U2)

CAD MAINTAINED DRAWING





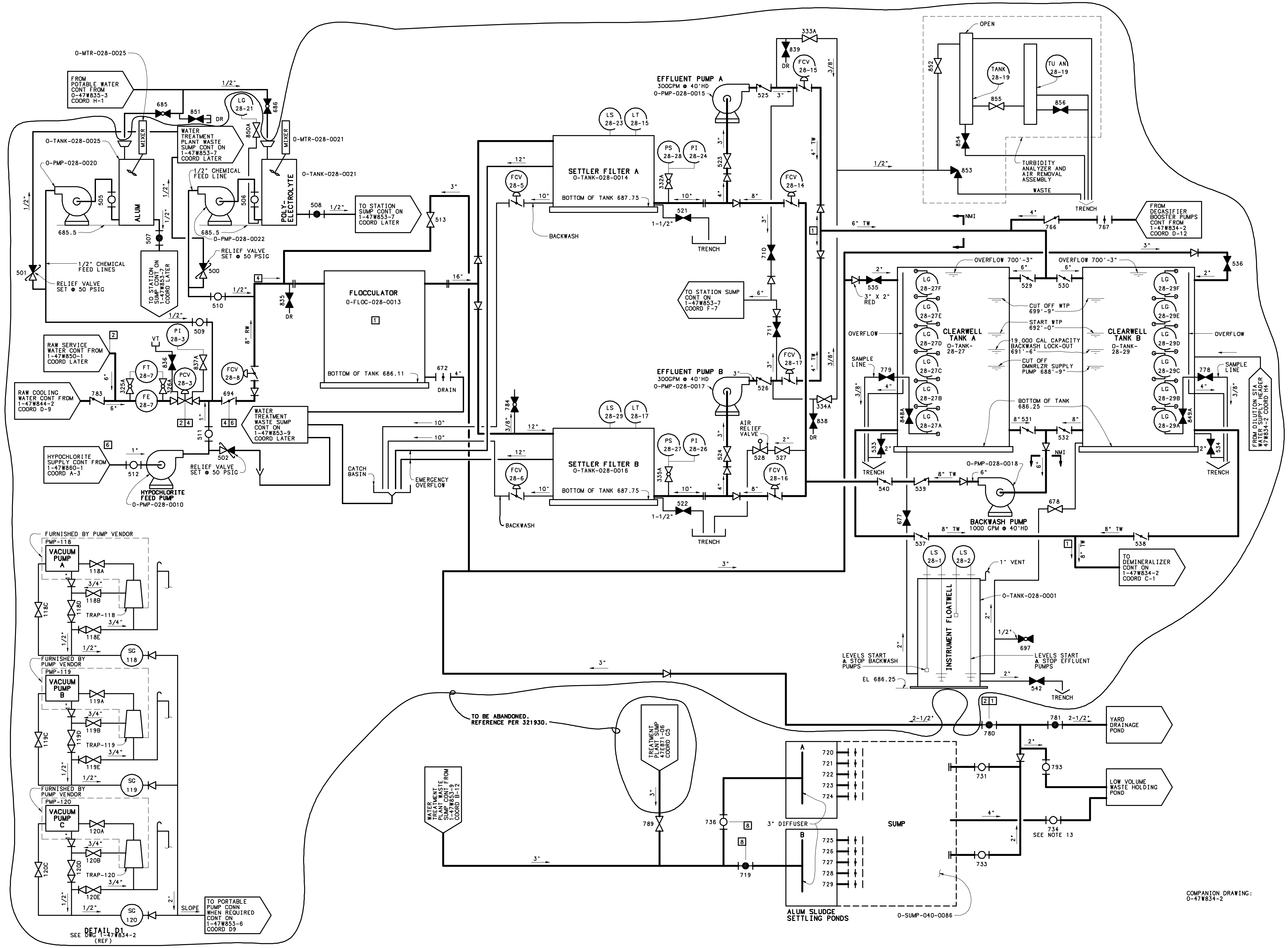
TYPICAL MOV CONTROL

NOTES:

1. FOR SYMBOLS AND GENERAL NOTES SEE 0-47W611-70-1.
2. CONTROL POWER FUSES AND THERMAL OVERLOADS FOR 1-FCV-70-207 HAVE BEEN REMOVED TO ISOLATE UNI1/UNIT 2 INTERFACE POINTS. REFERENCE DRAWING 1-45W760-70-10, NOTE 7.
3. VALVES REFERENCING THIS NOTE ARE MECHANICAL U1/U2 INTERFACE POINTS. THEY ARE CLOSED WITH CONTROL AND THERMAL OVERLOAD FUSES REMOVED TO PRECLUDE ADVERSE INTERACTION BETWEEN UNIT 1 AND UNIT 2.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
COMPONENT COOLING SYSTEM
TVA DWG NO. 0-47W611-70-4 R1
FIGURE 9.2-25A



COMPANION DRAWING: 0-47W834-2

NOTES:

1. FOR DETAILED OPERATING INSTRUCTIONS OF THE WATER TREATMENT PLANT AND THE DEMINERALIZER EQUIPMENT, SEE THE NEPTUNE AND L*A INSTRUCTION MANUALS, RESPECTIVELY.
2. UNLESS OTHERWISE NOTED, ALL THE VALVES ARE THE SAME SIZE AS THE PIPE.
3. OPERATIONAL VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITIONS.
4. ALL VALVE NUMBERS, EXCEPT AS NOTED, ARE TO HAVE PREFIX 0, SYSTEM 28, I.E., 0-28-500, 0-28-501.
5. VALVES HAVING FUNCTION DESIGNATION AS FLOW CONTROL VALVES SHALL BE NOTED ON THE DRAWING AS FOLLOWS: FCV 28-3
6. M-V5, AS-V2, C-V1, ETC. REFER TO MFGR VALVE IDENTIFICATION, L*A MATERIAL LIST 6000 SERIES.
7. DENOTES PIPING INTERFACE WITH L*A WATER TREATMENT (CONTRACT NO. 74C31-83089),NEPTUNE MICROFLOC, INC (CONTRACT NO. 74C31-83124), OR UNIVERSAL CORP OF ECOLOGY.
8. ALL PIPING TO BE TVA CLASS H.
9. FOR VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISC VALVE REPORT-009.
10. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED.SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFCATION".):
    - N3-28-4002 ------ MAKEUP WATER TREATMENT PLANT
    - N3-928-4002 ----- MAKEUP WATER TREATMENT PLANT
    - WB-DC-40-35.1 --- MAKEUP WATER TREATMENT PLANT AND DEMINERALIZED WATER STORAGE AND DISTRIBUTION SYSTEM
11. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
12. THIS IS A UNIT 1/UNIT 2 INTERFACE POINT. SAFETY RELATED, (1|2), INTERFACE POINTS MUST BE LOCKED CLOSED. NON-SAFETY RELATED, [1|2], INTERFACE POINTS MUST BE CLOSED WITH HAND WHEELS REMOVED OR LOCKED IN PLACE.
13. VALVE MUST BE CLOSED WHEN LEVEL IN THE LOW VOLUME WASTE HOLDING POND IS ABOVE EL 707'-8".

REFERENCE DRAWINGS:

47W800-1 SERIES ------ FLOW DIAGRAM GENERAL PLANT SYSTEMS
30B617 SERIES -------- INSTRUMENTATION STANDARDS FLOW AND CONTROL VALVE SYMBOLS
1-47W610-28 SERIES --- INSTRUMENT AND CONTROL DIAGRAM
47B601-28 SERIES ----- TABULATION OF INSTRUMENTS
47W550 SERIES -------- WATER TREATMENT & MAKEUP DEMIN. PIPING & EQUIPMENT

KEY TO ABBREVIATIONS:

GPD - GALLONS PER DAY
GPM - GALLONS PER MINUTE
CCW - CONDENSER CIRCUILATING WATER
DW - DEMINERALIZED WATER
POT-W-POTABLE WATER
RW - RAW WATER
TW - TREATED WATER
VCW - VACUUM PUMP COOLING WATER

MAKEUP WATER TREATMENT DATA

FILTRATION PLANT:

MAXIMUM CAPACITY (INLET)------------------ 560 GPM*, 280 GPM/SETTLER-FILTER UNIT
MINIMUM CAPACITY (INLET)------------------ 133 GPM
NET CAPACITY (OUTLET) -------------------- 800,000 GPD **
SETTLER-FILTER BACKWASH TIME ------------- 10 MIN
SETTLER-FILTER BACKWASH WATER REQUIRED --- 10,000 GAL PER FILTER
CLEARWELL STORAGE ------------------------ 19,000 GAL EACH, 38,000 GAL TOTAL

* BASED ON DESIGN INFORMATION FROM NEPTUNE MICROFLOR OWNERS MANUAL
** BASED ON TEST SCOPING DOCUMENT NCS-25A ACCEPTANCE CRITERIA

DEMINERALIZER PLANT:

	PER TRAIN	TOTAL
FLOW RATE (INLET)	240 GPM*	480 GPM
NET CAPACITY (OUTLET)	288,000 GPD **	576,000 GPD**
DEMINERALIZER WASTE NEUTRALIZATION TANK ----		3,500 GAL
DEMINERALIZER WATER STORAGE TANK -----------		10,000 GAL

* BASED ON DESIGN INFORMATION FROM L*A/WATER TREATMENT INSTRUCTION MANUAL
** BASED ON TEST SCOPING DOCUMENT NCS-25A ACCEPTANCE CRITERIA

SYSTEM PRESS TEMP DATA:

LINE MARK NO.	DESIGN PRESS	TEST PRESS	DESIGN TEMP
1	15 PSI	15 PSI	95°F
2	100 PSI	150 PSI	100°F
3	125 PSI	200 PSI	150°F
4	50 PSI	75 PSI	95°F
5	100 PSI	150 PSI	150°F
6	ATMOSPHERIC	15 PSI	95°F
7	75 PSI	125 PSI	100°F
8	40 PSI	60 PSI	100°F

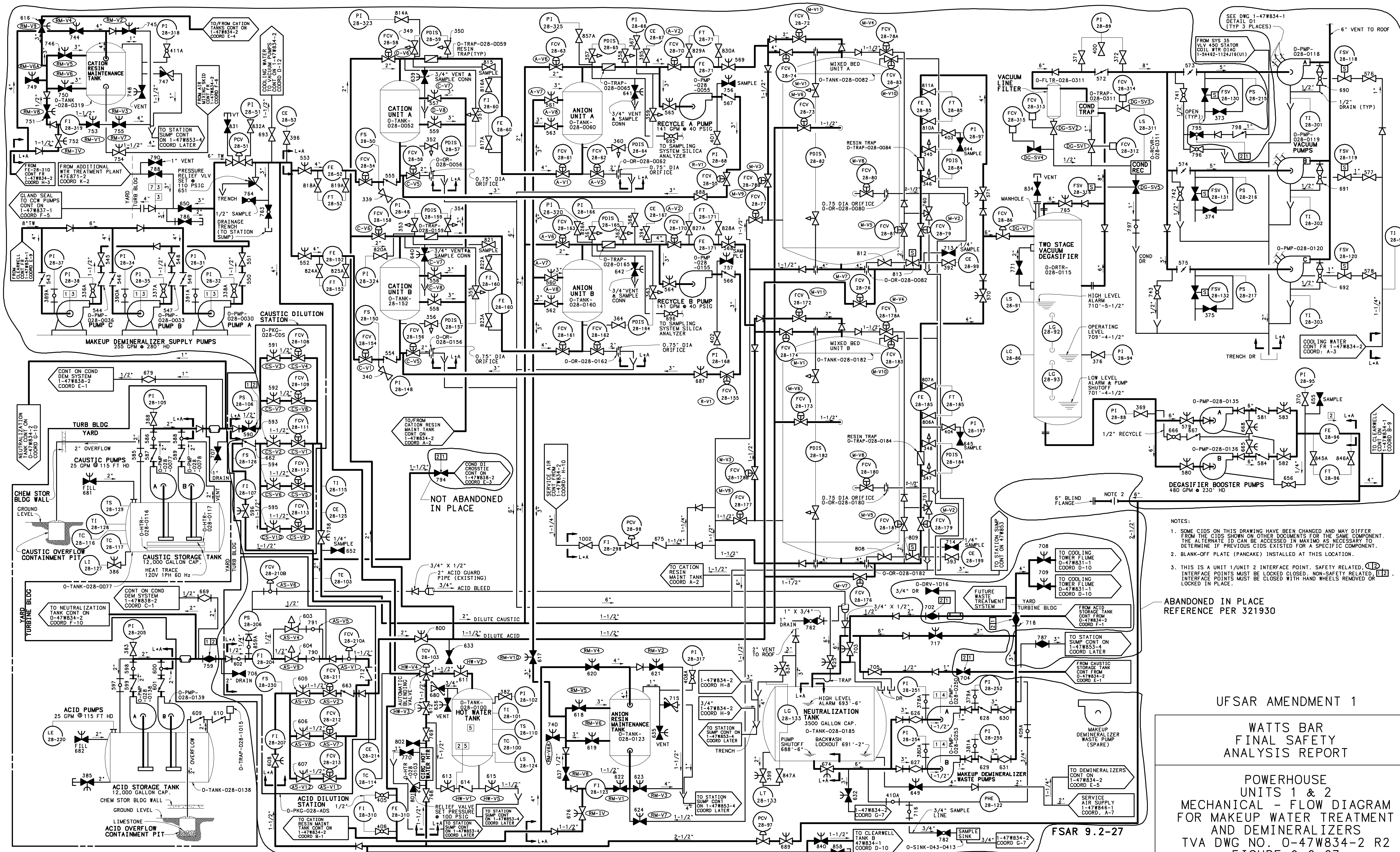
TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
WATER HEATER & DEMINERALIZERS
TVA DWG NO. 0-47W834-1 R1
FIGURE 9.2-26

CAD MAINTAINED DRAWING



NOTES:

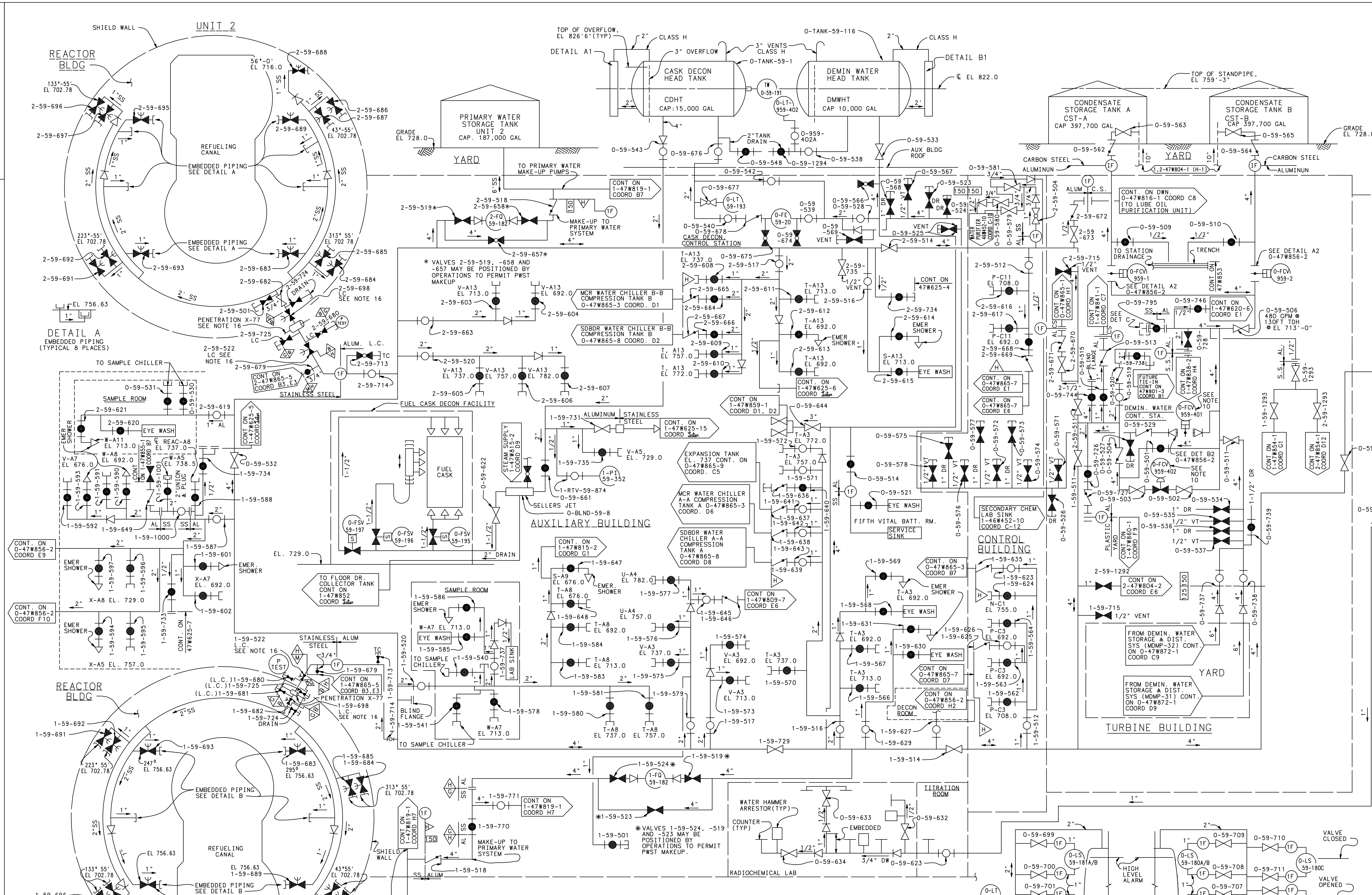
1. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
2. BLANK-OFF PLATE (PANCAKE) INSTALLED AT THIS LOCATION.
3. THIS IS A UNIT 1/UNIT 2 INTERFACE POINT. SAFETY RELATED. [1 2] INTERFACE POINTS MUST BE LOCKED CLOSED. NON-SAFETY RELATED. [1 2] INTERFACE POINTS MUST BE CLOSED WITH HAND WHEELS REMOVED OR LOCKED IN PLACE.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
MECHANICAL - FLOW DIAGRAM
FOR MAKEUP WATER TREATMENT
AND DEMINERALIZERS
TVA DWG NO. 0-47W834-2 R2
FIGURE 9.2-27

NOTE:
SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.



SERVICE BUILDING

NOTES:
1. ALL VALVE NUMBERS BEAR A SYSTEM DESIGNATION PREFIX (59).
2. ALL VALVES ON A UNIT BASIS ARE PREFIXED WITH THE UNIT NUMBER, I.E., 1-59-901. VALVES COMMON TO BOTH UNITS ARE PREFIXED WITH A "0", 0-59-700, ETC.
3. ALL VALVES ARE THE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
4. ALL SERVICE CONNECTIONS ARE 1" UNLESS OTHERWISE NOTED.
5. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
6. ⟨B|G⟩ INDICATES TVA PIPE CLASSIFICATION.
7. DESIGN PRESSURE AND TEMPERATURE FOR ENTIRE SYSTEM IS 100 PSI AT 150°F.
8. [150|125] INDICATES THE HYDROSTATIC TEST PRESSURE. CONST SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST. ASME CODE CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
9. SEE LATEST REVISION OF THE 47B21 SERIES DRAWING "PIPING SYSTEMS CLASSIFICATION."
10. THE FOLLOWING COMPONENTS ARE NOT REQUIRED AND ARE NOT TRANSFERRED FOR UNIT 1 OPERATION: L*A WATER PROGRAMMABLE CONTROLLER FOR VALVES 0-FCV-959-401 AND 0-FCV-959-402.
11. DEMINERALIZED WATER FROM CHECK VALVES 2-59-642, 643, 665, 666 AND 669 IS SEISMIC CATEGORY I (L).

NOTES CONTINUED ON 0-47W856-2

COMPANION DRAWING: 0-47W856-2

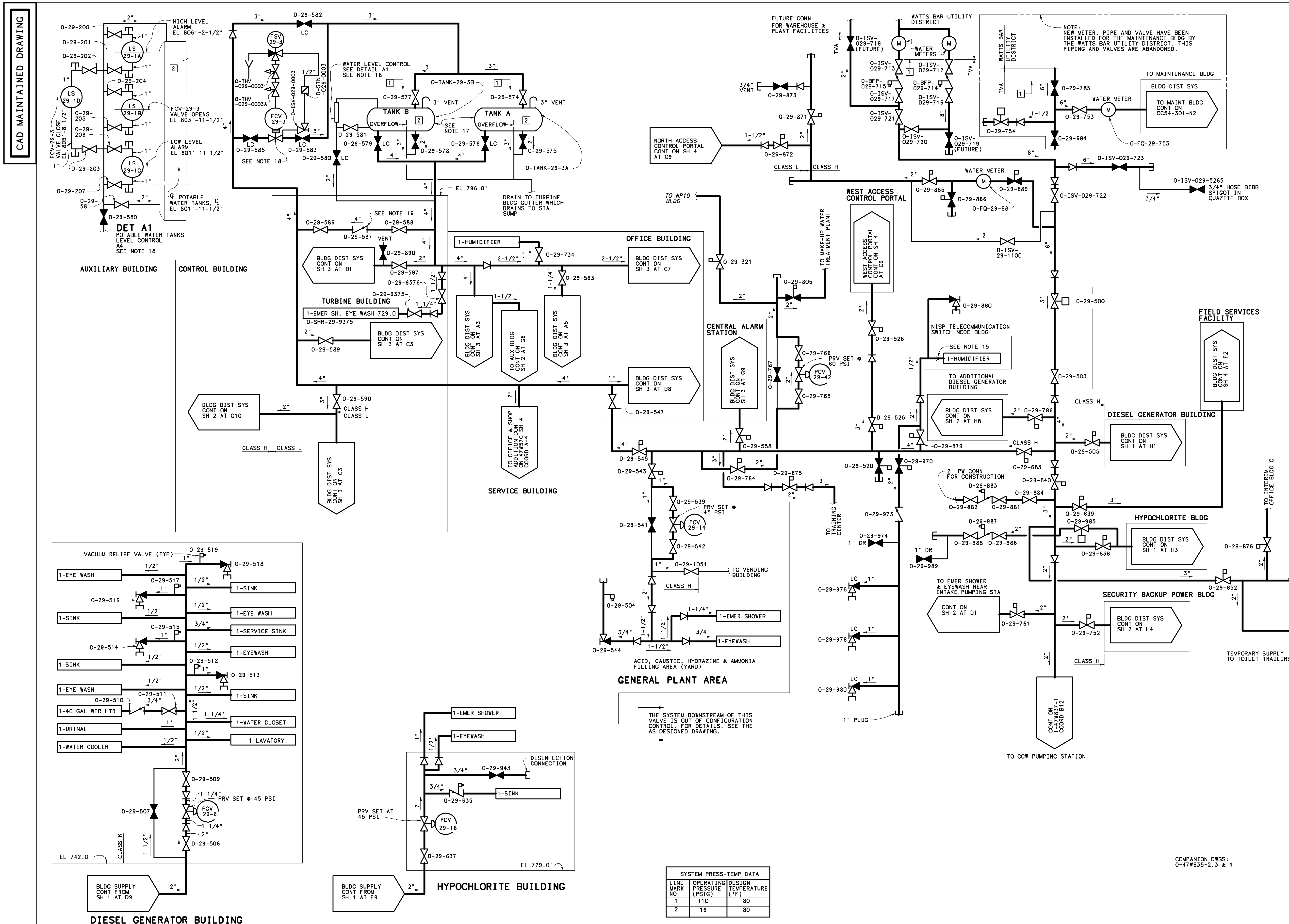
REFERENCE DRAWINGS

47W490 SERIES	-PIPING DRAWINGS - TURBINE BLDG
47W491 SERIES	-PIPING DRAWINGS - AUXILIARY BLDG
47W492 SERIES	-PIPING DRAWINGS - REACTOR BLDG
47W570 SERIES	-PIPING DRAWINGS - SERVICE BLDG
47W575 SERIES	-PIPING DRAWINGS - OFFICE BLDG
47W611-97-1	-LOGIC DIAGRAMS
47W610-59-1	-CONTROL DIAGRAMS
1,2-47W819-1	-FLOW DIAGRAM - PRIMARY WATER
47W800-1	-FLOW DIAGRAM - GENERAL PLANT SYSTEM
47B491-59X1 & 3	-MECH DW & C DEC SYS MVAR QUALITY CONTROLLED LIST
47W856-101	-MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - DEMINERALIZED WATER & CASK DECON SYSTEM

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE, SERVICE & OFFICE BLDGS
UNITS 1 & 2
FLOW DIAGRAM
DEMINERALIZED WATER
AND CASK DECON SYSTEM
TVA DWG NO. 0-47W856-1 R6
FIGURE 9.2-28



NOTES:

1. ALL VALVES ARE COMMON TO ALL UNITS AND ARE PREFIXED WITH AN "0" EXAMPLE:0-29-507, ETC.
2. ALL VALVES ARE THE SAME SIZE AS THE PIPE, UNLESS NOTED OTHERWISE.
3. ALL INSTRUMENT CONNECTIONS ARE 1", UNLESS NOTED OTHERWISE.
4. VALVE POSITIONS SHOWN ARE FOR NORMAL OPERATION.
5. INDIVIDUAL STOPS FOR PLUMBING FIXTURES AND WATER COOLERS ARE NOT SHOWN ON THIS DIAGRAM, ALTHOUGH THEY ARE PROVIDED.
6. HOT WATER SYSTEMS BEYOND HOT WATER STORAGE TANKS ARE NOT DIAGRAMMED.
7. ALL VALVES TO HAVE MARKER TAGS.
8. [1] DENOTES OPERATING PRESSURE AND TEMP AS GIVEN IN TABLE.
9. DESIGN PRESSURE AND TEMP FOR THE ENTIRE SYSTEM IS 110 PSI AT 80° F.
10. ALL POTABLE WATER PIPING AND TANKS, AND ANY SUBSEQUENT ADDITIONS, ALTERATIONS AND REPAIRS TO THE SYSTEM SHALL BE DISINFECTED IN ACCORDANCE WITH CONSTRUCTION SPEC G-11.
11. FOR VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISC VALVE REPORT -009.
12. ALL PIPING ON THIS DRAWING IS TVA CLASS H UNLESS OTHERWISE NOTED.
13. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."
14. CHANGES TO THE CONFIGURATION SHOWN ON THE FLOW DIAGRAM AND TO THE INSTALLED CONFIGURATION IN BUILDING NOT SPECIFICALLY DELINATED ON THE FLOW DIAGRAMS MUST BE EVALUATED BY ENGINEERING TO INSURE DESIGN STANDARD ARE BEING MET.
15. DOUBLE CHECK VALVE TYPE BACKFLOW PREVENTER SUPPLIED BY NODE BLDG VENDOR UNDER CONTRACT NO. 89NRB-34531B.
16. INTERNALS OF CHECK VALVE 0-CKV-29-587 HAVE BEEN REMOVED.
17. MAINTAIN NO LEVEL IN TANKS.
18. ELECTRICAL POWER TO THIS INSTRUMENTATION AND 0-FSV-29-3 HAS BEEN REMOVED PER DCN 57031-A.

REFERENCE DRAWINGS

47B601-29 SERIES----CONTROL DIAGRAM
47W800-1 SERIES----FLOW DIAGRAM-PRINCIPAL PIPING SYSTEM SYMBOLS AND INDEX
17W300 SERIES----YARD
17W705 SERIES----GATEHOUSE
17W710 SERIES----DIESEL GENERATOR BUILDING
47W490 SERIES----SERVICE PIPING
47W700 SERIES----TURBINE BUILDING
47W702 SERIES----CONTROL BUILDING
47W705 SERIES----AUXILIARY BUILDING
47W710 SERIES----SERVICE BUILDING
47W715 SERIES----OFFICE BUILDING
47W550 SERIES----TURBINE BUILDING
47W940 SERIES----OFFICE BUILDING-HVAC
47W950 SERIES----SERV & AUX BLDG-HVAC
17W525 SERIES----FIELD SERVICES FACILITY
17E530 SERIES----MAKE-UP WATER TREATMENT PLANT

SYMBOLS:

LC = LOCKED CLOSED

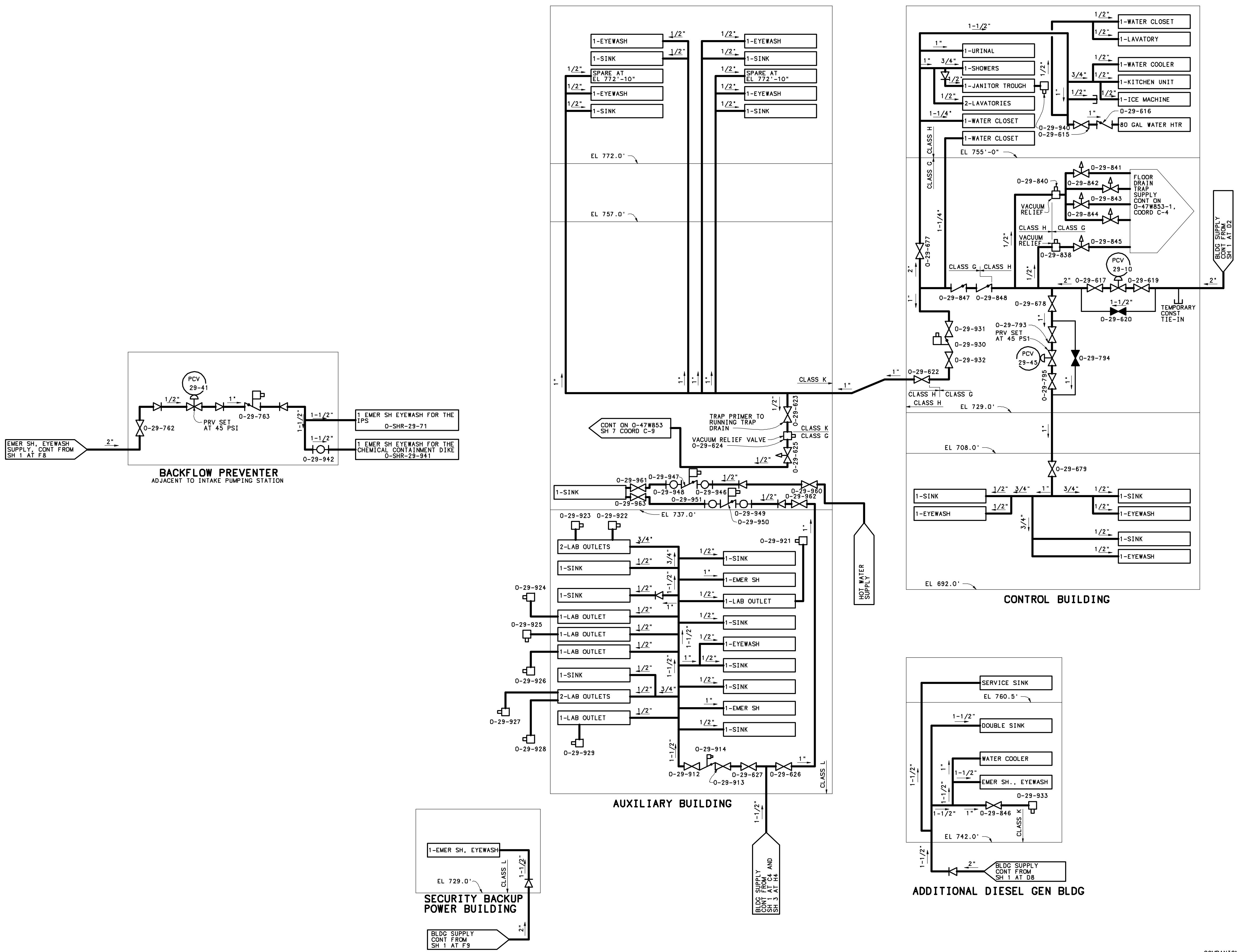
SYSTEM PRESS-TEMP DATA

LINE MARK NO	OPERATING PRESSURE (PSIG)	DESIGN TEMPERATURE (°F)
1	110	80
2	16	80

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

GENERAL
UNITS 1 & 2
FLOW DIAGRAM
POTABLE WATER
DISTRIBUTION SYSTEM
TVA DWG NO. 0-47W835-1 R1
FIGURE 9.2-29A

CAD MAINTAINED DRAWING

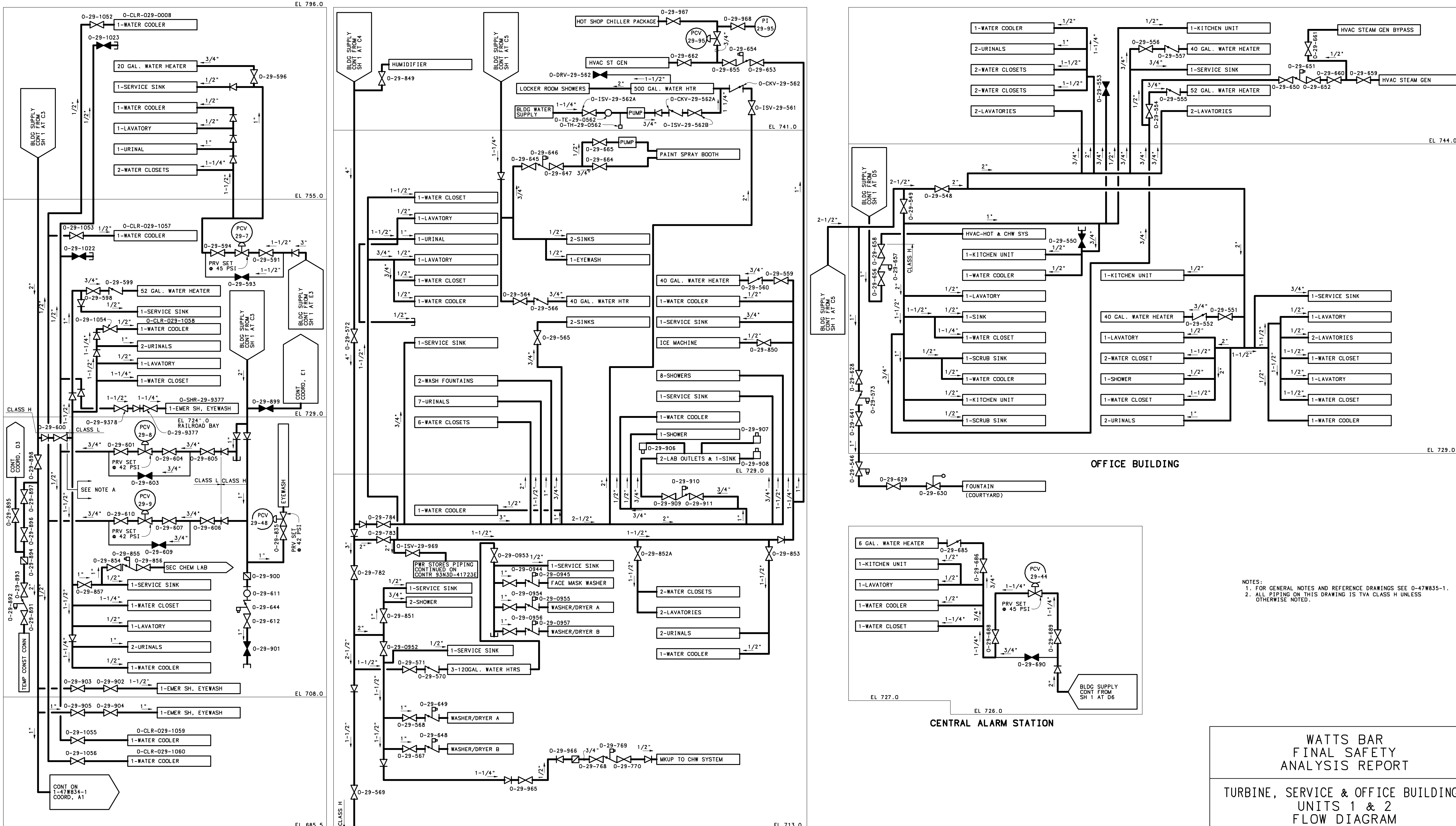


NOTES:
1. NOT USED
2. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W835-1.
3. ALL PIPING ON THIS DRAWING IS TVA CLASS H UNLESS OTHERWISE NOTED.

COMPANION DRAWINGS SEE SHEET 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

GENERAL
UNITS 1 & 2
FLOW DIAGRAM
POTABLE WATER
DISTRIBUTION SYSTEM
TVA DWG NO. 0-47W835-2 R0
FIGURE 9.2-29B



NOTE A: THE SYSTEM DOWNSTREAM OF THIS VALVE IS OUT OF CONFIGURATION CONTROL. ALL FUTURE CHANGES TO THIS PIPING SHALL BE CONDUCTED IN ACCORDANCE WITH NOTES SHOWN ON 0-47W835-1 AND 47W700-1.

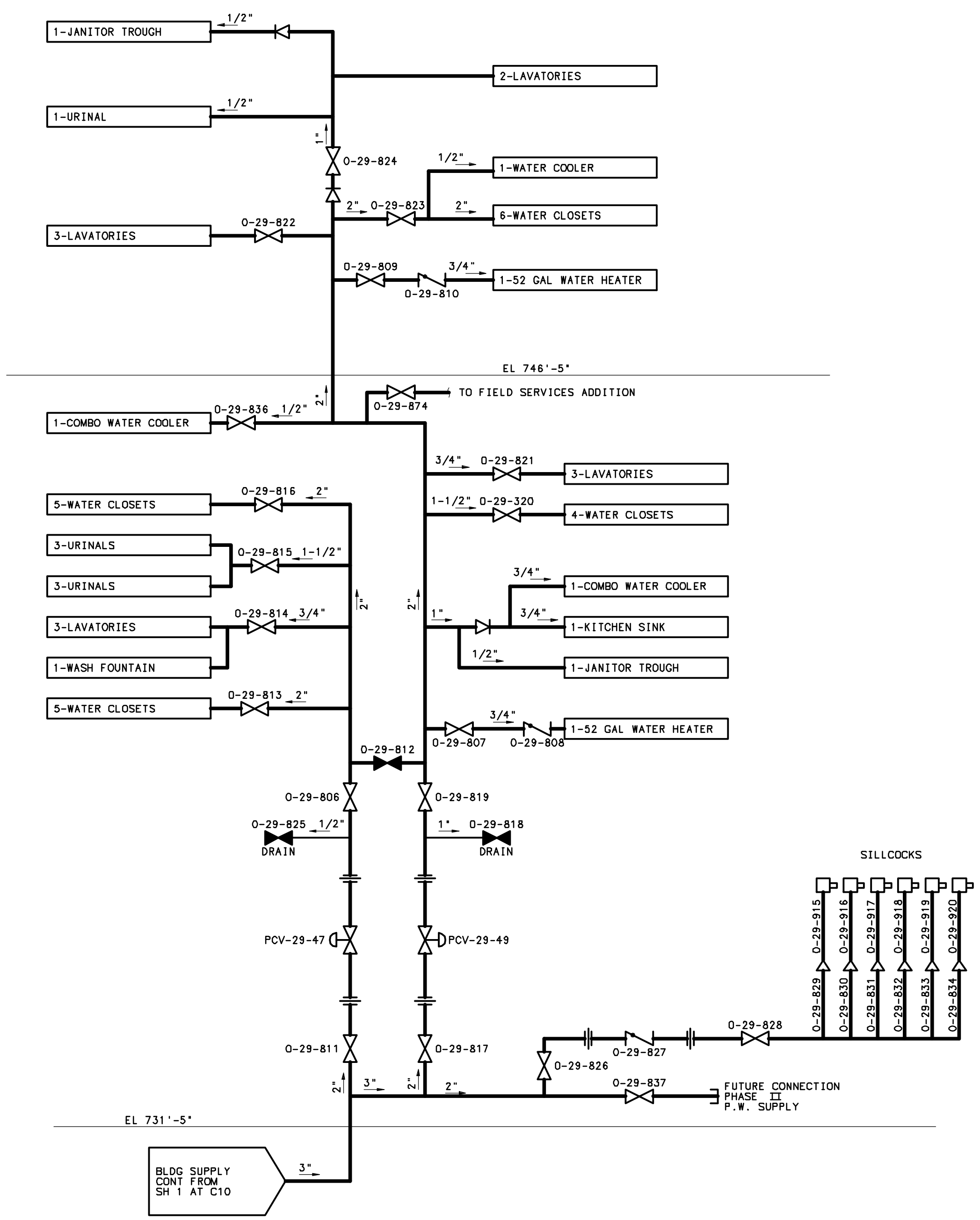
NOTES:
1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W835-1.
2. ALL PIPING ON THIS DRAWING IS TVA CLASS H UNLESS OTHERWISE NOTED.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

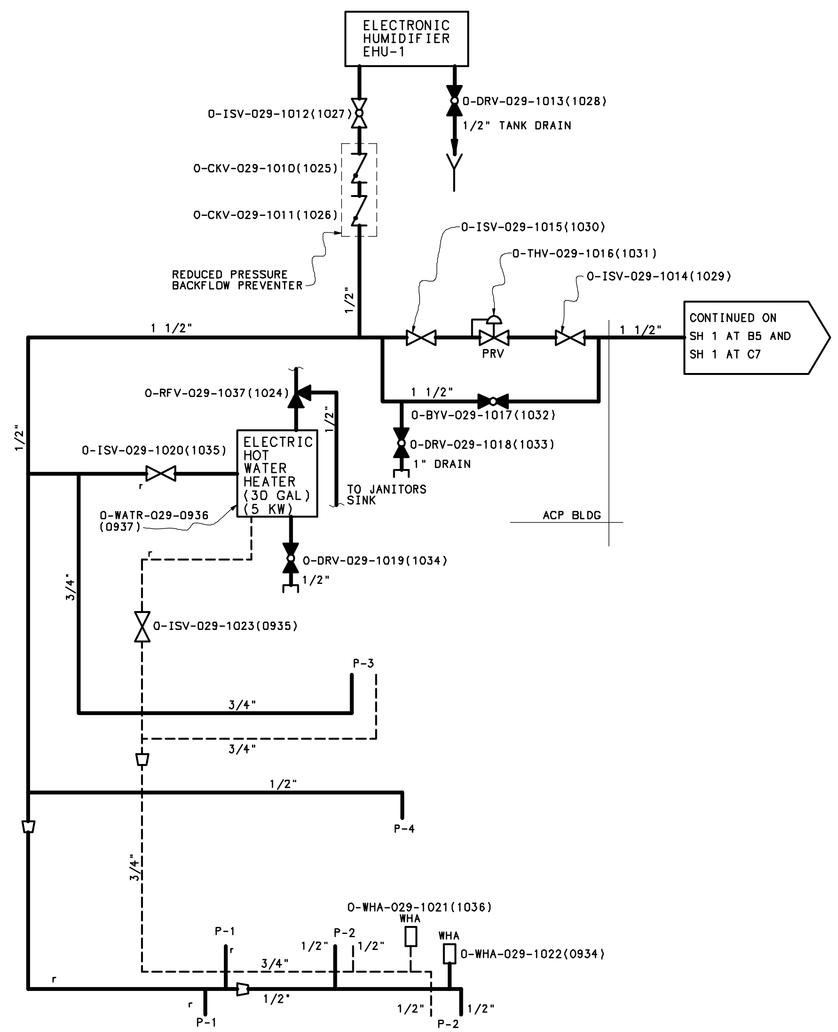
TURBINE, SERVICE & OFFICE BUILDINGS
UNITS 1 & 2
FLOW DIAGRAM
POTABLE WATER
DISTRIBUTION SYSTEM
TVA DWG NO. 0-47W835-3 R0
FIGURE 9.2-29C

CAD MAINTAINED DRAWING

NOTES:
1. FOR GENERAL NOTES AND REFERENCE DRAWING SEE 0-47W835-1.
2. ALL PIPING ON THIS DRAWING IS TVA CLASS H.



FIELD SERVICES FACILITY - PHASE I



PORTABLE WATER SYSTEM

NORTH & WEST ACCESS CONTROL PORTALS
(UNIDS NO. SHOWN ARE FOR NORTH ACP.
NOS IN ( ) ARE FOR THE WEST ACP)

FOR COMPANION DRAWINGS SEE SHEET 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

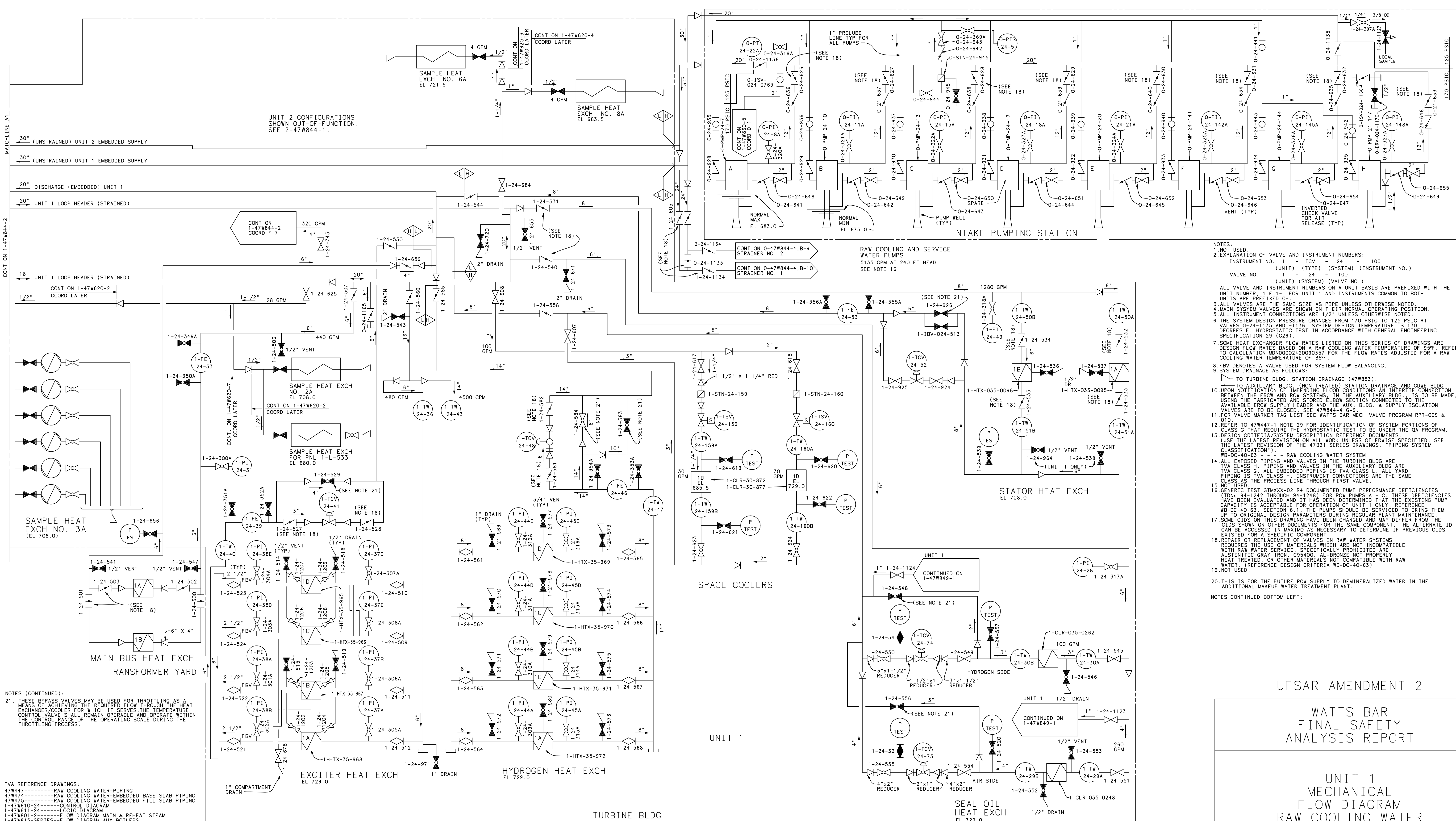
GENERAL
UNITS 1 & 2
FLOW DIAGRAM
POTABLE WATER
DISTRIBUTION SYSTEM
TVA DWG NO. 0-47W835-4 R0
FIGURE 9.2-29D

FIGURE 9.2-30

THRU 9.2-31

DELETED

CAD MAINTAINED DRAWING



NOTES:

1. NOT USED.
2. EXPLANATION OF VALVE AND INSTRUMENT NUMBERS:

INSTRUMENT NO. 1 - TCV - 24 - 100
(UNIT) (TYPE) (SYSTEM) (INSTRUMENT NO.)

VALVE NO. 1 - 24 - 100
(UNIT) (SYSTEM) (VALVE NO.)

ALL VALVE AND INSTRUMENT NUMBERS ON A UNIT BASIS ARE PREFIXED WITH THE UNIT NUMBER, 1.E.1-. FOR UNIT 1 AND INSTRUMENTS COMMON TO BOTH UNITS ARE PREFIXED O-.

3. ALL VALVES ARE THE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
4. MAIN SYSYEM VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
5. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
6. THE SYSTEM DESIGN PRESSURE CHANGES FROM 170 PSIG TO 125 PSIG AT VALVES 0-24-1135 AND -1136. SYSTEM DESIGN TEMPERATURE IS 130 DEGREES F. HYDROSTATIC TEST IN ACCORDANCE WITH GENERAL ENGINEERING SPECIFICATION 29 (G29).
7. SOME HEAT EXCHANGER FLOW RATES LISTED ON THIS SERIES OF DRAWINGS ARE DESIGN FLOW RATES BASED ON A RAW COOLING WATER TEMPERATURE OF 95°F. REFER TO CALCULATION MDN00002420090357 FOR THE FLOW RATES ADJUSTED FOR A RAW COOLING WATER TEMPERATURE OF 85°F.
8. FBV DENOTES A VALVE USED FOR SYSTEM FLOW BALANCING.
9. SYSTEM DRAINAGE AS FOLLOWS:

TO TURBINE BLDG. STATION DRAINAGE (47W853).

TO AUXILIARY BLDG. (NON-TREATED) STATION DRAINAGE AND CDWE BLDG.

10. UPON NOTIFICATION OF IMPENDING FLOOD CONDITIONS AN INTERTIE CONNECTION BETWEEN THE ERCW AND RCW SYSTEMS, IN THE AUXILIARY BLDG., IS TO BE MADE, USING THE FABRICATED AND STORED ELBOW SECTION CONNECTED TO THE AVAILABLE ERCW SUPPLY HEADER AND THE AUX. BLDG. & SUPPLY ISOLATION VALVES ARE TO BE CLOSED. SEE 47W844-4 G-9.
11. FOR VALVE MARKER TAG LIST SEE WATTS BAR MECH VALVE PROGRAM RPT-009 & 010.
12. REFER TO 47W447-1 NOTE 29 FOR IDENTIFICATION OF SYSTEM PORTIONS OF CLASS G THAT REQUIRE THE HYDROSTATIC TEST TO BE UNDER THE QA PROGRAM.
13. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS: (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS, "PIPING SYSTEM CLASSIFICATION").
WB-DC-40-63 - - - - RAW COOLING WATER SYSTEM
14. ALL EXPOSED PIPING AND VALVES IN THE TURBINE BLDG ARE TVA CLASS H. PIPING AND VALVES IN THE AUXILIARY BLDG ARE TVA CLASS G. ALL EMBEDDED PIPING IS TVA CLASS L. ALL YARD PIPING IS TVA CLASS H. INSTRUMENT CONNECTIONS ARE THE SAME CLASS AS THE PROCESS LINE THROUGH FIRST VALVE.
15. NOT USED.
16. GENERIC TEST GTMXXX-02 R4 DOCUMENTED PUMP PERFORMANCE DEFICIENCIES (TDNs 94-1242 THROUGH 94-1248) FOR RCW PUMPS A - G. THESE DEFICIENCIES HAVE BEEN EVALUATED AND IT HAS BEEN DETERMINED THAT THE EXISTING PUMP CAPACITY IS ACCEPTABLE FOR OPERATION OF UNIT 1 ONLY. REFERENCE WB-DC-40-63, SECTION 6.1. THE PUMPS SHOULD BE SERVICED TO BRING THEM UP TO ORIGINAL DESIGN PARAMETERS DURING REGULAR PLANT MAINTENANCE.
17. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
18. REPAIR OR REPLACEMENT OF VALVES IN RAW WATER SYSTEMS REQUIRES THE USE OF MATERIALS WHICH ARE NOT INCOMPATIBLE WITH RAW WATER SERVICE. SPECIFICALLY PROHIBITED ARE AUSTENITIC GRAY IRON, C95400, AL-BRONZE NOT PROPERLY HEAT TREATED, OR OTHER MATERIALS NOT COMPATIBLE WITH RAW WATER. (REFERENCE DESIGN CRITERIA WB-DC-40-63)
19. NOT USED.
20. THIS IS FOR THE FUTURE RCW SUPPLY TO DEMINERALIZED WATER IN THE ADDITIONAL MAKEUP WATER TREATMENT PLANT.

NOTES CONTINUED BOTTOM LEFT:

NOTES (CONTINUED):

21. THESE BYPASS VALVES MAY BE USED FOR THROTTLING AS A MEANS OF ACHIEVING THE REQUIRED FLOW THROUGH THE HEAT EXCHANGER/COOLER FOR WHICH IT SERVES. THE TEMPERATURE CONTROL VALVE SHALL REMAIN OPERABLE AND OPERATE WITHIN THE CONTROL RANGE OF THE OPERATING SCALE DURING THE THROTTLING PROCESS.

TVA REFERENCE DRAWINGS:

47W447---------RAW COOLING WATER-PIPING
47W474---------RAW COOLING WATER-EMBEDDED BASE SLAB PIPING
47W475---------RAW COOLING WATER-EMBEDDED FILL SLAB PIPING
1-47W610-24------CONTROL DIAGRAM
1-47W611-24------LOGIC DIAGRAM
1-47W801-2-------FLOW DIAGRAM MAIN & REHEAT STEAM
1-47W815-SERIES--FLOW DIAGRAM AUX BOILERS
1-47W831-SERIES--FLOW DIAGRAM CONDENSER CIRCULATING WATER
1-47W834-SERIES--FLOW DIAGRAM MAKEUP WATER TREATMENT
1-47W845-SERIES--FLOW DIAGRAM ESSENTIAL RAW COOLING WATER
1-47W850-SERIES--FLOW DIAGRAM FIRE PROTECTION & SERVICE WATER
1-47W852-SERIES--FLOW DIAGRAM STATION DRAINAGE AUX. BLDG.
1-47W853-SERIES--FLOW DIAGRAM STATION DRAINAGE TURBINE BLDG.

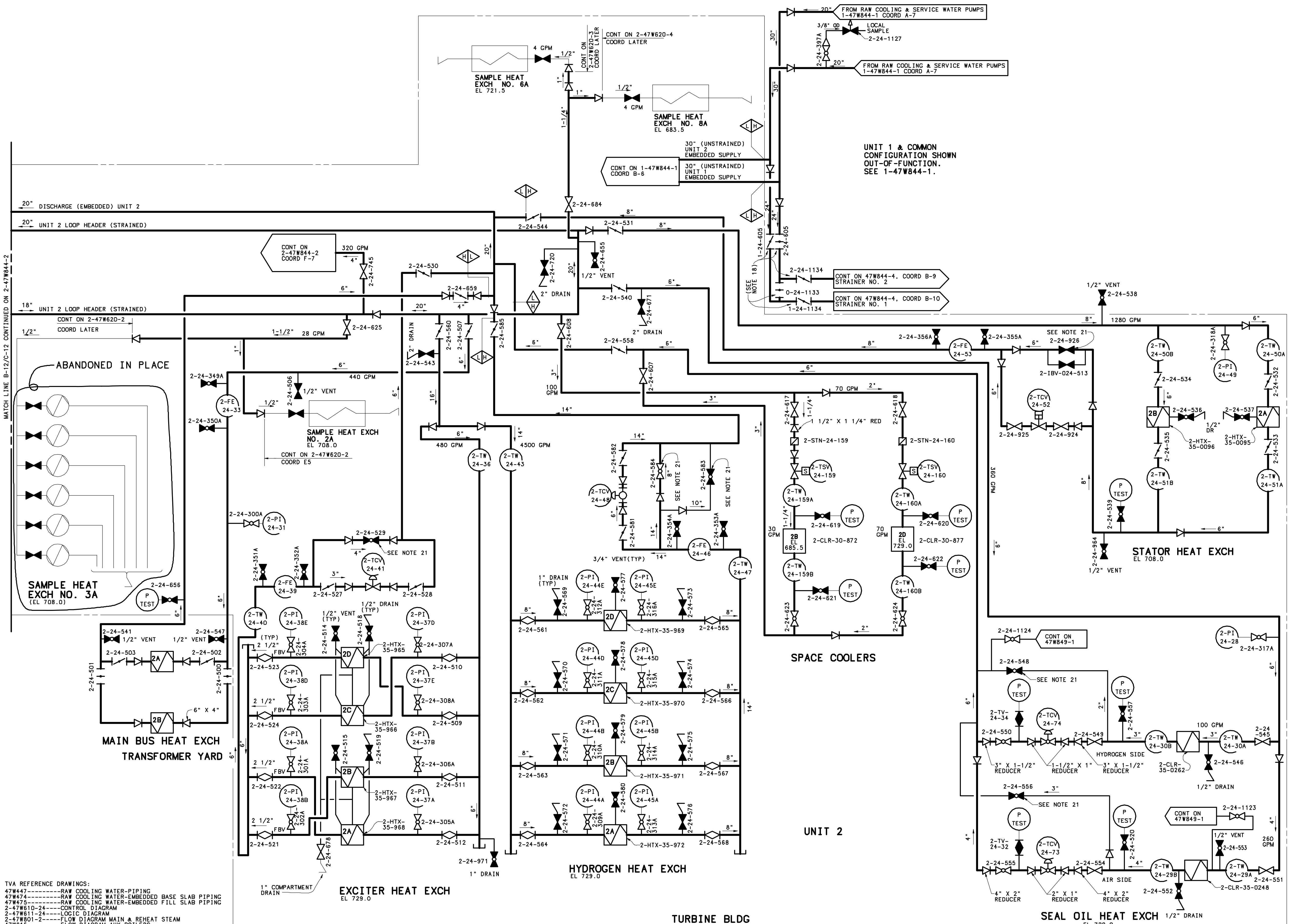
COMPANION DRAWINGS:
1-47W844-2 & 3
0-47W844-4 & 5

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

UNIT 1
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W844-1 R46
FIGURE 9.2-32

CAD MAINTAINED DRAWING



TVA REFERENCE DRAWINGS:
47W447----------RAW COOLING WATER-PIPING
47W474----------RAW COOLING WATER-EMBEDDED BASE SLAB PIPING
47W475----------RAW COOLING WATER-EMBEDDED FILL SLAB PIPING
2-47W610-24-----CONTROL DIAGRAM
2-47W611-24-----LOGIC DIAGRAM
2-47W801-2------FLOW DIAGRAM MAIN & REHEAT STEAM
47W815----------FLOW DIAGRAM AUX BOILERS
47W831----------FLOW DIAGRAM CONDENSER CIRCULATING WATER
47W834----------FLOW DIAGRAM MAKEUP WATER TREATMENT
47W845----------FLOW DIAGRAM ESSENTIAL RAW COOLING WATER
47W850----------FLOW DIAGRAM FIRE PROTECTION & SERVICE WATER
47W852----------FLOW DIAGRAM STATION DRAINAGE AUX. BLDG.
47W853----------FLOW DIAGRAM STATION DRAINAGE TURBINE BLDG.

COMPANION DRAWINGS:
2-47W844-2 & 3
0-47W844-4, -4A & -5

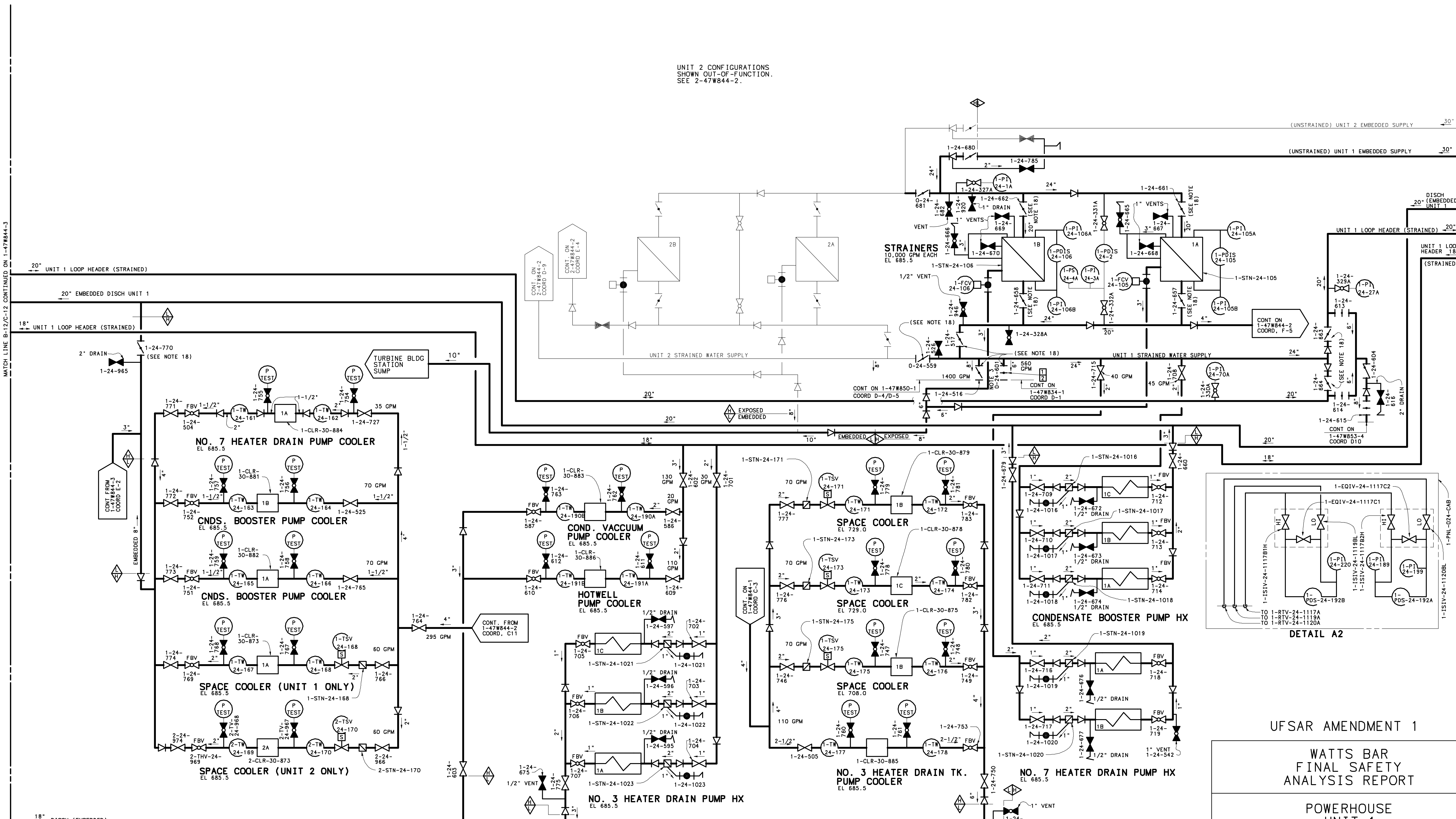
NOTES:

1. NOT USED
2. EXPLANATION OF VALVE AND INSTRUMENT NUMBERS:
   INSTRUMENT NO. 2 - TCV - 24 - 100 (UNIT) (TYPE) (SYSTEM) (INSTRUMENT NO.)
   VALVE NO. 2 - 24 - 100 (UNIT) (SYSTEM) (VALVE NO.)
   ALL VALVE AND INSTRUMENT NUMBERS ON A UNIT BASIS ARE PREFIXED WITH THE UNIT NUMBER, I.E.1-. FOR UNIT 1 AND 2-. FOR UNIT 2.
3. ALL VALVES ARE THE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
4. MAIN SYSTEM VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
5. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
6. NOT USED
7. NOT USED.
8. FBV DENOTES A VALVE USED FOR SYSTEM FLOW BALANCING.
9. SYSTEM DRAINAGE AS FOLLOWS:
   TO TURBINE BLDG. STATION DRAINAGE (47W853).
   TO AUXILIARY BLDG. (NON-TREATED) STATION DRAINAGE AND CDWE BLDG.
10. NOT USED.
11. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS: (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWING, "PIPING SYSTEM CLASSIFICATION").WB-DC-40-63----RAW COOLING WATER SYSTEM
12. REFER TO 47W447-1 NOTE 29 FOR IDENTIFICATION OF SYSTEM PORTIONS OF CLASS G THAT REQUIRE THE HYDROSTATIC TEST TO BE UNDER THE QA PROGRAM.
13. ALL EXPOSED PIPING AND VALVES IN THE TURBINE BLDG ARE TVA CLASS H. PIPING AND VALVES IN THE AUXILIARY BLDG ARE TVA CLASS G. ALL EMBEDDED PIPING IS TVA CLASS L. ALL YARD PIPING IS TVA CLASS H. INSTRUMENT CONNECTIONS ARE THE SAME CLASS AS THE PROCESS LINE THROUGH FIRST VALVE.
14. NOT USED.
15. VARIOUS HEAT EXCHANGER FLOW RATES LISTED ON THIS SERIES OF DRAWINGS ARE DESIGN FLOW RATES BASED ON A RAW COOLING WATER TEMPERATURE OF 95°F. REFER TO CALCULATION MDN0002420090357 FOR THE FLOW RATES ADJUSTED FOR A RAW COOLING WATER TEMPERATURE OF 85°F.
16. NOT USED.
17. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON THE OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
18. REPAIR OR REPLACEMENT OF VALVES IN RAW WATER SYSTEMS REQUIRES THE USE OF MATERIALS WHICH ARE NOT INCOMPATIBLE WITH RAW WATER SERVICE. SPECIFICALLY PROHIBITED ARE AUSTENITIC GRAY IRON, C95400, AL-BRONZE NOT PROPERLY HEAT TREATED, OR OTHER MATERIALS NOT COMPATIBLE WITH RAW WATER. (REFERENCE DESIGN CRITERIA WB-DC-40-63)
19. NOT USED.
20. THIS IS FOR THE FUTURE RCW SUPPLY TO DEMENERALIZED WATER IN THE ADDITIONAL MAKEUP WATER TREATMENT PLANT.
21. THESE BYPASS VALVES MAY BE USED FOR THROTTLING AS A MEANS OF ACHIEVING THE REQUIRED FLOW THROUGH THE HEAT EXCHANGER/COOLER FOR WHICH IT SERVES. THE TEMPERATURE CONTROL VALVE SHALL REMAIN OPERABLE AND OPERATE WITHIN THE CONTROL RANGE OF THE THE OPERATING SCALE DURING THE THROTTLING PROCESS.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

UNIT 2
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 2-47W844-1 R22
FIGURE 9.2-32(U2)

CAD MAINTAINED DRAWING



UNIT 1
TURBINE BLDG

NOTES:

1. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

2. NOT USED.

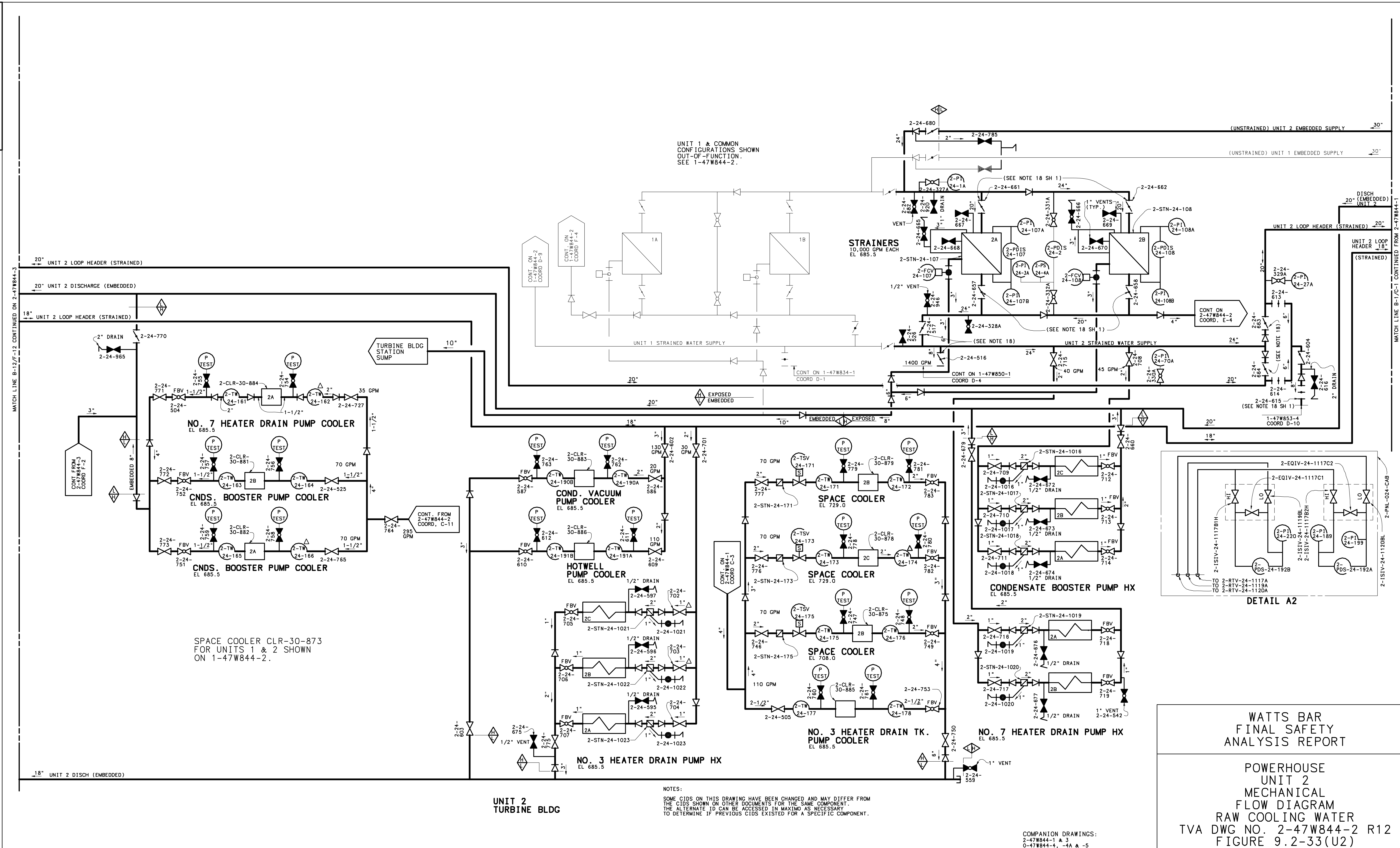
3. NON SAFETY RELATED UNIT 1/UNIT 2 INTERFACE POINTS ARE INDICATED BY 1 2 AND ARE REQUIRED TO BE CLOSED WITH HANDWHEEL REMOVED.

COMPANION DRAWINGS:
1-47W844-1 & 3
0-47W844-4 & 5

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W844-2 R23
FIGURE 9.2-33



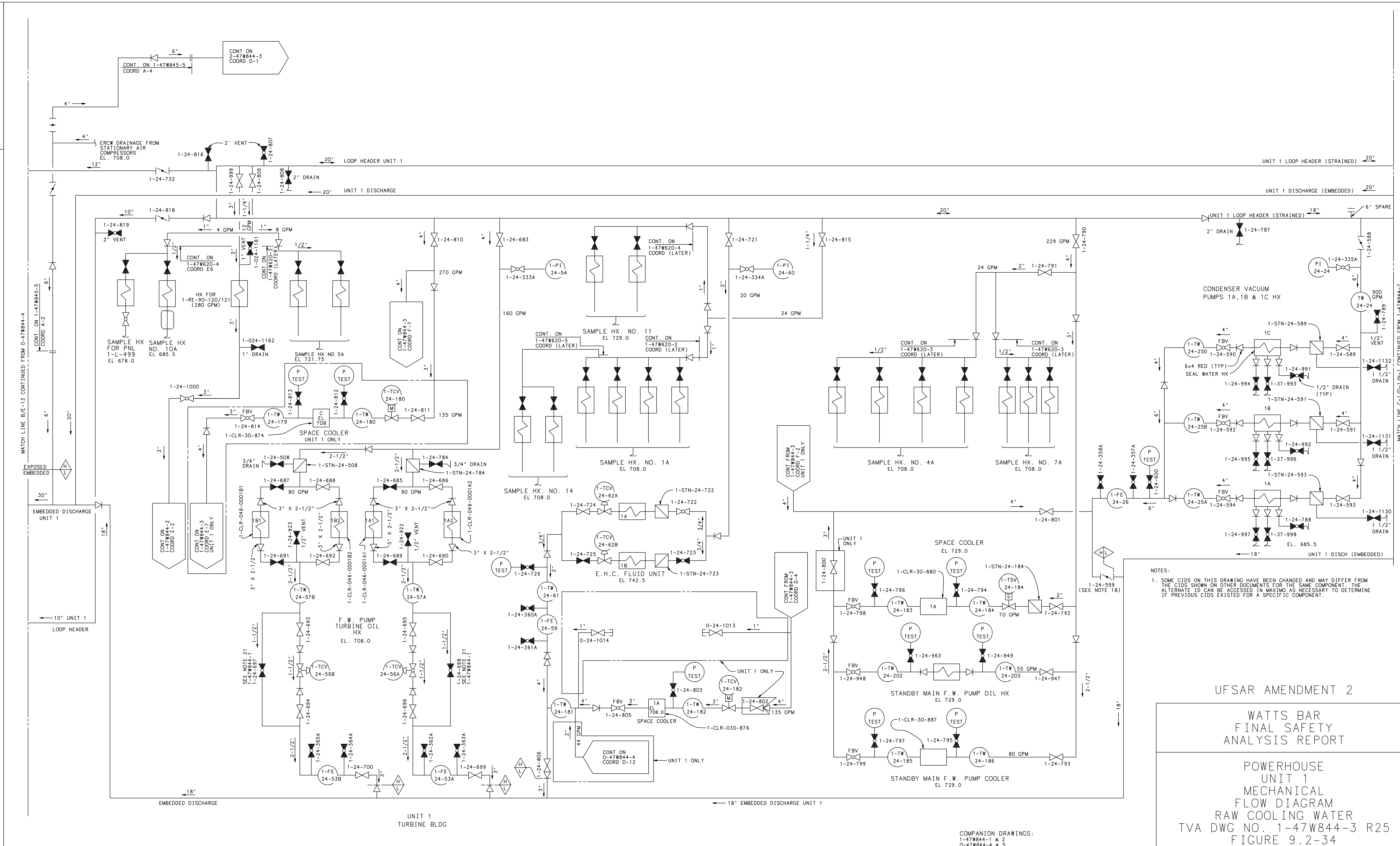
NOTES:

SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

COMPANION DRAWINGS:
2-47W844-1 & 3
0-47W844-4, -4A & -5

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 2-47W844-2 R12
FIGURE 9.2-33(U2)



NOTES:

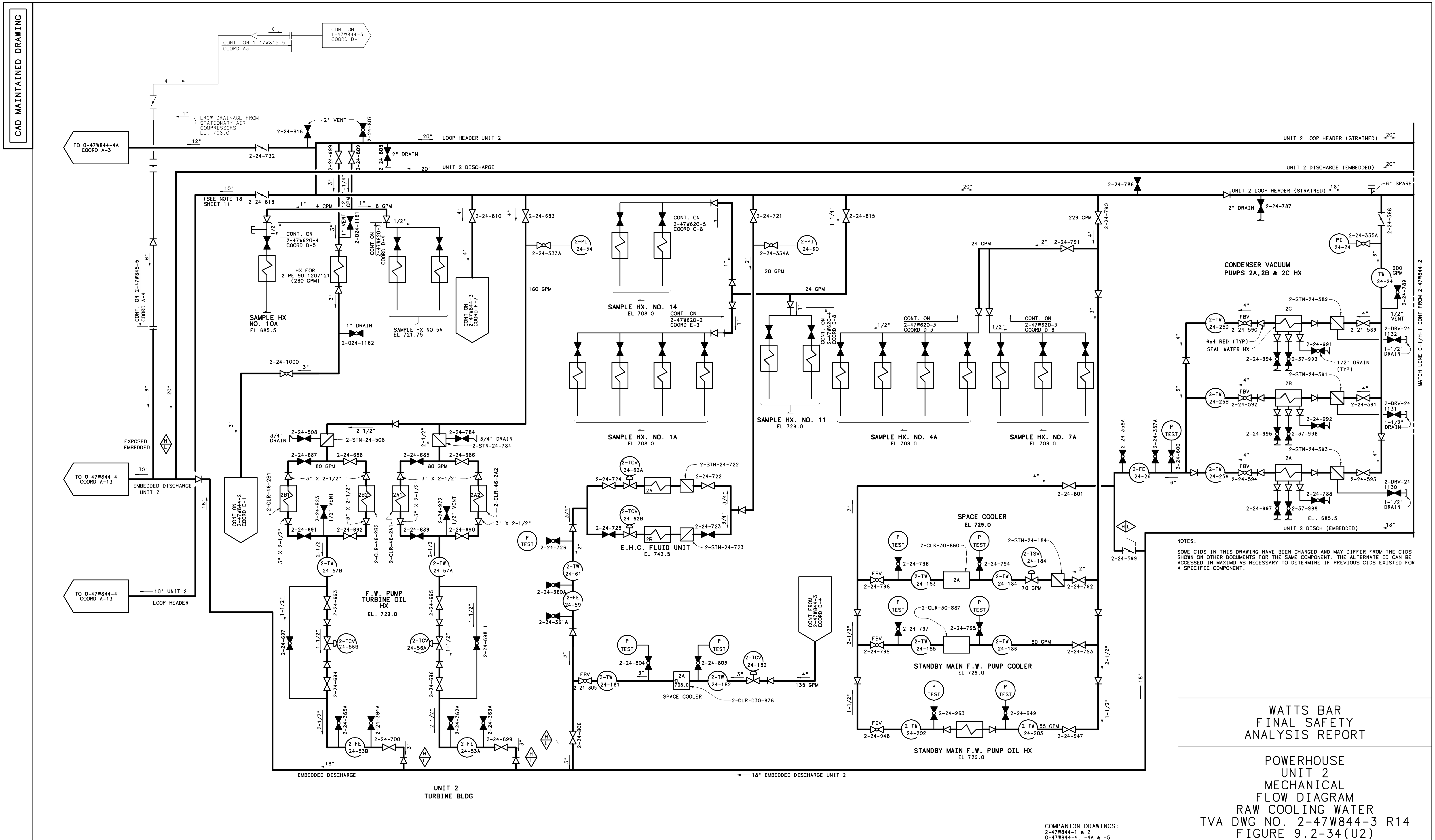
1. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

COMPANION DRAWINGS:
1-47W844-1 & 2
0-47W844-4 & 5

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W844-3 R25
FIGURE 9.2-34



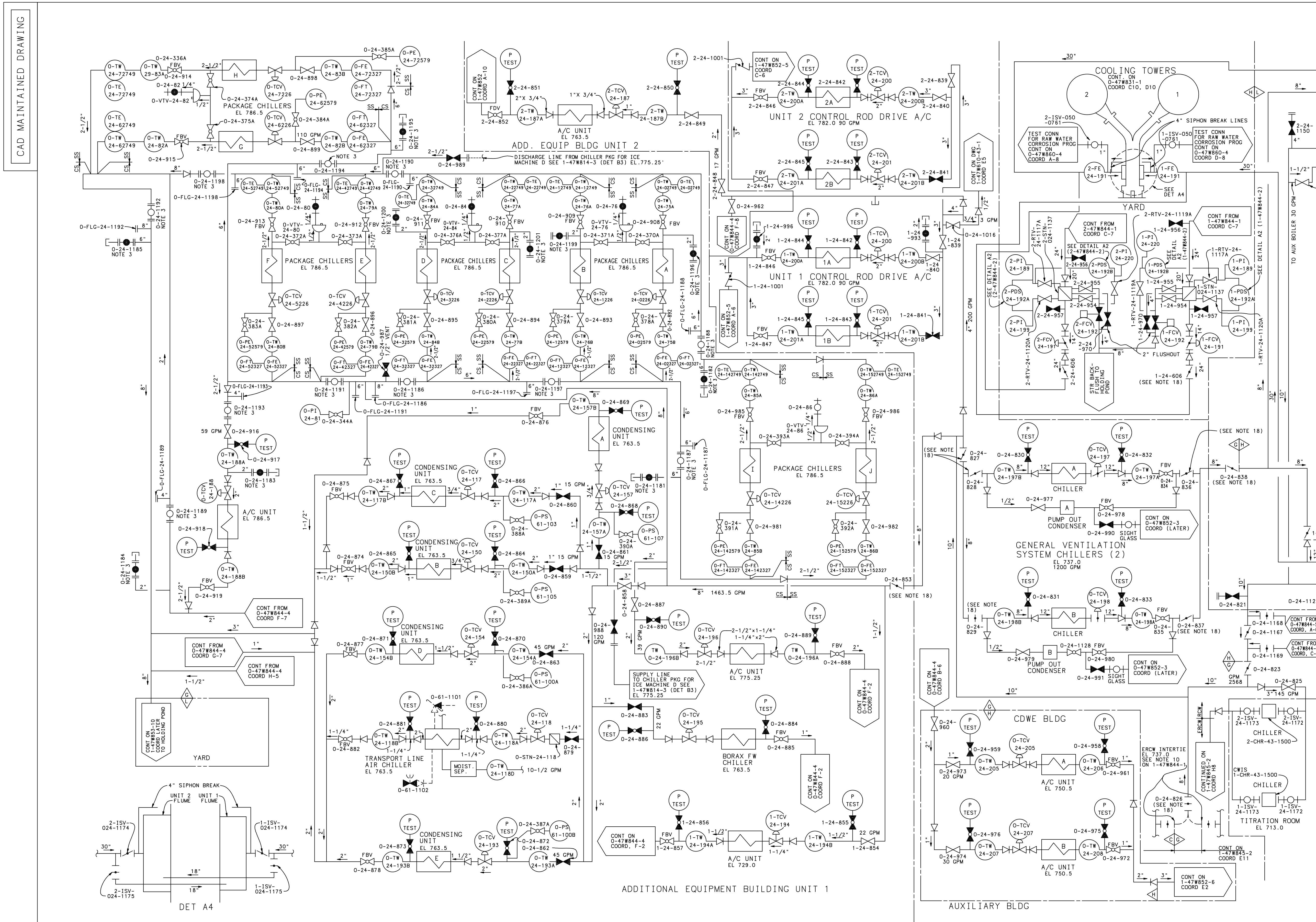
NOTES:

SOME CIDS IN THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

COMPANION DRAWINGS:
2-47W844-1 & 2
0-47W844-4, -4A & -5

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 2-47W844-3 R14
FIGURE 9.2-34(U2)



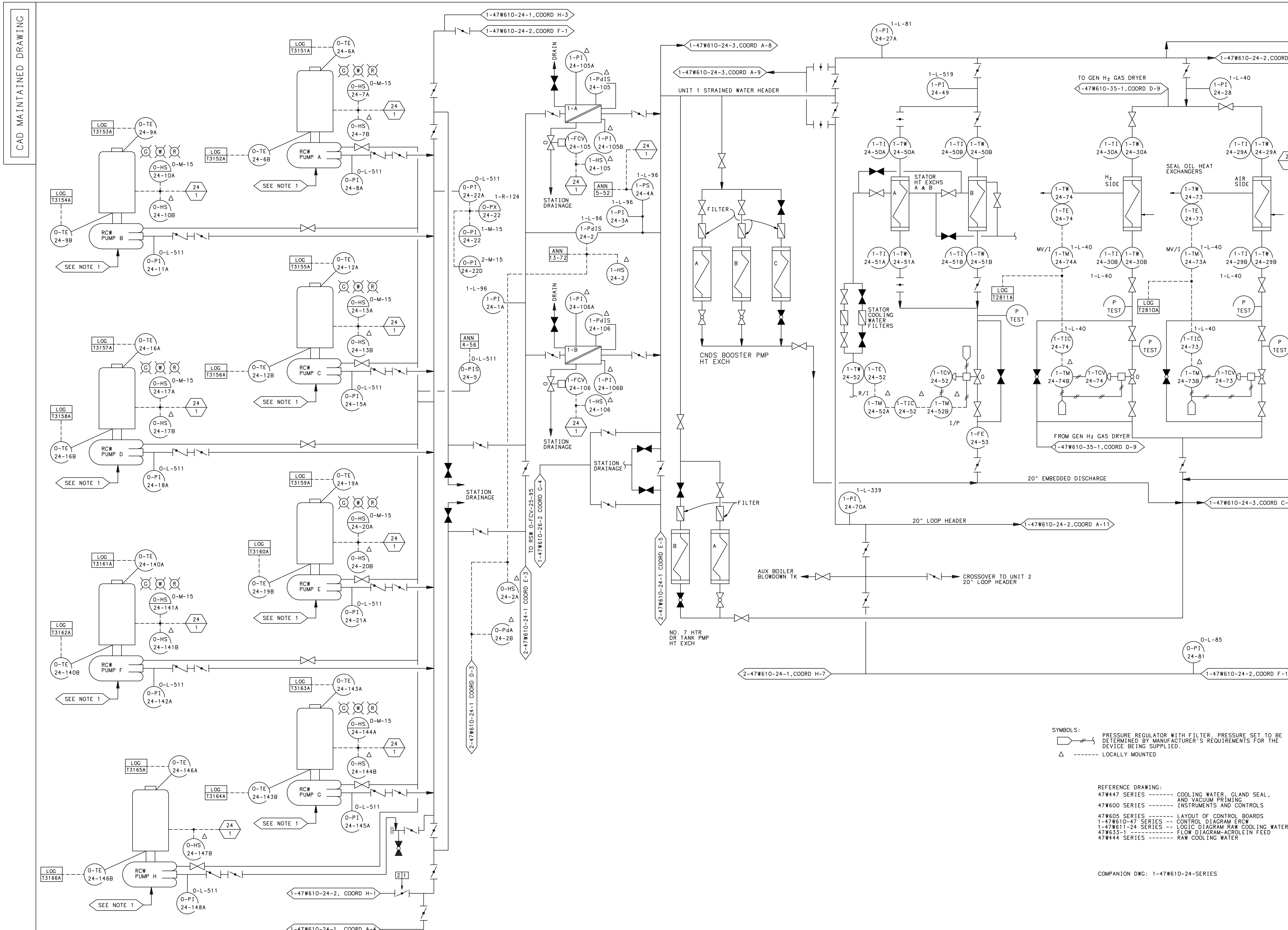
NOTES:
1. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
2. NOT USED
3. THESE VALVES ARE STAINLESS STEEL AND INSTALLED ON CARBON STEEL PIPING WITH FLANGE INSULATING KITS.

COMPANION DRAWINGS:
1-47W844-1 THRU 3
2-47W844-1 THRU 3
0-47W844-4A & 5

UFSAR AMENDMENT 2

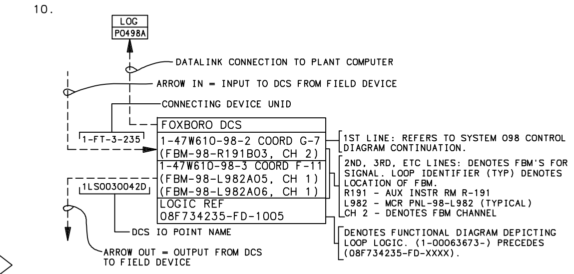
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
RAW COOLING WATER
TVA DWG NO. 0-47W844-4 R7
FIGURE 9.2-35



NOTES:

1. WATER SUPPLIED FROM PUMPING STATION.
2. THE RAW COOLING SYSTEM SUPPLIES COOLING WATER TO VARIOUS PLANT COMPONENTS AND HEAT EXCHANGERS. THE WATER IS SUPPLIED FROM PUMPING STATION THROUGH STRAINERS TO THE SUPPLY HEADERS. THE STRAINERS ARE MONITORED FOR CLOGGING BY 2-PdIS-24-2 WHICH ACTUATES ALARM 2-PdA-24-2A IN THE MAIN CONTROL ROOM AS WELL AS A LOCAL ALARM 0-PdA-24-2B WHEN THE DIFFERENTIAL ACROSS THE STRAINERS EXCEED THE SET POINT. STRAINER CLEANING IS ACCOMPLISHED LOCALLY BY MANUALLY OPENING BACKFLUSH VALVES MOTOR (1-HS-24-105 FOR STRAINER 1-A).
3. THE SUPPLY HEADER PRESSURE IS MONITORED BY 1-PS-24-4 WHICH OPERATES ALARM 1-PA-24-4 IN THE MAIN CONTROL ROOM WHEN THE HEADER PRESSURE DROPS BELOW THE SET POINT.
4. THE SEVEN RCW PUMPS DISCHARGE INTO A COMMON HEADER WHICH SUPPLIES BOTH UNIT 1 AND UNIT 2 EQUIPMENT. THE PUMPS ARE CONTROLLED FROM THE MAIN CONTROL ROOM BY SWITCHES 0-HS-24-7A, ETC., OR LOCALLY BY SWITCHES 0-HS-24-7B, ETC. NORMALLY PUMPS PROVIDE ADEQUATE COOLING WATER. A PUMP MAY BE SELECTED FOR AUTOMATIC OPERATION, AND IS STARTED BY PRESSURE SWITCH 1-PS-24-4A OR 2-PS-24-4A IF HEADER PRESSURE DROPS TOO LOW. PUMP DISCHARGE HEADER PRESSURE IS MONITORED BY 0-PT-24-22A AND DISPLAYED IN THE MAIN CONTROL ROOM ON 0-PI-24-22.
5. TO RCW CONTROL LOOPS, TURBINE OIL AND GENERATOR HYDROGEN COOLERS, MAY BE CONTROLLED FROM THE MAIN CONTROL ROOM. THIS IS ACCOMPLISHED BY TEMPERATURE INDICATOR CONTROLLERS 1-TIC-24-69 (TURBINE OIL) AND 1-TIC-24-48 (GENERATOR HYDROGEN). THESE CONTROLS ARE NEEDED DURING STARTUP TO CHANGE THE VISCOSITY OF THE TURBINE LUBRICATING OIL AND TO ADJUST THE GENERATOR HEAT REMOVAL AS REQUIRED.
6. THE TEMPERATURE CONTROLS ON MOST OF THE VARIOUS HEAT EXCHANGERS AND COOLERS ARE LOCAL AND OPERATE AS FOLLOWS: A THERMOCOUPLE IS PLACED IN THE OUTPUT OF THE PROCESS LINE LEAVING THE HEAT EXCHANGERS OR COOLERS. THE OUTPUT OF THE THERMOCOUPLE GOES TO A TEMPERATURE MODIFIER WHICH SENDS A PROPORTIONAL PNEUMATIC SIGNAL TO A TEMPERATURE INDICATOR CONTROLLER WHICH SENDS A PNEUMATIC SIGNAL TO THE VALVE POSITIONER ON THE RCW CONTROL VALVE. THE VALVE REGULATES THE FLOW OF RCW OUT OF THE COMPONENT TO HOLD THE PROCESS TEMPERATURE AT THE SET POINT.
7. PRESSURE GAUGES, PRESSURE TEST POINTS, TEMPERATURE INDICATORS, AND TEMPERATURE TEST WELLS ARE INSTALLED IN VARIOUS PORTIONS OF THE SYSTEM FOR OPERATION AND TEST.
8. INSTRUMENTS ASSOCIATED WITH THE BYPASS STRAINERS WILL HAVE HEAT TRACING, FOR THE HEAT TRACING SEE THERMON DWG 77-39A-70.
9. NOT USED.
10.



SYMBOLS:

PRESSURE REGULATOR WITH FILTER. PRESSURE SET TO BE DETERMINED BY MANUFACTURER'S REQUIREMENTS FOR THE DEVICE BEING SUPPLIED.

△ ------- LOCALLY MOUNTED

REFERENCE DRAWING:

47W447 SERIES ------- COOLING WATER, GLAND SEAL, AND VACUUM PRIMING
47W600 SERIES ------- INSTRUMENTS AND CONTROLS
47W605 SERIES ------- LAYOUT OF CONTROL BOARDS
1-47W610-47 SERIES -- CONTROL DIAGRAM ERCW
1-47W611-24 SERIES -- LOGIC DIAGRAM RAW COOLING WATER
47W633-1 ------------ FLOW DIAGRAM-ACROLEIN FEED
47W444 SERIES ------- RAW COOLING WATER

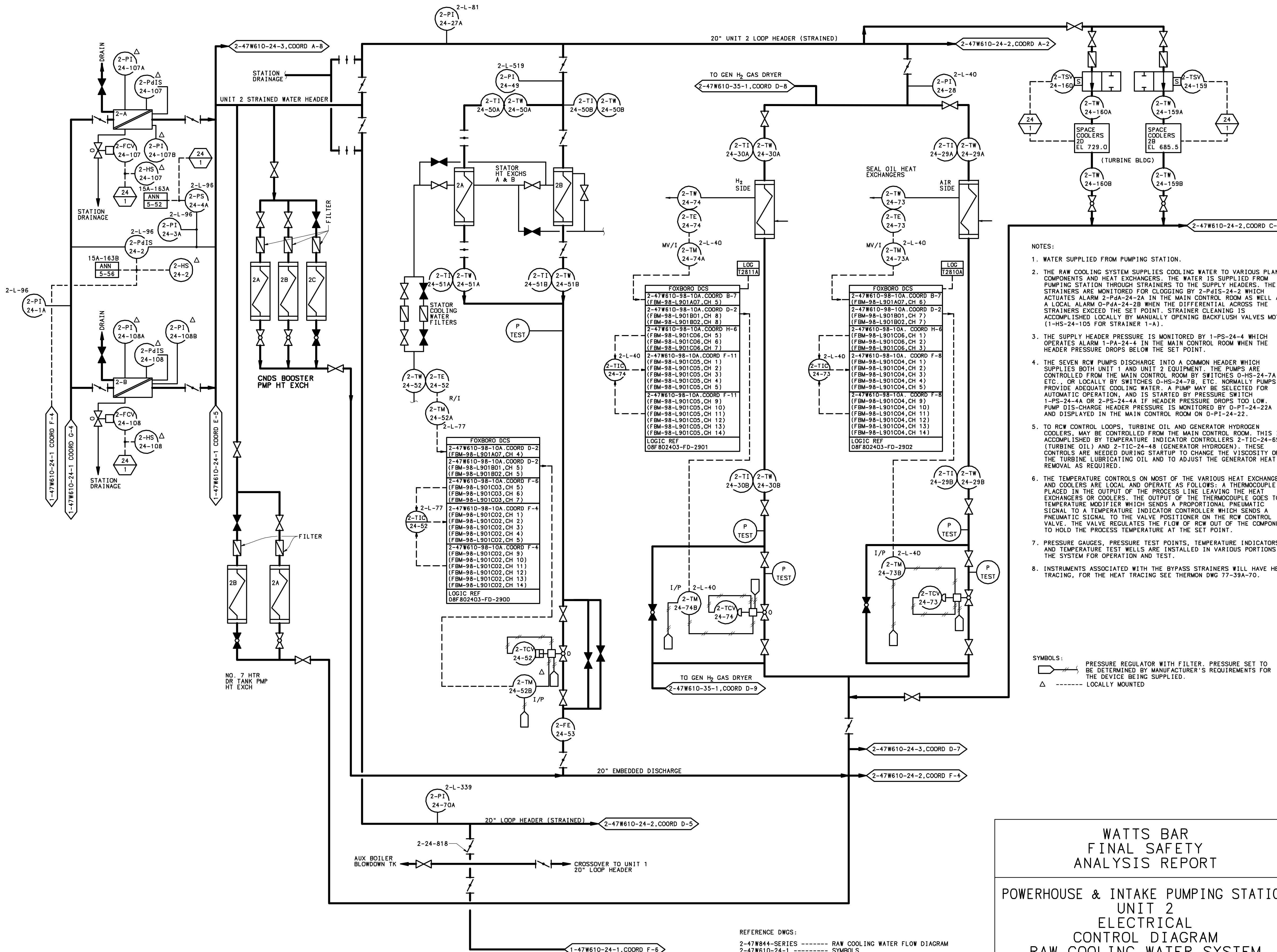
COMPANION DWG: 1-47W610-24-SERIES

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE & INTAKE PUMPING STATION
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER SYSTEM
TVA DWG NO. 1-47W610-24-1 R25
FIGURE 9.2-36

CAD MAINTAINED DRAWING



NOTES:

1. WATER SUPPLIED FROM PUMPING STATION.
2. THE RAW COOLING SYSTEM SUPPLIES COOLING WATER TO VARIOUS PLANT COMPONENTS AND HEAT EXCHANGERS. THE WATER IS SUPPLIED FROM PUMPING STATION THROUGH STRAINERS TO THE SUPPLY HEADERS. THE STRAINERS ARE MONITORED FOR CLOGGING BY 2-PdIS-24-2 WHICH ACTUATES ALARM 2-PdA-24-2A IN THE MAIN CONTROL ROOM AS WELL AS A LOCAL ALARM 0-PdA-24-2B WHEN THE DIFFERENTIAL ACROSS THE STRAINERS EXCEED THE SET POINT. STRAINER CLEANING IS ACCOMPLISHED LOCALLY BY MANUALLY OPENING BACKFLUSH VALVES MOTOR (1-HS-24-105 FOR STRAINER 1-A).
3. THE SUPPLY HEADER PRESSURE IS MONITORED BY 1-PS-24-4 WHICH OPERATES ALARM 1-PA-24-4 IN THE MAIN CONTROL ROOM WHEN THE HEADER PRESSURE DROPS BELOW THE SET POINT.
4. THE SEVEN RCW PUMPS DISCHARGE INTO A COMMON HEADER WHICH SUPPLIES BOTH UNIT 1 AND UNIT 2 EQUIPMENT. THE PUMPS ARE CONTROLLED FROM THE MAIN CONTROL ROOM BY SWITCHES 0-HS-24-7A, ETC., OR LOCALLY BY SWITCHES 0-HS-24-7B, ETC. NORMALLY PUMPS PROVIDE ADEQUATE COOLING WATER. A PUMP MAY BE SELECTED FOR AUTOMATIC OPERATION, AND IS STARTED BY PRESSURE SWITCH 1-PS-24-4A OR 2-PS-24-4A IF HEADER PRESSURE DROPS TOO LOW. PUMP DIS-CHARGE HEADER PRESSURE IS MONITORED BY 0-PT-24-22A AND DISPLAYED IN THE MAIN CONTROL ROOM ON 0-PI-24-22.
5. TO RCW CONTROL LOOPS, TURBINE OIL AND GENERATOR HYDROGEN COOLERS, MAY BE CONTROLLED FROM THE MAIN CONTROL ROOM. THIS IS ACCOMPLISHED BY TEMPERATURE INDICATOR CONTROLLERS 2-TIC-24-69 (TURBINE OIL) AND 2-TIC-24-48 (GENERATOR HYDROGEN). THESE CONTROLS ARE NEEDED DURING STARTUP TO CHANGE THE VISCOSITY OF THE TURBINE LUBRICATING OIL AND TO ADJUST THE GENERATOR HEAT REMOVAL AS REQUIRED.
6. THE TEMPERATURE CONTROLS ON MOST OF THE VARIOUS HEAT EXCHANGERS AND COOLERS ARE LOCAL AND OPERATE AS FOLLOWS: A THERMOCOUPLE IS PLACED IN THE OUTPUT OF THE PROCESS LINE LEAVING THE HEAT EXCHANGERS OR COOLERS. THE OUTPUT OF THE THERMOCOUPLE GOES TO A TEMPERATURE MODIFIER WHICH SENDS A PROPORTIONAL PNEUMATIC SIGNAL TO A TEMPERATURE INDICATOR CONTROLLER WHICH SENDS A PNEUMATIC SIGNAL TO THE VALVE POSITIONER ON THE RCW CONTROL VALVE. THE VALVE REGULATES THE FLOW OF RCW OUT OF THE COMPONENT TO HOLD THE PROCESS TEMPERATURE AT THE SET POINT.
7. PRESSURE GAUGES, PRESSURE TEST POINTS, TEMPERATURE INDICATORS, AND TEMPERATURE TEST WELLS ARE INSTALLED IN VARIOUS PORTIONS OF THE SYSTEM FOR OPERATION AND TEST.
8. INSTRUMENTS ASSOCIATED WITH THE BYPASS STRAINERS WILL HAVE HEAT TRACING, FOR THE HEAT TRACING SEE THERMON DWG 77-39A-70.

SYMBOLS:

PRESSURE REGULATOR WITH FILTER. PRESSURE SET TO BE DETERMINED BY MANUFACTURER'S REQUIREMENTS FOR THE DEVICE BEING SUPPLIED.

△ ------- LOCALLY MOUNTED

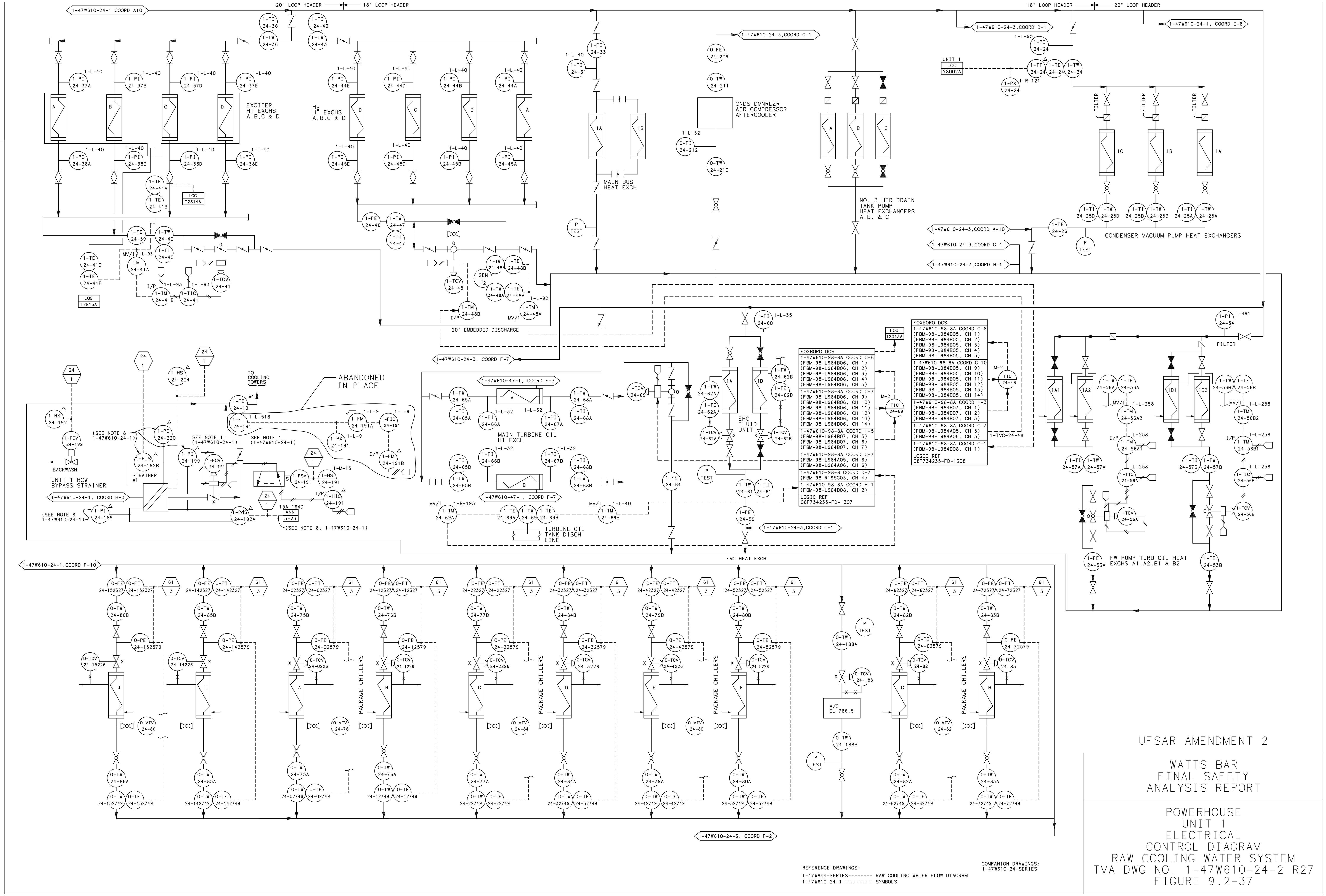
REFERENCE DWGS:

2-47W844-SERIES ------- RAW COOLING WATER FLOW DIAGRAM
2-47W610-24-1 --------- SYMBOLS

COMPANION DWG: 2-47W610-24-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE & INTAKE PUMPING STATION
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER SYSTEM
TVA DWG NO. 2-47W610-24-1 R11
FIGURE 9.2-36(U2)

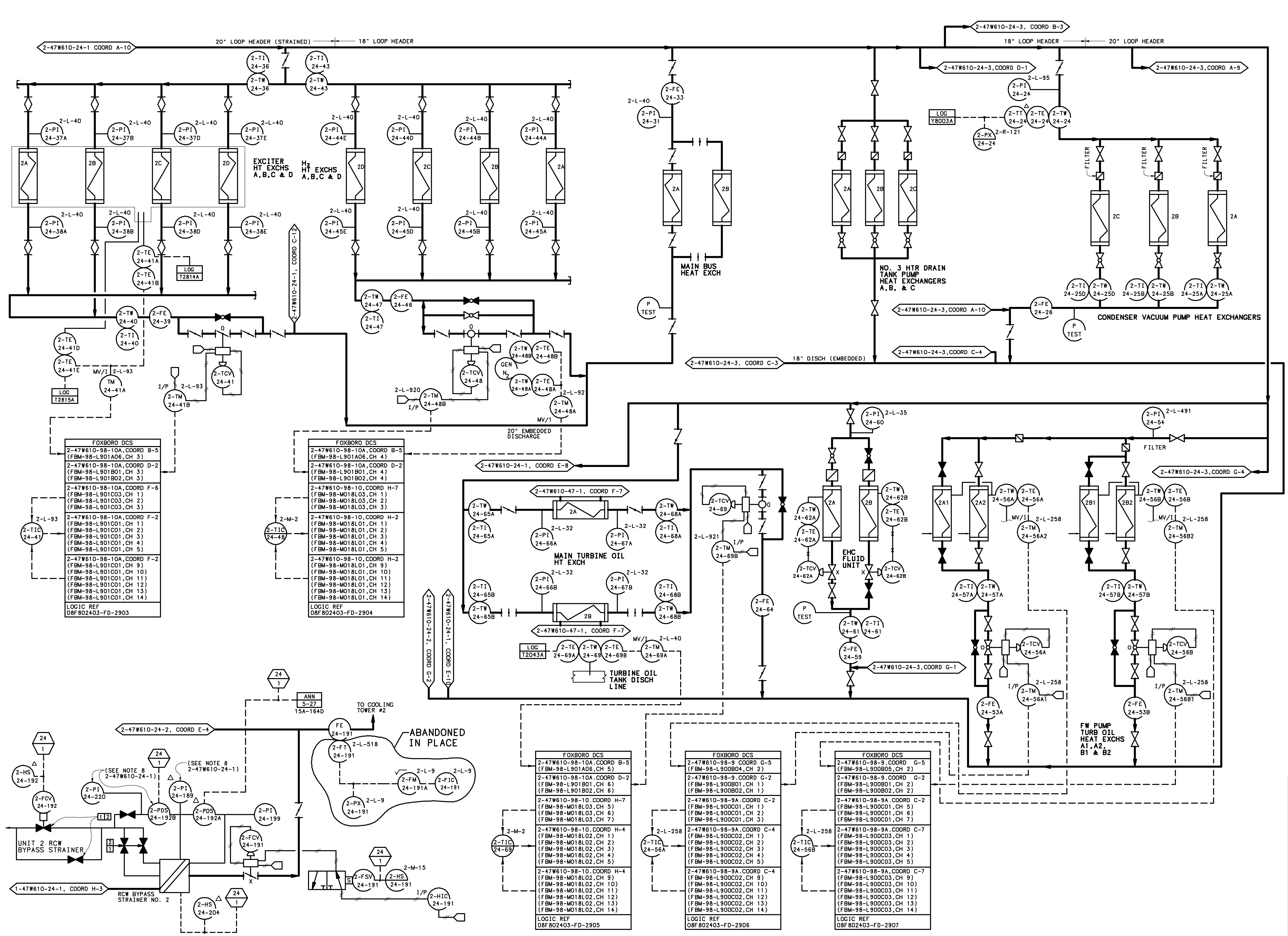


UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER SYSTEM
TVA DWG NO. 1-47W610-24-2 R27
FIGURE 9.2-37

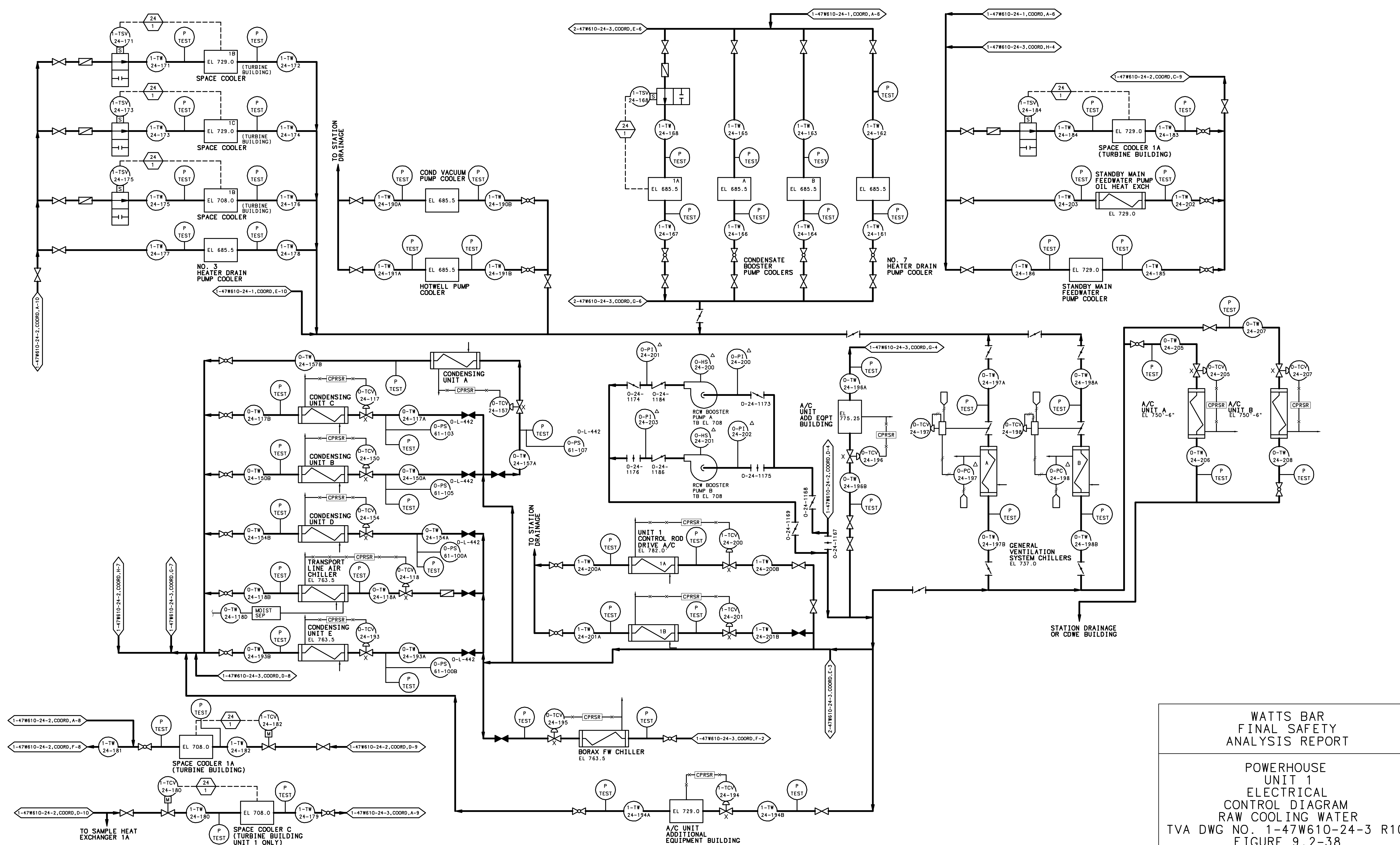
CAD MAINTAINED DRAWING



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER SYSTEM
TVA DWG NO. 2-47W610-24-2 R9
FIGURE 9.2-37(U2)

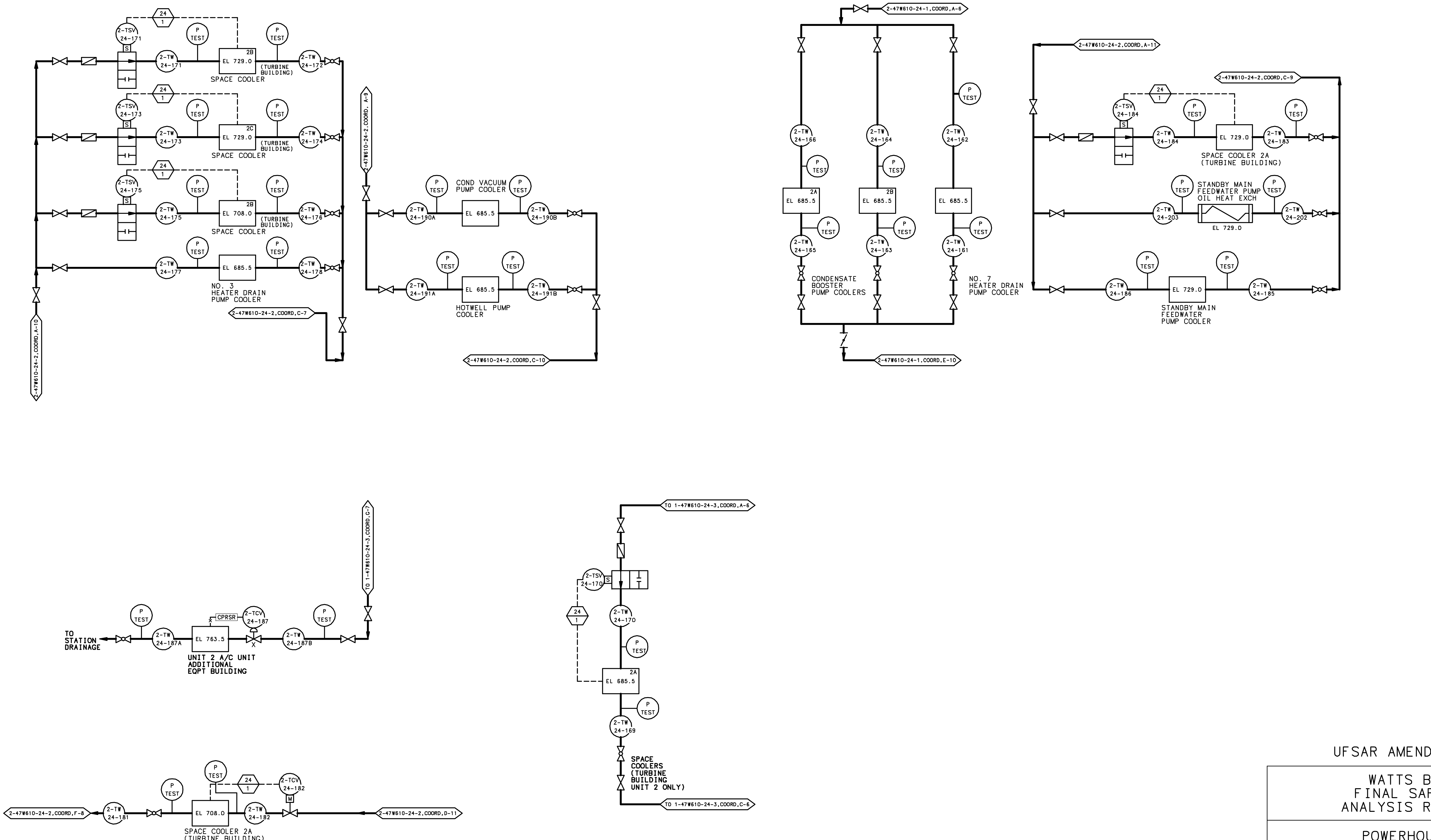
CAD MAINTAINED DRAWING



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W610-24-3 R10
FIGURE 9.2-38

CAD MAINTAINED DRAWING

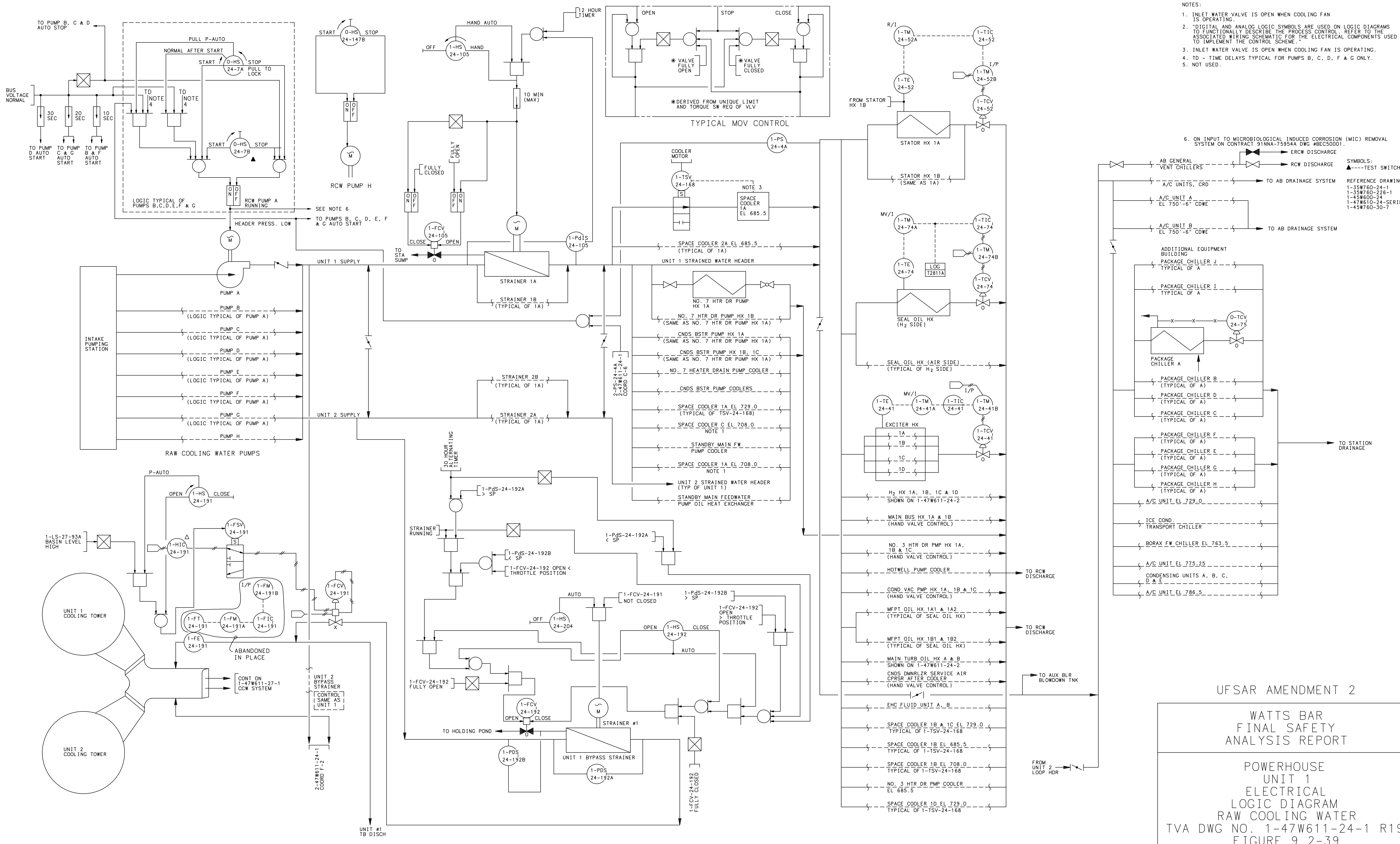


COMPANION DRAWINGS:
2-47W610-24-1,2

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
RAW COOLING WATER
TVA DWG NO. 2-47W610-24-3 R5
FIGURE 9.2-38(U2)



NOTES:

1. INLET WATER VALVE IS OPEN WHEN COOLING FAN IS OPERATING.
2. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
3. INLET WATER VALVE IS OPEN WHEN COOLING FAN IS OPERATING.
4. TD - TIME DELAYS TYPICAL FOR PUMPS B, C, D, F & G ONLY.
5. NOT USED.
6. ON INPUT TO MICROBIOLOGICAL INDUCED CORROSION (MIC) REMOVAL SYSTEM ON CONTRACT 91NNA-75954A DWG #BEC50001.

SYMBOLS:
▲----TEST SWITCH

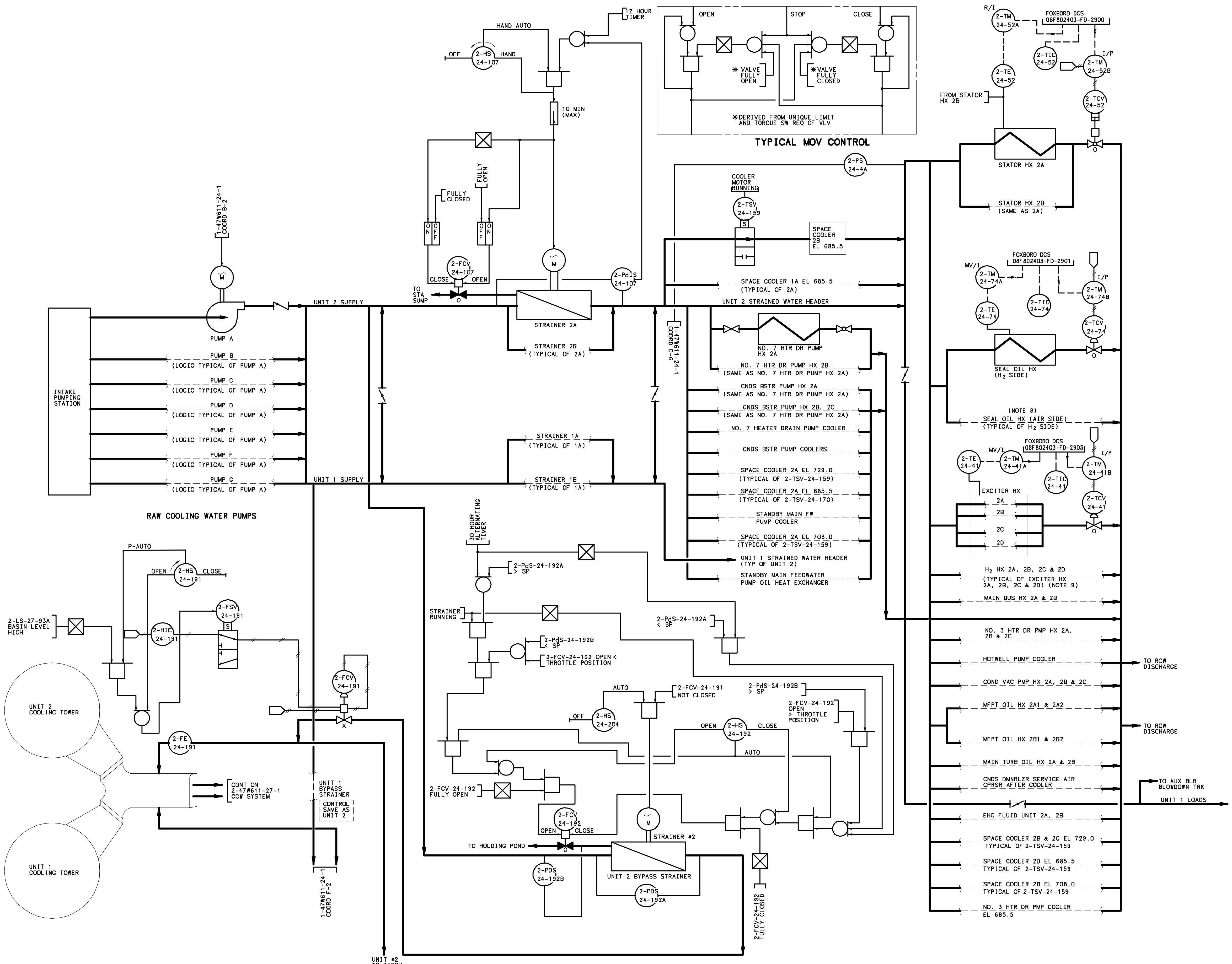
REFERENCE DRAWINGS:
1-35W760-24-1
1-35W760-226-1
1-45W600-24
1-47W610-24-SERIES
1-45W760-30-7

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W611-24-1 R19
FIGURE 9.2-39

CAD MAINTAINED DRAWING



NOTES:

1. NOTE 1 DELETED.
2. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
3. NOTE 3 DELETED.
4. TD - TIME DELAYS TYPICAL FOR PUMPS B, C, D, F & G ONLY.
5. NOT USED.
6. ON INPUT TO MICROBIOLOGICAL INDUCED CORROSION (MIC) REMOVAL SYSTEM ON CONTRACT 91NNA-75954A DWG #BEC50001.
7. NOT USED
8. FOXBORO DCS REFERENCE FOR AIR SIDE (LOOP 73) IS 08F802403-FD-2902.
9. FOXBORO DCS REFERENCE FOR H2 HX (LOOP 48) IS 08F802403-FD-2904.

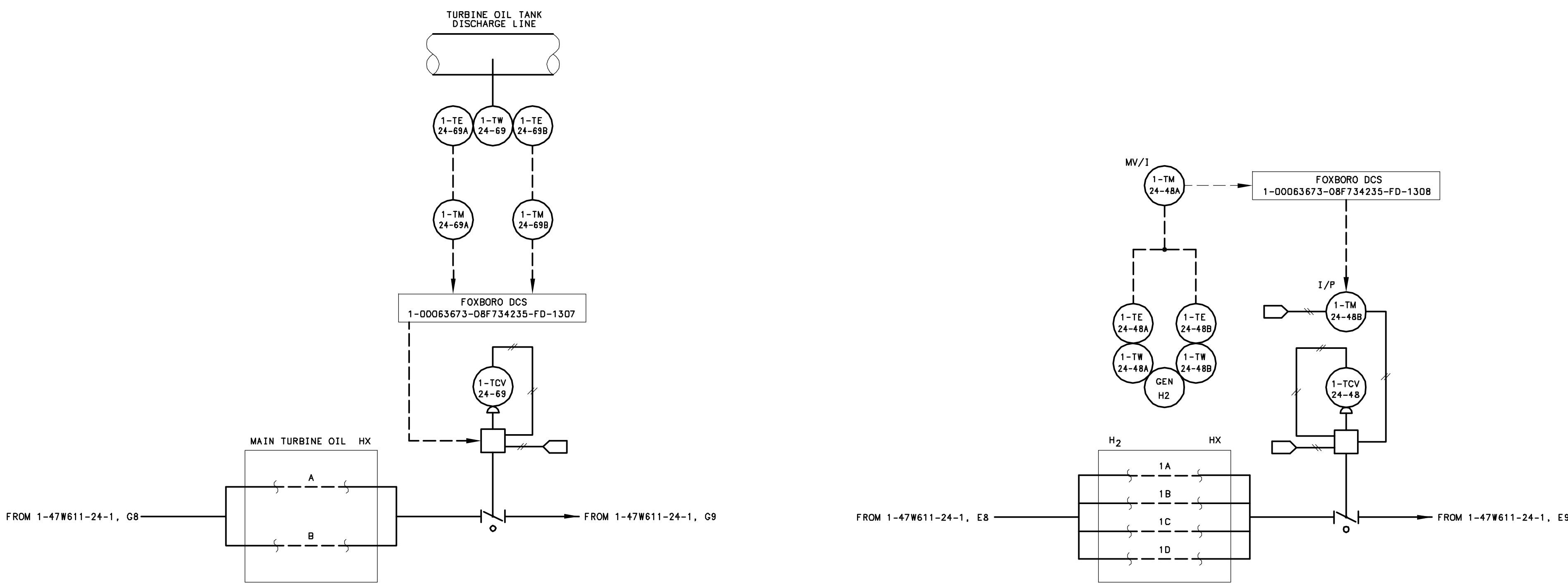
SYMBOLS:
▲----TEST SWITCH

REFERENCE DRAWINGS:
35W760-24-1
35W760-226-1
45W600-24
47W610-24-SERIES
45W760-30-7

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
RAW COOLING WATER
TVA DWG NO. 2-47W611-24-1 R9
FIGURE 9.2-39(U2)

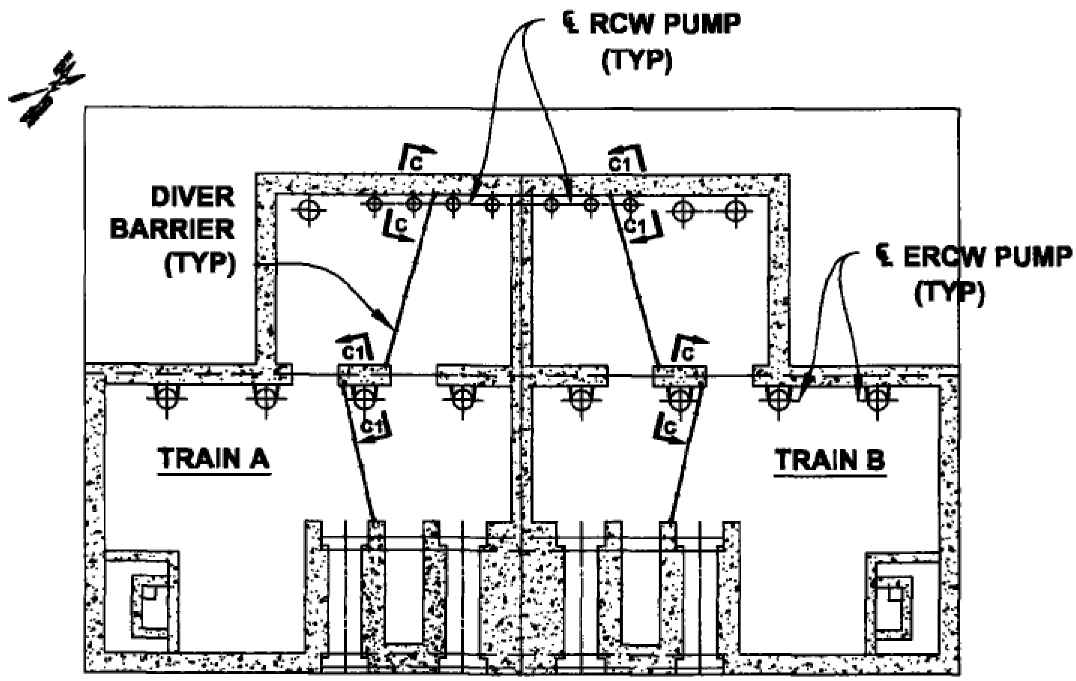


WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

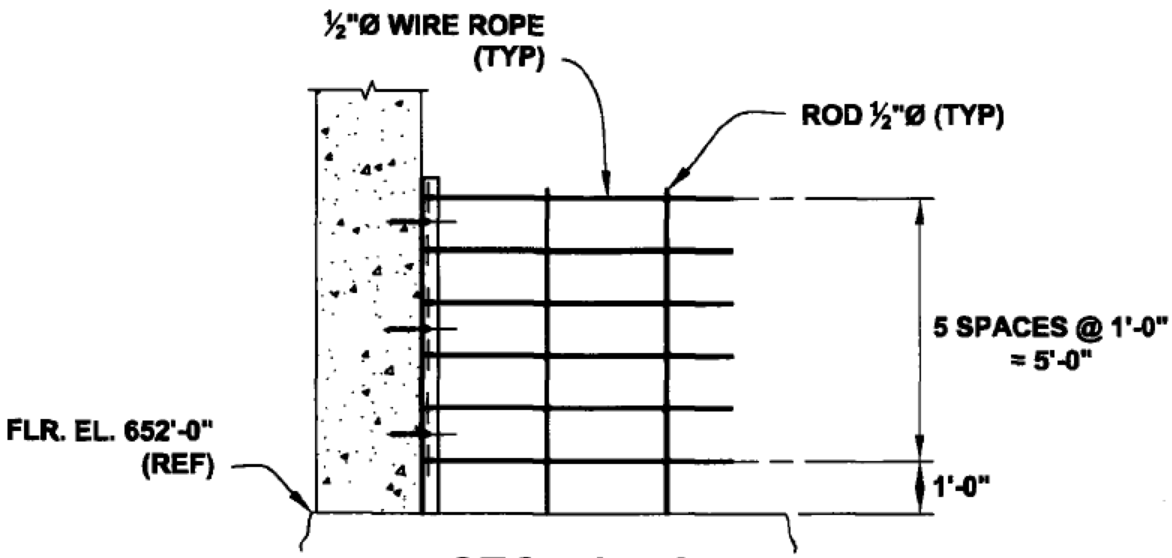
CONTROL BUILDING
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
RAW COOLING WATER
TVA DWG NO. 1-47W611-24-2 RO
FIGURE 9.2-39A

SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390

FIGURE 9.2-40



INTAKE PUMPING STATION
PLAN EL 652.0'



SECTION C-C
AS SHOWN
SECTION C1-C1
OPP. HAND

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Diver Protection
Barriers

FIGURE 9.2-41

9.3 PROCESS AUXILIARIES

9.3.1 Compressed Air System

9.3.1.1 Design Basis

The compressed air system is common to both units and is divided into two systems, the station control and service air system and the auxiliary control air systems for emergency use. The auxiliary control air system is comprised of two fully qualified and redundant trains or subsystems. The station control and service air system is designed to supply adequate compressed air capacity for general plant service, instrumentation, testing and control. Each subsystem of the auxiliary control air system supplies air to the auxiliary air distribution system of Unit 1 and Unit 2. The auxiliary air system ensures that all vital equipment will receive air from the appropriate assigned subsystem under all conditions, including safe shutdown earthquake and maximum possible flood.

9.3.1.2 System Description

Station control and service air is supplied by three motor-driven, oil-free, two stage, rotary screw compressors and one centrifugal air compressor. Two of the three rotary screw compressors or the centrifugal compressor will handle the total plant control air requirements under normal conditions with sufficient additional capacity to handle minimal service air requirements. With three rotary screw station air compressors operational and the centrifugal compressor shutdown for maintenance, the total plant control air and peak service air requirements will still be met. Peak service air requirements will occur during unit outages and other periods of heavy usage of pneumatic operated tools and equipment. The compressed air system includes normal accessory equipment such as intake air filters, intercoolers, after coolers, and safety relief valves.

All four air compressors are provided with intake air silencers to reduce noise and vibration levels due to the resonance characteristics of the intake pipes.

The station compressors discharge into two redundant headers which are provided with manual isolation valves. These headers feed the two control air receivers which in turn supply air through redundant headers to the control air station. The control air station contains three complete trains of prefilters, dryers, and after filters. Each dryer train is sized to fully handle plant control air requirements for one unit. Manual bypasses are provided around each element for abnormal or emergency operation. The control air is then piped through two independent headers to valves, controllers, instruments, etc., throughout the plant.

Service air is supplied to the service air receiver by a single header from the control air receivers. Service air is supplied through a back pressure valve which closes if control air pressure drops below 80 psig, thus assuring that control air requirements take precedence over service air requirements. Service air is piped from the receiver to service outlets and miscellaneous equipment throughout the plant. A connection is provided in the service air header, upstream of valve 2-33-675, to allow for the future installation and use of temporary air compressors if evaluated and installed under the proper design control process. Temporary air compressors shall meet system pressure and air quality requirements and should be sized to provide an adequate air supply for their intended application.

Auxiliary control air is supplied by two motor-driven, nonlubricated, single-stage, reciprocating compressors. Each compressor is sized to supply the total safety-related control air requirements in the event of an accident, flood, or loss of the station control air system. The auxiliary control air system (ACAS) is separated into two independent subsystems each containing its own compressor, receiver, dryer, and filter. The auxiliary control air piping is arranged so that the auxiliary receivers are charged from the non-qualified station control air system during normal operation. Electric power for the auxiliary systems is provided from both normal and emergency sources. The auxiliary control air system is located entirely within Category I structures and is designed to Category I seismic requirements. The auxiliary air system is automatically isolated from the station air system upon loss of air from the station system. Refer to the tabulation of descriptive information in Table 9.3-1.

The dryer and filter trains for both the station control and auxiliary control air systems are designed to give compressed air of high instrument quality. The auxiliary control air system inlet filters (from control air system) are designed to remove 100% liquid water entrainment and other foreign matter from the compressed airstream down to 0.9 micron size. The station control air prefilters are designed to remove 99.99% of all liquids and oil and all particulates down to 0.6 microns. The air dryers dry the air to a dewpoint of 0°F or less at line pressure. The discharge of the auxiliary control air dryers is routed through an afterfilter which removes 100% of particles of desiccant and other foreign matter down to 0.9 micron size. The discharge of the station control air dryers is routed through 0.9 micron afterfilter elements which remove 100% of particles of desiccant and other foreign matter larger than 0.9 microns.

9.3.1.3 Safety Evaluation

The compressed air system meets General Design Criterion 5 and is designed to provide a highly reliable source of compressed air for all plant uses. The two independent auxiliary systems are powered from separate emergency electrical power sources to provide a single failure capability.

The station compressors are also powered from diverse electrical sources. One compressor is powered from the 480-volt Auxiliary Building common board, one from the 480-volt Turbine Building common board, and the other two from 480-volt shutdown boards. Two of the three rotary screw compressors or the centrifugal compressor will handle the total plant control air requirement. Thus two of the four station compressors can fail due to power loss, accident, or other cause and system pressure will still be maintained. The compressed air system contains sufficient receiver capacity to supply air for several minutes. The loss of all four station compressors would result in the shutdown of both units after this reserve is expended. Loss of station control air pressure from an accident such as a pipe break would result in the in the shutdown of both units if the break was not manually isolated before system pressure fell below the point required to sustain plant operation. The auxiliary compressors will start automatically when the system pressure in its respective trained receiver falls below 83 psig.

The control air dryers are divided into three independent units each containing a pre-filter, a dryer, and an after-filter. The loss of a dryer unit would result in a high moisture content in the air. This would be alarmed by moisture sensors located in the discharge headers. The air supply would then be diverted to the spare dryer unit.

The station air compressor system is designed for 115 psig and arranged for parallel operation. The maximum system pressure is 105 psig. For rotary screw compressors A, B and C, further protection against system overpressure is provided by safety relief valves set at 115 psig placed downstream of the after-cooler and on each receiver for the main air system. Safety relief valves are also placed on the auxiliary air compressors and auxiliary air receivers. These valves are also set at 115 psig. Station air compressor D has a relief valve located on its pulsation dampener.

The station air compressors and dryer units are located on Elevation 708.0 in the Turbine Building. The Turbine Building at this elevation is not a Category I structure and is below plant grade. Therefore, the main air system must be considered inoperable during (or after) a seismic event and flooding above plant grade.

Two independent auxiliary air systems are located on Elevation 757.0 of the Auxiliary Building. This is a Seismic Category I structure located above the maximum possible flood elevation. The auxiliary air systems are designed to Seismic Category I requirements; since they are completely separated, a single failure cannot render both systems inoperable. The auxiliary compressors start automatically upon loss of air from the main system for any reason. The auxiliary air system is automatically isolated from the main air system whenever the system pressure falls below 79.5 psig.

Each auxiliary air system is sized and equipped so that ample system capacity is provided for both units under all design basis accident conditions. Redundancy and train separation have been provided in the auxiliary compressed air system to the extent that no initial 'design basis event' followed by an arbitrarily selected 'single active failure' will prevent the system from performing its necessary safety functions. Total plant design is such that even total loss of all air will not prevent safe shutdown of the both units, assuming no breaks in the primary or secondary piping.

The station control and service air system performs no safety related function. Containment penetration piping is installed to TVA Class B (Safety Class ANS-N-182) requirements and is an integral part of the containment isolation system. Also, station air system piping located inside Seismic I structures is installed to Seismic Category I(L) requirements (see Section 3.2.1). It normally supplies air to both trains of the auxiliary control air system, but is automatically isolated when the output pressure drops below an acceptable value.

A failure modes and effects analysis (FMEA) for the compressed air system has been performed and a summary of the result is presented in Table 9.3-7. Since the station control and service air is a non-essential system, the scope of the FMEA for the compressed air system will include only an analysis of the auxiliary control air system. The essential raw cooling water (ERCW) system, floor drainage, high pressure fire protection, and the normal and emergency power systems define system interfaces with the auxiliary control air system. The redundant ERCW and emergency power trains are assigned to the appropriate redundant auxiliary control air system. All equipment receiving auxiliary control air is listed in Table 9.3-8.

The auxiliary compressor suction is taken from a nonfiltered area. Calculations were performed to verify that the amount of radioactivity introduced into the main control room (MCR) habitability area during an accident condition is not significant. Also, as an additional safety precaution, the air lines leading into the MCR are filtered by charcoal and HEPA filters.

A safety precaution was also provided to protect the MCR from airborne contaminants in the event of a pipe leak that may originate from the fire protection system, which was routed inside the MCR. The air supply to the fire protection system was provided with an orifice and a seismically qualified check valve.

The auxiliary control air systems are used to ensure plant safety, even if the station control and service air system fails for any reason.

Safety-related components and equipment which require instrument air to perform an active safety function are supplied from the auxiliary control air compressors. These safety-related items and their related safety functions are identified below and discussed in the indicated UFSAR sections.

1. Auxiliary Feedwater (AFW) system steam generator level control and Unit 2 pressure control valves (Section 10.4.9) - These valves are required during all AFW operating conditions,

2. Main steam atmospheric relief valves (Section 10.1) - control of these valves are necessary during flood mode operation,

3. Auxiliary building gas treatment system (ABGTS) - flow control and isolation dampers (Section 6.2.3),

4. Emergency gas treatment system (EGTS) isolation and flow control dampers and valves (Section 6.2.3),

5. Control Building HVAC isolation and flow control valves, dampers, temperature controllers, transmitters, and other pneumatic instruments (Section 9.4.1),

6. Radiation monitoring system containment isolation valves,

7. Reactor coolant system (RCS) pressurizer spray line pressure control valves (Section 5.5.10)

8. Sample isolation valves for radiation monitoring equipment which are required to remain functional during and after a safe shutdown earthquake, as discussed in Section 5.2.7.6, will be supplied with essential control air from the ACAS.

9.3.1.4 Tests and Inspections

Preoperational testing of the compressed air system and components is to be performed in compliance (see Section 14.2.7, for exceptions) with the requirements of Regulatory Guide 1.68.3, April 1982, 'Preoperational Testing of Instrument and Control Air Systems'. The compressed air system preoperational tests are discussed in more detail in Chapter 14.

Periodic tests will be performed after plant startup to ensure proper operation of the auxiliary system and isolation valves.

9.3.1.5 Instrumentation Applications

The control air system is designed to operate automatically. The auxiliary systems are started automatically upon loss of air pressure from the primary system. Control room instrumentation monitors control air pressure. Position lights indicate closure of any isolation valve. Audible alarms are produced in the MCR for high compressor oil temperature, low oil pressure, high discharge air temperature, high dewpoint of auxiliary control air, and low auxiliary control air pressure. Local indication of air pressure at various points and air temperature, is also provided in addition to local trouble lights. See Figure 9.3-1 and 9.3-2 for detailed control application, Figures 9.3-3 and 9.3-4 for logic, and Figures 9.3-5, 9.3-5A, and 9.3-6 for the detailed flow diagrams.

9.3.2 Process Sampling System

9.3.2.1 Design Basis

The process sampling system is composed of both the routine and post accident sampling subsystems. The routine sampling subsystem is designed to obtain samples from the various process systems in each of the two units. The samples are obtained in the titration room, hot sample room, or locally (grab samples) for laboratory analysis. This system has no primary safety-related function except for containment isolation valves. During a loss-of-coolant accident, this system is isolated at the containment boundary.

The postaccident sampling subsystem (PASS - for Unit 1 Only)) is used to acquire samples of the reactor coolant and containment atmosphere during a loss of coolant accident (LOCA). This system has no primary safety-related function. However, the operation of this subsystem requires the operation of various closed containment isolation valves. The PASS is discussed in Section 9.3.2.6.

9.3.2.2 System Description

The routine sampling subsystem consists of the following collection areas and equipment:

1. The titration room where secondary process system samples are routed for automatic analysis of several variables such as pH, conductivity, dissolved oxygen, and sodium. Typically these variables are indicated and recorded, and any variable exceeding established limits is annunciated.

   In addition, nonradioactive grab samples are obtained in this room.

2. The hot sample room where primary and secondary samples are routed for automatic analysis of several variables such as pH, sodium and conductivity. These variables are indicated in the hot sample room and typically recorded in the titration room. Typically a variable exceeding established limits is annunciated. Most hot sample room samples are radioactive grab samples which are taken to the radiochemical laboratory for further analysis.

3. Local grab samples are taken throughout the plant for detailed chemical and radiochemical analysis. These samples are analyzed either onsite or offsite, depending upon the analyses required.

4. During full power operations, primary system sampling is conducted once every week to determine boron concentration. Periodic sampling can effectively measure boron concentration in RCS and is described below.

5. A gas analyzer system sequentially monitors points in the waste disposal and chemical volume and control systems for oxygen concentrations in either a hydrogen or a nitrogen atmosphere. The concentrations are displayed, and recorded, and an alarm is given at the analyzer when appropriate. See Section 11.3.2 for a detailed description.

6. A zinc injection skid located in the hot sample room is connected to the sample return line to the VCT.

The routine sampling subsystem is operated manually throughout the full range of operations. Sample lines originating within containment have isolation valves near the sample point and inside and outside containment for automatic containment isolation. Sample lines outside containment normally have manual isolation valves. Sample line isolation valve hand switches are normally located on a wall panel in the hot sample room. Each sample line to the titration or hot sample room cubicles normally has indicators for pressure, temperature, and flow rate. Samples, whether local or to a sample room, normally have pressure throttling valves and/or heat exchangers (as required).

To ensure that representative samples are obtained, the sample points are normally located in a free-flowing stream and the sample takeoff points are normally on the side of the horizontal pipes. Prior to the collection of a sample, each sample line is normally purged of stagnant process fluid. The volume of fluid purged and the volume of sample collected are dependent on the stream being sampled, length of sample line, and analysis to be performed.

Sampling of the RCS is used to detect failed fuel. RCS sampling is used to determine gross specific activity and dose equivalent I-131 analyses. The gross specific activity is performed every seven days and the dose equivalent I-131 specific activity is performed every fourteen days, both during power operation. Operations is notified if a negative trend or significant change develops in the analysis.

Boron concentration measurement is performed once every week, during power operation. Operations is notified if a negative trend of significant change develops in the analysis.

Each sample is listed in Table 9.3-2 giving the sampled system, sample location, system design temperature and pressure, sample type (local, titration room, hot sample room, or gas analyzer). Sampling lines from systems covered by TVA Classes A, B, C and D from root valve through first valve in sampling lines, or through second containment isolation valve if sample lines are extensions of containment, are the same class or higher as the sampled systems. Also, sample lines which form a primary pressure boundary are TVA Class B. Each of these sample lines which interface with TVA Class A piping normally has a 3/8 inch O.D. The sample line itself serves as a flow restrictor. Sample lines in Seismic Category I structures are a minimum of TVA Class G.

Remaining sample lines are TVA Class H, except some sample piping are TVA Class C. The sample piping and equipment, where applicable, meets the following codes and standards:

1. NEMA SG-5 and IC-1.
2. ASME Boiler and Pressure Vessel Code, Section III (applicable sections) and Section IX (applicable sections).
3. ANSI B31.1 and B16.5.
4. IEEE.
5. ASTM.
6. SAMA PUB19 and PMC20-2-1970.

The hot sample room cubicles are able to withstand a 1.0 g horizontal acceleration to ensure their stability during a seismic event. Also, the hot sample room cubicle entry block valves meet ASME Section III, Paragraph NC-3676, Code Class 2 with applicable 'N' stamp.

The routine sampling subsystem provides the capability for sampling the reactor coolant hotleg and steam generator blowdown, in an emergency sample area during a maximum flood condition. However, steam generator blowdown sampling is not required during a maximum flood condition. Portable sample analyzer equipment is used to measure the boron concentration in the RCS.

9.3.2.3 Safety Evaluation

Sample lines have the required indicators, pressure throttling valves, heat exchangers, etc., to ensure plant operator safety when collecting samples.

The hot sample room has the following special safety features (due to handling primary loop samples):

1. Samples lines from the RCS hot legs contain a delay coil to provide a 40-second sample transient time within containment, plus a 20-second transient time from containment to the hot sample cubicles to provide decay time for N-16.

2. Cubicles 1A and 2A are expected to contain the most highly radioactive samples. Sample lines to these sinks are equipped with stainless steel sample cylinders. Cubicles 1A and 2A have a 2-inch lead shield behind the front plate of the cubicles. Samples can be obtained during conditions approximating 1% failed fuel.

3. Cubicles are designed to permit collection of a sample behind a shatterproof window.

4. Cubicles have individual exhaust hoods and fans to ensure that leakage of any gas is exhausted from the cubicle. Airborne particulates are removed by HEPA filters, and liquids are drained through the cubicle sink.

5. Entry block valves meet the ASME Section III, Class 2 (described in Section 9.3.2.2).

The presence of high pressure and temperature sample lines outside reactor containment is not considered hazardous because of the limited flow capacity.

9.3.2.4 Tests and Inspections

System equipment is tested prior to plant operation under normal conditions. Periodic tests are performed after plant operation begins, to ensure proper operation of the routine sampling subsystem equipment.

9.3.2.5 Instrumentation Applications

The routine sampling subsystem is designed to be operated manually except for the gas analyzer, and the automatic analyzers (e.g., conductivity, pH, cation conductivity, sodium, hydrazine, dissolved oxygen).

9.3.2.6 Postaccident Sampling Subsystem (Unit 1 only)

The postaccident sampling subsystem (PASS) provides samples of the reactor coolant, containment atmosphere, and containment sump fluid during a LOCA. It is designed to meet the intent of and provide for sample acquisition, analysis, and disposal, as described in Section II.B.3 of NUREG-0737, and keep personnel exposures within GDC19 limits (see Section 3.1).

The existing Post Accident Sampling System (PASS) for Unit 2 has been disconnected and abandoned in place.

9.3.2.6.1 System Description

The PASS is composed of the following:

a. The postaccident sampling facility (PASF) which contains Sentry Equipment Corporation (SEC) high radiation sampling system (HRSS) or equivalent and associated control panels.

b. Sample connections to the reactor coolant, containment sump, and containment atmosphere.

c. Tubing, valving, and fittings as required to convey samples to the PASS.

9.3.2.6.2 Postaccident Sampling Facility

The PASF is located in the Auxiliary Building on Elevation 729 between columns A5, W, and X (for Unit 1).

The PASF consists of piping, tubing, valves, components, and instrumentation necessary to obtain, do partial analysis, and dispose of the samples described in Section 9.3.2.6. Boron and isotopic analysis is performed. The major equipment used for these activities is the SEC HRSS. It is described in Section 9.3.2.6.3. The ventilation exhaust is filtered with charcoal adsorbers and high-efficiency particulate air (HEPA) filters. Liquid waste from the SEC HRSS, with the exception of the sampling panel drip pans, is routed to the waste holdup tank. From this tank the liquid is routed back to containment or the radwaste system for disposal. The liquid waste from the panels drip pans is routed to the floor drain system.

Gaseous waste is routed back to containment.

9.3.2.6.3 Sampling Equipment

The major component used in the PASF for sampling acquisition and portions of the chemical analysis is the SEC HRSS. This system is composed of the liquid sampling panel (LSP), chemical analysis panel (CAP), containment air sampling panel (CASP), and their associated control panels. These components are discussed in the ensuing sections.

9.3.2.6.3.1 Liquid Sampling Panel

The following types of samples can be obtained from the LSP during accident conditions:

a. Undiluted and diluted (1,000:1) liquid grab samples of the reactor coolant.

b. An in-line sample of pressurized coolant.

c. A diluted (15,000:1) stripped gas sample from the reactor coolant pressurized liquid sample.

The LSP is able to purge sample lines before sampling to assure representative samples will be obtained and to flush the lines after sampling to reduce residual radioactivity.

The LSP uses shielded cart/casks for the removal of the reactor coolant samples. The cask is mounted on a cart, which allows the samples obtained to be mobile. A shielded syringe can be used to handle the aliquot to be analyzed. Isotopic analysis of reactor coolant (undiluted concentration 1 μCi/g to 10 Ci/g) can be performed.

9.3.2.6.3.2 Chemical Analysis Panel

The CAP can receive reactor coolant liquid and gas samples from LSP. The CAP has the capability to analyze for the following parameters: pH, specific conductivity, dissolved oxygen, chloride, hydrogen, temperature, and total dissolved gas. The ranges of the on-line equipment are listed below for their specific analyses:

a.	pH	1 -14
b.	Conductivity	0.1-500 μmho/cm
c .	Chlorides	0.1-20 ppm
d.	Dissolved Hydrogen	10-2000 cc(STP)/kg
e.	Dissolved Oxygen	0.1-20 ppm

Lines carrying liquid and gaseous samples have the capability to be flushed to limit personnel radiation exposure and prepare for the acquisition of the next sample.

9.3.2.6.3.3 Containment Air Sampling Panel (CASP)

The CASP is used to obtain samples of the containment atmosphere. A particulate, iodine, and gas partitioning system is used to obtain these components in the containment atmosphere sample. As an alternate method, samples are located in shielded cart/casks. The shielded mobile assemblies can be used for sample transport to onsite analysis facilities. All CASP sample lines are purged with nitrogen following the sampling operations to remove radioactive gases and prepare for the next sample. Also, the sample lines are heat traced to minimize plateout of radioactive material. Each of these components is then analyzed for radioactivity.

9.3.2.6.3.4 HRSS Control Panels

Operation of the HRSS is performed at various control panels. These panels give readouts of all in-line analysis performed by the CAP. The control panels are separated from the sample panels within the PASF. This separation makes possible a reduction in the operators' exposure to radiation from the sampling panels in the PASF.

9.3.2.6.4 Sample Points

The sample points chosen for use during postaccident conditions were selected to be representative of the required samples. The reactor coolant samples are obtained from the reactor vessel hot leg loops. Containment sump samples are acquired from the discharge of the residual heat removal system (RHR) pumps. Containment atmosphere samples are acquired from upper and lower containment from an opening at Elevations 815 (upper) and 750 (lower).

9.3.2.6.5 Postaccident Counting Facilities

Radiological analysis of liquids and gaseous samples is performed in plant counting room facilities. Analyses are performed within applicable Regulatory Guide 1.97 criteria. Appropriate radiation shielding is provided to reduce counting equipment background levels as necessary.

9.3.2.6.6 Piping, Tubing, and Valves

Sample piping, tubing, and valves are normally 304, 316, or 304L stainless steel designed to assure turbulent flow (RE $\geq$ 4,000). Sample lines between the containment isolation valves, and containment isolation valves, are ASME Section III, Class 2.

Sample lines outside containment are ANSI B31.1. The minimum tube size is 1/4 or 3/8 inch and root valves are 1/2 inch.

Sample lines are routed to be as short as practical, avoiding traps, dips, and deadlegs if possible to the PASF. Provisions have been incorporated to allow flushing of sample lines to reduce unnecessary radiation exposure to operating personnel. Also, consideration has been given to the routing of sample and waste return lines so that the radiation field of the pipe is consistent with the zone of the area it traverses. This is also accomplished by normally routing lines through shielded pipe tunnels, trenches, or chases.

All sample lines have been thermally evaluated to assure that pipe expansion caused by high operating temperatures does not impact the integrity of the sample piping or supports.

9.3.2.6.7 Safety Evaluation

The design life of all major components, equipment, and instrumentation is 40 years (100 days during accident conditions). The PASF does not serve a safety-related function.

9.3.2.6.8 Tests and Inspections

The postaccident sampling (PAS) equipment is preoperationally tested before startup. Instruments are calibrated and tested to verify equipment readiness. This equipment is used periodically to simulate actual sampling techniques for personnel training purposes.

9.3.3 Equipment and Floor Drainage System

9.3.3.1 Design Bases

Equipment drains and floor drains in the Auxiliary and Reactor Buildings are designed so that tritiated liquids (defined as liquids whose tritium concentration is 10% or more of the reactor water tritium concentration) are normally handled separately from nontritiated liquids, in so far as possible. Equipment drains and floor drains are routed to collector tanks in which the liquid can be held pending further treatment.

Except as specified below, Turbine Building drains are collected in the sump and periodically sampled as required by the NPDES permit for discharges.

Drainage in the condensate demineralizer area of the Turbine Building drains to the condensate polishing demineralizer sump. The sump contents are routed to the neutralization tank for processing and subsequent discharge. Drainage in the makeup water treatment plant area of the Turbine Building drains to the water treatment plant (WTP) waste sump. The WTP sump contents are routed to the alum sludge settling ponds. The supernatant from the alum sludge settling ponds is discharged to the yard low volume waste holding pond.

9.3.3.2 System Design

The liquid drains are normally segregated into two basic systems. The first system collects all tritiated water. This system is further divided into aerated liquids, which are collected in the tritiated drain collector tank and deaerated liquids, which are collected in the reactor coolant drain tank or the chemical volume control system (CVCS) holdup tank. This segregation promotes the recycling (if required) of radioactive tritiated liquids. The second system collects nontritiated water in the floor drain collector tank.

Detailed data for the various equipment and floor drains is presented in Table 9.3-3. Information contained in this table was generated from Attachment 2 of Westinghouse Letter, WAT-D-221. The flow and logic diagrams for the system are contained in Figures 9.3-7 to 9.3-14.

Critical exposed drain piping in the Control Building is supported per Seismic Category I(L) requirements.

Critical exposed drain piping in other areas where ESF equipment is located is supported per Seismic Category I(L) requirements. Embedded drain piping in Category I structures is in seismically qualified concrete, and therefore meets seismic considerations in that the flow paths will remain inviolate during a safe shutdown earthquake.

9.3.3.2.1 Drains from Lowest Floor Level in the Auxiliary Building

In the Auxiliary Building, most equipment is located at an elevation which permits gravity feed into the desired drain collector tank. However, since the drain collector tanks are located on the lowest floor, the drains on this floor cannot be gravity fed to a drain collector tank. Therefore, there is an Auxiliary Building Floor and Equipment Drains (ABF & ED) sump and a tritiated sump. The drains on this floor are piped to the ABF & ED sump or to the tritiated sump. These sumps are then pumped to their respective drain tanks. There are sumps in the Additional Equipment Buildings that are normally pumped to the floor drain collector tank.

Excess fluid due to flooding would be collected in the ABF & ED passive sump. This passive sump is large enough to contain any postulated major rupture Watts Bar could experience with the exception of an unisolable break in the RWST discharge header. In the event this break occurs, flooding on Elevations 674.0 and 676.0 is minimized by transferring water to storage locations available inside the Auxiliary Building. Most equipment components sit on foundations high enough to keep them above most flood levels. Floor drains were provided in all areas where there is possibility of major rupture. Leak detectors are located where required in the Auxiliary Building and Reactor Building to alarm for a buildup of water on the floor.

9.3.3.2.2 Residual Heat Removal Pump (RHR) and Containment Spray Pump (CSP) Compartments

Each RHR pump and containment spray pump is located in a separate curbed compartment designed to control any leakage. There is a small sump located in each compartment with a drain pipe extending above the bottom of the sump. There are 2 weep holes of 1/2 inch diameter in the drain pipe at the sump bottom to take care of small ordinary seepage. The drain pipe is designed to handle a leakage of 50 gpm and is piped to the Auxiliary Building floor and equipment drain sump. A water level detector is located in each RHR and CSP compartment sump to sound an alarm prior to overflowing in the drain pipe. An emergency drain is provided in each RHR and containment spray pump room, as shown in Figure 1.2-7, plan Elevation 676.0. These drains are provided to direct large breaks to the large, ABF & ED passive sump volume above Elevation 666.

The design basis for the emergency drains is to provide environmental isolation for each separately drained area unless needed for drainage purposes. These functions are assured by installing a breakaway plate in a 4-foot by 4-foot square hole in each room, which is held in place by breakaway bolts. If drainage into the room exceeds the capacity of the normal drain and flows over a small lip surrounding the breakaway emergency drain hole, the weight of approximately 2 feet 8 inches of water above the emergency drain causes failure of the bolts and a large drain is established to remove water from the pump room. Water then released to the ABF & ED passive sump can be processed by opening the passive sump to the ABF & ED sump by means of a 6 inch valve.

9.3.3.2.3 CVCS Holdup Tank Compartment and Tritiated Drain Collector Tank Room

The CVCS holdup tanks are located in separate watertight rooms designed to contain the tank contents should a tank rupture. The tritiated drain collector tank is in a curbed room designed to contain the tank volume should there be a rupture. A drain with a normally closed valve is provided from each room to the building sump. In case of a rupture, the valve keeps the water within the room until the level of the drain collector tank is lowered to handle the additional volume of water.

Since these tanks are not essential, the rooms are not designed to exclude flood water. In case of flooding, the tanks are filled with a sufficient volume of water to prevent flotation and are sealed.

Both open and closed drains are provided in the tritiated system. The open drains are defined as being open to the atmosphere, and they usually empty into a funnel connected to the embedded drain header. The closed drains are connected directly to the drain header and are not open to the atmosphere. The embedded drain headers are normally routed to an 8 inch horizontal collection header at the tritiated drain collector tank. This header has a blind flange at each end to aid in cleaning. The various drain headers normally extend through the top of the 8-inch collection header to within 1½ inches of the bottom of the header. The outlet from the 8-inch collection header to the tritiated drain collector tank is normally a 4 inch pipe welded to the upper half of the 8 inch pipe. This provides a 2 inch water seal in the 8-inch pipe at all times.

The floor drain collector tank, in addition to receiving the floor drains, also collects nontritiated open and closed equipment drains. These drains are normally piped to an 8-inch header at the floor drain collector tank where a water seal is maintained at all times. The 8-inch header normally has a 4-inch pipe welded to the top half which discharges to the floor drain collector tank. This ensures a 2-inch water seal. Some of the floor drains located in areas where a strong possibility exists for a tritium leak are provided with solid stainless steel cover plates to prevent tritium from entering the systems. The use of floor drains has been limited to areas where an emergency need for them exists. The floor drains are normally not used for regular maintenance washdown.

9.3.3.2.4 Volume Control Tanks

The volume control tanks (VCT) are located in rooms with a curb to contain the liquid in case of a rupture. A floor drain is provided and piped separately to the floor drain collector tank to provide rapid room drainage.

9.3.3.2.5 Boric Acid Tanks

The boric acid tanks are enclosed by a curb designed to contain the acid should there be a major tank leak. A number of floor drains are located within this area with a valve on the drain header to the floor drain collector tank. This valve permits the containment of the boric acid until it is pumped by a portable pump to other storage tanks. In case there are no storage tanks available, the acid can be diluted before being released to the floor drain collector tank.

9.3.3.3 Drains - Reactor Building

Most equipment drains in the Reactor Building are for tritiated deaerated liquids which are piped to the reactor coolant drain tank. The reactor coolant drain pumps, pump this liquid to either the CVCS holdup tanks or to the tritiated drain collector tank in the Auxiliary Building.

The annulus floor drains are piped to the annulus sump which is emptied by gravity to the ABF & ED passive sump by opening a 10-inch butterfly valve in the Auxiliary Building.

The rest of the floor drains and equipment drains are piped to either the Reactor Building Floor and Equipment Drains (RBF&ED) sump or the RBF&ED pocket sump. The RBF & ED sump pumps automatically pump this liquid to the tritiated drain collector tank in the Auxiliary Building. If analysis shows the liquid is nontritiated it can be pumped to the floor drain collector tank.

9.3.3.4 Design Evaluation

The drains are segregated and leakage is contained to ensure that there is no leakage of fluid or fumes to the atmosphere. This has been accomplished with the use of water seals or traps in drain lines where there is a possibility of cross-ventilation. See Chapter 11 for a more in-depth evaluation.

There is no mechanism for an inadvertent transfer of contaminated fluids to the non-contaminated drainage system. In the Auxiliary and Reactor Buildings only contaminated drain systems are provided.

9.3.3.5 Tests and Inspections

Open equipment and floor drains are periodically monitored to ensure that there is no cross-ventilation. The water seals and traps are serviced by periodic addition of water through the drain and drains are inspected periodically for blockage.

9.3.3.6 Instrumentation Application

Instrumentation related to this system is described in Chapter 11.

9.3.3.7 Drain List

The following are the tanks used to collect drains from the NSSS:

1. Chemical Drain Tank (CDT) - collects radioactive sample waste from laboratory. (Described in Chapter 11, Radioactive Waste Management)

2. Component Cooling Surge Tank (CCST) - collects water from component cooling equipment drains.

3. Reactor Building Floor and Equipment Drain (RBF&ED) Sump and the RBF&ED Pocket Sump - collect water from floor drains and aerated equipment drains inside the containment, and the sump pumps can be directed to the FDCT or the TDCT.

4. Floor Drains Collector Tank (FDCT) - collects non-tritiated equipment and floor drains.

5. Laundry and Hot Shower Drain Tank (LHSDT) - collects water from laundry and hot showers (described in Chapter 11).

6. CVCS Holdup Tank (CVCS HUT) - collects deaerated tritiated water (reactor grade) inside the containment.

7. Tritiated Drain Collector Tank (TDCT) - collects aerated tritiated water in the Auxiliary Building, via the drain header (DH), from the RCDT and RBF&ED sump and RBF&ED pocket sump in containment and from the tritiated sump.

8. Component Cooling System (CCS) Pump Seal Leakage Collection Tank (SLCT) - collects seal leakage from CCS pumps and returns source to CCS or to FDCT.

9.3.4 Chemical and Volume Control System

The chemical and volume control system (CVCS), is shown in Figure 9.3-15:

9.3.4.1 Design Bases

The CVCS provides the following services to the RCS.

A. Maintains the coolant inventory in the RCS within the allowable pressurizer level range for all normal modes of operation including startup from cold shutdown, full power operation and plant cooldown. This system also has sufficient makeup capacity to maintain the minimum required inventory in the event of minor RCS leaks.

B. Supplies filtered water to each reactor coolant pump (RCP) seal, as required by the RCP design.

C. Provides a means for adding chemicals to the RCS. These chemicals control the pH of the reactor coolant, scavenge oxygen from the reactor coolant during startup, counteract the production of oxygen in the reactor coolant due to radiolysis of water in the core region, chemically degas the RCS during the shutdown, and modifies the primary system corrosion film layer. (The CVCS maintains the RCS water chemistry within the limits specified in Table 5.2-10.)

D. Removes fission and activation products, and zinc in ionic form or as particulates, from the reactor coolant in order to provide limited access to those process lines carrying reactor coolant during operation and to reduce activity releases due to leaks.

E. Collects and processes excess borated water and regulates the concentration of chemical neutron adsorber (boron) in the reactor coolant to control reactivity changes resulting from the change in reactor coolant temperature between cold shutdown and hot full-power operation, burnup of fuel and burnable poisons, buildup of fission products in the fuel, and xenon transients. The CVCS is capable of borating the RCS through either one of two flow paths and from either one of two boric acid sources. The amount of boric acid retained and ready for injection always exceeds that amount required to borate the RCS to cold shutdown concentration assuming that the control assembly with the highest reactivity worth is stuck in its fully withdrawn position. This amount of boric acid also exceeds the amount required to bring the reactor to hot shutdown and to compensate for subsequent xenon decay.

F. Provides reactor coolant makeup via the primary water makeup pumps to the VCT.

G. Provides, via the centrifugal charging pumps high-head safety injection for the emergency core cooling system. Other than the centrifugal charging pumps and associated piping and valves, the CVCS is not required to function during a loss-of-coolant accident (LOCA). During a LOCA, both centrifugal charging pumps serve as high head ECCS pumps by taking suction from the RWST and injecting borated water to the boron injection line and the RCP seals. The CVCS is isolated except for the centrifugal charging pumps and the piping in the safety injection path, and the supply to the RCP seals.

9.3.4.2 System Description

The CVCS consists of several subsystems: the charging, letdown and seal water system; the reactor coolant purification and chemistry control system; and the reactor makeup control system.

A. Charging and Letdown (Inventory Control)

The CVCS maintains a programmed water level in the RCS pressurizer, thus maintaining proper reactor coolant inventory during all phases of plant operation. This is achieved by means of continuous feed and bleed process during which the feed rate is automatically controlled based on pressurizer water level. The bleed rate can be chosen to suit various plant operational requirements by selecting the proper combination of letdown orifices in the letdown flow path.

Reactor coolant is discharged to the CVCS from a reactor coolant loop cold leg; it then flows through the shell side of the regenerative heat exchanger where its temperature is reduced by heat transfer to the charging flow passing through the tubes. The coolant then experiences a large pressure reduction as it passes through the letdown orifice(s) and flows through the tube side of the letdown heat exchanger where its temperature is further reduced. Downstream of the letdown heat exchanger a second pressure reduction occurs through the low pressure letdown valve. This second pressure reduction maintains sufficient pressure upstream of the low pressure letdown valve to prevent flashing downstream of the letdown orifices.

The reactor coolant then normally flows through the mixed bed demineralizers. If additional purification of the reactor coolant is required the flow can be directed to the cation bed demineralizer. (If the temperature of the coolant exceeds the temperature limit of the demineralizer a temperature control valve will bypass flow around the demineralizer). The coolant then flows through the reactor coolant filter and into the VCT through a spray nozzle in the top of the tank. If the VCT is full, the excess reactor coolant is directed to the HUT for future use or disposal. The VCT is pressurized by hydrogen which is used for control of oxygen that is produced by radiolysis of water in the core. The partial pressure of hydrogen in the VCT determines the concentration of hydrogen dissolved in the reactor coolant. A remotely operated vent allows the removal of hydrogen and fission gases stripped from the reactor coolant. The contaminated hydrogen is vented back to the gaseous waste processing system.

Two centrifugal charging pumps take suction from the VCT and return the cooled, purified reactor coolant to the RCS. The charging flow splits into two paths. The bulk of the flow is pumped back to the RCS through the tube side of the regenerative heat exchanger. The second flow path provides the coolant to the RCP seals [See Section 9.3.4.2(B)]. The letdown flow in the shell side of the regenerative heat exchanger raises the charging flow to a temperature approaching the reactor coolant temperature. The flow is then injected into a cold leg of the RCS. Two charging paths are provided from a point downstream of the regenerative heat exchanger. A flow path is also provided from the regenerative heat exchanger outlet to the pressurizer spray line. An air-operated valve in the spray line is employed to provide auxiliary spray to the vapor space of the pressurizer during plant cooldown.

The excess letdown path is provided as an alternate letdown path from the RCS in the event that the normal letdown path is inoperable. Reactor coolant can be discharged from a cold leg to flow through the tube side of the excess letdown heat exchanger where it is cooled by component cooling water. Downstream of the heat exchanger a remote-manual control valve controls the letdown flow. The flow path normally joins the number 1 seal discharge manifold and passes through the seal water return filter and heat exchanger to the suction side of the charging pumps. The excess letdown flow can also be directed to the reactor coolant drain tank. When the normal letdown line is not available, the normal purification path is also not in operation. Therefore this alternate condition would allow continued power operation for a limited period of time, dependent on RCS chemistry and activity. The excess letdown flow path is also available and can be used if needed to provide additional letdown capability during the final stages of plant heatup. This path removes some of the excess reactor coolant due to expansion of the system as a result of the RCS volume increase.

Surges in RCS volume due to load changes are accommodated for the most part in the pressurizer. The VCT provides additional surge capacity for reactor coolant expansion. If the water level in the VCT exceeds the normal operating range, a proportional controller modulates a three-way valve downstream of the reactor coolant filter to divert a portion of the letdown to the HUT. If the high-level limit in the VCT is reached, an alarm is actuated in the control room and the letdown flow is completely diverted to the HUT.

Low level in the VCT initiates makeup from the reactor makeup control system. If the reactor makeup control system does not supply sufficient makeup to keep the VCT level from falling to a lower level, a low alarm is actuated. Manual action is taken to correct the situation. If the level continues to decrease, an emergency low level signal from both of the level channels causes the suction of the charging pumps to be transferred to the RWST.

B. Reactor Coolant Pump Seal Water Flow

A portion of the charging flow is directed to the reactor coolant pumps (nominally 8 gpm per pump) through a seal water injection filter. It is directed to a point between the pump shaft bearing and the thermal barrier cooling coil. Here the flow splits and a portion (nominally 5 gpm per pump) enters the RCS through the labyrinth seals and thermal barrier. The remainder of the flow is directed up the pump shaft, cooling the lower bearing, and to the number 1 seal. The number 1 seal leakoff flow discharges to a common manifold, exits from the containment, and then passes through the seal water return filter and the seal water heat exchanger to the suction side of the charging pumps, or by alternate path to the VCT. A very small portion of the seal flow leaks through to the number 2 seal. The number 3 seal provides a final barrier to leakage of reactor coolant to the containment atmosphere. The number 2 and 3 leakoff flow is discharged to the reactor coolant drain tank in the waste disposal system.

C. Reactor Coolant System Water Chemistry Control

Reactor coolant chemistry specifications are given in Table 5.2-10.

(1) pH Control

Lithium hydroxide is used to control the pH of the reactor coolant. This chemical is chosen for its compatibility with the materials and water chemistry of borated water/stainless steel/zirconium/inconel systems. Lithium-7 is produced in the core region due to irradiation of the dissolved boron in the coolant. The concentration of Lithium-7 in the RCS is maintained for pH control. If needed, the cation bed demineralizer is employed to reduce lithium in the letdown line in series operation with a mixed bed demineralizer. If cation bed is unavailable, the mixed bed, with appropriate resins, may be utilized to reduce lithium. Since the amount of lithium to be removed is small and its buildup can be readily calculated, the flow through the cation bed demineralizer is not required to be full letdown flow. If the concentration of Lithium-7 is below the desired values, lithium hydroxide can be introduced into the RCS via the charging flow. The solution is prepared in the laboratory and poured into the chemical mixing tank. Reactor makeup water is then used to flush the solution to the suction manifold of the charging pumps.

(2) Oxygen Control

During reactor startup from shutdown condition, hydrazine may be employed as an oxygen scavenging agent. The hydrazine solution is introduced into the RCS in the same manner as described above for the pH control agent. Dissolved hydrogen is employed to control and scavenge oxygen produced due to radiolysis of water in the core region. Sufficient partial pressure of hydrogen is maintained in the VCT such that the specified equilibrium concentration of hydrogen is maintained in the reactor coolant. A pressure control valve maintains a minimum pressure in the vapor space of the VCT. This valve can be adjusted to provide the correct equilibrium hydrogen concentration (See Table 5.2-10). Hydrogen is supplied from the hydrogen manifold in the waste disposal system.

(3) Activity Level

Mixed bed demineralizers are provided in the letdown line to cleanup the letdown flow. The demineralizers remove ionic corrosion products and certain fission products. One demineralizer is normally in service and can be supplemented intermittently by the cation bed demineralizer, if necessary. The cation resin removes principally cesium and lithium isotopes from the purification flow. The second mixed bed demineralizer serves as a standby unit for use if the operating demineralizer becomes exhausted during operation.

A further cleanup feature is provided for use during cold shutdown and RHR. A remotely operated valve admits a bypass flow from the RHR system into the letdown line upstream of the letdown heat exchanger. The flow passes through the heat exchanger, through a mixed bed demineralizer and the reactor coolant filter to the VCT. The fluid is then returned to the RCS via the normal charging route. To accelerate shutdown cleanup, letdown and associated charging flow may be increased beyond the normal flow rates. See Tables 9.3-4 and Table 9.3-5. Filters are provided at various locations to ensure filtration of particulate and resin fines and to protect the seals on the RCPs.

(4) Neutron Adsorber (boron) Concentration Control

The reactor makeup control system consists of a group of instruments arranged to provide a manually preselected makeup composition to the charging pump suction header or the VCT. The makeup control function maintains the desired operating fluid inventory in the VCT and adjusts reactor coolant boron concentration for reactivity control. For emergency boration and makeup, the capability exists to provide refueling water at 3100 to 3300 ppm boron directly to the suction of the charging pumps.

The boric acid is stored in three boric acid tanks. Four two-speed boric acid transfer pumps are provided with one or more pumps normally aligned with one or more boric acid tanks and continuously running at low speed to provide recirculation within the boric acid system and the boric acid tank. One or more pumps may be on stand-by. On a demand signal from the reactor makeup control system, the stand-by boric acid transfer pump may be started or the recirculation pump is shifted to high speed and delivers boric acid as required.

During reactor operation, changes are made in the reactor coolant boron concentration for the following conditions:

a. Reactor startup - boron concentration must be decreased from shutdown concentration to achieve criticality.

b. Load follow - boron concentration must be either increased or decreased to compensate for the xenon transient following a change in load.

c. Fuel burnup - boron concentration must be decreased to compensate for fuel burnup and the buildup of fission products in the fuel.

d. Cold shutdown - boron concentration must be increased to the cold shutdown concentration.

(5) Makeup

The primary makeup water pumps, taking suction from the primary water storage tank, are employed for various makeup and flushing operations throughout the systems. One of these pumps operates continuously and provides flow to the blender as needed.

The reactor makeup control system can be set up for the following modes of operation:

a. Automatic Makeup

The "automatic makeup" mode of operation provides blended boric acid solution, preset to match the boron concentration in the RCS. Automatic makeup compensates for minor leakage of reactor coolant without causing significant changes in the reactor coolant boron concentration.

Under normal plant operating conditions, the mode selector switch is set in the "automatic makeup" position. This switch position establishes a preset control signal to the total makeup flow controller and establishes positions for the makeup stop valves for automatic makeup. The boric acid flow controller and primary water flow controller are set to blend to the same concentration of borated water as contained in the RCS. A preset low level signal from the VCT level controller initiates automatic makeup by shifting the operating boric acid transfer pump to high speed, opening the makeup stop valve to the charging pump suction, and positioning the boric acid flow control valve and the primary makeup water flow control valve. Since a primary makeup water pump normally runs continuously, automatic starting of this pump is normally not required. However, these pumps will be deenergized when the primary water storage tank is being bypassed. The primary makeup water will be supplied from the demineralized water and cask decontamination system. The flow controllers then blend the makeup stream according to the preset concentration. Makeup addition to the charging pump suction header causes water level in the VCT to rise. At a preset high level point, the makeup is stopped. This operation may be terminated manually at any time.

If the automatic makeup fails or is not aligned for operation and the tank level continues to decrease, a low level alarm is actuated. Manual actions may correct the situation or, if the level continues to decrease, an emergency low

level signal opens the stop valves in the refueling water supply line to the charging pumps, and closes the stop valves in the VCT outlet line.

b. Dilution

The "dilute" mode of operation permits the addition of a preselected quantity of reactor makeup water at a preselected flow rate to the RCS. The operator sets the mode selector switch to "dilute," the total makeup flow controller set point to the desired flow rate, the total makeup batch integrator to the desired quantity and initiates system start. This opens the reactor makeup water flow control valve, and opens the makeup stop valve to the VCT inlet. Excessive rise of the VCT water level is prevented by automatic actuation (by the tank level controller) of a three-way diversion valve which routes the reactor coolant letdown flow to the HUT. When the preset quantity of water has been added, the batch integrator causes makeup to stop. The operation may be terminated manually at any time.

c. Alternate Dilution

The "alternate dilute" mode of operation is similar to the dilute mode except a portion of the dilution water flows directly to the charging pump suction and a portion flows into the VCT via the spray nozzle and then flows to the charging pump suction. This decreases the delay in diluting the RCS caused by directing dilution water to the VCT.

d. Boration

The "borate" mode of operation permits the addition of a preselected quantity of concentrated boric acid solution at a pre-selected flow rate to the RCS. The operator sets the mode selection switch to "borate", the concentrated boric acid flow controller setpoint to the desired flow rate, the concentrated boric acid batch integrator to the desired quantity, and initiates system start. This opens the makeup stop valve to the charging pump suction, positions the boric acid flow control valve, and transfers the selected boric acid transfer pump to high-speed, which delivers 3.5 to 4.0 % weight (wt) boric acid solution to the charging pump suction header. The total quantity added in most cases is so small that it has only a minor effect on the VCT level. When the preset quantity of concentrated boric acid solution is added, the batch integrator causes makeup to stop. Also, the operation may be terminated manually at any time.

e. Manual

The "manual" mode of operation permits the addition of a pre-selected quantity and blend of boric acid solution to the refueling water storage tank, VCT, HUT, or to some other location via a temporary connection. The discharge flow path to places other than the VCT must be aligned by opening manual valves in the desired path.

The operator sets the mode selector switch to "manual", the boric acid and total makeup flow controllers to the desired flow rates, the boric acid and total makeup batch integrators to the desired quantities, and actuates the makeup start switch.

The start switch actuates the boric acid flow control valve and the reactor makeup water flow control valve and transfers the pre-selected boric acid transfer pump to high-speed.

When the preset quantities of boric acid and reactor makeup water have been added, the batch integrators cause makeup to stop. This operation may be stopped manually by actuating the makeup stop switch. If either batch integrator is satisfied before the other has recorded its required total, the pump and valve associated with the integrator which has been satisfied will terminate flow. The flow controlled by the other integrator will continue until that integrator is satisfied.

For Unit 1, the quantities and flow rates of boric acid and primary water injected are totalized by the Distributed Control System (DCS) and plant computer system which provides recorded data capability that can be recalled at a future time. Deviation alarms sound for both boric acid and primary water if flow rates deviate from setpoints. Deviation of either the boric acid or primary water flow rate for longer than the allowed setpoint of time will cause automatic termination of both flow paths.

For Unit 2, the quantities of boric acid and reactor makeup water injected are totalized by the batch counters and the flow rates are monitored by the plant computer system which provides recorded data capability. Deviation alarms sound for both boric acid and reactor makeup water if flow rates deviate from setpoints.

9.3.4.2.1 Component Description

A summary of principal component design parameters is given in Table 9.3-5, and safety classifications and design codes are given in Section 3.2.

A. Pumps

(1) Charging Pumps

For Unit 1, two charging pumps are supplied to inject coolant into the RCS. The pumps are of the single speed, horizontal, centrifugal type. All parts in contact with the reactor coolant are fabricated of austenitic stainless steel or other material of adequate corrosion resistance. The CCS system provides normal cooling water to the CCP lube and gear oil coolers for pumps 1A-A and 1B-B. ERCW, via the CCP 1A-A room cooler, provides backup cooling water to the CCP 1A-A lube and gear oil cooler. There is a minimum flow recirculation line to protect the centrifugal charging pumps from a closed discharge valve condition. Charging flow rate is determined from a pressurizer level signal. When operating a centrifugal charging pump, the flow paths remain the same but charging flow control is accomplished by a modulating valve on the discharge side of the centrifugal pumps. The centrifugal charging pumps also serve as high head safety injection pumps in the emergency core cooling system. A description of the charging pump function upon receipt of safety injection signal is given in Section 6.3.2.2.

For Unit 2, two charging pumps are supplied to inject coolant into the RCS. The pumps are of the single speed, horizontal, centrifugal type. All parts in contact with the reactor coolant are fabricated of austenitic stainless steel or other material of adequate corrosion resistance. The CCS system provides normal cooling water to the CCP lube and gear oil coolers for pumps 2A-A and 2B-B. ERCW, via the CCP 2A-A room cooler, provides backup cooling water to the CCP 2A-A lube and gear oil cooler. There is a minimum flow recirculation line to protect the centrifugal charging pumps from a closed discharge valve condition. Charging flow rate is determined from a pressurizer level signal. When operating a centrifugal charging pump, the flow paths remain the same but charging flow control is accomplished by a modulating valve on the discharge side of the centrifugal pumps. The centrifugal charging pumps also serve as high head safety injection pumps in the emergency core cooling system. A description of the charging pump function upon receipt of safety injection signal is given in Section 6.3.2.2.

(2) Boric Acid Transfer Pumps

Two horizontal, centrifugal, two speed pumps with mechanical seals are supplied for each unit. One pump of each pair is aligned with one boric acid tank and runs continuously at low speed to provide recirculation of the boric acid system and boric acid tank. The second pump of each pair is aligned with the third boric acid tank and is considered as a standby pump, with service being transferred as operation requires. These standby pumps also intermittently circulate fluid through the third tank. Manual or automatic initiation of the reactor makeup control system will activate the running pump for that unit to the higher speed to provide normal makeup of boric acid solution as required. For emergency boration, supplying of boric acid solution to the suction of the charging pump can be accomplished by manually actuating one or two pumps. The transfer pumps also function to transfer boric acid solution from the batching tank to the boric acid tanks. In addition to the automatic actuation by the makeup control system and manual actuation from the main control board, these pumps may also be controlled locally.

(3) Holdup Tank Recirculation Pump

The recirculation pump is used to mix the contents of a holdup tank for sampling or to transfer the contents of a holdup tank to another holdup tank. When one of the holdup tanks is used to store water from the fuel transfer canal, the recirculation pump is used to return the water to the transfer canal. The pump is the centrifugal type, manually actuated, with all wetted surfaces constructed of austenitic stainless steel.

(4) Gas Stripper Feed Pumps

Three centrifugal type gas stripper pumps are constructed of austenitic stainless steel. These pumps were originally part of the boric acid recovery system which is not used for unit operation. These pumps are used to provide a flow path from the HUT to the waste disposal system.

B. Heat Exchanger

(1) Regenerative Heat Exchangers

The regenerative heat exchanger is designed to recover heat from the letdown flow by reheating the charging flow, which reduces thermal effects on the charging penetrations into the reactor coolant loop piping. The unit is constructed of austenitic stainless steel, and is of all welded construction. The temperatures of both outlet streams from the heat exchanger are monitored with indication given in the control room. A high temperature alarm is actuated on the main control board if the temperature of the letdown stream exceeds desired limits.

(2) Letdown Heat Exchanger

The letdown heat exchanger cools the letdown stream to the operating temperature of the mixed bed demineralizers. Reactor coolant flows through the tube side of the exchanger while component cooling water flows through the shell side. Surfaces in contact with the reactor coolant are austenitic stainless steel, and the shell is carbon steel.

The low pressure letdown valve, located downstream of the heat exchanger, maintains the pressure of the letdown flow upstream of the heat exchanger in a range sufficiently high to prevent two phase flow. Pressure indication and high pressure alarm are provided on the main control board.

The letdown temperature control indicates and controls the temperature of the letdown flow exiting from the letdown heat exchanger. A temperature sensor, which is part of the CVCS, provides input to the controller in the component cooling system. The exit temperature of the letdown stream is thus controlled by regulating the component cooling water flow through the letdown heat exchanger. Temperature indication is provided on the main control board. If the outlet temperature from the heat exchanger is excessive, a high temperature alarm is actuated and a temperature controlled valve diverts the letdown directly to the VCT. Valve failure mode also directs flow to the VCT.

The outlet temperature from the shell side of the heat exchanger is allowed to vary over an acceptable range compatible with the equipment design parameters and required performance of the heat exchanger in reducing letdown stream temperature.

(3) Excess Letdown Heat Exchanger

The excess letdown heat exchanger cools reactor coolant letdown flow at a rate which is equivalent to the portion of the nominal seal injection flow which flows into the RCS through the RCP labyrinth seals.

The excess letdown heat exchanger can be employed either when normal letdown is temporarily out of service to maintain the reactor in operation or it can be used to supplement maximum letdown during the final stages of heatup. The letdown flows through the tube side of the unit and component cooling water is circulated through the shell. Surfaces in contact with reactor coolant are austenitic stainless steel and the shell is carbon steel. Tube joints are welded.

A temperature detector measures the temperature of the excess letdown flow downstream of the excess letdown heat exchanger. Temperature indication and high temperature alarm are provided on the main control board.

A pressure sensor indicates the pressure of the excess letdown flow downstream of the excess letdown heat exchanger and excess letdown control valve. Pressure indication is provided on the main control board.

(4) Seal Water Heat Exchanger

The seal water heat exchanger is designed to cool fluid from three sources: RCP number 1 seal leakage, reactor coolant discharged from the excess letdown heat exchanger, and miniflow from a centrifugal charging pump. Reactor coolant flows through the tube side of the heat exchanger and component cooling water is circulated through the shell. The design flow rate through the tube side is equal to the sum of the nominal excess letdown flow, maximum design RCP seal leakage, and miniflow from one centrifugal charging pump. The unit is designed to cool the above flow to the temperature normally maintained in the VCT. Surfaces in contact with reactor coolant are austenitic stainless steel and the shell is carbon steel.

C. Tanks

(1) Volume Control Tank (VCT)

The VCT provides surge capacity for part of the reactor coolant expansion volume not accommodated by the pressurizer. Overfilling of the VCT is prevented by automatic diversion of the letdown stream to the HUT. The VCT also provides a means for introducing hydrogen into the coolant to maintain the required equilibrium concentration and is used for degassing the reactor coolant. It also serves as a head tank for the charging pumps.

Venting of hydrogen gas which may come out of solution and collect in the charging pump suction lines is provided through three vent lines which are connected to piping high points between the VCT and the charging pumps. These vent lines are connected to a header which then connects to the VCT vent line upstream of the vent valve.

A spray nozzle located inside the tank on the letdown line provides liquid to gas contact between the incoming fluid and the hydrogen atmosphere in the tank.

Hydrogen (from the hydrogen manifold in the waste disposal system) is continuously available to the VCT while a remotely operated vent valve, discharging to the waste disposal system, permits removal of gaseous fission products which are stripped from the reactor coolant and collected in this tank. Relief protection, gas space sampling, and nitrogen purge connections are also provided. The tank can also accept the seal water return flow from the RCPs although this flow normally goes directly to the suction of the charging pumps.

VCT pressure and temperature are monitored with indication given in the control room. Alarm is actuated in the control room for high and low pressure conditions and for high temperature. The VCT pressure control valve is automatically closed by the low pressure signal.

For Unit 1, two level channels govern the water inventory in the VCT. These channels provide local and remote level indication, level alarms, level control, makeup control, and emergency makeup control.

For Unit 2, two level channels govern the water inventory in the VCT. These channels are input to a distributed control system (DCS) which provides signals for local and remote level indication, level alarms, level control, makeup control, and emergency makeup control. An average of the two level signals is provided for normal control. If a failed channel is detected by the DCS, the other channel will be used for control.

For Unit 1, if the VCT level rises above the normal operating range, the DCS provides a signal to modulate the three-way valve downstream of the reactor coolant filter to maintain the VCT level within the normal operating band. The three-way valve can split letdown flow so that a portion goes to the HUT and a portion to the VCT. The controller would operate in this fashion during a dilution operation when reactor makeup water is being fed to the VCT from the reactor makeup control system.

For Unit 2, if the VCT level rises above the normal operating range, a proportional controller modulates the three-way valve downstream of the reactor coolant filter to maintain VCT level within the normal operating band. The three-way valve can split letdown flow so that a portion goes to the holdup tanks and a portion to the VCT. The controller would operate in this fashion during a dilution operation when reactor makeup water is being fed to the VCT from the reactor makeup control system.

For Unit 1, if the modulating function of the channel fails and the VCT level continues to rise, the high level alarm will alert the operator to the malfunction and the full letdown flow will be automatically diverted by the backup level channel.

For Unit 2, if the modulating function of the control system fails and the VCT level continues to rise, the high level alarm will alert the operator to the malfunction and the full letdown flow will be automatically diverted by a high level interlock.

During normal power operation, a low level in the VCT initiates auto makeup which injects a pre-selected blend of boric acid solution and reactor makeup water into the charging pump suction header. When the VCT level is restored to normal, auto makeup stops.

If the automatic makeup fails or is not aligned for operation and the tank level continues to decrease, a low level alarm is actuated. If the level continues to decrease, a low-low signal from both of the level channels opens the isolation valves in the refueling water supply line. This signal also closes the isolation valves in the VCT outlet line which in turn closes the isolation valves of the hydrogen vent header for the charging pump suction side piping. Failure of the VCT level controller, may require operator action to prevent damage to the charging pump. Following a low level alarm, the operator would have sufficient time to transfer the charging pump suction to the RWST, stop the pump or restore letdown to the VCT to prevent pump damage.

(2) Chemical Mixing Tank

The primary use of the chemical mixing tank is in the preparation of caustic solutions for pH control and hydrazine solution for oxygen scavenging.

(3) Batching Tank

The batching tank is used for mixing a makeup supply of boric acid solution for transfer to the boric acid tanks.

A local sampling point is provided for verifying the solution concentration prior to transferring it out of the tank. The tank is provided with an agitator to improve mixing during batching operations and electric strip heaters to heat the tank contents to expedite dissolution of boric acid.

(4) Holdup Tanks

Two holdup tanks hold radioactive liquid which enters from the letdown line or other sources. The liquid is released from the RCS during startup, shutdowns, load changes and from boron dilution to compensate for burnup. When it is necessary to empty the fuel transfer canal, one of the tanks is emptied and is used to store the canal water.

(5) Boric Acid Tanks

Approximately two and one-half full tanks of 4% wt boric acid solution (based on 9890 gallons usable volume per tank) are required for shutdown and refueling of one unit. This is normally the most limiting evolution that an operator must perform involving system boration, i.e., the addition of maximum amount of boron to the RCS. Two tanks, one for each unit, supply boric acid for each reactor coolant makeup system during normal operation, while the third tank serves as a spare.

The concentration of boric acid solution in storage is maintained between 3.5 and 4.0% by weight. Periodic manual sampling and corrective action, if necessary, ensure that these limits are maintained. As a consequence, measured boric acid solution can be delivered to the reactor coolant to control the chemical poison concentration. The combination overflow and breather vent connection has a water loop seal to minimize vapor discharge during storage of the solution.

Manually-operated electric immersion heaters in each boric acid tank can raise the temperature of boric acid solution to 100°F, if required. The heaters are sheathed in austenitic stainless steel.

One temperature detector provides temperature measurement of each tank's contents. Local temperature indication is provided and high and low temperature alarms are indicated on the main control board.

A level detector indicates the level in each boric acid tank. Level indication with high and low level alarms is provided on the main control board. The low alarm is set to indicate the minimum level of boric acid in the tank to ensure sufficient boric acid to provide suction head to the boric acid transfer pumps.

D. Demineralizers

(1) Mixed Bed Demineralizers

Two flushable mixed bed demineralizers assist in maintaining reactor coolant purity. A cation resin and anion resin are charged into the demineralizers. The anion resin is converted to the borate form in operation.

Both types of resin remove fission and corrosion products. The resin bed is designed to reduce the concentration of ionic isotopes in the purification stream, except for cesium, yttrium and molybdenum, by a minimum factor of 10. If cation bed is unavailable, the mixed bed, with appropriate resins, may be used to reduce lithium.

Each demineralizer has more than sufficient capacity for one core cycle with 1% of the rated core thermal power being generated by defective fuel rods. One demineralizer is normally in service with the other in standby.

(2) Cation Bed Demineralizers

A flushable demineralizer with cation resin in the hydrogen form is located downstream of the mixed bed demineralizers and is used intermittently to control the concentration of Lithium-7 which builds up in the coolant from the B^{10} (N, α) Lithium-7 reaction. The demineralizer also has sufficient capacity to maintain the Cesium-137 concentration in the coolant below 1.0 µCi/cc with 1% defective fuel. The resin bed is designed to reduce the concentration of ionic isotopes, particularly cesium and lithium.

The demineralizer has more than sufficient capacity for one core cycle with 1% of the rated core thermal power being generated by defective fuel rods.

E. Filter

(1) Reactor Coolant Filter

The reactor coolant filter is located in the letdown line down stream of the mixed bed and cation bed demineralizers. The filter collects resin fines and particulates from the letdown stream. The nominal flow capacity of the filter is equal to the maximum purification flow rate.

Two local pressure indicators are provided upstream and downstream of the reactor coolant filter to provide filter differential pressure.

(2) Seal Water Injection Filters

Two seal water injection filters are located in parallel in a common line to the reactor coolant pump seals; they collect particulate matter that could be harmful to seal faces. Each filter is sized to accept flow in excess of the normal seal water flow requirements.

A differential pressure indicator monitors the pressure drop across each seal water injection filter and gives local indication with high differential pressure alarm on the main control board.

(3) Seal Water Return Filter

This filter collects particulates from the reactor coolant pump seal water return and from the excess letdown flow. The filter is designed to pass the sum of the excess letdown flow and the maximum design leakage from all reactor coolant pumps.

Two local pressure indicators are provided to show the pressures upstream and downstream of the filter and thus provide indication of differential pressure across the filter.

(4) Boric Acid Filter

The boric acid filter collects particulates from the boric acid solution being pumped from the boric acid tanks by the boric acid transfer pumps. The filter is designed to pass the design flow of two boric acid transfer pumps operating simultaneously.

Local pressure indicators indicate the pressure upstream and downstream of the boric acid filter and thus, can be used to provide filter differential pressure.

F. Boric Acid Blender

The boric acid blender promotes thorough mixing of boric acid solution and primary makeup water for the reactor coolant makeup circuit. The blender consists of a conventional pipe-tee. The blender decreases the pipe length required to homogenize the mixture for taking a representative local sample. A sample point is provided in the piping just downstream of the blender.

G. Orifices

(1) Letdown Orifices

Three letdown orifices are provided to reduce the letdown pressure from reactor conditions and to control the flow of reactor coolant leaving the RCS. The orifices are placed into or out of service by remote operation of their respective isolation valves. One orifice is designed for normal letdown flow with the other two serving as standby. One or both of the standby orifices may be used in parallel with the normally operating orifice for flow control when the RCS pressure is less than the maximum allowable during normal RHR operating conditions. Maximum purification letdown flow is limited to 120 gpm when RCS exceeds allowable RHR operating conditions. Each orifice consists of an assembly which provides for permanent pressure loss without recovery. In addition to the three letdown orifice noted above, another orifice has been provided to limit the rate of thermal change on the welds upstream of the Regenerative Heat Exchanger. All letdown orifices assemblies are made of austenitic stainless steel or other adequate corrosion resistant material.

A flow monitor provides indication in the control room of the letdown flow rate, and a high alarm to indicate unusually high flow.

A low pressure letdown controller located downstream of the letdown heat exchanger controls the pressure upstream of the letdown heat exchanger to prevent flashing of the letdown liquid. Pressure indication and high pressure alarm are provided on the main control board.

(2) Seal Water Return Bypass Orifice

An orifice in each reactor coolant pump number 1 seal bypass line can be in service during startup or shutdown when the RCS pressure is low. The bypass flow may be necessary to ensure adequate flow for cooling of the pump's lower radial bearing and to limit the temperature rise of the water cooling the number 1 seal. The orifice is constructed of austenitic stainless steel and designed to pass adequate flow for the differential pressure existing at the lowest allowable RCS pressure for reactor coolant pump operation.

(3) Chemical Mixing Tank Orifice

An orifice is provided in the piping upstream of the mixing tank. This orifice limits the flow rate through the tank to 2 gpm to avoid slugging the pump seals with concentrated chemicals.

(4) Reactor Coolant Pump Standpipe Orifice

A seal stand pipe which contains water applies a constant head to the reactor coolant pump No. 3 seal to minimize leakage along the reactor coolant pump shaft. An orifice is provided in the standpipe drain line to the reactor coolant drain tank to limit the rate of drainage from the standpipe to the design leakage rate for the No. 2 seal. An increase in the No. 2 seal leak rate would then result in an increase in standpipe level and an eventual high level alarm which would alert the operator of a possible reactor coolant pump seal failure.

(5) Charging Pump Bypass Orifices

A bypass orifice is provided for each centrifugal charging pump. The purpose of these orifices is to provide a minimum flow for pump protection.

(6) Boric Acid Tank Orifice

Each boric acid tank orifice is designed to pass the minimum flow required to provide sufficient recirculation through the piping and tanks with the transfer pumps. The orifice is constructed of austenitic stainless steel.

Alternatively, valves may have enhanced "live loads" packing allowing the lantern leak-off to be capped.

H. Valves

Where pressure and temperature conditions permit, diaphragm type valves are used to essentially eliminate leakage to the atmosphere. All packed valves which are larger than 2 inches and which are designated for radioactive services are provided with stuffing box and lantern leakoff connections. Alternatively valves may have enhanced “live loads” packing allowing the lantern leak-off to be capped. All control (modulating) and three-way valves are either provided with stuffing box and leakoff connections or are totally enclosed. Leakage to the atmosphere is essentially zero for these valves. Basic material of construction is stainless steel for all valves which handle radioactive liquid or boric acid solutions.

Relief valves are provided for lines and components that might be pressurized above design pressure by improper operation or component malfunction.

(1) Check - Charging Line Downstream of Regenerative Heat Exchanger

If the charging side of the regenerative heat exchanger is isolated while the hot letdown flow continues at its maximum rate, the volumetric expansion of coolant on the charging side of the heat exchanger is relieved to the RCS through a spring-loaded check valve.

(2) Pressurizer Relief

a. Letdown Line Downstream of Letdown Orifices

The pressure relief valve downstream of the letdown orifices protects the low pressure piping and the letdown heat exchanger from overpressure when the low pressure piping is isolated. The capacity of the relief valve is equal to the maximum flow rate through all letdown orifices. The valve set pressure is equal to the design pressure of the letdown heat exchanger tube side.

b. Letdown Line Downstream of Low Pressure Letdown Valve

The pressure relief valve downstream of the low pressure letdown valve protects the low pressure piping and equipment from overpressure when this section of the system is isolated. The overpressure may result from leakage through the low pressure letdown valve. The capacity of the relief valve equals the maximum flow rate through all letdown orifices. The valve set pressure is equal to the design pressure of the demineralizers.

(3) Relief

a. Volume Control Tank

The relief valve protects the VCT from overpressurization when the tank normal outlet lines are closed and flow from several sources are still entering the tank. The valve set pressure is equal to the VCT design pressure minus valve inlet piping losses.

b. Charging Pump Suction

A relief valve on the common charging pump suction header relieves pressure that may build up if the suction line isolation valves are closed or if the system is overpressurized. Also, each charging pump has a relief valve downstream of the suction isolation valve to provide overpressure protection of the suction piping in the event of check valve back leakage. Valve set pressure is equal to the design pressure of the associated piping and equipment.

c. Seal Water Return Line (Inside Containment)

This relief valve is designed to relieve over-pressurization in the seal water return piping inside the containment if the motor-operated isolation valve is closed. The valve is designed to relieve the total leakoff flow from the No. 1 seals of the reactor coolant pumps plus the design excess letdown flow.

d. Seal Water Return Line (Charging Pumps Bypass Flow)

This relief valve protects the seal water heat exchanger and its associated piping from over-pressurization. If either of the isolation valves for the heat exchanger are closed and if the bypass line is closed, the piping would be over-pressurized by the miniflow from the centrifugal charging pumps. The valve is sized to handle the miniflow from the centrifugal charging pumps. The valve is set to relieve at the design pressure of the heat exchanger.

I. Piping

All CVCS piping that handles radioactive liquid is austenitic stainless steel. All piping joints and connections are welded, except where flanged connections are required to facilitate equipment removal for maintenance and hydrostatic testing.

9.3.4.2.2 System Operation

A. Reactor Startup

(1) Reactor startup is defined as the operations which bring the reactor from cold shutdown to normal operating temperature and pressure. It is assumed that:

a. Normal RHR is in progress.

b. RCS boron concentration is at the cold shutdown concentration.

c. Reactor makeup control system is set to provide makeup at the cold shutdown concentration.

d. RCS is either water solid or drained to minimum level for the purpose of refueling or maintenance. If the RCS is water solid, system pressure is maintained by operation of a charging pump and controlled by the low pressure letdown valve in the letdown line (letdown is achieved via the RHR system).

e. The charging and letdown lines of the CVCS are filled with coolant at the cold shutdown boron concentration. The letdown orifice isolation valves are open.

(2) If the RCS requires filling and venting, the procedure is as follows:

a. One charging pump is started, which provides blended flow from the reactor makeup control system at the cold shutdown boron concentration.

b. The vents on the head of the reactor vessel and pressurizer are opened.

c. The RCS is filled and the vents closed.

(3) The system pressure is raised by using the charging pump and controlled by the low pressure letdown valve. When the system pressure is adequate for operation of the reactor coolant pumps, seal water flow to the pumps is established and the pumps are operated and vented sequentially until the gases are cleared from the system. Final venting takes place at the pressurizer. RCS vacuum refill may be performed in lieu of, or in conjunction with the conventional method of filling and venting the RCS. The RCS vacuum refill method is accomplished by applying a vacuum to the system and drawing out the gases as the reactor vessel pressurizer, and steam generator tubes are filled.

(4) After the filling and venting operations are completed, charging and letdown flows are established. Pressurizer heaters are energized to form a steam bubble in the pressurizer. At this point, steam formation in the pressurizer is accomplished by manual control of the charging flow and automatic pressure control of the letdown flow. When the pressurizer water level reaches the no-load programmed setpoint, the pressurizer level control is shifted to control the charging flow to maintain programmed level. The RHRS is then isolated from the RCS and the normal letdown path is established. The pressurizer heaters are now used to increase RCS pressure and RCP's are started to increase RCS temperature.

(5) The reactor coolant boron concentration is now reduced by operating the reactor makeup control system in the "dilute" mode. The reactor coolant boron concentration is corrected to the point where the control rods may be withdrawn and criticality achieved. Power increase may then proceed with corresponding manual adjustment of the reactor coolant boron concentration to balance the temperature coefficient effects and maintain the control rods within their operating range.

(6) Prior to or during this process, the CVCS is employed to obtain the correct chemical properties in the RCS. The reactor makeup control system is operated on a continuing basis to ensure correct control rod position. Chemicals are added through the chemical mixing tank as required to control reactor coolant chemistry such as pH and dissolved oxygen content. Hydrogen overpressure is established in the VCT to assure the appropriate hydrogen concentration in the reactor coolant.

B. <u>Power Generation and Hot Standby Operation</u>

(1) <u>Base Load</u>

At a constant power level, the rates of charging and letdown are dictated by the requirements for seal water to the reactor coolant pumps and the normal purification of the RCS. One charging pump is employed and charging flow is controlled automatically from pressurizer level. The only adjustments in boron concentration necessary are those to compensate for core burnup. These adjustments are made at infrequent intervals to maintain the control groups within their allowable limits. Rapid variations in power demand are accommodated automatically by control rod movement. If variations in power level occur, and the new power level is sustained for long periods, some adjustment in boron concentration may be necessary to maintain the control groups within their maneuvering band.

During normal operation, normal letdown flow is maintained and one mixed bed demineralizer is in service. Reactor coolant samples are taken periodically to check zinc concentration, boron concentration, water quality, pH and activity level. The charging flow to the RCS is controlled automatically by the pressurizer level control signal through the discharge header flow control valve.

(2) Load Follow

A power reduction will initially cause a xenon buildup followed by xenon decay to a new, lower equilibrium value. The reverse occurs if the power level increases; initially, the xenon level decreases and then it increases to a new and higher equilibrium value associated with the amount of the power level change.

The reactor makeup control system is used to vary the boron concentration in the reactor coolant to compensate for xenon transients occurring when reactor power level is changed.

Control rod position provides the operator with an indication of whether dilution or boration of the reactor coolant is necessary. If rod position is out of the desired range proper manipulation of boron concentration will return the rods to the desired range.

During periods of plant loading, the reactor coolant expands as its temperature rises. The pressurizer absorbs this expansion as the level controller raises the level setpoint to the increased level associated with the new power level. Any excess coolant due to RCS expansion is let down and stored in the VCT. During this period, the flow through the letdown orifice remains constant and the charging flow is reduced by the pressurizer level control signal, resulting in an increased temperature at the regenerative heat exchanger outlet. The temperature controller downstream from the letdown heat exchanger increases the component cooling water flow to maintain the desired letdown temperature.

During periods of plant unloading, the charging flow is increased to make up for the coolant contraction not accommodated by the programmed reduction in pressurizer level.

(3) Hot Shutdown

If required, for periods of maintenance, or following reactor trips, the reactor can be held subcritical, but with the capability to return to full power within the period of time it takes to withdraw control rods. During this hot shutdown period, temperature is maintained at no-load T_{avg} by dumping steam to remove core residual heat, and by running reactor coolant pumps to maintain system temperature.

Following shutdown xenon buildup occurs and increases the degree of shutdown (delta-k/k). The effect of xenon build-up is to increase the degree of shutdown (delta-k/k) to a maximum at about eight hours following shutdown from equilibrium full power conditions. If hot shutdown is maintained past this point, xenon decay results in a decrease in degree of shutdown. Since the delta-k/k value of the initial xenon concentration is high (assuming that an equilibrium concentration had been reached during operation), boration of the reactor coolant is necessary to counteract the xenon decay and maintain shutdown.

If a rapid recovery is required, dilution of the system may be performed to counteract this xenon buildup. However, after the xenon concentration reaches a peak, boration must be performed to maintain the reactor subcritical as the xenon decays out.

(4) Cold Shutdown

Cold shutdown is the operation which takes the reactor from hot shutdown conditions to cold shutdown conditions (reactor is subcritical by at least 1% delta-k/k and $T_{avg} \leq$ 200°F).

Before initiating a cold shutdown, the RCS hydrogen concentration is lowered by reducing the VCT overpressure, by replacing the VCT hydrogen atmosphere with nitrogen, and by continuous purging to the waste disposal system.

During the plant cooldown, charging is provided to make up for coolant contraction. During the initial phase of the cooldown, the makeup is provided from the boric acid tanks. The boric acid tanks should be used until at least the technical specification minimum volume has been charged. At that point, operators can continue using the boric acid tanks if additional volume is available, or shift suction of the charging pumps to the refueling water storage tank. If the boric acid tanks are used, 3.5 to 4.0% boric acid solution should be charged until the RCS reaches the desired cold shutdown Xe free concentration. The cooldown is completed by using blended makeup at the cold shutdown concentration.

Contraction of the coolant during cooldown of the RCS results in actuation of the pressurizer level control to maintain normal pressurizer water level. The charging flow is increased, relative to letdown flow, and results in a decreasing VCT level. The VCT level controller automatically initiates makeup to maintain the inventory.

After the RHRS is placed in service and the reactor coolant pumps are shutdown, further cooling of the pressurizer liquid is accomplished by charging through the auxiliary spray line. Coincident with plant cooldown, a portion of the reactor coolant flow is diverted from the RHRS to the CVCS for cleanup. Demineralization of ionic radioactive impurities and stripping of fission gases reduce the reactor coolant activity level sufficiently to permit personnel access for refueling or maintenance operations.

9.3.4.3 Safety Evaluation

A. Reactivity Control

Any time that the plant is at power, the quantity of boric acid retained and ready for injection always exceeds that quantity required for the normal cold shutdown assuming that the control assembly of greatest worth is in its fully withdrawn position. This quantity always exceeds the quantity of boric acid required to bring the reactor to hot shutdown and to compensate for subsequent xenon decay.

When the reactor is subcritical, i.e., during cold or hot shutdown, refueling and approach to criticality, the neutron source multiplication is continuously monitored and indicated. Any appreciable increase in the neutron source multiplication, including that caused by the maximum physical boron dilution rate, is slow enough to give ample time to start a corrective action to prevent the core from becoming critical. The rate of boration, with a single boric acid transfer pump operating, is sufficient to take the reactor from full power operation to 1% shutdown in the hot condition, with no rods inserted, in less than 185 minutes. In less than 140 additional minutes, enough boric acid can be injected to compensate for xenon decay, although xenon decay below the equilibrium operating level will not begin until approximately 25 hours after shutdown. Additional boric acid is employed if it is desired to bring the reactor to cold shutdown conditions.

Two separate and independent flow paths are available for reactor coolant boration, i.e., the charging line and the reactor coolant pump seal injection line. A single failure does not result in the inability to borate the RCS.

If the normal charging line is not available, charging to the RCS is continued via reactor coolant pump seal injection at the rate of approximately 5 gpm per pump. At the charging rate of 20 gpm (5 gpm per reactor coolant pump), approximately 6.5 hours are required to add enough boric acid solution to counteract xenon decay, although xenon decay below the full power equilibrium operating level will not begin until approximately 25 hours after the reactor is shutdown.

As backup to the normal boric acid supply, the operator can align the refueling water storage tank outlet to the suction of the charging pumps.

Since inoperability of a single component does not impair ability to meet boron injection requirements, plant operating procedures allow components to be temporarily out of service for repairs. However, with an inoperable component, the ability to tolerate additional component failure is limited. Therefore, Technical Specifications require immediate action to effect repairs of an inoperable component, restrict permissible repair time, and require demonstration of the operability of the redundant component.

B. Reactor Coolant Purification

The CVCS is capable of reducing the concentration of ionic isotopes in the purification stream as required in the design basis. This is accomplished by passing the letdown flow through one of the mixed bed demineralizers which removes ionic isotopes, (except those of cesium, molybdenum and yttrium, with a minimum decontamination factor of 10), and zinc. Through occasional use of the cation bed demineralizer the concentration of cesium can be maintained below 1.0 microcuries per cubic centimeter, assuming 1% of the rated core thermal power is being produced by fuel with defective cladding. The cation bed demineralizer is capable of passing the maximum purification letdown flow, though only a portion of this capacity is normally utilized. Each mixed bed demineralizer is capable of processing the maximum purification letdown flow rate. If the normally operating mixed bed demineralizer resin has become exhausted, the second demineralizer can be placed in service. Each demineralizer is designed, however, to operate for one core cycle with 1% defective fuel.

There would be no safety problem associated with over-heating of the demineralizer resins. The only effect on reactor operating conditions would be the possibility of an increase in the reactor coolant activity level. If the activity level in the reactor coolant were to exceed the limit given in the Technical Specifications, reactor operation would be restricted as required by the Technical Specifications.

C. Seal Water Injection

Flow to the reactor coolant pumps' seals is assured by the fact that there are two charging pumps, any one of which is capable of supplying the normal charging line flow plus the nominal seal water flow.

D. Leakage Provisions

CVCS components, valves, and piping which see radioactive service are designed to limit leakage to the atmosphere. Leakage to the atmosphere is limited through:

(1) Welding of piping joints and connections except where flanged connections are provided to facilitate maintenance and hydrostatic testing,

(2) Extensive use of leakoffs to collect leakage, and use of enhanced “live load” packing.

(3) Use of diaphragm valves where conditions permit.

The VCT in the CVCS provides an inferential measurement of leakage from the CVCS as well as the RCS. Low level in the VCT actuates makeup at the prevailing reactor coolant boron concentration. The amount of leakage can be inferred from the amount of makeup added by the reactor makeup control system.

E. Ability to Meet the Safeguards Function

A failure analysis of the portion of the CVCS which is safety-related (used as part of the emergency core cooling system) is included as part of the emergency core cooling system failure analysis presented in Section 6.3.

9.3.4.4 Tests and Inspections

As part of plant operation, periodic tests, surveillance inspections and instrument calibrations are made to monitor equipment condition and performance. Most components are in use regularly; therefore, assurance of the availability and performance of the systems and equipment is provided by control room and/or local indication.

9.3.4.5 Instrumentation Application

Process control instrumentation is provided to acquire data concerning key parameters about the CVCS. The location of the instrumentation is shown on Figure 9.3-15.

The instrumentation furnishes input signals for monitoring and/or alarming purposes. Indications and/or alarms are provided for the following parameters:

1. Temperature
2. Pressure
3. Flow
4. Water level

The instrumentation also supplies input signals for control purposes. Some specific control functions are:

1. Letdown flow is diverted to the VCT upon high temperature indication upstream of the mixed bed demineralizers.

2. Pressure upstream of the letdown heat exchanger is controlled to prevent flashing of the letdown liquid.

3. Charging flow rate is controlled during charging pump operation.

4. Water level is controlled in the VCT.

5. Reactor makeup is controlled.

9.3.5 Failed Fuel Detection System

9.3.5.1 Design Bases

The Gross-Failed fuel Detection System is not safety-related and is not used for Unit 1 or Unit 2 operations.

9.3.5.2 System Description

The gross failed fuel detector is connected to the hot leg of a primary coolant loop (Figure 9.3-16). The coolant sample passes through a cooler and then into a coil encompassing a neutron detector and moderator, then to a connection upstream of the mixed bed demineralizers after which it flows back into the VCT. The sample delay time to the neutron detector is adjusted by means of a flow controller. The delay time also depends on the length of tubing used. Once set, the flow is kept relatively constant by the automatic flow control valve. A transmitting flowmeter is installed for periodic checks of the flow rate. A sensor monitors the sample cooler outlet temperature.

Figure 9.3-17 shows the block diagram of the gross failed fuel detector channel. The detector, pre-amplifier, sample cooler, and associated flow controls are located outside the containment. The signal processing equipment and readout are mounted in a rack located in the control room. The delayed neutron signal of the detector is displayed on a recorder located in the rack. The recorder and associated equipment have been removed from the Unit 1 control room rack. The response time for the gross failed fuel detector is on the order of 60 seconds.

9.3.5.3 Safety Evaluation

The GFFDS does not perform a safety-related function, and is not designed to satisfy any specific safety criteria. As shown on Figure 9.3-16, the gross failed fuel detector is outside of containment and is installed in the primary coolant hot leg sample line. It is isolated from the containment by means of the sample system isolation valves. The safety evaluation of the sampling system, including the isolation valves, is discussed in Section 9.3.2.

9.3.5.4 Tests and Inspections

The GFFDS is equipped with a test oscillator in the preamplifier and a test oscillator in the electronics drawer, each of which can be used to test the proper operation of the signal processing circuitry.

9.3.5.5 Instrument Applications

Instrumentation associated with GFFDS is described in Section 9.3.5.2.

9.3.6 Auxiliary Charging System

9.3.6.1 Design Bases

The auxiliary charging system is designed to provide makeup to the RCS when the plant is operating in the "flood mode." For definition of "flood mode" see Section 2.4.14. This system is an essential part of the equipment used in flood protection provisions. This system is also designated as the flood mode boration makeup system (FMBMS).

The auxiliary charging system includes the following equipment:

1. 4 full-capacity auxiliary charging pumps (2 per unit).

2. 1 auxiliary boration makeup tank.

3. 2 filters

4. 1 demineralizer.

5. 2 auxiliary charging booster pumps.

6. Associated instrumentation and control equipment.

Each auxiliary charging pump capacity is 100 gph and each auxiliary charging booster pump capacity is 300 gph. Both capacities are several times greater than the maximum postulated leakage loss from the primary system. Postulated total recoverable leakage is based on No. 2 and No. 3 seal leakage (approximately 576 gallons) with No. 1 seal injection and return lines isolated for each reactor coolant pump of both units plus the total recoverable leakage of 225 gpd at an RCS pressure of 350 psig (maximum during 'flood mode'). Nonrecoverable leakage need not be considered during flood mode operation since any two of the four steam generators provides adequate cooling and a steam generator with primary to secondary leakage can be isolated. Also, any other system leakage will be insignificant since the operating pressure during flood mode is considerably less than during normal operation.

The auxiliary boration makeup tank has a usable capacity of 868 gallons to provide a minimum of 12 hours makeup (approximately 801 gallons) based on the above leakage loss from each unit.

The demineralizer is provided for cleanup of makeup water and the filters prevent the demineralizer resins from leaving the FMBMS. The filters are designed for a maximum flow rate of 10 gpm each, and the demineralizer is designed for a maximum flow rate of 27 gpm. Auxiliary charging system equipment is located above flood level on Elevation 757.0 of the Auxiliary Building.

9.3.6.2 System Design Description

The auxiliary charging system is shown on Figure 9.3-18. The initial fill of makeup water for the auxiliary boration makeup tank will come from the demineralized water tank. The majority of leakage, from RCS pump seals, etc., is collected in the reactor coolant drain tank (RCDT) and is pumped by the reactor coolant drain tank pumps to the auxiliary boration makeup tank. This recoverable leakage is the main preferred source of makeup water. Additional makeup water is supplied from other preferred sources: (1) cold leg accumulator tanks via the RCDT pumps, (2) pressurizer relief tank via the RCDT pumps, and (3) demineralized water tanks.

The above preferred sources of makeup water are backed up by the pumps of the high pressure fire protection system which can pump river water to the auxiliary makeup tank. To prevent inadvertent injection of raw water into the primary system, this source requires manual addition, via fire hose, only if it is needed.

The makeup water is borated to the extent necessary to maintain refueling shutdown concentration in the RCS. Boric acid, lithium hydroxide, and hydrazine are added and mixed with the makeup water in the auxiliary boration makeup tank in a batch process.

The process system provides a means to be sampled periodically for water quality analysis. Sample outlets are provided that are accessible in the flood mode.

The makeup water is pumped from the auxiliary boration makeup tank to the primary system as required to maintain pressurizer level. One booster pump per plant and one charging pump per unit are sufficient to provide the required makeup; two booster pumps and four charging pumps are provided.

Spool pieces are used to connect the auxiliary charging system to the normal charging lines. These spool pieces are installed only in the event of a flood warning and after the RCS pressure has been reduced to less than 350 psig.

9.3.6.3 Design Evaluation

See Table 3.2-2a for classification of the auxiliary charging system components.

Sufficient separation and redundancy of components and circuits are provided so that no single failure can jeopardize system operation. The components are capable of being supplied with emergency power.

Refer to Sections 2.4.14.1.2 and 2.4.14.10 for the limitation on the coincidence of seismic events and a flood exceeding plant grade. As indicated in Table 3.2-2a, the auxiliary charging system piping essential for makeup and boration in the event of a flood above plant grade and portions of the system necessary for containment isolation are designed to Seismic Category I requirements. The balance of the system is designed to limited seismic Category I(L) requirements.

9.3.6.4 Tests and Inspection

Components of the auxiliary charging system are accessible for inspection. The system was tested during preoperational testing to assure its adequacy and is tested per the requirements of the ASME Augmented Inservice Testing Program for pumps and valves.

Inservice inspections of the Class C (ASME Class 3) for the tanks will be performed to the extent practical per the guidelines of the ASME Code, Section XI. Inservice inspections of the Class C (ASME Class 3) for the pumps and valves will be performed to the extent practical per the guidelines of the ASME OM Code as required by 10CFR50.55a.

9.3.6.5 Instrument Application

Manual control is employed to the maximum extent practicable.

The level of the RCDT is indicated continuously and alarmed on high and low level on a panel in the Auxiliary Building. The RCDT level is controlled between the high and low alarm setpoints by the actuation of start and stop signals to the RCDT pumps. Completely manual operation will be used to transfer water to the auxiliary boration makeup tank (ABMT). Levels in the ABMT can be visually checked (a level indicator is provided) since the tank has 1/2 day supply under worst case conditions. The redundant pressure and pressurizer level loops in the RCS serve as indications of the low pressure necessary for the activation of the auxiliary charging pumps.

9.3.7 Boron Recycle System

The boron recycle system (BRS) is not required for the operation of Unit 1 or Unit 2. The portions of this system which are used for the operation of Unit 1 and Unit 2 are discussed in Section 9.3.4. The components which make up the BRS are installed in the Auxiliary Building and were originally intended to recover boron from the excess RCS.

A summary of the principal components of the BRS is listed below:

Evaporator Feed Ion Exchanger
Evaporator Condensate Demineralizer
Condensate Filter
Concentration Filter
Ion-Exchanger Filter
Gas Stripper and Boric Acid Evaporator Package

9.3.8 Heat Tracing

Electric heat tracing is used to supply heat to some of the insulated mechanical piping systems to prevent freezing of the fluid in the pipe or to provide process temperature control to maintain the media within its specified temperature range and it is used on some instrument sense lines.

The following systems use heat tracing:

(a) Condensate - System 002

(b) Main and auxiliary feedwater - System 003(Note 1)

(c) Raw cooling water - System 024

(d) High pressure fire protection - System 026

(e) Sampling and water quality - System 043 (UNIT 1 ONLY)

(f) Safety injection - System 063

(g) Essential raw cooling water - System 067

(h) Radiation monitoring - System 090

(i) Makeup water treatment plant - System 928

(j) Main Steam - System 001(Note 1)

(k) Ice Condenser - System 061

Note 1 - No main control room alarm for instrument sense lines in North and South valve vault rooms.

REFERENCES

None

TABLE 9.3-1 (Sheet 1 of 2)

COMPRESSED AIR SYSTEM DESCRIPTIVE INFORMATION
STATION CONTROL AND SERVICE AIR SYSTEMS

Station Air Compressors	
Number	4
Type	3 rotary screw, 1 centrifugal
Discharge pressure, psig	100
Discharge Temperature, °F	100 (A, B, C)
Capacity, acfm (nominal),total	691 (A, B, C)
Station Air Compressors A, B, C (rotary screw) Coolers	
Intercooler/Aftercooler	Integral
Type	Shell and tube
Tube side flow, gpm (water)	54 (A, B, C) (includes flow to oil cooler)
Shell side flow, acfm (air)	691 (A, B, C)
Shell material	Stainless steel
Tube material	Stainless steel
Design code	Manufacturer’s standard
Discharge Temperature, °F	105
Design Temperature, °F	428
Station Air Compressor D Coolers	
Intercooler/Aftercooler	Integral
Type	Shell & Tube
Tube Side Flow, SCFM (Air)	1166
Total Shell Side Water Flow, gpm	96.3 (Includes flow to external oil cooler)
Discharge Temperature, °F	105
Shell side design pressure, psig	75
Tube Side Design pressure, psig	150
Shell Material	Cast Iron
Tube Material	Copper (ASTM B111)
Tube FIN Material	Copper (ASTM B152)
Header	Muntz Metal (ASTM B111)
Design Code	Manufacturer's standard

TABLE 9.3-1 (Sheet 2 of 2)

COMPRESSED AIR SYSTEM DESCRIPTIVE INFORMATION
STATION CONTROL AND SERVICE AIR SYSTEMS (Cont'd)

Station Air Receivers	
Number	3 (two control and one service air)
Capacity, ft^3	266
Design pressure, psig	150
Design temperature, °F	300
Operating pressure, psig	100
Operating temperature, °F	105
Material	Carbon steel
Design code	ASME VIII
Auxiliary Air Compressors	
Number	2
Type	Reciprocating
Discharge pressure, psig	100
Discharge temperature, °F	430 (to aftercooler)
Capacity, scfm	75 each (this value is the procurement capacity; actual tested capacity could be lower)
Auxiliary Air Compressor Aftercooler	
Number	1 per compressor
Type	Tube and shell
Tube side flow, scfm (air)	75
Shell side flow, gpm (water)	4.5
Discharge temperature, °F	100 (15°F above ERCW inlet temperature of 85°F)
Auxiliary Air Receivers	
Number	2
Capacity, ft^3	34
Design pressure, psig	125
Operating pressure, psig	115
Design Code	ASME Section VIII

Table 9.3-2 (Sheet 1 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
CVCS	Outlet Boric Acid Blender	P = 150 T = 250	Hot Sample Room
CVCS	*Outlet Batching tank	P = ATM T = 300	Local
WDS	*Downstream Monitor Tank Pumps A and B (One Sample)	P = 150 T = 180	Local
CVCS	Downstream Evaporator Feed, Ion Exchanger No. 1A and 1 B	P = ATM T = 150	Hot Sample Room
CVCS	Volume Control Tank Vent	P = 75 T = 250	Hot Sample Room
CVCS	Inlet Mixed Bed Demineralizer	P = 200 T = 250	Hot Sample Room
CVCS	Outlet Mixed Bed Demineralizer	P = 200 T = 250	Hot Sample Room
CVCS	Inlet Evaporator Feed Ion Exchanger (1A & 1 B)	P = 150 T = 200	Hot Sample Room
CVCS	*CVCS Holdup Tank Recirc	P = 150 T = 200	Hot Sample Room
WDS	*Downstream Laundry Pump	P = 150 T = 180	Local
WDS	*Downstream Waste Condensate Pumps	P = 150 T = 180	Local
WDS	Waste Gas Decay Tanks (Auto and Manual)	P = 150 T = 180	Gas Analyzer
WDS	Spent Resin Storage Tank	P = 150 T = 180	Gas Analyzer
WDS	CVCS Holdup Tanks A & B	P = 150 T = 200	Gas Analyzer

Table 9.3-2 (Sheet 2 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
WDS	RCS Pressurizer Relief Tank	P = 2485 T = 650	Gas Analyzer
WDS	CVCS Vol. Control Tank Vent	P = 75 T = 250	Gas Analyzer
WDS	Reactor Coolant Drain Tank	P = 150 T = 180	Gas Analyzer
WDS	*Chemical Drain Tank Recirculate	P = 150 T = 180	Local
WDS	*Cask Decontamination Collector Tank	P = 150 T = 180	Local
WDS	*Tritiated Drain Tank Recirculation	P = 150 T = 180	Hot Sample Room
WDS	*Floor Drain Collector Tank Recirculation	P = 150 T = 180	Hot Sample Room
RCS	Hot Leg Loop 1	P = 2485 T = 650	Hot Sample Room
RCS	Hot Leg Loop 3	P = 2485 T = 650	Hot Sample Room
RCS	Pressurizer Liquid	P = 2485 T = 680	Hot Sample Room
RCS	Pressurizer Gas	P = 2485 T = 650	Hot Sample Room
Main Steam	Steam Gen No. 1 to H.P. Turbine	P = 1185 T = 600	Titration Room
Main Steam	Steam Gen No. 1 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 2 to H.P. Turbine	P = 1185 T = 600	Titration Room

Table 9.3-2 (Sheet 3 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Main Steam	Steam Gen No. 2 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 3 to H.P. Turbine	P = 1185 T = 600	Titration Roomr
Main Steam	Steam Gen No. 3 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 4 to H.P. Turbine	P = 1185 T = 600	Titration Room
Main Steam	Steam Gen No. 4 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 1,2,3,&4 Dowcomers	P = 1185 T = 600	Hot Sample Room
Main Steam	Steam Gen Blowdown No. 1, 2, 3 & 4	P = 1185 T = 600	Hot Sample Room
Steam Generator Blowdown	Steam Gen No. Blowdown Pumps	P = 450 T = 250	Local
Steam Generator Blowdown	Downstream of Steam Gen Blowdown Heat Exchanger	P = 1185 T = 150	Local
S.F.P.C.	*Upstream Spent Fuel Pool Demin	P = 150 T = 200	Local
S.F.P.C.	*Downstream Spent Fuel Pool Demin	P = 150 T = 200	Local
S.F.P.C.	*Refueling Water Purification Filter (Upstream)	P = 150 T = 200	Local
S.F.P.C.	*Refueling Water Purification Filter (Downstream)	P = 150 T = 200	Local
Htr Dr & V	No. 3 Htr Drain Tank	P = 250 T = 370	Local

Table 9.3-2 (Sheet 4 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Htr Dr & V	No. 7 Htr Drain Tank	P = 50 T = 180	Titration Room
Htr Dr & V	No. 7 Htr Drain Tank Pump A Discharge	P = 410 T = 180	Local
Htr Dr & V	No. 7 Htr Drain Tank Pump B Discharge	P = 410 T = 180	Local
Htr Dr & V	No. 7 Htr Drain Tank Pumps Common Discharge Header	P = 410 T = 180	Local
FW	Downstream Htr 1A-1	P = 1185 T = 465	Local
FW	Downstream Htr 1B-1	P = 1185 T = 465	Local
FW	Downstream Htr 1C-1	P = 1185 T = 465	Local
FW	Htrs 1 A-1, 1B-1, and 1C-1 Hdr	P = 1185 T = 465	Titration Room
FW	Htrs 1A-1, 1B-1, and 1C-1 Header	P = 1185 T = 465	Local
FW	Auxiliary FW Pump Hdr 1A-A	P = 1975 T = 120	Local
FW	Auxiliary FW Pump Hdr 1B-B	P = 1975 T = 120	Local
FW	Turbine Driven Auxiliary FW Pump 1A	P = 1975 T = 120	Local
Cnds	Hotwell Pumps Discharge Header	P = 350 T = 270	Titration Room
Cnds	Inlet Cond Booster Pump	P = 350 T = 270	Titration Room

Table 9.3-2 (Sheet 5 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Cnds	Outlet Heaters A-5, A-6, and A-7s	P = 350 T = 270	Local
Cnds	Outlet Heaters B-5, B-6, and B-7	P = 350 T = 270	Local
Cnds	Outlet Heaters C-5, C-6, and C-7	P = 350 T = 270	Local
Cnds	Inlet to Heaters A-4, B-4, and C-4	P = 650 T = 300	Local
Cnds	Downstream Heater A-2	P = 650 T = 410	Local
Cnds	Downstream Heater B-2	P = 650 T = 410	Local
Cnds	Downstream Heater C-2	P = 650 T = 410	Local
Cnds	Heaters A-2, B-2, and C-2 Downstream Hdr	P = 650 T = 410	Local
Cnds	Upstream MFP A and B	P = 650 T = 410	Local
Cnds	Hotwell Pump Discharge Header	P = 350 T = 270	Local
Cnds	Downstream MFPT Cond A	P = 350 T = 270	Local
Cnds	Downstream MFPT Cond B	P = 350 T = 270	Local
Cnds	Condenser Inlet Tube Sheet	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condense Inlet Tube Sheet	P = 150/30" Hg & Total Vacuum T = 140	Local

Table 9.3-2 (Sheet 6 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Cnds	Condenser Zone A Low Pressure	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condenser Zone A Low Pressure	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condenser Outlet Tube Sheet	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condenser Outlet Tube Sheet	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condenser Zone B Intermediate Pressure Crossover	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condenser Zone B Intermediate Pressure Crossover	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condensate Demineralizer Influent Header	P = 350 T = 270	Local
Cnds	Condensate Demineralizer Effluent Header	P = 350 T = 270	Local
Cnds	Outlet of Each Polisher Vessel	P = 300 T = 140	Local
Cnds	Dilute Caustic	P = 60 T = 140	Local
Cnds	Dilute Acid	P = 60 T = Ambient	Local
Cnds	Downstream Anion Tank	P = 75 T = 140	Local
Cnds	Condenser Zone C Bottom (High Pressure)	P = 150/30" Hg & Total Vacuum T = 140	Local
Ext Steam	Inlet Htrs A-1, B-1, and C-1	P = 475 T = 460	Local

Table 9.3-2 (Sheet 7 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Ext Steam	Inlet Htrs A-2, B-2, and C-2	P = 325 T = 420	Local
Ext Steam	Inlet Htrs A-3, B-3, and C-3	P = 250 T = 375	Local
Ext Steam	Inlet MST SEP Reheaters A-1, B-1, and C-1	P = 475 T = 460	Local
Ext Steam	Inlet MST SEP Reheaters A-2, B-2, and C-2	P = 475 T = 460	Local
RCW	RCW Header	P = 125 T = 130	Local
Aux Blr	*Auxiliary Deareator Tank	P = 50 T = 75	Titration Room
Aux Blr	*Continuous Blowdown (Aux Blr A)	P = 200 T = 300	Titration Room
Aux Blr	*Continuous Blowdown (Aux Blr B)	P = 200 T = 300	Titration Room
Aux Blr	*Upper Drum Stm Sample (Aux Blr A)	P = 200 T = 300	Titration Room
Aux Blr	*Upper Drum Stm Sample (Aux Blr B)	P = 200 T = 300	Titration Room
Station Drainage	*Demin Waste Sump Turbine Bldg	P = ATM T = 100	Local
CCS	Downstream Component Cooling System Heat Exchanger A	P = 150 T = 200	Local
CCS	Downstream Component Cooling System Heat Exchanger B	P = 150 T = 200	Local
CCS	Downstream Component Cooling System Heat Exchanger C	P = 150 T = 200	Local
ERCW	*Downstream CCS Heat Exchanger A	P = 160 T = 130	Local

Table 9.3-2 (Sheet 8 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
ERCW	*Downstream CCS Heat Exchanger B	P = 160 T = 130	Local
ERCW	*Downstream CCS Heat Exchanger C	P = 160 T = 130	Local
PMW	Primary Water Storage Tank	P = 150 T = 130	Local
RHR	RHR Pump 1A Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	RHR Pump 1B Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 1A	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 1B	P = 600 T = 400	Hot Sample Room
SIS	Accumulator Tanks No. 1, 2, 3, and 4	P = 700 T = 300	Hot Sample Room
SIS	Accumulator Tank Header Outlet	P = 2485 T = 650	Hot Sample Room
SIS	SIS Pump (Unit 1) Refueling Water/Minimum Flow Line	P = 1750 T = 200	Hot Sample Room
SIS	Refueling Water Storage Tank	P = 150 T = 200	Local at SFPC Refueling Water Purification Filter (Upstream)
SIS	Downstream Boron Injection Tank (Unit 1)	P = 2735 T = 200	Hot Sample Room
SIS	Upstream Boron Injection Tank (Unit 1)	P = 2735 T = 200	Hot Sample Room
Flood Mode Boration Makeup System	Downstream Auxiliary Boration Makeup System	P = 70 T = 180	Local
WLRS	Wet Layup Recirculation	P = 150 T = 200	Local

Table 9.3-2 (Sheet 9 of 9)
UNIT 1
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Gland Seal	Gland Seal water at Demineralized Water Connection	P = 100 T = 150	Local
PMW	Primary Makeup Water Pump 1A Discharge	P = 150 T = 130	Local
PMW	Primary Makeup Water Pump 1B Discharge	P = 150 T = 130	Local

*These are common plant samples

Note 1: The sample type indicates sample collection area or sample equipment.
Note 2: All samples listed for unit 1 unless noted as unit 2 or common.

Table 9.3-2 (Sheet 1 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
CVCS	Outlet Boric Acid Blender	P = 150 T = 250	Hot Sample Room
WDS	*Downstream Monitor Tank Pumps A and B (One Sample)	P = 150 T = 180	Local
CVCS	Upstream Evaporator Feed, Ion Exchanger No. 1A and 2A	P = ATM T = 150	Hot Sample Room
CVCS	Downstream Evaporator Feed, Ion Exchanger No. 1B and 2B	P = ATM T = 150	Hot Sample Room
CVCS	Volume Control Tank Vent	P = 75 T = 250	Hot Sample Room
CVCS	Inlet Mixed Bed Demineralizer	P = 200 T = 250	Hot Sample Room
CVCS	Outlet Mixed Bed Demineralizer	P = 200 T = 250	Hot Sample Room
CVCS	*CVCS Holdup Tank Recirc	P = 150 T = 200	Hot Sample Room
WDS	*Downstream Laundry Pump	P = 150 T = 180	Local
WDS	*Downstream Waste Condensate Pumps	P = 150 T = 180	Local
WDS	Waste Gas Decay Tanks Auto and Manual	P = 150 T = 180	Gas Analyzer
WDS	Spent Resin Storage Tank	P = 150 T = 180	Gas Analyzer
WDS	CVCS Holdup Tanks A & B	P = 150 T = 200	Gas Analyzer

Table 9.3-2 (Sheet 2 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
WDS	CVCS Holdup Tanks A & B	P = 150 T = 200	Gas Analyzer
WDS	RCS Pressurizer Relief Tank	P = 2485 T = 650	Gas Analyzer
WDS	CVCS Vol. Control Tank Vent	P = 75 T = 250	Gas Analyzer
WDS	Reactor Coolant Drain Tank	P = 150 T = 180	Gas Analyzer
WDS	*Chemical Drain Tank Recirculate	P = 150 T = 180	Local
WDS	*Cask Decontamination Collector Tank	P = 150 T = 180	Local
WDS	*Tritiated Drain Tank Recirculation	P = 150 T = 180	Hot Sample Room
WDS	*Floor Drain Collector Tank Recirculation	P = 150 T = 180	Hot Sample Room
RCS	Hot Leg Loop 1	P = 2485 T = 650	Hot Sample Room
RCS	Hot Leg Loop 3	P = 2485 T = 650	Hot Sample Room
RCS	Pressurizer Liquid	P = 2485 T = 680	Hot Sample Room
RCS	Pressurizer Gas	P = 2485 T = 650	Hot Sample Room
Main Steam	Steam Gen No. 1 to H.P. Turbine	P = 1185 T = 600	Titration Room
Main Steam	Steam Gen No. 1 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 2 to H.P. Turbine	P = 1185 T = 600	Local

Table 9.3-2 (Sheet 3 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Main Steam	Steam Gen No. 2 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 3 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 4 to H.P. Turbine	P = 1185 T = 600	Local
Main Steam	Steam Gen No. 1,2,3,&4 Dowcomers	P = 1185 T = 600	Hot Sample Room
Main Steam	Steam Gen Blowdown No. 1, 2, 3 & 4	P = 1185 T = 600	Hot Sample Room
Steam Generator Blowdown	Downstream of Steam Gen Blowdown Heat Exchanger	P = 1185 T = 150	Local
S.F.P.C.	*Upstream Spent Fuel Pool Demin	P = 150 T = 200	Local
S.F.P.C.	*Downstream Spent Fuel Pool Demin	P = 150 T = 200	Local
S.F.P.C.	*Refueling Water Purification Filter (Upstream)	P = 150 T = 200	Local
S.F.P.C.	*Refueling Water Purification Filter (Downstream)	P = 150 T = 200	Local
Htr Dr & V	No. 3 Htr Drain Tank	P = 250 T = 370	Local

Table 9.3-2 (Sheet 4 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Htr Dr & V	No. 7 Htr Drain Tank Pump A Discharge	P = 410 T = 180	Local
Htr Dr & V	No. 7 Htr Drain Tank Pump B Discharge	P = 410 T = 180	Local
Htr Dr & V	No. 7 Htr Drain Tank Pumps Common Discharge Header	P = 410 T = 180	Local
FW	Downstream Htr 2A-1	P = 1185 T = 465	Local
FW	Downstream Htr 2B-1	P = 1185 T = 465	Local
FW	Downstream Htr 2C-1	P = 1185 T = 465	Local
FW	Htrs 2 A-1, 2B-1, and 2C-1 Hdr	P = 1185 T = 465	Titration Room
FW	Htrs 2A-1, 2B-1, and 2C-1 Header	P = 1185 T = 465	Local
FW	Auxiliary FW Pump Hdr 2A-A	P = 1975 T = 120	Local
FW	Auxiliary FW Pump Hdr 2B-B	P = 1975 T = 120	Local
FW	Turbine Driven Auxiliary FW Pump 2A	P = 1975 T = 120	Local
Cnds	Hotwell Pumps Discharge Header	P = 350 T = 270	Titration Room

Table 9.3-2 (Sheet 5 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Cnds	Outlet Heaters A-5, A-6, and A-7s	P = 350 T = 270	Local
Cnds	Outlet Heaters B-5, B-6, and B-7	P = 350 T = 270	Local
Cnds	Outlet Heaters C-5, C-6, and C-7	P = 350 T = 270	Local
Cnds	Inlet to Heaters A-4, B-4, and C-4	P = 650 T = 300	Local
Cnds	Upstream MFP A and B	P = 650 T = 410	Local
Cnds	Hotwell Pump Discharge Header	P = 350 T = 270	Local
Cnds	Downstream MFPT Cond A	P = 350 T = 270	Local
Cnds	Downstream MFPT Cond B	P = 350 T = 270	Local

Table 9.3-2 (Sheet 6 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
Cnds	Condenser Zone A Low Pressure	P = 150/30" Hg & Total Vacuum T = 140	Local
Cnds	Condensate Demineralizer Influent Header	P = 350 T = 270	Local
Cnds	Condensate Demineralizer Effluent Header	P = 350 T = 270	Local
Cnds	Outlet of Each Polisher Vessel	P = 300 T = 140	Local
Ext Steam	Inlet Htrs A-1, B-1, and C-1	P = 475 T = 460	Local
Ext Steam	Inlet MST SEP Reheaters A-1, B-1, and C-1	P = 475 T = 460	Local
Ext Steam	Inlet MST SEP Reheaters A-2, B-2, and C-2	P = 475 T = 460	Local
RCW	RCW Header	P = 125 T = 130	Local
Aux Blr	*Auxiliary Deareator Tank	P = 50 T = 75	Titration Room
Aux Blr	*Continuous Blowdown (Aux Blr A)	P = 200 T = 300	Titration Room
Aux Blr	*Continuous Blowdown (Aux Blr B)	P = 200 T = 300	Titration Room
Aux Blr	*Upper Drum Stm Sample (Aux Blr A)	P = 200 T = 300	Titration Room
Aux Blr	*Upper Drum Stm Sample (Aux Blr B)	P = 200 T = 300	Titration Room
Station Drainage	*Demin Waste Sump Turbine Bldg	P = ATM T = 100	Local
CCS	Downstream Component Cooling System Heat Exchanger A	P = 150 T = 200	Local

Table 9.3-2 (Sheet 7 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
CCS	Downstream Component Cooling System Heat Exchanger B	P = 150 T = 200	Local
CCS	Downstream Component Cooling System Heat Exchanger C	P = 150 T = 200	Local
ERCW	*Downstream CCS Heat Exchanger A	P = 160 T = 130	Local
ERCW	*Downstream CCS Heat Exchanger B	P = 160 T = 130	Local
ERCW	*Downstream CCS Heat Exchanger C	P = 160 T = 130	Local
PMW	Primary Water Storage Tank	P = 150 T = 130	Local
RHR	RHR Pump 1A Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	RHR Pump 1B Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	RHR Pump 2A Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	RHR Pump 2B Minimum Flow Line	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 1A	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 1B	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 2A	P = 600 T = 400	Hot Sample Room
RHR	Upstream RHR Exchanger 2B	P = 600 T = 400	Hot Sample Room
SIS	Accumulator Tanks No. 1, 2, 3, and 4	P = 700 T = 300	Hot Sample Room

Table 9.3-2 (Sheet 8 of 8)
UNIT 2
PROCESS SAMPLING SYSTEM SAMPLE LOCATIONS AND DATA

Sampled System	Sample Location	Design Pressure, psig Temperature, °F	Sample Type (See Note 1)
SIS	Accumulator Tank Header Outlet	P = 2485 T = 650	Hot Sample Room
SIS	SIS Pump (Unit 1) Refueling Water/Minimum Flow Line	P = 1750 T = 200	Hot Sample Room
SIS	SIS Pump (Unit 2) Refueling Water	P = 1750 T = 200	Hot Sample Room
SIS	Refueling Water Storage Tank	P = 150 T = 200	Local at SFPC Refueling Water Purification Filter (Upstream)
SIS	Downstream Boron Injection Tank (Unit 1)	P = 2735 T = 200	Hot Sample Room
SIS	Upstream Boron Injection Tank (Unit 1)	P = 2735 T = 200	Hot Sample Room
Flood Mode Boration Makeup System	Downstream Auxiliary Boration Makeup System	P = 70 T = 180	Local
WLRS	Wet Layup Recirculation	P = 150 T = 200	Local
Gland Seal	Gland Seal water at Demineralized Water Connection	P = 100 T = 150	Local
PMW	Primary Makeup Water Pump 2A Discharge	P = 150 T = 130	Local
PMW	Primary Makeup Water Pump 2B Discharge	P = 150 T = 130	Local

*These are common plant samples

Note 1: The sample type indicates sample collection area or sample equipment.
Note 2: All samples listed for unit 2 unless noted as unit 1 or common.

TABLE 9.3-3 (Sheet 1 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel[7]	Drain Tank[8]	Comments
Reactor Vessel	Flange Leak-off	X		A	RCDT	
Pressurizer Relief Tank	Drain	X		A	RCDT Pump Suction	
Reactor Coolant Pump (Seals)	No. 2 Seal Leakoff	X[1]		A	RCDT	
	No. 3 Seal Leakoff*	X	X	A	RCDT	
Reactor Cool-ant Pump (Cooling)	Thermal Barrier Relief	X[2]	X	B or A	FDCT or TDCT via sump	
	Bearing oil cooler Pres. Relief	X	X	B or A	FDCT or TDCT via sump	
Loop Drain	Drain	X	X[4]	A	RCDT	
Volume Control Tank	Drain	X		A	TDCT	
	Pres. Relief	X		A	CVCS HUT	
Boric Acid Tank	Overflow			A	TDCT	
	Drain			A	TDCT	
Batching Tank	Drain Overflow			A	TDCT TDCT	
Regenerative HX	Shell & Tube Drain	X	X[4]	A	(FDCT or TDCT)[3] via sump	

TABLE 9.3-3 (Sheet 2 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel [7]	Drain Tank [8]	Comments
Letdown HX	Shell Drain		X	B	FDCT	
	Tube Drain	X	X[4]	A	TDCT	
Excess Let-down HX	Shell Drain		X	B	FDCT or TDCT via sump	
	Tube Drain	X	X[4]	A	FDCT or TDCT via sump	
Seal Water Hx	Shell Drain Tube Drain	 X	X X[4]	B A	FDCT TDCT	
Charging Pump	Drain	X	X[4]	A	TDCT	
Boric Acid Transfer Pump	Drain		X[4]	B	TDCT	
All CVCS Filters	Drain	X[9]	X[4]	A	TDCT	
All CVCS Resin Columns	Drain	X	X[4]	A	TDCT	
Chemical Mixing Tank	Drain	X	X	A	TDCT	
CVCS Holdup Tank	Safety Valve Relief	X		A	TDCT	
	Drain	X		A	TDCT via Sump	
Gas Stripper Feed Pump	Drain	X	X[4]	A	TDCT via Sump	
Monitor Tank	Overflow	X		A	TDCT	

TABLE 9.3-3 (Sheet 3 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel[7]	Drain Tank[8]	Comments
	Drain	X		A	TDCT	
Monitor Tank Pumps	Drain	X	X[4]	A	TDCT	
CVCS Holdup Tank Recirculation Pump	Drain	X		A	TDCT via Sump	
Reactor Coolant Pump Seal Injection Line	Drain	X	X[4]	A	FDCT or TDCT via sump	
Excess Letdown to Waste Disposal System	Drain	X		A	RCDT	
Tritiated Drain Collector Tank	Overflow Drain	X X	X X	A A	Sump Sump	
Waste Condensate Tanks	Overflow	X		B	FDCT	
Waste Condensate Tank Pump	Drain		X[4]	B	FDCT	
Reactor Coolant Drain Tanks	Overflow (or Safety Valve)	X		A	TDCT or FDCT via sump	
	Drain	X		A	TDCT or FDCT	

TABLE 9.3-3 (Sheet 4 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel [7]	Drain Tank [8]	Comments
					via RBF&ED sump	
Floor Drain Collector Tank	Overflow Drain		X X	B B	Sump Sump	
Laundry and Hot Shower Tanks	Overflow		X	B	FDCT	
Chemical Drain Tank	Drain & Over-flow	X[10]	X	B	FDCT	
CCS Pump Seal Leakage Collection Tank	Overflow Drain		X X	B B	FDCT FDCT	This is a small tank to be used for return of pump seal leakage to system
Spent Resin Storage Tank	Drain	X			TDCT	
Reagent Tanks	Drain		X	A	TDCT	
TDCT Pumps	Drain	X	X	A	Sump	
Chemical Drain Pump	Drain	X[10]	X	B	FDCT	
FDCT Pumps	Drain		X	B	Sump	
Laundry Pump	Drain		X	B	FDCT	
Reactor Coolant Drain Tank Pumps	Drain	X	X[4]	A	TDCT or FDCT via sump	
Auxiliary Waste Evaporator Feed Pumps	Drain		X	B	Sump	
Waste Package	Drains	X		A	TDCT	

TABLE 9.3-3 (Sheet 5 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

Fluid (water and)						
Component	Drain Type	Tritium	Air	Drain Channel [7]	Drain Tank [8]	Comments
Area						
TDCT Discharge Filter	Drain	X	X[4]	A	TDCT via Sump	
FDCT Discharge Filter	Drain	X	X[4]	B	FDCT via Sump	
Waste Condensate Tank Feed Filter	Drain			B	FDCT	
Waste Evap. Condensate Demineralizer	Drain	X	X	A	TDCT	
Waste Gas Compressor	Condensate HX Drain	X		A B	TDCT FDCT	Expected to be insignificant
Waste Gas Vent Header (Power)	Drain	X		A	TDCT	
Gas Decay Tank (Shut-downs)	Drain	X		A	TDCT via Sump	
Accumulator	Drain Pressure Relief Drain	X X		A A	RCDT FDCT or TDCT via Sump	Drain to RCDT
Boron Injection Tank	Drain	X	X[4]	A	TDCT	
Safety Injection Pump	Drain	X	X[4]	A	TDCT	
Containment Spray Pump	Drain	X	X[4]	A	TDCT via Sump	
Residual HX	Shell Drain CCS		X	B	FDCT	
	Tube Drain	X	X	A	TDCT	

TABLE 9.3-3 (Sheet 6 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

	Fluid (water and)					
Component	Drain Type	Tritium	Air	Drain Channel[7]	Drain Tank[8]	Comments
	RCS					
Residual Heat Removal Pumps	Drain	X	X	A	TDCT via Sump	
Component Cooling Surge Tank	Pres. Relief		X	B	FDCT	
	Overflow		X	B	FDCT	
	Drain		X	B	FDCT	
Component Cooling HX	Shell Drain		X	B	FDCT	
	Tube Drain (ERCW)			Special	Send overboard or to a floor drain	
Component Cooling Pumps	Drain		X	B	(CCST via CCS Pump SLCT) or FDCT	
Thermal Barrier Booster Pumps	Drain		X	B	Portable Container	
CCS Pump	Drain		X	B	FDCT	
SLCT & Pump	Overflow		X	B	FDCT	
Spent Fuel Pit HX	Shell Drain CCS		X	B	FDCT[5]	
	Tube Drain RCS	X	X	A	TDCT[5]	
Spent Fuel Pit Pump	Drain	X	X	A	TDCT[5]	

TABLE 9.3-3 (Sheet 7 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

Component	Drain Type	Fluid (water and) Tritium	Air	Drain Channel[7]	Drain Tank[8]	Comments
Spent Fuel Pit Skimmer Pump	Drain	X	X	A	TDCT[5]	
Refueling Water Purification Pumps	Drain	X		A	TDCT	
Refueling Water Purification Filter	Drain	X		A	TDCT	
Spent Fuel Pit Leakage	Drain	X		A	TDCT	
Spent Fuel Pit Skimmer Filter	Drain	X	X	A	TDCT	
Spent Fuel Pit Demineralizer	Drain	X	X	A	TDCT	
Radiochem. Laboratory	Spent or Treated Sample & Chem'ls	X			CDT	
	Radioactive Excess Tritiated Sample Sink Drain	X	X	A	TDCT	
	Non-Tritium Sample & Rinse Sink Drains		X	B	FDCT	
Sample Heat Exchanger	Shell Drain		X	B	FDCT[5]	
	Tube Drain	X	X	A	TDCT	

TABLE 9.3-3 (Sheet 8 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel [7]	Drain Tank [8]	Comments
	Non-Tritium Tube Drain		X		FDCT	
Sample Vessel	Drain	X	X	A	VCT	
Sample Room	Sample Sink Drain	X	X	A	TDCT	Liquid from secondary side must be re-turned to secondary side or discharged to FDCT.
	Non-Tritium		X	B	FDCT	
Floor Drain Inside Containment	Floor Drain	X	X	A	FDCT or TDCT via Sump	
Floor Drains Aux. Building	Floor Drain		X	B	FDCT	See 2.3.1 and 2.3.3.
Valve Leakoff Inside Containment	Leakoff	X		A	RCDT	
Valve Leakoff Outside Containment	Leakoff	X		A	TDCT	
	Leakoff	X	X	A	TDCT	
Hot Shower	Drain		X	B	LHSDT	
Laundry	Drain		X	B	LHSDT	
Containment Fan Coolers	Condensate Drain	X[6]	X	A	FDCT or TDCT via Sump	Service Water may be either (1) routed to a floor drain or (2) use portable container or (3) use procedure to force liquid into discharge header.
	Cooling Water Drain (ERCW)		X	Special	(Sent overboard) or (FDCT or TDCT via Sump)	

TABLE 9.3-3 (Sheet 9 of 9)

EQUIPMENT AND FLOOR DRAINAGE DATA REACTOR COOLANT SYSTEM

		Fluid (water and)				
Component	Drain Type	Tritium	Air	Drain Channel[7]	Drain Tank[8]	Comments
Gas Analyzer Drain	Drain	X		A	TDCT	
Fuel Transfer Canal Leakage	Drain	X		A	TDCT	
Primary Water Makeup Pumps	Drain				TDCT	
Liner Leakage (Reactor Bldg)	Drain	X		A	FDCT or TDCT via sump	
Cask Loading Area	Drain	X		A	TDCT	
Auxiliary Feedwater Pumps	Drain			B	FDCT	

NOTES:

1. This liquid is aerated; however, because of the small amount it is directed to the RCDT.
2. Only in abnormal case or thermal barrier leak.
3. Flush after drain if desired to reduce airborne activity levels.
4. Becomes aerated during drain.
5. Or drain to portable container and recycle to respective system.
6. If high concentration, flow can be directed to TDCT.
7. Channel A is for tritiated liquid. Channel B is for non-tritiated liquid. See Section 9.3.3.2.
8. See Section 9.3.3.7 for explanation of acronyms.
9. Drains do not contain tritium because the RCS liquid is not being recycled.
10. Only in abnormal case.

TABLE 9.3-4

CHEMICAL AND VOLUME CONTROL SYTEM DESIGN PARAMETERS

General	
Seal water supply flow rate, for four reactor coolant pumps, nominal, gpm	32
Seal water return flow rate, for four reactor coolant pumps, nominal, gpm	12
Letdown flow:	
Normal, gpm (centrifugal pump operation)	75
Maximum, gpm	120*
Charging flow (excludes seal water):	
Normal, gpm (centrifugal pump operation)	55
Maximum, gpm	100*
Temperature of letdown reactor coolant entering system at full power, °F	557.3
Normal temperature of charging flow directed to Reactor Coolant System, °F	514
Temperature of effluent directed to Mixed Bed Demineralizer, °F	127
Centrifugal charging pump bypass flow (each), gpm	60
Amount of 3.5 to 4.0% boric acid solution required to meet cold shutdown requirements at the end of a core cycle with the most reactive control rod stuck out of the core, gallons	See Figure 9.3-21 for Requirements
Maximum pressurization required for hydrostatic testing of Reactor Coolant System, psig	3107

* During RHR Shutdown Cleanup, letdown flow is qualified for 180 gpm and charging flow is qualified to 200 gpm (including seal water). Reference: Westinghouse Summary Report on the Equipment Evaluation for the Effects of an Increased Shutdown Purification Flow Rate for Watts Bar Unit 1 (LTR-SEE-05-20). The maximum allowable letdown and charging flows provide margin for volume expansion transient event mitigation. Letdown and charging piping qualified flows provide for accelerated shutdown cleanup operation only in Modes 5 and 6.

TABLE 9.3-5 (Sheet 1 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY

Centrifugal Charging Pumps

Number	2
Design pressure, psig	2800
Design temperature, °F	300
Design flow, gpm	150
Total Developed head, ft.	5800
Material	Austenitic stainless steel

Boric Acid Transfer Pumps

Number	4
Design pressure, psig	150
Design temperature, °F	250
Design flow, gpm	75
Design head, ft.	235
Material	Austenitic stainless steel

Gas Stripper Feed Pumps

Number	3
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	30
Design head, ft.	320
Material	Austenitic stainless steel

Holdup Tank Recirculation Pump

Number	1
Design pressure, psig	150
Design temperature, °F	200
Design flow, gpm	500
Design head, ft.	100
Material	Austenitic stainless steel

TABLE 9.3-5 (Sheet 2 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY (Cont'd)

Regenerative Heat Exchanger

Number	1
Heat transfer rate at design conditions, Btu/hr	10.84×10^6
Shell Side	
Design pressure, psig	2485
Design temperature, °F	650
Fluid	Borated reactor coolant
Material	Austenitic stainless steel
Tube Side	
Design pressure, psig	2735
Design temperature, °F	650
Fluid	Borated reactor coolant
Material	Austenitic stainless steel
Shell Side (Letdown)	
Normal Flow, lb/hr	37,020
Inlet temperature, °F	557.3
Outlet temperature, °F	290
Tube Side (Charging)	
Normal Flow, lb/hr	27,148
Inlet temperature, °F	130
Outlet temperature, °F	514

Letdown Heat Exchanger

Number		1
Heat transfer rate at design conditions, Btu/hr		15.27×10^6
Shell Side		
Design pressure, psig		150
Design temperature, °F		250
Fluid		Component cooling water
Material		Carbon steel
Tube Side		
Design pressure, psig		600
Design temperature, °F		400
Fluid		Borated reactor coolant
Material		Austenitic stainless steel
Shell Side	(Heat up)	(Normal)
Flow, lb/hr	498,000	203,000
Inlet temperature, °F	95	95
Outlet temperature, °F	126	126

TABLE 9.3.5 (Sheet 3 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY (Cont'd)

Letdown Heat Exchanger (Cont'd)

Tube Side (Letdown)	(Heatup)	(Normal)
Flow, lb/hr	59,232	37,050
Inlet temperature, °F	380	290
Outlet temperature, °F	126	127

Excess Letdown Heat Exchanger

Number		1
Heat transfer rate at design conditions, Btu/hr		4.79×10^6
	Shell Side	Tube Side
Design pressure, psig	150	2485
Design temperature, °F	250	650
Design flow, lb/hr	115,000	12,340
Inlet temperature, °F	95	557.3
Outlet temperature, °F	137	195
Fluid	Component cooling water	Borated reactor coolant
Material	Carbon steel	Austenitic stainless steel

Seal Water Heat Exchanger

Number	1	
Heat transfer rate at design conditions, Btu/hr	1.46×10^6	
	Shell Side	Tube Side
Design pressure, psig	150	200
Design temperature, °F	250	250
Design flow, lb/hr	99,500	47,879
Inlet temperature, °F	95	157.4
Outlet temperature, °F	109.7	127
Fluid	Component cooling water	Borated reactor coolant
Material	Carbon steel	Austenitic stainless steel

Volume Control Tank

Number	1
Volume, ft^3	400
Design pressure, psig	75
Design temperature, °F	250
Material	Austenitic stainless steel

TABLE 9.3-5 (Sheet 4 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY (Cont'd)

Boric Acid Tanks

Number	3
Capacity, gal.	11,000
Design pressure, psig	Atmospheric
Design temperature, °F	200
Material	Austenitic stainle

Boric Acid Batching Tank

Number	1
Capacity, gal.	800
Design pressure, psig	Atmospheric
Design temperature, °F	300
Material	Austenitic stainless steel

Holdup Tanks

Number	2
Capacity, gal.	126,000 (per tank)
Design pressure, psig	15
Design temperature, °F	200
Material	Stainless Steel

Chemical Mixing Tank

Number	1
Capacity, gal.	5
Design pressure, psig	150
Design temperature, °F	200
Material	Austenitic stainless steel

Mixed Bed Demineralizers

Number	2
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	120*
Resin volume, each, $ft.^3$	30
Material	Austenitic stainless steel

Cation Bed Demineralizer

Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	75
Resin volume, $ft.^3$	20
Material	Austenitic stainless steel

* Flow may be increased to 180 gpm for shutdown cleanup.

TABLE 9.3-5 (Sheet 5 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY (Cont'd)

Reactor Coolant Filter

Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150 (max.)*
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic stainless steel

Seal Water Injection Filters

Number	2
Design pressure, psig	3100
Design temperature, °F	250
Design flow, gpm	80
Particle retention	98% of 5 micron size
Material, (vessel)	Austenitic stainless steel

Seal Water Return Filter

Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150 *
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic stainless steel

Boric Acid Filters

Number	1
Design pressure, psig	300
Design temperature, °F	250
Design flow, gpm	150
Particle retention	98% of 25 micron size
Material, (vessel)	Austenitic stainless steel

* Flow may be increased to 180 gpm for shutdown cleanup.

TABLE 9.3-5 (Sheet 6 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY (Cont'd)

Letdown Orifice	Approx. 3 gpm	45 gpm(note 1)	75 gpm(note 2)
Number	1	1	2
Design flow, lb/hr	Approx. 1482	22,230	37,050
Differential pressure at design flow, psid	1900	1900	1900
Design pressure, psig	2485	2485	2485
Design temperature, °F	650	650	650
Material	Austenitic Stainless Steel	Austenitic Stainless Steel	Austenitic Stainless Steel

Seal Water Return Bypass Orifice	
Number	4
Design flow, gpm	1
Differential pressure at design flow, psid	300
Design pressure, psig	2485
Design temperature, °F	250
Material	Austenitic Stainless Steel

Chemical Mixing Tank Orifice	
Number	1
Design flow, gpm	2
Differential pressure at design flow, psid	50
Design pressure, psig	150
Design temperature, °F	200
Material	Austenitic Stainless Steel

Reactor Coolant Pump Standpipe Orifice	
Number	4
Design, flow, gpm	0.5
Differential pressure	9 inches of H_2O
Design pressure, psig	150
Design temperature, °F	200
Material	Stainless Steel

TABLE 9.3-5 (Sheet 7 of 7)

PRINCIPAL COMPONENT DESIGN DATA SUMMARY

Charging Pump Bypass Orifice

Number	2
Design flow, gpm	60
Differential pressure at design flow, psid	6000
Design pressure, psig	2800
Design temperature, °F	300
Material	Stainless Steel

Boric Acid Blender

Number	1
Design pressure, psig	150
Design temperature, °F	250
Material	Austenitic Stainless Steel

Boric Acid Tank Orifice

Number	3
Design flow, gpm	3
Differential pressure at design flow, psid	100
Design pressure, psig	150
Design temperature, °F	200
Material	Austenitic stainless steel

NOTES:
1) During preoperational testing for Unit 1, only 44.7 gpm was achieved. During preoperational testing for Unit 2, only 41.5 gpm was achieved.
2) During preoperational testing for Unit 1, one (1) orifice only achieved 69.3 gpm. During preoperational testing for Unit 2, the two 75 gpm orifices only achieved 73.3 gpm and 72.4 gpm respectively.

TABLE 9.3-6

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TABLE 9.3-7 (Sheet 1 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
1.	ACAS Compressor Intake Filter 0-FLTR-32-60	Filters Air Prior to compressor	None	None	None	None	None	No active failures for 0-FLTR-32-60
2.	Auxiliary Compressor 0-COMP-32-60	Provide required pressure and flow to essential loads due to loss of CAS supply	Fails to start	Control/Mechanical failure	Pressure indication VIA PI-32-62, -66, and/or -1000.	Loss of Train "A"	None Train "B" available to provide for safe shutdown.	
			Unloader fails (FSV-32-62)	Control/Mechanical failure	Relief valves 0-32-366, -367, and/or -372 relieve at pressure >115 psig. If compressor fails to load low pressure indicated via PI-32-62, -66, and/or -1000.	Loss of Train "A"	None Train "B" available to provide for safe shutdown.	
			Cooling water failure	Control/Mechanical failure	High air temperature alarm via 0-TS-32-64	Loss of cooling water to compressor will cause failure of compressor due to high temperature	None Train "B" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 2 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
3.	After cooler 0-HTX-32-60	Remove the heat of compression from the auxiliary control air.	Tube rupture	Mechanical failure	High moisture alarm via ME-32-83	High moisture would cause saturation of the air dryers and degradation loss of Train "A"	None Train "B" available to provide for safe shutdown	
			Cooling water failure	Control/Mechanical failure	High temperature indication via 0-TI-32-65 if failure is just to after cooler supply. Also, high temperature alarm via 0-TS-32-64 if entire cooling water supply disrupted.	High system Temperatures resulting in possible system degradation.	None Train "B" available to provide for safe shutdown.	
4.	Compressor Accumulator 0-ACUM-32-60	Dampen compressor discharge pressure pulses and provide sufficient air volume (in conjunction with the receivers) to minimize compressor starts/stops and unloading/loading cycles	None	None	None	None	None	No active failure for the accumulator

TABLE 9.3-7 (Sheet 3 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
5.	Check valve 0-32-240	Prevents backflow of air from the receiver back to the compressor	Fails open	Mechanical failure	Low receiver pressure indication via PI-32-66. Compressor running longer than normal.	Compressor will cycle more often in order to maintain receiver pressure	None	
			Fails closed	Mechanical failure	Low receiver pressure indicated via PI-32-66 without any resultant pressure increase due to compressor operation.	Reduction of system pressure until too low for user operation. Loss of Train "A"	None Train "B" available to provide for safe shutdown.	
6.	Auxiliary Air Receiver 0-RCVR-32-62	Dampen compressor pressure pulses and provide a sufficient stored air volume to minimize startups and load/unload cycling of the ACAS compressors.	None	None.	None	None	None	No active failures for the receiver.
7.	Isolation valve 0-32-246	To isolate the CAS supply from the inlet to the ACAS air dryers.	None	None	None	None	None	No active failure for 0-32-246.

TABLE 9.3-7 (Sheet 4 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
8.	Flow control valve to Air Dryer No. 1 0-FCV-32-71	To regulate inlet air flow to dryer No. 1	Fails open	Control/Mechanical failure	No switching to Dryer No. 2 flowpath as indicated by PI-32-74 and -75 along with possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switch over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation	None Train “B” available to provide for safe shutdown	When the A-A ACAS Compressor’s NOT running, the 0-FCV-32-70 & -71 valves are manually positioned (one OPEN, one CLOSED). Upon A-A ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 5 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Fails closed	Control/Mechanical failure	Continual flow through dryer No. 2 flowpath as indicated by PI-32-74 and -75 along with possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switch over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation. Fail closed position will also result in low header pressure which will alarm in the MCR via 0-PS-32-0104.	None Train "B" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 6 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
9.	Flow Control Valve to Air Dryer No. 2 0-FCV-32-70	To regulate inlet air flow to Dryer No. 2	Fails open	Control/Mechanical failure	No switchover to Dryer No. 1 flowpath as indicated by PI-32-74 and -75 along with possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switchover to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation.	None Train “B” available to provide for safe shutdown.	When the A-A ACAS Compressor is NOT running, the 0-FCV-32-70 & -71 valves are manually positioned (one OPEN, one CLOSED). Upon A-A ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 7 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Fails closed.	Control/Mechanical failure	Continual flow through Dryer No. 1 flowpath as indicated by PI-32-74 and -75 along with possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switch-over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation. Fail closed position will also result in low header pressure which will alarm in the MCR via 0-PS-32-0104.	None Train "B" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 8 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
10.	Flow Control Valve for Dryer No. 1 purge flow 0-FCV-32-72	Provides flow path for backflow of air for drying the desiccant in Dryer No. 1 when not in operation	Fails open	Control/Mechanical Failure	Switchover will not occur due to electrical interlock which can be determined by pressure indications on PI-32-74 & -75 and possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switchover to Dryer No. 2 high moisture levels could occur as indicated via alarm at Annunciator Window 136-C on 1-XA-55-6D.	None Train "B" available to provide for safe shutdown.	When the A-A ACAS Compressor is NOT running, the 0-FCV-32-72 & -73 valves are manually positioned (one OPEN, one CLOSED). Upon A-A ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 9 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
			Fails closed	Control/Mechanical Failure	No purge flow through Dryer No. 1 or switchover to Dryer No. 2 which can be determined by pressure indications on PI-32-74 and -75 and possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switchover to Dryer No. 2 high moisture levels could occur as indicated via alarm at Annunciator Window 136-C on 1-XA-55-6D.	None Train "B" available to provide for safe shutdown.	
10a.	Flow control valve for Dryer No. 2 purge flow 0-FCV-32-73	Provides flow path for back flow of air for drying the desiccant in Dryer No. 2 when not in operation.	Fails open	Control/Mechanical Failure	Switchover will not occur due to electrical interlock which can be determined by pressure indications on PI-32-74 and -75 and possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switchover to Dryer No. 1 high moisture levels could occur as indicated via alarm at Annunciator Window 136-C on 1-XA-55-6D.	None Train "B" available to provide for safe shutdown.	When the A-A ACAS Compressor is NOT running, the 0-FCV-32-72 & -73 valves are manually positioned (one OPEN, one CLOSED). Upon A-A ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 10 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Fails closed	Control/Mechanical Failure	No purge flow through Dryer No. 2 or switchover to Dryer No. 1 which can be determined by pressure indications on PI-32-74 and -75 and possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	Without switchover to Dryer No. 1 high moisture levels could occur as indicated via alarm at Annunciator Window 136-C on 1-XA-55-6D.	None Train "B" available to provide for safe shutdown.	
11.	Dryer No. 1 0-DRYR-32-75	Reduce the moisture content of the air to a dew point of -40°F at line pressure and design flow for air usage.	None	None	None	None	None	No active failures for 0-DRYR-32-75
12.	Dryer No. 2 0-DRYR-32-74	Reduce the moisture content of the air to a dew point of -40°F at line pressure and design flow for air usage.	None	None	None	None	None	No active failures for 0-DRYR-32-74
13.	Dryer No. 1 purge check valve 0-CKV-32-70B	Prevent backflow through the dryer purge line when dryer No. 1 is in service	Stuck open	Mechanical failure	Reduced air header pressure as indicated by PT-32-104 due to loss of air through Dryer No. 2 purge when Dryer No. 1 is in service.	Reduced header pressure resulting in more frequent cycling of ACAS compressor "A". Possible reduction of pressure below minimum operating.	None Train "B" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 11 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
		Allow backflow through the dryer purge line when Dryer No. 2 is in service.	Stuck closed	Mechanical failure	No flow indicated via FI-32-76 for purge flow when Dryer No. 2 is in service. Also, possible alarm via Annunciator Window 136-C on 1-XA-55-6D when Dryer No. 1 is in service.	Possible high moisture levels when Dryer No. 1 is in service due to no backflow when Dryer No. 2 is in operation. Potential for high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	None Train "B" available to provide for safe shutdown.	
14.	Dryer No. 2 Purge check valve 0-CKV-32-70A	Prevent backflow through the dryer purge line when Dryer No. 2 is in service	Stuck open	Mechanical failure	Reduced air header pressure as indicated by PT-32-104 due to loss of air through Dryer No. 1 purge when Dryer No. 2 is in service.	Reduced header pressure resulting in more frequent cycling of ACAS Compressor A. Possible reduction of pressure below minimum operating.	None Train "B" available to provide for safe shutdown	

TABLE 9.3-7 (Sheet 12 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
		Allow backflow through the dryer purge line when Dryer No. 1 is in service.	Stuck closed	Mechanical failure	No flow indicated via FI-32-76 for purge flow when Dryer No. 1 is in service. Also, possible alarm via Annunciator Window 136-C on 1-XA-55-6D when Dryer No. 2 is in service.	Possible high moisture levels when Dryer No. 2 is in service due to no backflow when Dryer No. 1 is in operation. Potential for high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D.	None Train “B” available to provide for safe shutdown.	
15.	Dryer No. 1 flowpath check valve 0-CKV-32-70D	Prevents backflow through Dryer No. 1 flowpath (except for purge flow) when Dryer No. 2 is in service.	Stuck open	Mechanical failure	When Dryer No. 2 is in service, air system pressure would drop as indicated via 0-PT-32-104 alarm and PI-32-75 indication.	Reduced system pressure would cause more frequent compressor “A” cycling. Possible reduction of system pressure below minimum operating.	None Train “B” available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 13 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
			Stuck closed	Mechanical failure	When Dryer No. 1 is in service there would be no purge flow to Dryer No. 2 and no flow to the system; therefore, FI-32-76 and PT-32-104 would give indication of no purge flow and a drop in system pressure. Possible high moisture alarm via Annunciator Window 136-C on 1-XA-55-6D when Dryer No. 2 is in service.	Reduced system pressure and high moisture contents in Dryer No. 2 due to lack of purge flow.	None Train "B" available to provide for safe shutdown.	
16.	Dryer No. 2 flowpath check valve 0-CKV-32-70C	Prevents backflow through Dryer No. 2 flowpath (except for purge flow) when Dryer No. 1 is in service.	Stuck open	Mechanical failure	When Dryer No. 1 is in service, air system pressure would drop as indicated via 0-PT-32-104 alarm and PI-32-74 indication.	Reduced system pressure would cause more frequent compressor "A" cycling. Possible reduction of system pressure below minimum operating.	None Train "B" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 14 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Stuck closed	Mechanical failure	When Dryer No. 2 is in service there would be no purge flow to Dryer No. 1 and no flow to the system; therefore, FI-32-76 and PT-32-104 would give indication of no purge flow and a drop in system pressure. Possible high via Annunciator Window 136-C on 1-XA-55-6D moisture alarm when Dryer No. 1 is in service.	Reduced system pressure and high moisture contents in Dryer No. 1 due to lack of purge flow.	None Train "B" available to provide for safe shutdown.	
17.	Dryer after filter 0-FLTR-32-76	Filter out 100% of particles of desiccant and other foreign matter down to 0.9 micron size	None	None	None	None	None	No active failure for 0-FLTR-32-76.
18.	Dryer Isolation Valve 0-32-249	Isolates dryer unit from air header.	None	None	None	None	None	No active failure for 0-32-249
19.	ACAS Inlet filter 0-FLTR-32-82	Filter CAS air entering the ACAS during normal operation	None	None	None	None	None	No active failure for 0-32-82

TABLE 9.3-7 (Sheet 15 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
20.	ACAS Isolation Valve 0-FCV-32-82	Isolates ACAS from CAS supply on low control air pressure	Stuck open	Control/Mechanical failure	Valve position indication	ACAS compressor "A" will take control of ACAS in the case of low CAS pressure, therefore, with 0-FCV-32-82 stuck open, check valve 0-32-256 will prevent back flow with no effect on Train "A" operation	None	
			Stuck closed	Control/Mechanical failure	Valve position indication	ACAS Compressor "A" will take control of ACAS; therefore, Train "A" will not be effected.	None	
21.	ACAS Backflow Check Valve 0-32-256	Prevents flow from ACAS back to CAS	Stuck open	Mechanical failure	None	0-FCV-32-82 will cycle to maintain system pressure and isolate any backflow; therefore, Train "A" will not be effected	None	

TABLE 9.3-7 (Sheet 16 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Stuck closed	Mechanical failure	None	ACAS Compressor “A” will supply Train “A”; therefore, no effect on Train “A” operation	None	
22.	CAS Isolation Valve 0-32-251	Bypasses CAS around ACAS air dryers	None	None	None	None	None	No active failure for 0-32-251.
23.	Moisture element (ME-32-83) inlet isolation valve 0-32-252	Isolates inlet of ME-32-83 for maintenance	None	None	None	None	None	No active failure for 0-32-252.
24.	Moisture element (ME-32-83) outlet isolation valve 0-32-253	Isolates outlet of ME-32-83 for maintenance	None	None	None	None	None	No active failure for 0-32-253
25.	Moisture element (ME-32-83) bypass valve 0-32-254	Isolates ME-32-83 for bypass	None	None	None	None	None	No active failure for 0-32-254

TABLE 9.3-7 (Sheet 17 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
26.	Control air check valve 0-32-380 for 1-LCV-3-172 and -175 backflow	Prevents loss of air pressure in piping to ensure operation in the event of loss of air header pressure	Fails open	Mechanical failure	No position change indication for 1-LCV-3-172 and -175 in control room via HS-3-172A and -175A.	Unable to operate SG level control valves 1-LCV-3-172 and -175 on loss of header pressure. No effect with full header pressure	None Valves 1-LCV-3-173 and -174 operable in Train “B”	
			Fails closed	Mechanical failure	Unable to cycle valves 1-LCV-3-172 and -175 as indicated on control room hand switches HS-3-172A and -175A.	Valves 1-LCV-3-172 and -175 inoperable	None Valves 1-LCV-3-173 and -174 operable in Train “B”	
27.	Train “A” Containment Isolation Valve 1-FCV-32-80	Isolate containment on low air pressure or containment isolation signal	Fails open	Control/Mechanical failure	Valve position indication via 1-HS-32-80A	None Check 1-32-303 provides containment isolation backup	None	

TABLE 9.3-7 (Sheet 18 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
					TRAIN A			
			Fails closed	Control/Mechanical failure	Valve position indication via 1-HS-32-80A	Pressurizer spray valves not operable, however, these will not effect Train "A" safety function.	None While Train "A" spray valves will be inoperable, the Train "A" components required for safe shutdown are still available. Train "B" spray valves operable for plant operation.	
28.	Containment Isolation Valve (1-FCV-32-80) Inlet Isolation Valve 1-32-297	Isolates Inlet to 1-FCV-32-80 for maintenance.	None	None	None	None	None	No active failure mode for 1-32-297
29.	Containment Isolation Valve (1-FCV-32-80) Outlet Isolation Valve 1-32-301	Isolates Outlet to 1-FCV-32-80 for maintenance	None	None	None	None	None	No active failure mode for 1-32-301
30.	Containment Isolation Valve (1-FCV-32-80) Bypass Valve 1-32-298	Isolates 1-FCV-32-80 Bypass	None	None	None	None	None	No active failure mode for 1-32-298

TABLE 9.3-7 (Sheet 19 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A				
31.	Containment Isolation Check Valve 1-32-303	Provide containment isolation as a backup for 1-FCV-32-80	Fails open	Mechanical failure	None	None 1-FCV-32-80 would provide containment isolation	None	
			Fails closed	Mechanical failure	Pressurizer spray valve 1-PCV-68-340D position indication via 1-HS-340	Safety function not effected, however, spray valve inoperable	None Train “A” components required for safe shutdown are still available and Train “B” spray valve 1-PCV-68-340B is operable	
32.	Isolation valve 0-32-385	Isolation air supply to system 65 dampers and valves	None	None	None	None	None	No active failure for 0-32-385
74.	Dryer Discharge Check Valve 0-CKV-32-1316	Open to provide flowpath - See Remarks	Fail Closed	Mechanical Failure	Low pressure indicated on 0-PT-32-104 due to loss of air while in service	Reduction of system pressure until too low for user operation. Loss of train “A”.	None. Train “B” available to provide for safe shutdown.	Check valve 0-CKV-32-1316 added to allow a future air supply to be tied into the

TABLE 9.3-7 (Sheet 20 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A								
			Fails Open	Mechanical Failure	None	None	None	system while in service. The current function is to open while the system is in this configuration. After the new air supply is tied in, the function of this valve will be to prevent backflow from the header.
75.	ACAS Dryer Isolation Valve 0-32-635	Isolate dryer unit from air header	None	None	None	None	None	No active failure for 0-32-635

TABLE 9.3-7 (Sheet 21 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
37.	ACAS Compressor Intake Filter 0-FLTR-32-86	Filters air prior to compressor	None	None	None	None	None	Non active failure for 0-FLTR-32-86
38.	Auxiliary Compressor 0-COMP-32-86	Provide required pressure and flow to essential loads due to loss of CAS supply	Fails to start	Control/Mechanical failure	Pressure indication via PI-32-88, -89, and/or-1100	Loss of Train "B"	None Train "A" available to provide for safe shutdown	
			Unloader fails (FSV-32-88)	Control/Mechanical failure	Relief valves 0-32-368, -391, and/or -369 relieve at pressure >115 psig. If compressor fails to load low pressure indicated via PI-32-88, -89, and/or -1100	Loss of Train "B"	None Train "A" available to provide for safe shutdown	
			Cooling water failure	Control/Mechanical failure	High air temperature alarm via 0-TS-32-91	Loss of cooling water to compressor will cause failure of compressor due to high temperature.	None Train "A" available to provide for safe shutdown	
39.	After cooler 0-HTX-32-86	Remove the heat of compression from the auxiliary control air	Tube rupture	Mechanical failure	High moisture alarm via ME-32-84	High moisture would cause saturation of air dryers and degradation of Train "B"	None Train "A" available to provide for safe shutdown	

TABLE 9.3-7 (Sheet 22 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			TRAIN B					
			Cooling water failure	Control/Mechanical failure	High temperature indication via 0-TI-32-92 if failure is just to after cooler supply. Also, high temperature alarm via 0-TS-32-91 if entire cooling water supply disrupted.	High system temperatures resulting in possible system degradation	None Train "A" available to provide for safe shutdown.	
40.	Compressor Accumulator 0-ACUM-32-86	Dampen compressor discharge pressure pulses and provide sufficient air volume (in conjunction with the receivers) to minimize compressor starts/stops and unloading/loading cycles	None	None	None	None	None	No active failures for the accumulators
41.	Check valve 0-32-279	Prevents backflow of air from the receiver back to the compressor	Fails open	Mechanical failure	Low receiver pressure indication via PI-32-89. Compressor running longer than normal	Compressor will cycle more often in order to maintain receiver pressure	None	

TABLE 9.3-7 (Sheet 23 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
			Fails closed	Mechanical failure	Low receiver pressure indicated via PI-32-89 without any resultant pressure increase due to compressor operation.	Reduction of system pressure until too low for user operation. Loss of Train “B”	None Train “A” capable of carrying entire system load.	
42.	Auxiliary Air Receiver 0-RCVR-32-88	Dampen compressor pressure pulses and provide a sufficient stored air volume to minimize startups and load/unload cycling of the ACAS compressors.	None	None	None	None	None	No active failures for the receiver.
43.	Isolation Valve 0-32-275	To isolate the CAS supply from the inlet to the ACAS air dryers.	None	None	None	None	None	No active failure for 0-32-275

TABLE 9.3-7 (Sheet 24 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
44.	Flow control valve to Air Dryer No. 1 0-FCV-32-95	To regulate air flow to Dryer No. 1	Fails open	Control/Mechanical failure	No switchover to Dryer No. 2 flowpath as indicated by PI-32-99 and -100 along with possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch-over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation	None Train “A” available to provide for safe shutdown.	When the B-B ACAS Compressor is NOT running, the 0-FCV-32-94 & -95 valves are manually positioned (one OPEN, one CLOSED). Upon B-B ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 25 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
			Fails closed	Control/Mechanical failure	Continual flow through Dryer No. 2 flowpath as indicated by PI-32-99 and -100 along with possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch-over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation Fail closed position will also result in low header pressure which will alarm in the MCR via 0-PS-32-0105.	None Train “A” available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 26 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
45.	Flow control valve to Air Dryer No. 2 0-FCV-32-94	To regulate inlet air flow to Dryer No. 2	Fails open	Control/Mechanical failure	No switchover to Dryer No. 1 flowpath as indicated by PI-32-99 and -100 along with possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation.	None Train "A" available to provide for safe shutdown.	When the B-B ACAS Compressor is NOT running, the 0-FCV-32-94 & -95 valves are manually positioned (one OPEN, one CLOSED). Upon B-B ACAS Compressor start, control logic returns these valves to normal automatic operation.

TABLE 9.3-7 (Sheet 27 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
			Fails closed	Control/Mechanical failure	Continual flow through Dryer No. 1 flowpath as indicated by PI-32-99 and -100 along with possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch-over to the other dryer, the moisture will begin to carry over until the high moisture alarm sounds thus causing potential system high moisture levels and degradation Fail closed position will also result in low header pressure which will alarm in the MCR via 0-PS-032-0105.	None Train “A” available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 28 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
46.	Flow control Valve for Dryer No. 1 Purge Flow 0-FCV-32-96	Provides flow path for backflow of air for drying the desiccant in Dryer No. 1 when not in operation	Fails open	Control/Mechanical failure	Switchover will not occur due to electrical interlock which can be determined by pressure indications on PI-32-99 and -100 and possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D	Without switch-over to Dryer No. 2 high moisture levels could occur as indicated via alarm at Annunciator Window 137-C on 1-XA-55-6D	None Train "A" available to provide for safe shutdown	When the B-B ACAS Compressor is NOT running, the 0-FCV-32-96 & -97 valves are manually positioned (one OPEN, one CLOSED). Upon B-B ACAS Compressor start, control logic returns these valves to normal automatic operation.
			Fails closed	Control/Mechanical failure	No purge flow through Dryer No. 1 or switch over to Dryer No. 2 which can be determined by pressure indications on PI-32-99 and -100 and possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch-over to Dryer No. 2 high moisture levels could occur as indicated via alarm at Annunciator Window 137-C on 1-XA-55-6D.	None Train "A" available to provide for safe shutdown	

TABLE 9.3-7 (Sheet 29 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
46a.	Flow control Valve for Dryer No. 2 Purge Flow 0-FCV-32-97	Provides flow path for backflow of air for drying the desiccant in Dryer No. 2 when not in operation	Fails open	Control/Mechanical failure	Switch over will not occur due to electrical interlock which can be determined by pressure indications on PI-32-99 and -100 and possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch-over to Dryer No. 1 high moisture levels could occur as indicated via alarm at Annunciator Window 137-C on 1-XA-55-6D.	None Train "A" available to provide for safe shutdown	When the B-B ACAS Compressor is NOT running, the 0-FCV-32-96 & -97 valves are manually positioned one OPEN, one CLOSED). Upon B-B ACAS Compressor start, control logic returns these valves to normal automatic operation.
			Fails closed	Control/Mechanical failure	No purge flow through Dryer No. 2 or switchover to Dryer No. 1 which can be determined by pressure indications on PI-32-99 and -100 and possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	Without switch over to Dryer No. 1 high moisture levels could occur as indicated via alarm at Annunciator Window 137-C on 1-XA-55-6D.	None Train "A" available to provide for safe shutdown	

TABLE 9.3-7 (Sheet 30 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
47.	Dryer No. 1, 0-DRYR-32-100	Reduce the moisture content of the air to a dew point of -40°F at line pressure and design flow for air usage	None	None	None	None	None	No active failure for 0-DRYR-32-100
48.	Dryer no. 2, 0-DRYR-32-99	Reduce the moisture content of the air to a dew point of -40°F at line pressure and design flow for air usage	None	None	None	None	None	No active failure for 0-DRYR-32-99
49.	Dryer No. 1 Purge Check Valve 0-CKV-32-94B	Prevent backflow through the dryer purge line when Dryer No. 1 is in service	Stuck open	Mechanical failure	Reduced air header pressure as indicated by PT-32-105 due to loss of air through Dryer No. 2 purge when Dryer No. 1 is in service.	Reduced header pressure resulting in more frequent cycling of ACAS compressor "B". Possible, reduction of pressure below minimum operating.	None Train "A" available to provide for safe shutdown.	

TABLE 9.3-7 (Sheet 31 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
		Allow backflow through the dryer purge line when Dryer No. 2 is in operation.	Stuck closed	Mechanical failure	No flow indicated via FI-32-101 for purge flow when Dryer No. 2 is in service. Also, possible alarm via Annunciator Window 137-C on 1-XA-55-6D when Dryer No. 1 is in service.	Possible high moisture levels when Dryer No. 1 is in service due to no backflow when Dryer No. 2 is in operation. Potential for high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	None If Train "A" available to provide for safe shutdown	
50.	Dryer No. 2 Purge Check Valve 0-CKV-32-94A	Prevent backflow through the dryer merge line when Dryer No. 2 is in service	Stuck open	Mechanical failure	Reduced air header pressure as indicated by PT-32-105 due to loss of air through Dryer No. 1 purge when Dryer No. 2 is in service	Reduced header pressure resulting in more frequent cycling of ACAS compressor "B". Possible, reduction of pressure below minimum operating.	None Train "A" available to provide for safe shutdown	

TABLE 9.3-7 (Sheet 32 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
		Allow backflow through the dryer purge line when Dryer No. 1 is in service.	Stuck closed	Mechanical failure	No flow indicated via FI-32-101 for purge flow when Dryer No. 1 is in service. Also, possible alarm via Annunciator Window 137-C on 1-XA-55-6D when Dryer No. 2 is in service	Possible high moisture levels when Dryer No. 2 is in service due to no backflow when Dryer No. 1 is in operation. Potential for high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D.	None If Train “A” available to provide for safe shutdown	
51.	Dryer No. 1 Flow path Check Valve 0-CKV-32-94D	Prevents backflow through Dryer No. 1 flowpath (except for purge flow when Dryer No. 2 is in service)	Stuck open	Mechanical failure	When Dryer No. 2 is in service, air system pressure would drop as indicated via 0-PT-32-105 alarm and PI-32-100	Reduced system pressure would cause more frequent compressor “B” cycling. Possible reduction of system pressure below minimum operating.	None Train “A” available too provide for safe shutdown	

TABLE 9.3-7 (Sheet 33 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
			Stuck closed	Mechanical failure	When Dryer No. 1 is in service, there would be no purge flow to Dryer No. 2 and no flow to the system, therefore, FI-32-101 and PT-32-105 would give indications of no purge flow and drop in system pressure respectively. Possible high moisture alarm via Annunciator Window 137-C on 1-XA-55-6D when Dryer No. 2 is in service.	Reduced system pressure and high moisture content in Dryer No. 2 due to lack of purge flow.	None Train "A" available to provide for safe shutdown.	
52.	Dryer No. 2 Flowpath Check Valve 0-CKV-32-94C	Prevents backflow through Dryer No. 2 flowpath (except for purge flow) when Dryer No. 1 is in service	Stuck open	Mechanical failure	When Dryer No. 1 is in service, air system pressure would drop as indicated via 0-PT-32-105 alarm and PI-32-99 indication	Reduced system pressure would cause more frequent compressor "B" cycling. Possible reduction of system pressure below minimum operating	None Train "A" available too provide for safe shutdown	

TABLE 9.3-7 (Sheet 34 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
			Stuck closed	Mechanical failure	When Dryer No. 2 is in service, there would be no purge flow to Dryer No. 1 and no flow to the system, therefore, FI-32-101 and PT-32-105 would give indications of no purge flow and drop in system pressure. Possible high via Annunciator Window 137-C on 1-XA-55-6D moisture alarm when Dryer No. 1 is in service.	Reduced system pressure and high moisture content in Dryer No. 1 due to lack of purge flow.	None Train “A” available to provide for safe shutdown.	
53.	Dryer After filter 0-FLTR-32-101	Filter out 100% of particles of desiccant and other foreign matter down to 0.9 micron size	None	None	None	None	None	No active failure for 0-FLTR-32-101
54.	Dryer Isolation Valve 0-32-270	Isolates dryer unit from air header	None	None	None	None	None	No active failure for 0-32-270

TABLE 9.3-7 (Sheet 35 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
55.	ACAS Inlet Filter 0-FLTR-32-85	Filter CAS air entering the ACAS during normal operation	None	None	None	None	None	No active failure for 0-FLTR-32-85
56.	ACAS Isolation Valve 0-FCV-32-85	Isolates ACAS from CAS supply on low control air pressure	Stuck open	Control/Mechanical failure	Valve position indication	ACAS Compressor “B” will take control of ACAS in the case of low CAS pressure; therefore, with 0-FCV-32-85 stuck open, check valve 0-32-264 will prevent backflow with no effect on Train “B” operation.	None	
			Stuck closed	Control/Mechanical failure	Valve position indication	ACAS Compressor “B” will take control of ACAS; therefore, Train “B” will not be effected.	None	

TABLE 9.3-7 (Sheet 36 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
57.	ACAS Backflow Check Valve 0-32-264	Prevents flow from ACAS back to CAS	Stuck open	Mechanical failure	None	0-FCV-32-85 will cycle to maintain system pressure and isolate any backflow, therefore, Train “B” will not be effected.	None	
			Stuck closed	Mechanical failure	None	ACAS Compressor “B” will supply Train “B”; therefore, no effect on Train “B” operation.	None	
58.	CAS Isolation Valve 0-32-265	Bypasses CAS around ACAS air dryers.	None	None	None	None	None	No active failure for 0-32-265
59.	Moisture Element (ME-32-84) Inlet Isolation Value 0-32-268	Isolates Inlet of ME-32-84 for maintenance	None	None	None	None	None	No active failure for 0-32-268
60.	Moisture Element (ME-32-84) Outlet Isolation Value 0-32-269	Isolates Outlet of ME-32-84 for maintenance	None	None	None	None	None	No active failure for 0-32-269
61.	Moisture Element (ME-32-84) Bypass Valve 0-32-266	Isolates ME-32-84 Bypass	None	None	None	None	None	No active failure for 0-32-266

TABLE 9.3-7 (Sheet 37 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
62.	Control Air Check Valve 0-32-407 for 1-LCV-3-173 and -174 Backflow Control Air Check Valve 0-32-407	Prevents loss of air pressure in piping to ensure operation in the event of loss of air header pressure.	Fails open	Mechanical failure	No position change indicated for 1-LCV-3-173 and -174 in control room via HS-3-173A and -174A.	Unable to operate SG level control valves 1-LCV-3-173 and -174 on loss of header pressure. No effect with full header pressure.	None Valves 1-LCV-3-172 and -175 operable in train “A”.	
			Fails closed	Mechanical failure	Unable to cycle valves 1-LCV-3-173 and -174 as indicated on control room hand switches HS-3-173A and -174A.	Valves 1-LCV-3-173 and -174 inoperable.	None Valves 1-LCV-3-172 and -175 operable in Train “A”.	
63.	Train “B” Containment Isolation Valve 1-FCV-32-102	Isolate containment on low air pressure or containment isolation signal.	Fails open	Control/Mechanical failure	Valve position indication via 1-HS-32-102A.	None Check valve 1-32-313 provides containment isolation as a backup.	None	

TABLE 9.3-7 (Sheet 38 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			TRAIN B					
			Fails closed	Control/Mechanical failure	Valve position indication via 1-HS-32-102A	Pressurizer spray valves not operable; however, these will not affect train "B" the safety function.	None While train "B" spray valves will be inoperable, the train "B" safety functions are still available. Train "B" spray valves operable for plant operation.	
64.	Containment Isolation Valve (1-FCV-32-102) Inlet isolation Valve 1-32-307	Isolate inlet to 1-FCV-32-102 for maintenance	None	None	None	None	None	No active failure mode for 1-32-307
65.	Containment Isolation Valve (1-FCV-32-102) Outlet Isolation Valve 1-32-311	Isolates outlet to 1-FCV-32-102 for maintenance	None	None	None	None	None	No active failure mode for 1-32-311
66.	Containment Isolation Valve (1-FCV-32-102) Bypass Valve 1-32-308)	Isolates 1-FCV-32-102 bypass	None	None	None	None	None	No active failure mode for 1-32-308

TABLE 9.3-7 (Sheet 39 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B								
67.	Containment Isolation Check Valve 1-32-313	Provide containment isolation as a backup for 1-FCV-32-102.	Fails open	Mechanical failure	None	None 1-FCV-32-102 would provide containment isolation.	None	
			Fails closed	Mechanical failure	Pressurizer spray valve 1-PCV-68-340B position indication via 1-HS-340.	Safety function not effected; however, spray valve inoperable.	None Train "B" safety functions operable and train "A" spray valve 1-PCV-68-340D operable.	
68.	Isolation Valve 0-32-413	Isolates air supply to system 65 dampers and valves	None	None	None	None	None	No active failure for 0-32-413

TABLE 9.3-7 (Sheet 40 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B				
76.	Dryer Discharge Check Valve 0-CKV-32-1317	Open to provide flowpath - See remarks.	Fail Closed	Mechanical Failure	Low pressure indicated on 0-PT-32-105 due to loss of air while in service.	Reduction of system pressure until too low for user operation. Loss of train “B”.	None Train “A” available to provide for safe shutdown.	Check valve 0-CKV-32-1317 added to allow a future air supply to be tied into the system while in service. The current function is to open while the system is in this configuration. After the new air supply is tied in, the function of this valve will be to prevent backflow from the header.
			Fail Open	Mechanical Failure	None	None	None	
77.	ACAS Dryer Isolation Valve 0-32-637	Isolate dryer unit from air header	None	None	None	None	None	Non active failure for 0-32-637

TABLE 9.3-7 (Sheet 41 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				CAS				
73.	Control Air System Containment Isolation Valve 1-FCV-32-110	Isolate containment on the non-safety portion of Control Air on a low pressure signal or containment isolation signal.	Fails open	Control/Mechanical failure	Valve position indication via 1-HS-32-110A	None Check valve 1-32-293 provides containment isolation backup. Manual isolation of an upstream valve can also provide containment isolation or by turning off the non-safety related control air compressors by removing breakers. See remarks.	None	The line inside containment downstream of check valve 1-32-293 is not protected from a HELB. The check valve will allow flow to enter containment with a single failure of 1-FCV-32-110. Action is required to manually isolate valve 0-ISV-32-4105. If manual action is unsuccessful, the non-accident unit should be shutdown, then breakers shall be removed to stop the non-safety related compressors.
			Fails closed	Control/Mechanical failure	Valve position indication via 1-HS-32-110A.	Non-safety air loads inside containment not available.	None	

TABLE 9.3-7 (Sheet 42 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A (UNIT 2)								
74.	Control Air check Valve 0-32-386 for 2-LCV-3-172 and -175 Backflow	Prevents loss of air pressure in piping to ensure operation in the event of loss of air header pressure	Fails open	Mechanical failure	No position change indicated for 2-LCV-3-172 and -175 in control room via 2-HS-3-172A and -175A	Unable to operate SG level control valves 2-LCV-3-172 and -175 on loss of header pressure. No effect with full header pressure.	None. Valves 2-LCV-3-173 and -174 operable in Train “B”	
			Fails closed	Mechanical failure	Unable to cycle valves 2-LCV-3-172 and -175 as indicated on control room hand switches 2-HS-3-172A and -175A	Valves 2-LCV-3-172 and -175 inoperable.	None. Valves 2-LCV-3-173 and -174 operable in Train “B”	
75.	Train “A” Containment isolation valve 2-FCV-32-81	Isolate containment on low air pressure or containment isolation signal.	Fails open	Control/Mechanical failure	Valve position indication via 2-HS-3-81A	None. Check valve 2-32-333 provides containment isolation backup	None	

TABLE 9.3-7 (Sheet 43 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN A (UNIT 2)								
			Fails closed	Control/Mechanical failure	Valve position indication via 2-HS-3-81A	Pressurizer spray valves not operable; however these will not effect Train “A” safety function	None. While Train “2-A” spray valves will be inoperable the Train “A” components required for safe shutdown are still available. Train “B” spray valves operable for plant operation.	
76.	Containment Isolation Valve(2-FCV-32-81) Inlet Isolation Valve 2-32-327	Isolates Inlet to 2-FCV-32-81 for maintenance	None	None	None	None	None	No active failure mode for 2-32-327
77.	Containment Isolation Valve (2-FCV-32-81) Outlet Isolation Valve 2-32-331	Isolates Outlet to 2-FCV-32-81 for maintenance	None	None	None	None	None	No active failure mode for 2-32-331
78.	Containment Isolation Valve (2-FCV-32-81) Outlet Isolation Valve 2-32-328	Isolates 2-FCV-32-81 bypass	None	None	None	None	None	No active failure mode for 2-32-328

TABLE 9.3-7 (Sheet 44 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN A (UNIT 2)				
79.	Containment Isolation Check Valve 2-32-333	Provide containment isolation as a back up for 2-FCV-32-81	Fails open	Mechanical failure	None	None. 2-FCV-32-81 would provide containment isolation	None	
			Fails closed	Mechanical failure	Pressurizer spray valve 2-PCV-68-340D position indication via 2-HS-68-340D	Safety function not effected; however, spray valve inoperable.	None. Train “A” components required for safe shutdown are still available and train “B” spray valve 2-PCV-68-340B is operable.	

TABLE 9.3-7 (Sheet 45 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B (UNIT 2)								
80.	Control Air Check Valve 0-32-414 for 2-LCV-3-173 and -174 Backflow	Prevents loss of air pressure in piping to ensure operation in the event of loss of air header pressure	Fails open	Mechanical failure	No position change indicated for 2-LCV-3-173 and -174 in control room via 2-HS-3-173A and -174A	Unable to operate SG level control valves 2-LCV-3-173 and -174 on loss of header pressure. NO effect with full header pressure	None. Valves 2-LCV-3-172 and -175 operable in Train "A"	
			Fails closed	Mechanical failure	Unable to cycle valves 2-LCV-3-173 and -174 as indicated on control room hand switches 2-HS-3-173A and -174A.	Valves 2-LCV-3-173 and -174 inoperable	None. Valves 2-LCV-3-172 and -175 operable in Train "A"	
81.	Train "B" Containment Isolation Valve 2-FCV-32-103	Isolates containment on low air pressure or containment isolation signal.	Fails open	Control/Mechanical failure	Valve position indication via 2-HS-3-103A	None. Check valve 2-32-323 provides containment isolation backup	None	

TABLE 9.3-7 (Sheet 46 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
TRAIN B (UNIT 2)								
			Fails closed	Control/Mechanical failure	Valve position indication via 2-HS-3-103A	Pressurizer spray valves not operable; however these will not effect Train "B" safety function	None. While Train "B" spray valves will be inoperable, the Train "B" components required for safe shutdown are still available. Train "A" spray valves operable for plant operation.	
82.	Containment Isolation Valve (2-FCV-32-103) Inlet Isolation Valve 2-32-317	Isolates Inlet to 2-FCV-32-103 for maintenance	None	None	None	None	None	No active failure mode for 2-32-317
83.	Containment Isolation Valve (2-FCV-32-103) Inlet Isolation Valve 2-32-321	Isolates Inlet to 2-FCV-32-103 for maintenance	None	None	None	None	None	No active failure mode for 2-32-321
84.	Containment Isolation Valve (2-FCV-32-103) Bypass Valve 2-32-318	Isolates Inlet 2-FCV-32-103 bypass	None	None	None	None	None	No active failure mode for 2-32-318

TABLE 9.3-7 (Sheet 47 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				TRAIN B (UNIT 2)				
85.	Containment Isolation Check Valve 3-32-323	Provide containment isolation as a backup for 2-FCV-32-103	Fails open	Mechanical failure	None	None. 2-FCV-103 would provide containment isolation	None	
			Fails closed	Mechanical failure	Pressurizer spray valve 2-PCV-68-340B position indication via 2-HS-68-340B	Safety function not effected; however, spray valve inoperable.	None. Train “B” components required for safe shutdown are still available and Train “A” spray valve 2-PCV-68-340D is operable.	

TABLE 9.3-7 (Sheet 48 of 48)

FAILURE MODE AND EFFECTS ANALYSIS AUXILIARY AIR SUPPLY EQUIPMENT

No	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
CAS (UNIT 2)								
86.	Control Air System Containment Isolation Valve 2-FCV-32-111	Isolates containment on the non-safety portion of control air on a low air pressure or containment isolation signal	Fails open	Control/Mechanical failure	Valve position indication via 2-HS-32-111A	None. Check valve 2-32-342 provides containment isolation backup by manual isolation of an upstream valve or by turning off the related control air compressors by removing breakers. See remarks.	None	The line inside containment downstream of the check valve 2-32-343 is not protected from HELB. The check valve will allow flow to enter containment with a single failure 2-FCV-32-111. Action is required to manually isolate valve 0-ISV-32-4108. If manual action is not successful, the non-accident unit should be shutdown, then breakers shall be removed to stop the non-safety related compressors.
			Fails closed	Control/Mechanical failure	Valve position indication via 2-HS-62-111A	Non-safety air loads inside containment not available	None.	

TABLE 9.3-8 (Sheet 1 of 3)

EQUIPMENT SUPPLIED WITH AUXILIARY CONTROL SYSTEM AIR

Auxiliary Building Gas Treatment System Dampers

Component ID	OP Mode - Failure Mode	Supplied From
0-FCO-30-148	(N/A-FC)	Train B
0-FCO-30-149	(N/A-FC)	Train A
0-FCO-30-279	(NC-FC)	Train B
0-FCO-30-280	(NC-FC)	Train A
1-FCO-30-146B	(NC-FC)	Train A
1-FCO-30-146A	(NC-FC)	Train A
2-FCO-30-157B	(NC-FC)	Train B
2-FCO-30-157A	(NC-FC)	Train B

Auxiliary Feedwater Control Valves

Component ID	OP Mode - Failure Mode	Supplied From
1,2-LCV-3-148	(NC-FO)	Train B
1,2-LCV-3-148A	(NC-FC)	Train B
1,2-LCV-3-156	(NC-FO)	Train A
1,2-LCV-3-156A	(NC-FC)	Train A
1,2-LCV-3-164	(NC-FO)	Train A
1,2-LCV-3-164A	(NC-FC)	Train A
1,2-LCV-3-171	(NC-FO)	Train B
1,2-LCV-3-171A	(NC-FC)	Train B
1,2-LCV-3-172	(NC-FC)	Train A
1,2-LCV-3-173	(NC-FC)	Train B
1,2-LCV-3-174	(NC-FC)	Train B
1,2-LCV-3-175	(NC-FC)	Train A
2-PCV-3-122	(NC-FC)	Train A
2-PCV-3-132	(NC-FC)	Train B
Panel 1-L-222B	NA	Train B
Panel 1-L-214B	NA	Train A
Panel 2-L-222B	NA	Train B
Panel 2-L-214B	NA	Train A
Panel 2-L-218A	NA	Train A
Panel 2-L-929	NA	Train B

Main Steam Pressure Relief Valves

Component ID	OP Mode - Failure Mode	Supplied From
1,2-PCV-1-5	(NC-FC)	Train A
1,2-PCV-1-12	(NC-FC)	Train B
1,2-PCV-1-23	(NC-FC)	Train A
1,2-PCV-1-30	(NC-FC)	Train B

TABLE 9.3-8 (Sheet 2 of 3)

EQUIPMENT SUPPLIED WITH AUXILIARY CONTROL SYSTEM AIR

Main Steam Pressure Relief Valves (Cont'd)

Component ID	OP Mode - Failure Mode	Supplied From
Panel 2-L-420*	NA	Train A
Panel 1-L-420	NA	Train A
Panel 2-L-423*	NA	Train A
Panel 1-L-423	NA	Train A
Panel 2-L-421*	NA	Train B
Panel 1-L-421	NA	Train B
Panel 2-L-422*	NA	Train B
Panel 1-L-422	NA	Train B

Reactor Coolant System Valves

1,2-PCV-68-340B	(NC-FC)	Train B
1,2-PCV-68-340D	(NC-FC)	Train A
Panels 1,2-L-366	NA	Train A
Panels 1,2-L-180	NA	Train B
Panel 2-L-351B	NA	Train A

Emergency Gas Treatment System Equipment

Train A		Train B
2-FCV-65-5	(NC-FC)	2-FCV-65-4
2-FCV-65-9	(NC-FC)	2-FCV-65-7
1-FCV-65-10	(NC-FC)	1-FCV-65-8
0-FCV-65-24	(NC-FC)	1-FCO-65-27
1-FCO-65-26	(NC-FC)	0-FCV-65-28A
2-FCO-65-46	(NC-FC)	0-FCV-65-28B
0-FCV-65-47A	(NC-FC)	2-FCV-65-29
0-FCV-65-47B	(NC-FC)	1-FCV-65-30
2-FCV-65-50	(NC-FC)	0-FCV-65-43
1-FCV-65-51	(NC-FC)	2-FCO-65-45
1-FCV-65-52	(NC-FC)	1-FCV-65-53
1,2-PCV-65-81	(NO-FC)	1,2-PCV-65-83
1,2-PCV-65-86	(NC-FC)	1,2-PCV-65-87
1,2-PCO-65-80**	(NC-FO)	1,2-PCO-54-82**
1,2-PCO-65-88**	(NO-FC)	1,2-PCO-65-89**
Panel 1-L-44	NA	Panel 1-L-45
Panel 2-L-44	NA	Panel 2-L-45

Control Building
Heating, Ventilation, and Air Conditioning Equipment

Train A		Train B
FCO-31-335	(NC-FC)	FCO-31-337
FCO-31-336	(NC-FC)	FCO-31-338
TCV-31-108	NA	TCV-31-138
TCV-31-112	NA	TCV-31-142
FCV-31-3	(NO-FC)	FCV-31-4
FCV-31-6	(NC-FC)	FCV-31-5
FCO-31-8	(NC-FC)	FCO-31-7
FCO-31-30	(NO-FO)	FCO-31-31

TABLE 9.3-8 (Sheet 3 of 3)

EQUIPMENT SUPPLIED WITH AUXILIARY CONTROL SYSTEM AIR

0-FCO-31-12	(NO-FO)	0-FCO-31-11
0-FCO-31-82	(NA-FO)	0-FCO-31-91
0-MCV-31-176*	(NA-FO)	0-MCV-31-201*
0-MCV-31-231*	(NA-FO)	0-MCV-31-261*
0-MCV-31-232*	(NA-FO)	0-MCV-31-262*

Equipment Supplied with Auxiliary Control System Air

Train A		Train B
TT-31-41	NA	TT-31-54
TT-31-47	NA	TT-31-59
TT-31-82	NA	TT-31-91
TT-31-335	NA	TT-31-337
TT-31-336	NA	TT-31-338
TC-31-82	NA	TC-31-91
TC-31-335	NA	TC-31-337
TC-31-336	NA	TC-31-338
0-MC-31-176	NA	0-MC-31-201
0-MC-31-231	NA	0-MC-31-261
Panel L-523	NA	Panel L-524
Panel L-529	NA	Panel L-530

Radiation Monitoring Sample Isolation Valves

Train A		Train B
1,2-FCV-90-107	(NO-FC)	1,2-FCV-90-108
1,2-FCV-90-111	(NO-FC)	1,2-FCV-90-109
1,2-FCV-90-113	(NO-FC)	1,2-FCV-90-110
1,2-FCV-90-117	(NO-FC)	1,2-FCV-90-114
	(NO-FC)	1,2-FCV-90-115
	(NO-FC)	1,2-FCV-90-116

Auxiliary Control Air System

Train A		Train B
1-FCV-32-80	(NO-FC)	1-FCV-32-102
2-FCV-32-81	(NO-FC)	2-FCV-32-103
Air Dryers A-A	NA	Air Dryers B-B

*Valves 0-MCV-31-176, 0-MCV-31-201, 0-MCV-31-231, 0-MCV-31-232, 0-MCV-31-261 and 0-MCV-31-262 do not directly receive control air from ACAS but instead receive an input signal for position control from controllers 0-MC-31-176, 0-MC-31·201, 0-MC-31-231 and 0-MC-31-261 which are supplied with control air from ACAS.

**Dampers 1-PCO-65-80 and 2-PCO-55-80 are mechanically linked to dampers 1-PCO-65-BB and 2-PCO- 65-88, respectively. Dampers 1-PCO-65-82 and 2-PCO-65-82 are mechanically linked to dampers 1-PCO-65-89 and 2-PCO-65-89, respectively.

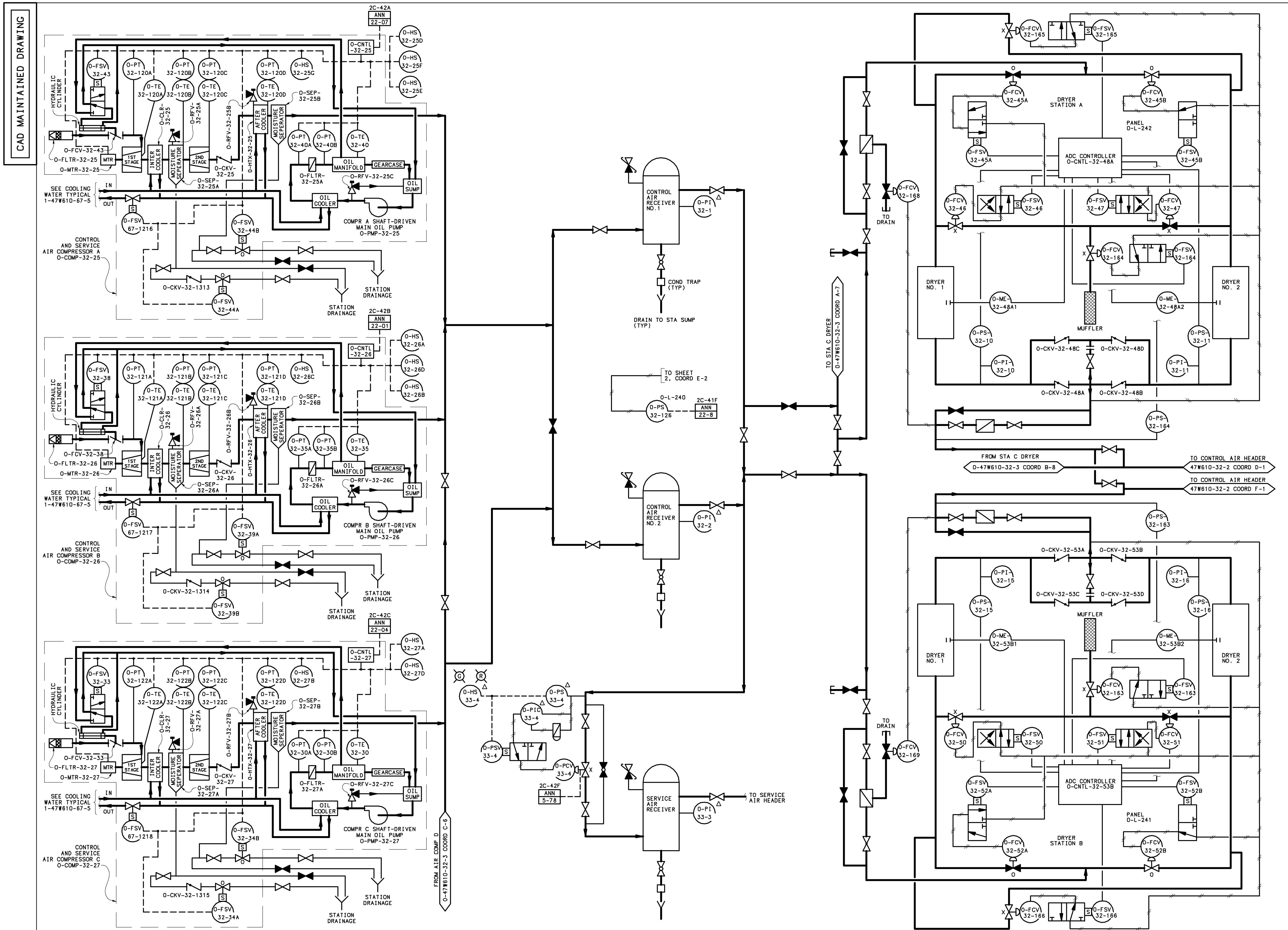


TABLE A1
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
0-CMPR-32-60	XD2040	AUX CONT AIR COMPR A-A
0-HS-32-60	HD2026	AUX CONT AIR COMPR A-A SW
1-HS-32-80A	HD2024	RX BLDG UNIT 1 TR-A ISO VLV SW
0-HS-32-86	HD2060	AUX CONT AIR COMPR B-B SW
0-CMPR-32-86	XD2093	AUX CONT AIR COMPR B-B
1-HS-32-102A	HD2058	RX BLDG UNIT 1 TR-B ISO VLV SW

SEE SHEET 2 FOR ASSOCIATED INSTRUMENTATION

NOTES:

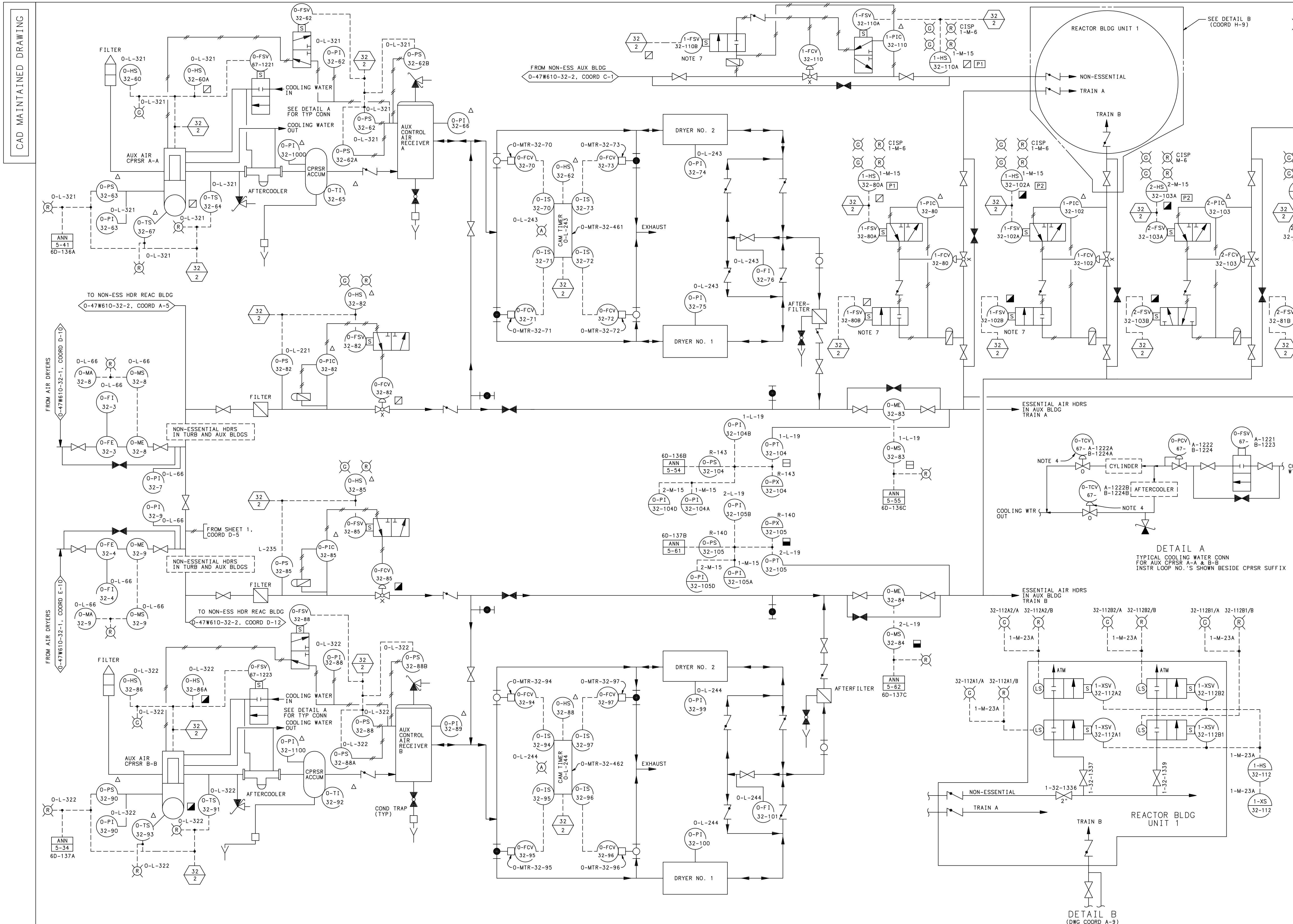
1. THIS SYSTEM PROVIDES DRY, COMPRESSED AIR FOR ALL EQUIPMENT REQUIRING CONTROL AIR. THE PRIMARY SYSTEM IS LOCATED IN THE TURBINE BUILDING. UNDER FLOOD CONDITIONS THE AUXILIARY COMPRESSORS LOCATED IN THE AUXILIARY BUILDING SUPPLY AIR TO THE SAFETY RELATED EQUIPMENT.
2. HS-32-25A AND HS-32-25B ARE COMMON TO COMPRESSORS A, B AND C.
3. 0-PIC-32-125 HAS BEEN UPGRADED WITH A FOXBORO INTERGRAL KIT PART NUMBER 43AP-CL2541 PER CONTRACT NUMBER 87NLC-467902 RD-143167.
4. INACTIVE DIGITAL PORT(S) ARE DISABLED THROUGH HARDWARE AND MAY ALSO BE DISABLED THROUGH SOFTWARE. DIGITAL PORT(S) DISABLED THROUGH SOFTWARE MUST BE ENABLED BY THE SYSTEM ENGINEER OR CYBER SECURITY PERSONNEL.
5. DISABLED DIGITAL PORT(S) MAY BE ENABLED FOR MAINTENANCE PURPOSES, CONTACT THE SYSTEM ENGINEER OR CYBER SECURITY.

REFERENCE DRAWINGS:

47W600-200 THRU 225-----PIPING
47W846-1----------------SERVICE AIR FLOW DIAGRAM
47W848-1 THRU 10--------CONTROL AIR FLOW DIAGRAM
0-47W611-32-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CONTROL AIR SYSTEM
TVA DWG NO. 0-47W610-32-1 R0
FIGURE 9.3-1



NOTES:

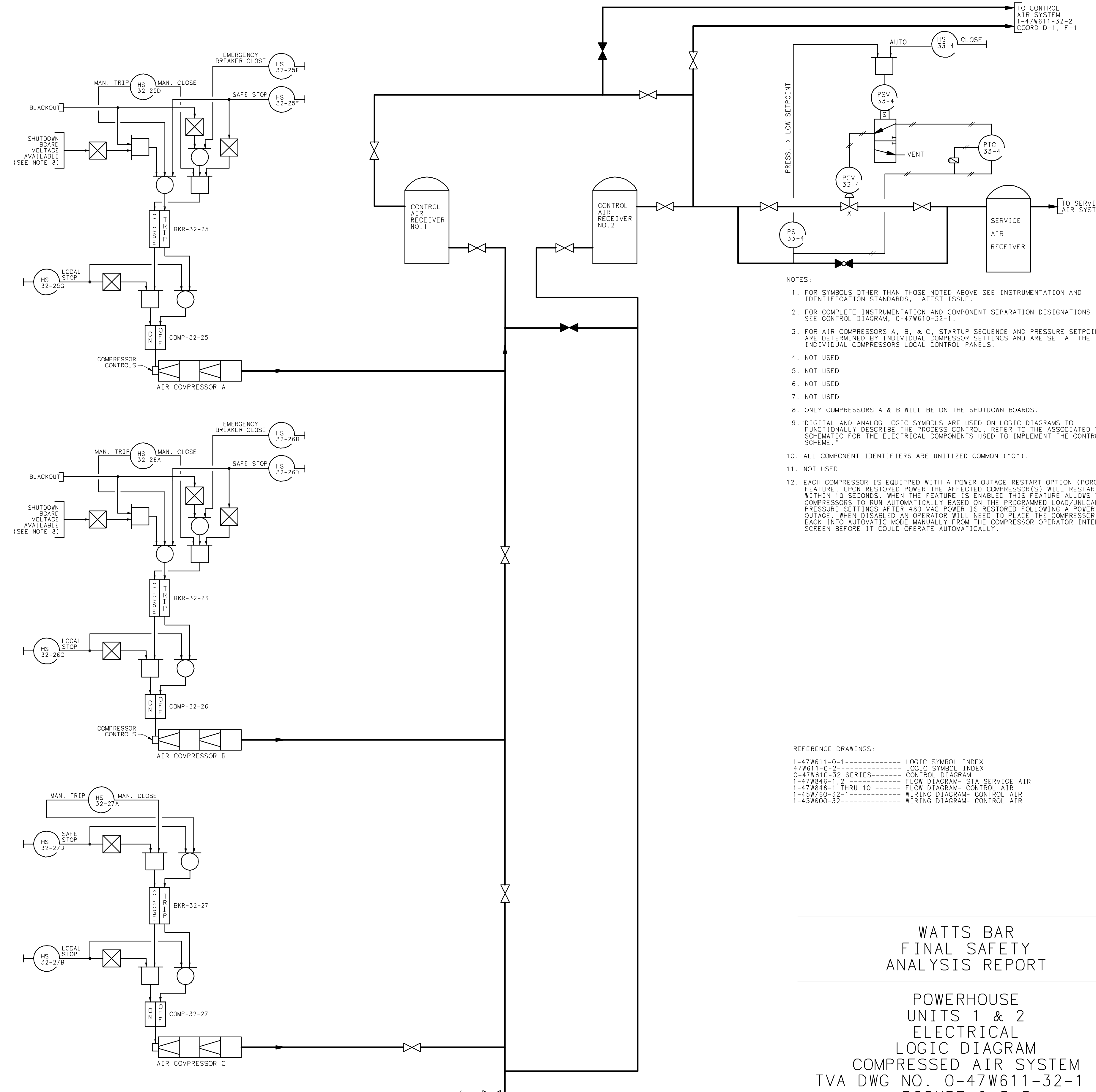
1. FOR GENERAL NOTES SEE 0-47W610-32-1.
2. AUXILIARY CONTROL AIR RECEIVERS ARE CHARGED BY PRIMARY COMPRESSORS LOCATED IN TURBINE BLDG. IF RECEIVED PRESSURE FALLS BELOW SETPOINT, THE AUXILIARY COMPRESSORS ARE STARTED.
3. IF CONTROL AIR HEADER PRESSURE FALLS BELOW SETPOINT, THE AUXILIARY SYSTEM IS ISOLATED BY FCV-32-82 AND FCV-32-85.
4. THESE VALVES ARE SELF-CONTAINED THERMOSTAT TYPE.
5. SOME CIDs ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDs SHOWN ON THE OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDs EXISTED FOR A PREVIOUS COMPONENT.
6. REFER TO TABLE A1 FOR DIGITAL COMPUTER POINTS (POWER AVAILABLE, SWITCH POSITION, ETC.).
7. THIS 3-WAY VALVE HAS ITS EXHAUST PORT PLUGGED AND ACTS AS A 2-WAY, ENERGIZE TO OPEN VALVE.

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CONTROL AIR SYSTEM
TVA DWG NO. 0-47W610-32-2 R1
FIGURE 9.3-2

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTED ABOVE SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAM, 0-47W610-32-1.
3. FOR AIR COMPRESSORS A, B, & C, STARTUP SEQUENCE AND PRESSURE SETPOINTS ARE DETERMINED BY INDIVIDUAL COMPESSOR SETTINGS AND ARE SET AT THE INDIVIDUAL COMPRESSORS LOCAL CONTROL PANELS.
4. NOT USED
5. NOT USED
6. NOT USED
7. NOT USED
8. ONLY COMPRESSORS A & B WILL BE ON THE SHUTDOWN BOARDS.
9. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
10. ALL COMPONENT IDENTIFIERS ARE UNITIZED COMMON ("O").
11. NOT USED
12. EACH COMPRESSOR IS EQUIPPED WITH A POWER OUTAGE RESTART OPTION (PORO) FEATURE. UPON RESTORED POWER THE AFFECTED COMPRESSOR(S) WILL RESTART WITHIN 10 SECONDS. WHEN THE FEATURE IS ENABLED THIS FEATURE ALLOWS THE COMPRESSORS TO RUN AUTOMATICALLY BASED ON THE PROGRAMMED LOAD/UNLOAD PRESSURE SETTINGS AFTER 480 VAC POWER IS RESTORED FOLLOWING A POWER OUTAGE. WHEN DISABLED AN OPERATOR WILL NEED TO PLACE THE COMPRESSOR BACK INTO AUTOMATIC MODE MANUALLY FROM THE COMPRESSOR OPERATOR INTERFACE SCREEN BEFORE IT COULD OPERATE AUTOMATICALLY.

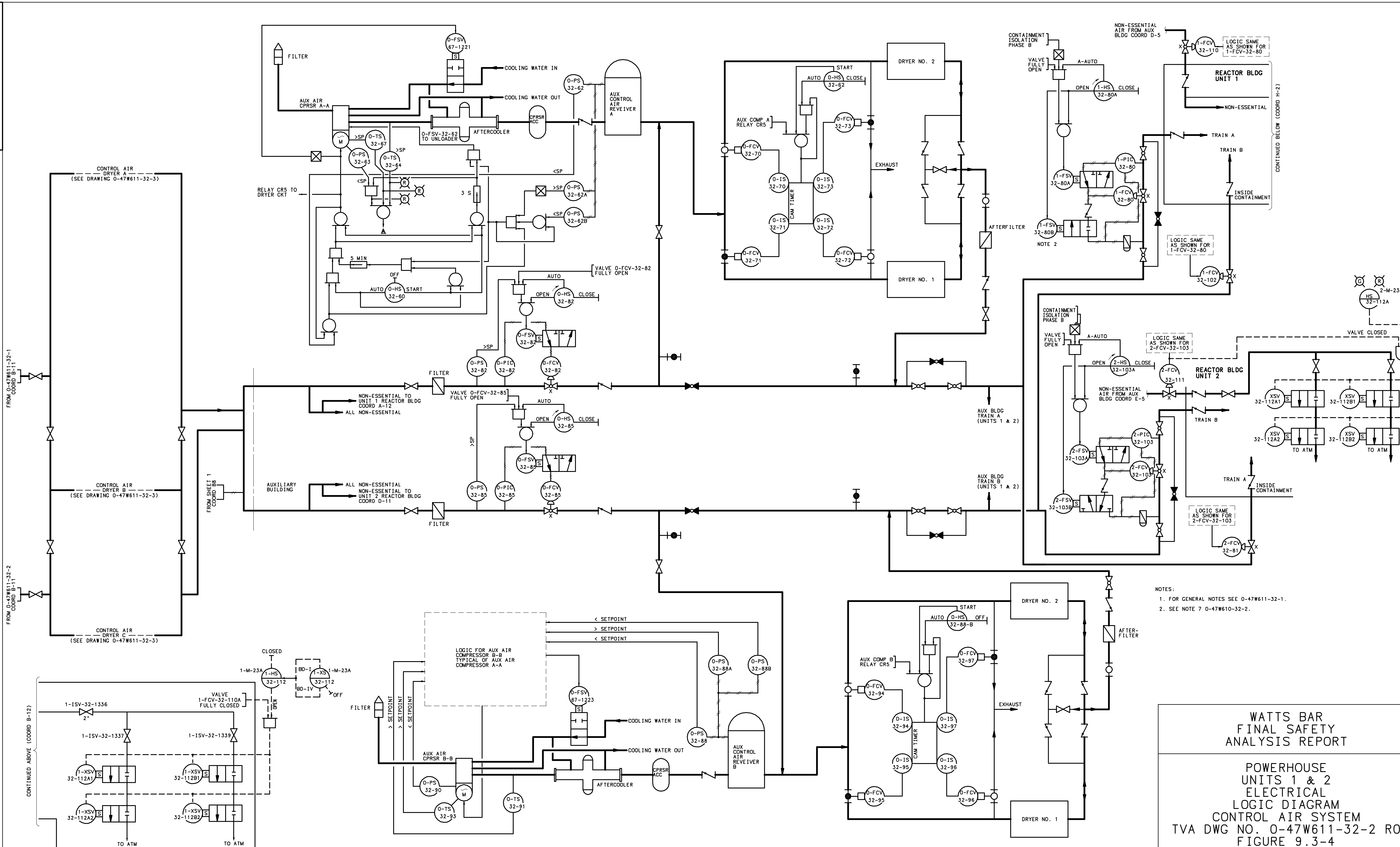
REFERENCE DRAWINGS:

1-47W611-0-1--------------- LOGIC SYMBOL INDEX
47W611-0-2----------------- LOGIC SYMBOL INDEX
0-47W610-32 SERIES-------- CONTROL DIAGRAM
1-47W846-1,2 ------------- FLOW DIAGRAM- STA SERVICE AIR
1-47W848-1 THRU 10 ------- FLOW DIAGRAM- CONTROL AIR
1-45W760-32-1------------- WIRING DIAGRAM- CONTROL AIR
1-45W600-32--------------- WIRING DIAGRAM- CONTROL AIR

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
COMPRESSED AIR SYSTEM
TVA DWG NO. 0-47W611-32-1 R0
FIGURE 9.3-3

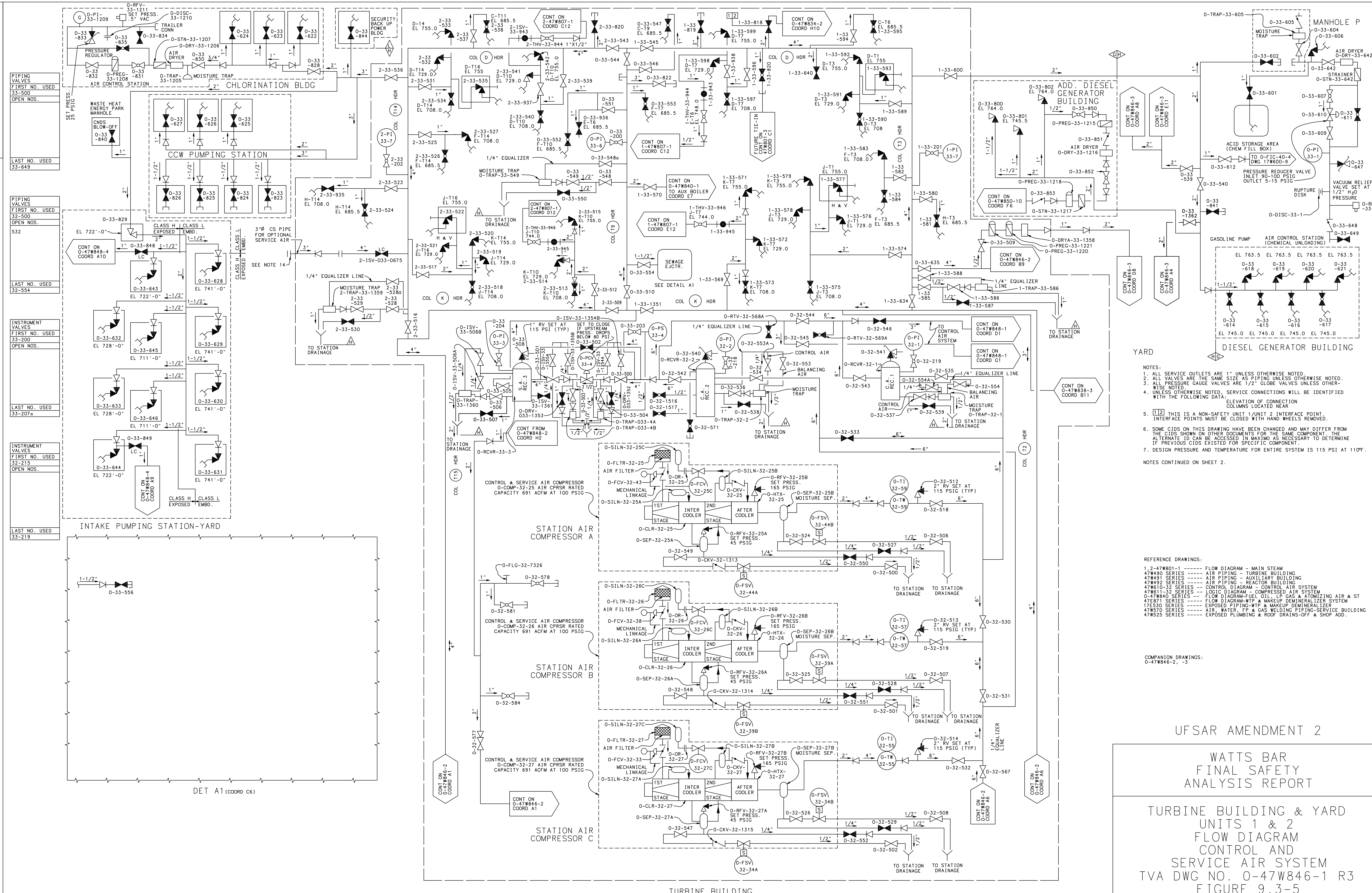
CAD MAINTAINED DRAWING



NOTES:
1. FOR GENERAL NOTES SEE 0-47W611-32-1.
2. SEE NOTE 7 0-47W610-32-2.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
CONTROL AIR SYSTEM
TVA DWG NO. 0-47W611-32-2 R0
FIGURE 9.3-4



NOTES:

1. ALL SERVICE OUTLETS ARE 1" UNLESS OTHERWISE NOTED.
2. ALL VALVES ARE THE SAME SIZE AS PIPING UNLESS OTHERWISE NOTED.
3. ALL PRESSURE GAUGE VALVES ARE 1/2" GLOBE VALVES UNLESS OTHERWISE NOTED.
4. UNLESS OTHERWISE NOTED, SERVICE CONNECTIONS WILL BE IDENTIFIED WITH THE FOLLOWING DATA:
   ELEVATION OF CONNECTION
   COLUMNS LOCATED NEAR
5. [1|2] THIS IS A NON-SAFETY UNIT 1/UNIT 2 INTERFACE POINT. INTERFACE POINTS MUST BE CLOSED WITH HAND WHEELS REMOVED.
6. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR SPECIFIC COMPONENT.
7. DESIGN PRESSURE AND TEMPERATURE FOR ENTIRE SYSTEM IS 115 PSI AT 110°F.

NOTES CONTINUED ON SHEET 2.

REFERENCE DRAWINGS:

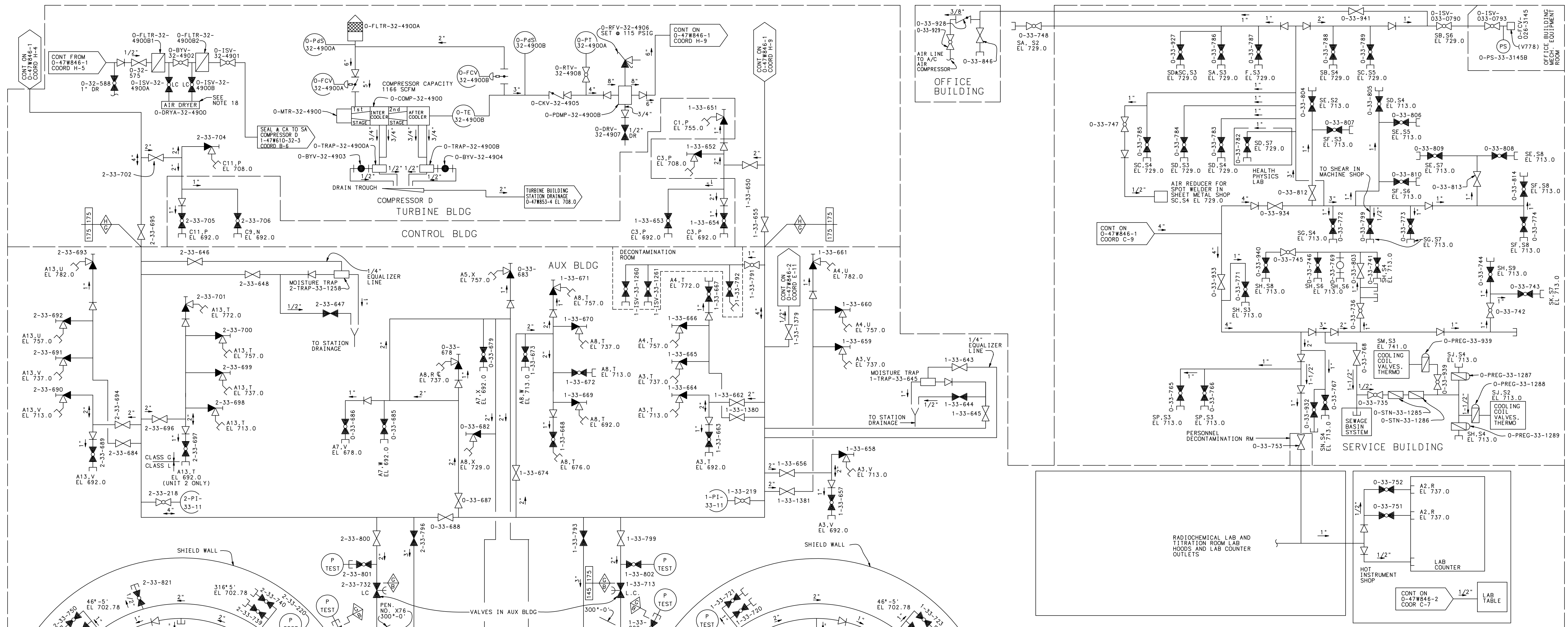
1,2-47W801-1 ------ FLOW DIAGRAM - MAIN STEAM
47W490 SERIES ----- AIR PIPING - TURBINE BUILDING
47W491 SERIES ----- AIR PIPING - AUXILIARY BUILDING
47W492 SERIES ----- AIR PIPING - REACTOR BUILDING
47W610-32 SERIES -- CONTROL DIAGRAM - CONTROL AIR SYSTEM
47W611-32 SERIES -- LOGIC DIAGRAM - COMPRESSED AIR SYSTEM
0-47W840 SERIES -- FLOW DIAGRAM-FUEL OIL, LP GAS & ATOMIZING AIR & ST
47E871 SERIES ----- FLOW DIAGRAM-WTP & MAKEUP DEMINERALIZER SYSTEM
17E530 SERIES ----- EXPOSED PIPING-WTP & MAKEUP DEMINERALIZER
47W570 SERIES ----- AIR, WATER, FP & GAS WELDING PIPING-SERVICE BUILDING
47W525 SERIES ----- EXPOSED PLUMBING & ROOF DRAINS-OFF & SHOP ADD.

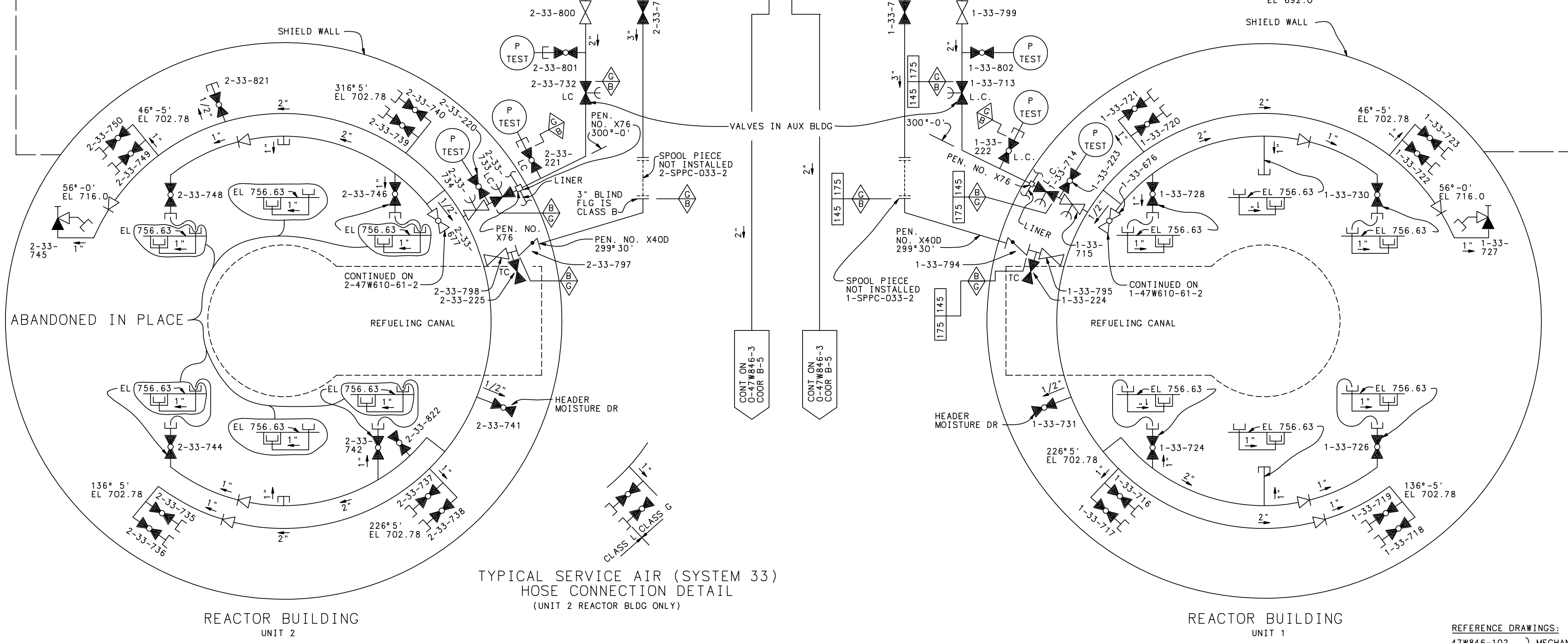
COMPANION DRAWINGS:
0-47W846-2, -3

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

TURBINE BUILDING & YARD
UNITS 1 & 2
FLOW DIAGRAM
CONTROL AND
SERVICE AIR SYSTEM
TVA DWG NO. 0-47W846-1 R3
FIGURE 9.3-5





NOTE:

8. [175|145] INDICATES THE PNEUMATIC TEST PRESSURE. CONST SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE PNEUMATIC TEST. ASTM CODE CASES INVOLVING PNEUMATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION.
9. FOR NON QA VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISCELLANEOUS VALVES MASTER STATUS REPORT -009.
10. FOR DEFINITION OF LC AND LO REFER TO MEMO B26850402001.
11. (B/C) INDICATES TVA PIPE CLASSIFICATION AS SHOWN ON 47B21-1

    TVA PIPING CLASSIFICATION ARE AS FOLLOWS:
    0-47W846-1 CLASS H EXCEPT AS NOTED
    0-47W846-2 CLASS B, G AND H AS NOTED
    0-47W846-3 CLASS G AND H AS NOTED
12. PORTABLE MINE SAFETY APPLIANCES (MSA) FILTRATION UNITS SHALL NOT BE CONNECTED DIRECTLY TO THE SAS DUE TO LACK OF C.O. MONITORS/ALARMS AND SUSCEPTIBILITY TO LOSS OF AIR DUE TO AUTOMATIC CLOSURE OF PCV-33-4 ON LOW PRESSURE.
13. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
    N3-32-4002 ------ COMPRESSED AIR SYSTEMS
14. TEMPORARY AIR COMPRESSORS, CONNECTED TO CONNECTION FLANGE, SHALL BE EQUIVALENT TO THE INSTALLED STATION AIR COMPRESSORS, IN TEMPERATURE, PRESSURE, AND AIR QUALITY DELIVERED. RADCON SHALL VERIFY, PRIOR TO CONNECTION, THAT THE AIR SUPPLIED MEETS THE REQUIREMENTS FOR BREATHING AIR.
15. AUXILIARY BUILDING SECONDARY CONTAINMENT ENCLOSURE (ABSCE) MUST BE CONSIDERED WHENEVER SYSTEM BREACH WILL OCCUR IN NORTH/SOUTH VALVE ROOMS (A10 & A11). BEFORE PERFORMING ANY MODIFICATION/MAINTENANCE ACTIVITIES IN ROOMS A10 & A11 ENSURE APPROPRIATE PRECAUTIONS ARE TAKEN TO MAINTAIN ABSCE BOUNDARY.
16. NOT USED
17. PLASTIC AIR TUBING AND ASSOCIATED FITTINGS MAY BE REPLACED WITH EQUIVALENT SIZE AND PRESSURE RATING COPPER OR STAINLESS TUBING AND COMPRESSION FITTINGS AS NECESSARY.
18. ABANDON 0-DRYA-032-4900 IN PLACE.
19. USE FITTINGS ON SYSTEM 059 IF REQUIRED DURING REFUELING.

CLASS L EMBEDDED | CLASS H EXPOSED | CLASS H EXPOSED

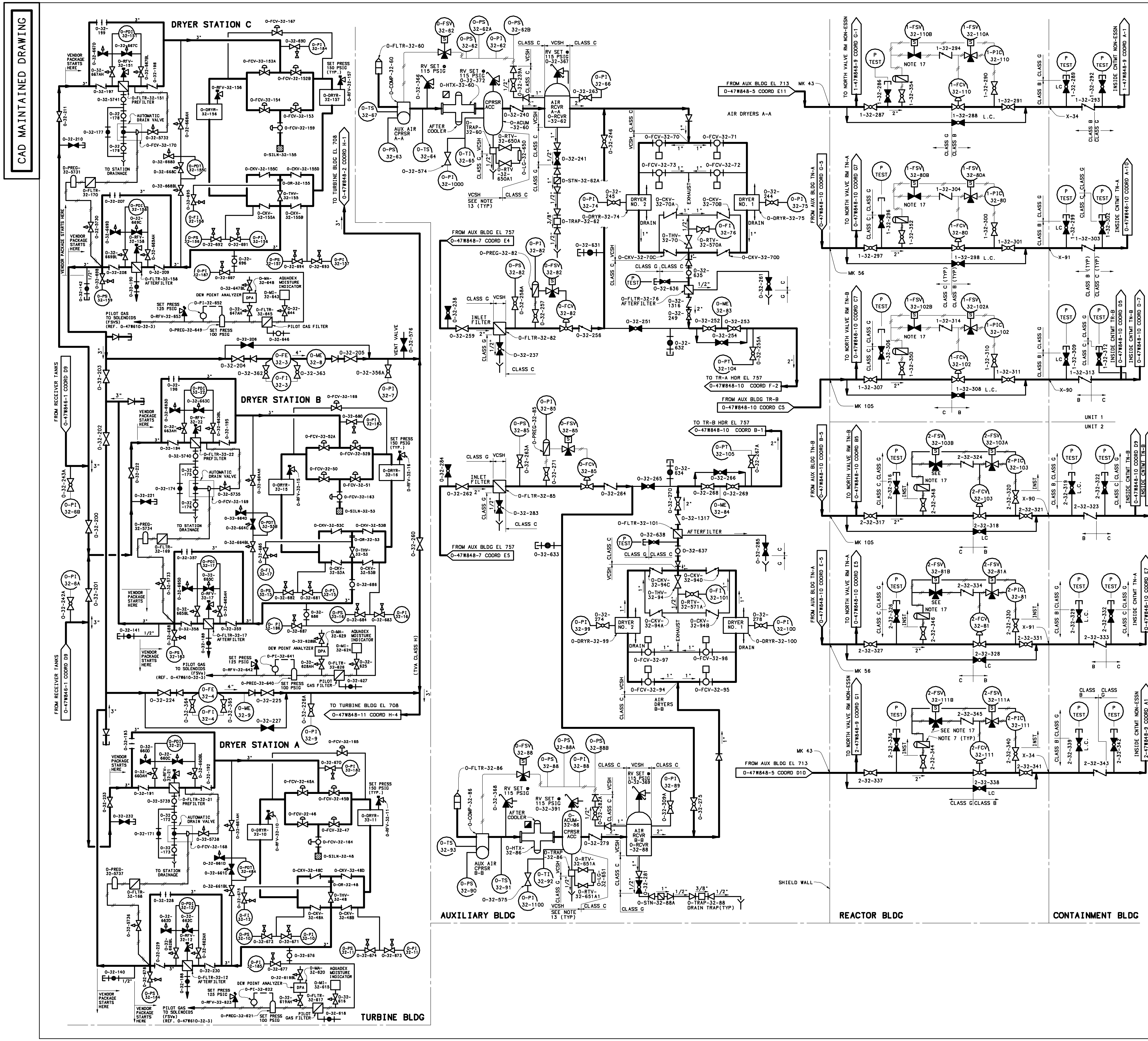
REFERENCE DRAWINGS:
47W846-102 } MECHANICAL STRESS ANALYSIS PROBLEM
2-47W846-102 } BOUNDARY CONTROL AND SERVICE AIR SYSTEM

COMPANION DRAWINGS:
0-47W846-1 & 3

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

CONT, AUX, REAC, TURB, OFF. & SERV BUILDING
UNITS 1 & 2
FLOW DIAGRAM
CONTROL AND
SERVICE AIR SYSTEM
TVA DWG NO. 0-47W846-2 R4
FIGURE 9.3-5A



NOTES:

1. THIS SYSTEM PROVIDES DRY, COMPRESSED AIR FOR ALL EQUIPMENT REQUIRING CONTROL AIR. THE PRIMARY SYSTEM IS LOCATED IN THE TURBINE BUILDING. UNDER FLOOD AND ACCIDENT CONDITIONS, THE AUXILIARY COMPRESSORS LOCATED IN THE AUXILIARY BUILDING SUPPLY AIR TO THE SAFETY RELATED EQUIPMENT.
2. AUXILIARY CONTROL AIR RECEIVERS ARE CHARGED BY PRIMARY COMPRESSORS LOCATED IN TURBINE BLDG. IF RECEIVER PRESSURE FALLS BELOW SETPOINT, THE AUXILIARY COMPRESSORS ARE STARTED.
3. IF CONTROL AIR HEADER PRESSURE FALLS BELOW SETPOINT, THE AUXILIARY SYSTEM IS ISOLATED BY FCV-32-82 & FCV-32-85.
4. ALL RELIEF VALVES SET POINT AT 115 PSIG, EXCEPT AS NOTED.
5. SYSTEM DESIGN PRESS. 115 PSIG AT 100°F EXCEPT 430°F BETWEEN AUX CPRSR AND AFTERCOOLER.
6. CONTROL AIR HDR SAFETY CLASS:
   A. TURBINE BLDG-CLASS H
   B. AUX BLDG: NON-ESSENTIAL-CLASS G CLASS H MATERIAL MAY BE USED AND SHALL BE QUALIFIED TO SEISMIC CATEGORY IL REQUIREMENTS AS PER DESIGN CRITERIA WB-DC-40-36
      ESSENTIAL-CLASS C
   C. REACTOR BLDG (EXCEPT AS SHOWN ON DWG):
      NON-ESSENTIAL-SAME AS AUX BLDG NON-ESSENTIAL, NOTE 6B.
      ESSENTIAL-CLASS C
7. SET REGULATOR TO MINIMUM PRESSURE NEEDED TO OPERATE CONTROLLER (30 PSIG RECOMMENDED).
8. CLASS BOUNDARY OF BRANCH LINE IS THE SAME AS THE HEADER, PROVIDED THE ISOLATION VALVE OFF THE HEADER IS NORMALLY OPEN.
9. ALL VALVE TAGS ARE PREFIXED BY UNIT NUMBER, TYPE, AND SYSTEM NUMBER (I.E. 1-RTV-32-XXX DESIGNATES A ROOT VALVE USED IN UNIT 1 FOR SYSTEM 32). FOR VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISCELLANEOUS VALVES MASTER STATUS REPORT-009 AND INSTRUMENTATION VALVES CONSTRUCTION STATUS REPORT 010.
10. L.C. DENOTES LOCKED CLOSED VALVE. SEE MEMORANDUM B26 '85 0402001 FOR ADDITIONAL INFORMATION.
11. ALL PNEUMATIC DEVICES SHOWN DOWN STREAM OF THE ROOT VALVE IN THIS SERIES OF DRAWINGS, ARE RELATIVE ONLY TO IT'S ROOT VALVE (TO ALLOW EVALUATION OF THE EFFECT OF ROOT VALVE CLOSURE). THIS SERIES OF DWGS. DOES NOT DEPICT THE ACTUAL FIELD ROUTING (E.G. TEES, ELBOWS, ETC.).
12. EQUIPMENT CONNECTIONS ARE SHOWN DIAGRAMMATICALLY AS AN ISOLATION VALVE FOLLOWED BY A SQUARE AND CONNECTION NUMBER(VXXX). THE CONNECTION NUMBERS ARE LISTED ON SHEETS 47W600-190 THRU -199 WITH THE CORRESPONDING HOOKUP DETAIL IDENTIFIED. THE APPLICABLE DETAIL SHOWS THE ISOLATION VALVE SHOWN ON THIS DRAWING SERIES WITH APPROPRIATE MARK NUMBERS. TVA PIPING CLASSIFICATIONS SPECIFIED ON THIS DRAWING SERIES ARE APPLICABLE UP TO AN INTERFACE POINT ON THE CORRESPONDING HOOK UP DETAIL AS SPECIFIED IN THE ENGINEERING REQUIREMENTS SPECIFICATION N3E-934 "INSTRUMENT AND INSTRUMENT LINE INSTALLATION AND INSPECTION".
13. "VCSH" DENOTES "VENDOR CONTRACT STARTS HERE". THIS EQUIPMENT IS DESIGNATED "VENDOR-SUPPLIED SAFETY-RELATED EQUIPMENT PACKAGE". THE EQUIPMENT SHALL MEET THE FOLLOWING REQUIREMENTS:
    a. THE EQUIPMENT PACKAGE (COMPONENTS AND PIPING) CONTAINED WITHIN THE PIPING SYSTEM CLASSIFIED AS CLASS C WHICH DO NOT MEET THE REQUIREMENTS OF ASME SECTION III SHALL BE INSTALLED AND DOCUMENTED USING THE RULES OF ASME SECTION III, AND MANUFACTURER'S INSTRUCTION MANUALS, AS REQUIREMENTS, EXCEPT THAT THE MATERIALS AND EQUIPMENT ARE NOT CERTIFIED TO SECTION III, AND A N-5 DATA REPORT IS NOT REQUIRED. 10 CFR 50 APPENDIX B APPLIES.
    b. ANY SUBSTITUTE MATERIALS USED OR REPAIRS PERFORMED BY CONSTRUCTION OR MAINTENANCE SHALL BE IN ACCORDANCE WITH THE ORIGINAL CONTRACT SPECIFICATION AND DRAWING REQUIREMENTS.
14. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
    N3-32-4002-----COMPRESSED AIR SYSTEM
15. NOT USED.
16. NOT USED.
17. SEE NOTE 7 0-47W610-32-2.

FOR INFORMATION ONLY:
A RELIEF REQUEST WILL BE SENT TO THE NRC REQUESTING EXEMPTION FROM RE-HYDRO TESTING THE SYSTEM DUE TO THE INCREASE IN DESIGN PRESSURE. NO RE-HYDRO TESTING IS "AT RISKS" UNTIL AN ANSWER IS RECEIVED FROM THE NRC. THIS DCN WILL BE REVISED UPON RECIEPT OF THE ANSWER TO THE RELIEF REQUEST DOCUMENTING THAT A HYDRO TEST IS NOT REQUIRED OR THAT A HYDRO TEST IS REQUIRED.

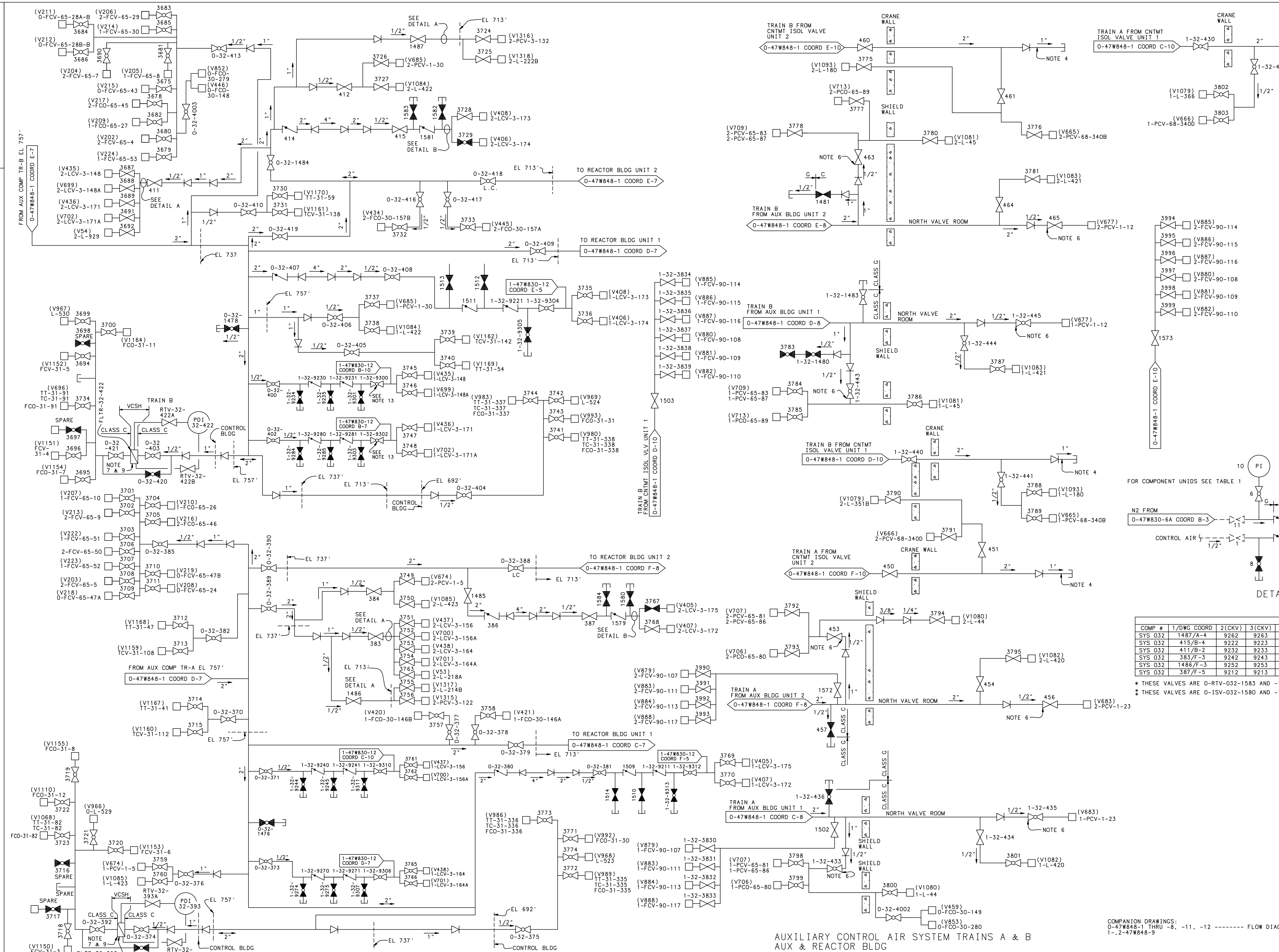
REFERENCE DRAWINGS:

47W610-32 SERIES--------CONTROL DIAGRAM
47W611-32 SERIES--------LOGIC DIAGRAM
47W600-220---------------PIPING
47W846 SERIES-----------SERVICE AIR FLOW DIAGRAM
47W600-206---------------AUX AIR STATION
47W600-200 THRU 205----AUX BLDG
47W600-212 THRU 215----TURB BLDG
47W600-210, 211,
216 THRU 219,
370 THRU 375------------U1 AND U2 REACTOR BUILDING
47W600-221 THRU 225----AIR SCHEMATICS
47W600-190 THRU
199, 209, 293-----------CONNECTIONS

COMPANION DRAWINGS:
0, 1, 2-47W848 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
CONTROL AIR
TVA DWG NO. 0-47W848-1 R0
FIGURE 9.3-6

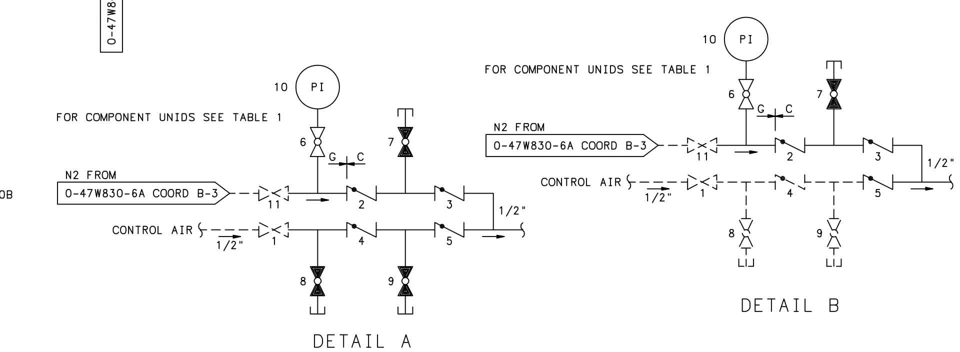


NOTES:

1. SEE SHEET 1 FOR GENERAL NOTES.
2. LINE SIZES OFF HEADER ARE 1/2" UNLESS NOTED.
3. NOT USED.
4. ROUTE 1" SS PIPE TO BOTTOM OF PRESSURIZER.
5. NOT USED.
6. THIS VALVE WILL BE USED FOR HDR BLOWDOWN.
7. CONTROL BLDG RADIATION FILTER TO BE INSTALLED & SUPPORTED USING REQUIREMENTS OF TVA SAFETY CLASS C. VENDOR WILL BUILD FILTER TO ASME SECTION VIII REQUIREMENTS (TVA CLASS G). REFER TO 1-47W848-1 NOTE 13 FOR VCSH DEFINITION.
8. ALL PIPING IS CLASS C. THIS CLASSIFICATION EXTENDS UP TO AND INCLUDING THE FEATURE ISOLATION VALVE PIPING AND TUBING DOWNSTREAM OF THE FEATURE ISOLATION VALVE IS CLASSIFIED AS "INSTRUMENT". SEE ENGINEERING REQUIREMENTS SPECIFICATION (ERS) N3E-934 FOR INSTALLATION AND INSPECTION REQUIREMENTS.
9. FILTER IS VENDOR SUPPLIED UNDER REQ NO. 831283.
10. NOT USED.
11. NOT USED.
12. NOT USED.
13. 1-ISV-32-9300 AND 1-ISV-32-9302 WERE INADVERTENTLY INSTALLED IN THE REVERSE FLOW DIRECTION AND WERE FOUND ACCEPTABLE PER PIC 60331.

REFERENCE DRAWINGS:

47W600-210, 211, 216 THRU 219, 370 THRU 375------U1 AND U2 REACTOR BUILDING
47W600-203--------------------------------PHYSICAL PIPING AUX BLDG EL 737'
47W600-204--------------------------------PHYSICAL PIPING AUX BLDG EL 757'
47W600-207--------------------------------PHYSICAL PIPING AUX BLDG
47W848-110--------------------------------MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY CONTROL AIR
47W600-190 THRU 199, 209, 293------------CONNECTIONS



CONTROL AIR TABLE 1

COMP #	1/DWG COORD	2(CKV)	3(CKV)	4(CKV)	5(CKV)	6(ISV-077)	7(TV)	8(TV)	9(TV)	10(2-077)	11(2-77-)	47W600 DETAIL
SYS 032	1487/A-4	9262	9263	9260	9261	9267	9266	9264	9265	9268	2570	A208
SYS 032	415/B-4	9222	9223	1581	9221	9227	9226	*1583	**1582	9228	2566	B208
SYS 032	411/B-2	9232	9233	9230	9231	9237	9236	9234	9235	9238	2567	P208
SYS 032	383/F-3	9242	9243	9240	9241	9247	9246	9244	9245	9248	2568	P208
SYS 032	1486/F-3	9252	9253	9250	9251	9257	9256	9254	9255	9258	2569	A208
SYS 032	387/F-5	9212	9213	1579	9211	9217	9216	*1584	**1580	9218	2565	B208

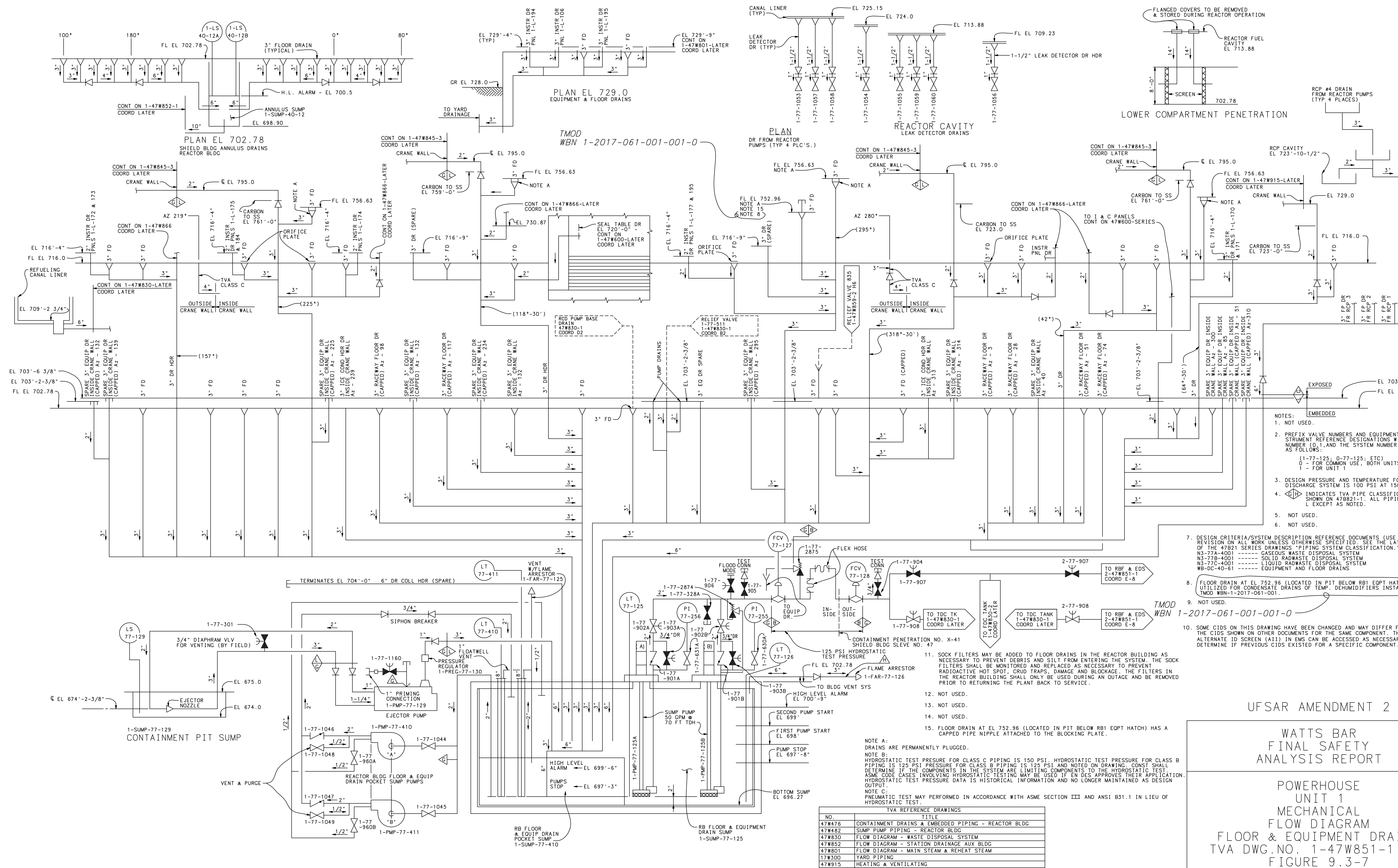
* THESE VALVES ARE 0-RTV-032-1583 AND -1584

** THESE VALVES ARE 0-ISV-032-1580 AND -1582

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
CONTROL AIR
TVA DWG NO. 0-47W848-10 R2
FIGURE 9.3-6A



NOTES:
1. NOT USED.
2. PREFIX VALVE NUMBERS AND EQUIPMENT AND INSTRUMENT REFERENCE DESIGNATIONS WITH THE UNIT NUMBER (0,1,AND THE SYSTEM NUMBER (77) AS FOLLOWS:
   (1-77-125; 0-77-125; ETC)
   0 - FOR COMMON USE, BOTH UNITS
   1 - FOR UNIT 1
3. DESIGN PRESSURE AND TEMPERATURE FOR SUMP DISCHARGE SYSTEM IS 100 PSI AT 150°F.
4. (G/H) INDICATES TVA PIPE CLASSIFICATION AS SHOWN ON 47B821-1. ALL PIPING IS CLASS L EXCEPT AS NOTED.
5. NOT USED.
6. NOT USED.
7. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
   N3-77A-4001 ------ GASEOUS WASTE DISPOSAL SYSTEM
   N3-77B-4001 ------ SOLID RADWASTE DISPOSAL SYSTEM
   N3-77C-4001 ------ LIQUID RADWASTE DISPOSAL SYSTEM
   WB-DC-40-61 ------ EQUIPMENT AND FLOOR DRAINS
8. FLOOR DRAIN AT EL 752.96 (LOCATED IN PIT BELOW RB1 EQPT HATCH) WILL BE UTILIZED FOR CONDENSATE DRAINS OF TEMP. DEHUMIDIFIERS INSTALLED UNDER TMOD WBN-1-2017-061-001.
9. NOT USED.
10. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
11. SOCK FILTERS MAY BE ADDED TO FLOOR DRAINS IN THE REACTOR BUILDING AS NECESSARY TO PREVENT DEBRIS AND SILT FROM ENTERING THE SYSTEM. THE SOCK FILTERS SHALL BE MONITORED AND REPLACED AS NECESSARY TO PREVENT RADIOACTIVE HOT SPOT, CRUD TRAPS, DAMAGE AND BLOCKAGE. THE FILTERS IN THE REACTOR BUILDING SHALL ONLY BE USED DURING AN OUTAGE AND BE REMOVED PRIOR TO RETURNING THE PLANT BACK TO SERVICE.
12. NOT USED.
13. NOT USED.
14. NOT USED.
15. FLOOR DRAIN AT EL 752.96 (LOCATED IN PIT BELOW RB1 EQPT HATCH) HAS A CAPPED PIPE NIPPLE ATTACHED TO THE BLOCKING PLATE.

NOTE A:
DRAINS ARE PERMANENTLY PLUGGED.
NOTE B:
HYDROSTATIC TEST PRESURE FOR CLASS C PIPING IS 150 PSI. HYDROSTATIC TEST PRESSURE FOR CLASS B PIPING IS 125 PSI PRESSURE FOR CLASS B PIPING IS 125 PSI AND NOTED ON DRAWING. CONST SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST. ASME CODE CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
NOTE C:
PNEUMATIC TEST MAY PERFORMED IN ACCORDANCE WITH ASME SECTION III AND ANSI B31.1 IN LIEU OF HYDROSTATIC TEST.

TVA REFERENCE DRAWINGS

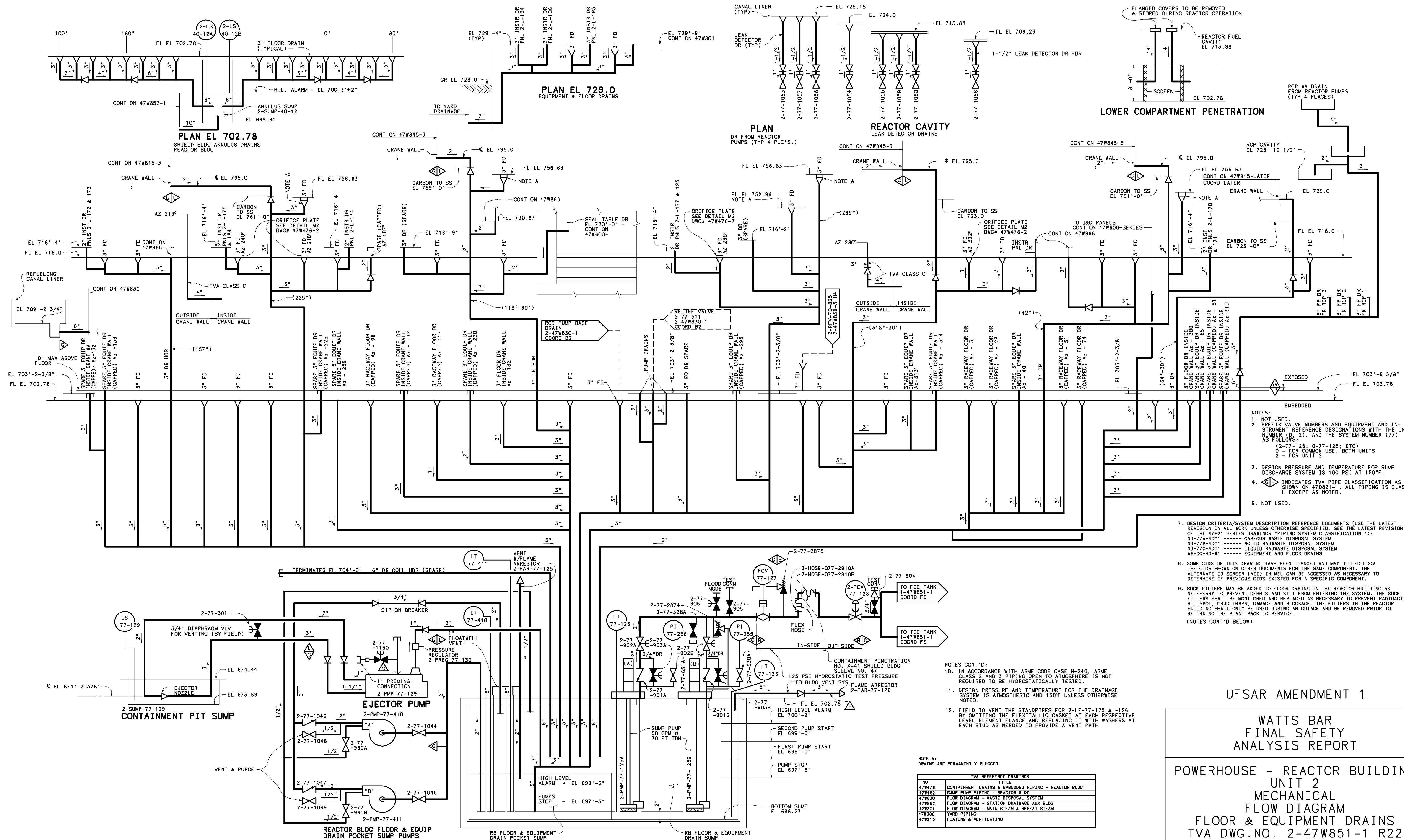
NO.	TITLE
47W476	CONTAINMENT DRAINS & EMBEDDED PIPING - REACTOR BLDG
47W482	SUMP PUMP PIPING - REACTOR BLDG
47W830	FLOW DIAGRAM - WASTE DISPOSAL SYSTEM
47W852	FLOW DIAGRAM - STATION DRAINAGE AUX BLDG
47W801	FLOW DIAGRAM - MAIN STEAM & REHEAT STEAM
17W300	YARD PIPING
47W915	HEATING & VENTILATING
47W851-101	STRESS ANALYSIS PROBLEM BOUNDARY FLOOR EQUIPMENT DRAINS

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
MECHANICAL
FLOW DIAGRAM
FLOOR & EQUIPMENT DRAINS
TVA DWG.NO. 1-47W851-1 R38
FIGURE 9.3-7

CAD MAINTAINED DRAWING



NOTES:

1. NOT USED.
2. PREFIX VALVE NUMBERS AND EQUIPMENT AND INSTRUMENT REFERENCE DESIGNATIONS WITH THE UNIT NUMBER (0, 2), AND THE SYSTEM NUMBER (77) AS FOLLOWS:
   (2-77-125; 0-77-125; ETC)
   0 - FOR COMMON USE, BOTH UNITS
   2 - FOR UNIT 2
3. DESIGN PRESSURE AND TEMPERATURE FOR SUMP DISCHARGE SYSTEM IS 100 PSI AT 150°F.
4. ⟨G|H⟩ INDICATES TVA PIPE CLASSIFICATION AS SHOWN ON 47B821-1. ALL PIPING IS CLASS L EXCEPT AS NOTED.

6. NOT USED.

7. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
   N3-77A-4001 ------ GASEOUS WASTE DISPOSAL SYSTEM
   N3-77B-4001 ------ SOLID RADWASTE DISPOSAL SYSTEM
   N3-77C-4001 ------ LIQUID RADWASTE DISPOSAL SYSTEM
   WB-DC-40-61 ------ EQUIPMENT AND FLOOR DRAINS
8. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN MEL CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
9. SOCK FILTERS MAY BE ADDED TO FLOOR DRAINS IN THE REACTOR BUILDING AS NECESSARY TO PREVENT DEBRIS AND SILT FROM ENTERING THE SYSTEM. THE SOCK FILTERS SHALL BE MONITORED AND REPLACED AS NECESSARY TO PREVENT RADIOACTIVE HOT SPOT, CRUD TRAPS, DAMAGE AND BLOCKAGE. THE FILTERS IN THE REACTOR BUILDING SHALL ONLY BE USED DURING AN OUTAGE AND BE REMOVED PRIOR TO RETURNING THE PLANT BACK TO SERVICE.

(NOTES CONT'D BELOW)

NOTES CONT'D:

10. IN ACCORDANCE WITH ASME CODE CASE N-240, ASME CLASS 2 AND 3 PIPING OPEN TO ATMOSPHERE IS NOT REQUIRED TO BE HYDROSTATICALLY TESTED.
11. DESIGN PRESSURE AND TEMPERATURE FOR THE DRAINAGE SYSTEM IS ATMOSPHERIC AND 150°F UNLESS OTHERWISE NOTED.
12. FIELD TO VENT THE STANDPIPES FOR 2-LE-77-125 & -126 BY OMITTING THE FLEXITALLIC GASKET AT EACH RESPECTIVE LEVEL ELEMENT FLANGE AND REPLACING IT WITH WASHERS AT EACH STUD AS NEEDED TO PROVIDE A VENT PATH.

NOTE A:
DRAINS ARE PERMANENTLY PLUGGED.

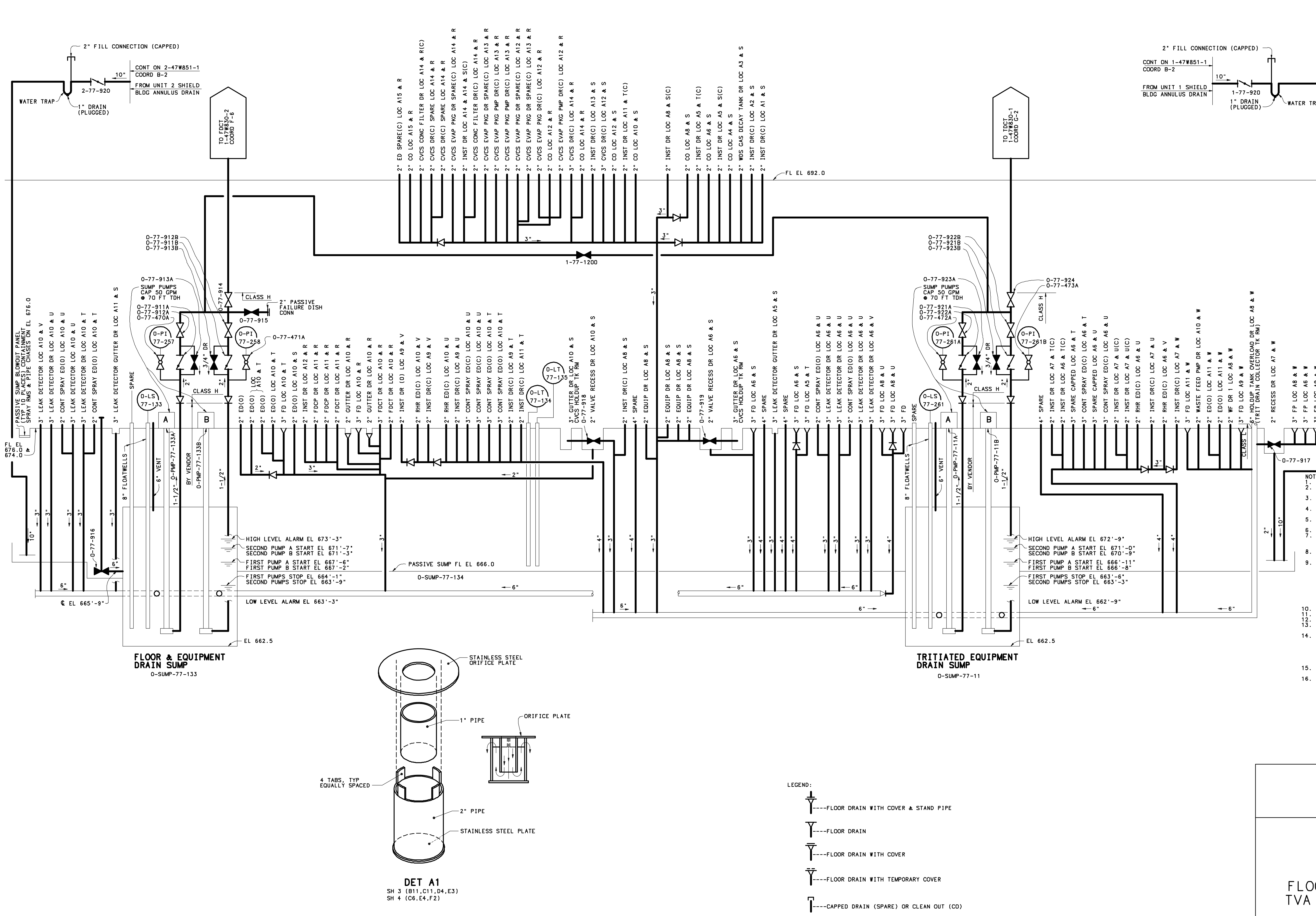
TVA REFERENCE DRAWINGS	
NO.	TITLE
47W476	CONTAINMENT DRAINS & EMBEDDED PIPING - REACTOR BLDG
47W482	SUMP PUMP PIPING - REACTOR BLDG
47W830	FLOW DIAGRAM - WASTE DISPOSAL SYSTEM
47W852	FLOW DIAGRAM - STATION DRAINAGE AUX BLDG
47W801	FLOW DIAGRAM - MAIN STEAM & REHEAT STEAM
17W300	YARD PIPING
47W915	HEATING & VENTILATING

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE - REACTOR BUILDING
UNIT 2
MECHANICAL
FLOW DIAGRAM
FLOOR & EQUIPMENT DRAINS
TVA DWG.NO. 2-47W851-1 R22
FIGURE 9.3-7(U2)

CAD MAINTAINED DRAWING



NOTES:

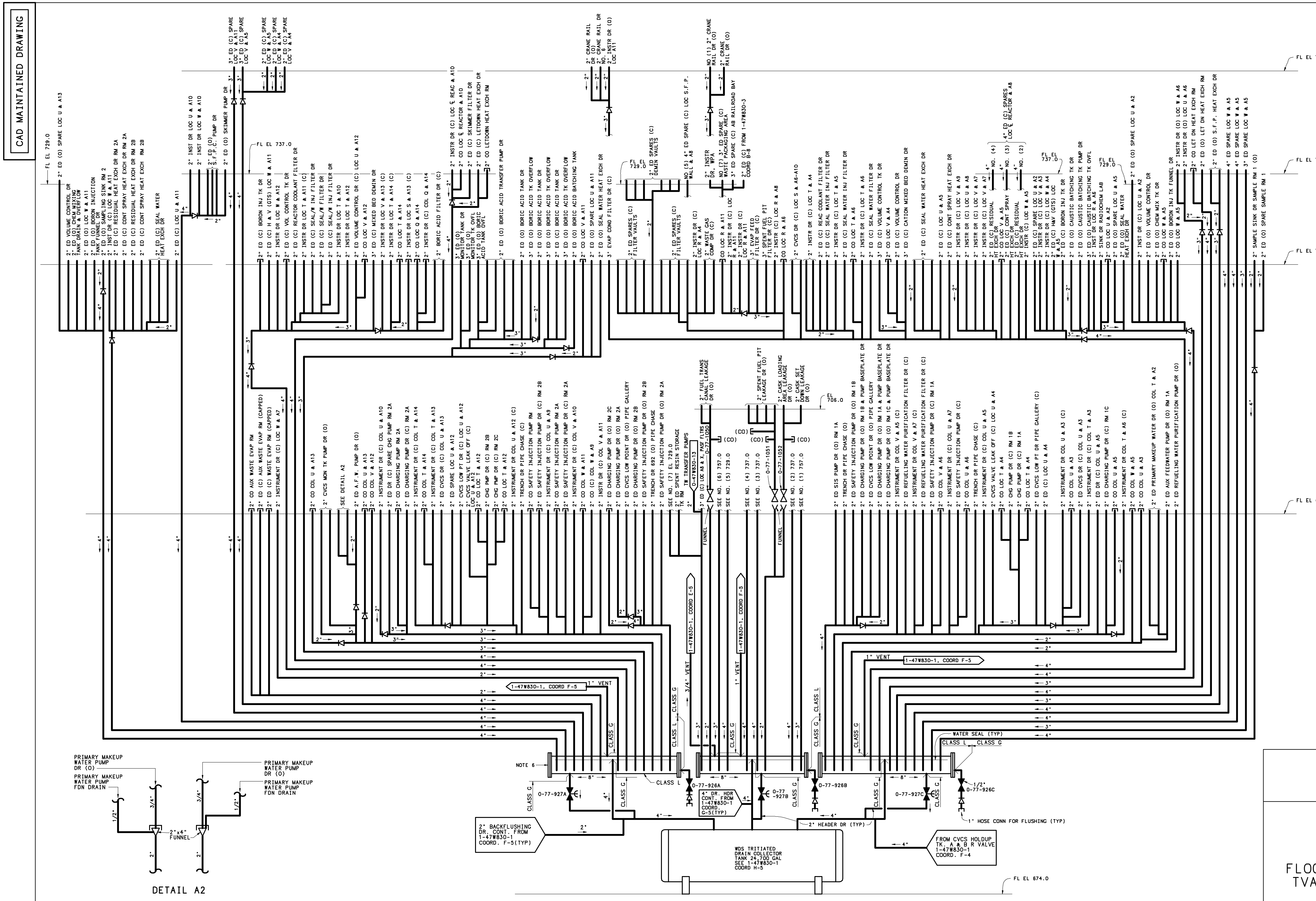
1. ALL VALVES ARE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
2. OPERATIONAL VALVES ARE SHOWN IN THEIR NORMAL OPERATING POSITION.
3. VALVE AND INSTRUMENT NUMBERS ARE COMMON TO ALL UNITS EXCEPT WHERE A PREFIX OF THE UNIT NUMBER IS ADDED.
4. DESIGN PRESSURE AND TEMPERATURE FOR THE ENTIRE DRAINAGE SYSTEM IS ATMOSPHERIC AND 150°F.
5. DRAINS SHALL BE TESTED FOR LEAKS ACCORDING TO TVA SPECIFICATIONS.
6. ALL PIPING TVA CLASS L EXCEPT AS NOTED.
7. REFER TO 47W479-1,7 & 14 FOR IDENTIFICATION OF SYSTEM PORTIONS OF CLASS G,H,K & L THAT REQUIRE THE HYDROSTATIC TEST TO BE UNDER THE QA PROGRAM.
8. DESIGN PRESSURE AND TEMPERATURE FOR SUMP DISCHARGE SYSTEM IS 100 PSI AT 150°F.
9. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION.")
   N3-77A-4001 ------- GASEOUS WASTE DISPOSAL SYSTEM
   N3-77B-4001 ------- SOLID RADWASTE DISPOSAL SYSTEM
   N3-77C-4001 ------- LIQUID RADWASTE DISPOSAL SYSTEM
   WB-DC-40-61 ------- EQUIPMENT AND FLOOR DRAINS
10. NOT USED.
11. NOT USED.
12. NOT USED.
13. THIS TRAP SHALL HAVE WATER ADDED TO IT PERIODICALLY TO INSURE THAT THE WATER SEAL IS MAINTAINED.
14. SOCK FILTERS MAY BE ADDED TO FLOOR DRAINS IN THE AUXILIARY BUILDING AS NECESSARY TO PREVENT DEBRIS AND SILT FROM ENTERING THE SYSTEM. THE SOCK FILTERS SHALL BE MONITORED AND REPLACED AS NECESSARY TO PREVENT RADIOACTIVE HOT SPOT, CRUD TRAPS, DAMAGE AND BLOCKAGE.
15. EQUIPMENT DRAINS NOT IN USE MAY BE CAPPED PER NOTES ON PHYSICAL DWG 47W479-1.
16. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08, CONTROL OF UNIT INTERFACES.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

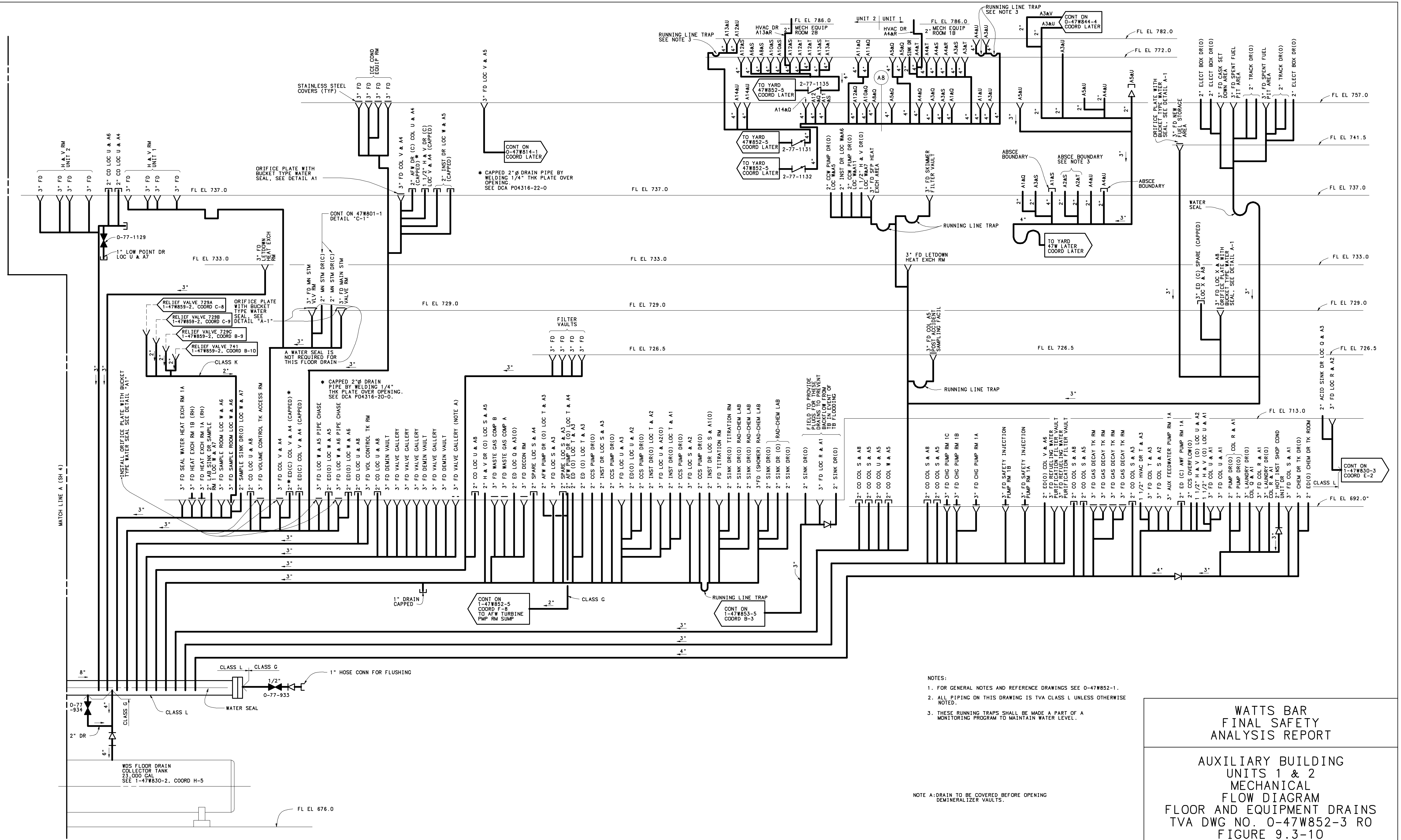
POWERHOUSE
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
FLOOR & EQUIPMENT DRAINS
TVA DWG NO. 0-47W852-1 R1
FIGURE 9.3-8

NOTES:
1. FOR GENERAL NOTES AND REFERENCE DRAWINGS, SEE 0-47W852-1.
2. ALL PIPING ON THIS DRAWING IS TVA CLASS L, UNLESS OTHERWISE NOTED.
3. WHEN REMOVING ANY EQUIPMENT FROM UNIT 2 BE SURE TO CAP THE DRAIN LINE TO PREVENT AIRBORNE RADIOACTIVE RELEASE FROM POSSIBLE COMMON EQUIPMENT WHICH MAY BE USING THE SAME DRAIN HEADER.
4. NOT USED.
5. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08, CONTROL OF UNIT INTERFACES.
6. THE HEADER IS TO BE TREATED AS A TI-12.08 INTERFACE BETWEEN UNITS 1 AND 2 TO ALLOW RECONNECTION OF U2 DRAINS IN PREPARATION FOR U2 OPERATION.



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
FLOOR AND EQUIPMENT DRAINS
TVA DWG NO. 0-47W852-2 R1
FIGURE 9.3-9



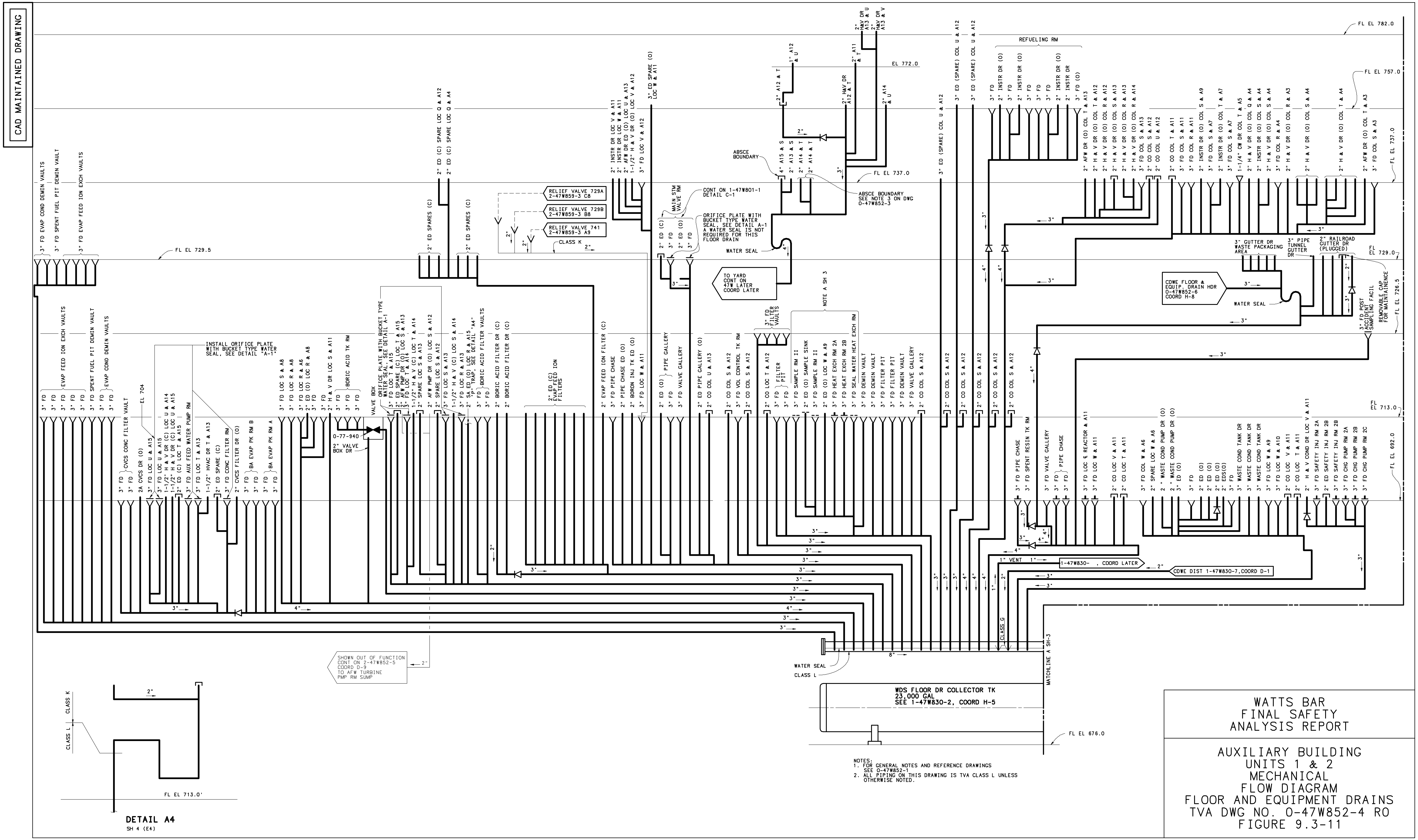
NOTES:

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W852-1.
2. ALL PIPING ON THIS DRAWING IS TVA CLASS L UNLESS OTHERWISE NOTED.
3. THESE RUNNING TRAPS SHALL BE MADE A PART OF A MONITORING PROGRAM TO MAINTAIN WATER LEVEL.

NOTE A: DRAIN TO BE COVERED BEFORE OPENING DEMINERALIZER VAULTS.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

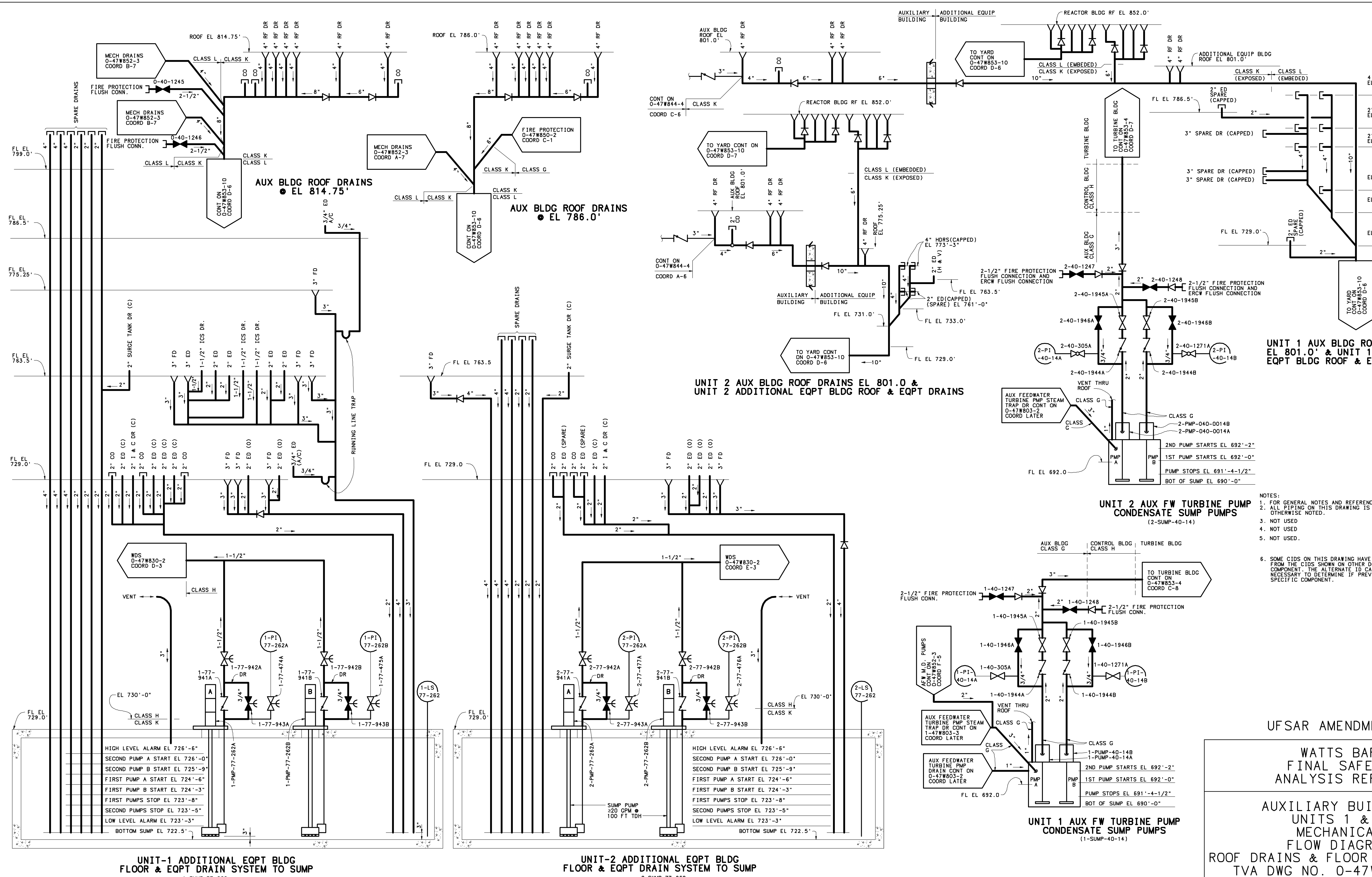
AUXILIARY BUILDING
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
FLOOR AND EQUIPMENT DRAINS
TVA DWG NO. 0-47W852-3 R0
FIGURE 9.3-10



NOTES:
1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W852-1
2. ALL PIPING ON THIS DRAWING IS TVA CLASS L UNLESS OTHERWISE NOTED.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
FLOOR AND EQUIPMENT DRAINS
TVA DWG NO. 0-47W852-4 RO
FIGURE 9.3-11



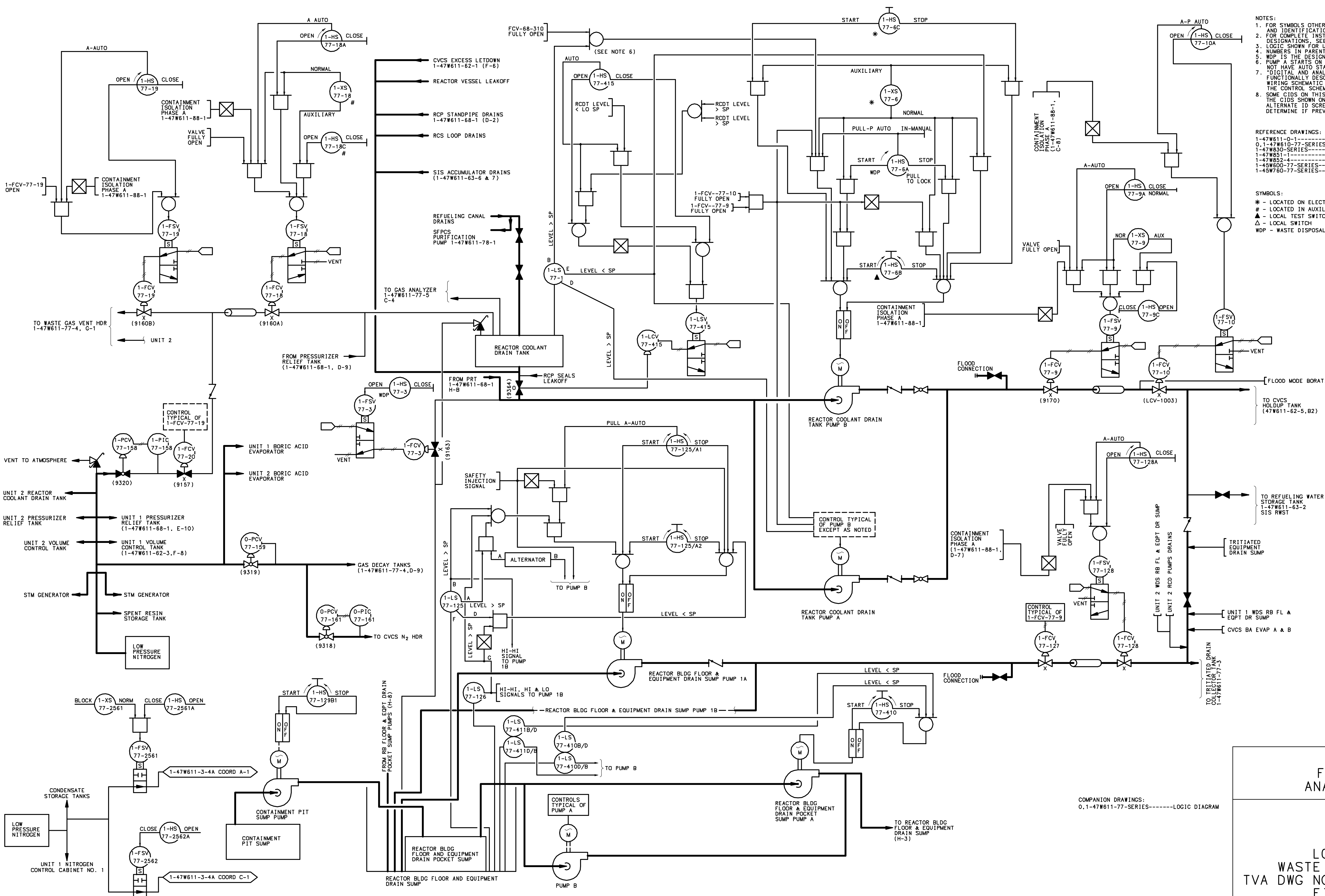
NOTES:

1. FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W852-1.
2. ALL PIPING ON THIS DRAWING IS TVA CLASS L UNLESS OTHERWISE NOTED.
3. NOT USED
4. NOT USED
5. NOT USED.
6. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
MECHANICAL
FLOW DIAGRAM
ROOF DRAINS & FLOOR EQPT DRAINS
TVA DWG NO. 0-47W852-5 R1
FIGURE 9.3-12



NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTED BELOW, SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS, SEE CONTROL DIAGRAM, 1-47W610-77-SERIES.
3. LOGIC SHOWN FOR UNIT 1, TYPICAL FOR UNIT 2, EXCEPT AS NOTED.
4. NUMBERS IN PARENTHESIS ARE WESTINGHOUSE DEVICE NUMBERS.
5. WDP IS THE DESIGNATION FOR WASTE DISPOSAL PANEL.
6. PUMP A STARTS ON HI LEVEL INSTEAD OF HI-HI LEVEL, AND DOES NOT HAVE AUTO START WHEN FCV-68-310 IS OPENED.
7. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME"
8. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

REFERENCE DRAWINGS:

1-47W611-0-1---------LOGIC DIAGRAM INDEX & SYMBOLS
0,1-47W610-77-SERIES---CONTROL DIAGRAM
1-47W830-SERIES------FLOW DIAGRAM-WASTE DISPOSAL
1-47W851-1-----------FLOW DIAGRAM-REACT BLDG DRAINAGE
1-47W852-4-------------FLOW DIAGRAM-AUX BLDG DRAINAGE
1-45W600-77-SERIES---SCHEMATIC DIAGRAM
1-45W760-77-SERIES---SCHEMATIC DIAGRAM

SYMBOLS:

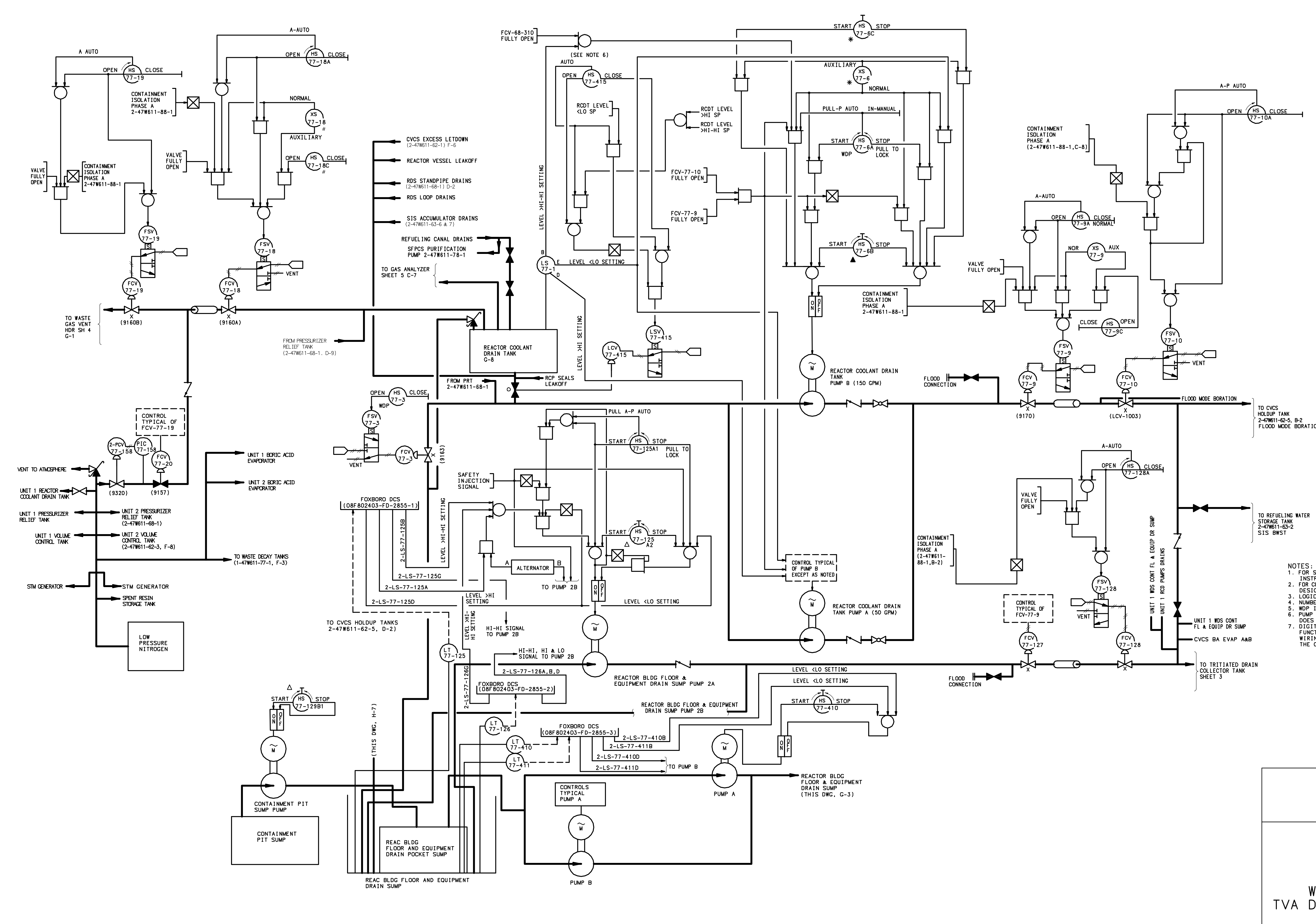
* - LOCATED ON ELECTRICAL SWITCHGEAR
# - LOCATED IN AUXILIARY CONTROL ROOM
▲ - LOCAL TEST SWITCH
△ - LOCAL SWITCH
WDP - WASTE DISPOSAL PANEL

COMPANION DRAWINGS:
0,1-47W611-77-SERIES-------LOGIC DIAGRAM

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
WASTE DISPOSAL SYSTEM
TVA DWG NO. 1-47W611-77-1 R10
FIGURE 9.3-13

CAD MAINTAINED DRAWING



SYMBOLS:
* - LOCATED ON ELECTRICAL SWITCHGEAR
# - LOCATED IN AUXILIARY CONTROL ROOM
△ - LOCAL TEST SWITCH
▲ - LOCAL SWITCH

REFERENCE DRAWINGS:
0,1,2-47W611-77-SERIES------------LOGIC DIAGRAM
0,1,2-47W610-77-SERIES----------CONTROL DIAGRAM
47W830-1/6------FLOW DIAGRAM-WASTE DISPOSAL
47W851-1---FLOW DIAGRAM-REACT BLDG DRAINAGE
47W852-1-4---FLOW DIAGRAM-AUX BLDG DRAINAGE

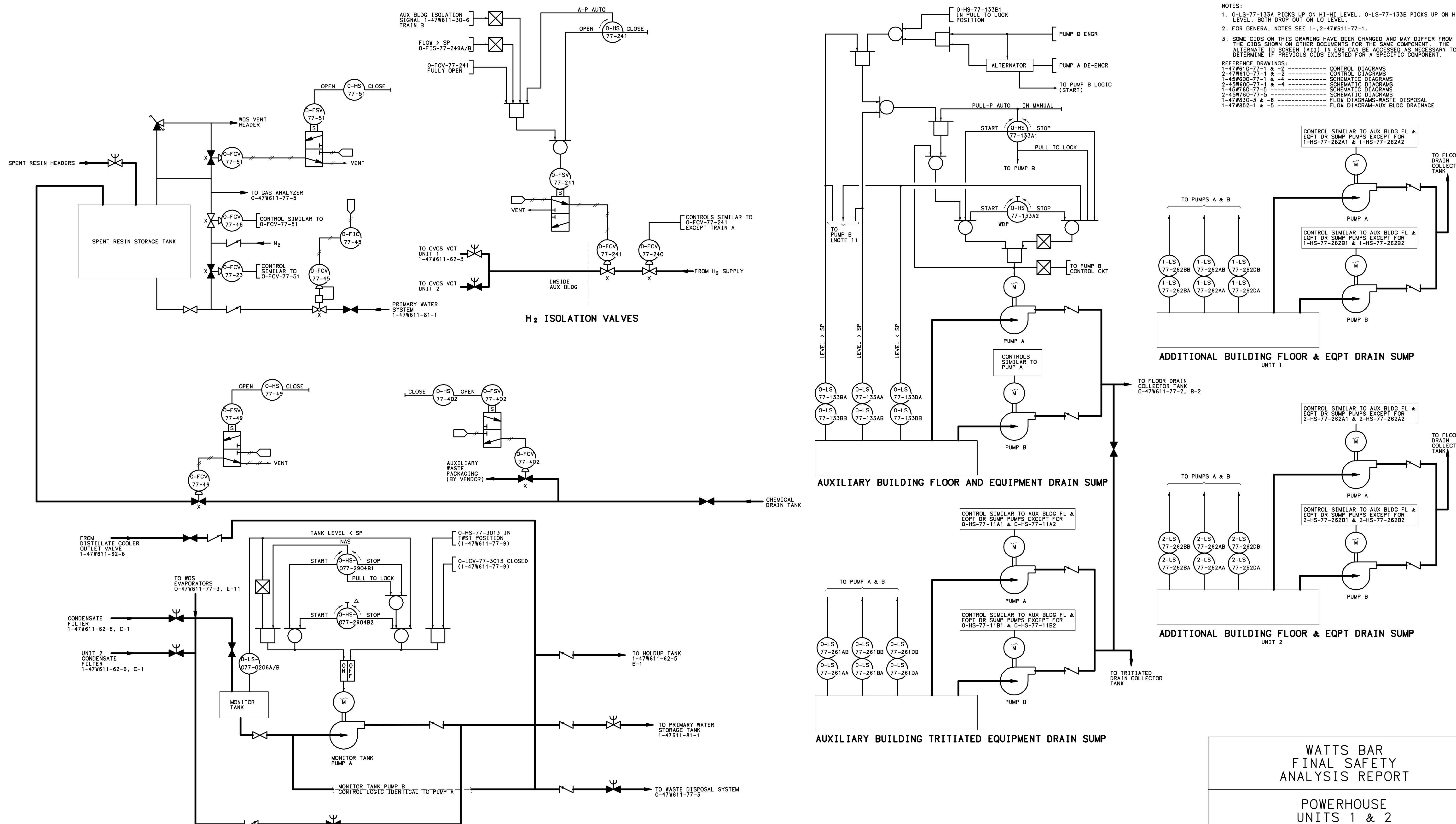
NOTES:
1. FOR SYMBOLS OTHER THAN THOSE NOTED ABOVE,SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS, SEE CONTROL DIAGRAM 2-47W610-77.
3. LOGIC SHOWN FOR UNIT 2, EXCEPT AS NOTED.
4. NUMBERS IN PARENTHESIS ARE WESTINGHOUSE DEVICE NUMBERS.
5. WDP IS THE DESIGNATION FOR WASTE DISPOSAL PANEL.
6. PUMP A STARTS ON HI LEVEL INSTEAD OF HI-HI LEVEL, AND DOES NOT HAVE AUTO START WHEN FCV-68-310 IS OPEN.
7. DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
WASTE DISPOSAL SYSTEM
TVA DWG NO. 2-47W611-77-1 R13
FIGURE 9.3-13(U2)

CAD MAINTAINED DRAWING



NOTES:

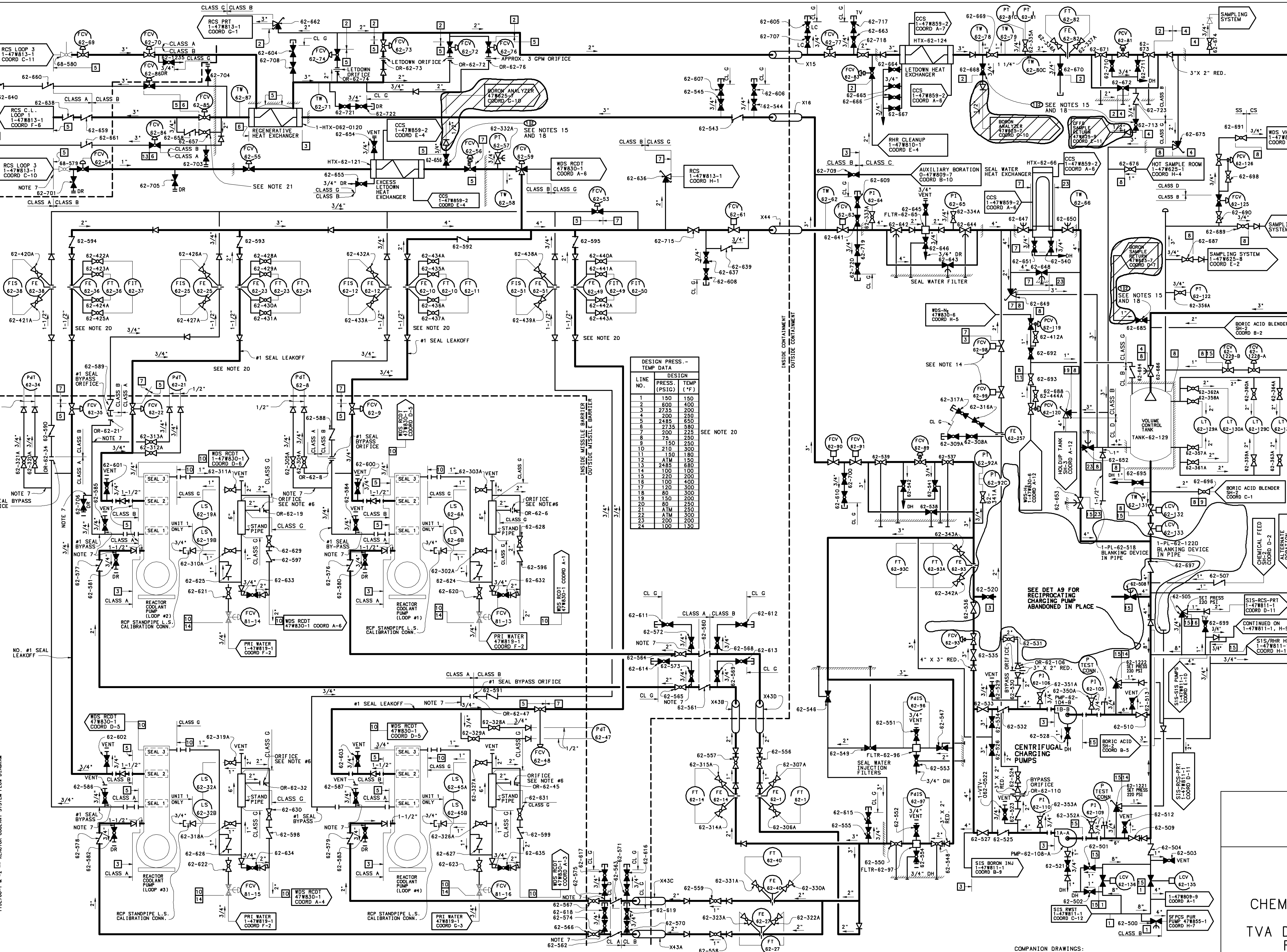
1. 0-LS-77-133A PICKS UP ON HI-HI LEVEL. 0-LS-77-133B PICKS UP ON HI LEVEL. BOTH DROP OUT ON LO LEVEL.
2. FOR GENERAL NOTES SEE 1-,2-47W611-77-1.
3. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

REFERENCE DRAWINGS:
1-47W610-77-1 & -2 ------------ CONTROL DIAGRAMS
2-47W610-77-1 & -2 ------------ CONTROL DIAGRAMS
1-45W600-77-1 & -4 ------------ SCHEMATIC DIAGRAMS
2-45W600-77-1 & -4 ------------ SCHEMATIC DIAGRAMS
1-45W760-77-5 ----------------- SCHEMATIC DIAGRAMS
2-45W760-77-5 ----------------- SCHEMATIC DIAGRAMS
1-47W830-3 & -6 --------------- FLOW DIAGRAMS-WASTE DISPOSAL
1-47W852-1 & -5 --------------- FLOW DIAGRAM-AUX BLDG DRAINAGE

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
WASTE DISPOSAL SYSTEM
TVA DWG NO. 0-47W611-77-7 R0
FIGURE 9.3-14

CAD MAINTAINED DRAWING



DESIGN PRESS.- TEMP DATA		
LINE NO.	DESIGN	
	PRESS. (PSIG)	TEMP (°F)
1	150	150
2	600	400
3	2735	200
4	200	250
5	2485	650
6	2735	580
7	200	225
8	75	250
9	150	250
10	210	300
11	150	180
12	ATM	150
13	2485	680
14	100	100
15	220	200
16	100	400
17	120	300
18	80	300
19	150	200
20	80	250
21	ATM	250
22	ATM	300
23	200	200
24	100	130

SEE NOTE 20

NOTES:

1. ALL VALVES ARE THE SAME SIZE AS THE PIPING UNLESS OTHERWISE NOTED.
2. TV AND TC DENOTE "TEST VENT" AND "TEST CONNECTION".
3. FLOW DIAGRAM FOR UNIT 1 SHOWN.
4. ALL PIPE CLASS B UNLESS OTHERWISE NOTED.
5. "D" DENOTES LOCAL DRAIN; "DH" DENOTES DRAIN HEADER: AND "V" DENOTES VENT.
6. THE ORIFICE IS LOCATED A MINIMUM OF 7 FT ABOVE THE RCP CONN.
7. SPECIAL TRANSITION PIECE (3/8" ID FLOW RESTRICTOR) REQUIRED FOR TRANSITION FROM CLASS A SYSTEM TO CLASS B.
8. [1], ETC, INDICATES LINE NO. CORRESPONDING TO DESIGN PRESSURE AND TEMPERATURE CHART ON THIS SHEET.
9. ALL INSTRUMENTS CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
10. ALL INSTRUMENT VALVES ARE 3/4" UNLESS OTHERWISE NOTED.
11. SAFETY CLASS (I.E.,CLASS A,B, AND C) PIPING SHALL BE HYDROSTATICALLY TESTED TO 1.25 TIMES DESIGN PRESSURE. ALL NON-SAFETY RELATED PIPING SHALL BE TESTED TO 1.5 TIMES DESIGN PRESSURE. CONSTRUCTION SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST ASME CODE. CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
12. FOR DEFINITIONS OF SYMBOLS OF "LC" OR "LO", REFER TO MEMO B26850402001.
13. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."): N3-62-4001---------CHEMICAL VOLUME AND CONTROL SYSTEM
14. VALVES #1-FCV-62-98 AND 1-FCV-62-99 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION. (WITH BREAKER OPEN) (APPENDIX R)
15. (1/2) & [1/2] DENOTE UNIT 1 & UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
16. SEE CALCULATION EPM-GRS-032293 FOR REVIEW AND ACCEPTANCE OF VALVES USED WHERE DESIGN PRESSURE AND TEMPERATURE HAVE CHANGED PER DCN S-21156-B. FOR W SUPPLIED VALVES SEE WAT-D-9224 (RIMS NO. T33 930308 978) FOR ACCEPTANCE OF VALVES WHERE DESIGN PRESSURE AND TEMPERATURE HAVE CHANGED FROM PREVIOUS DESIGN CONDITIONS.
17. FOR TVA CLASS B,C & D PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS, TEST CONNECTIONS & VALVE STEM LEAKOFF PIPING IS TVA CLASS H,UNLESS OTHERWISE NOTED. THIS NOTE APPLIES TO SH 1 & 9
18. WITH THE VALVE CLOSED, THE HANDWHEEL SHALL BE LOCKED CLOSED OR REMOVED.
19. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
20. THE DESIGN PRESSURE AND TEMPERATURE RATINGS OF THE RCP SEAL LEAKOFF LINES BETWEEN ISOLATION VALVES WBN-1-FCV-062-0009, 0022, 0035 AND 0048, AND FLOW MEASURING ORIFICES WBN-FE-062-0010, 0023, 0036 AND 0049 MAY BE EXCEEDED DURING A STATION BLACKOUT (SBO) EVENT. AN EVALUATION OF THE ACCEPTABILITY OF THE LINES FOR THE NON-DESIGN BASIS SBO EVENT IS DOCUMENTED IN CALCULATION EPMMA041592.
21. VALVE 1-BYV-062-0657-S HAS BEEN DISABLED BY DRILLING HOLES IN THE VALVE DISC TO ELIMINATE ITS ISOLATION CAPABILITY IN ORDER TO ASSURE ASME CODE REQUIREMENTS ARE MET. SEE DCN W-32637-A.

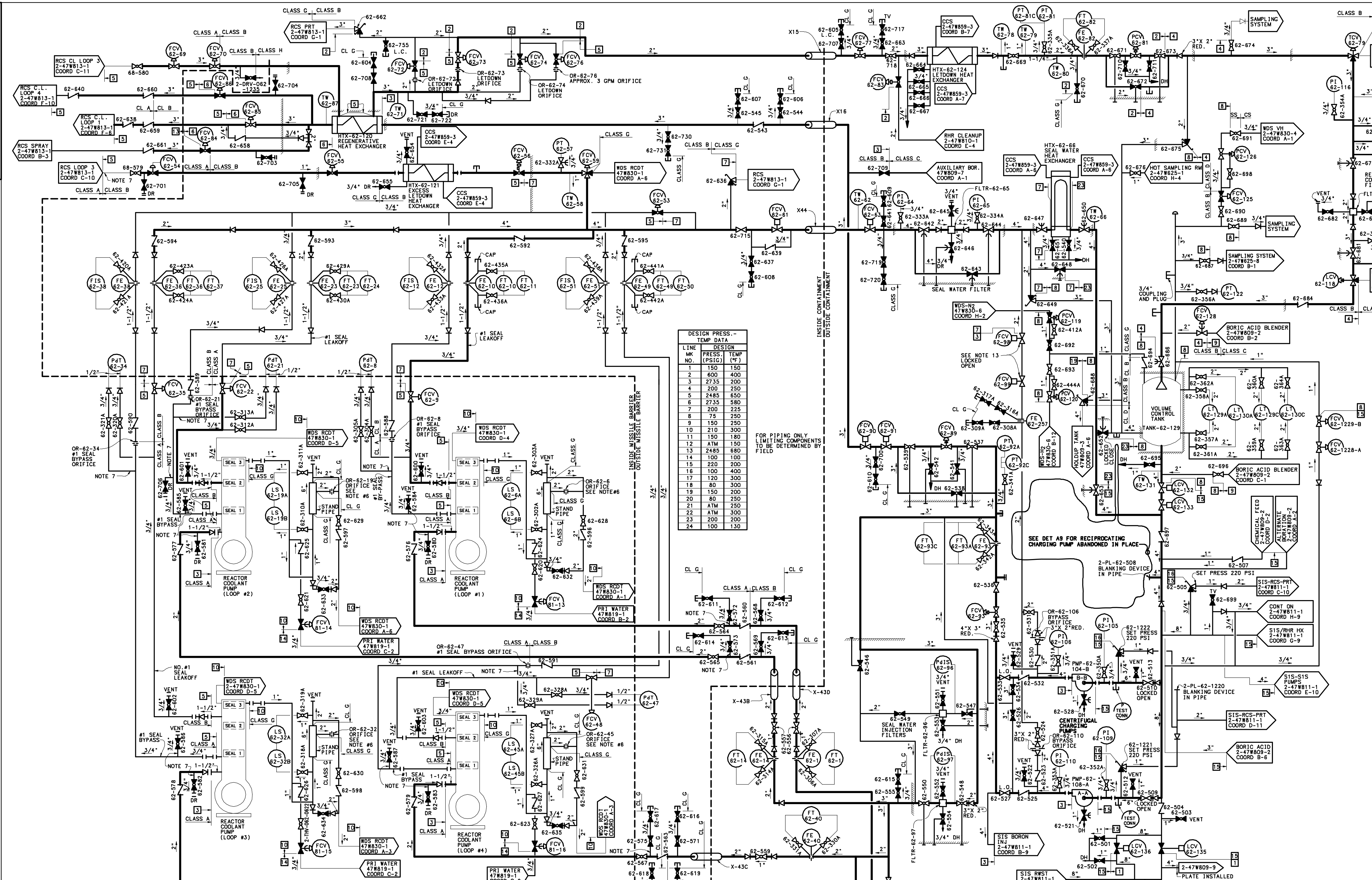
REFERENCE DRAWINGS:
TVA
30B617 SERIES DWGS - INSTRUMENTATION SYMBOLS & IDENTIFICATION
47W800-1 ------------ FLOW DIAGRAM GENERAL PLANT SYSTEMS
47B601-62-1-27 ------ INSTRUMENT TABULATION
47W611-62-1 --------- LOGIC DIAGRAM
47W809-100 ---------- SERIES STRESS ANALYSIS PROBLEM BOUNDARY
47W406 SERIES ------- CHEMICAL & VOLUME CONTROL SYSTEM PIPING
47W610-62-1-6 ------- CONTROL DIAGRAM
47W555 SERIES ------- CHEMICAL & VOLUME CONTROL SYSTEM PIPING (BORON RECYCLE & BORIC ACID)
92QL062 SERIES------- Q LIST

WESTINGHOUSE
113E789-1 & -2 -- CHEMICAL AND VOLUME CONTROL SYSTEM FLOW DIAGRAM
113E788-1 & -2 -- REACTOR COOLANT SYSTEM FLOW DIAGRAM

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
FLOW DIAGRAM
CHEMICAL & VOLUME CONTROL
SYSTEM
TVA DWG NO. 1-47W809-1 R67
FIGURE 9.3-15 SH 1

CAD MAINTAINED DRAWING



DESIGN PRESS.- TEMP DATA		
LINE MK NO.	DESIGN PRESS. (PSIG)	DESIGN TEMP (°F)
1	150	150
2	600	400
3	2735	200
4	200	250
5	2485	650
6	2735	580
7	200	225
8	75	250
9	150	250
10	210	300
11	150	180
12	ATM	150
13	2485	680
14	100	100
15	220	200
16	100	400
17	120	300
18	80	300
19	150	200
20	80	250
21	ATM	250
22	ATM	300
23	200	200
24	100	130

NOTES:

1. ALL VALVES ARE THE SAME SIZE AS THE PIPING UNLESS OTHERWISE NOTED.
2. TV AND TC DENOTE "TEST VENT" AND "TEST CONNECTION".
3. FLOW DIAGRAM FOR UNIT 2 SHOWN.
4. ALL PIPE CLASS B UNLESS OTHERWISE NOTED.
5. "D" DENOTES LOCAL DRAIN; "DH" DENOTES DRAIN HEADER: AND "V" DENOTES VENT.
6. THE ORIFICE IS LOCATED A MINIMUM OF 7 FT ABOVE THE RCP CONN.
7. SPECIAL TRANSITION PIECE (3/8" ID FLOW RESTRICTOR) REQUIRED FOR TRANSITION FROM CLASS A SYSTEM TO CLASS B.
8. [1] ,ETC, INDICATES LINE NO. CORRESPONDING TO DESIGN PRESSURE AND TEMPERATURE CHART ON THIS SHEET.
9. ALL INSTRUMENTS CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
10. ALL INSTRUMENT VALVES ARE 3/4" UNLESS OTHERWISE NOTED.
11. SAFETY CLASS (I.E.,CLASS A,B, AND C) PIPING SHALL BE HYDROSTATICALLY TESTED TO 1.25 TIMES DESIGN PRESSURE. ALL NON-SAFETY RELATED PIPING SHALL BE TESTED TO 1.5 TIMES DESIGN PRESSURE. CONSTRUCTION SHALL DETERMINE IF THE COMPONENTS IN THE SYSTEM ARE LIMITING COMPONENTS TO THE HYDROSTATIC TEST ASME CODE. CASES INVOLVING HYDROSTATIC TESTING MAY BE USED IF EN DES APPROVES THEIR APPLICATION. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
12. FOR DEFINITIONS OF SYMBOLS OF "LC" OR "LO",REFER TO MEMO B26850402001.
13. VALVES 2-FCV-62-98 AND 2-FCV-62-99 ARE LOCKED IN THE OPEN POSITION. (WITH POWER REMOVED AND HANDWHEEL LOCKED) (APPENDIX R) (NRC BTP ICSB 18).
14. FOR TVA CLASS B,C & D PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS, & TEST CONNECTIONS IS CLASS H, UNLESS OTHERWISE NOTED. THIS NOTE APPLIES TO SH 1 & 9.
15. ALL VALVE STEM LEAKOFF PIPING INSIDE CONTAINMENT SHALL BE TVA CLASS G.
16. ALL VALVE STEM LEAKOFF PIPING OUTSIDE CONTAINMENT SHALL BE TVA CLASS H.

REFERENCE DRAWINGS:

TVA
30B617 SERIES DWGS --- INSTRUMENTATION SYMBOLS & IDENTIFICATION
47W800-1 ------------- FLOW DIAGRAM GENERAL PLANT SYSTEM
47B601-62-1-27 ------- INSTRUMENT TABULATION
47W611-62-1 ---------- LOGIC DIAGRAM
47B21-1 -------------- PIPING SYSTEMS CLASSIFICATION
47W406 SERIES -------- CHEMICAL & VOLUME CONTROL SYSTEM PIPING
47W610-62-1-6 -------- CONTROL DIAGRAM
47W555 SERIES -------- CHEMICAL & VOLUME CONTROL SYSTEM PIPING (BORON RECYCLE & BORIC ACID)
WBN2-62-4001 --------- SYSTEM DESCRIPTION CHEMICAL AND VOLUME CONTROL SYSTEM.

WESTINGHOUSE
113E789-1 & -2 -------- CHEMICAL AND VOLUME CONTROL SYSTEM FLOW DIAGRAM
113E788-1 & -2 ------- REACTOR COOLANT SYSTEM FLOW DIAGRAM

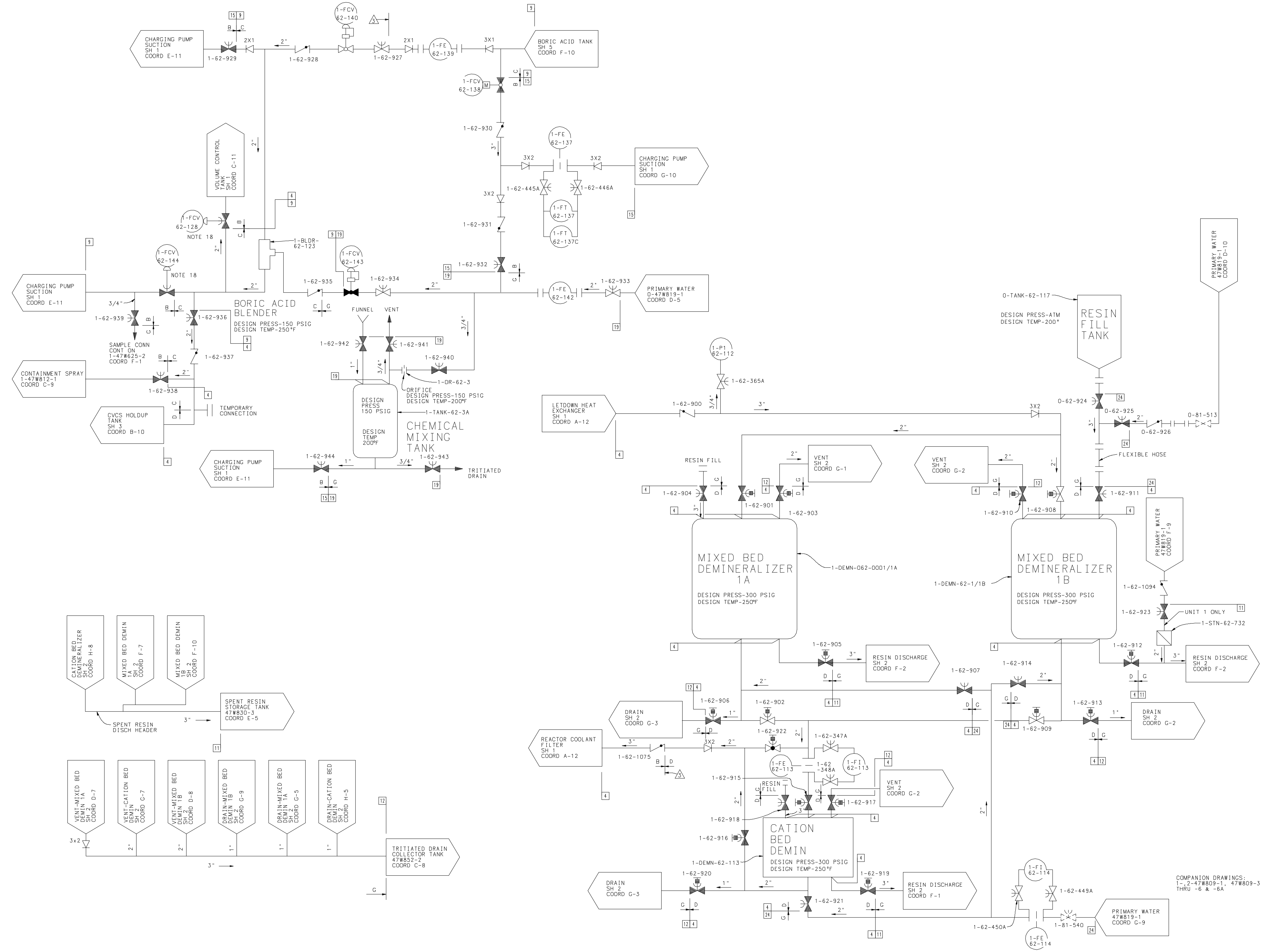
COMPANION DRAWINGS:
2-47W809-1 THRU 6, 6A & 9

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
FLOW DIAGRAM
CHEMICAL & VOLUME CONTROL
SYSTEM
TVA DWG NO. 2-47W809-1 R45
FIGURE 9.3-15 SH 1(U2)

CAD MAINTAINED DRAWING



COMPANION DRAWINGS: 1-,2-47W809-1, 47W809-3 THRU -6 & -6A

NOTES:

1. FOR ADDITIONAL NOTES, SEE SH 1.
2. NOT USED.
3. PIPING ON SHEETS 2 THRU 6 IS TVA CLASS B, C, D, G, OR L.
4. CLASS CHANGES ARE SHOWN IN THE TYPICAL MANNER
5. PIPING SHOWN IN THIS MANNER IS ELECTRICALLY HEAT TRACED.
6. ALL TVA PIPING SHOWN ON SHEETS 2 THRU 6 IS DESIGNED FOR 150 PSIG AND 200°F ON 2" DIAMETER AND SMALLER, AND FOR 210 PSIG AND 300°F ON 3" DIAMETER AND LARGER. EXCEPT AS SHOWN BY □, SEE LINE NO. TABLE ON SHEET 1. DESIGN OF SKID MOUNTED PIPING FOR THE GAS STRIPPER BORIC ACID EVAPORATOR PACKAGE IS BY THE VENDOR.
7. DESIGN PRESSURE AND TEMPERATURE FOR INDIVIDUAL TANKS AND COMPONENTS IS GIVEN IN THE VICINITY OF THE ITEM.
8. THE OPERATING TEMPERATURE FOR ALL HEAT TRACED PIPING AND EQUIPMENT IS 165°F.
9. VALVES SHOWN IN THIS MANNER ARE PROVIDED WITH EXTENSION STEM VALVE OPERATORS.
10. ARROW BLOCKS INDICATE LOCATION OF INTERFACES ON THIS SERIES OF DRAWINGS AND ON OTHER RELATED DRAWINGS.
11. DELETED
13. ALL CLASS "G" PIPING IS SEISMICALLY SUPPORTED AND NON QA UNLESS OTHERWISE NOTED. WHERE NOTED, CLASS "G" PIPING IS TO BE HYDROSTATICALLY TESTED WITHIN THE QA PROGRAM.
14. ALL WELDING TO AND INSPECTION AND DOCUMENTATION OF THE VENT CONDENSER, DISTILLATE COOLER AND EVAP. CONDENSER SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS FOR TVA CLASS "C".
15. WHERE THIS NOTE IS REFERENCED, ALL FIELD FABRICATION, ASSEMBLY, EXAMINATION AND TESTS FOR PIPING SYSTEMS PERFORMED AFTER ISSUANCE OF R-10 OF THIS FLOW DIAGRAM AND ALL WORK REQUIRED BY ECN 3815 SHALL BE WITHIN THE REQUIREMENTS OF GENERAL CONSTRUCTION SPECIFICATION NO. G-69.
16. DOWNGRADE TO NON NUCLEAR SAFETY CLASS AT THIS POINT IS BASED ON AN EXISTING STATIC LEG IN THE PIPING CONFIGURATION. SEE EN DES CALCS BRS DOWNGRADE (NEB840426-700) PRIOR TO ANY PIPING CONFIGURATION REVISION.
17. L.O.=LOCKED OPEN. CONCURRENT CLOSURE OF 1-ISV-62-953 AND 2-ISV-62-953 IS NOT PERMITTED. CONCURRENT CLOSURE OF 1-ISV-62-957 AND 2-ISV-62-957 IS NOT PERMITTED UNLESS THE SPENT RESIN STORAGE TANK (SRST), GAS ANALYZERS, AND WASTE GAS COMPRESSORS A & B ARE TAGGED OUT FOR THE DURATION OF THE CONCURRENT CLOSURE OF 1-ISV-62-957 AND 2-ISV-62-957. 0-ISV-62-1080 CLOSURE IS PERMITTED ONLY WHILE UNIT 2 IS UNDER CONSTRUCTION WITH UNIT 1 OPERATIONAL. AFTER UNIT 2 BECOMES OPERATIONAL 0-ISV-62-1080 IS TO REMAIN LOCKED OPEN UNLESS PRIOR APPROVAL IS OBTAINED FROM NUCLEAR ENGINEERING.
18. VALVES REFERENCING THIS NOTE WILL HAVE THE VALVE "DIAPHRAGM SUPPORT SHEET" REMOVED. THESE VALVES ARE LIMITED TO A MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 225 PSIG AND 200°F OR LESS FOR 3" AND 4" VALVES AND 150 PSIG AND 200°F OR LESS FOR 2" AND BELOW. VALVES 3" AND ABOVE ARE QUALIFIED FOR DESIGN PRESSURE AND TEMPERATURE ON LIMITED TIME BASIS (48 HOURS PER RIMS B26 88 0105 957). NO OPERATING CONDITIONS EXCEED THESE PARAMETERS PER OPERATING MODE CALCULATION (B26 85 0724 014) PROBLEM N3-62-5A.
19. ALL PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS AND TEST CONNECTIONS IS TVA CLASS G UNLESS OTHERWISE NOTED. THIS NOTE APPLIES TO SHEETS 2 THROUGH 6 ONLY.
20. NOT USED.
21. (1|2) & [1|2] DENOTE UNIT 1 & UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
22. UNIT 1/UNIT 2 INTERFACE POINTS ARE INDICATED BY (1|2) = SAFETY RELATED AND [1|2] = NON-SAFETY RELATED. WHEN MANUAL VALVES ARE USED, NON-SAFETY RELATED INDICATES THE HANDWHEELS ARE REMOVED AND SAFETY RELATED INDICATES THE VALVE IS LOCKED CLOSED. WHEN A MOTOR OPERATED VALVE IS USED, THE VALVE IS CLOSED, ELECTRICAL MOTIVE POWER IS DISCONNECTED AND THE MANUAL OPERATOR IS DISABLED. WHEN AN AIR OPERATED VALVE IS USED, THE VALVE IS CLOSED, THE AIR SUPPLY IS ISOLATED BY CLOSING THE AIR SYSTEM ROOT VALVE, SOLENOIDS MAY BE DEENERGIZED AND HAND OPERATING MECHANISM (IF ANY) IS DISABLED. WHEN AN EXISTING FLANGE PAIR IS AVAILABLE, THE INTERFACE POINT CAN BE IMPLEMENTED BY BOLTING IN A BLANK PLATE, AS WAS DONE AT THE EDUCTORS.
23. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

UFSAR AMENDMENT 1

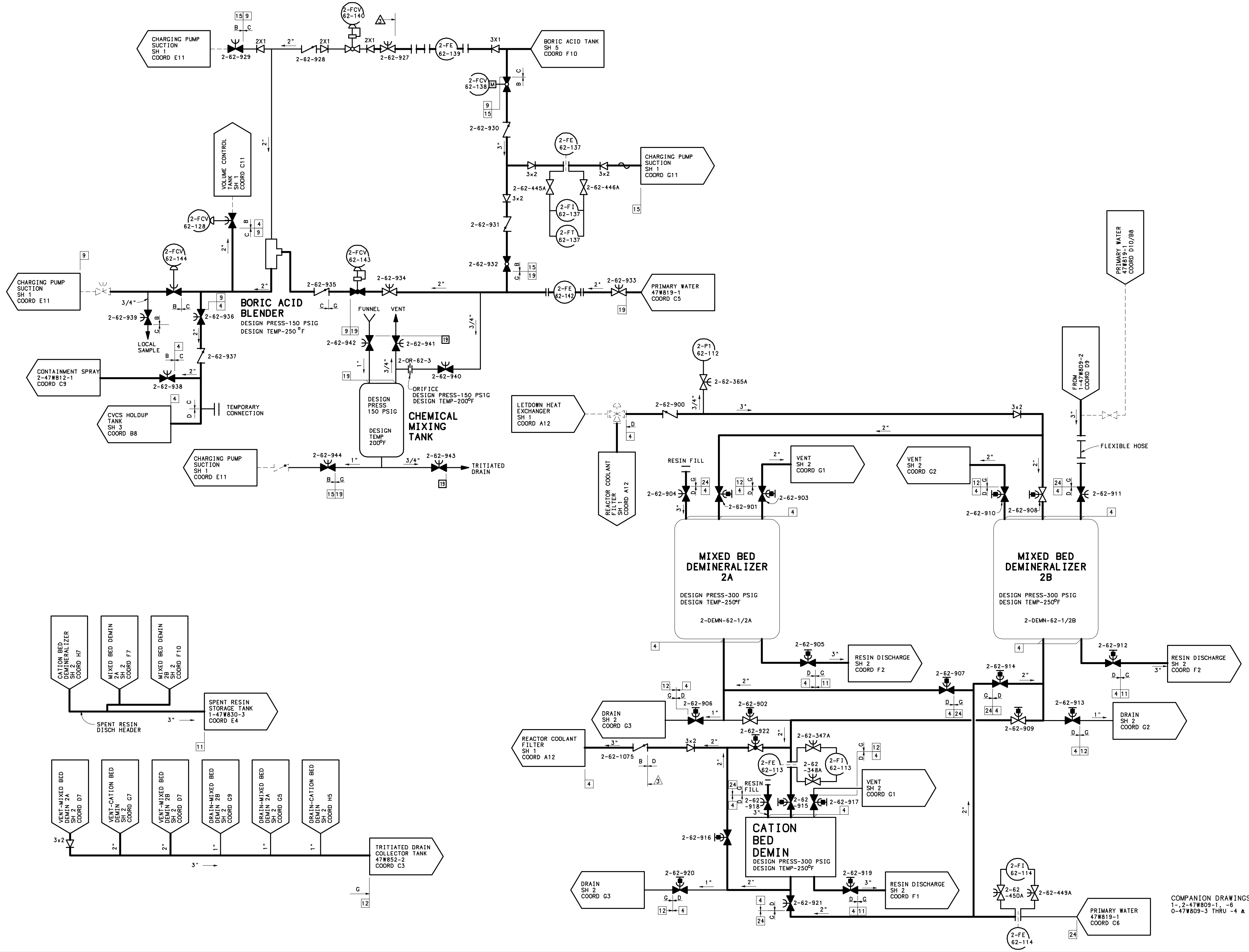
WATTS BAR FINAL SAFETY ANALYSIS REPORT

AUXILIARY BUILDING UNIT 1 FLOW DIAGRAM CHEMICAL AND VOLUME CONTROL SYSTEM (BORON RECOVERY)

TVA DWG NO. 1-47W809-2 R27

FIGURE 9.3-15-2

CAD MAINTAINED DRAWING



COMPANION DRAWINGS:
1-,2-47W809-1, -6
0-47W809-3 THRU -4 & -9

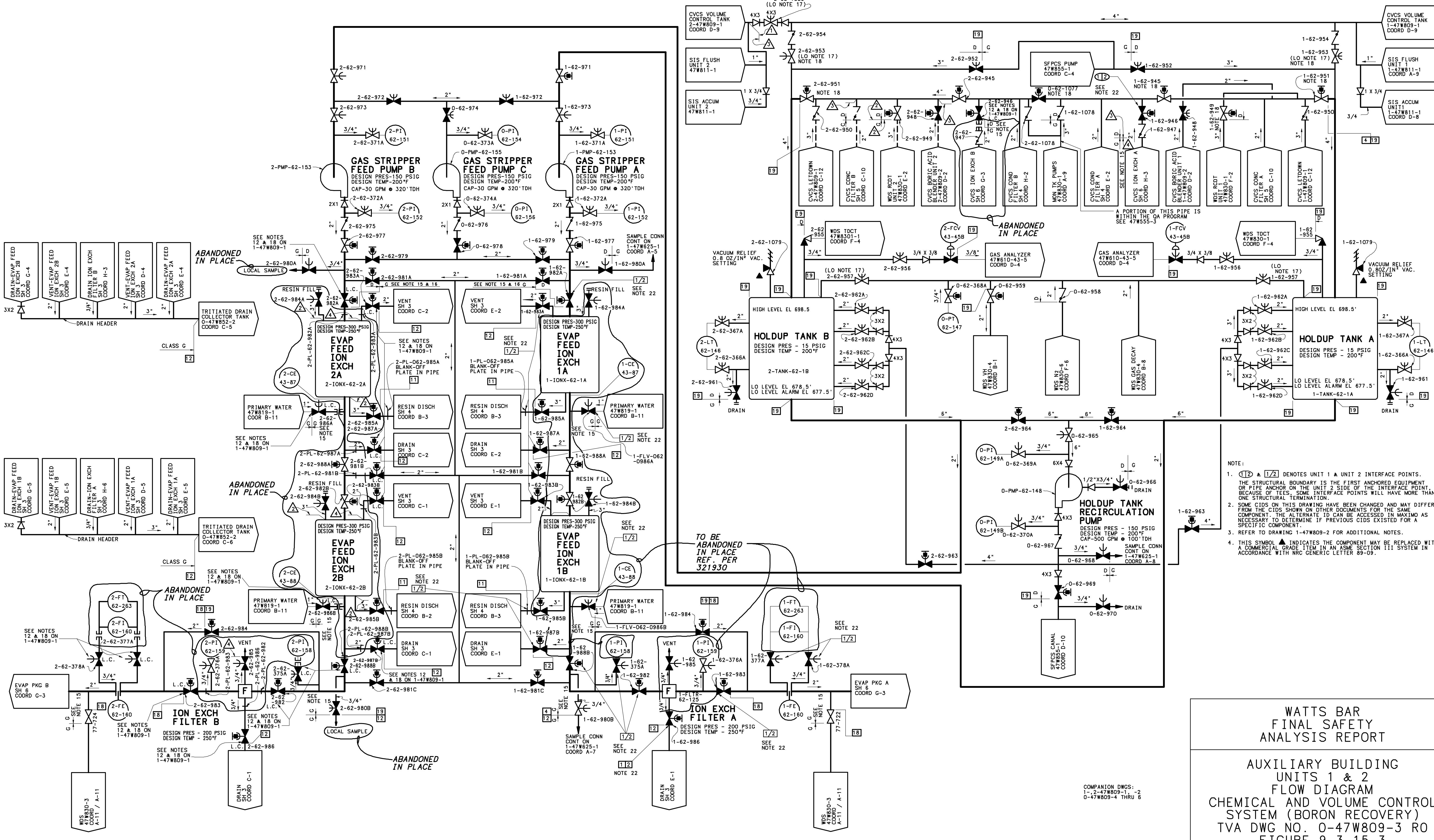
NOTES:

1. FOR ADDITIONAL NOTES, SEE SH 1.
2. NOT USED.
3. PIPING ON SHEETS 2 THRU 6 IS TVA CLASS B, C, D, G, OR L.
4. CLASS CHANGES ARE SHOWN IN THE TYPICAL MANNER. B|C
5. NOT USED.
6. NOT USED.
7. DESIGN PRESSURE AND TEMPERATURE FOR INDIVIDUAL TANKS AND COMPONENTS IS GIVEN IN THE VICINITY OF THE ITEM.
8. NOT USED.
9. VALVES SHOWN IN THIS MANNER ARE PROVIDED WITH EXTENSION STEM VALVE OPERATORS.
10. ARROW BLOCKS INDICATE LOCATION OF INTERFACES ON THIS SERIES OF DRAWINGS AND ON OTHER RELATED DRAWINGS.
11. NOT USED
12. NOT USED
13. ALL CLASS "G" PIPING IS SEISMICALLY SUPPORTED AND NON QA UNLESS OTHERWISE NOTED. WHERE NOTED, CLASS "G" PIPING IS TO BE HYDROSTATICALLY TESTED WITHIN THE QA PROGRAM.
14. NOT USED.
15. NOT USED.
16. NOT USED.
17. L.O.=LOCKED OPEN. CONCURRENT CLOSURE OF 1-ISV-62-953 AND 2-ISV-62-953 IS NOT PERMITTED. O-ISV-62-1080 CLOSURE IS PERMITTED ONLY WHILE UNIT 2 IS UNDER CONSTRUCTION WITH UNIT 1 OPERATIONAL. AFTER UNIT 2 BECOMES OPERATIONAL O-ISV-62-1080 IS TO REMAIN LOCKED OPEN UNLESS PRIOR APPROVAL IS OBTAINED FROM NUCLEAR ENGINEERING.
18. ALL PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS, AND TEST CONNECTIONS IS TVA CLASS G UNLESS OTHERWISE NOTED. THIS NOTE APPLIES TO SHEETS 2 THROUGH 6 ONLY.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNIT 2
FLOW DIAGRAM
CHEMICAL AND VOLUME CONTROL
SYSTEM (BORON RECOVERY)
TVA DWG NO. 2-47W809-2 R19
FIGURE 9.3-15-2(U2)

CAD MAINTAINED DRAWING

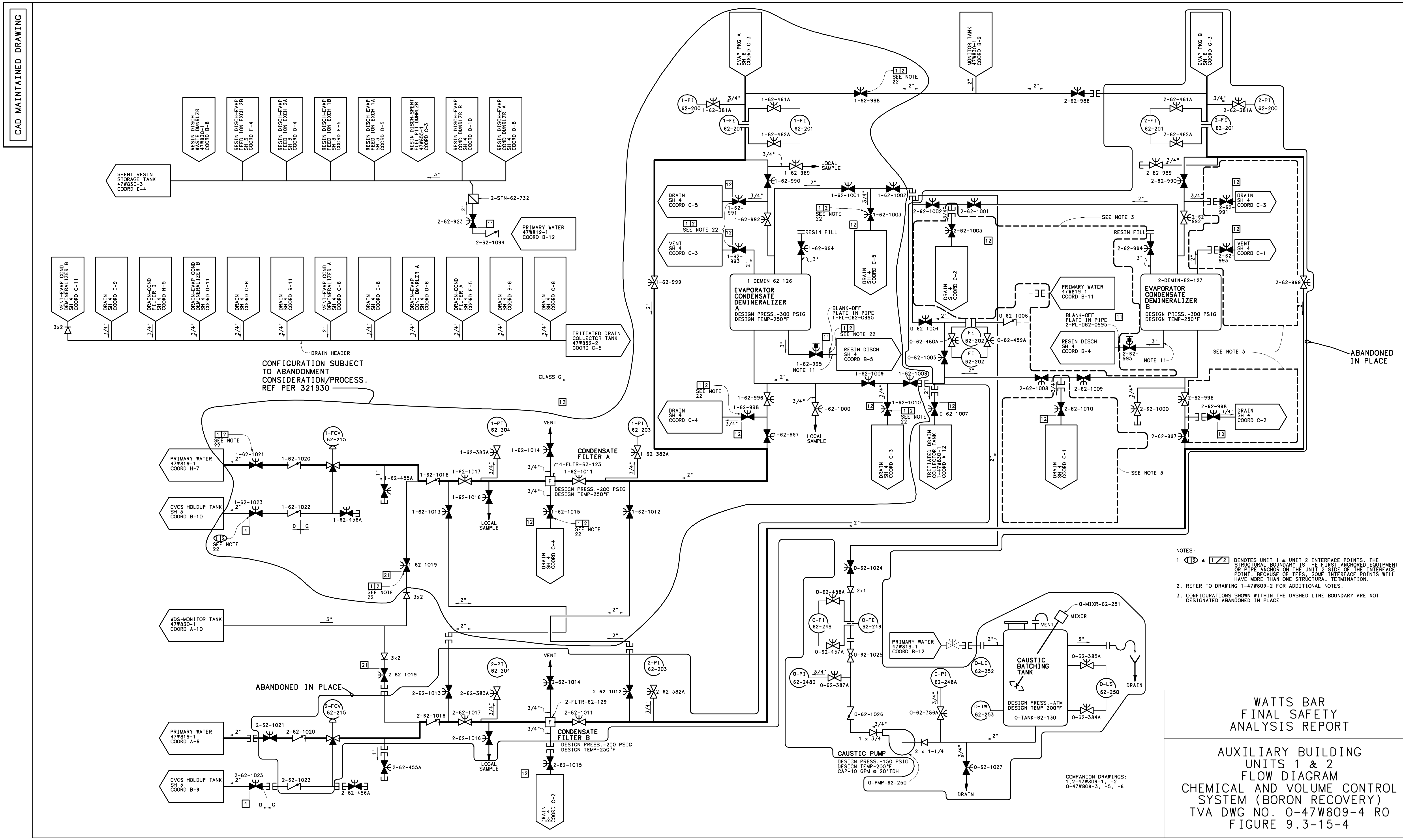


NOTE:

1. (1|2) & 1|2 DENOTES UNIT 1 & UNIT 2 INTERFACE POINTS.
   THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
2. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
3. REFER TO DRAWING 1-47W809-2 FOR ADDITIONAL NOTES.
4. THIS SYMBOL ▲ INDICATES THE COMPONENT MAY BE REPLACED WITH A COMMERCIAL GRADE ITEM IN AN ASME SECTION III SYSTEM IN ACCORDANCE WITH NRC GENERIC LETTER 89-09.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
CHEMICAL AND VOLUME CONTROL
SYSTEM (BORON RECOVERY)
TVA DWG NO. 0-47W809-3 RO
FIGURE 9.3-15-3



NOTES:

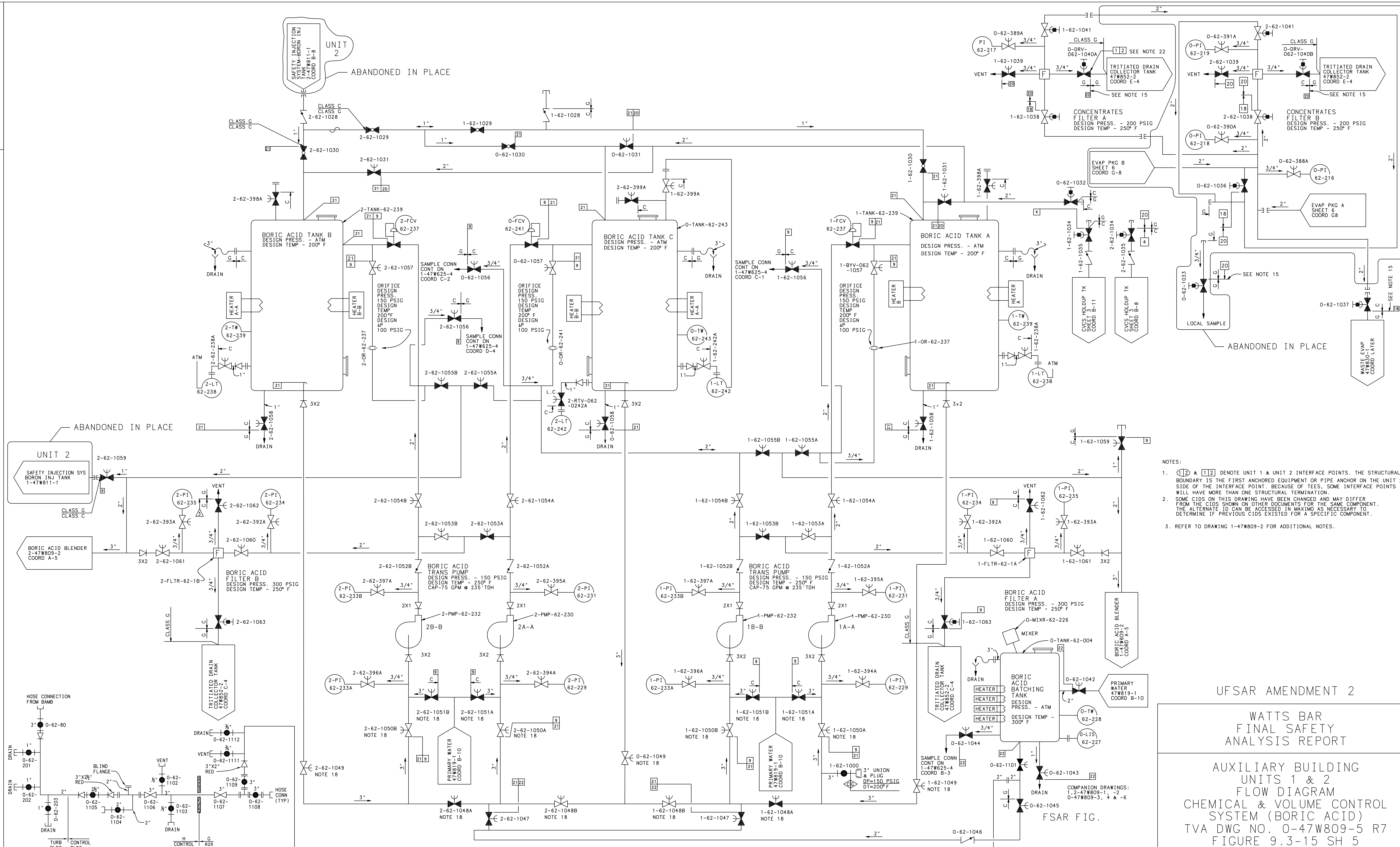
1. (1|2) & [1/2] DENOTES UNIT 1 & UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
2. REFER TO DRAWING 1-47W809-2 FOR ADDITIONAL NOTES.
3. CONFIGURATIONS SHOWN WITHIN THE DASHED LINE BOUNDARY ARE NOT DESIGNATED ABANDONED IN PLACE

COMPANION DRAWINGS:
1,2-47W809-1, -2
0-47W809-3, -5, -6

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
CHEMICAL AND VOLUME CONTROL
SYSTEM (BORON RECOVERY)
TVA DWG NO. 0-47W809-4 R0
FIGURE 9.3-15-4

CAD MAINTAINED DRAWING



NOTES:

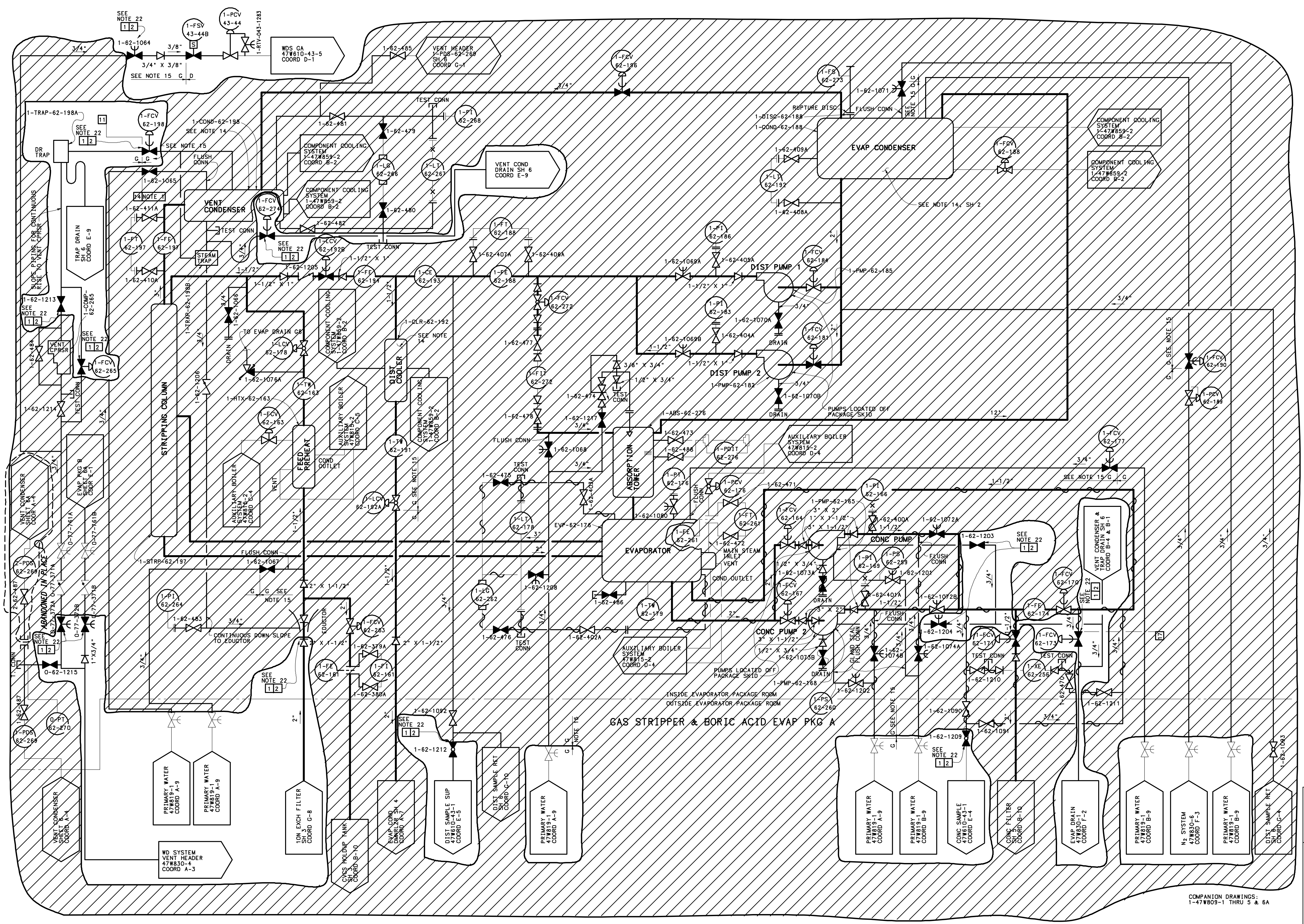
1. [1|2] & [1|2] DENOTE UNIT 1 & UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
2. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
3. REFER TO DRAWING 1-47W809-2 FOR ADDITIONAL NOTES.

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
CHEMICAL & VOLUME CONTROL
SYSTEM (BORIC ACID)
TVA DWG NO. 0-47W809-5 R7
FIGURE 9.3-15 SH 5

CAD MAINTAINED DRAWING



NOTES:

1. REFER TO DRAWING 1-47W809-2 FOR NOTES.

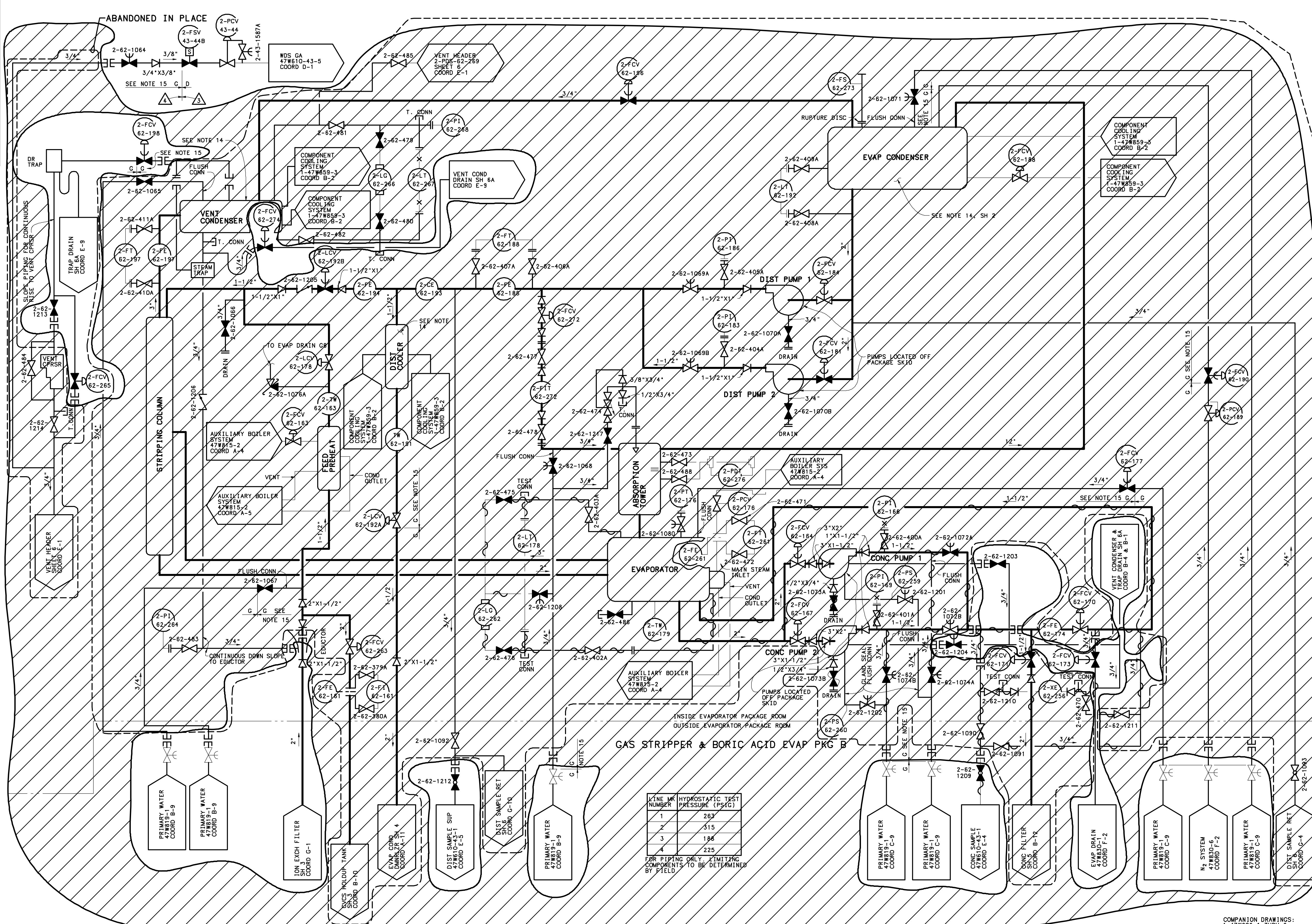
COMPANION DRAWINGS:
1-47W809-1 THRU 5 & 6A

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
CHEMICAL & VOLUME CONTROL
SYSTEM (BORON RECOVERY)
TVA DWG NO. 1-47W809-6 R11
FIGURE 9.3-15-6

CAD MAINTAINED DRAWING

NOTE:
1. REFER TO DRAWING 1-47W809-2 FOR NOTES.



LINE MK NUMBER	HYDROSTATIC TEST PRESSURE (PSIG)
1	263
2	315
3	188
4	225

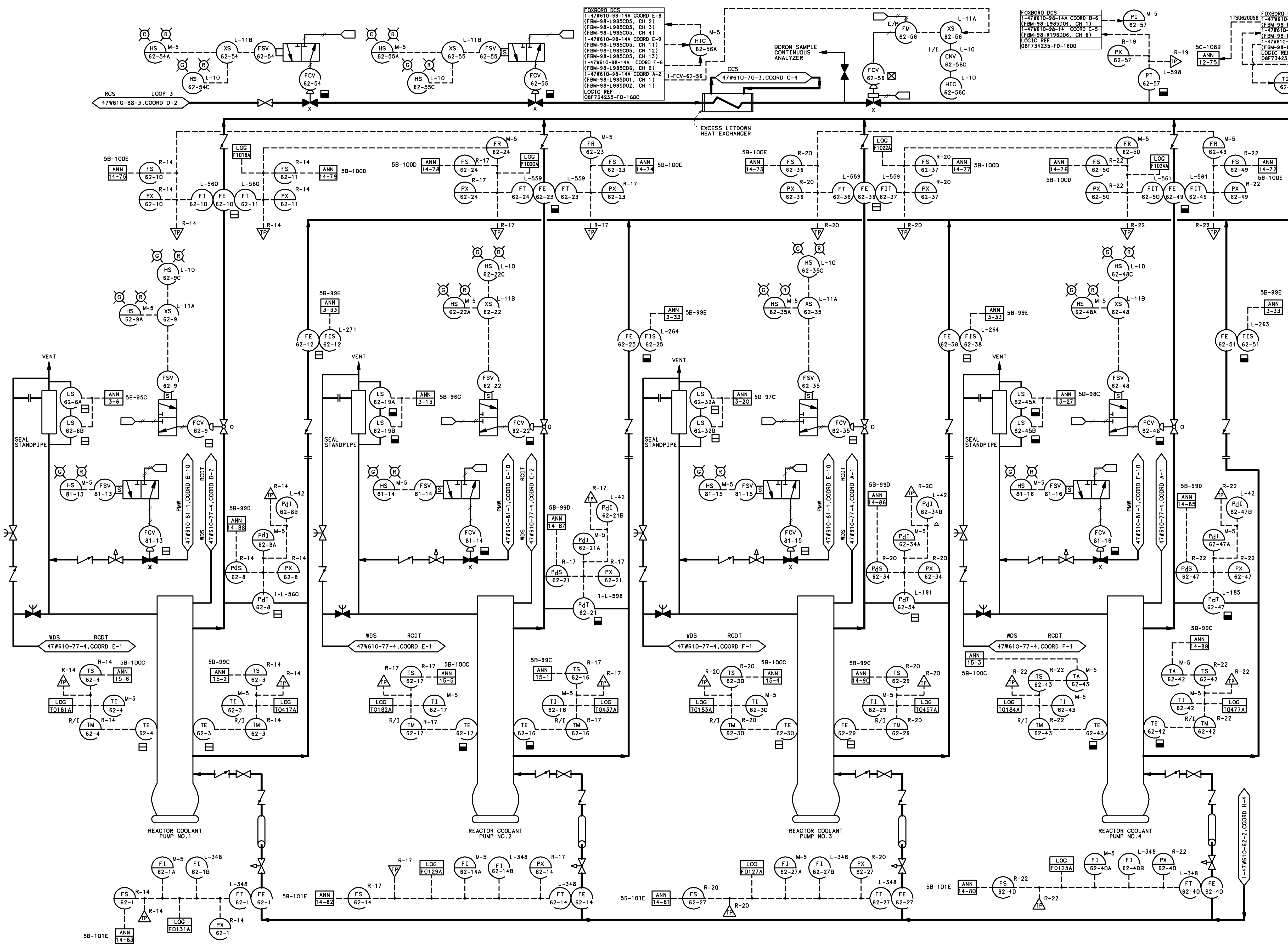
FOR PIPING ONLY. LIMITING COMPONENTS TO BE DETERMINED BY FIELD.

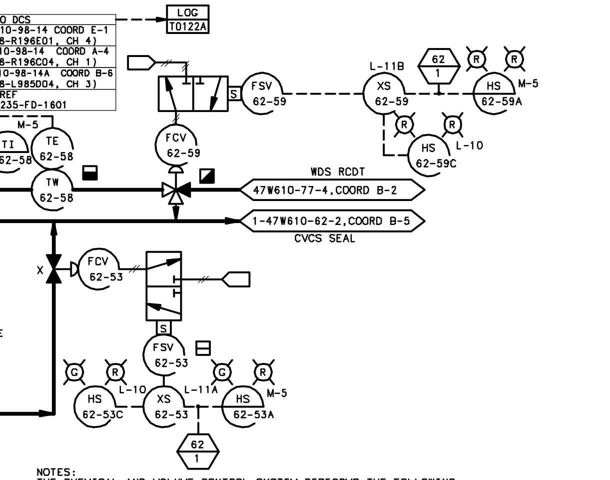
COMPANION DRAWINGS:
1-47W809-1 THRU 6

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNIT 2
FLOW DIAGRAM
CHEMICAL & VOLUME CONTROL
SYSTEM (BORON RECOVERY)
TVA DWG NO. 1-47W809-6A R6
FIGURE 9.3-15 SH 6A

CAD MAINTAINED DRAWING





NOTES:
THE CHEMICAL AND VOLUME CONTROL SYSTEM PERFORMS THE FOLLOWING FUNCTIONS:

1. CHARGING FLOW-PZR LEVEL CONTROLS THE POSITIONING OF THE CHARGING FLOW CONTROL VALVE THROUGH THE FOXBORO DCS.
2. SEAL WATER-A PORTION OF THE CHARGING FLOW IS SENT THROUGH THE SEAL INJECTION FILTERS TO THE REACTOR COOLANT PUMP SEALS. THIS FLOW IS RETURNED THROUGH THE SEAL WATER FILTER AND SEAL WATER HEAT EXCHANGER TO THE CHARGING PUMP SUCTION.
3. LETDOWN FLOW-THE REACTOR LETDOWN FLOW PASSES THROUGH A REGENERATIVE HEAT EXCHANGER WHERE HEAT IS TRANSFERRED TO THE CHARGING FLOW. THE FLOW THEN PASSES THROUGH LETDOWN ORIFICES WHERE THE PRESSURE IS REDUCED. THE LETDOWN HEAT EXCHANGER REDUCES THE TEMPERATURE AND A PRESSURE CONTROL VALVE PCV-62-81 MAINTAINS A PRESSURE LEVEL TO PREVENT FLASHING. THE FLOW IS THEN PASSED THROUGH THE MIXED-BED DEMINERALIZERS (WHERE FISSION AND CORROSION PRODUCTS ARE REMOVED) TO THE VOLUME CONTROL TANK.
4. VOLUME CONTROL-TWO LEVEL TRANSMITTERS, LT-62-129A AND LT-62-130A, SENSE THE LEVEL IN THE VOLUME CONTROL TANK, IF THE LEVEL IS LOW AND HS-62-140D IS IN THE AUTO MODE, THESE SIGNALS WILL START THE MAKEUP OF PRIMARY WATER AND BORIC ACID FLOW TO THE BORIC ACID BLENDER. TWO PREDETERMINED COUNTERS, FQ-62-142 AND FQ-62-139, REGULATE THE MIXTURE TO OBTAIN THE PROPER BORIC ACID LEVEL FOR THE CHEMICAL NEUTRON ABSORBER. PCV-62-120 MAINTAINS A 15-20 PSIG HYDROGEN SUPPLY TO THE VCT, THIS H_2 IS USED TO COMBINE WITH THE FREE OXYGEN IN THE SYSTEM, FSV-62-125 IS USED TO VENT THE FISSION GAS TO THE WASTE DISPOSAL SYSTEM.
5. BORIC ACID AND CHEMICAL SUPPLY-BORIC ACID AND HOT WATER ARE MIXED IN THE BATCHING TANK TO A CONCENTRATION OF APPROXIMATELY 12 WEIGHT PERCENT. ONE OF THE BORIC ACID TRANSFER PUMPS IS USED TO TRANSFER THE BATCH TO THE BORIC ACID TANK FOR USE IN THE BLENDER OR A SIS BIT SIGNAL. HYDRAZINE AND LITHIUM HYDROXIDE ARE ADDED THROUGH THE CHEMICAL MIXING TANK TO REDUCE OXYGEN CONTENT AND CORROSIVE ELEMENTS.
6. CLEANUP-THE SYSTEM CONTAINS A GAS STRIPPER AND BORIC ACID EVAPORATOR PACKAGE TO CLEAN UP THE LETDOWN AND VENT THE GASES TO THE WASTE DISPOSAL PACKAGE.
7. INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL AND MARKED WITH AN ASTERISK (*) WILL BE LOCATED ON THE APPROPRIATE 480-V MOV OR 6.9-KV SHUTDOWN BOARDS. OTHER INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL WILL BE LOCATED IN THE AUXILIARY CONTROL ROOM ON PANELS INDICATED ON THE DIAGRAM.
8. THE UNITED ELECTRIC SWITCHES SERIES 300 ARE NO LONGER MANUFACTURED. USE UNITED ELECTRIC CONTROLS CO. SWITCHES SERIES 400 IF REPLACEMENT IS REQUIRED.
9. LOG P0496A

DATALINK CONNECTION TO PLANT COMPUTER
ARROW IN = INPUT TO DCS FROM FIELD DEVICE
CONNECTING DEVICE UNID
FOXBORO DCS
1-47W610-98-2 COORD G-7
(FBM-98-R191B03, CH 2)
1-47W610-98-3 COORD F-11
(FBM-98-L982A05, CH 1)
(FBM-98-L982A06, CH 1)
LOGIC REF
08F734235-FD-1005
1-FT-3-235
1LS0030042D
DCS IO POINT NAME
ARROW OUT = OUTPUT FROM DCS TO FIELD DEVICE
1ST LINE: REFERS TO SYSTEM 098 CONTROL DIAGRAM CONTINUATION.
2ND, 3RD, ETC LINES: DENOTES FBM'S FOR SIGNAL. LOOP IDENTIFIER (TYP) DENOTES LOCATION OF FBM.
R191 - AUX INSTR RM R-191
L982 - MCR PNL-98-L982 (TYPICAL)
CH 2 - DENOTES FBM CHANNEL
DENOTES FUNCTIONAL DIAGRAM DEPICTING LOOP LOGIC. (1-00063673-) PRECEDES (08F734235-FD-XXXX).

REFERENCE DRAWINGS:
47W406-1 THRU later - CVCS PIPING - HIGH PRESS.
47W555-1 THRU 21 - CVCS PIPING - LOW PRESS.
47W601-62-1 THRU 46 - INSTRUMENT TABULATION
47W611-62-1 THRU 6 - LOGIC DIAGRAM
47W809-1 THRU 6 - FLOW DIAGRAM - CVCS

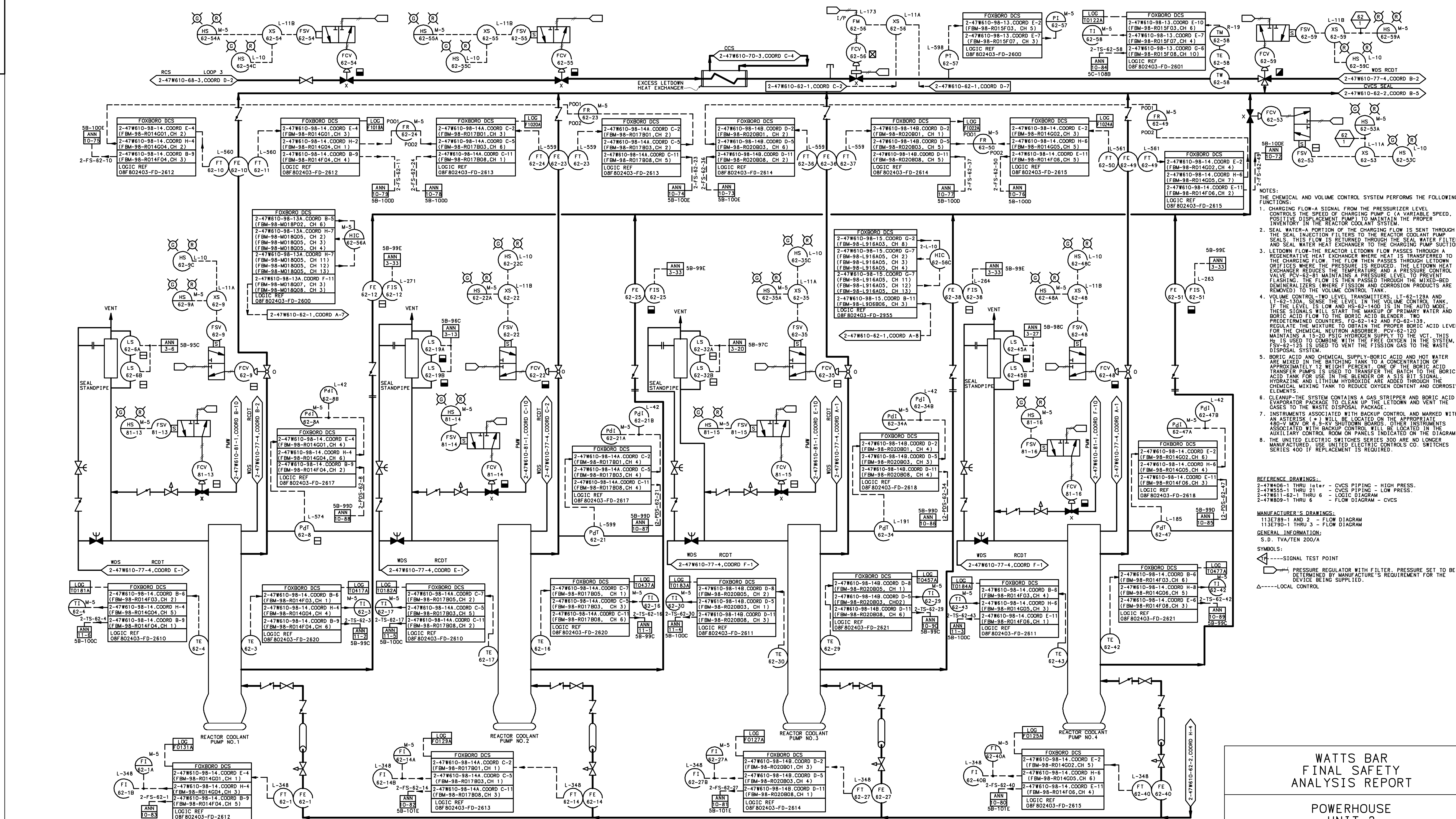
MANUFACTURER'S DRAWINGS:
113E789-1 AND 2 - FLOW DIAGRAM
113E790-1 THRU 3 - FLOW DIAGRAM

GENERAL INFORMATION:
S.D. TVA/TEN 200/A

SYMBOLS:
TP ----SIGNAL TEST POINT
PRESSURE REGULATOR WITH FILTER. PRESSURE SET TO BE DETERMINED BY MANUFACTURE'S REQUIREMENT FOR THE DEVICE BEING SUPPLIED.
△-----LOCAL CONTROL

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 1-47W610-62-1 R24
FIGURE 9.3-15 SH 7



NOTES:

THE CHEMICAL AND VOLUME CONTROL SYSTEM PERFORMS THE FOLLOWING FUNCTIONS:

1. CHARGING FLOW-A SIGNAL FROM THE PRESSURIZER LEVEL CONTROLS THE SPEED OF CHARGING PUMP C (A VARIABLE SPEED, POSITIVE DISPLACEMENT PUMP) TO MAINTAIN THE PROPER INVENTORY IN THE REACTOR COOLANT SYSTEM.
2. SEAL WATER-A PORTION OF THE CHARGING FLOW IS SENT THROUGH THE SEAL INJECTION FILTERS TO THE REACTOR COOLANT PUMP SEALS. THIS FLOW IS RETURNED THROUGH THE SEAL WATER FILTER AND SEAL WATER HEAT EXCHANGER TO THE CHARGING PUMP SUCTION.
3. LETDOWN FLOW-THE REACTOR LETDOWN FLOW PASSES THROUGH A REGENERATIVE HEAT EXCHANGER WHERE HEAT IS TRANSFERRED TO THE CHARGING FLOW. THE FLOW THEN PASSES THROUGH LETDOWN ORIFICES WHERE THE PRESSURE IS REDUCED. THE LETDOWN HEAT EXCHANGER REDUCES THE TEMPERATURE AND A PRESSURE CONTROL VALVE PCV-62-81 MAINTAINS A PRESSURE LEVEL TO PREVENT FLASHING. THE FLOW IS THEN PASSED THROUGH THE MIXED-BED DEMINERALIZERS (WHERE FISSION AND CORROSION PRODUCTS ARE REMOVED) TO THE VOLUME CONTROL TANK.
4. VOLUME CONTROL-TWO LEVEL TRANSMITTERS, LT-62-129A AND LT-62-130A, SENSE THE LEVEL IN THE VOLUME CONTROL TANK, IF THE LEVEL IS LOW AND HS-62-140D IS IN THE AUTO MODE, THESE SIGNALS WILL START THE MAKEUP OF PRIMARY WATER AND BORIC ACID FLOW TO THE BORIC ACID BLENDER. TWO PREDETERMINED COUNTERS, FQ-62-142 AND FQ-62-139, REGULATE THE MIXTURE TO OBTAIN THE PROPER BORIC ACID LEVEL FOR THE CHEMICAL NEUTRON ABSORBER. PCV-62-120 MAINTAINS A 15-20 PSIG HYDROGEN SUPPLY TO THE VCT, THIS H_2 IS USED TO COMBINE WITH THE FREE OXYGEN IN THE SYSTEM, FSV-62-125 IS USED TO VENT THE FISSION GAS TO THE WASTE DISPOSAL SYSTEM.
5. BORIC ACID AND CHEMICAL SUPPLY-BORIC ACID AND HOT WATER ARE MIXED IN THE BATCHING TANK TO A CONCENTRATION OF APPROXIMATELY 12 WEIGHT PERCENT. ONE OF THE BORIC ACID TRANSFER PUMPS IS USED TO TRANSFER THE BATCH TO THE BORIC ACID TANK FOR USE IN THE BLENDER OR A SIS BIT SIGNAL. HYDRAZINE AND LITHIUM HYDROXIDE ARE ADDED THROUGH THE CHEMICAL MIXING TANK TO REDUCE OXYGEN CONTENT AND CORROSIVE ELEMENTS.
6. CLEANUP-THE SYSTEM CONTAINS A GAS STRIPPER AND BORIC ACID EVAPORATOR PACKAGE TO CLEAN UP THE LETDOWN AND VENT THE GASES TO THE WASTE DISPOSAL PACKAGE.
7. INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL AND MARKED WITH AN ASTERISK (*) WILL BE LOCATED ON THE APPROPRIATE 480-V MOV OR 6.9-KV SHUTDOWN BOARDS. OTHER INSTRUMENTS ASSOCIATED WITH BACKUP CONTROL WILL BE LOCATED IN THE AUXILIARY CONTROL ROOM ON PANELS INDICATED ON THE DIAGRAM.
8. THE UNITED ELECTRIC SWITCHES SERIES 300 ARE NO LONGER MANUFACTURED. USE UNITED ELECTRIC CONTROLS CO. SWITCHES SERIES 400 IF REPLACEMENT IS REQUIRED.

REFERENCE DRAWINGS:

2-47W406-1 THRU later - CVCS PIPING - HIGH PRESS.
2-47W555-1 THRU 21 - CVCS PIPING - LOW PRESS.
2-47W611-62-1 THRU 6 - LOGIC DIAGRAM
2-47W809-1 THRU 6 - FLOW DIAGRAM - CVCS

MANUFACTURER'S DRAWINGS:

113E789-1 AND 2 - FLOW DIAGRAM
113E790-1 THRU 3 - FLOW DIAGRAM

GENERAL INFORMATION:

S.D. TVA/TEN 200/A

SYMBOLS:

TP ----SIGNAL TEST POINT

PRESSURE REGULATOR WITH FILTER. PRESSURE SET TO BE DETERMINED BY MANUFACTURE'S REQUIREMENT FOR THE DEVICE BEING SUPPLIED.

△-----LOCAL CONTROL

COMPANION DWGS:
2-47W610-62-2 THRU -6.

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POWERHOUSE
UNIT 2
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CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 2-47W610-62-1 R15
FIGURE 9.3-15 SH 7(U2)

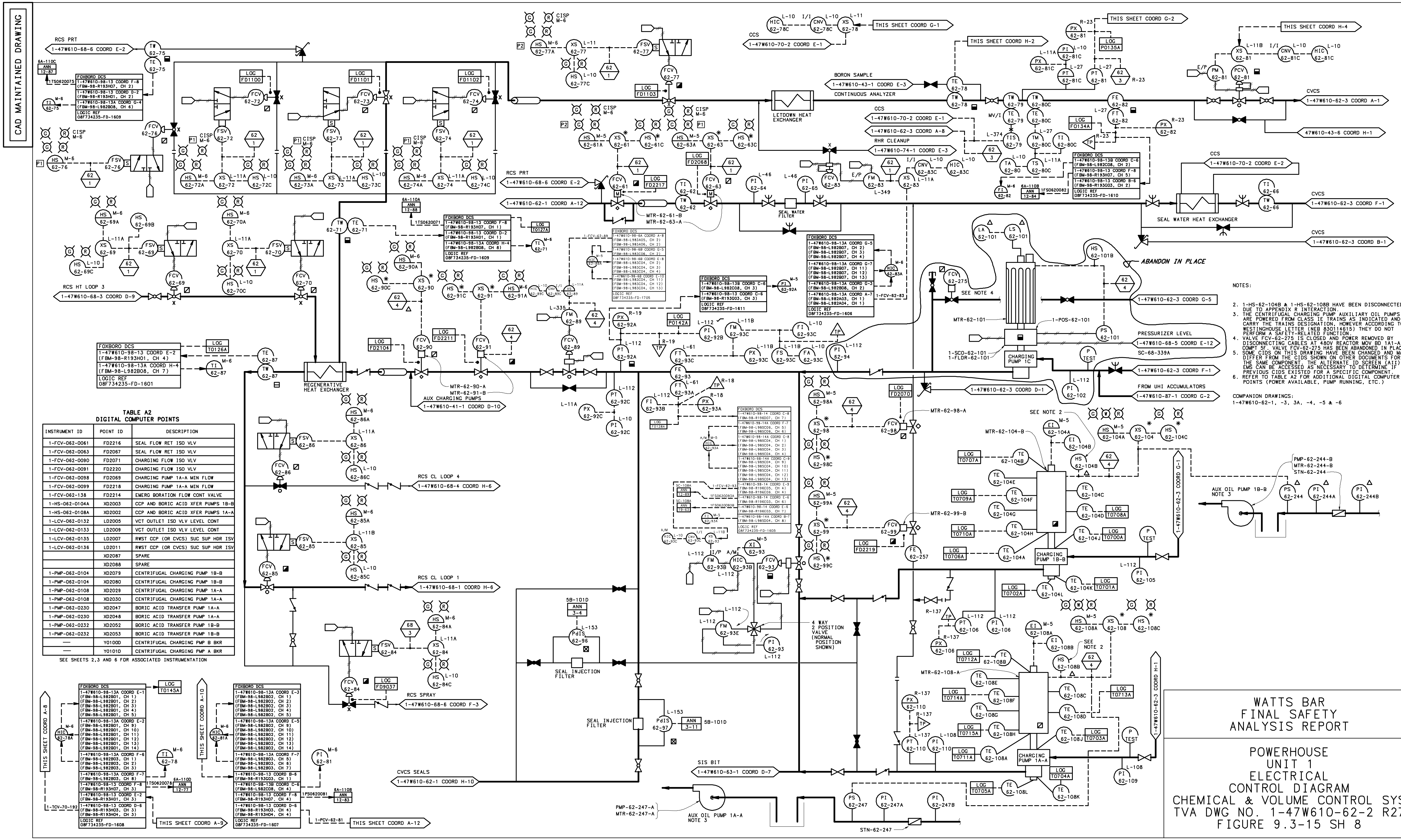

TABLE A2
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
1-FCV-062-0061	FD2216	SEAL FLOW RET ISO VLV
1-FCV-062-0063	FD2067	SEAL FLOW RET ISO VLV
1-FCV-062-0090	FD2071	CHARGING FLOW ISO VLV
1-FCV-062-0091	FD2220	CHARGING FLOW ISO VLV
1-FCV-062-0098	FD2069	CHARGING PUMP 1A-A MIN FLOW
1-FCV-062-0099	FD2218	CHARGING PUMP 1A-A MIN FLOW
1-FCV-062-138	FD2214	EMERG BORATION FLOW CONT VALVE
1-HS-062-0104A	XD2003	CCP AND BORIC ACID XFER PUMPS 1B-B
1-HS-062-0108A	XD2002	CCP AND BORIC ACID XFER PUMPS 1A-A
1-LCV-062-0132	LD2005	VCT OUTLET ISO VLV LEVEL CONT
1-LCV-062-0133	LD2009	VCT OUTLET ISO VLV LEVEL CONT
1-LCV-062-0135	LD2007	RWST CCP (OR CVCS) SUC SUP HDR ISV
1-LCV-062-0136	LD2011	RWST CCP (OR CVCS) SUC SUP HDR ISV
	XD2087	SPARE
	XD2088	SPARE
1-PMP-062-0104	XD2079	CENTRIFUGAL CHARGING PUMP 1B-B
1-PMP-062-0104	XD2080	CENTRIFUGAL CHARGING PUMP 1B-B
1-PMP-062-0108	XD2029	CENTRIFUGAL CHARGING PUMP 1A-A
1-PMP-062-0108	XD2030	CENTRIFUGAL CHARGING PUMP 1A-A
1-PMP-062-0230	XD2047	BORIC ACID TRANSFER PUMP 1A-A
1-PMP-062-0230	XD2048	BORIC ACID TRANSFER PUMP 1A-A
1-PMP-062-0232	XD2052	BORIC ACID TRANSFER PUMP 1B-B
1-PMP-062-0232	XD2053	BORIC ACID TRANSFER PUMP 1B-B
—	Y0100D	CENTRIFUGAL CHARGING PMP B BKR
—	Y0101D	CENTRIFUGAL CHARGING PMP A BKR

SEE SHEETS 2,3 AND 6 FOR ASSOCIATED INSTRUMENTATION

NOTES:

2. 1-HS-62-104B & 1-HS-62-108B HAVE BEEN DISCONNECTED DUE TO APPENDIX R INTERACTION.
3. THE CENTRIFUGAL CHARGING PUMP AUXILIARY OIL PUMPS ARE POWERED FROM CLASS IE TRAINS AS INDICATED AND CARRY THE TRAINS DESIGNATION, HOWEVER ACCORDING TO WESTINGHOUSE LETTER (NEB 830114615) THEY DO NOT PERFORM A SAFETY-RELATED FUNCTION.
4. VALVE FCV-62-275 IS CLOSED AND POWER REMOVED BY DISCONNECTING CABLES AT 480V REACTOR MOV BD 1A1-A, COMPT 5F. VALVE FCV-62-275 HAS BEEN ABANDONED IN PLACE.
5. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
6. REFER TO TABLE A2 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.)

COMPANION DRAWINGS:
1-47W610-62-1, -3, 3A, -4, -5 & -6

WATTS BAR
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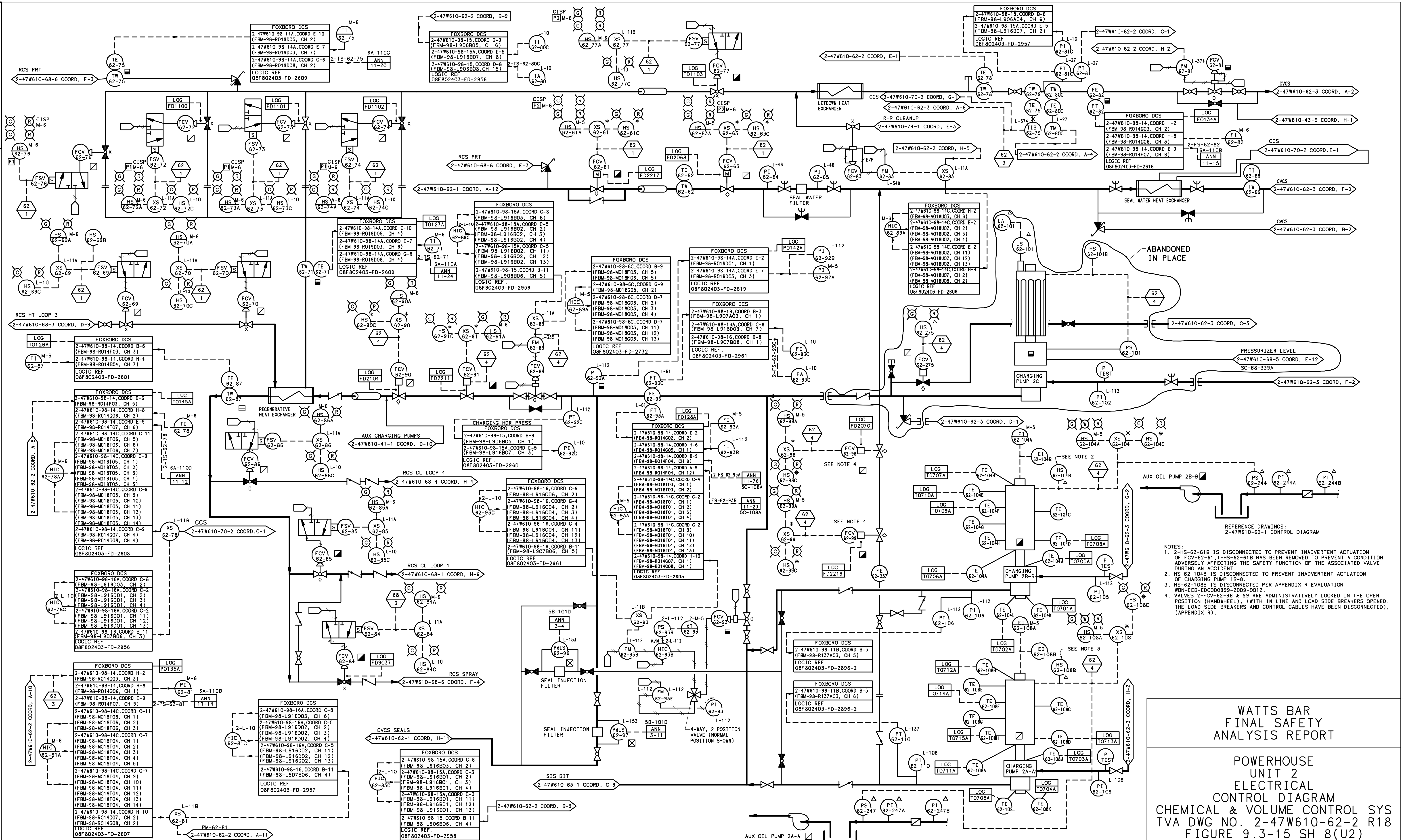
POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 1-47W610-62-2 R27
FIGURE 9.3-15 SH 8

CAD MAINTAINED DRAWING



REFERENCE DRAWINGS:
2-47W610-62-1 CONTROL DIAGRAM

NOTES:
1. 2-HS-62-61B IS DISCONNECTED TO PREVENT INADVERTENT ACTUATION OF FCV-62-61,1-HS-62-61B HAS BEEN REMOVED TO PREVENT A CONDITION ADVERSELY AFFECTING THE SAFETY FUNCTION OF THE ASSOCIATED VALVE DURING AN ACCIDENT.
2. HS-62-104B IS DISCONNECTED TO PREVENT INADVERTENT ACTUATION OF CHARGING PUMP 1B-B.
3. HS-62-108B IS DISCONNECTED PER APPENDIX R EVALUATION WBN-EEB-EDQ000999-2009-0012.
4. VALVES 2-FCV-62-98 & 99 ARE ADMINISTRATIVELY LOCKED IN THE OPEN POSITION (HANDWHEEL), (WITH IN LINE AND LOAD SIDE BREAKERS OPENED. THE LOAD SIDE BREAKERS AND CONTROL CABLES HAVE BEEN DISCONNECTED), (APPENDIX R).

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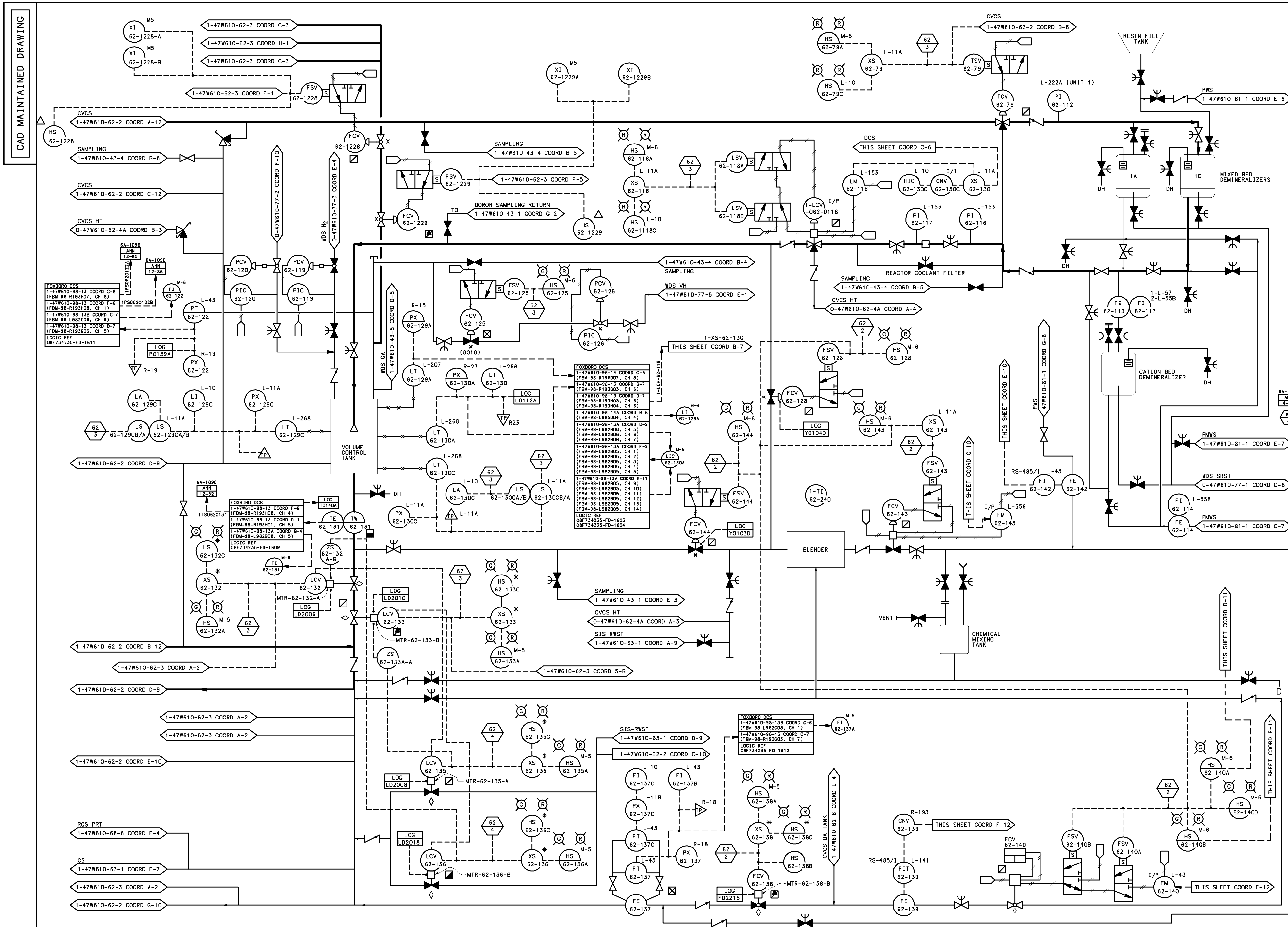
POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 2-47W610-62-2 R18
FIGURE 9.3-15 SH 8(U2)



NOTES:

1. NOT USED

2. SOME CID'S ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CID'S SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CID'S EXISTED FOR A SPECIFIC COMPONENT.

3. REFER TO TABLE A2 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

COMPANION DRAWINGS: 1-47W610-62-1, -2, -4, -5, -6.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
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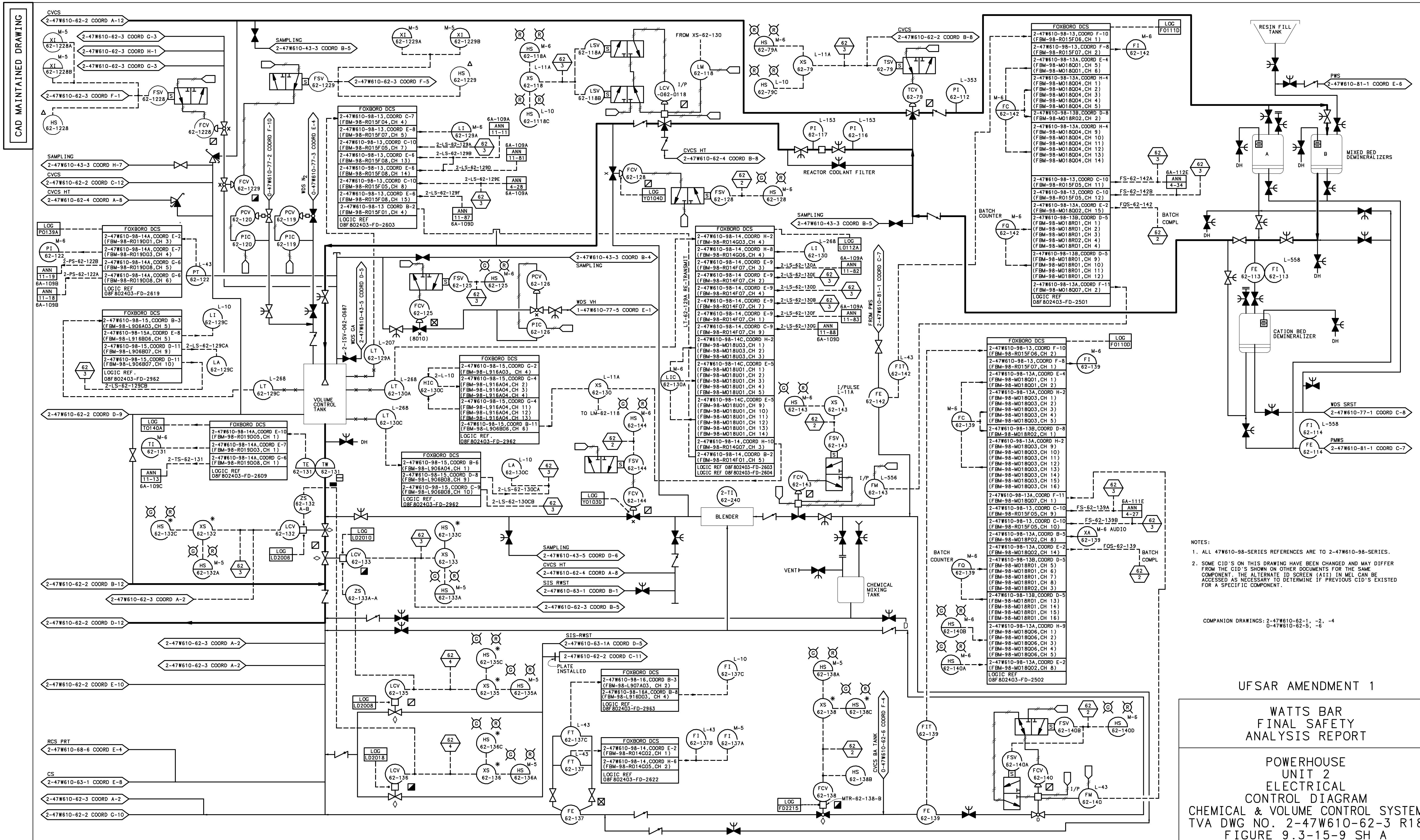
POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 1-47W610-62-3 R33
FIGURE 9.3-15 SH 9



NOTES:

1. ALL 47W610-98-SERIES REFERENCES ARE TO 2-47W610-98-SERIES.

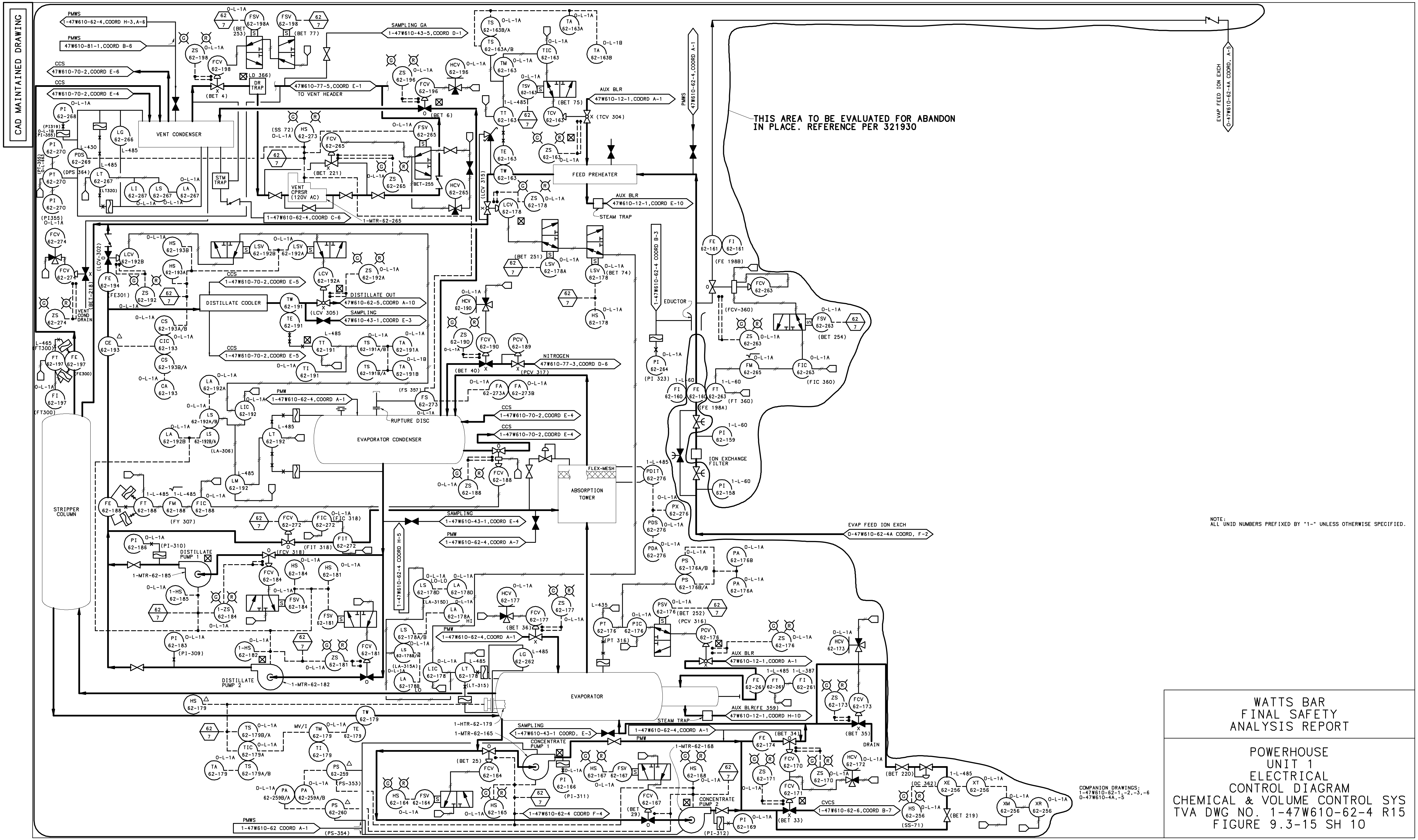
2. SOME CID'S ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CID'S SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN MEL CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CID'S EXISTED FOR A SPECIFIC COMPONENT.

COMPANION DRAWINGS: 2-47W610-62-1, -2, -4
0-47W610-62-5, -6

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYSTEM
TVA DWG NO. 2-47W610-62-3 R18
FIGURE 9.3-15-9 SH A


CAD MAINTAINED DRAWING
THIS AREA TO BE EVALUATED FOR ABANDON IN PLACE. REFERENCE PER 321930
VENT CONDENSER
FEED PREHEATER
DISTILLATE COOLER
EVAPORATOR CONDENSER
ABSORPTION TOWER
STRIPPER COLUMN
EVAPORATOR
ION EXCHANGE FILTER
EVAP FEED ION EXCH
NOTE:
ALL UNID NUMBERS PREFIXED BY "1-" UNLESS OTHERWISE SPECIFIED.
COMPANION DRAWINGS:
1-47W610-62-1,-2,-3,-6
0-47W610-4A,-5
WATTS BAR
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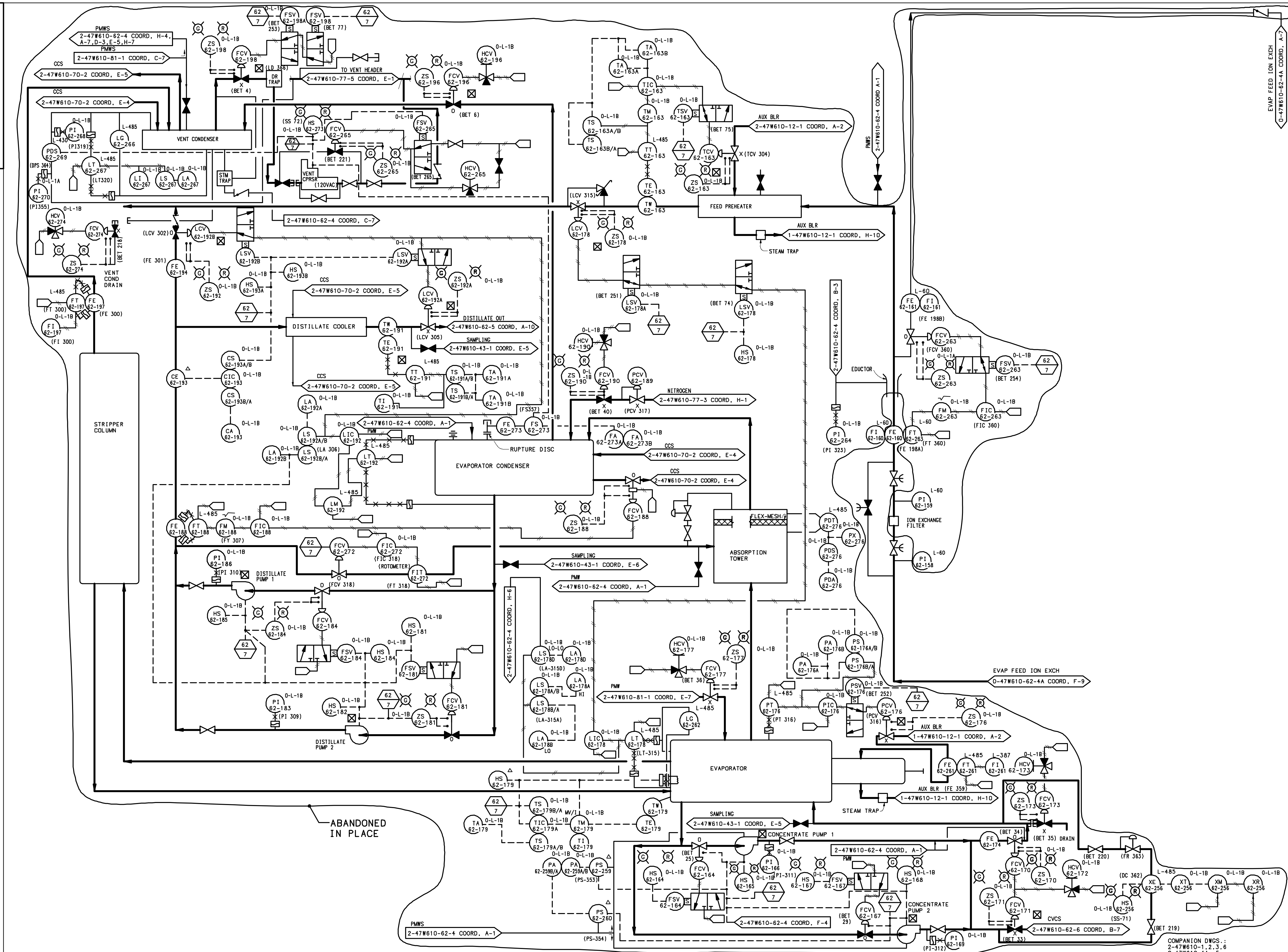
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 1-47W610-62-4 R15
FIGURE 9.3-15 SH 10

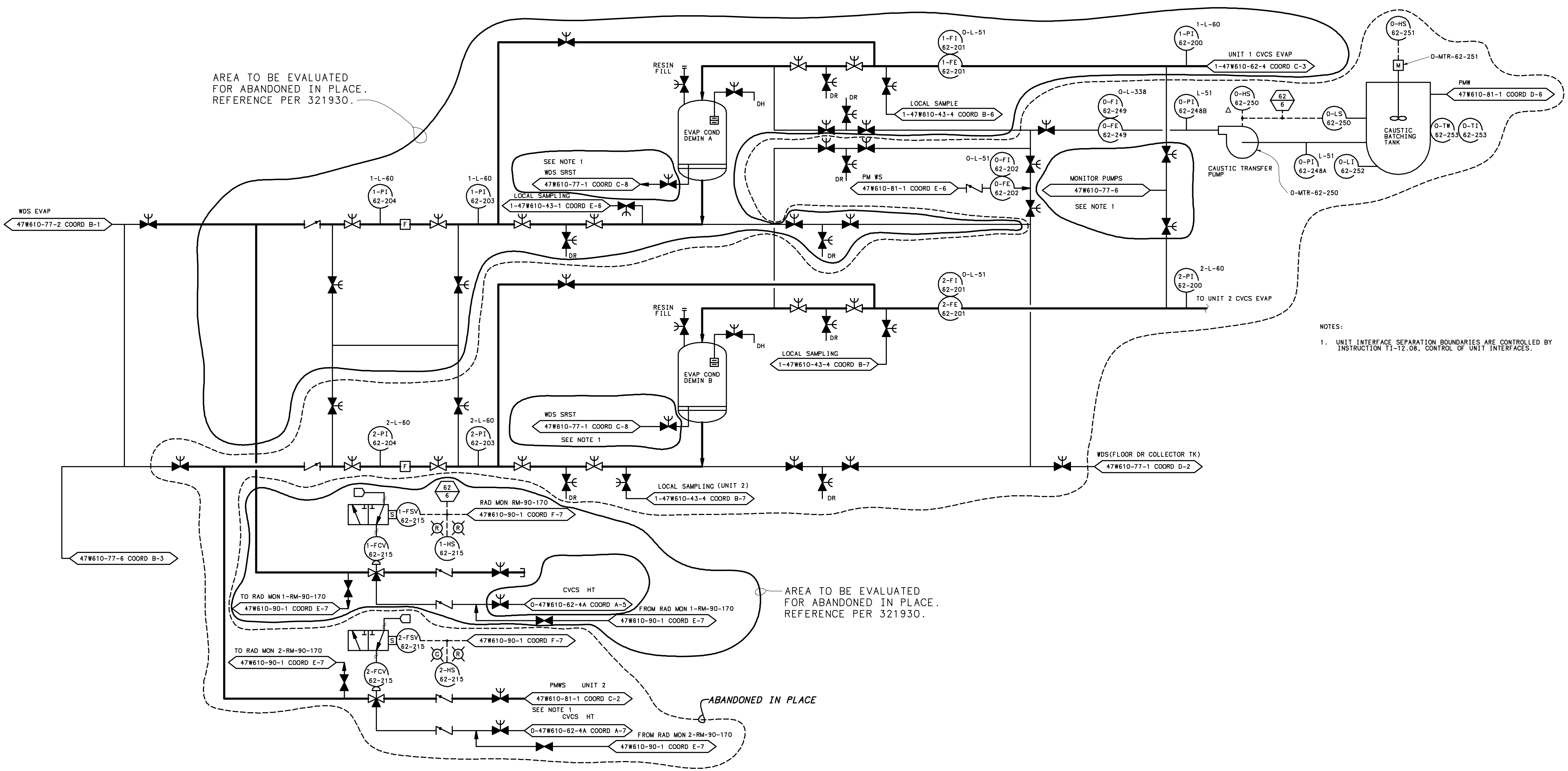
CAD MAINTAINED DRAWING



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 2-47W610-62-4 R6
FIGURE 9.3-15 SH 10(U2)

CAD MAINTAINED DRAWING



NOTES:

1. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08, CONTROL OF UNIT INTERFACES.

COMPANION DRAWINGS:

O-47W610-62-SERIES
1-47W610-62-SERIES
2-47W610-62-SERIES

WATTS BAR
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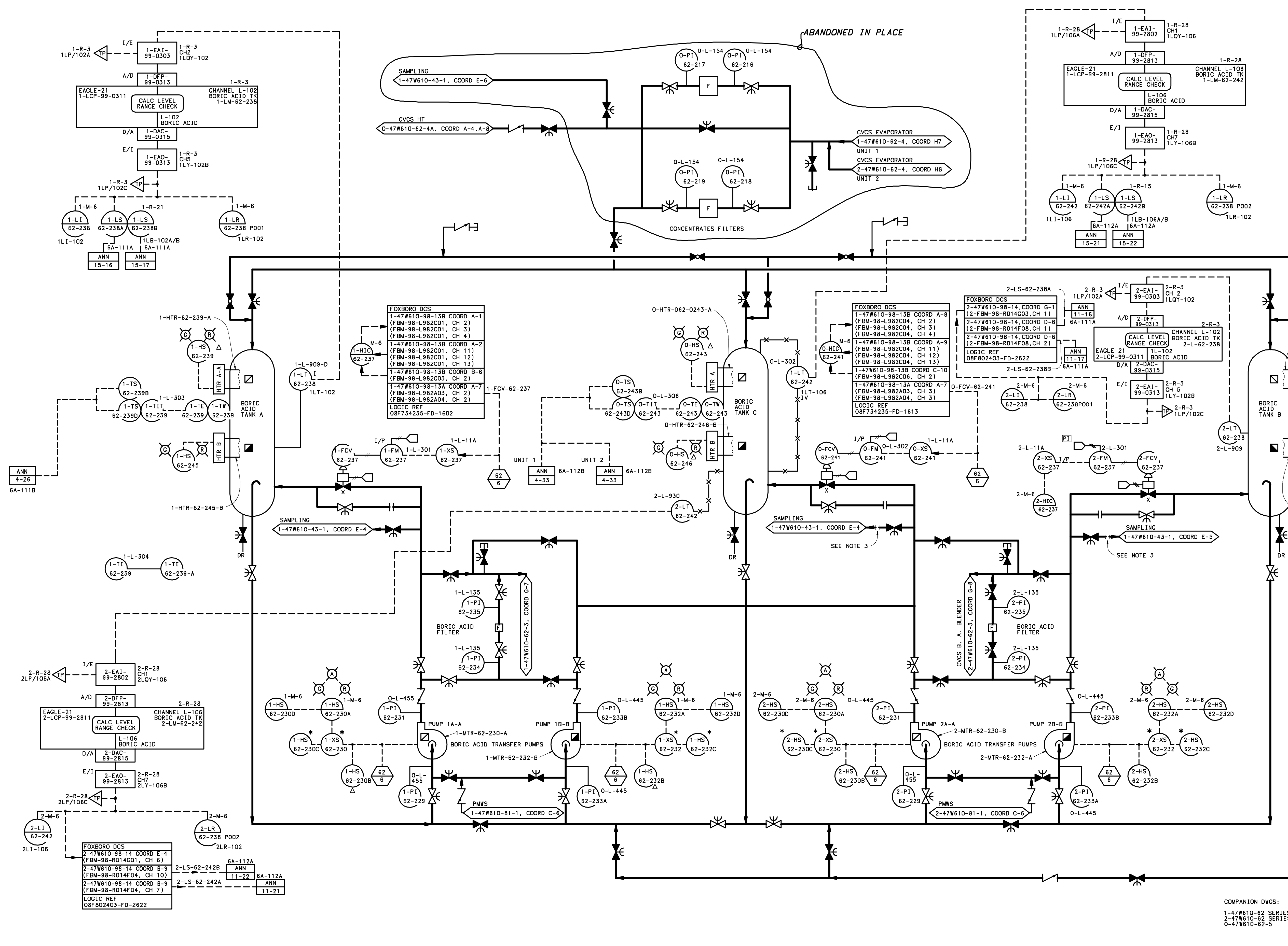
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL & VOLUME CONTROL SYS
TVA DWG NO. 0-47W610-62-5 R1
FIGURE 9.3-15 SH 11

CAD MAINTAINED DRAWING



NOTES:

1. NOT USED.
2. NOT USED.
3. SAMPLE STATION DISCONNECTED FROM PROCESS (RETAIN FOR FUTURE USE).
4. NOT USED.
5. SOME CID'S ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CID'S SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CID'S EXISTED FOR A SPECIFIC COMPONENT.
6. TO OBTAIN THE COMPUTER POINT IDENTIFIER FOR A CORRESPONDING EAGLE-21 TEST POINT OR TVA UNID SEE TABLE 16 ON 1-47W610-99-6, FOR UNIT 2 POINTS SEE TABLE 16 ON 2-47W610-99-6.

SYMBOLS: FOR EAGLE 21 SYMBOLS, SEE 1-47W610-99-1 (2-47W610-99-1 FOR UNIT 2).

WATTS BAR
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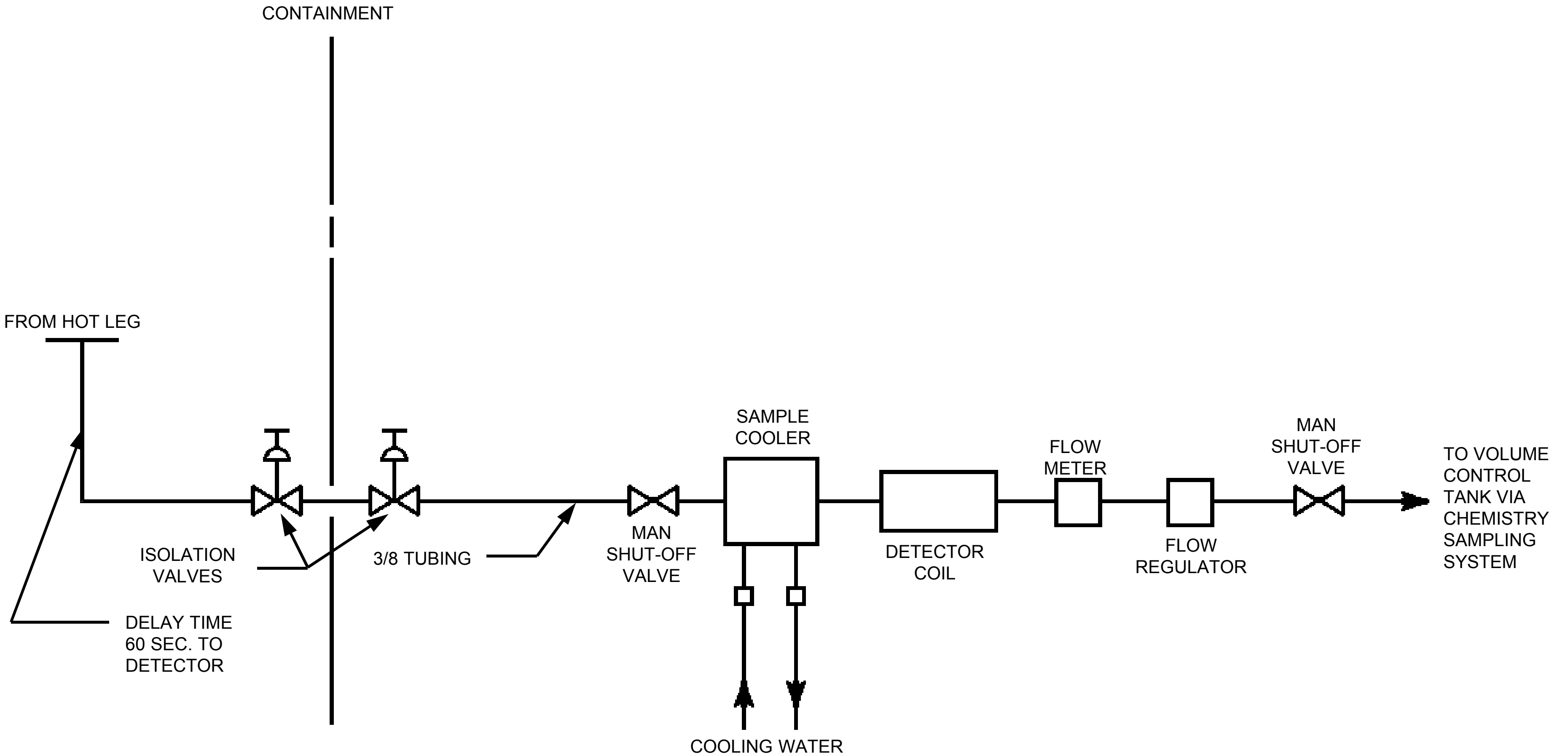
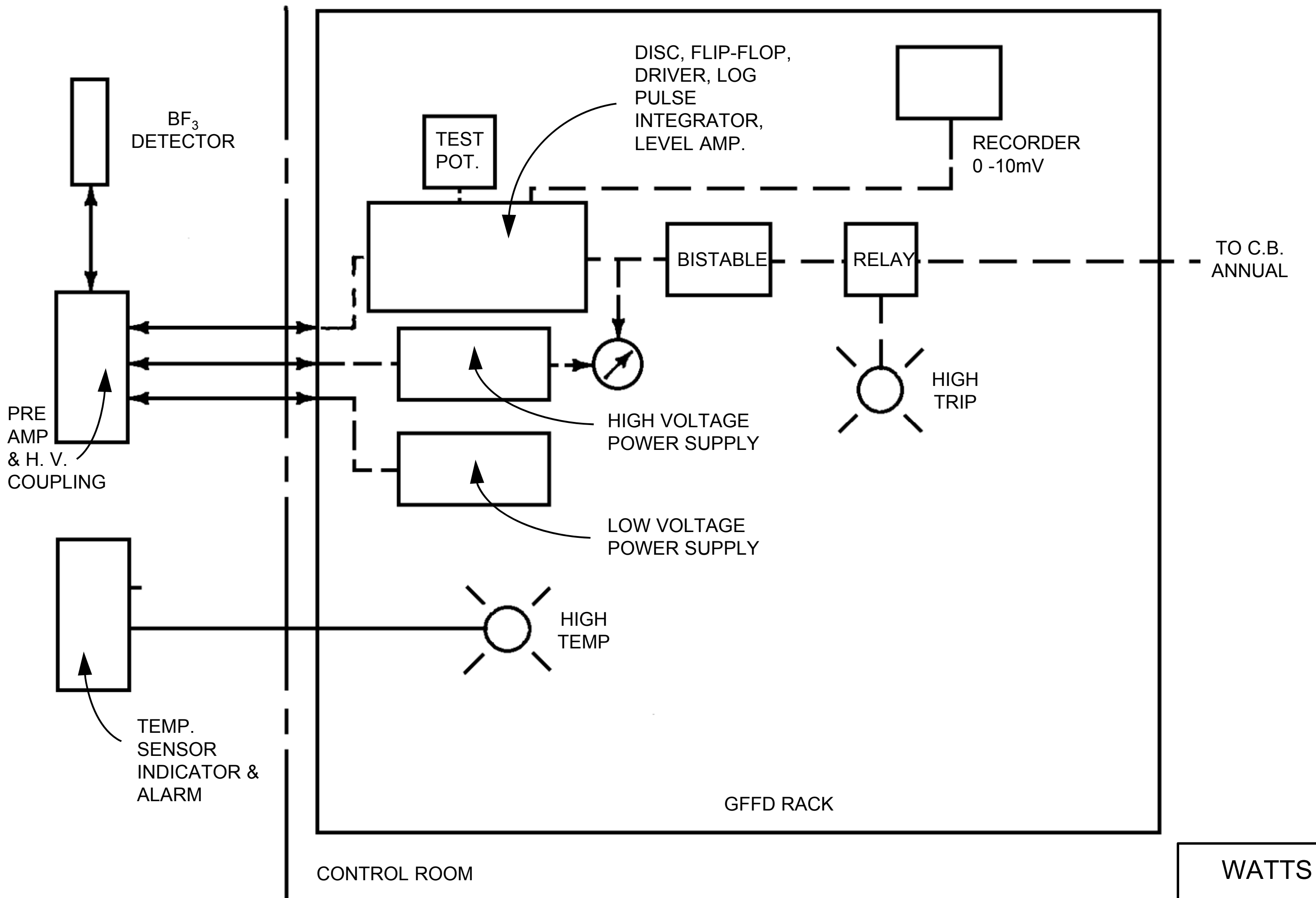
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CHEMICAL AND VOLUME CONTROL SYS
TVA DWG NO. 0-47W610-62-6 R1
FIGURE 9.3-15 SH 12



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Gross Failed Fuel Detector
Flow Diagram
Unit 1

FIGURE 9.3-16

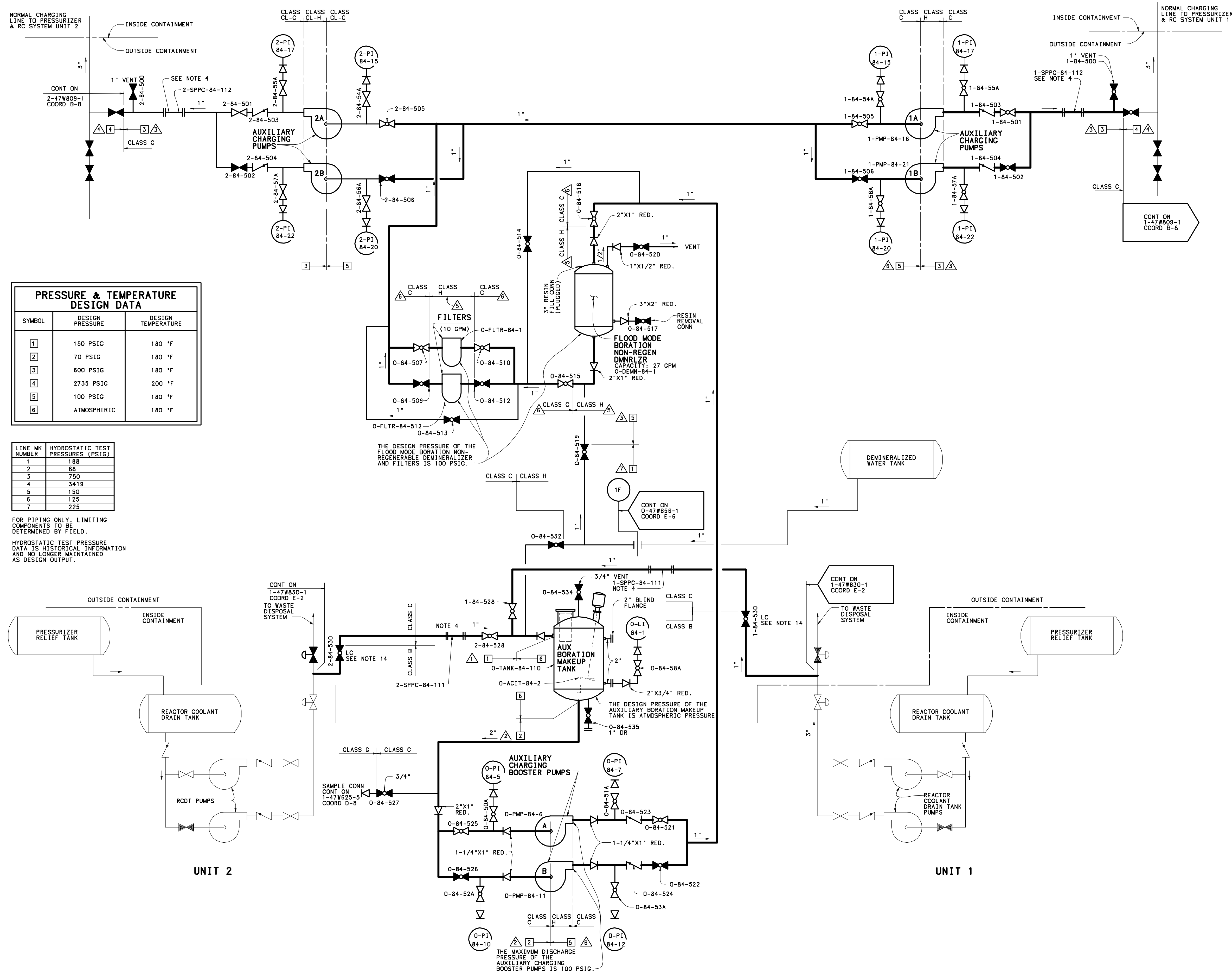


WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Gross Failed Fuel Detector
Electronics Diagram
Unit 1

FIGURE 9.3-17

CAD MAINTAINED DRAWING



PRESSURE & TEMPERATURE DESIGN DATA

SYMBOL	DESIGN PRESSURE	DESIGN TEMPERATURE
1	150 PSIG	180 °F
2	70 PSIG	180 °F
3	600 PSIG	180 °F
4	2735 PSIG	200 °F
5	100 PSIG	180 °F
6	ATMOSPHERIC	180 °F

LINE MK NUMBER	HYDROSTATIC TEST PRESSURES (PSIG)
1	188
2	88
3	750
4	3419
5	150
6	125
7	225

FOR PIPING ONLY, LIMITING COMPONENTS TO BE DETERMINED BY FIELD.

HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.

NOTES:

1. ALL VALVES ARE THE SAME SIZE AS THE PIPING UNLESS OTHERWISE NOTED.
2. ALL INSTRUMENT VALVES ARE 3/4" UNLESS OTHERWISE NOTED.
3. ALL VALVE TAG NUMBERS SHALL BE PREFIXED BY UNIT NUMBER OR COMMON NUMBER.
4. SPOOL PIECES ARE NOT TO BE INSTALLED EXCEPT FOR FLOOD MODE OPERATION OR TEST.
5. ESSENTIAL MAKEUP WATER FROM THE FIRE PROTECTION SYSTEM MAY BE SUPPLIED TO THE AUX BORATION MAKEUP TANK WITH FIRE PROTECTION HOSES.
6. [1], ETC. INDICATE SYSTEM DESIGN TEMPERATURE AND PRESSURE FOR INDICATED PIPING BOUNDARIES ON THE FLOW DIAGRAM AS SPECIFIED IN THE TABLE.
7. THE DESIGN TEMPERATURE AND PRESSURE OF ALL COMPONENTS WITHIN A PIPING BOUNDARY ARE THE SAME AS THE PIPING WITH WHICH THEY ARE INSTALLED, EXCEPT WHERE OTHERWISE INDICATED ON THE FLOW DIAGRAM.
8. △1, ETC. INDICATES SYSTEM HYDROSTATIC TEST PRESSURE FOR INDICATED PIPING BOUNDARIES ON THE FLOW DIAGRAM, AS SPECIFIED IN THE TABLE. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH APPLICABLE CODE CASES WITH CASE BY CASE APPLICATIONS REQUIRING PRIOR APPROVAL BY ENGINEERING DESIGN.
9. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS: (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS, "PIPING SYSTEM CLASSIFICATION."):

   N3-84-4001----------------FLOOD MODE BORATION MAKEUP SYSTEM
   WB-DC-40-29---------------FLOOD MODE PROVISIONS
10. ALL PIPING ON THIS DRAWING IS TVA CLASS C UNLESS OTHERWISE NOTED.
11. ALL PIPING DOWNSTREAM OF THE LAST ISOLATION VALVE ON LOCAL DRAINS, VENTS AND TEST CONNECTIONS IS TVA CLASS G UNLESS OTHERWISE NOTED.
12. NOT USED.
13. NOT USED
14. VALVES DENOTED AS L.C. ARE LOCKED CLOSED DURING NORMAL PLANT OPERATION.

REFERENCE DRAWINGS:

47W406-16, -17, & -18 ----PIPING DRAWINGS
47B601-84 SERIES ----------INSTRUMENTATION TABULATION
1,2-47W809-1 --------------CVCS FLOW DIAGRAM
47W809-100 SERIES ---------STRESS ANALYSIS PROBLEM BOUNDARY
1,2-47W830-1 --------------WDS FLOW DIAGRAM
0-47W856-1 ----------------DEMIN WATER AND CASK DECON FLOW DIAGRAM
1,2-47W610-41 -------------CONTROL DIAGRAM
1,2-47W611-41 -------------LOGIC DIAGRAM
RPT-009 & 010--------------MECH COMPUTER PROGRAM FOR VALVE TAGS

WATTS BAR
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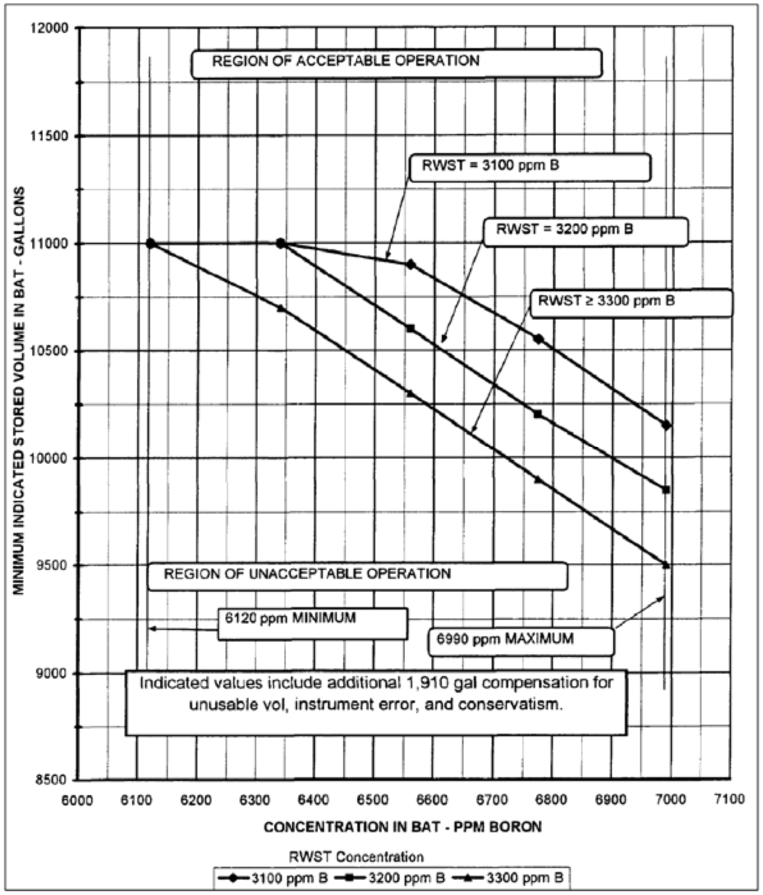
POWERHOUSE
UNITS 1 & 2
FLOW DIAGRAM
FLOOD MODE BORATION
MAKEUP SYSTEM
TVA DWG NO. 0-47W809-7 R3
FIGURE 9.3-18

FIGURE 9.3-19 (Sheets 1-3)

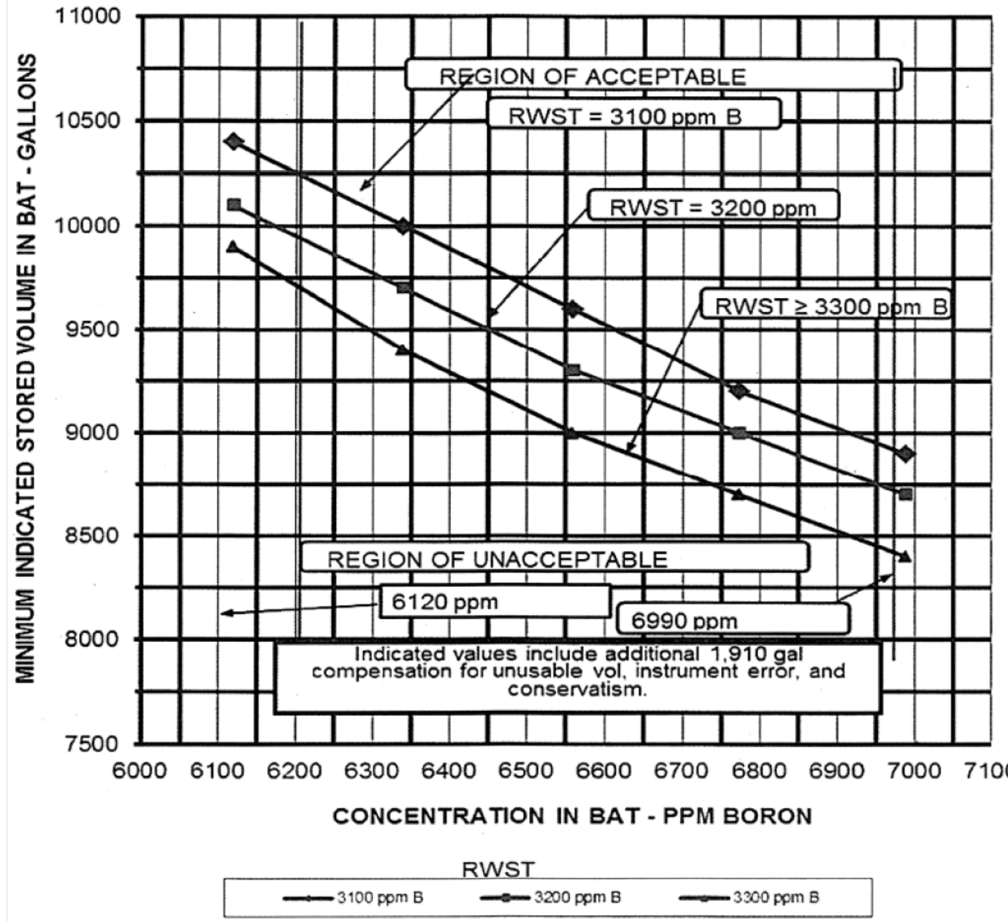
DELETED

FIGURE 9.3-20

DELETED



UNIT 1



UNIT 2

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Boric Acid
Tank Limits

FIGURE 9.3-21

9.4 AIR CONDITIONING, HEATING, COOLING, AND VENTILATION SYSTEMS

9.4.1 Control Room Area Ventilation System

9.4.1.1 Design Bases

The Control Building heating, ventilating, air-conditioning (HVAC), and air cleanup systems are designed to maintain temperature and humidity conditions throughout the building for the protection, operation, and maintenance and testing of plant controls, and for the safe, uninterrupted occupancy of the main control room (MCR) habitability system (MCRHS) area during an accident and the subsequent recovery period. Refer to Section 6.4 for further information regarding control room habitability and definition of MCRHS area. The main control room habitability zone (MCRHZ) is designed to maintain a positive pressure relative to the outdoors and to the adjacent areas at all times, except during a tornado warning, to minimize air inleakage.

The Control Building air-conditioned equipment areas and normally occupied personnel spaces are maintained in the range of 60°F minimum to 104°F maximum temperature during all modes of operation. Adequate environmental conditions are provided for equipment operation and protection, and personnel comfort in the control room during normal, accident, and post-accident recovery conditions.

The Control Building outside air intakes are provided with radiation monitors, and smoke detectors. Indicators are provided with the radiation monitors. MCR common annunciation is provided. Isolation of the MCRHZ occurs automatically upon the actuation of a safety injection signal from either unit or upon indication of high radiation, or smoke concentrations in the outside air supply stream to the building. The Control Building HVAC outside air intakes can also be isolated by closing the tornado dampers. The tornado dampers are closed manually from the MCR during a tornado warning to protect the Control Building from tornado depressurization effects.

Upon receipt of a signal for MCRHS area isolation, Control Room Isolation (CRI), the following conditions are automatically implemented:

1. The Control Building emergency air cleanup fans operate to recirculate a portion of the MCRHS area air-conditioning system return air through the cleanup trains composed of HEPA filters and charcoal adsorbers.

2. The Control Building emergency pressurizing air supply fan operates to supply a reduced stream of outside air to the MCR air-conditioning system to maintain the MCRHZ pressurized relative to outside and the adjacent areas. This fresh air is routed through the emergency air cleanup trains.

3. The EBR air handling units continue to draw outside air to maintain the lower floor spaces at atmospheric pressure.

4. The exhaust fan in the toilet rooms is stopped, and double isolation dampers are closed.

5. The spreading room supply and exhaust fans are stopped and any operating battery room exhaust fan continues to run.

6. Double isolation dampers in the spreading room supply duct and isolation dampers in the exhaust duct close.

7. The Auxiliary Building Elevation 757 shutdown board rooms pressurizing air supply fans are automatically de-energized.

8. Double isolation valves close to isolate the normal pressurizing supply to the MCRHZ.

MCRHZ isolation may be accomplished manually at any time by the control room operators.

The following building air-conditioning and ventilating system components are each provided with two 100% capacity units. Each meets the single failure criterion, and automatic switchover is assured if one of the units fails. These systems include the:

1. MCR air-conditioning system, water chillers, air handling units, and piping.

2. Control Building emergency air cleanup supply fans and filter assemblies.

3. Control Building emergency pressurizing air supply fans.

The EBR air conditioning system is provided with two 100% capacity package water chillers and four 50% capacity air handling units with associated piping, valves, and controls. This system meets the single failure criterion, and automatic switchover is assured if one of the components fails.

Two existing isolation valves, 0-FCV-31-36 and 0-FCV-31-37, in the fresh air supply duct to the spreading room remain closed and the outlet is blanked off.

Fresh air for control room emergency pressurizing is taken from the outdoors from either of two intakes. One is the emergency air intake, located on the east end of the Control Building roof at Elevation 775 and the other is connected to the fresh air intake on the roof at the west end of the Control Building. Both intakes are isolated during a tornado warning.

All essential air-conditioning equipment, ventilating equipment, isolation dampers, and ducts are designed to withstand the safe shutdown earthquake (SSE). Nonessential components are seismically designed to the extent that they will not affect system operation if they should fail due to a seismic event. All air-conditioning and essential ventilating equipment are protected from the effects of a design basis tornado (Section 3.3.2), by isolation dampers located at all external openings to the Control Building. A concrete hood located over the air intake provides additional protection from the effects of tornado generated missiles.

All air conditioning equipment necessary to ensure MCR habitability in the event of a flood is located in the Auxiliary and Control Buildings at elevations where the equipment remains functional during flooding up to the design basis flood elevation. The EBR air conditioning system is not required during a flood.

Piping which could be a source of pipe whip (i.e., high energy lines) does not pass through areas containing essential Control Building air conditioning or air cleanup equipment. The equipment is also separated from and protected from potential sources of missiles and jet impingement which could adversely affect operation of the system. See Section 3.5.1.1.4 for further discussion on Control Building internal missiles.

System and component quality group classification for the Control Building HVAC and air cleanup systems is commensurate with the importance to safety of the function performed by the systems. For further discussion of quality group classification refer to Section 3.2.2.

9.4.1.2 System Description

The Control Building HVAC, and air cleanup systems are shown on Figures 9.4-1, 9.4-2, and 9.4-3 and the logic and control on Figures 9.4-4, 9.4-4a, 9.4-5, 9.4-6, and 9.4-7, and consist of the following systems:

1. MCR air-conditioning system

2. EBR air-conditioning system.

3. Control Building emergency air cleanup system.

4. Control Building emergency pressurizing system.

5. Battery room ventilating system.

6. Miscellaneous ventilating systems.

The MCR air-conditioning system water chillers are located in the Auxiliary Building at Elevation 737.0. The associated air handling units are located in the Control Building in the mechanical equipment room at Elevation 755.0. The area served by this system includes the MCR, the relay room, the DPSO engineers shop, Control Building offices, the technical support center (TSC), conference rooms, kitchen, toilets, locker rooms, the mechanical equipment room and the NRC Office at Elevation 755.0.

The EBR air-conditioning system water chillers are located in the Control Building in the east mechanical equipment room at Elevation 692.0. The associated air handling units are located in the west mechanical equipment room at Elevation 692.0. Rooms served by this system include the battery board rooms, battery rooms, battery room exhaust fan room, the communications room, the secondary alarm station at Elevation 692.0, and the computer and auxiliary instrument rooms at Elevation 708.0.

The communications room located on Elevation 692.0 has two nonsafety-related air conditioning units to supplement the electric board room air conditioning system. The units receive cooling water from the raw service water system. The units are provided with local controls.

The MCR air conditioning system is provided with two 100% capacity package water chillers, two 100% capacity fan-coil type air handling units, and associated pumps, piping, ductwork, and controls.

The EBR air conditioning system is provided with two 100% capacity package water chillers, four 50% capacity fan-coil type air handling units, and associated pumps, piping, ductwork, and controls.

Fresh air is drawn in from the air intake by the operating MCR air handling unit to replace that mechanically exhausted to the outdoors plus makeup for leakage in order to pressurize the MCRHZ.

Fresh air is drawn in by the operating EBR air handling unit and supplied to spaces on Elevations 692.0 and 708.0. System airflow balancing provides for makeup air which replaces that mechanically exhausted to the outdoors and maintains atmospheric pressure at these floors.

During normal and CRI operating modes, all MCRHS air, fresh and recirculated, is filtered by passing through an air handling unit containing a bank of filters. Filters associated with an inactive air handling unit are available for servicing.

During normal operations, all fresh air supplied to the air conditioning systems is heated by a thermostatically controlled duct heater to maintain spaces within design temperature limits. Additional electric heaters are located in air supply ducts serving the battery board rooms at Elevation 692.0; the auxiliary instrument and computer rooms at Elevation 708.0; and the relay room, TSC, Control Building offices, conference rooms, toilets, locker room and kitchen at Elevation 755.0. The above heaters are each thermostatically controlled to maintain room design conditions.

During normal operation, air is exhausted from the Control Building by the toilet and locker room exhaust fan, a spreading room exhaust fan, and a battery room exhaust fan. The spreading room supply fan transfers air from the mechanical equipment room on Elevation 755.0 to the spreading room. The makeup air and pressurizing air is drawn into the Control Building by the operating MCR and EBR air handling units. The air supply quantity is manually preadjusted by balancing dampers, as required, to maintain a minimum 1/8-inch positive static pressure in the main control room and atmospheric pressure in the remainder of the building, except the spreading room which is manually preset at a slight negative pressure relative to outdoors.

During a CRI, double isolation valves automatically close to terminate the normal supply of fresh air to the MCRHZ. The EBR air handling units continue to draw a measured quantity of outside air to maintain the lower floors at approximately atmospheric pressure.

In the event of a single active failure which causes the MCRHZ pressure to drop below 1/8-inch water gage positive pressure, any of the four differential pressure switches activate an alarm in the MCR. The control room operator provides corrective action in the normal operating mode and has the option of starting the standby air handling unit. If there is a single failure during the isolation mode, the differential pressure switches automatically start the standby emergency pressurizing fan and its associated air cleanup unit to maintain the pressure in the MCRHZ. The switches also activate an alarm in the MCR.

The Control Building emergency air cleanup system is located within the mechanical equipment room at Elevation 755. This system is provided with two 100% capacity emergency air cleanup fans, and two 100% capacity air cleanup filter assemblies arranged in two parallel 100% capacity fan-filter trains. Refer to Section 6.5 for further information related to the emergency air cleanup units.

The emergency air cleanup system automatically operates upon a safety injection signal, indication of high radiation, or smoke concentrations in the building fresh air supply. This system can also be manually started from the MCR at any time. During an accident, both of the emergency air cleanup supply fans are started. Controls are provided to permit the control room operators to shut down either one of the air cleanup units and to keep it as a backup. The backup unit automatically starts in the event the operating unit fails.

During air cleanup system operation, a portion of the MCR air conditioning system return air is continuously routed through one or both of the air cleanup units and then to the system return air plenum. The cleaned air is thus recirculated to the MCR by the air-conditioning system. The system may be manually operated from the MCR at any time as required for periodic testing in accordance with the technical specifications filter testing program.

The Control Building emergency air cleanup fans are engineered safety features (ESF) equipment and are connected to separate divisions of the emergency power system.

The MCRHZ is pressurized with cleaned outdoor air during operation of the control room emergency air cleanup system. The minimum 1/8-inch positive pressure of the MCRHS area relative to the outdoors and adjoining spaces minimizes the inleakage of unprocessed air during the emergency mode. Section 6.4.3 discusses the three modes of system operation. The control room emergency pressurization system is provided with two 100% capacity emergency pressurizing air supply fans located within the mechanical equipment room Elevation 755. The fresh or pressurizing air is taken from either of two air intakes, one located on the Control Building roof at Elevation 775 near the east end of the building and the other located on the west end of the building. Each fan is duct-connected to an intake hood to provide two separate 100% capacity air supply systems. Air from each emergency intake is ducted to the associated emergency pressurizing fan. A cross-connection is provided just upstream of the fans (refer to Figure 9.4-1) which allows either emergency pressurization fan to draw air from either emergency air intake if necessary. The manual damper in the cross connection is normally in the closed position. The damper, which is accessible from within the habitability area, is opened only if one of the emergency pressurizing fans has failed and contamination of the air intake associated with the non-failed fan is great enough to require air to be drawn from the other emergency intake. Determination of contamination level is discussed in Section 6.4.3.

Emergency pressurization air supply fans which discharge to the control room air-conditioning system return air upstream of the air cleanup filter assembly trains. The emergency pressurizing fans are the vaneaxial type with a capacity to deliver 711 cfm. These fans (one redundant) are ESF equipment and are connected to separate divisions of the emergency power system.

Both emergency pressurizing fans (100% redundant) are started by the same accident signal that starts the air cleanup units. The capability is provided to place either of the operating air cleanup units and the associated emergency pressurizing fans in the standby mode. The standby components start automatically in the event of a failure of the operating air cleanup unit or its emergency pressurizing fan.

During non-tornado operation, power is removed from tornado isolation dampers 0-FCO-31-21 and 0-FCO-31-34, which are located in the ductwork connected to the two fresh air intakes. The dampers' control circuits remain de-energized during all plant conditions, except tornado warning, to preclude the possibility of a single failure in their control circuit isolating both air intakes.

The battery rooms ventilation system consists of two 100% capacity and one reduced capacity exhaust fans. The fans are located on the Elevation 692.0 floor with the two 100% capacity fans located near the west end of the building and the other fan located in the east mechanical equipment room.

Fire dampers provided in each room's air exhaust duct and air supply opening operate to isolate the room upon high temperature due to fire.

The battery room ventilation system is required to operate at all times except during the design basis flood and during a 72-hour period following a fire. A standby fan automatically starts upon failure of the operating fan to produce airflow. The battery room fans are ESF equipment and are connected to the emergency power system. The reduced capacity exhaust fan C-B is normally unpowered, but can be manually started if needed to control hydrogen in the battery rooms.

The spreading room is ventilated by one of two 100% capacity exhaust fans (one being on manual standby) located at the east end of the spreading room at Elevation 729.0. One spreading room supply fan, located in the mechanical equipment room at Elevation 755.0, supplies air from the mechanical equipment room. Because the spreading room is maintained at a slight negative pressure during normal operation, some air enters via leakage from the MCR and the electrical board room areas.

The spreading room supply and exhaust fans are nonsafety-related and are not connected to the emergency power system. During MCR isolation, the spreading room fans are automatically shut off and isolation dampers closed.

The mechanical equipment room at Elevation 755.0 is normally ventilated by the passage of air-conditioning system supply air from the system air handling unit.

The mechanical equipment room at Elevation 692.0 is ventilated at all times with air supplied by the EBR air-conditioning system supply and with air drawn through the room to the air-conditioning return air duct.

The kitchen, toilet, and locker rooms at Elevation 755.0 are ventilated by exhausting a portion of the MCRHZ conditioned air through the rooms. The toilet and locker room exhaust fan is located in the Elevation 755.0 mechanical equipment room and discharges directly to the outdoors.

The toilet and locker rooms exhaust fan is nonsafety-related; however, the fans are designed with capability to be connected to the emergency power system. During MCR isolation the toilet and locker room exhaust fan is automatically shut down, and double isolation dampers close.

Dampers used to isolate the MCRHZ from the outside and from portions of the ventilation systems serving other areas of the Control Building are low leakage type dampers. They are heavy-duty dampers provided with resilient seals along the blade edges. These dampers close following detection of high levels of radiation, concentrations of smoke, or receipt of an isolation signal. Refer to Section 6.4 for further information regarding damper leakage.

9.4.1.3 Safety Evaluation

The Control Building air-conditioning systems are ESF. Each pair of full-capacity (one redundant) water chillers and each redundant set of air handling units is served from a separate train of the emergency power system and from a coordinated separate loop of the essential raw cooling water system (ERCW). Upon loss of offsite power, emergency power to the MCR and EBR chiller packages is automatically reestablished in sequence by the diesel generator in accordance with UFSAR Table 8.3-3. The failure modes and effects analysis presented in Table 9.4-7 verifies the capability of the system to maintain acceptable environmental conditions within the Control Building during any mode of system operation following any single active failure.

All MCR equipment operates normally at an ambient temperature of 75°F. Abnormal excursions of short duration (12 hours or less) to 104°F maximum and 60°F minimum may occur without adverse effects on the equipment. Loss of ventilation is discussed further in Section 3.11.6.

The air cleanup equipment installed to purify air supplied to the MCRHZ during emergencies is classified as an ESF air cleanup system. Good general agreement with Regulatory Guide 1.52 standards for air cleanup equipment is achieved. Details on this compliance are given in Table 6.5-4.

Each of the Control Building emergency air cleanup units consists of a bank of HEPA filter cells and a bank of carbon adsorber modules. Test connections and appropriate instrumentation are also provided for each air cleanup unit. For further details refer to Section 6.5.1.

Filter banks are provided in the suction-side of each MCR and EBR air handling unit.

For discussions on radioactivity dose levels and detection of airborne contaminants, refer to Section 12.4 and 12.3.4.

Tornado dampers are provided to isolate the Control Building HVAC outside air intakes during a tornado warning. The isolation is provided upon damper closure during either normal system operation or MCR Isolation. The loss of MCRHZ pressurization during this time will not result in contaminated air leaking into the MCRHZ since a LOCA is not postulated concurrent with a tornado.

The only heating, ventilating, and air conditioning required in the Control Building in the event of a flood above plant grade is for the Elevation 755.0 rooms, including the MCR. Equipment used during the flood mode operation includes the MCR air-conditioning subsystem components on Control Building Elevation 755.0 and the water chillers and the chilled water circulating pumps on Auxiliary Building Elevation 737.0. Equipment located at floor Elevation 755 of the Control Building is unaffected by the design basis flood. The water chillers and chilled water circulating pumps serving the MCR air handling units located in the Auxiliary Building at floor Elevation 737 are functional for floods up to the design basis flood level. Refer to Section 2.4.14 for additional discussion of the plant flood protection plan.

9.4.1.4 Tests and Inspection

The system was tested initially as part of the preoperational test program (Chapter 14.0).

The Control Building air-conditioning systems are in continuous operation and are accessible for periodic inspection. After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operation.

The building emergency pressurizing air supply fans and air cleanup assemblies are tested periodically. Details of the testing program for the air cleanup units are included in Section 6.5.

Details of the radiation monitors are included in Section 11.4.

The battery rooms ventilating system is in continuous operation. The exhaust fans are accessible for periodic inspection.

9.4.2 Fuel Handling Area Ventilation System

9.4.2.1 Design Bases

The fuel handling area ventilation system, a subsystem of the Auxiliary Building ventilating system, serves the fuel-handling area at Elevation 757, the penetration rooms at Elevation 737, Elevation 757 and Elevation 782, and the fuel, waste, and cask handling areas at Elevation 729 and Elevation 692.

The system is designed to: (1) maintain acceptable environmental conditions for personnel access, operation, inspection, maintenance, and testing, (2) protect mechanical and electrical equipment and controls, and (3) limit the release of radioactivity to the environment during all weather conditions. The environmental control system is designed to maintain building temperatures between 60°F minimum and 104°F maximum.

During accident conditions, the fuel handling area ventilation system is shut down and all environmental control is handled by the Auxiliary Building gas treatment system (ABGTS), described in Section 6.2.3. Although the ABGTS is available to minimize the consequences of a fuel handling accident, it is not required to function in order to meet control room and offsite dose limits based on the use of the Regulatory Guide 1.183, Revision 0 (Alternate Source Term) methodology.

All ductwork, dampers, and grilles of the fuel handling area ventilation system essential to operation of the ABGTS are designed to Seismic Category I and Safety Class 2b requirements. Each fuel handling area exhaust fan is provided with a primary circuit breaker and a shunt trip isolation switch which is tripped by a signal of the opposite train from that for the primary circuit breaker to ensure that power is isolated from the fan. All other system components, including exhaust fans and remaining ductwork and dampers, are designed to Seismic Category I(L) requirements.

To control airborne activity, ventilation air is supplied to clean areas, then routed to areas of progressively greater contamination potential. The fuel handling area is maintained at a slightly negative pressure to limit outleakage, and can be physically isolated from the outdoors in case of radiological contamination.

Air utilized to ventilate the fuel handling area, waste packaging, and cask shipping areas is exhausted through the fuel handling area exhaust fans. An exhaust duct system from the waste packaging area and cask loading area is connected to a duct system around the periphery of the spent fuel pit and fuel transfer canal. Thus, exhaust air from the fuel handling area passes across the spent fuel pit forming an air curtain across the pool.

Exhaust is provided by two 100% capacity fuel handling area exhaust fans. During normal operation one fan is in operation with the other on standby. Both fans discharge to the Auxiliary Building exhaust stack.

An inlet damper furnished with each fuel handling area exhaust fan is used to regulate the volume of air exhausted as required to maintain a ¼-inch negative pressure within the building. These dampers are automatically operated by static pressure controllers.

During periods of high radiation in the fuel handling area or upon initiation of a containment isolation signal, or for high air temperature at the supply intake the Auxiliary Building supply and exhaust fans and the fuel handling exhaust fans are automatically stopped and isolation dampers located in the ducts that penetrate the Auxiliary Building Secondary Containment Enclosure (ABSCE) are closed. Additionally, during refueling operations when containment and/or the annulus is open to the Auxiliary Building ABSCE space, a Containment Vent Isolation (CVI) signal will automatically stop the above described fans and close the same isolation dampers as described above. Similarly, the high radiation signal in the fuel handling area can also automatically initiate a CVI during refueling operations when containment and/or the annulus is open to the Auxiliary Building ABSCE spaces. Likewise, a Containment Isolation Phase A (SI Signal) from the operating unit or high temperature in the Unit 1 or Unit 2 Auxiliary Building air intake, or manual ABI will cause a CVI signal in the refueling unit. In addition, when Unit 1 is in refuel mode, an ABI signal or HRRA will initiate shutdown and isolation of the refueling unit's containment purge system independent of the CVI signal. In the case where containment of both units is open to the Auxiliary Building spaces, a CVI in one unit will initiate a CVI in the other unit in order to maintain those spaces open to the ABSCE.

An isolation barrier is thus formed between the building and the outdoor environment, and the Auxiliary Building gas treatment system (ABGTS) is started up automatically (see Section 6.2.3) to maintain the ABSCE at less than a 1/4-inch water gauge negative pressure during these high radiation or accident periods. Although the ABGTS is available to minimize the consequences of a fuel handling accident, it is not required to function in order to meet control room and offsite dose limits based on the use of the Regulatory Guide 1.183, Revision 0 (Alternate Source Term) methodology.

The fuel-handling area ventilation system is located completely within Seismic Category I structures and all safety-related components are fully protected from floods and tornado-missile damage.

9.4.2.2 System Description

The fuel-handling area ventilation system is shown on Figure 9.4-8, on logic Figures 9.4-9 and 9.4-10, and on control Figures 9.4-11 and 9.4-17.

The fuel-handling area is supplied with outdoor air from the Auxiliary Building general ventilation air supply system, described in Section 9.4.3. All supply air is ducted to clean areas of the fuel-handling area from where it flows to areas of progressively greater contamination potential before being exhausted through a duct system by the exhaust fans. The fuel-handling area exhaust fans are capable of being connected to emergency power.

The cask decontamination area on Elevation 729 is ventilated by a separate supply fan which circulates air through the area when the decontamination room is in use. This air flow assures an acceptable environment for motor reliability and preservation.

The cask decontamination room is kept under negative pressure at all times since the room is connected to the fuel handling area exhaust ductwork.

9.4.2.3 Safety Evaluation

A fuel handling accident in the Auxiliary Building is detected by the two gamma radiation detectors mounted above the fuel pool, as shown in Figure 9.4-12. The high radiation signals via redundant trains will then shut off the fuel handling and Auxiliary Building general supply and exhaust fans and start the ABGTS, as shown in Figures 9.4-9 and 9.4-10. No credit is taken in the dose or accident analyses for these functions. The fuel handling area ventilation system will accomplish the following functions:

1. Isolate the normal ventilation pathways between the spent fuel pool and the environment.

2. Filter the contaminants out of the air by the ABGTS before exhausting it to the environment.

The two redundant radiation monitors (safety-related) located above the spent fuel pit assure that the accident is promptly detected and that a high radiation signal is provided to each ventilation train, even if one monitor fails. Also, during refueling operations when containment and/or the annulus is open to the Auxiliary Building ABSCE spaces, a Containment Vent Isolation (CVI) signal from either the operating or refueling unit is procedurally configured to assure that a fuel handling accident in containment is promptly detected and the CVI signal is provided to each ventilation train. In addition, the Auxiliary Building radiation monitor (non-safety related) which monitors the Auxiliary Building exhaust vent is also capable of providing a high radiation signal to the MCR.

A high radiation signal from either of the monitors located above the spent fuel pit or a CVI signal whenever containment and/or the annulus is open to the Auxiliary Building ABSCE spaces during refueling operations causes the fuel handling area (FHA) and Auxiliary Building general supply and exhaust fans to shut down and their associated dampers to close, as shown in Figures 9.4-9 and 9.4-10. Each of the two FHA exhaust fans has both train A and train B dampers, to ensure building isolation in the event of one damper's failure to close. As an added safety feature, all ABSCE boundary isolation dampers are designed to fail-closed on loss of instrument air or electrical power.

These two monitors also start the ABGTS upon detection of a high radiation signal in the Auxiliary Building spent fuel pool area. See Section 6.2.3 for a further analysis of the ABGTS.

From the study of anticipated failure modes and the analysis of their associated effects, it has been determined that the safety-related portions of the system are capable of functioning in spite of the loss of any active component. See Tables 9.4-8, 9.4-8A, and 9.4-8B for a detailed failure modes and effects analysis (FMEA) on the Auxiliary Building (including fuel handling area) HVAC system.

During normal operation the fuel handling areas are continuously maintained at a slightly negative pressure relative to outdoors to minimize outleakage.

During periods of high radiation or upon initiation of an Auxiliary Building isolation signal, the ABSCE, which includes the fuel handling areas, is maintained at a nominal 1/4-inch water gauge negative pressure by the ABGTS. See Sections 9.4.3 and 6.2.3 for further information.

9.4.2.4 Inspection and Testing

The system is tested initially as part of the preoperational test program.

The fuel handling area ventilation system is in continuous operation and is accessible for periodic inspection. After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operational/functional integrity.

Details of the radiation monitors are included in Section 11.4.

See Section 6.2.3.4 for inspection and testing requirements for the ABGTS.

9.4.3 Auxiliary Building and Radwaste Area Ventilation System

9.4.3.1 Design Bases

The Auxiliary Building ventilating systems serve all areas of the Auxiliary Building including the fuel handling area (see Section 9.4.2) and the radwaste areas. Separate subsystems are utilized for the environmental control of the shutdown board rooms, auxiliary board rooms, and other miscellaneous rooms and laboratories. The ventilating systems also incorporate individual cubicle coolers to provide supplementary cooling to specific safety feature equipment.

The Auxiliary Building ventilating systems are designed to: (1) maintain acceptable environmental conditions for personnel access, operation, inspection, maintenance and testing, and for protection of mechanical and electrical equipment and controls, and (2) control airborne activity during outside environmental conditions as stated on the Environmental Data drawings.

The shutdown board, auxiliary control, and battery board rooms at Elevation 757 and the auxiliary board and battery rooms at Elevation 772 are cooled by mechanical refrigeration to maintain the room temperatures within the range for which the equipment is environmentally qualified.

To control airborne activity, ventilation air is supplied to clean areas, then exhausted through areas of progressively greater contamination potential. Ventilation system design ensures that the areas of the building which are subject to radioactive contamination are maintained at a slightly more negative pressure to limit outleakage. All exhaust air from the Auxiliary Building is routed through a duct system, and is discharged past a radiation monitor and into the Auxiliary Building exhaust vent, except the shutdown board rooms, auxiliary control room, battery board rooms on Elevation 757, and auxiliary board rooms, battery rooms, and transformer rooms on Elevation 772, which are not tied to the Auxiliary Building exhaust.

Upon indication of high radiation in the fuel handling area of the Auxiliary Building, high temperature in the Auxiliary Building air intake(s), or upon a safety injection signal from either reactor unit, the Auxiliary Building supply and exhaust fans are automatically stopped and isolation dampers located in the ducts which penetrate the ABSCE are closed to complete the isolation barrier. In addition, a containment vent isolation signal from the operating or refueling unit during fuel handling operations with containment and/or the annulus open to the Auxiliary Building ABSCE spaces will result in the above actions. When Unit 1 is in refuel mode, an ABI signal or HRRA will also initiate shutdown and isolation of the refueling unit’s containment purge system independent of the CVI signal. Two 100% capacity gas treatment system filter trains consisting of air heaters, prefilters, HEPA filters and carbon absorbers, are automatically energized and a reduced quantity of building exhaust is diverted through the filter trains and discharged into the Shield Building exhaust vent (see Section 6.2.3). The exhaust vent is located within the annulus space of the Reactor Building and extends to the top of the Reactor Building.

Upon detection of smoke in the Auxiliary Building air intake rooms (Units 1 and 2), the affected unit's Auxiliary Building general ventilation air supply fans are automatically stopped and their isolation dampers closed.

The HVAC components in the shutdown board rooms, auxiliary board rooms, shutdown transformer rooms, ABGTS, and Auxiliary Building ESF coolers, associated ductwork and piping, are designed to seismic Category I requirements. Other parts of the Auxiliary and Radwaste Area ventilation system are designed to meet Seismic Category I(L) requirements.

For safety-related portions of the system, components are designed to assure that a single active failure cannot result in the loss of a safety-related function. This is accomplished by using 100% redundancy where required as described in the following sections. The Auxiliary Building is structurally designed to resist damage by missiles, either internally or externally produced. Specific design considerations for missile protection are also described in the following subsections.

9.4.3.2 System Description

The Auxiliary Building ventilation systems are shown on Figures 9.4-13, to 9.4-16, on logic Figures 9.4-9 and 9.4-10, and on control Figures 9.4-11 and 9.4-17. The auxiliary and radwaste area ventilation systems consist of the following subsystems:

1. Building air supply and exhaust system (general ventilation)

2. Building cooling system (chilled water)

3. Safety features equipment coolers

4. Shutdown board room air-conditioning system

5. Auxiliary board and battery room air-conditioning system

6. Shutdown transformer room ventilation system

7. Miscellaneous ventilation and air-conditioning system

9.4.3.2.1 Building Air Supply and Exhaust Systems (General Ventilation)

The Auxiliary Building air supply system filters 100% of outdoor air through a bank of filters for each of two mechanical equipment rooms located at opposite ends of the building at Elevation 737.0.

Ventilation supply air is heated or cooled at the air intake, as needed, to maintain suitable temperatures in the Auxiliary Building general spaces, for equipment protection and personnel comfort during normal operation.

The air supply system utilizes four 50% capacity supply fans, two being located in each of the two mechanical equipment rooms at Elevation 737.0. During normal operation, one fan in each equipment room is in operation with the other fan in the standby mode.

Supply air is ducted to various clean or accessible areas of the AB from which it flows to areas of progressively greater contamination potential before being exhausted through a duct system by the building exhaust fans. In the event of a fuel-handling accident, radiation monitors in the vicinity of the spent fuel pool may initiate an Auxiliary Building isolation (ABI) signal which stops the building ventilation system and starts the ABGTS fans (see Sections 9.4.2 and 6.2.3). An ABI signal can also be initiated manually. In addition, during fuel handling operations when the containment and/or the annulus is open to the AB ABSCE spaces, a high radiation signal from the spent fuel pool radiation monitors, Containment Isolation Phase A (SI signal), high temperature in the AB air intake, or manual ABI may result in a containment ventilation isolation (CVI) in addition to an ABI and ABGTS start. An ABI or HRRA when Unit 1 is in refuel mode, will also initiate shutdown and isolation of the refueling unit's containment purge system independent of the CVI signal. Further, a CVI signal, including a CVI signal generated by a high radiation signal from the containment purge air exhaust radiation monitors, may initiate an ABI and start of ABGTS. Likewise, a Containment Isolation Phase A (SI Signal) from the operating unit or high temperature in the Unit 1 or Unit 2 Auxiliary Building air intake, or manual ABI will cause a CVI signal in the refueling unit. These actions will ensure proper operation of the ABSCE. In the case where containment of both units is open to the Auxiliary Building spaces, a CVI in one unit will initiate a CVI in the other unit in order to maintain those spaces open to the ABSCE. Although the ABGTS and ABSCE may be available to minimize the consequences of a fuel handling accident, it is not required to function in order meet control room and offsite dose limits based on the use of Regulatory Guide 1.183 (Alternate Source Terms) methodology.

The building supply air is provided by centrifugal fans located downstream of the heating/cooling coils. These fans which operate only during normal operating conditions, are not engineered safety features.

The general exhaust air from the AB is provided by four exhaust fans each rated at 50% of system capacity. These fans are located on the roof of the AB and discharge into the AB exhaust stack.

An inlet damper in series with each AB exhaust fan is used to regulate the volume of air exhausted as required to maintain the required negative pressure within the building with respect to the outside environment.

The isolation dampers and the ductwork between these dampers that make up part of the ABSCE are designed to the requirements of Safety Class 2b and Seismic Category I. For the exhaust fans, the trip circuits for the primary circuit breaker and the shunt trip isolation switch arranged in series with the primary circuit breaker are designed as Class 1E. All other portions of this system are Seismic Category I(L).

9.4.3.2.2 Building Cooling System (Chilled Water)

The purpose of the Auxiliary Building chilled water cooling system is to supplement the general ventilation system and to maintain temperatures within design limits in the general spaces of the Auxiliary Building during normal plant operating conditions. The cooling system consists of two 100% capacity packaged water chillers, two 100% capacity primary loop circulating pumps, two 100% capacity secondary loop circulating pumps, heating/cooling coils, fan-coil type air handling units, and associated piping, ductwork, and controls.

9.4.3.2.3 Safety Feature Equipment Coolers

The safety feature equipment coolers are described in Section 9.4.5.3.

9.4.3.2.4 Shutdown Board Room Air-Conditioning System

Shutdown board rooms are located on Elevation 757.0 of the Auxiliary Building with a firewall separating Units 1 and 2 equipment. The electrical boards for either unit can provide the service necessary for the safe shutdown of both plant units following an accident in either unit. Environmental control is provided by four fan-coil air-handling units supplied with chilled water from two 100% redundant water chillers.

Environmental control for the auxiliary control room is maintained by the SDBR air-conditioning system. The four SDBR air-handling units are arranged so that each shutdown board room and battery board room is cooled by either of two redundant (train A or B) air-handling units. Each pair of Train A and Train B units is located in its respective reactor unit's mechanical equipment room. The air distribution system is arranged such that the auxiliary control room is cooled by two of the four fan-coil units from different equipment rooms. Four unit heaters provide heating as required to maintain the minimum design ambient conditions. Each SDBR air-conditioning system is connected to an emergency power source and rejects heat to the ERCW system.

Upon loss of offsite power, emergency power to both SDBR air-conditioning system chillers is automatically reestablished in sequence by the diesel generator in accordance with UFSAR Table 8.3-3. One of the two redundant chillers is normally operating and the other is in standby. The standby chiller starts if the operating chiller fails. If one train of the SDBR air conditioning system is inoperable or taken out of service to perform maintenance activities, a risk assessment associated with the activity will be managed in accordance with paragraph (a)(4) of 10 CFR 50.65, the “maintenance rule,” Reference [1]. The SDBR air-conditioning system is designed to meet Safety Class 2b and Seismic Category I requirements.

Each of two pairs of 100% capacity pressurizing fans is designed to maintain the SDBRs at a slight positive pressure with respect to the outdoors.

Each of the two air-handling units and each of the two pressurizing air supply fans serving one set of SDBRs is powered by different power trains.

Redundant tornado dampers are installed in the Elevation 757 shutdown board room pressurizing supply fan ductwork which extends to Elevation 772; this ductwork is designed for a pressure differential of 3 $lb/inch^2$. In addition, ductwork penetrating the Elevation 757 personnel and equipment access rooms from the emergency gas treatment system and blowdown treatment rooms is designed for 3 $lb/inch^2$. Thus, the Elevation 757 electrical equipment areas are protected from tornado-induced depressurization.

9.4.3.2.5 Auxiliary Board Rooms Air-Conditioning Systems

The Auxiliary Building electrical boards, located on floor Elevation 772.0, are separated into two sub-areas per unit corresponding to Train A and Train B emergency power. Four separate air - conditioning systems are provided, one to serve each of the four board room sub-areas. Train B areas which contain both Train A and Train B electrical equipment are cooled by Train A and Train B air conditioning subsystems. Following an accident, the electrical boards in either subarea have the capability to support a safe shutdown of the unit. Because each sub-areas is served by an attendant air conditioning system sized to remove 100% of the heat produced by electrical equipment in that sub-areas, full redundancy is provided.

The Train A air-conditioning equipment located within the Elevation 772.0 mechanical equipment room and the Train B air-conditioning equipment located on the roof above are provided structural protection from environmental hazards, including tornado missiles, and floods. The system is also designed to meet Safety Class 2b and Seismic Category I requirements.

Each board room air-conditioning system contains a refrigerant compressor, air-cooled condenser, fan-coil air handling unit with direct expansion cooling coils, two 100% pressurizing air supply fans, air supply distribution system and control and safety devices.

Two 100%-capacity roof ventilator exhaust fans located on the roof of each of the four separate battery rooms on Elevation 772 provide continuous ventilation to prevent the possible accumulation of dangerous hydrogen gas.

The two 100%-capacity pressurizing air supply fans per air-conditioning system serve a twofold purpose. One is to replace a portion of air- conditioning system air exhausted through the battery room and the other is to pressurize the electrical board room to prevent infiltration of contaminated air. The mixture of this makeup air and board room return air is conditioned upon passing through the air handling unit.

One pressurizing air supply fan and one battery room exhaust fan in each individual air-conditioning system are connected to Train A electric power, and the remaining fans are connected to Train B power. Control system interlocks provide simultaneous operation of the pressurizing air supply fan and battery room exhaust fan. The availability of this fan combination on either power train ensures continuous ventilation in each battery room regardless of operability of the direct-expansion air-conditioning equipment. In the event of air-conditioning system failure, pressurizing fan air is drawn through the normal board room supply ducts by the battery room exhaust fan.

Condensing unit cooling air for the Train A air-conditioning system of each plant unit is routed from intakes located on the roof at Elevation 786, through the condenser, and discharged through a roof-mounted exhaust housing. The Train B system condenser cooling air is drawn through an intake on the side of the equipment housing on the roof and is discharged through an exhaust opening atop the equipment housing.

Each Train A and each Train B room air conditioning system air handling unit is designed to maintain the room temperature within the range for which the equipment is environmentally qualified. The minimum temperature is 50°F for the board rooms and the battery rooms. The maximum temperature for each room is 104°F. This ensures that the equipment and components are not exposed to environmental conditions that could degrade the operability of safety-related equipment.

Each battery room exhaust fan has a damper capable of withstanding pressure differentials imposed by tornado conditions. The dampers are mounted below the fans at Elevation 786.0. Small ventilation holes are provided in each damper frame between the exhaust fan and the damper to allow continuous venting of hydrogen gas even when the damper is closed. Each of these dampers is interlocked with its respective exhaust fan such that it will provide isolation of the fan when it is not operating. These dampers are locally operated and will automatically close when the exhaust fans are turned off upon tornado warning.

The fifth vital battery room exhaust fans also have dampers capable of withstanding pressure differentials imposed by tornado conditions. The dampers are mounted below the Elevation 786.0 between the ceiling and the in-line fan.

The fifth vital battery room is cooled by air which is drawn from the 480V Board Room 1A through an opening in the common partition wall at the “T” line and is exhausted directly to the outside. This configuration is similar to that of the four battery rooms discussed above, with the exception that the exhaust fans are in-line axial fans and are located in the room. The cooling system is designed to maintain temperatures in this room within the range of 50°F to 104°F, and for continuous venting of hydrogen gas.

9.4.3.2.6 Shutdown Transformer Room Ventilating Systems

The shutdown transformers, located on Elevation 772.0, are located in Unit 1 and Unit 2 sub-areas. Each one of these two sub-areas contains three Train A, three Train B, and one non-divisional transformers.

Outside air enters each sub-areas through air intake structures located on the Auxiliary Building roof. Each roof-mounted exhaust ventilator is energized from the same train of the emergency power system that supplies power to the transformer for which it provides ventilation. Exceeding the temperature setpoints in a room automatically starts the exhaust fans, and opens the air operated dampers in the two air intake structures. Manually starting the exhaust fans also opens the air-operated dampers in the two air intake structures.

Electric motor-driven centrifugal-type roof exhaust fans in the individual transformer rooms are staged by thermostatic control to maintain the transformer temperatures within the range for which the safety-related equipment is environmentally qualified.

The pneumatically-operated air intake dampers have the capability of being manually powered to the open position without regard to thermostatic control by starting a fan.

This ventilation system is designed to maintain the temperature in the transformer rooms within the range 19°F minimum and 110°F for which the equipment is environmentally qualified.

The system is designed to meet Safety Class 2b and Seismic Category I requirements.

9.4.3.2.7 Auxiliary Building Miscellaneous Ventilation and Air Conditioning Systems

The control rod drive equipment room design temperature limits are maintained by two 100% capacity non-safety related air-conditioning units located in each room. During normal operation, one of the air-conditioning units in each room is in operation with the other on standby. Each unit is automatically controlled by a self-contained thermostat. Electric unit heaters are located in each room to provide heating during cold weather.

The hot instrument shop is cooled by a chilled water cooling coil which utilizes 100% makeup air to prevent the recirculation of any contaminants. The hot instrument shop exhaust is provided by a lab exhaust hood which is connected to the general building exhaust duct system.

The sample room is ventilated by five lab hoods, each with an exhaust fan. Air enters the sample room through doors with transfer grilles and back draft dampers. Each hood is provided with a separate exhaust fan and HEPA filter assembly. A differential pressure gauge is used to indicate the need for filter replacement. Each hood exhaust fan discharges into the general building exhaust system.

The Additional Equipment Buildings are cooled by non-safety related packaged air-conditioning units.

The Reactor Building steam valve rooms are cooled by independent ventilation systems, each consisting of two roof mounted exhaust fans. (See Failure Modes and Effects Analysis in Table 9.4-10). The fans draw outside ventilation air for room cooling through a wall opening near the floor. Space temperature is controlled by dampers which are manually opened or closed in response to inside ambient conditions. The exhaust fans operate until a low temperature setpoint is reached when the fans automatically stop.

9.4.3.3 Safety Evaluation

Functional analyses and failure modes and effects analyses have shown that the auxiliary and radwaste area ventilation system has the capabilities needed for normal operations and for accident mitigation. These are described in the sections that follow.

9.4.3.3.1 Auxiliary Building General Ventilation System

A functional analysis of the general ventilation system shows that:

1. Adequate ventilation is provided to achieve acceptable air flow patterns needed for airborne activity control. See Section 9.4.3.2.1.

2. There are three different signals that will automatically cause the system to change from the normal operating mode to the accident mode, the Phase A containment isolation signal, the high temperature signal from the Auxiliary Building air intakes, and the high radiation signal from the fuel handling area radiation monitors. Either a Train A or a Train B signal from any of these sources will cause the system to change to the accident mode of operation.

3. Ventilation fan operations cease and isolation dampers in the intake and exhaust ducting close in the accident mode of operation. Air flow patterns and air cleanup operations appropriate for accident mitigation during the accident mode of operation are established and maintained by the ABGTS. See Section 6.2.3 for further information.

4. A smoke detection signal from either the Unit 1 or the Unit 2 Auxiliary Building air intake, will shut down that unit's supply fans and close their discharge isolation dampers.

5. During normal mode operations, substandard airflows are detected by a low flow sensor and this sensor signals the MCR for operators to verify automatic start up of fan(s). Each redundant Auxiliary Building general ventilation supply and exhaust fan is automatically started upon low flow detection of the operating fan.

The failure modes and effects analyses performed on safety related systems interfacing with the general ventilation system have shown that:

1. A failure of any one of the two radiation monitors above the spent fuel pool does not prevent a high radiation signal from being relayed to necessary isolation components.

2. A failure of the whole or any part of either Train A or Train B components to complete isolation does not prevent total isolation. Each supply and exhaust line to the environment is equipped with both Train A and Train B low leakage isolation dampers.

3. Essential portions of the system remain functional after a seismic event because of their design to Seismic Category I requirements. Nonessential portions of the system and other systems located close to essential components and not designed to Seismic Category I standards are designed to Seismic Category I(L) standards to prevent their failure from precluding operation of essential system components.

4. All essential isolation valves and their associated ductwork are located above the maximum flood level in a Seismic Category I building that is designed to resist damage by tornado missiles.

5. A loss of power causes closure of the isolation dampers by virtue of their fail-safe design (closed when unpowered). Preferred air flows will be maintained by the ABGTS.

9.4.3.3.2 Building Cooling System

This system serves no safety-related function. The air handling units and their associated piping, valves, ductwork, and dampers are all designed to Seismic Category I(L) requirements to prevent their failure from endangering safety-related equipment.

9.4.3.3.3 Safety Feature Equipment Coolers

This system is discussed in Section 9.4.5.3.

9.4.3.3.4 Shutdown Board Room Air-Conditioning System

A functional analysis of the shutdown board room air-conditioning system shows that:

1. During all modes of operation, the system will maintain adequate air temperatures to assure optimum operation of the safety-related equipment it serves. See Section 9.4.3.2.4.

2. There are redundant pressurizing air supply fans serving each of the two subareas to maintain a slightly positive pressure in the shutdown board areas to minimize contaminated inleakage.

The failure modes and effects analyses provided in Table 9.4-9 has shown that:

1. During all operational modes, substandard cooling or pressurizing air flows are detected by local sensors and a corresponding warning is provided to the main control room.

2. A failure of one air handling unit initiates the startup and loading of the standby redundant unit.

3. The failure of one of the two pressurizing air supply fans serving each shutdown board area is detected by local sensors and a signal is provided to activate the standby redundant fan.

4. The essential components of the system are designed to Seismic Category I standards to assure that they remain functional after a seismic event.

5. All components of this system are located above the maximum probable flood level and are in a Seismic Category I building that is designed to resist damage by tornado missiles.

6. Electrical components of this system are powered by one of two trains of emergency electrical power to ensure their operability upon loss of offsite power.

9.4.3.3.5 Auxiliary Board Rooms Air-Conditioning System

A functional analysis of the auxiliary board rooms air-conditioning system shows that:

1. During all modes of operation, the system maintains adequate air cooling to assure optimum operation of the safety-related equipment it serves. See Section 9.4.3.2.5.

2. Two redundant pressurizing air supply fans serve each of the four sub-areas to maintain a slightly positive pressure in the sub-area to minimize contaminated inleakage.

3. The four battery rooms receive continuous ventilation air supplies to prevent any accumulation of hydrogen gas.

The failure modes and effects analysis in Table 9.4-5 has shown that:

1. During all operations, substandard cooling or pressurizing air flows are detected by local sensors and a corresponding warning is provided in the main control room.

2. Failure of the air handling unit serving one of the two sub-areas per plant unit does not prevent the remaining sub-area and its air handling unit from accomplishing all the safety-related functions of the auxiliary board area for that unit. Essential Train A electrical equipment located in the Train B 480V board rooms is spot cooled by the Train A HVAC system, assuring it's operability should the Train B HVAC system fail.

3. The failure of one of the two pressurizing air supply fans serving each of the four auxiliary board sub-areas is detected by local sensors and a signal is provided to activate the standby redundant fan.

4. A battery room exhaust fan failure causes automatic activation of the standby exhaust fan and activates an alarm in the MCR. If the air supply to a battery room from the corresponding air handling unit is lost, air is provided by the associated pressurizing air supply fan.

5. Essential portions of the system are designed to Seismic Category I standards to assure that they remain functional after a seismic event. Nonessential portions of this system and other systems located close to essential components are designed to Seismic Category I(L) requirements to prevent their failure from precluding operation of essential system components.

6. All components of this system are located above the maximum probable flood level and are in a Seismic Category I building that is designed to resist damage by tornado missiles.

7. Upon a loss of offsite power, all essential functions provided by this system are powered by two trains of emergency electrical power.

9.4.3.3.6 Shutdown Transformer Room Ventilating System

A functional analysis of the shutdown transformer room ventilating system shows that adequate ventilation air flow is provided to the transformer rooms to maintain environmental conditions conducive to optimum transformer operation.

The failure modes and effects analyses in Table 9.4-6 indicate that:

1. Failure of one or more fans in each room results in room temperature rise which is detected by temperature sensors located in the room. This alerts the operators to activate other available exhaust fans in the same room to replace the damaged unit(s).

2. Loss of flow through one of the two intake structures serving each transformer room would be no safety concern since the second intake opening also opens (both intake structures open simultaneously).

3. All required portions of this system are designed to Seismic Category I requirements to assure that they remain functional after a seismic event. Other components, and systems, located close to this system are qualified to either Seismic Category I or I(L) standards; therefore, their failure can not preclude operation of this system.

4. All components of this system are located above the maximum probable flood level and are in a Seismic Category I building that is designed to withstand the effects of tornado missiles. Where components are subject to tornado-generated missile damage, operator actions have been defined in the event of damage.

5. In the event of a loss of offsite power, emergency electrical power is provided to the transformers and their associated exhaust fans. One of the two subareas serving each unit is provided with Train A power and the other with Train B power.

9.4.3.3.7 Auxiliary Building Miscellaneous Ventilation and Air-Conditioning System

The miscellaneous ventilation and air-conditioning systems do not perform a safety function, however, the system components are designed to seismic category I(L) as necessary for the protection of safety related features.

The main steam valve vault ventilation exhaust airflow is regulated to maintain an adequate temperature environment for the main steam safety valves. During low temperature conditions, the exhaust fans are shutdown and electric heating is provided. The ambient temperature in the valve vault is periodically monitored in accordance with the Technical Requirements Manual area temperature monitoring program.

9.4.3.4 Inspection and Testing Requirements

The systems are tested initially as part of the preoperational test program. See Section 14.2 for testing acceptance criteria.

The Auxiliary Building environmental control systems are in continuous operation and are accessible for periodic inspection. After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operation.

See Sections 6.2.3.4 and 9.4.5.3.4 for inspection and testing requirements of the ABGTS and the ESF coolers.

Details of the radiation monitors are discussed in Section 11.4.

9.4.4 Turbine Building Area Ventilation System

9.4.4.1 Design Bases

The Turbine Building heating, cooling and ventilating systems are designed to maintain an acceptable building environment for the protection of plant equipment and controls; for the comfort and safety of operating personnel; and to allow personnel access for the operation, inspection, maintenance, and testing of mechanical and electrical equipment. The areas served by these systems are not considered potentially radioactive because the reactor is of the pressurized water type which does not normally produce radioactive steam. Potential sources of radioactivity were not, therefore, considered in establishing air flow paths, and the air flows are not monitored for radiation. For additional information on facility design features for radiation protection, refer to Section 12.3.1.

The building's environmental control systems are designed to maintain building temperatures between a minimum of 50°F and a maximum of 110°F, by use of forced ventilation, mechanical cooling, and heating systems.

9.4.4.2 System Description

The Turbine Building can be considered to contain four large rooms: Elevation 755.0 turbine room, Elevation 729.0 spaces, Elevation 708.0 spaces, and Elevation 685.5 spaces. See Figure 9.4-18. Because the Elevation 755.0 floor is predominantly concrete and thus isolated from the floors below, the Turbine Building ventilation is provided by two separate systems. One system serves Elevation 755.0 spaces, and the other system provides ventilation for the spaces on Elevation 729.0 and Elevation 708.0. Because the Elevation 708.0 floor is predominantly grating, air supplied to Elevation 708.0 spaces also provides ventilation for spaces on Elevation 685.5.

Both ventilation systems operate on the basis of mechanically supplying the required flow of outside air to spaces being ventilated, and exhausting the building air to outdoors.

Each supply and exhaust fan is provided with a motor operated damper designed to automatically close when the fan is stopped, in order to prevent air back flow. Outside air is distributed to areas of heat concentration either by duct distribution systems or by induction using the negative pressure caused by operation of roof exhaust fans, through strategically located air intake openings.

9.4.4.2.1 Elevation 755.0 Ventilation

The ventilation system for elevation 755.0 consists of two mechanical air supply systems, one on the north side and the other on the south, free-air-intake openings on the east and west walls, and exhaust fans on the elevation 820.0 roof. Total air exhausted is 570,000 cfm, whereas only 206,000 cfm is mechanically supplied through supply ducts. The remaining 364,000 cfm is drawn through the east and west free-air-intake openings by the negative pressure created by the operation of exhaust fans.

9.4.4.2.2 Elevation 729.0 and Elevation 708.0 Ventilation

The elevation 729.0 and elevation 708.0 ventilation system consists of two mechanical air supply systems, one on the north side and the other on the south, and exhaust fans on the elevation 755.0 roof. A total of 412,000 cfm is exhausted, and a total of 412,000 cfm outside air is supplied.

9.4.4.2.3 Elevation 685.5 Ventilation

There is no direct air supply to, or exhaust from, the Elevation 685.5 areas. However, the Elevation 708.0 floor above it is predominately grating; therefore, the air supplied to Elevation 708.0 spaces, and the circulation effected by the space and pump coolers located on Elevation 685.5, together, provide adequate ventilation for spaces on this floor.

9.4.4.2.4 Cold Weather Building Pressurization

During cold weather, all supply and exhaust systems can be isolated by closing the motor operated dampers to conserve heat. However, the two supply fans serving north Elevation 708.0 floor may be operated at half speed since two hot water heating coils located in the supply duct connected to each of these fans heat the incoming air. With no exhaust fan running, the operation of these two supply fans will pressurize the entire Turbine Building to prevent infiltration of cold outside air. However, the very slight positive pressure within the Turbine Building at the MCRHZ elevation does not challenge the MCRHZ required positive minimum pressure of + 1/8 inch water gauge with respect to the outdoors and adjacent areas during both normal, or emergency modes of operation.

9.4.4.2.5 Turbine Building Miscellaneous Ventilating Systems

The three toilet rooms and three janitor's closets are each ventilated by roof-mounted, roof-ventilator type exhaust fans. Plant air enters each room through a louvered door and is exhausted into the main room.

The lubricating oil purification room at Elevation 708.0 is ventilated by a centrifugal fan mounted on the room wall, which discharges to the outdoors by means of a duct routed to a basement exhaust housing. A fire damper, mounted in the exhaust opening, and the room firedoor are designed to shut off all airflow in case of fire.

The elevator machinery room at Elevation 708.0 is ventilated by a wall-exhauster type fan. The lubricating oil dispensing room at Elevation 708.0 is ventilated by a wall-exhauster type fan. A fire damper mounted in the exhaust opening and the room's firedoor are designed to shut off all airflow in case of fire.

9.4.4.2.6 Coolers

Fan-coil type raw water cooled cooling units have been installed throughout the Turbine Building to supplement the building ventilation system during peak cooling load conditions. Each cooling unit consists of a centrifugal fan and its motor, and a finned tube type water coil through which raw cooling water is circulated and over which air is passed and cooled.

Space coolers located on different elevations help prevent concentration of heat produced by various plant equipment by recirculating air in their immediate vicinities and so establishing the desired airflow patterns.

Pump coolers located in areas where miscellaneous Turbine Building pumps dissipate large amounts of heat, are each designed to remove heat produced by its pump to maintain maximum ambient temperature at 110°F.

9.4.4.2.6.1 Space Coolers

Space coolers are located on elevation 729.0, elevation 708.0, and elevation 685.5 floors. A thermostat located near the return airflow to each cooler controls a solenoid valve on the raw cooling water supply line to each coil and the cooler fan. The solenoid valve and the fan on each cooler are interlocked to operate together.

9.4.4.2.6.2 Pump Coolers

Pumps and the fans of the coolers assigned to them are interlocked to run simultaneously. However, raw cooling water to each cooling coil can be turned off and on manually to conserve water during off time. These coolers are not controlled thermostatically.

9.4.4.2.7 Building Heating System

The building heating system serves the Turbine Building and the air preheating coils belonging to the Auxiliary Building general ventilation system, and the Reactor Building purge air preheating coils.

The heating system is a high-temperature hot water, closed, forced-circulation loop. The system consists of two 100% capacity water circulating pumps, two 70% capacity steam to water heat exchangers, tanks, heating coils, space and unit heaters, nitrogen pressurization, demineralized water makeup, chemical treatment, controls, and supply and return water distribution piping.

Steam is normally taken from the turbo-generator cold reheat cycle during operation of either unit, or is taken from the plant auxiliary boiler during plant shutdown or when both units are operating at less than 55% power. The heating system heat exchangers, pumps, and tanks are located at Elevation 729.0 along the north end of Unit 2.

The heating system is designed to maintain the Turbine Building at a minimum temperature of 50°F with both units shutdown and a 13°F outdoor temperature. Heat is distributed by thermostatically controlled hot water unit and space heaters strategically located throughout the Turbine Building and by hot water heating coils mounted in the north elevation 708.0 air supply ducts. See Figures 9.4-19 and 9.4-20.

Fresh air may be supplied (136,000 cfm for plant) through the north elevation 708.0 air supply ducts. The hot water heating coils mounted in the ducts heat the incoming air.

The auxiliary building air preheating portion of the heating system consists of a secondary forced-circulation loop system for each plant unit containing two pumps and a 3-way temperature control valve. The valve is thermo-statically controlled to supply outdoor air heated to approximately 60°F.

9.4.4.3 Safety Evaluation

The Turbine Building ventilating and heating systems are designed to assure their reliable operation during normal plant operation and are not safety related. The free air intake dampers, located along the east and west walls of the elevation 755.0 turbine room are designed to close if a power failure occurs. There is no safety related equipment located in their immediate vicinity. Portions of the building heating system piping which supply hot water to the Auxiliary Building Unit 1 and 2 air intake air preheating coils, are supported to seismic Category I(L) requirements to preclude any adverse effects on nearby safely related equipment.

9.4.4.4 Inspection and Testing Requirements

The Turbine Building environmental control systems are in continuous operation and are accessible for periodic inspection.

9.4.5 Engineered Safety Feature Ventilation Systems

The function of the engineered safety features ventilation systems is to provide a suitable and controlled environment for engineered safety feature components during normal plant operation, during adverse environmental transients, and following design basis accidents.

9.4.5.1 ERCW Intake Pumping Station (IPS)

9.4.5.1.1 Design Bases

The ERCW and the high pressure fire protection (HPFP) pump area at Elevation 741 and the raw cooling water and cooling tower makeup pump area at Elevation 728 are open to the outside environment and are therefore cooled by natural convection. The ERCW and HPFP pump area, the electrical equipment room, and the 100% redundant mechanical equipment rooms are the only areas containing safety-related equipment. The nature of the ventilation system in the ERCW and HPFP pump area provides assurance that a single active failure cannot result in loss of the ERCW and HPFP system functional performance capabilities.

The mechanical and electrical equipment rooms heating and ventilation systems are not safety-related. Their primary function is to maintain the room temperatures within the maximum and minimum design values during normal plant operation. Operator action is taken to periodically monitor the IPS mechanical and electrical equipment rooms space temperatures to ensure that the maximum and minimum design values are not exceeded.

The ERCW and HPFP pump areas may experience a maximum ambient air temperature of 120°F when the surrounding outside air is 95°F. Since they are exposed to the outside environment the pumps and their associated equipment are designed to withstand low ambient air temperatures, or else they are protected by periodic temperature monitoring and providing supplemental heating, as necessary.

Electrical and mechanical equipment rooms are individually ventilated and heated during operation to maintain the room temperatures within the range of 40 to 115°F. Low temperature is limited by means of thermostatically controlled electric duct heaters and unit heaters, to above 32°F during extreme outside conditions by periodic temperature monitoring and providing supplemental heating, as necessary.

Because the IPS contains no sources of potential radioactivity, there are no safety-related airflow directions that must be maintained and no required radiation monitors.

The IPS is a Seismic Category I structure that is protected from the threats of tornado missiles and floods. A grid-type roof system is utilized to provide both missile protection and allow natural ventilation to the ERCW and HPFP pump area. The roof is composed of a series of horizontal 'I' beams rotated 45° about their longitudinal axes. The beams are supported by steel members which are in turn supported by concrete walls. The grillage is designed to meet Seismic Category I(L) requirements. The heating and ventilation equipment, ductwork, dampers, supply and exhaust fans, duct heater, and unit heater serving the electrical equipment and the mechanical equipment rooms meet Seismic Category I(L) requirements.

9.4.5.1.2 System Description

The IPS heating and ventilating systems for the electrical and mechanical equipment areas are shown in Figure 9.4-21. The pump areas are cooled by natural convection.

The electrical equipment room and mechanical equipment rooms are individually ventilated by separate ventilation systems. Each system is provided with 100% capacity supply and exhaust fans. The supply fan delivers air through a short vertical duct which encases the duct heater, a motor operated isolation damper, and a discharge grille. Two electric unit heaters are provided in each room. The duct heater and the unit heaters are thermostatically controlled.

Periodic temperature monitoring is necessary to ensure that the equipment room temperatures are maintained within design limits. Equipment room space temperatures are monitored during all plant conditions. Ventilation fans are shut down during subfreezing outdoor temperatures, and portable electric heaters and power generators are utilized as necessary during potential loss of heating to prevent freezing conditions in the equipment rooms. Non-essential cooling loads are manually shut down as necessary to maintain the space temperatures within design limits if ventilation is not available.

9.4.5.1.3 Safety Evaluation

The analysis of the ventilation system shows that:

1. Adequate flow-through ventilation is provided for the ERCW and HPFP pump area by natural convection during all credible environmental conditions. Compensatory actions are taken during severe environmental conditions. A structural failure of the grillage roof will not prevent supply of adequate ventilation air to the pump deck.

2. Adequate heating and forced air ventilation are provided to each mechanical equipment room and electrical equipment room to maintain acceptable temperatures during normal operation. Compensatory actions are taken during abnormal or accident conditions, as needed. See Section 9.4.5.1.2 and Table 9.4-2.

A failure modes and effects analysis as shown in Table 9.4-2 indicates that the IPS ventilation systems have the capabilities needed for normal operations, abnormal, and accident conditions. The IPS ventilation systems are not classified as safety-related. However, operator actions are taken to periodically monitor mechanical and electrical equipment room temperatures, and provide supplementary heating, shutdown fans, or shed nonsafety-related heat loads, as necessary, to maintain room temperatures between the minimum and maximum design values. The systems are also designed to maintain their structural integrity during a seismic event to not damage safety-related equipment in their vicinity.

9.4.5.1.4 Inspection and Testing Requirements

The IPS ventilating and heating system is accessible for periodic inspection and testing.

9.4.5.2 Diesel Generator Buildings

9.4.5.2.1 Diesel Generator Building

9.4.5.2.1.1 Design Bases

The Diesel Generator Building (DGB) ventilating system is designed to provide adequate ventilation to the DGB spaces to maintain the required environmental conditions for safety-related equipment, and prevent hydrogen buildup in the battery area during normal operation and design basis events (DBE) conditions.

The diesel units are redundant and are each served by a separate ventilation system consisting of two 50% capacity exhaust fans. Each ventilation system maintains a proper environment for the operation of safety-related components. Each diesel engine room ventilation subsystem consists of two room exhaust fans and one generator and electrical panel cooling fan. Each EBR is ventilated by a separate fan. Battery area is ventilated by its associated diesel generator room exhaust fans. These are safety-related fans which are designed to provide adequate ventilation to maintain the required ambient temperature limits.

A backdraft damper is installed in the duct between the air intake room 1A-A and the carbon dioxide storage room in order to prevent carbon dioxide backflow into the diesel generator air intake room in the event of a carbon dioxide system rupture.

Each diesel generator unit room and electrical board rooms are separately ventilated in order to limit average room temperatures to a design maximum of 120°F respectively when outdoor air entering the room is 95°F and the diesel generator is in operation. Remaining areas of the DGB are ventilated to maintain maximum air temperatures within design limits. Personnel comfort conditions are maintained as required during low outside temperatures by means of thermostatically controlled electric unit heaters. Battery areas are ventilated by the operation of the diesel generator room exhaust fans. There is not a separate battery area ventilation system. The diesels are started up and load-tested at least every 31 days. Although the DG room exhaust fans may not auto start and run during DG surveillance testing in the winter months, normal operation of the exhaust fans during surveillance testing of the DGs at the other times of the year in addition to the fans running during the summer months (without concurrent DG operation) will assure that the hydrogen concentration does not reach the Lower Explosion Limit (LEL) of 2% by volume. In addition, the exhaust fans operate whenever their room thermostats call for cooling, as described in Section 9.4.5.2.1.2.

The generator for each engine room is supplied with outside air and the electrical control panels within the engine rooms are forced ventilated to assure adequate cooling.

Because the DGB contains no sources of potential radioactivity, there are no safety-related airflow directions that must be maintained and no required radiation monitors.

The DGB is a Seismic Category I structure that is designed to withstand the effects of tornado missiles and flood. The diesel generator room exhaust fans, the generator and electrical panel cooling fans, electrical board room exhaust fans, and all associated ductwork, fittings and dampers are located within the building and are designed to meet Safety Class 2b and Seismic Category I requirements. The portions of these systems, located on the roof of the building, are protected against missile damage by missile shields. These fans, their associated controls, and motor-operated dampers are connected to emergency power. The use of concrete air intake and exhaust hoods provides additional protection from the effects of missiles.

9.4.5.2.1.2 System Description

One diesel generator room exhaust fan automatically starts upon diesel startup. The second exhaust fan starts when the upper setpoint of a temperature switch mounted in the air exhaust room is reached or on low flow of the first fan. The generator and electrical panel cooling fan can start along with either exhaust fan. The temperature switches mounted in the air exhaust room monitor the temperature of the air as it leaves the diesel generator room. Each switch may actuate its respective room exhaust fan upon detection of high diesel generator room temperature conditions or may deenergize its respective fan, as necessary, in order to maintain the diesel generator room exhaust temperature between 50°F and 120°F. During testing of the diesel generators, the diesel room exhaust fans start automatically in response to diesel start if the temperature at the local temperature switches located in the exhaust fan rooms is greater than the required setpoint. Although the DG room exhaust fans may not auto start and run during the monthly testing in the winter months, normal operation of the exhaust fans during testing of the diesel generators at other times of the year in addition to the fans running during the summer months (without concurrent DG operation) prevents a buildup of hydrogen gas above the LEL of 2% by volume.

All three fans automatically stop if the diesel generator room carbon dioxide fire suppression system is activated. Switches for manual operator action are provided to override the carbon dioxide system interlocks and start fans, open dampers to restore ventilation and fulfill the safety function if the carbon dioxide is activated by a failure in the carbon dioxide or fire detection systems.

The toilet room is ventilated by a manually controlled fan. The electrical board rooms, lube oil storage room, and fuel oil transfer room are ventilated by manually controlled fans at all times except when their respective carbon dioxide fire suppression systems are activated. The muffler rooms are ventilated as required to remove heat during warm weather. Muffler room exhaust fans are manually operated from hand switches located on the electrical board that serves the particular fan, or start along with the diesel when in the auto mode.

Fire dampers are provided in each air supply and exhaust opening to the diesel generator room, electrical board room, lube oil storage room, and oil-transfer room. Motor-operated dampers located at the air intake to each diesel generator room are automatically opened whenever either of the exhaust fans starts. All fans except for the generator and electrical panel cooling fans are equipped with motor-operated shutoff dampers which close when their associated fan is not operating. Similarly, all relief vents are provided with motor operated shutoff dampers except the electrical board room intake vents which are provided with fire dampers instead.

The DGB heating and ventilating system is shown on Figures 9.4-22, -23, -24, -24A and 9.4-25. Two diesel generator room exhaust fans, and one electrical board room exhaust fan are located in the air exhaust room at Elevation 760.5 for each of the four diesel generator units. These fans discharge to the outdoors. One generator and electrical panel cooling fan is located within each diesel generator room.

During tornadoes, the essential components of the system remain functional because the components are located in a Seismic Category I structure that is designed to resist damage by tornado missiles. For tornado depressurization mitigation, intake, and exhaust dampers are opened to assist in pressure equalization.

Fresh air is introduced through each air intake room and drawn to the corresponding diesel generator room. The generator and electrical panel cooling fan draws air from the room intake vicinity for distribution to the generator air intake and to the electrical panel. Following absorption of the heat load in the room the air is drawn into the air exhaust room by the room exhaust fan(s) and is discharged through the air exhaust hood.

Each battery area is ventilated by the operation of its respective diesel generator room exhaust fan during the periodic diesel generator testing as required by the Technical Specifications.

Each of the electrical board rooms is ventilated by a centrifugal exhaust fan. The fan draws outside air into the board room through its associated electrical board room intake vent.

Other building exhaust fans provide individual ventilation for the lubricating oil storage room, fuel oil transfer room, carbon dioxide storage room, toilet room, and muffler rooms.

The thermostatically controlled electric unit heaters located within the diesel generator rooms are designed to maintain the 50°F minimum temperature. Electric unit heaters in the equipment access corridor, storage rooms, radiation shelter rooms, and toilet room are designed to maintain normal temperature within these areas at not less than 40°F.

Thermostats in the diesel generator air exhaust rooms are designed to automatically stop all operating diesel generator room exhaust fans upon a drop in room exhaust air temperature to a low setpoint, and to automatically start the exhaust fans upon a room temperature rise to a high setpoint. The thermostats will also start the standby exhaust fan during diesel generator operation, when the room exhaust air temperature exceeds the high setpoint.

9.4.5.2.1.3 Safety Evaluation

A functional analysis and a failure modes and effects analysis have shown that the Diesel Generator Building ventilation system has the capabilities needed for normal operations and for accident mitigation. The functional analysis shows that:

1. Adequate ventilation is provided to maintain the required environmental conditions for optimum equipment operation during all operational modes. See Section 9.4.5.2.1.1.

2. The battery area is adequately ventilated (except for system shutdown after a CO_2 system actuation signal) to prevent hydrogen buildup in the diesel generator room.

3. The lack of a dedicated battery hood exhaust fan will not prevent forced air circulation past the batteries. During testing of the diesel generators, the diesel room exhaust fans start automatically in response to diesel start if the temperature at the local temperature switches located in the exhaust fan rooms is greater than the required set point. Concurrent with fan operation, dampers in the diesel room exhaust structure and at the air intake to each diesel generator room also open to facilitate adequate air flow to pass through the diesel generator room. Although the DG room exhaust fans may not auto start and run during the monthly testing in the winter months, normal operation of the exhaust fans during testing of the diesel generators at other times of the year in addition to the fans running during the summer months (without concurrent DG operation) prevents a buildup of hydrogen gas above the Lower Explosion Limit (LEL) of 2% by volume.

4. Essential portions of this system remain functional during and after a seismic event because of their design to Seismic Category I requirements. Nonessential portions of this system and other system located close to essential components are designed to Seismic Category I(L) requirements to prevent their failure from precluding operation of essential system components.

The failure modes and effects analysis, as shown in Table 9.4-4, confirms that:

1. During diesel generator operation, low air flows through the fans serving the diesel generator room and generator and electrical panels is detected by flow sensors. The failure will annunciate in the MCR.

2. A failure of an electrical board room exhaust fan, and the resulting heat buildup in the room to above 110°F, may cause loss of the associated diesel generator. However, the redundant train diesel generator provides power to safely shut down the unit.

3. During flooding conditions, all essential components of this system will remain functional because they are located above the maximum possible flood level.

4. During tornadoes, the essential components of the system remain functional because they are located in a Seismic Category I structure that is designed to resist damage by tornado missiles. For tornado depressurization mitigation, intake, and exhaust dampers are opened to assist in pressure equalization.

5. Upon loss of offsite power, each diesel generator provides emergency electrical power to its associated ventilation components. All are connected to their respective diesel generator engineered safety power supply, so operation of a diesel generator assures power to the corresponding fans.

9.4.5.2.1.4 Tests and Inspections

This system is tested initially as part of the preoperational test program. See section 14.2 for testing acceptance criteria.

The Diesel Generator Building ventilating and heating systems are accessible for periodic inspection. After maintenance or modification activities that affect a system function, testing is performed as necessary to reverify the system or component operation.

9.4.5.3 Auxiliary Building Engineered Safety Features (ESF) Equipment Coolers

9.4.5.3.1 Design Bases

The Auxiliary Building ESF equipment coolers are designed to maintain acceptable environmental conditions for (1) personnel access, operation, inspection, maintenance and testing and (2) the protection of safety-related mechanical and electrical equipment and controls. The system utilizes fan/coil type safety-related air cooling units. Air cooling units are provided for the following rooms and areas:

1. Residual heat removal pump room
2. Safety injection pump room
3. Containment spray pump room
4. Centrifugal charging pump room
5. Reciprocating charging pump room*
6. Unit 1 auxiliary feedwater and component cooling water pumps area
7. Unit 2 auxiliary feedwater and boric acid transfer pumps area
8. Component cooling water booster and spent fuel pool pumps area
9. Emergency gas treatment system filter room
10. Elevation 692.0 penetration rooms
11. Elevation 713.0 penetration rooms
12. Elevation 737.0 penetration rooms
13. Pipe chases

*Not safety-related

All air coolers listed above, except the reciprocating charging pump coolers (indicated with an asterisk), are ESF equipment and are provided with coordinated emergency power and ERCW water sources (see Sections 8.3 and 9.2). Pumps 1 through 5 in the above list are each located in a separate room with their corresponding cooler. Safety-related pump rooms are paired with a 100% redundant room containing another pump/cooler set. Pumps and equipment listed in Items 6 through 13 are each provided with two 100% coolers in the room/area. In addition to the above coolers, this system includes two 100% emergency exhaust fans, one safety-related and the other nonsafety-related, in each turbine-driven auxiliary feedwater pump room. Each of these fans is capable of providing the required air flow in the room for the volume changes method of cooling.

Rooms and areas containing ESF equipment are ventilated by airflows induced by the building ventilation exhaust subsystem during normal plant operation and when equipment is not required to operate. All air cooling units are thermostatically controlled to automatically operate upon room temperature rise above the setpoint. Air cooling units for pumps 1 through 4 will automatically start to provide the necessary additional cooling in the space whenever their associated pumps are operated. All other coolers for ESF equipment will automatically start on an Auxiliary Building isolation signal. If cooler starts due to ABI signal, it remains on until ABI is reset or hand switch position is changed. If cooler starts due to high temperature, a thermostat, located near the return airflow to each cooler, allows the cooler to remain in operation until the low limit temperature setpoint is reached. The cooling water valve and fan are interlocked to operate together for all coolers, except for the residual heat removal and centrifugal charging pump rooms, whose cooling water valves are electrically disconnected in the open position due to 10 CFR 50 Appendix R considerations.

The ESF equipment ventilation system is designed to maintain temperatures within the range for which the equipment is environmentally qualified, to ensure that equipment and components are not exposed to environmental conditions that could degrade the operability of safety-related equipment.

All components of this system, including air cooling units, fans, ductwork, dampers, valves, and grilles, are designed to meet Seismic Category I and Safety Class 2b requirements. The system is completely enclosed in a Seismic Category I structure that is designed against flood and tornado missile threats.

9.4.5.3.2 System Description

The Auxiliary Building ESF coolers are shown on Figures 9.4-10, 9.4-13, 9.4-14, 9.4-16, 9.4-26, and 9.4-27. The individual coolers are listed below:

	Number
RHR Pump Room	4
Safety Injection Pump Room	4
Containment Spray Pump Room	4
Centrifugal Charging Pump Room	4
Reciprocating Charging Pump Room	2
Unit 1 Auxiliary Feedwater and Component Cooling Water Pumps	2
Unit 2 Auxiliary Feedwater and Boric Acid Treatment Pumps	2
Emergency Gas Treatment Room	2
Component Cooling Water Booster and Spent Fuel Pool Pumps	2
Pipe Chase	4
Elevation 692.0 Penetration Room	4
Elevation 713.0 Penetration Rooms	4
Unit 1 Elevation 737.0 Penetration Rooms	4

The turbine-driven auxiliary feedwater pump (TDAFWP) rooms are normally cooled by the Auxiliary Building general ventilation system. For emergency ventilation, two roof ventilator type exhaust fans are located on the roof of each room (See Figure 9.4-13), venting into the general spaces of the Auxiliary Building. One of the two fans per room operates on 115v, 60 Hz ac emergency power while the other operates on 115V dc station vital battery power. The ac-powered fan is nonsafety-related and the dc-powered fan is safety-related. Both fans in each room are thermostatically controlled to automatically operate upon room temperature rise above setpoint. The dc powered fan also automatically runs upon pump start. Each fan is rated at 1200 cfm and designed to circulate a sufficient quantity of building air through their rooms to limit the maximum temperature rise to approximately 20°F above ambient.

In the event of a steam line break within the room, two isolation valves are provided in the common portion of the steam supply piping to the TDAFWP, to close on high room temperature.

9.4.5.3.3 Safety Evaluation

A functional analysis and failure modes and effects analysis have shown that the Auxiliary Building ESF coolers have the capabilities needed for normal operations and for accident mitigation. These are described in the paragraphs that follow.

A functional analysis of the system shows that:

1. Adequate ventilation is provided during normal operations by the Auxiliary Building general ventilation system. When the applicable equipment is operating, the ESF equipment area and TDAFWP room fans provide adequate temperature control to assure reliable equipment operation.

2. The containment isolation Phase A signal, high radiation in the spent fuel pool area, a CVI signal from the operating or refueling unit when containment and/or the annulus is open to the Auxiliary Building ABSCE spaces, and high air temperature in the Auxiliary Building air intakes provide for a two-train isolation signal for the Auxiliary Building. Isolation of the general ventilation system, described in Section 9.4.3, results in the disruption of normal airflow patterns; and thus, provide for an effectively sealed ABSCE boundary.

3. After the building is isolated from the environment, airflow patterns and air cleanup operations appropriate for accident mitigation during the accident mode of operation are established and maintained by the ABGTS, as described in Section 6.2.3.

The failure modes and effects analysis, as shown in Table 9.4-3, indicates that:

1. The safety-related radiation monitors in the Auxiliary Building refueling area provide redundant signals, for isolation of the Auxiliary Building.

2. During normal operation, each ESF space is cooled by the general ventilation system and an ESF cooler. During accident conditions, cooling of the ESF equipment is provided by the ESF coolers. In the event of failure of one ESF area cooler, the redundant cooler is available. In the event of failure of one pump room cooler, the redundant pump and its associated room cooler are also available.

3. During its emergency mode of operation, the TDAFWP receives cooling from the dc-driven TDAFW pump room fan, the failure of which is not postulated since a single failure in the two 50% capacity motor-driven AFW pumps would have already been postulated.

4. Failure of any portion of this system as the result of a seismic event is prevented by use of only Seismic Category I components in this system.

5. During the accident mode of operations, emergency electrical power is provided to the ESF pumps and their corresponding coolers or fans. In the event one emergency power train fails, the essential safety-related functions of the system are accomplished by the redundant parts of the system powered by the remaining power train.

6. Water is supplied to each cooler from the ERCW system described in Section 9.2.1. Failure of one ERCW supply train, and the resulting failure of the area coolers supplied by that train, will not prevent the redundant coolers, supplied by a different ERCW train from supporting shutdown of the reactor unit. In the case of the loss of ERCW supply to a pump room cooler, the redundant pump is available.

9.4.5.3.4 Inspection and Testing Requirements

The system is tested initially as part of the preoperational test program. See Section 14.2 for testing acceptance criteria.

The Auxiliary Building ESF coolers are designed to be available for continuous operation and are accessible for periodic maintenance. After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operation.

9.4.6 Reactor Building Purge Ventilating System (RBPVS)

9.4.6.1 Design Bases

The RBPVS is designed to maintain the environment in the primary containment and Shield Building annulus within acceptable limits for equipment operation and for personnel access during inspection, testing, maintenance, and refueling operations; and to provide a filtration path for any through-duct outleakage from the primary containment to limit the release of radioactivity to the environment.

The RBPVS performs three distinct functions, the forced air purge function, the continuous pressure relief function, and the alternate containment pressure relief function.

The forced air purge function is performed by a purge supply and purge exhaust system consisting of two trains, each of which is designed to provide 50% of the capacity needed for normal purging. Each train consists of a supply fan, an exhaust fan, a HEPA filter-charcoal adsorber assembly, containment isolation valves and associated dampers and ductwork. This function provides a means by which containment air may be forcibly exchanged and filtered. The purge function provides a means by which containment air may be forcibly exchanged and filtered. The purge function of the RBPVS is not a safety-related function. The safety functions are to assure isolation of primary containment during an accident and to isolate the purge air supply intake upon receipt of an Auxiliary Building Isolation (ABI) signal.

In the case of a fuel handling accident, the filtration units provide a filtration path following a fuel handling accident until all containment isolation valves are closed. However, neither the filtration nor the isolation functions are credited in the Fuel Handling Dose Analysis. Thus, they are not safety functions for this accident.

During Operating Modes 1 thru 5, continuous pressure relief is provided by a passive ducting system which passes through containment penetration X-80, through two 100% redundant containment vent air cleanup units (CVACU) containing HEPA filters and charcoal adsorbers. Containment air is moved into the annulus by the motive force created by differential pressure between the two spaces. Filtration redundancy allows maintenance on one unit at a time while maintaining an open pathway through the other. This ventilation pathway is isolable using containment isolation valves FCV-30-40 and FCV-30-37 which are closed when containment isolation is required.

The alternate pressure relief function is provided by way of a configuration alignment in the forced air purge system. This function is accomplished by opening lower compartment purge lines (one supply and one exhaust) or one of the two pairs of lines (one supply and one exhaust) in the upper compartment. During purging mode, the purge air fans may or may not be used. To prevent inadvertent pressurization of containment due to supply and exhaust side ductwork flow imbalances, the supply ductwork airflow may be temporarily throttled as needed.

The purge function of the RBPVS is not a safety-related function.

The design bases include provisions to:

1. Supply fresh air for breathing and contamination control when the primary containment or annulus is occupied.

2. Exhaust primary containment and annulus air to the outdoors whenever the purge air supply system is operated.

3. Clean up containment exhaust during normal operation by routing the air through HEPA-carbon filter trains before release to the atmosphere to limit the potential release of radioactivity to the environment.

4. Provide a reduced quantity of ventilating air to permit occupancy of the instrument room during reactor operation. The provisions for 1, 2, and 3 above will apply.

5. Assure closure of primary and secondary containment isolation valves following accidents which result in the initiation of a containment ventilation isolation signal.

6. Assure closure of the system air intake dampers, which form part of the ABSCE (see Section 6.2.3.2.1), upon receipt of a signal for Auxiliary Building isolation.

7. Provide a continuous containment pressure relief path through HEPA-carbon filter trains before release to the atmosphere, during normal operation.

Items 5 and 6 above are safety-related functions.

The primary containment penetrations for the ventilation supply and exhaust subsystems are designed to primary containment structural standards. These are discussed in detail in Section 6.2.4.

The RBPVS is sized to maintain an acceptable working environment within the containment during all normal operations. The system has the capabilities to provide a filtration path for outleakage from the primary containment, and clean up containment atmosphere following a design basis accident. It also has provisions to filter air flow exhausted from containment for pressure control, during normal operation.

The controls are designed to have simultaneous starting and stopping of the matching supply and exhaust equipment and to initiate an automatic shutdown and isolation upon receipt of the containment ventilation isolation signal.

In addition, RBPVS supply fans will shut down and the ABSCE isolation dampers in purge air supply ducts will close on an ABI signal.

The RBPVS components are designed or qualified to meet Seismic Category I requirements, except all purge ductwork within the containment, up to the inboard isolation valves, and the supply air ductwork from the downstream flange of the ABSCE isolation dampers to the upstream flange of the Shield Building isolation valves, which are designed to meet Seismic Category I(L) requirements.

The primary containment exhaust is monitored by redundant radiation detectors which provide automatic RBPVS isolation upon detecting the setpoint radioactivity in the exhaust air stream. The RBPVS isolation valves automatically close upon the actuation of a containment ventilation isolation signal, or upon manual actuation from the MCR. In addition, during fuel handling operations in the Auxiliary Building with containment and/or the annulus open to the Auxiliary Building ABSCE spaces, the RBPVS isolation valves will close upon an ABI or HRRA with the unit in refuel mode or upon a high radiation signal from the spent fuel pool radiation monitors, via a CVI signal from the operating or refueling unit.

The system air supply and exhaust ducts are routed through the Shield Building annulus to several primary containment penetrations. Two air supply locations are provided for each of the upper and lower compartments and one for the instrument room. Air is supplied to areas of low potential radioactivity and is allowed to flow to the air pickup exhaust points in areas of higher potential radioactivity. The air pickup points, located to exhaust air from the lower compartment and instrument room, also provide an air sweep across the surface of the refueling canal.

During cold shutdown and refueling operations, the entire containment may be purged using any number and size of purge supply and exhaust lines.

During reactor operation, the number and size of lines used for containment purging, are restricted to two 24-inch diameter lines (i.e., one supply line with 50°-open valves, and one exhaust line with 50°-open valves), or two 24-inch diameter lines with wide-open valves (i.e, one supply line and one exhaust line).

9.4.6.2 System Description

The RBPVS is shown schematically in Figures 9.4-28 to 9.4-30. One complete and independent RBPVS is provided for each unit.

The containment upper and/or lower compartments are purged with fresh air by the RBPVS before occupancy. The annulus can be purged with fresh air during reactor shutdown or at times when the annulus vacuum control system of the EGTS is shut down. The instrument room is purged with fresh air during operation of the RBPVS or is separately purged by the instrument room purge subsystem.

Containment is vented into the annulus, during normal operation, continuously, through the containment vent air cleanup units (CVACUs), which contain HEPA and charcoal filters, to maintain the containment pressure within the Technical Specification limits. Exhaust air mixes with the annulus atmosphere before it is discharged into the Auxiliary Building exhaust stack by the annulus vacuum control fan(s) (See Section 6.3.2.2).

RBPVS for each unit consists of two trains, each designed to provide 50% of the capacity required for normal operation. Each train contains an air supply fan, an air exhaust fan, a cleanup filter unit, containment isolation valves, system air flow control valves, and all necessary ductwork. The system also includes single air supply distribution and air exhaust collection subsystems as well as an instrument room supply fan and an instrument room exhaust fan.

The RBPVS supply fans are located in the penetration rooms at Elevation 737.0 in the Auxiliary Building. Filtered fresh air, heated when required, is taken from the Auxiliary Building air supply systems located in the mechanical equipment rooms at Elevation 737.0. These fans are of centrifugal type and belt-driven, with adequate system air flowrate (See Figure 9.4-28).

The filtered air is discharged to the outdoors by means of the Shield Building exhaust vent located in the annular space of the Reactor Building and extending through the roof of the Reactor Building. The purge air exhaust fans are centrifugal type and belt driven, with a combined flow of 22,949 ft^3/min.

Each air cleanup unit has a stainless steel housing equipped with air treatment components, dampers, test fittings, and access facilities for maintenance. The air treatment components within the housing include a prefilter section, a HEPA filter bank, and a carbon filter bank. This equipment is installed in the order listed. Integral to the housing are test fittings properly sized and proportioned to permit orderly and efficient testing of the HEPA filter and carbon absorber banks. The HEPA filters installed in the air cleanup units are 1000 cfm units designed to remove at least 99.97% of the particulates greater than 0.3 microns in diameter, and meet the requirements of military specification MIL-F-51068. The carbon absorbers installed in the air cleanup units are Type II unit trays, fabricated in accordance with AACC standard CS-8T requirements. AACC-SC-8Thas been superseded; and, ANSI/ASME-N509-1989 specifies ASME AG-1-1988 to be used. Therefore, all new charcoal Type II cells shall meet AG-1, section FD, with the exception that the 1991 version of the code be used. Existing Type II cells do not have to be replaced to meet the AG-1 code if being refilled. New replacement charcoal adsorbent (for use in new and refilled Type II cells) shall be procured to meet the ASME AG-1-1991 requirements in lieu of the 1988 version (or later version, provided proper evaluation justifies adequacy), with the exception that laboratory testing of absorbent be in accordance with ASTM D3803-1989.

Annulus purging air is taken from system ducts and routed through the annulus. The air supply

and exhaust duct openings are located approximately 180° apart for maximum ventilation.

To permit personnel access to the instrument room during reactor operation or during the RBPVS shutdown, the room can be purged by the instrument room purge subsystem fans. These supply and exhaust fans are located alongside the main system supply and exhaust fans and use the main system ducts and one of the filter trains. Butterfly valves are positioned to allow only the instrument room to be served.

Each RBPVS containment penetration is provided with both inboard and outboard air-operated isolation butterfly valves designed for minimum leakage in their closed position. A similar type of valve is mounted in each purge supply and exhaust air opening for the annulus, and in each of the main supply and exhaust ducts located exterior to the Shield Building. The purge air supply line is provided with two air-operated isolation dampers in series for ABSCE isolation. Each of the above butterfly valves and the intake dampers are designed to fail closed and are normally closed during purge system shutdown. See Section 6.2.4 for more on the containment isolation system.

The single air supply duct serving the two purge air supply fans and the instrument room supply fan is provided with two isolation dampers. These dampers are air operated, normally closed, failed closed dampers which close automatically on receipt of Auxiliary Building isolation or high radiation in refueling area signals. These dampers establish the boundary for the ABSCE. See Section 6.2.3.

Since the annulus is maintained at a 5-inch water gauge negative pressure by the annulus vacuum control system, the annulus portion of the purge system ducts is maintained at the negative pressure by four 1/2-inch leakoffs. This arrangement is designed to prevent containment contamination leakage from escaping through the purge system ducts into the Auxiliary Building.

The purge function of the RBPVS is not a safety-related function and the filtration units are not required to provide a safety-related filtration path following a fuel-handling accident. The primary containment isolation valves and intermediate piping of the RBPVS are designed in accordance with ANS safety class 2A; other portions are designated ANS safety class 2B except the purge fans, all purge ductwork within the containment, purge supply air ductwork from the ABSCE boundary, fire protection, and drain piping. The instrument room purge subsystem is not an engineered safety feature, and credit for its operability for a LOCA or a fuel-handling accident is not claimed.

A containment ventilation isolation signal automatically shuts down the fans and isolates the RBPVS by closing its respective dampers and butterfly valves. In addition, when Unit 1 is in refuel mode, an ABI signal or HRRA will automatically shutdown the fans and isolate the RBPVS independent of the CVI signal. Each RBPVS primary containment isolation valve is designed for fail safe closing within 4 seconds of receipt of a closure signal for containment penetrations (See Tables 6.2.4-1 through 6.2-4-4 and Figure 6.2.4-21). The RBPVS primary containment isolation valve locations and descriptions are given in Table 6.2.4-1. Each valve is provided with an air cylinder valve operator, control air solenoid valve, and valve position indicating limit switches.

Smoke detectors, located in the Auxiliary Building air intake and the general ventilation supply ducts, shut down the purge air supply and the incore instrument room purge supply fans and their isolation dampers.

9.4.6.3 Safety Evaluation

Functional analyses and failure modes and effects analysis have shown that the RBPVS meets the containment isolation requirements. The CVACUs, performing a continuously filtered containment vent function during normal operation, are isolated by the closure of their containment isolation valves; therefore are not operable after accidents.

A functional analysis of the system shows that:

1. During normal operation, adequate fresh air is provided for breathing and for contamination control when the primary or secondary containment (annulus) is occupied.

2. Primary and secondary containment exhaust air is cleaned up during normal operations and following a fuel handling accident.

3. Purge supply and exhaust fan operations cease and isolation dampers in the intake and exhaust ducting close when the system is in the accident isolation mode of operation.

4. Three signals cause the system to change from the normal purge mode to the accident isolation mode. These signals, which include manual, SIS auto-initiate, and high purge exhaust radiation (automatic), initiate a containment ventilation isolation signal. Additionally, during refueling operations whenever containment and/or the annulus is open to the Auxiliary Building ABSCE spaces, a high radiation signal from the spent fuel pool accident radiation monitors, Containment Isolation Phase A (SI signal), high temperature in the AB air intake or CVI signal from the operating unit automatically cause the system to change from the purge mode to the accident isolation mode.

5. Discharges from the annulus, during normal operation, which are exhausted through the Auxiliary Building exhaust stack, are monitored at the stack. Although, these radiation monitors do not initiate an automatic containment isolation signal, radioactive release limits have been established as a basis for controlling plant discharges during operation. Radioactive releases from the plant resulting from equipment faults of moderate frequency are within 10 CFR 50 Appendix I and 40 CFR 190 limits as specified in the ODCM (See Section 11.3 for further details). In addition, analyses have shown that any accident with the potential consequence to exceed the 10 CFR 100 limits, would be detected by other indicators (see Item 4 above) and cause an automatic primary and/or secondary containment isolation.

The failure modes and effects analyses show that:

1. Each purge supply and exhaust line is equipped with two primary containment isolation valves, each connected to different control and power trains. Failure of one train does not prevent the remaining isolation valve from providing the required isolation capability.

2. Essential portions of the system remain functional after a seismic event because of their design to Seismic Category I requirements. Nonessential portions of the system and other systems located close to essential components and not designed to Seismic Category I standards are designed to meet Seismic Category I(L) requirements to prevent their failure from precluding operation of essential safety-related equipment.

3. All essential equipment is located above the maximum possible flood level in a Seismic Category I building that is designed to resist tornado missiles.

4. A loss of offsite power causes closure of the isolation valves.

5. ABGTS safety-related functions are not impeded by the worst-case failure in the RBPVS; i.e., one train of ABI signal failing, thus resulting in only one ABGTS train starting, one RBPVS supply fan and the Incore Instrument Room supply fan continuing to run, all the ABSCE isolation dampers of the same train remaining open, and all RBPVS exhaust fans shutting down.

9.4.6.4 Inspection and Testing Requirements

Before power operation, tests are conducted to assure that the Reactor Building purge ventilation system performs as designed. The system is tested initially as part of the preoperational test program.

After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operation. Purge system containment penetration isolation valves are tested for inplace closing speed and leak tested in the closed position to comply with the requirements of 10 CFR 50, Appendix J. The inspection and testing of these valves is discussed in Section 6.2.4.

Periodic testing of the Purge system air filtration unit is performed in accordance with Regulatory Guide 1.140 Rev 1.

9.4.7 Containment Air Cooling System

9.4.7.1 Design Bases

The containment air cooling systems are designed to maintain acceptable temperatures within the Reactor Building upper and lower compartments, reactor well, control rod drive mechanism (CRDM) shroud, and instrument room for the protection of equipment and controls during normal reactor operation and normal shutdown. The instrument room is mechanically cooled to permit personnel access during normal reactor operation.

The lower compartment cooling (LCC) air system, together with operation of the CRDM air cooling system, is designed to maintain a maximum weighted average air temperature of 120°F in most lower compartment spaces during normal reactor operation. These spaces include the steam generator and pressurizer compartments, the space below the reactor vessel, the space around the reactor vessel, the spaces around the reactor vessel nozzles and supports and the upper reactor cavity well space around the CRDM shroud. Four 33-1/3% capacity LCC fan coil assemblies are provided to allow three or less to operate during reactor normal operation with one or more on standby.

The LCC air system manual dampers are adjusted to provide sufficient air flow through the reactor well to maintain an approximate air temperature of 120°F. The system is designed for two of four units to recirculate air through the lower containment and equipment compartments, although all four may be operated, anytime there is a loss of normal containment cooling following any non-LOCA design basis event, which results in a hot standby condition. The LCC system is not required to operate after a LOCA. See Section 6.2.2.1 for detailed information, and operation after a MSLB.

The CRDM air cooling system is designed to operate during normal reactor operation in conjunction with the LCC air system to maintain a maximum air temperature within the upper reactor cavity of 120°F and to route all of the reactor well air through the CRDM shroud to maintain a maximum air temperature of 185°F. Air drawn through the CRDM shroud is cooled by the active fan-coil assemblies to approximately 120°F and discharged into the lower compartment of the Reactor Building.

When additional cooling in the lower compartment is required, an arrangement of dampers allows either or both standby CRDM fan-coil assemblies to be operated to recirculate and supplement the LCC system capacity.

The upper compartment cooling (UCC) air system is designed to maintain the upper compartment weighted average temperature at a maximum of 110°F during normal reactor operation.

The Reactor Building instrument room air cooling system is designed to automatically maintain the room air temperature between 50°F and 120°F during normal reactor operation.

The heat sink for each LCC, UCC, and CRDM air cooling fan-coil assembly, and for each instrument room air cooling system condensing unit, is the ERCW.

The LCC units and CRDM air fan-coil assemblies are manually energized from the emergency power system upon loss of offsite power; however, these components are not required to operate during LOCA conditions. The LCC units may be operated continuously throughout all accidents, except a MSLB, which do not initiate a Phase B containment isolation signal. Following a MSLB, two of the four LCC unit fans are required, but all four are started, manually, within 1.5 to 4 hours after the detection of the MSLB accident to recirculate air in the lower compartment dead-ended spaces. This is a safety function of the LCC units' fans.

9.4.7.2 System Description

The containment air cooling system flow scheme is shown in Figure 9.4-28. The system's control scheme is shown in Figures 9.4-30 and 9.4-31 and the logic scheme in Figures 9.4-29 and 9.4-32 through 9.4-34. The containment air cooling system is composed of four subsystems as follows:

1. Lower Compartment Air Cooling

2. CRDM Air Cooling

3. Upper Compartment Air Cooling

4. Reactor Building Instrument Room Air Cooling

9.4.7.2.1 Lower Compartment Air Cooling System

There are four LCC air fan-coil assemblies which are located in two annular concrete chambers around the periphery of the lower compartment at floor Elevation 716. Each fan-coil assembly consists of a plenum, eight air cooling coils, vaneaxial fan, backdraft damper, instruments, and controls.

These fan-coil assemblies are supplied water from the plant ERCW system. A cooling water throttling valve for each assembly is automatically controlled by a temperature indicating controller which utilizes an input from a thermocouple mounted in the assembly's return air supply and set to control the cooler outlet temperature as required to maintain the required weighted average temperature. The ERCW system is described in Section 9.2.1.

Lower compartment air passes directly to each active fan-coil assembly where it is cooled and supplied through a common duct distribution system to the lower compartment spaces. The system is designed for three of the four fan-coil assemblies to operate together, with one on standby. The cooled air is supplied directly to each steam-generator compartment, pressurizer compartment, excess letdown heat exchanger room, main lower compartment space, and to the space below the reactor vessel.

Connections are available in the A-Train ERCW supply and return headers for the lower compartment coolers that will allow chilled water from a non-safety related chiller to be used to provide additional cooling of the Unit 1 Reactor Building during outages.

9.4.7.2.2 Control Rod Drive Mechanism Air Cooling System

The four CRDM air cooling fan-coil assemblies are located in the main lower compartment space at floor Elevation 702.78. Each assembly consists of a plenum, three air cooling coils, two vaneaxial fans, in series, assembly isolating motor-operated damper, instruments, and controls. Each fan-coil assembly is designed to cool the CRDM shroud to 185°F with water from the plant ERCW system. A cooling water throttling valve for each assembly is automatically controlled by a temperature indicating controller which utilizes an input from a thermocouple mounted on the intake side of the CRDM cooling unit.

The four CRDM air cooling fan-coil assemblies are divided into two pairs. One fan-coil assembly in each pair is normally operated to provide adequate cooling to the CRDM shroud during normal reactor operation. Reactor well air exiting the shroud is cooled by the fan-coil assemblies and discharged into the lower compartment spaces.

9.4.7.2.3 Upper Compartment Air Cooling System

The four UCC air fan-coil assemblies are located within the upper compartment at Elevation 801.69. Fan-coil assemblies consist of plenums, air cooling coils, vaneaxial fans, instruments, and controls. They are designed to maintain the upper compartment weighted average temperature at a maximum of 110°F with water from the plant ERCW system. A cooling water throttling valve for each assembly is automatically controlled by a temperature indicating controller which utilizes an input from a thermocouple mounted in the return air supply.

A portion of the upper containment air is continuously recirculated and cooled by the UCC fan-coil assemblies. For Unit 1, the system capacity is such that two UCCs are sufficient to maintain the upper compartment temperatures below the maximum temperature of 110°F. For Unit 2, the system is designed for three of the four assemblies to operate together with one on standby.

9.4.7.2.4 Reactor Building Instrument Room Air Cooling System

The instrument room air cooling system consists of two 100% capacity air conditioning systems. Each system consists of a serviceable, packaged water chilling unit and chilled water pump located in the Auxiliary Building penetration room at Elevation 692, a fan-coil unit with air supply duct located in the Reactor Building instrument room, connecting chilled water piping with double containment penetration isolation valves, and all necessary and customary control and indicating devices. Chiller condensers are cooled by ERCW.

The chilled water piping penetrations through the primary containment vessel (For Unit 1,See Tables 6.2.4-1 through 6.2.4-4 and Figure 6.2.4-21 For Unit 2, See Tables 6.2.4-1, 6.2.4-2, and Figure 6.2.4-17D), are each provided with two isolation valves, one located inside and one located outside containment for each penetration. These 2-inch valves are pneumatic-motor operated and are designed to fail closed.

9.4.7.2.5 Controls and Instrumentation

Operation of each fan-coil unit (LCC, UCC, CRDM, and instrument room) is indicated in the MCR. The UCC system standby unit automatically starts when pressure differential to two of the four coolers is below the setpoint, or upon compartment high temperature signal. The LCC system standby unit automatically starts when airflow is below the setpoint in two of the four fans. A CRDM cooling system standby unit automatically starts on low air flow in an operating unit. The instrument room standby cooler automatically starts when airflow is below the setpoint in the operating cooler. The LCC, UCC, and CRDM coolers are administratively controlled to prevent automatic starting of the standby unit during normal operation. Air temperature is continuously monitored to evaluate system performance for each of the four cooling systems. Class 1E temperature elements are mounted near the intake side air stream of each LCC with direct read-out in the MCR. Containment pressure is used by the operators as input for manual initiation of the air return fans and the containment spray system to maintain lower compartment temperature within limits during events in which the ERCW supplied coils are inoperable.

9.4.7.3 Safety Evaluation

The LCC fans are started (only two are required) to recirculate air through the lower containment and equipment compartments anytime there is a loss of LCC following any non-LOCA design basis event, resulting in the reactor in a hot standby condition. After a MSLB, all four LCCs are started (only two are required), within 1.5 to 4 hours after the MSLB, to recirculate air throughout the lower compartment spaces to prevent hot spots from developing. This is a safety function. Otherwise, the containment air cooling systems are not required for maintenance of temperature limits within the primary containment in the event of an accident, and therefore, are not engineered safety features. However, the reactor containment penetration valves for the instrument room air conditioning chilled water system have a Nuclear Safety Class designation in accordance with ANS Safety Class 2A.

The capability of assuring containment ambient temperature levels and the anticipated degradation of equipment performance if temperature levels are exceeded are discussed in Section 3.11.

To prevent damage to adjacent safety related equipment necessary for the plant safe shutdown, CRDM air cooling assemblies, instrument room fan-coil units, water cooled condenser portions of the instrument room water chillers, ductwork and duct supports, and chilled water piping and pipe supports are designed and installed to Seismic Category I(L) requirements, and the LCC units, fans, ductwork, duct supports, and Unit 1 UCC units are designed to Seismic Category I requirements.

To ensure the ERCW system can perform its safety functions, those coolers that are relied upon for pressure boundary integrity are designed to Seismic Category I(L)A or Seismic Category I requirements.

9.4.7.4 Test and Inspection Requirements

Air-cooling assemblies and their temperature-controlling devices which are located within the containment are tested prior to reactor operation and are generally accessible for inspection only during unit shutdown. The system is tested initially as part of the preoperational test program.

After maintenance or modification activities that affect a system function, testing is done to reverify the system or component operations. Instrument room fan-coil units, control devices, and containment-isolation chilled-water valves are accessible for periodic inspection. Water-chilling equipment, pumps, and all essential electrical starting and switchover controls located in the Auxiliary Building are available for periodic inspection.

Instrument room chilled-water containment-isolation valve testing and inspection requirements are discussed in Section 6.2.4.

9.4.8 Condensate Demineralizer Waste Evaporator Building Environmental Control System (Not required for Unit 1 or Unit 2 operation)

The Condensate Demineralizer Waste Evaporator (CDWE) Building Environmental Control System is a separate nonsafety air conditioning system which is not required for Unit 2 operation.

The CDWE Building is inside the ABSCE boundary; therefore, it is connected to the AB ventilation exhaust system. The ventilation exhaust system provides a negative pressure inside CDWE Building.

9.4.9 Postaccident Sampling Facility (PASF) Environmental Control System (Unit 1 Only)

Unit 2 equipment has been abandoned in place.

9.4.9.1 Design Basis

The postaccident sampling facility environmental control system (PASFECS) provides heating, and ventilation during normal plant operations and training activities. In addition, heating, ventilation, and control of airborne radiological contamination is provided during postaccident acquisition and testing of samples. This is accomplished through pressurization of the sampling areas by the ventilation system which induces air from areas of lesser to areas of greater contamination potential. The system is designed to maintain acceptable environmental conditions. The PASFECS has redundant isolation capability in all ductwork which interfaces with the ABGTS or penetrates the ABSCE.

9.4.9.2 System Description

The PASFECS is shown on Figure 9.4-35 (Flow Diagram 47W866-15), Figure 9.4-36 (Logic Diagram 47W611-31-9), and Figure 9.4-37 (Control Diagram 47W610-31-9). The PASFECS consists of a ventilation subsystem (PASFVS), a heating and cooling subsystem (PASFHCS), and a radiological gas treatment subsystem (PASFGTS).

9.4.9.2.1 PASFVS

During normal plant operation, ventilation air is supplied to the facility via the Auxiliary Building general ventilation system and an auxiliary supply fan. Exhaust air is ducted directly to the Auxiliary Building fuel handling area exhaust ductwork.

During postaccident conditions or sampling operations, the normal supply and exhaust systems are isolated and ventilation air is taken directly from the outside at a point on the roof of the unit 1 Additional Equipment Building. Both the Unit 1 and Unit 2 systems share this common intake. A supply fan provides air to the sampling side of the facility in response to a differential pressure controller. Air is drawn from both the sample and valve gallery areas by the PASFGTS exhaust fan and routed to the exhaust duct downstream of the ABGTS air cleanup unit. The sampling area is maintained at a positive pressure with respect to atmosphere while the valve gallery is kept at a negative pressure with respect to the sample side.

9.4.9.2.2 PASFHCS

In the normal mode of operation, supply air taken from the Auxiliary Building general ventilation system has already been tempered and no additional heating or cooling is required.

In the postaccident mode, incoming air is preheated in response to a duct mounted temperature switch. No cooling is provided in this mode.

9.4.9.2.3 PASFGTS

The radiological gas treatment subsystem consists of one HEPA/charcoal-type air cleanup unit located just upstream of the exhaust fan. Air supplied to the facility during postaccident conditions or sampling operations is processed through the air cleanup unit prior to being discharged to the atmosphere.

9.4.9.3 Safety Evaluation

The PASFECS is not a nuclear safety related system; however, the isolation valves and duct which interface with the ABGTS and ABSCE are designed to meet Seismic Category I requirements. These valves are also backed (by Class 1E power). All remaining portions of the system are designed to Category I(L) requirements.

9.4.9.4 Inspection and Testing Requirements

The PASFECS is pretested initially to assure that design criteria requirements have been met and periodically thereafter.

Air cleanup units are designed and tested per the requirements of NRC Regulatory Guide 1.140. Preoperational tests provide data for the initial balance of the system and verification of design flow rates. Manufactured components are tested in accordance with applicable standards for the components.

REFERENCES

1. NRC Letter dated April 5, 2002 (Docket No. 50-440) - Application of Generic Letter 80-30 Guidance to an Inoperable Non-Technical Specification Support Subsystem as defined in the Technical Specification Bases for LCO 3.0.6.

TABLE 9.4-1

PURGE AIR CLEANUP UNIT DATA

Reactor Building Purge System Air Flow Rate: 22, 949 cfm total

Type	Banks/Train	Cells/Bank	Cells/ Train	Total Cells
Prefilter	1	14	14	28
HEPA	1	14	14	28
Carbon	1	42	42	84

TABLE 9.4-2 (Sheet 1 of 6)

FAILURE MODES AND EFFECTS ANALYSIS

INTAKE PUMPING STATION VENTILATION SYSTEM

WINTER								
#	COMPONENT IDENTIFICATION	FUNCTION	FAILUREMODE	POTENTIALCAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
1.	All components of the Intake Pumping Station Ventilation System. Electrical Equipment Room and Mechanical Equipment Rooms A or B.	Provide heating during the winter.	Total loss of heating	Electrical failure (Loss of power)	Surveillance	Total loss of the heating system resulting in room temperatures lower than design value.	None. See Remarks.	1) Room temperature is verified once a shift. 2) Supplemental heating is provided if necessary to maintain the space temperatures above 32°F.

TABLE 9.4-2 (Sheet 2 of 6)

FAILURE MODES AND EFFECTS ANALYSIS
INTAKE PUMPING STATION VENTILATION SYSTEM

SUMMER								
#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
2.	All components of the Intake Pumping Station Ventilation System; Electrical Equipment Room or Mechanical Equipment Room A or B	Provide ventilation cooling during the Summer	Loss of all Supply and Exhaust Fans concurrent with operation of a Unit Heater 0-HTR-30-715 or -716 in the Electrical Equipment Room	Electrical and/or mechanical failure	Surveillance	Room temperature s higher than design value.	None. See Remarks	1) Room temperature is verified once a shift. 2) If the room temperatures are above 104°F, Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans are operational. If the fans are non-operable, non-essential loads are shed if necessary to maintain the room temperatures at less than 130°F.
3.	All components of the Intake Pumping Station Ventilation System; Electrical Equipment Room or Mechanical Equipment Room A	Provide ventilation cooling during the Summer	Operation of Supply and Exhaust Fans, 0-FAN-30-714A & -714B,	Electrical and/or mechanical failure	Surveillance	Additional heat added to the space. Room temperature will be higher than	None. See Remarks	1) Room temperature is verified once a shift. 2) If the room temperatures are above 104°F,

TABLE 9.4-2 (Sheet 3 of 6)

FAILURE MODES AND EFFECTS ANALYSIS
INTAKE PUMPING STATION VENTILATION SYSTEM

SUMMER								
#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
	or B		concurrent with operation of Duct Heater 0-HTR-30-714 in the Electrical Equipment Room. Total loss of ventilation in the Mechanical Equipment Rooms.			design value.		Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans are operational.
4.	All components of the intake Pumping Station Ventilation System: Electrical Equipment Room, or Mechanical Equipment Room A or B	Provide ventilation cooling during the Summer	Loss of all Supply and Exhaust Fans concurrent with operation of a Unit Heater 0-HTR-30-710 or -711 in Mechanical	Electrical and/or mechanical failure	Surveillance	Room temperature s higher than design value.	None. See Remarks	1) Room temperature is verified once a shift. 2) If the room temperatures are above 104°F, Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans

FAILURE MODES AND EFFECTS ANALYSIS
INTAKE PUMPING STATION VENTILATION SYSTEM

SUMMER

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
			Equipment Room A					are operational. If the fans are non-operable, non-essential loads are shed if necessary to maintain the room temperatures at less than 130°F.
5.	All components of the Intake Pumping Station Ventilation System; Electrical Equipment Room or Mechanical Equipment Room A or B	Provide ventilation cooling during the Summer	Operation of Supply and Exhaust Fans, 0-FAN-30-708A & -708B, concurrent with operation of Duct Heater 0-HTR-30-708 in Mechanical Equipment Room A. Total loss of ventilation in the Electrical Equipment	Electrical and/or mechanical failure	Surveillance	Additional heat added to the space. Room temperature will be higher than design value.	None. See Remarks	1) Room temperature is verified once a shift. 2) If the room temperatures are above 104°F, Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans are operational.

FAILURE MODES AND EFFECTS ANALYSIS
INTAKE PUMPING STATION VENTILATION SYSTEM

SUMMER								
#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
			Room and Mechanical Equipment Room B.					
6.	All components of the intake Pumping Station Ventilation System: Electrical Equipment Room, or Mechanical Equipment Room A or B	Provide ventilation cooling during the Summer	Loss of all Supply and Exhaust Fans concurrent with operation of a Unit Heater 0-HTR-30-712 or -713 in Mechanical Equipment Room B	Electrical and/or mechanical failure	Surveillance	Room temperature s higher than design value.	None. See Remarks	1) Room temperature is verified once a shift. 2) If the room temperatures are above 104°F, Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans are operational. If the fans are non-operable, non-essential loads are shed if necessary to maintain the room temperatures at less than 130°F.
7.	All components of the Intake Pumping Station Ventilation	Provide ventilation cooling	Operation of Supply and Exhaust	Electrical and/or mechanical	Surveillance	Additional heat added to the space.	None. See Remarks	1) Room temperature is verified once a shift.

TABLE 9.4-2 (Sheet 6 of 6)

FAILURE MODES AND EFFECTS ANALYSIS
INTAKE PUMPING STATION VENTILATION SYSTEM

SUMMER								
#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OFFAILURED ETECTION	EFFECT ONSYSTEM	EFFECT ONPLANT	REMARKS
	System; Electrical Equipment Room or Mechanical Equipment Room A or B	during the Summer	Fans, 0-FAN-30-709A & -709B, concurrent with operation of Duct Heater 0-HTR-30-709 in Mechanical Equipment Room B. Total loss of ventilation in the Electrical Equipment Room and Mechanical Equipment Room A.	failure		Room temperature will be higher than design value.		2) If the room temperatures are above 104°F, Operator ensures that the duct heaters and unit heaters are "OFF" and that the supply and exhaust fans are operational.

TABLE 9.4-3 (Sheet 1 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	1-PMCL-30-180-A Safety Injection Pump 1A-A Cooler (Train A)	Provides cooling air to SI Pump 1A-A Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-176-A fully open (1-ZS-67-176). Fan motor running light on MCC.	Loss of cooling to SIP 1A-A room with the potential for loss of SIP 1A-A.	None. Train B SI Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump. See Remark # 3.	1. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature on 1-TS-30-180-A or SI Pump 1A-A start; and, manually by local handswitch 1-HS-30-180. 2. The Cooler Fan and the flow control valve 1-FCV-67-176-A are interlocked to operate together. 3. Train B equipment is located in SIP Room 1B. Failure of the Train A equipment, will not adversely impact Train B SI pump operation.
2	1-PMCL-30-179-B Safety Injection Pump 1B-B Cooler (Train B)	Provides cooling air to SI Pump 1B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; auto-start signal failure; Operator error (handswitch	Status monitor light in MCR for 1-FCV-67-182 fully open (1-ZS-67-182). Fan motor	Loss of cooling to SIP 1B-B room with the potential for loss of SIP 1B-B.	None. Train A SI Pump is not affected by the failure of Train B pump room cooler, and is 100%	1. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains

TABLE 9.4-3 (Sheet 2 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				placed in wrong position)	running light on MCC.		redundant to Train B pump. See Remark # 3.	to be independent. The cooler automatically starts upon high temperature on 1-TS-30-179-B or SI Pump 1B-B start; and, manually by local handswitch 1-HS-30-179. 2. The Cooler Fan and the flow control valve 1-FCV-67-182 are interlocked to operate together. 3. Train A equipment is located in SIP Room 1A. Failure of the Train B equipment will not adversely impact Train A SI pump operation.
3	1-FCV-67-176-A Essential Raw Cooling Water Flow Control Valve for the Safety Injection System Pump 1A-A Cooler.	Provides flowpath for cooling water from the ERCW Header 1A to the cooler for Pump 1A-A	Fails to open, stuck closed	Mechanical failure; Opening signal failure	Status monitor light in MCR (1-ZS-67-176)	Loss of cooling water to SIP 1A-A pump room cooler with the potential for loss of SIP 1A-A.	None. Train B SI Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump.	1-FCV-67-176-A FCV fails open on loss of power or air.
4	1-FCV-67-182-B Essential Raw	Provides flowpath for cooling water from the	Fails to open, stuck closed	Mechanical failure; Opening signal failure	Status monitor light in MCR (1-ZS-67-182)	Loss of cooling water to SIP 1B-B pump room cooler with the potential	None. Train A SI Pump is not affected by the	1-FCV-67-182-B FCV fails open on loss of power or air.

TABLE 9.4-3 (Sheet 3 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooling Water Flow Control Valve for the Safety Injection System Pump 1B-B Cooler.	ERCW Header 1B to the cooler for Pump 1B-B				for loss of SIP 1B-B.	failure of Train B pump room cooler, and is 100% redundant to Train B pump.	
5	1-PMCL-30-175-A Residual Heat Removal Pump 1A-A Cooler (Train A).	Provides cooling air to RHR Pump 1A-A Room.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A Power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position).	Fan motor running light on MCC. Status monitor light in MCR for 1-FCV-67-188 (1-ZS-67-188)	Loss of cooling water to RHR Pump 1A-A Room cooler with the potential loss of RHR Pump 1A-A.	None. Train B RHR Pump is not affected by the failure of Train A Pump Room Cooler and is 100% redundant to Train A Pump.	Train A and Train B RHR pump/cooler sets are in separate rooms. Review of the schematics for the Train A and Train B coolers shows the trains to be independent. The cooler is started automatically upon high temperature at 1-TS-30-175-A, or RHR Pump 1A-A start; Manually by local handswitch 1-HS-30-175.
6	1-PMCL-30-176-B Residual Heat Removal Pump 1B-B Cooler (Train B)	Provides cooling air to RHR Pump 1B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; auto-start signal failure; Operator error (handswitch placed in wrong position)	Fan motor running light on MCC. Status monitor light in MCR for 1-FCV-67-190 (1-ZS-67-190)	Loss of cooling to RHR Pump 1B-B Room with the potential loss of RHR pump 1B-B.	None. Train A RHR Pump is not affected by the failure of Train B pump Room Cooler, and is 100% redundant to Train B pump.	Train A and Train B RHR pump/cooler sets are in separate rooms. Review of the schematics for the Train A and Train B coolers shows the trains to be independent. The cooler started automatically upon high temperature at 1-TS-30-176-B or RHR Pump 1B-B start; Manually by

TABLE 9.4-3 (Sheet 4 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								local handswitch 1-HS-30-176.
7	1-FCV-67-188-A Essential Raw Cooling Water Flow Control Valve for the Residual Heat Removal System Pump 1A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for RHR Pump 1A-A.	See 'remarks' column	See 'remarks' column.	See 'remarks' column.	See 'remarks' column.	See 'remarks' column.	1-FCV-67-188-A has been electrically disconnected due to App. 'R' interaction to keep the valve permanently open.
8	1-FCV-67-190-B Essential Raw Cooling Water Flow Control Valve for the Residual Heat Removal System Pump 1B-B Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for RHR Pump 1B-B.	See 'remarks' column	See 'remarks' column	See 'remarks' column	See 'remarks' column	See 'remarks' column	1-FCV-67-190-B has been electrically disconnected due to App. 'R' interaction to keep the valve permanently open.
9	1-PMCL-30-177-A Containment Spray Pump 1A-A Cooler (Train A)	Provides cooling air to CS Pump 1A-A Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-184-A (1-ZS-67-184). Fan motor running light on MCC.	Loss of cooling to CSP 1A-A Room with the potential for loss of CSP 1A-A.	None. Train B Pump is not affected by the failure of Train A pump/cooler, and is 100% redundant to Train A pump.	Equipment includes fan and motor. Train A and Train B CS pump/cooler sets are in separate rooms. Review of the schematics for the Train A and B coolers shows the trains to be independent. The

TABLE 9.4-3 (Sheet 5 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								cooler is started automatically upon high temperature at 1-TS-30-177-A or CS Pump 1A-A start; manually by local handswitch 1-HS-30-177. The cooler and the flow control valve 1-FCV-67-184-A are interlocked to operate together.
10	1-PMCL-30-178-B Containment Spray Pump 1B-B Cooler (Train B)	Provides cooling air to CS Pump 1B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-186-B (1-ZS-67-186). Fan motor running light on MCC.	Loss of cooling to CSP 1B-B Room with the potential for loss of CSP 1B-B.	None. Train A Pump is not affected by the failure of Train B pump/cooler, and is 100% redundant to Train B pump.	Equipment includes fan and motor. Train A and Train B CS pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler is started automatically upon high temperature at 1-TS-30-178-B or CS Pump 1B-B start; manually by local handswitch 1-HS-30-178. The cooler and the flow control valve 1-FCV-67-186-B are interlocked to operate together.

TABLE 9.4-3 (Sheet 6 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
11	1-FCV-67-184-A Essential Raw Cooling Water Flow Control Valve for the Containment Spray System Pump 1A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CS Pump 1A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-184).	Loss of cooling to CSP 1A-A room with the potential for loss of CSP 1A-A.	None. Train B CS Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump.	1-FCV-67-184-A fails to the open position on loss of power or air.
12	1-FCV-67-186-B Essential Raw Cooling Water Flow Control Valve for the Containment Spray System Pump 1B-B Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CS Pump 1B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-186).	Loss of cooling to CSP 1B-B room with the potential for loss of CSP 1B-B.	None. Train A CS Pump is not affected by the failure of Train B pump room cooler, and is 100% redundant to Train B pump.	1-FCV-67-186-B fails to the open position on loss of power or air.
13	1-PMCL-30-183-A Centrifugal Charging Pump 1A-A Cooler (Train A).	Provides cooling air to CC Pump 1A-A Room.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position).	Fan motor running light on MCC. Status monitor light in MCR for 1-FCV-67-168 (1-ZS-67-168)	Loss of cooling to CC pump 1A-A Room with the potential for loss of CC Pump 1A-A.	None. Train B CC pump is not affected by the failure of Train A pump/cooler, and is 100% redundant to Train A pump.	Equipment includes fan and motor. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature at 1-TS-30-183-A, or pump 1A-A

TABLE 9.4-3 (Sheet 7 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								start; Manually by local handswitch 1-HS-30-183.
14	1-PMCL-30-182-B Centrifugal Charging Pump 1B-B Cooler (Train B).	Provides cooling air to CC Pump 1B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Fan motor running light on MCC. Status monitor light in MCR for 1-FCV-67-170 (1-ZS-67-170)	Loss of cooling to CC pump 1B-B Room with the potential for loss of CC pump 1B-B.	None. Train A CC pump is not affected by the failure of Train B pump/cooler, and is 100% redundant to Train B pump.	Equipment includes fan and motor. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature at 1-TS-30-182-B or pump 1B-B start; Manually by local handswitch 1-HS-30-182.
15	1-FCV-67-168-A Essential Raw Cooling water Flow Control Valve for the centrifugal Charging Pump Room 1A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CC Pump 1A-A.	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	1-FCV-67-168-A is electrically disconnected to keep the valve permanently open.
16	1-FCV-67-170-B Essential Raw Cooling water Flow Control Valve for	Provides flowpath for cooling water from the ERCW Header to the cooler for CC	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	1-FCV-67-170-B is electrically disconnected to keep the valve permanently open.

TABLE 9.4-3 (Sheet 8 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	the centrifugal Charging Pump Room 1B-B Cooler.	Pump 1B-B.						
17	1-PMCL-30-190 CCS and Aux. FW Pump Cooler 1A-A.	Provides cooling air to the CCS and Aux. FW pumps space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-162-A (1-ZS-67-162). Indicating light on MCC for fan motor running.	Loss of redundancy in providing cooling air for CCS and Aux FW pumps space.	None. The Train B Cooler B-B is available to start on high temperature (1-TS-30-190B-A1A-B) and is 100% redundant to the Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature sensed by 1-TS-30-190A-A. In standby mode, the cooler will start upon high temperature at 1-TS-30-190B-A. Cooler fan motor and 1-FSV-67-162-A are interlocked to open 1-FCV-67-162-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
18	1-PMCL-30-191-A CCS and Aux. FW Pump/Cooler 1B-B	Provides cooling air to the CCS and Aux. FW pumps space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-164-B (1-ZS-67-164). Indicating light on MCC for fan motor running.	Loss of redundancy in providing cooling air for CCS and Aux. FW pumps space.	None. The standby Train A Cooler A-A is available to start on high temperature (1-TS-30-1910A-AB-B) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature sensed by 1-TS-30-191A-B. In standby mode, the cooler will start upon high temperature at 1-TS-30-191B-B. Cooler fan motor and 1-FSV-67-164-B are interlocked to open 1-FCV-67-164 for ERCW Supply on

TABLE 9.4-3 (Sheet 9 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
19	1-FCV-67-162-A Essential Raw Cooling Water Flow Control Valve for the CCS and Aux. FW Pump Cooler 1A-A.	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump 1A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (or 1-ZS-67-162).	Loss of redundancy in providing cooling to CCS and Aux FW Pump space.	None. Train B pump spaceroom cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the train A pump space room cooler.	1-FCV-67-162-A fails open on loss of power or air.
20	1-FCV-67-164-B Essential Raw Cooling Water Flow Control Valve for the CCS and Aux. FW Pump Cooler B-B.	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (or 1-ZS-67-164).	Loss of redundancy in providing cooling to CCS and Aux FW Pump space.	None. Train A pump space room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump space room cooler.	1-FCV-67-164-B fails open on loss of power or air.
21	2-CLR-30-200-A EGTS Cooler 2A-A	Provides cooling air to the EGTS Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong	Status monitor light in MCR for 2-FCV-67-336 (2-ZS-67-336). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the EGTS Room.	None. The standby Train B Cooler is available to start on high temperature (2-TS-30-207A-B) and is 100% redundant to Train	The cooler automatically starts upon Train A ABI signal . In standby mode the cooler will start uponor high temperature at 2-TS-30-200A-A. Cooler fan motor and 2-FSV-67-

TABLE 9.4-3 (Sheet 10 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				position)			A cooler.	336-A are interlocked to open 2-FCV-67-336 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
22	2-CLR-30-207-B EGTS Cooler A-A2B-B.	Provides cooling air to the EGTS Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-338 (2-ZS-67-338). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the EGTS Room.	None. The standby Train A Cooler is available to start on high temperature at 2-TS-30-200A-A and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal . In standby mode, the cooler will start upon or high temperature at 2-TS-30-207A-B. Cooler fan motor and 2-FSV-67-338-B are interlocked to open 2-FCV-67-338 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
23	2-FCV-67-336 Essential Raw Cooling Water Flow Control Valve for the EGTS Room Cooler A-A.	Provides flowpath for cooling water from the ERCW Header to the A-A cooler for the EGTS Rooms.	Fails to open, stuck closed.	Mechanical failure; signal failure.	Status monitor light in MCR (2-ZS-67-336)	Loss of redundancy in providing cooling to EGTS room.	None. Train B Pump cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-336 fails open on loss of power or air.
24	2-FCV-67-338	Provides	Fails to open,	Mechanical failure;	Status monitor	Loss of redundancy	None.	2-FCV-67-338 fails open

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UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Essential Raw Cooling Water Flow Control Valve for the EGTS Room Cooler B-B	flowpath for cooling water from the ERCW Header to the B-B cooler for the EGTS Rooms.	stuck closed.	signal failure.	light in MCR (2-ZS-67-338).	in providing cooling to EGTS room.	Train A Pump cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	on loss of power or air.
25	0-PMCL-30-192-A CCS TB Booster and Spent Fuel Pit Pump Cooler A-A	Provides cooling air to the CCS TB Booster and Spent Fuel Pit Cooler Space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-213-A (1-ZS-67-213) Fan motor running light on MCC.	Loss of redundancy in providing cooling air for CCS TB Booster and Spent Fuel Pit Cooler Space	None. The standby Train B Cooler A-A is available to start on high temperature (0-TS-30-193BA-B) and is 100% redundant to the Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 0-TS-30-192A-A. In standby mode, the cooler will start upon high temperature at 0-TS-30-192B-A. Cooler fan motor and 1-FSV-67-213-A are interlocked to open 1-FCV-67-213-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
26	0-PMCL-30-193-B CCS TB Booster and Spent Fuel Pit Cooler B-B	Provides cooling air to the CCS TB Booster and Spent Fuel Pit Cooler B-B space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-215-B (1-ZS-67-215). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for CCS TB Booster and Spent Fuel Pit Cooler space.	None. The standby Train A Cooler is available to start on high temperature (1-TS-30-192B192A-A) and is 100% redundant to the Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 0-TS-30-193A-B. In standby mode, the cooler will start upon high temperature at 0-TS-30-193B-B. Cooler fan motor and 1-FSV-67-

TABLE 9.4-3 (Sheet 12 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								215-B are interlocked to open 1-FCV-67-215-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
27	1-FCV-67-213-A Essential Raw Cooling Water Flow Control Valve for the CCS TB Booster and Spent Fuel Pit Cooler A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-213)	Loss of redundancy in providing cooling air to CCS TB Booster and Spent Fuel Pit Coolers space.	None. Train B Pump area cooler is not affected by the failure of Train A pump area cooler, and is 100% redundant to the Train A pump area cooler.	1-FCV-67-213-A fails open on loss of power or air.
28	1-FCV-67-215-B Essential Raw Cooling Water Flow Control Valve for the CCS TB Booster and Spent Fuel Pit Cooler B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-215)	Loss of redundancy in providing cooling air to CCS TB Booster and Spent Fuel Pit Coolers space.	None. Train A Pump area cooler is not affected by the failure of Train B pump area cooler, and is 100% redundant to the Train B pump area cooler.	1-FCV-67-215-B fails open on loss of power or air.
29	0-BKD-31-2956 CCS TB Booster and Spent Fuel Pit Pump Cooler	Provides flowpath for cool air flow from Cooler A-A to common	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate	Loss of redundancy in providing cooling air to room.	None. The standby Train B cooler will start upon high temperature on 0-	Operability of the dampers is periodically verified.

TABLE 9.4-3 (Sheet 13 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	A-A Backdraft Damper	discharge headers to room.			if damper was stuck closed		TS-30-193B-B.	
		Protects standby Cooler A-A from reverse air flow from running cooler B-B.	Fails to backseat (stuck open) when Train B Cooler B-B is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	None (See Remarks)	None (See Remarks)	
30	0-BKD-31-2957 CCS TB Booster and Spent Fuel Pit Pump Cooler B-B Backdraft Damper	Provides flowpath for cool air flow from Cooler B-B to common discharge headers to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed.	Loss of redundancy in providing cooling air to room.	None. The standby Train A cooler will start upon high temperature on 0-TS-30-192B-A.	Operability of the dampers is periodically verified.
		Protects standby Cooler B-B from reverse air flow from running cooler A-A.	Fails to backseat (stuck open) when Train A Cooler A-A is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	None (See Remarks)	None (See Remarks)	
31	2-PMCL-30-184-A AFW and BAT Cooler Fan A-A	Provides cooling air to the AFW and BAT pumps space	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch	Status monitor light in MCR for 2-FCV-67-217 (2-ZS-67-217). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for AFW and BAT pumps Space	None. The Train B Cooler is available to start on high temperature (2-TS-30-185BA-B) and is 100% redundant	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-184A-A. In standby mode, the cooler will start upon high

TABLE 9.4-3 (Sheet 14 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				placed in wrong position)			to tTrain A cooler.	temperature at 2-TS-30-184B-A. Cooler fan motor and 2-FSV-67-217-A are interlocked to open 2-FCV-67-217 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
32	2-PMCL-30-185-B AFW and BAT Cooler Fan B-B	Provides cooling air to the AFW and BAT pumps space	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-219 -B (2-ZS-67-219). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for AFW and BAT pumps Space	None. The standby Train A Cooler is available to start on high temperature (2-TS-30-184BA-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-185A-B. In standby mode, the cooler will start upon high temperature at 2-TS-30-185B-B. Cooler fan motor and 2-FSV-67-219-B are interlocked to open 1-FCV-67-219 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
33	2-FCV-67-217 Essential Raw Cooling Water Flow Control	Provides flowpath for cooling water from the ERCW Header	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-217)	Loss of redundancy in providing cooling to AFW and BAT Pumps Space.	None. Train B pump room cooler is not affected by the failure of Train A	2-FCV-67-217 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 15 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Valve for the AFW and BAT Cooler A-A	to the Cooler for Pump A-A.					pump room cooler, and is 100% redundant to the Train A pump room cooler.	
34	2-FCV-67-219 Essential Raw Cooling Water Flow Control Valve for the AFW and BAT Cooler B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-219)	Loss of redundancy in providing cooling to AFW and BAT pumps Space.	None. Train A pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-219 fails open on loss of power or air.
35	2-BKD-31-2952 Aux FW and BAT Pump Cooler A-A Backdraft Damper	Provides flowpath for cool air flow from Cooler A-A to common discharge header to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to room.	None. The standby Train B cooler will start upon high temperature on 2-TS-30-185B-B.	Operability of the dampers is periodically verified.
		Protects standby Cooler A-A from reverse air flow from running cooler B-B.	Fails to backseat (stuck open) when Train B Cooler B-B is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	None (See Remarks)	None (See Remarks)	
36	2-BKD-31-2953	Provides flowpath for cool air flow	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on	Loss of redundancy in providing cooling	None. The standby Train A cooler will start	Operability of the dampers is periodically verified.

TABLE 9.4-3 (Sheet 16 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Aux FW and BAT Pump Cooler B-B Backdraft Damper	from Cooler B-B to common discharge header to room.			the damper would indicate if damper was stuck closed	air to room.	upon high temperature on 2-TS-30-184B-A.	
		Protects standby Cooler B-B from reverse air flow from running cooler A-A.	Fails to backseat (stuck open) when Train A Cooler A-A is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	None (See Remarks)	None (See Remarks)	Potential loss of, or diminished, air cooling from both trains. The consequences of the diversion of cooling air flow through standby cooler is possible damage to the Train B motor and motor premature trip. Automatic switchover to the standby Train B cooler, if it is experiencing reverse rotation due to damper not backseating could, upon demand, fail the motor due to overload. Therefore, neither train cooler would be available to perform the system function. For this reason, the damper will be periodically checked for correct position.
37	1-CLR-30-201-A Pipe Chase	Provides cooling air to the pipe chase.	Fails to start, fails while running;	Mechanical failure; Train A power failure;	Status monitor light in MCR for 1-FCV-67-	Loss of redundancy in providing cooling	None. The standby Train B Cooler Fan 1B-B	The cooler automatically starts upon Train A ABI signal or high

TABLE 9.4-3 (Sheet 17 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooler Fan 1A-A		Spuriously stops.	Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	342-A (1-ZS-67-342-A). Fan motor running light on MCC.	air for the Pipe Chase.	is available to start on high temperature (1-TS-30-202BA-B) and is 100% redundant to Train A cooler.	temperature at 1-TS-30-201A-A. In standby mode, the cooler will start upon high temperature at 1-TS-30-201B-A. Cooler fan motor and 1-FSV-67-342-A are interlocked to open 1-FCV-67-342-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
38	1-CLR-30-202-B Pipe Chase Cooler Fan 1-B-B	Provides cooling air to the pipe chase.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-344-B (1-ZS-67-344-B). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the Pipe Chase.	None. The standby Train A Cooler Fan 1A-A is available to start on high temperature at 1-TS-30-201BA-A and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 1-TS-30-202A-B. In standby mode, the cooler will start upon high temperature at 1-TS-30-202B-B. Cooler fan motor and 1-FSV-67-344-B are interlocked to open 1-FCV-67-344-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
39	1-FCV-67-342-A	Provides flowpath for	Fails to open,	Mechanical failure; Opening	Status monitor light in MCR	Loss of redundancy in	None.	1-FCV-67-342 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 18 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Essential Raw Cooling Water Flow Control Valve for the Pipe Chase Cooler 1A-A	cooling water from the ERCW Header to the Cooler 1A-A.	stuck closed.	signal failure.	(1-ZS-67-342)	providing cooling air to the Pipe Chase.	Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	
40	1-FCV-67-344-B Essential Raw Cooling Water Flow Control Valve for the Pipe Chase Cooler 1B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler 1B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-344)	Loss of redundancy in providing cooling air to the Pipe Chase.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	1-FCV-67-344 fails open on loss of power or air.
41	1-BKD-31-2925 Pipe Chase Cooler 1A-A Backdraft Damper	Provides flowpath for cool air flow from Cooler 1A-A to Pipe Chase Header.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to Pipe Chase.	None. The standby Train B cooler will start upon high temperature on 1-TS-30-202B-B.	Operability of the dampers is periodically verified.
		Protects standby Cooler 1A-A from reverse air flow from running cooler 1B-B.	Fails to backseat (stuck open) when Train A Cooler 1B-B is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was	Loss of redundancy	None. (See Remarks)	

TABLE 9.4-3 (Sheet 19 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
					stuck open.			
42	1-BKD-31-2927 Pipe Chase Cooler 1B-B Backdraft Damper	Provides flowpath for cool air flow from Cooler 1B-B to Pipe Chase Header.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to Pipe Chase.	None. The standby Train A cooler will start upon high temperature on 1-TS-30-201B-A.	Operability of the dampers is periodically verified.
		Protects standby Cooler 1B-B from reverse air flow from running cooler 1A-A.	Fails to backseat (stuck open) when Train B Cooler 1A-A is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	Loss of redundancy.	None. (See Remarks)	
43	1-CLR-30-186-A Penetration Room Cooler Fan 1A-A (Train A)	Provides cooling air to Penetration Room (El 692)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-346-A fully open (1-ZS-67-346). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 692) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (1-TS-30-187BA-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 1-TS-30-186A-A. In standby mode, the cooler will start upon high temperature at 1-TS-30-186B-A. Cooler fan motor and 1-FSV-67-346-A are interlocked to open 1-FCV-67-346-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
44	1-CLR-30-187-B	Provides	Fails to start,	Mechanical	Status monitor	Loss of cooling to	None.	The cooler automatically starts upon Train B ABI

TABLE 9.4-3 (Sheet 20 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Penetration Room Cooler Fan 1B-B (Train B).	cooling air to Penetration Room (El 692)	fails while running; Spuriously stops.	failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	light in MCR for 1-FCV-67-348-B fully open (1-ZS-67-348). Fan motor running light on MCC.	Penetration Room (El 692) with the potential for loss of room equipment.	The standby Train A Cooler is available to start on high temperature at 0-TS-30-186BA-A and is 100% redundant to Train B cooler.	signal or high temperature at 1-TS-30-187A-B. In standby mode, the cooler will start upon high temperature at 1-TS-30-187B-B. Cooler fan motor and 1-FSV-67-348-B are interlocked to open 1-FCV-67-348-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
45	1-FCV-67-346-A Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El. 692) Cooler 1A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-346)	Loss of redundancy in providing cooling to Penetration Room (El. 692) space. .	None. Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	1-FCV-67-346-A fails open on loss of power or air.
46	1-FCV-67-348-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El. 692) Cooler 1B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-348)	Loss of redundancy in providing cooling to Penetration Room (El. 692) space.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	1-FCV-67-348-B fails open on loss of power or air.

TABLE 9.4-3 (Sheet 21 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
47	1-CLR-30-196 Penetration Room Cooler Fan 1A-A (Train A).	Provides cooling air to Penetration Room (El 713)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-350-A fully open (1-ZS-67-350). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 713) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (1-TS-30-197B197A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature (1-TS-30-1967A-AB-B). In standby mode, the cooler will start upon high temperature at 1-TS-30-196B-A. Cooler fan motor and 1-FSV-67-350-A are interlocked to open 1-FCV-67-350-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
48	1-CLR-30-197 Penetration Room Cooler Fan 1B-B (Train B).	Provides cooling air to Penetration Room (el 713)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-352-B fully open (1-ZS-67-352). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 713) with the potential for loss of room equipment.	None. The standby Train A Cooler is available to start on high temperature (1-TS-30-196BA-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 1-TS-30-197A-B. In standby mode, the cooler will start upon high temperature at 1-TS-30-197B-B. Cooler fan motor and 1-FSV-67-352-B are interlocked to open 1-FCV-67-352-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
49	1-FCV-67-350-A	Provides flowpath for	Fails to open,	Mechanical failure; Opening signal	Status monitor light in MCR (1-	Loss of redundancy in providing cooling	None.	1-FCV-67-350 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 22 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 713) Cooler 1A-A.	cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	stuck closed.	failure.	ZS-67-350)	to Penetration Room (El 713) Space	Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	
50	1-FCV-67-352-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 713) Cooler 1B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-352)	Loss of redundancy in providing cooling to Penetration Room (El 713) Space.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	1-FCV-67-352 fails open on loss of power or air.
51	1-CLR-30-194-A Penetration Room Cooler Fan 1A-A (Train A)	Provides cooling air to Penetration Room (El 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-354-A fully open (1-ZS-67-354). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 737) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (1-TS-30-195B195A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 1-TS-30-194A-A. In standby mode, the cooler will start upon high temperature at 1-TS-30-194B-A. Cooler fan motor and 1-FSV-67-354-A are interlocked to open 1-FCV-67-354-A for ERCW supply on cooler start. Review of the schematics for the

TABLE 9.4-3 (Sheet 23 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								coolers A-A and B-B shows their independence.
52	1-CLR-30-195-B Penetration Room Cooler Fan 1B-B (Train B).	Provides cooling air to Penetration Room (el 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-356-B (1-ZS-67-356). Fan motor running light on MCC.	Loss of cooling to Penetration Room (el 737) with the potential for loss of room equipment.	None. The standby Train A Cooler is available to start on high temperature (1-TS-30-194BA-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 1-TS-30-195A-B. In standby mode, the cooler will start upon high temperature at 1-TS-30-195B-B. Cooler fan motor and 1-FSV-67-356-B are interlocked to open 1-FCV-67-356-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
53	1-FCV-67-354-A Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 737) Cooler 1A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-354)	Loss of redundancy in providing cooling to Penetration Room (El 737) Space	None. Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	1-FCV-67-354-A fails open on loss of power or air.
54	1-FCV-67-356-B Essential Raw Cooling Water	Provides flowpath for cooling water from the	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-356)	Loss of redundancy in providing cooling to Penetration Room	None. Train A Pump room cooler is not affected by the	1-FCV-67-356 fails open on loss of power or air.

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UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Flow Control Valve for the Penetration Room (El 737) Cooler 1B-B	ERCW Header to the Cooler for the Penetration Room Space.				(El 737) Space.	failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	
55	Backdraft Dampers 1-BKD-31-2998 1-BKD-31-2999 1-BKD-31-3000 1-BKD-31-3001 1-BKD-31-3002 1-BKD-31-3003 1-BKD-31-3004 1-BKD-31-3005 1-BKD-31-3006 1-BKD-31-1790 1-BKD-31-3078 1-BKD-31-5093 1-BKD-31-3088 1-BKD-31-3087 1-BKD-31-3080 1-BKD-31-4001	Backseat to stop flow of hot air developed due to a HELB in the pipe chase from adjacent rooms and maintains a mild environment in rooms adjacent to pipe chase. hot air / steam developed due to a break in either the RHR or CVCS lines in the pipe chase from adjacent rooms and maintain them as a mild environment. NOTE: Consistent with NRC Standard Review Plan Branch Technical	Fails to backseat (Stuck Open)	Mechanical Failure	No direct indication of damper stuck open.	See “Remark #2s” column	See “Remarks” columnSee Remark #2	For a CVCS HELB, a failure of one of these dampers is mitigated by the Aux Bldg HVAC (Calculation WBNAPS2068), which does not isolate on a HELB event (DCN M-16270-A); therefore, the environment of the adjacent room is not adversely impacted. For a RHR MELB, per USNRC BTP MED 3-1, Rev. 2, Sections B.3a&b 1. Backdraft dampers 1-BKD-31-1790 and 1-BKD-31-5093 exist so that a backdraft damper is provided in every connection from the pipe chase to an adjacent room, and determined that the single failure of a backdraft damper (to close), when normal HVAC continues to operate, will not result in a severe environment in

TABLE 9.4-3 (Sheet 25 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Position 3.6.1, Subjection B.3.b(3) and WB-DC-40-64, Appendix B, Exception B.5.5, it is not required to assume a single failure in conjunction with a break in the RHR line as this is a dual purpose moderate energy system as it : 1) is designed to Seismic Category I standards; 2) is powered from both off-site and on-site sources; and is constructed, operated and inspected to quality assurance, testing and in-service inspection standards						the room with the failed backdraft damper. 2. The ABI Signal does not automatically isolate the normal HVAC System during a HELB. As a result, the HELB in the pipe chase will not result in isolation of normal HVAC. Thus, proper air flow is maintained. As a result, the single failure of any of the listed backdraft dampers will have no effect on the system or the plant.and WB-DC-40-64, App. B, Exception B.5.5 (PIC 58376), when the initiating event is the postulated failure of one of two redundant trains of a dual purpose moderate-energy SR system, a single failure in systems necessary to mitigate the consequences of the piping failure need not be assumed; therefore, the failure of one of these dampers need not be postulated.

TABLE 9.4-3 (Sheet 26 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		appropriate for nuclear safety systems.						
56	2-CLR-30-194-A Penetration Room Cooler Fan 2A-A (Train A)	Provides cooling air to Penetration Room (EL 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-354 fully open (2-ZS-67-354). Fan motor running light on MCC.	Loss of cooling to Penetration Room (EL 737) with the potential for loss of room equipment.	None. The Train B cooler is available to start on high temperature (2-TS-30-195A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-194A-A. Cooler fan motor and 2-FSV-67-354-A are interlocked to open 2-FCV-67-354-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
57	2-CLR-30-195-B Penetration Room Cooler Fan 2B-B (Train B)	Provides cooling air to Penetration Room (EL 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-356 fully open (2-ZS-67-356). Fan motor running light on MCC.	Loss of cooling to Penetration Room (EL 737) with the potential for loss of room equipment.	None. The Train A cooler is available to start on high temperature (2-TS-30-194A-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-195A-B. Cooler fan motor and 2-FSV-67-356-B are interlocked to open 2-FCV-67-356-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
58	2-FCV-67-354-A Essential Raw Cooling Water	Provides flowpath for cooling water	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-354).	Loss of redundancy in providing cooling to	None. Train B pump room cooler is not	2-FCV-67-354-A fails open on loss of power or air.

TABLE 9.4-3 (Sheet 27 of 27)
UNIT 1

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Flow Control Valve for the Penetration Room (EL 737) Cooler 21A-A3.	from the ERCW Header to the Cooler for the Penetration Room Space.				Penetration Room (EL 737) space.	affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	
59	2-FCV-67-356-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (EL 737) Cooler 12b-bB3.	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-356).	Loss of redundancy in providing cooling to Penetration Room (EL 737) space.	None. Train A pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-356-B fails open on loss of power or air.

TABLE 9.4-3 (Sheet 1 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	2-PMCL-30-180-A Safety Injection Pump 2A-A Cooler (Train A)	Provides cooling air to SI Pump 2A-A Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-176-A fully open (2-ZS-67-176). Fan motor running light on MCC.	Loss of cooling to SIP 2A-A room with the potential for loss of SIP 2A-A.	None. Train B SI Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump. See Remark # 3.	1. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature on 2-TS-30-180-A or SI Pump 2A-A start; and, manually by local handswitch 2-HS-30-180. 2. The Cooler Fan and the flow control valve 2-FCV-67-176-A are interlocked to operate together. 3. Train B equipment is located in SIP Room 2B. Failure of the Train A equipment, will not adversely impact Train B SI pump operation.
2	2-PMCL-30-179-B Safety Injection Pump 2B-B Cooler (Train B)	Provides cooling air to SI Pump 2B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; auto-start signal failure; Operator error (handswitch	Status monitor light in MCR for 2-FCV-67-182 fully open (2-ZS-67-182). Fan motor	Loss of cooling to SIP 2B-B room with the potential for loss of SIP 2B-B.	None. Train A SI Pump is not affected by the failure of Train B pump room cooler, and is 100%	1. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains

TABLE 9.4-3 (Sheet 2 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				placed in wrong position)	running light on MCC.		redundant to Train B pump. See Remark # 3.	to be independent. The cooler automatically starts upon high temperature on 2-TS-30-179-B or SI Pump 2B-B start; and, manually by local handswitch 2-HS-30-179. 2. The Cooler Fan and the flow control valve 2-FCV-67-182 are interlocked to operate together. 3. Train A equipment is located in SIP Room 2A. Failure of the Train B equipment will not adversely impact Train A SI pump operation.
3	2-FCV-67-176-A Essential Raw Cooling Water Flow Control Valve for the Safety Injection System Pump 2A-A Cooler.	Provides flowpath for cooling water from the ERCW Header 2A to the cooler for Pump 2A-A	Fails to open, stuck closed	Mechanical failure; Opening signal failure	Status monitor light in MCR (2-ZS-67-176)	Loss of cooling water to SIP 2A-A pump room cooler with the potential for loss of SIP 2A-A.	None. Train B SI Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump.	2-FCV-67-176-A FCV fails open on loss of power or air.
4	2-FCV-67-182-B Essential Raw	Provides flowpath for cooling water from the	Fails to open, stuck closed	Mechanical failure; Opening signal failure	Status monitor light in MCR (2-ZS-67-182)	Loss of cooling water to SIP 2B-B pump room cooler with the potential	None. Train A SI Pump is not affected by the failure of Train B	2-FCV-67-182-B FCV fails open on loss of power or air.

TABLE 9.4-3 (Sheet 3 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooling Water Flow Control Valve for the Safety Injection System Pump 2B-B Cooler.	ERCW Header 2B to the cooler for Pump 2B-B				for loss of SIP 2B-B.	pump room cooler, and is 100% redundant to Train B pump.	
5	2-PMCL-30-175-A Residual Heat Removal Pump 2A-A Cooler (Train A).	Provides cooling air to RHR Pump 2A-A Room.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A Power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position).	Fan motor running light on MCC. Status monitor light in MCR for 2-FCV-67-188 (2-ZS-67-188)	Loss of cooling water to RHR Pump 2A-A Room cooler with the potential loss of RHR Pump 2A-A.	None. Train B RHR Pump is not affected by the failure of Train A Pump Room Cooler and is 100% redundant to Train A Pump.	Train A and Train B RHR pump/cooler sets are in separate rooms. Review of the schematics for the Train A and Train B coolers shows the trains to be independent. The cooler is started automatically upon high temperature at 2-TS-30-175-A, or RHR Pump 1A-A start; Manually by local handswitch 2-HS-30-175.
6	2-PMCL-30-176-B Residual Heat Removal Pump 2B-B Cooler (Train B)	Provides cooling air to RHR Pump 2B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; auto-start signal failure; Operator error (handswitch placed in wrong position)	Fan motor running light on MCC. Status monitor light in MCR for 2-FCV-67-190 (2-ZS-67-190)	Loss of cooling to RHR Pump 2B-B Room with the potential loss of RHR pump 2B-B.	None. Train A RHR Pump is not affected by the failure of Train B pump Room Cooler, and is 100% redundant to Train B pump.	Train A and Train B RHR pump/cooler sets are in separate rooms. Review of the schematics for the Train A and Train B coolers shows the trains to be independent. The cooler started automatically upon high temperature at 2-TS-30-176-B or RHR Pump 2B-B start; Manually by

TABLE 9.4-3 (Sheet 4 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								local handswitch 2-HS-30-176.
7	2-FCV-67-188-A Essential Raw Cooling Water Flow Control Valve for the Residual Heat Removal System Pump 2A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for RHR Pump 2A-A.	See 'remarks' column	See 'remarks' column.	See 'remarks' column.	See 'remarks' column.	See 'remarks' column.	2-FCV-67-188-A has been electrically disconnected due to App. 'R' interaction to keep the valve permanently open.
8	2-FCV-67-190-B Essential Raw Cooling Water Flow Control Valve for the Residual Heat Removal System Pump 2B-B Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for RHR Pump 2B-B.	See 'remarks' column	See 'remarks' column	See 'remarks' column	See 'remarks' column	See 'remarks' column	2-FCV-67-190-B has been electrically disconnected due to App. 'R' interaction to keep the valve permanently open.
9	2-PMCL-30-177-A Containment Spray Pump 2A-A Cooler (Train A)	Provides cooling air to CS Pump 2A-A Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-184-A (2-ZS-67-184). Fan motor running light on MCC.	Loss of cooling to CSP 2A-A Room with the potential for loss of CSP 2A-A.	None. Train B Pump is not affected by the failure of Train A pump/cooler, and is 100% redundant to Train A pump.	Equipment includes fan and motor. Train A and Train B CS pump/cooler sets are in separate rooms. Review of the schematics for the Train A and B coolers shows the trains to be independent. The

TABLE 9.4-3 (Sheet 5 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								cooler is started automatically upon high temperature at 2-TS-30-177-A or CS Pump 2A-A start; manually by local handswitch 2-HS-30-177. The cooler and the flow control valve 2-FCV-67-184-A are interlocked to operate together.
10	2-PMCL-30-178-B Containment Spray Pump 2B-B Cooler (Train B)	Provides cooling air to CS Pump 2B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-186-B (2-ZS-67-186). Fan motor running light on MCC.	Loss of cooling to CSP 2B-B Room with the potential for loss of CSP 2B-B.	None. Train A Pump is not affected by the failure of Train B pump/cooler, and is 100% redundant to Train B pump.	Equipment includes fan and motor. Train A and Train B CS pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler is started automatically upon high temperature at 2-TS-30-178-B or CS Pump 2B-B start; manually by local handswitch 2-HS-30-178. The cooler and the flow control valve 2-FCV-67-186-B are interlocked to operate together.

TABLE 9.4-3 (Sheet 6 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
11	2-FCV-67-184-A Essential Raw Cooling Water Flow Control Valve for the Containment Spray System Pump 2A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CS Pump 2A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-184).	Loss of cooling to CSP 2A-A room with the potential for loss of CSP 2A-A.	None. Train B CS Pump is not affected by the failure of Train A pump room cooler, and is 100% redundant to Train A pump.	2-FCV-67-184-A fails to the open position on loss of power or air.
12	2-FCV-67-186-B Essential Raw Cooling Water Flow Control Valve for the Containment Spray System Pump 2B-B Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CS Pump 2B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-186).	Loss of cooling to CSP 2B-B room with the potential for loss of CSP 2B-B.	None. Train A CS Pump is not affected by the failure of Train B pump room cooler, and is 100% redundant to Train B pump.	2-FCV-67-186-B fails to the open position on loss of power or air.
13	2-PMCL-30-183-A Centrifugal Charging Pump 2A-A Cooler (Train A).	Provides cooling air to CC Pump 2A-A Room.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position).	Fan motor running light on MCC. Status monitor light in MCR for 2-FCV-67-168 (2-ZS-67-168)	Loss of cooling to CC pump 2A-A Room with the potential for loss of CC Pump 2A-A.	None. Train B CC pump is not affected by the failure of Train A pump/cooler, and is 100% redundant to Train A pump.	Equipment includes fan and motor. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature at 2-TS-30-183-A, or pump 2A-A

TABLE 9.4-3 (Sheet 7 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								start; Manually by local handswitch 2-HS-30-183.
14	2-PMCL-30-182-B Centrifugal Charging Pump 2B-B Cooler (Train B).	Provides cooling air to CC Pump 2B-B Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Fan motor running light on MCC. Status monitor light in MCR for 2-FCV-67-170 (2-ZS-67-170)	Loss of cooling to CC pump 2B-B Room with the potential for loss of CC pump 2B-B.	None. Train A CC pump is not affected by the failure of Train B pump/cooler, and is 100% redundant to Train B pump.	Equipment includes fan and motor. Train A and Train B pump/cooler sets are in separate rooms. Review of schematics for the Train A and B coolers shows the trains to be independent. The cooler automatically starts upon high temperature at 2-TS-30-182-B or pump 2B-B start; Manually by local handswitch 2-HS-30-182.
15	2-FCV-67-168-A Essential Raw Cooling water Flow Control Valve for the centrifugal Charging Pump Room 2A-A Cooler.	Provides flowpath for cooling water from the ERCW Header to the cooler for CC Pump 2A-A.	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	2-FCV-67-168-A is electrically disconnected to keep the valve permanently open.
16	2-FCV-67-170-B Essential Raw Cooling water Flow Control Valve for	Provides flowpath for cooling water from the ERCW Header to the cooler for CC	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	See 'Remarks' column	2-FCV-67-170-B is electrically disconnected to keep the valve permanently open.

TABLE 9.4-3 (Sheet 8 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	the centrifugal Charging Pump Room 2B-B Cooler.	Pump 2B-B.						
17	2-PMCL-30-190 CCS and Aux. FW Pump Cooler 2A-A.	Provides cooling air to the CCS and Aux. FW pumps space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-162-A (2-ZS-67-162). Indicating light on MCC for fan motor running.	Loss of redundancy in providing cooling air for CCS and Aux FW pumps space.	None. The Train B Cooler B-B is available to start on high temperature (2-TS-30-190B-A1A-B) and is 100% redundant to the Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature sensed by 2-TS-30-190A-A. In standby mode, the cooler will start upon high temperature at 2-TS-30-190B-A. Cooler fan motor and 2-FSV-67-162-A are interlocked to open 2-FCV-67-162-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
18	2-PMCL-30-191-A CCS and Aux. FW Pump/Cooler 2B-B	Provides cooling air to the CCS and Aux. FW pumps space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-164-B (2-ZS-67-164). Indicating light on MCC for fan motor running.	Loss of redundancy in providing cooling air for CCS and Aux. FW pumps space.	None. The standby Train A Cooler A-A is available to start on high temperature (2-TS-30-1910A-AB-B) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature sensed by 2-TS-30-191A-B. In standby mode, the cooler will start upon high temperature at 2-TS-30-191B-B. Cooler fan motor and 2-FSV-67-164-B are interlocked to open 2-FCV-67-164 for ERCW Supply on

TABLE 9.4-3 (Sheet 9 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
19	2-FCV-67-162-A Essential Raw Cooling Water Flow Control Valve for the CCS and Aux. FW Pump Cooler 2A-A.	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump 2A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (or 2-ZS-67-162).	Loss of redundancy in providing cooling to CCS and Aux FW Pump space.	None. Train B pump spaceroom cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the train A pump space room cooler.	2-FCV-67-162-A fails open on loss of power or air.
20	2-FCV-67-164-B Essential Raw Cooling Water Flow Control Valve for the CCS and Aux. FW Pump Cooler B-B.	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (or 2-ZS-67-164).	Loss of redundancy in providing cooling to CCS and Aux FW Pump space.	None. Train A pump space room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump space room cooler.	2-FCV-67-164-B fails open on loss of power or air.
21	2-CLR-30-200-A EGTS Cooler A-A	Provides cooling air to the EGTS Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong	Status monitor light in MCR for 2-FCV-67-336 (2-ZS-67-336). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the EGTS Room.	None. The standby Train B Cooler is available to start on high temperature (2-TS-30-207A-B) and is 100% redundant to Train	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-200A-A. Cooler fan motor and 2-FSV-67-336-A are interlocked to open 2-FCV-67-336 for

TABLE 9.4-3 (Sheet 10 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				position)			A cooler.	ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
22	2-CLR-30-207-B EGTS Cooler B-B.	Provides cooling air to the EGTS Room	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-338 (2-ZS-67-338). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the EGTS Room.	None. The standby Train A Cooler is available to start on high temperature at 2-TS-30-200A-A and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal . In standby mode, the cooler will start upon or high temperature at 2-TS-30-207A-B. Cooler fan motor and 2-FSV-67-338-B are interlocked to open 2-FCV-67-338 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
23	2-FCV-67-336 Essential Raw Cooling Water Flow Control Valve for the EGTS Room Cooler A-A.	Provides flowpath for cooling water from the ERCW Header to the A-A cooler for the EGTS Rooms.	Fails to open, stuck closed.	Mechanical failure; signal failure.	Status monitor light in MCR (2-ZS-67-336)	Loss of redundancy in providing cooling to EGTS room.	None. Train B Pump cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-336 fails open on loss of power or air.
24	2-FCV-67-338 Essential Raw	Provides flowpath for cooling water from the ERCW	Fails to open, stuck closed.	Mechanical failure; signal failure.	Status monitor light in MCR (2-ZS-67-338).	Loss of redundancy in providing cooling to EGTS room.	None. Train A Pump cooler is not affected by the failure of Train B	2-FCV-67-338 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 11 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooling Water Flow Control Valve for the EGTS Room Cooler B-B	Header to the B-B cooler for the EGTS Rooms.					pump room cooler, and is 100% redundant to the Train B pump room cooler.	
25	0-PMCL-30-192-A CCS TB Booster and Spent Fuel Pit Pump Cooler A-A	Provides cooling air to the CCS TB Booster and Spent Fuel Pit Cooler Space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-213-A (1-ZS-67-213) Fan motor running light on MCC.	Loss of redundancy in providing cooling air for CCS TB Booster and Spent Fuel Pit Cooler Space	None. The standby Train B Cooler A-A is available to start on high temperature (0-TS-30-193BA-B) and is 100% redundant to the Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 0-TS-30-192A-A. In standby mode, the cooler will start upon high temperature at 0-TS-30-192B-A. Cooler fan motor and 1-FSV-67-213-A are interlocked to open 1-FCV-67-213-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
26	0-PMCL-30-193-B CCS TB Booster and Spent Fuel Pit Cooler B-B	Provides cooling air to the CCS TB Booster and Spent Fuel Pit Cooler B-B space.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-215-B (1-ZS-67-215). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for CCS TB Booster and Spent Fuel Pit Cooler space.	None. The standby Train A Cooler is available to start on high temperature (0-TS-30-192A-A) and is 100% redundant to the Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 0-TS-30-193A-B. In standby mode, the cooler will start upon high temperature at 0-TS-30-193B-B. Cooler fan motor and 1-FSV-67-215-B are interlocked to open 1-FCV-67-215-B for ERCW supply on

TABLE 9.4-3 (Sheet 12 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
27	1-FCV-67-213-A Essential Raw Cooling Water Flow Control Valve for the CCS TB Booster and Spent Fuel Pit Cooler A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-213)	Loss of redundancy in providing cooling air to CCS TB Booster and Spent Fuel Pit Coolers space.	None. Train B Pump area cooler is not affected by the failure of Train A pump area cooler, and is 100% redundant to the Train A pump area cooler.	1-FCV-67-213-A fails open on loss of power or air.
28	1-FCV-67-215-B Essential Raw Cooling Water Flow Control Valve for the CCS TB Booster and Spent Fuel Pit Cooler B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (1-ZS-67-215)	Loss of redundancy in providing cooling air to CCS TB Booster and Spent Fuel Pit Coolers space.	None. Train A Pump area cooler is not affected by the failure of Train B pump area cooler, and is 100% redundant to the Train B pump area cooler.	1-FCV-67-215-B fails open on loss of power or air.
29	0-BKD-31-2956 CCS TB Booster and Spent Fuel Pit Pump Cooler A-A Backdraft Damper	Provides flowpath for cool air flow from Cooler A-A to common discharge headers to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to room.	None. The standby Train B cooler will start upon high temperature on 0-TS-30-193B-B.	
		Protects standby Cooler	Fails to backseat (stuck	Mechanical failure	Local position indicator	None	None	Operability of the dampers is periodically

TABLE 9.4-3 (Sheet 13 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		A-A from reverse air flow from running cooler B-B.	open) when Train B Cooler B-B is running.		attachment on the damper would indicate if damper was stuck open.	(See Remarks)	(See Remarks)	verified.
30	0-BKD-31-2957 CCS TB Booster and Spent Fuel Pit Pump Cooler B-B Backdraft Damper	Provides flowpath for cool air flow from Cooler B-B to common discharge headers to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed.	Loss of redundancy in providing cooling air to room.	None. The standby Train A cooler will start upon high temperature on 0-TS-30-192B-A.	Operability of the dampers is periodically verified.
		Protects standby Cooler B-B from reverse air flow from running cooler A-A.	Fails to backseat (stuck open) when Train A Cooler A-A is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	Loss of redundancy in providing cooling air to room.	None (See Remarks)	Operability of the dampers is periodically verified.
31	2-PMCL-30-184-A AFW and BAT Cooler Fan A-A	Provides cooling air to the AFW and BAT pumps space	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-217 (2-ZS-67-217). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for AFW and BAT pumps Space	None. The Train B Cooler is available to start on high temperature (2-TS-30-185A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-184A-A. Cooler fan motor and 2-FSV-67-217-A are interlocked to open 2-FCV-67-217 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their

TABLE 9.4-3 (Sheet 14 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								independence.
32	2-PMCL-30-185-B AFW and BAT Cooler Fan B-B	Provides cooling air to the AFW and BAT pumps space	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-219 -B (2-ZS-67-219). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for AFW and BAT pumps Space	None. The standby Train A Cooler is available to start on high temperature (2-TS-30-184A-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-185A-B. Cooler fan motor and 2-FSV-67-219-B are interlocked to open 2-FCV-67-219 for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
33	2-FCV-67-217 Essential Raw Cooling Water Flow Control Valve for the AFW and BAT Cooler A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-217)	Loss of redundancy in providing cooling to AFW and BAT Pumps Space.	None. Train B pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-217 fails open on loss of power or air.
34	2-FCV-67-219 Essential Raw Cooling Water Flow Control Valve for the AFW and BAT Cooler B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for Pump B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-219)	Loss of redundancy in providing cooling to AFW and BAT pumps Space.	None. Train A pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-219 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 15 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
35	2-BKD-31-2952 Aux FW and BAT Pump Cooler A-A Backdraft Damper	Provides flowpath for cool air flow from Cooler A-A to common discharge header to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to room.	None. The standby Train B cooler will start upon high temperature on 2-TS-30-185B-B.	Operability of the dampers is periodically verified.
		Protects standby Cooler A-A from reverse air flow from running cooler B-B.	Fails to backseat (stuck open) when Train B Cooler B-B is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	Loss of redundancy in providing cooling air to room.	None	
36	2-BKD-31-2953 Aux FW and BAT Pump Cooler B-B Backdraft Damper	Provides flowpath for cool air flow from Cooler B-B to common discharge header to room.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to room.	None. The standby Train A cooler will start upon high temperature on 2-TS-30-184B-A.	Operability of the dampers is periodically verified.
		Protects standby Cooler B-B from reverse air flow from running cooler A-A.	Fails to backseat (stuck open) when Train A Cooler A-A is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	Loss of redundancy in providing cooling air to room.	None	
37	2-CLR-30-201-A	Provides cooling air to	Fails to start, fails while	Mechanical failure; Train A	Status monitor light in MCR	Loss of redundancy in	None. The standby Train B	The cooler automatically starts upon Train A ABI

TABLE 9.4-3 (Sheet 16 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Pipe Chase Cooler Fan 2A-A	the pipe chase.	running; Spuriously stops.	power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	for 2-FCV-67-342-A (2-ZS-67-342-A). Fan motor running light on MCC.	providing cooling air for the Pipe Chase.	Cooler Fan 2B-B is available to start on high temperature (2-TS-30-202A-B) and is 100% redundant to Train A cooler.	signal or high temperature at 2-TS-30-201A-A. Cooler fan motor and 2-FSV-67-342-A are interlocked to open 2-FCV-67-342-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
38	2-CLR-30-202-B Pipe Chase Cooler Fan 2-B-B	Provides cooling air to the pipe chase.	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-standby start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-344-B (2-ZS-67-344-B). Fan motor running light on MCC.	Loss of redundancy in providing cooling air for the Pipe Chase.	None. The standby Train A Cooler Fan 2A-A is available to start on high temperature at 2-TS-30-201A-A and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-202A-B. Cooler fan motor and 2-FSV-67-344-B are interlocked to open 2-FCV-67-344-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
39	2-FCV-67-342-A Essential Raw Cooling Water Flow Control Valve for the Pipe Chase Cooler 2A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler 2A-A.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-342)	Loss of redundancy in providing cooling air to the Pipe Chase.	None. Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-342 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 17 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
40	2-FCV-67-344-B Essential Raw Cooling Water Flow Control Valve for the Pipe Chase Cooler 2B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler 2B-B.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-344)	Loss of redundancy in providing cooling air to the Pipe Chase.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-344 fails open on loss of power or air.
41	2-BKD-31-2925 Pipe Chase Cooler 2A-A Backdraft Damper	Provides flowpath for cool air flow from Cooler 2A-A to Pipe Chase Header.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to Pipe Chase.	None. The standby Train B cooler will start upon high temperature on 2-TS-30-202B-B.	Operability of the dampers is periodically verified.
		Protects standby Cooler 2A-A from reverse air flow from running cooler 2B-B.	Fails to backseat (stuck open) when Train A Cooler 2B-B is running.	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck open.	Loss of redundancy	None. (See Remarks)	
42	2-BKD-31-2927 Pipe Chase Cooler 2B-B Backdraft Damper	Provides flowpath for cool air flow from Cooler 2B-B to Pipe Chase Header.	Fails to open (stuck closed).	Mechanical failure	Local position indicator attachment on the damper would indicate if damper was stuck closed	Loss of redundancy in providing cooling air to Pipe Chase.	None. The standby Train A cooler will start upon high temperature on 2-TS-30-201B-A.	Operability of the dampers is periodically verified.
		Protects	Fails to	Mechanical failure	Local position	Loss of	None.	

TABLE 9.4-3 (Sheet 18 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		standby Cooler 2B-B from reverse air flow from running cooler 2A-A.	backseat (stuck open) when Train B Cooler 2A-A is running.		indicator attachment on the damper would indicate if damper was stuck open.	redundancy.	(See Remarks)	
43	2-CLR-30-186-A Penetration Room Cooler Fan 2A-A (Train A)	Provides cooling air to Penetration Room (El 692)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-346-A fully open (2-ZS-67-346). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 692) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (2-TS-30-187A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-186A-A. Cooler fan motor and 2-FSV-67-346-A are interlocked to open 2-FCV-67-346-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
44	2-CLR-30-187-B Penetration Room Cooler Fan 2B-B (Train B).	Provides cooling air to Penetration Room (El 692)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-348-B fully open (2-ZS-67-348). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 692) with the potential for loss of room equipment.	None. The standby Train A Cooler is available to start on high temperature at 2-TS-30-186BA-A and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-187A-B. Cooler fan motor and 2-FSV-67-348-B are interlocked to open 2-FCV-67-348-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
45	2-FCV-67-346-A	Provides	Fails to open,	Mechanical failure;	Status monitor	Loss of redundancy	None.	2-FCV-67-346-A fails

TABLE 9.4-3 (Sheet 19 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El. 692) Cooler 2A-A	flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	stuck closed.	Opening signal failure.	light in MCR (2-ZS-67-346)	in providing cooling to Penetration Room (El. 692) space. .	Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	open on loss of power or air.
46	2-FCV-67-348-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El. 692) Cooler 2B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-348)	Loss of redundancy in providing cooling to Penetration Room (El. 692) space.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-348-B fails open on loss of power or air.
47	2-CLR-30-196 Penetration Room Cooler Fan 2A-A (Train A).	Provides cooling air to Penetration Room (El 713)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-350-A fully open (2-ZS-67-350). Fan motor running light on MCC.	Loss of cooling to Penetration Room (El 713) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (2-TS-30-197A-B) and is 100% redundant to Train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature (2-TS-30-1967A-AB-B). Cooler fan motor and 2-FSV-67-350-A are interlocked to open 2-FCV-67-350-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
48	2-CLR-30-197 Penetration Room	Provides cooling air to Penetration	Fails to start, fails while running;	Mechanical failure; Train B power failure; Auto-start	Status monitor light in MCR for 2-FCV-67-352-	Loss of cooling to Penetration Room (El 713) with the	None. The standby Train A Cooler is available to start on	The cooler automatically starts upon Train B ABI signal or high

TABLE 9.4-3 (Sheet 20 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooler Fan 2B-B (Train B).	Room (el 713)	Spuriously stops.	signal failure; Operator error (handswitch placed in wrong position)	B fully open (2-ZS-67-352). Fan motor running light on MCC.	potential for loss of room equipment.	high temperature (2-TS-30-196A-A) and is 100% redundant to Train B cooler.	temperature at 2-TS-30-197A-B. Cooler fan motor and 2-FSV-67-352-B are interlocked to open 2-FCV-67-352-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
49	2-FCV-67-350-A Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 713) Cooler 2A-A.	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-350)	Loss of redundancy in providing cooling to Penetration Room (El 713) Space	None. Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-350 fails open on loss of power or air.
50	2-FCV-67-352-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 713) Cooler 2B-B	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-352)	Loss of redundancy in providing cooling to Penetration Room (El 713) Space.	None. Train A Pump room cooler is not affected by the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	2-FCV-67-352 fails open on loss of power or air.
51	1-CLR-30-194-A Penetration Room Cooler Fan 1A-A (Train A)	Provides cooling air to Penetration Room (El 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch	Status monitor light in MCR for 1-FCV-67-354-A fully open (1-ZS-67-354). Fan	Loss of cooling to Penetration Room (El 737) with the potential for loss of room equipment.	None. The standby Train B Cooler is available to start on high temperature (1-TS-30-195B195A-B) and	The cooler automatically starts upon Train A ABI signal or high temperature at 1-TS-30-194A-A. Cooler fan motor and 1-FSV-67-

TABLE 9.4-3 (Sheet 21 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				placed in wrong position)	motor running light on MCC.		is 100% redundant to Train A cooler.	354-A are interlocked to open 1-FCV-67-354-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
52	1-CLR-30-195-B Penetration Room Cooler Fan 1B-B (Train B).	Provides cooling air to Penetration Room (el 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 1-FCV-67-356-B (1-ZS-67-356). Fan motor running light on MCC.	Loss of cooling to Penetration Room (el 737) with the potential for loss of room equipment.	None. The standby Train A Cooler is available to start on high temperature (1-TS-30-194A-A) and is 100% redundant to Train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 1-TS-30-195A-B. Cooler fan motor and 1-FSV-67-356-B are interlocked to open 1-FCV-67-356-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
53	2-FCV-67-354-A Essential Raw Cooling Water Flow Control Valve for the Penetration Room (El 737) Cooler 2A-A	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-354)	Loss of redundancy in providing cooling to Penetration Room (El 737) Space	None. Train B Pump room cooler is not affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	2-FCV-67-354-A fails open on loss of power or air.
54	2-FCV-67-356-B Essential Raw	Provides flowpath for cooling water	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-356)	Loss of redundancy in providing cooling to	None. Train A Pump room cooler is not affected by	2-FCV-67-356 fails open on loss of power or air.

TABLE 9.4-3 (Sheet 22 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Cooling Water Flow Control Valve for the Penetration Room (El 737) Cooler 2B-B	from the ERCW Header to the Cooler for the Penetration Room Space.				Penetration Room (El 737) Space.	the failure of Train B pump room cooler, and is 100% redundant to the Train B pump room cooler.	
55	Backdraft Dampers 2-BKD-31-3136 2-BKD-31-3137 2-BKD-31-3138 2-BKD-31-3139 2-BKD-31-3140 2-BKD-31-3141 2-BKD-31-3142 2-BKD-31-3143 2-BKD-31-3144 2-BKD-31-3145 2-BKD-31-3204 2-BKD-31-3206 2-BKD-31-3208 2-BKD-31-3209	Backseat to stop flow of hot air developed due to a HELB in the pipe chase from adjacent rooms and maintains a mild environment in rooms adjacent to pipe chase. hot air / steam developed due to a break in either the RHR or CVCS lines in the pipe chase from adjacent rooms and maintain them as a mild environment. NOTE: Consistent with NRC Standard Review Plan Branch Technical	Fails to back seat (stuck open)	Mechanical Failure	No direct indication of damper stuck open.	See “Remarks” column	See “Remarks” column	For a CVCS HELB, a failure of one of these dampers is mitigated by the Aux Bldg HVAC (Calculation WBNAPS2068), which does not isolate on a HELB event (DCN M-16270-A); therefore, the environment of the adjacent room is not adversely impacted. For a RHR MELB, per USNRC BTP MED 3-1, Rev. 2, Sections B.3a&b and WB-DC-40-64, App. B, Exception B.5.5 (PIC 58376), when the initiating event is the postulated failure of one of two redundant trains of a dual purpose moderate-energy SR system, a single failure in systems necessary to mitigate the consequences of the piping failure need not be assumed; therefore,

TABLE 9.4-3 (Sheet 23 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Position 3.6.1, Subjection B.3.b(3) and WB-DC-40-64, Appendix B, Exception B.5.5, it is not required to assume a single failure in conjunction with a break in the RHR line as this is a dual purpose moderate energy system as it : 1) is designed to Seismic Category I standards; 2) is powered from both off-site and on-site sources; and is constructed, operated and inspected to quality assurance, testing and in-service inspection standards						the failure of one of these dampers need not be postulated.

TABLE 9.4-3 (Sheet 24 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		appropriate for nuclear safety systems.						
56	2-CLR-30-194-A Penetration Room Cooler Fan 2A-A	Provides cooling air to Penetration Room (EL 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train A power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-354 fully open (2-ZS-67-354). Fan motor running light on MCC.	Loss of cooling to Penetration Room (EL 737) with the potential for loss of room equipment.	None. The Train B cooler is 100% redundant to train A cooler.	The cooler automatically starts upon Train A ABI signal or high temperature at 2-TS-30-194A-A. Cooler fan motor and 2-FSV-67-354-A are interlocked to open 2-FCV-67-354-A for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
57	2-CLR-30-195-B Penetration Room Cooler Fan 2B-B (Train B)	Provides cooling air to Penetration Room (EL 737)	Fails to start, fails while running; Spuriously stops.	Mechanical failure; Train B power failure; Auto-start signal failure; Operator error (handswitch placed in wrong position)	Status monitor light in MCR for 2-FCV-67-356 fully open (2-ZS-67-356). Fan motor running light on MCC.	Loss of cooling to Penetration Room (EL 737) with the potential for loss of room equipment.	None. The Train A cooler is 100% redundant to train B cooler.	The cooler automatically starts upon Train B ABI signal or high temperature at 2-TS-30-195A-B. Cooler fan motor and 2-FSV-67-356-B are interlocked to open 2-FCV-67-356-B for ERCW supply on cooler start. Review of the schematics for the coolers A-A and B-B shows their independence.
58	2-FCV-67-354 Essential Raw Cooling Water	Provides flowpath for cooling water	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-354).	Loss of redundancy in providing cooling to	None. Train B pump room cooler is not	2-FCV-67-354-A fails open on loss of power or air.

TABLE 9.4-3 (Sheet 25 of 25)
UNIT 2

FAILURE MODES AND EFFECTES ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM; SAFETY FEATURE EQUIPMENT COOLERS

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Flow Control Valve for the Penetration Room (EL 737) Cooler 2A-A.	from the ERCW Header to the Cooler for the Penetration Room Space.				Penetration Room (EL 737) space.	affected by the failure of Train A pump room cooler, and is 100% redundant to the Train A pump room cooler.	
59	2-FCV-67-356-B Essential Raw Cooling Water Flow Control Valve for the Penetration Room (EL 737) Cooler 2B-B.	Provides flowpath for cooling water from the ERCW Header to the Cooler for the Penetration Room Space.	Fails to open, stuck closed.	Mechanical failure; Opening signal failure.	Status monitor light in MCR (2-ZS-67-356).	Loss of redundancy in providing cooling to Penetration Room (EL 737) space.	None. Train A Penetration Room cooler is not affected by the failure of Train B Penetration Room cooler, and is 100% redundant to the Train B Penetration Room cooler.	2-FCV-67-356 fails open on loss of power or air.

TABLE 9.4-3A (Sheet 1 of 2)
UNIT 1
FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: TURBINE DRIVEN AUXILIARY FEEDWATER PUMP ROOM VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	1-FAN-30-214 Turbine-driven Auxiliary Feedwater Pump Room Ventilation Fan 125V Dc	Provides cooling to the TDAFW Pump Room	Fails to start; Fails while running; Spuriously stopped.	Mechanical failure; Temperature sensing failure; TDAFW Pump start signal failure.	No direct method of detection. (See Remark # 2)	Loss of cooling air/ventilation to the TDAFW Pump Room from the safety-related dc fan. Loss of all cooling/ventilation to the TDAFW Pump Room during loss of all ac (LOAC).	None. (See Remarks # 3 and 4)	1) The dc fan is intended to mitigate the effects of station blackout on the TDAFW Pump Room ventilation. During DBEs the TDAFW provides backup to the two 50% motor-driven AFW pumps. As such its operation during DBEs would imply a single failure to have already occurred; therefore, postulation of the failure of this fan is not required. 2) Local temperature indication. 3) In the event of loss of all ac the TDAFW Pump cooling is entirely dependent on the dc fan. A single active failure is not postulated during a SBO event; therefore, the fan and associated components are assumed to function properly during a loss of all ac power. 4) The dc fan starts

TABLE 9.4-3A (Sheet 2 of 2)
UNIT 1
FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: TURBINE DRIVEN AUXILIARY FEEDWATER PUMP ROOM VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								automatically by either TDAFW pump start, or high temperature sensed by 1-TS-30-214. It can also be started manually.
	1-BKD-31-3035 Backdraft Damper	Provides suction air flow path to the operating dc exhaust fan	Spuriously closed	Mechanical failure	No direct method of detection. Local position indicators or damper. (See Remarks)#2	Loss of cooling /ventilating for TDAFW Pump Room from dc fan.	(See Remarks) #1	1. During the loss of all ac, there will be no cooling/ventilating capability for TDAFW Pump room, with the possibility for loss of the TDAFW Pump. A non-safety, seismic category IL(B), non- 1E ac fan is present in the room. TDAFW is the backup for the motor-driven FW and is required to operate upon failure of motor-driven FW. Thus postulation of this failure is not required. A single active failure is not postulated during a SBO event; therefore, the fan and associated components are assumed to function properly during a loss of all ac power.

TABLE 9.4-3A (Sheet 1 of 2)
UNIT 2
FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: TURBINE DRIVEN AUXILIARY FEEDWATER PUMP ROOM VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	2-FAN-30-214 Turbine-driven Auxiliary Feedwater Pump Room Ventilation Fan 125V Dc	Provides cooling to the TDAFW Pump Room	Fails to start; Fails while running; Spuriously stopped.	Mechanical failure; Temperature sensing failure; TDAFW Pump start signal failure.	No direct method of detection. (See Remark # 2)	Loss of cooling air/ventilation to the TDAFW Pump Room from the safety-related dc fan. Loss of all cooling/ventilation to the TDAFW Pump Room during loss of all ac (LOAC).	None. (See Remarks # 3 and 4)	1) The dc fan is intended to mitigate the effects of station blackout on the TDAFW Pump Room ventilation. During DBEs the TDAFW provides backup to the two 50% motor-driven AFW pumps. As such its operation during DBEs would imply a single failure to have already occurred; therefore, postulation of the failure of this fan is not required. 2) Local temperature indication. 3) In the event of loss of all ac the TDAFW Pump cooling is entirely dependent on the dc fan. A single active failure is not postulated during a SBO event; therefore, the fan and associated components are assumed to function properly during a loss of all ac power. 4) The dc fan starts

TABLE 9.4-3A (Sheet 2 of 2)
UNIT 2
FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: TURBINE DRIVEN AUXILIARY FEEDWATER PUMP ROOM VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								automatically by either TDAFW pump start, or high temperature sensed by 1-TS-30-214. It can also be started manually.
2	2-BKD-31-3035 Backdraft Damper	Provides suction air flow path to the operating dc exhaust fan	Spuriously closed	Mechanical failure	No direct method of detection. (See Remarks)	Loss of cooling /ventilating for TDAFW Pump Room from dc fan.	(See Remarks)	During the loss of all ac, there will be no cooling/ventilating capability for TDAFW Pump room, with the possibility for loss of the TDAFW Pump. A non-safety, seismic category IL(B), non- 1E ac fan is present in the room. TDAFW is the backup for the motor-driven FW and is required to operate upon failure of motor-driven FW. Thus postulation of this failure is not required. A single active failure is not postulated during a SBO event; therefore, the fan and associated components are assumed to function properly during a loss of all ac power.

TABLE 9.4-4 (Sheet 1 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
1	Fire damper in Air Intake Room 0-30-603 for Train 1A-A 0-30-604 for Train 2A-A, 0-30-605 for Train 1B-B, and 0-30-606 for Train 2B-B	Isolate Air Intake Room from Diesel Gen Room	Open during fire	Mechanical failure	See Remarks	See Remarks	See Remarks.	Single failures of HVAC System need not to be postulated as being concurrent with fire.
			Closed during other modes of operation	Mechanical (fusible link) failure	Diesel Gen. Room exhaust fan low flow alarm in Main Control Room from fans air flow switches FS-30-447 or FS-30-451 for Train 1A-A, FS-30-449 or FS-30-453 for Train 1B-B FS-30-448 or FS-30-452 for Train 2A-A, and FS-30-450 or FS-30-454 for Train 2B-B.	None (See Remarks)	None (See Remarks)	Redundant train diesel generator system is available.
2	Motor-operated intake dampers to Diesel Gen. Room 1-FC0-30-443-A for Train 1A-A, 1-FC0-30-445-B for Train 1B-B,	To prevent air flow when associated diesel generator exhaust fans are de-energized	Closed or partially closed during associated exhaust fan(s) operation	Mechanical failure or actuator failure	Diesel Gen. Room exh fan low flow alarm in Main Control Room. From air flow switches FS-30-447 or FS-30-451 for Train 1A-A, FS-30-449 or FS-	Complete or partial loss of ventilation of associated safety train Diesel Gen Room.	None (See Remarks)	Redundant diesel generator system is available.

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	2-FCO-30-444-A for Train 2A-A, 2-FCO-30-446-B for Train 2B-B				30-453 for Train 1B-B FS-30-448, 452 for 2A-A and FS-30-450, 454 for 2B-B.			
			Spurious CO_2 system actuation	Dampers are spring-loaded to open upon power loss. However, CO_2 actuation signal can close them.	Diesel Gen. Room exh fan low flow alarm in Main Control Room. From air flow switches FS-30-447 or FS-30-451 for Train 1A-A, FS-30-449 or FS-30-453 for Train 1B-B FS-30-448, 452 for 2A-A and FS-30-450, 454 for 2B-B.	Partial loss of ventilation of associated safety train Diesel Gen Room.	None (See Remarks)	If closed due to spurious CO_2 system actuation, operator can verify and start the fan(s), which in turn reopen dampers, by use of the CO_2 bypass switches 1-HS-30-447D, 1-HS-30-449D, 2-HS-30-448D, and 2-HS-30-450D.
		To open and allow air flow during tornado watch/warning conditions for pressure equalization	Fails to open, or opens initially and then closes during tornado watch or warning	Mechanical Failure If the DG room exhaust fan low temperature switches	DG Room exh fan low flow alarm in Main Control Room resulting from flow switches FS-30-447 or FS-30-451 for Train 1AA, FS-30-449 or FS-30-453 for Train 1B-B, FS-30-448 or FS-30-452 for	Tornado induced differential pressure across damper in closed position could damage damper and	None (See Remarks)	Redundant DG system is available if a mechanical failure is the cause of damper failure. When a tornado watch or warning is declared by the National

TABLE 9.4-4 (Sheet 3 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				have cooled down below their setpoint value, they will prevent manual start of the fans and opening of the subject dampers until the re-set setpoint is reached.	2A-A, and FS-30-450 or FS-30-454 for train 2B-B.	result in partial or complete loss of ventilation to DG room		Weather Service for this area, the motor operated intake dampers can be opened by starting the DG room exhaust fans. To assure that the DG room exhaust fans will start and continue to run during conditions when the DG exhaust fan low temperature cut-out switches would normally prevent fan operation, tornado bypass switches have been added to the control system for each exhaust fan. These switches are placed in the bypass position during the tornado watch/warning and then returned to their NORMAL position once the tornado watch/warning has been cancelled. With the tornado bypass switches placed in the bypass position, the

TABLE 9.4-4 (Sheet 4 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								dampers can be opened by starting the DG room exhaust fans using handswitches mounted on the MCCs or locally in the exhaust fan rooms.
3	Fire damper between Diesel Generator Room & Air Exhaust Room	Isolate Diesel Gen Room from Air Exhaust Room	Open during fire	Mechanical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC System need not be postulated as being concurrent with fire.
	0-30-607 for Train 1A-A, 0-30-609 for Train 1B-B, 0-30-608 for Train 2A-A, 0-30-610 for Train 2B-B		Partially closed during other modes of operation	Mechanical (fusible link) failure	Diesel Gen Room exh fan low flow alarm in Main Control Room from fan air flow switches FS-30-447 or FS-30-451 For Train 1A-A, FS-30-449 or FS-30-453 For Train 1B-B, FS-30-448 or FS-30-452 For Train 2A-A, and FS-30-450 or FS-30-454 For Train 2B-B	Partial loss of ventilation of associated safety train Diesel Gen Room	None. (See Remarks)	One more dampers closing may or may not cause sufficiently high space temperatures to exceed environmental qualification limits. In any event, the redundant train diesel generator system is available.

TABLE 9.4-4 (Sheet 5 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
4	Diesel Generator Room exhaust fans 1-FAN-30-447 1-FAN-30-451 for Train 1A-A, 1-FAN-30-449 1-FAN-30-453 for Train 1B-B, 2-FAN-30-448 2-FAN-30-452 for Train 2A-A, and 2-FAN-30-450, 2-FAN-30-454 for Train 2B-B	Provide ventilation air	Fails to start; Stops running Stops on spurious CO_2 actuation*	Electrical or Mechanical Electrical or Mechanical System logic	Diesel Gen Room exh fan low flow alarm in Main Control Room. (Refer to Figure 9.4-25) From air flow switches FS-30-447 or FS-30-451 for Train 1A-A FS-30-449 or FS-30-453 for Train 1B-B FS-30-448 or FS-30-452 for Train 2A-A, and FS-30-450 or FS-30-454 for Train 2B-B	Partial loss of adequate ventilation for maintenance of design temperature	None. (See Remarks)	Redundant train diesel generator system is available. *Operator can verify if not result of fire, restart DG Room Exhaust fan(s) which in turn opens the dampers, by use of the CO2 bypass switches 1-HS-30-447D, 1-HS-30-449D, 2-HS-448D, and 2-HS-30-450D
			Fails to stop on low temp	Electrical	Surveillance	Drop in DG Room temp	None. (See Remarks)	One more dampers closing may or may not cause sufficiently high space temperatures to exceed environmental qualification limits. IN any event the redundant train diesel generator system is available.
5	Motor-operated discharge	Prevent air flow when	Closed during	Mechanical	Diesel Gen Room exh fan low flow	Loss of 50% ventilation flow	None.	Redundant train diesel generator system is

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	dampers of diesel generator room exhaust fans 1-FCO-30-447 for Fan 1, 1-FCO-30-451 for Fan 2, Train 1A-A and 1-FCO-30-449 for Fan 1 1-FCO-30-453 for Fan 2,Train 1B-B, 2-FCO-30-448 for Fan 1, 2-FCO-30-452 for Fan 2,Train 2A-A 2-FCO-30-450 for Fan 1 , 2-FCO-30-454 for Fan 2, Train 2B-B	associated diesel generator exhaust fan is deenergized	associated exhaust fan operation (see note in remarks)	Loss of power (dampers fail as-is)	alarm in Main Control Room. From air flow switches FS-30-447 or FS-30-451 for Train 1A-A, FS-30-449, or FS-30-453, for Train 1B-B, FS-30-448, or FS-30-452; for Train 2A-A and FS-30-450 FS-30-454 for Train 2B-B	required to maintain the environmental qualification temperatures in the DG room.	(See Remarks)	available.
		To open and allow air flow during tornado watch/warning conditions for pressure equalization	Fails to open, or opens initially and then closes during tornado watch or	Mechanical Failure If the DG room exhaust fan low temperature	DG room exhaust fan low flow alarm in main control room resulting from flow switches FS-30-447 or -451 (Train 1A-A), FS-30-449 or -453	Tornado induced differential pressure across damper in closed position could damage	None (See Remarks)	Redundant DG system is available if a mechanical failure is the cause of damper failure. When a tornado watch or warning is declared

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			warning	switches have cooled down below their setpoint value, they will prevent manual start of the fans and opening of the subject dampers until the re-set setpoint is reached.	(Train 1B-B), FS-30-448 or -452 (Train 2A-A), and FS-30-450 or -454 (Train 2B-B) (ref. 5.3)	damper and result in partial or complete loss of ventilation to DG room		by the National Weather Service for this area, the motor operated intake dampers can be opened by starting the DG room exhaust fans. To assure that the DG room exhaust fans will start and continue to run during conditions when the DG exhaust fan low temperature cut-out switches would normally prevent fan operation, tornado bypass switches have been added to the control system for each exhaust fan. These switches are placed in the bypass position during the tornado watch/warning and then returned to their NORMAL position once the tornado watch/warning has been cancelled. With the tornado bypass switches placed in the

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								bypass position, the dampers can be opened by starting the DG room exhaust fans using handswitches mounted on the MCCs or locally in the exhaust fan rooms.
6	Fire dampers of Elec. BD Rooms intake vent 0-30-595 0-30-596 0-30-597 0-30-598	Isolate Elec. BD Room from outside.	Open during fire Closed during other modes of operation	Mechanical Failure Mechanical	See Remarks	See Remarks Loss of ventilation for the associated Elec. BD Room and potential rise of space temp.	See Remarks None (See Remarks)	Single failures in HVAC Systems need not be postulated as being concurrent with a fire. Redundant train diesel generator system is available.
7	Fire dampers of Elec. BD Rooms exhaust: 0-30-599 0-30-600 0-30-601 0-30-602	Isolate Elec. BD Rooms from AIr Exh Rooms	Open during fire Closed during other modes of operation	Mechanical failure Mechanical failure	See Remarks Surveillance & Maintenance	See Remarks. Loss of ventilation of associated Elec. BD Room and rise of space temp.	See Remarks None. (See Remarks)	Single failures of HVAC System need not be postulated as being concurrent with fire. Redundant train diesel generator system is available.

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
8	Electric BD Room exhaust fans 1-FAN-30-459 for Train 1A-A, 1-FAN-30-461 for Train 1B-B, 2-FAN-30-460 for Train 2A-A, 2-FAN-30-462 for Train 2B-B	Provide ventilation air	Fails to start; Stops running spurious CO_2 system actuation*	Electrical, Mechanical	Surveillance	Loss of ventilation of associated Elec. BD Room and rise of space temp	None. (See Remarks)	Redundant train diesel generator system is started by operator *If failures resulted from spurious actuation of the CO_2 system, operator can verify and restart the fans from hand switches.
			Operates during winter	Fans are manually controlled; but not required to be shut down by operator action.	Surveillance	Decrease of space temp. below freezing	None. (See Remarks)	Calculation EPM-AMP-111589 concludes that no adverse effect will occur on safety-related equipment as a result of below freezing temperatures; therefore, the operation of the fan in winter time is allowed.
9	Motor-operated discharge damper of Elec. BD Room exhaust fans 1-FCO-30-459 for Train 1A-A, 1-FCO-30-461 for	Prevent air flow when associated Elec. BD Room exhaust fan is deenergized	Closed during associated exhaust fan operation	Mechanical	Surveillance	Loss of ventilation of associated Elec. BD Room and rise of space temp.	None. (See Remarks)	Redundant train diesel generator system is available NOTE: These dampers are to be opened by handswitches 0-HS-30-459B or 0-HS-30-459C for Train 1A-A, 0-HS-30-461B or 0-HS-30-461C

TABLE 9.4-4 (Sheet 10 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Train 1B-B, 2-FCO-30-460 for Train 2A-A, 2-FCO-30-462 for Train 2B-B							for Train 1B-B, 0-HS-30-460B or 0-HS-30-460C for Train 2A-A and 0-HS-30-462B or 0-HS-30-462C for Train 2B-B when tornado watch or warning is declared by National weather service for this area.
10	Generator & Electrical Panels ventilation fans 1-FAN-30-491 for Train 1A-A, 1-FAN-30-493 for train 1B-B, 2-FAN-30-492 for Train 2A-A, 2-FAN-30-494 for Train 2B-B	Provide ventilation for elec. panel & to generator inlet	Fails to start; stops running	Electrical or Mechanical	Low air flow alarm in Main Control Room via air flow switches FS-30-491 for Train 1A-A, FS-30-493 for Train 1B-B, FS-30-492 for Train 2A-A, and FS-30-494 for Train 2B-B	Loss of ventilation for the associated elec. panel and generator inlet and potential rise of temp	None (See Remarks)	Redundant train diesel generator system is available.
11	Filters for elec panel ventilation air supply 1-FLT-30-491 for Train 1A-A, 1-FLT-30-493 for Train 1B-B, 2-FLT-30-492 for	Filter the ventilation air supplied to elec panel	Clogged	Accumulation of dirt	Surveillance & Maintenance	Rise of temp in the elec panel due to reduced supply of vent air	None (See Remarks)	Redundant train diesel generator system is available.

TABLE 9.4-4 (Sheet 11 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Train 2A-A, 2-FLT-30-494 for Train 2B-B							
12	Class 1E AC power	Power safety related diesel generator building ventilation equipment	Loss of or inadequate power	Electrical	Indication and alarms in Main Control Room	Rise of temp in affected DG Rm due to lack of ventilation cooling.	None (See Remarks)	Redundant train diesel generator system is available
13	Class 1E power to instrumentation and control	Power safety-related diesel generator building ventilation system instrumentatio n and controls	Loss of or inadequate power	Electrical	Indication and alarms in main control room	Loss of control of the diesel generator ventilation system safety related equipment	None (See Remarks)	Redundant train diesel generator system is available.
14	Non-safety heaters 1-HTR-30-471, 1-HTR-30-472 for Diesel Gen. 1A-A Room, 1-HTR-30-473, 1-HTR-30-474 for	Provide heating during winter normal operation	On during summer LOCA operation	Spurious operation	Surveillance & Maintenance	Increase of Diesel Gen. Room & Air Exh. Room temp. above environmental design conditions	None. (See Remarks)	Redundant train diesel generator system is available.

TABLE 9.4-4 (Sheet 12 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Diesel Gen. 1B-B Room 2-HTR-30-475, 2-HTR-30-476 for diesel gen. 2A-A Room and 2-HTR-30-477, 2-HTR-30-478 for diesel gen. 2B-B Room		Off during winter conditions	Electrical	Surveillance	Drop in Diesel Gen Room temp	None (See Remarks)	Same as above
15	Non-safety heaters 1-HTR-30-487 for 480V BD Room 1-A-A, 1-HTR-30-489 for 480V BD Room 1B-B, 2-HTR-30-488 for 480V BD Room 2A-A, 2-HTR-30-490 for 2B-B Room	Provide heating during winter normal operation	On during summer LOCA operation Off during winter operation	Spurious Operation Electrical	Surveillance & Maintenance Surveillance	Increase 480V BD Room temp. above environmental design conditions Drop in 480V board room temp.	None. (See Remarks) None. (See Remarks)	Redundant train diesel generator system is available Redundant train diesel generator system is available.
16	Non-safety heaters 0-HTR-30-479	Provide heating during winter normal operation	Off during winter operation	Electrical	Surveillance & Maintenance	Decrease in Pipe Gallery Room temp below	None (See Remarks)	Minimum temperature in pipe gallery is calculated to be 36.3^{o}F.

TABLE 9.4-4 (Sheet 13 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	0-HTR-30-480 0-HTR-30-481 0-HTR-30-482 for the Pipe Gallery					environmental design conditions		
17	Toilet Room exhaust fan 0-FAN-469	Provide cooling and ventilation for the toilet and corridor	Fails to start; stops running	Electrical or Mechanical	Surveillance	Increase in Toilet Rm and Corrider temp, and loss of ventilation.	None. (See Remarks)	Maximum temperature in corridor is calculated to be 120^{o}F and the failure of toilet fan will not adversely affect any safety related equipment areas.
18	Muffler Rm Exhaust Fan 1-FAN-30-463 1-FAN-30-465 1-FAN-30-464 1-FAN-30-466	Removes heat from Muffler Rm Area during Diesel Operation	Fails ON during minimum outside design condition and diesel not operating.	Electrical Operator (switch in wrong position)	Surveillance	None (See Remarks)	None (See Remarks)	Each fan, located on the roof, is interlocked with its respective diesel. The fan starts when its diesel starts. It can also be started from a hand switch. In the event of a spurious start during minimum outside temperature conditions, and its diesel not operating, the fan would not cause any adverse conditions on the diesel operation. The DG Rm air intake structure, which is an external opening into the Muffler Rm, would allow cold air currents into the room, by natural

TABLE 9.4-4 (Sheet 14 of 14)

FAILURE MODES AND EFFECTS ANALYSIS
DIESEL GENERATOR VENTILATION SYSTEM

#	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								convection, and very likely cause the room temperature to drop to outside design temperature even without the fan operating. Environmental data drawing 47E235-31 documents the normal and abnormal temperature limits for this room as 13 and 6 degrees F, respectively. Therefore, the spurious operation of the fan would not result in any unacceptable consequences.

TABLE 9.4-4A

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TABLE 9.4-5 (Sheet 1 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	1-AHU-31-461-A Air Handling Unit 1A-A for 480 V Board Room 1A and Battery Room I (Train A)	Provides cooling air supply to 480 V Board Room 1A Battery Room I, Train A equipment in Board Room 1B, Train B press fan, and Fifth Vital Battery Room (FVBR).	Fails to run; Fails while running	Mechanical failure; Train A power failure; Control signal failure; Temperature control sensing failure at 1-TS-31-441A; low flow control sensing failure at 1-FS-31-460; Operator error (handswitch 1-HS-31-461B in wrong position) Hardware related failures; i.e., motor burns out, fan drive belt failures, loss of	Annunciation of 480 V Board Room 1A HVAC System abnormal for 1-FS-31-460 closed on low flow from AHU 1A-A Indicating lights in MCR (1-HS-31-461A). Motor running light on MCC. No indication in MCR of a low temperature sensing failure other than indication that the AHU is not running.	Loss of capability to provide cooling air to 480 V Board Room 1A and Battery Board Room I, and partial loss of cooling to FVBR..	None. (See Remarks)	1. Failures of the cooling coil, fan, motor, and filter are enveloped by the failure of the AHU. 2. The Condenser 1A-A and Compressor 1A-A are interlocked to automatically stop or start with the AHU 1A-A stop or start. 3. Board Room 1B and Battery Room II provide the redundancy. 4. Operator actions are defined to deal with a loss of Train A cooling. 5. Battery Rm I and FVBR can be exhausted from the pressurizing fan supply air to provide hydrogen ventilation. Prepared calculations indicate that sufficient cooling is still available to

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				refrigerant to the cooling coil, and/or restricted air flow path.				assure the battery rooms remain below the maximum temperature limits.
2	1-AHU-31-475-B Air Handling Unit 1B-B for 480 V Board Room 1B and Battery Room II (Train B)	Provides cooling air supply to 480 V Board Room 1B Battery Room II	Fails to run; Fails while running	Mechanical failure; Train B power failure; Control signal failure; Temperature control sensing failure at 1-TS-31-447A; low flow control sensing failure at 1-FS-31-476; Operator error (handswitch 1-HS-31-475B in wrong position)	Annunciation of 480 V Board Room 1B HVAC System abnormal for 1-FS-31-476 closed on low flow from AHU 1B-B Indicating lights in MCR (1-HS-31-475-A). Motor running light on MCC. No indication in MCR of a low temperature sensing failure other than indication that the AHU is not running.	Loss of capability to provide cooling air to 480 V Board Room 1B and Battery Board Room II Battery Room II will continue to be ventilated. The pressurizing fan will supply air to the battery room through the AHU duct. Loss of Train A equipment located in these rooms.	None; See Remarks	1. Failures of the cooling coil, fan, motor, and filter are enveloped by the failure of the AHU. 2. The Condenser 1B-B and Compressor 1B-B are interlocked to automatically stop or start with the AHU 1B-B stop or start. 3. A review of the schematics establishes the separation of the AC system: for the 480V Board Room 1A with Battery Room I and its redundant 480V Board Room 1B with Battery Room II. 4 Train A provides cooling to the Train A

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								components in the 480V Board Room 1B. 5. Operator actions are defined to deal with a loss of Train B cooling.
3	2-AHU-31-461-A Air Handling Unit 2A-A for 480 V Board Room 2A and Battery Room III(Train A)	Provides cooling air supply to 480 V Board Room 2A Battery Room III, and to Train A equipment in Board Room 2B, and Train B press fan	Fails to run; Fails while running	Mechanical failure; Train A power failure; Control signal failure; Temperature control sensing failure at 2-TS-31-441A; low flow control sensing failure at 2-FS-31-460; Operator error (handswitch 2-HS-31-461B in wrong position)	Annunciation of 480 V Board Room 2A HVAC System abnormal for 2-FS-31-460 closed on low flow from AHU 2A-A Indicating lights in MCR (2-HS-31-461A). Motor running light on MCC. No indication in MCR of a low temperature sensing failure other than indication that	Loss of capability to provide cooling air to 480 V Board Room 2A and Battery Board Room III. Battery Room III will continue to be ventilated. The pressurizing fan will supply air to the battery room through the AHU duct. Loss of Train B equipment located in these rooms.	None; See Remarks	1. Failures of the cooling coil, fan, motor, and filter are enveloped by the failure of the AHU. 2. The Condenser 2A-A and Compressor 2A-A are interlocked to automatically stop or start with the AHU 2A-A stop or start. 3. Board Room 2B and Battery Room IV provide the redundancy. 4. Operator actions are identified to deal with a loss of Train A cooling. 5. Battery Rm I can be exhausted from the

TABLE 9.4-5 (Sheet 4 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
					the AHU is not running.			pressurizing fan supply air to provide hydrogen ventilation. Calculations indicate that sufficient cooling is still available to assure the battery rooms remain below the maximum temperature limit.
4	2-AHU-31-475-B Air Handling Unit 2B-B for 480 V Board Room 2B and Battery Room IV (Train B)	Provides cooling air supply to 480 V Board Room 2B Battery Room IV	Fails to run; Fails while running	Mechanical failure; Train B power failure; Control signal failure; Temperature control sensing failure at 2-TS-31-447A; low flow control sensing failure at 2-FS-31-476; Operator error (handswitch 2-HS-31-	Annunciation of 480 V Board Room 2B HVAC System abnormal for 2-FS-31-476 closed on low flow from AHU 2B-B Indicating lights in MCR (2-HS-31-475A). Motor running light on MCC. No indication in MCR of a low temperature	Loss of capability to provide cooling air to 480 V Board Room 2B and Battery Board Room IV Battery Room IV will continue to be ventilated. The pressurizing fan will supply air to the battery room through the AHU duct. Loss of Train A equipment located in these rooms	None, See Remarks	1. Failures of the cooling coil, fan, motor, and filter are enveloped by the failure of the AHU. 2. The Condenser 2B-B and Compressor 2B-B are interlocked to automatically stop or start with the AHU 2B-B stop or start. 3. Board Room 2A and Battery Room III provide the redundancy. 4. Train A provides cooling to the Train A components in the

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				475B in wrong position)	sensing failure other than indication that the AHU is not running.			480V Board Room 2B. 5. Operator actions are defined to deal with a loss of Train B cooling.
5	1-COND-31-290-A Air Cooled Condenser Unit 1A-A	Provides refrigerant to AHU 1A-A	Fails to run; Stops while running	Mechanical failure; Train A power failure; Start signal failure.	Motor running light on MCC	Loss of cooling to 480 V Board Room 1A. The Battery Room I will be ventilated by the air supply from the Pressurizing Fan to provide Hydrogen ventilation.	None. (See Remarks)	1. Failure of the condenser envelopes failure of its fan, coils and motor. 2. The condenser is interlocked to automatically start or stop with the AHU and compressor start or stop. 3. The condenser is interlocked to automatically open 1-FSV-31-290 when running and close it when stopped. 4. Board Room 1B and Battery Room II provide the redundancy. 5. Actions are defined that deal with a loss of

TABLE 9.4-5 (Sheet 6 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								Train A cooling. 6. Battery Room I can be exhausted from the pressurizing fan supply air to provide hydrogen ventilation. Calculations indicates that sufficient cooling is still available to assure the battery rooms remain below the maximum temperature limit.
6	1-COND-31-289-B Air Cooled Condenser Unit 1B-B	Provides refrigerant to AHU 1B-B	Fails to run; Stops while running	Mechanical failure; Train B power failure; Start signal failure.	Motor running light on MCC	Loss of cooling to 480V Board Room 1B. The Battery Room II will be ventilated by the air supply from the Pressurizing Fan to provide Hydrogen ventilation.	None. (See Remarks)	1. Failure of the condenser envelopes failure of its fan, coils and motor. 2. The condenser is interlocked to automatically start or stop with the AHU and compressor start or stop. 3. The condenser is interlocked to automatically open 1-FSV-31-289 when running and close it

TABLE 9.4-5 (Sheet 7 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								when stopped. 4. Board Room 1A and Battery Room I provide the redundancy. 5. The Train A equipment located in the Board Room 1B is cooled by Train A.
7	2-COND-31-290-A Air Cooled Condenser Unit 2A-A	Provides refrigerant to AHU 2A-A	Fails to run; Stops while running	Mechanical failure; Train B power failure; Start signal failure.	Motor running light on MCC	Loss of cooling to 480V Board Room 2A. The Battery Room III will be ventilated by the air supply from the Pressurizing Fan to provide Hydrogen ventilation.	None. (See Remarks)	1. Failure of the condenser envelopes failure of its fan, coils and motor. 2. The condenser is interlocked to automatically start or stop with the AHU and compressor start or stop. 3. The condenser is interlocked to automatically open 2-FSV-31-290 when running and close it when stopped. 4. Board Room 2B

TABLE 9.4-5 (Sheet 8 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								and Battery Room IV provide the redundancy.
8	2-COND-31-289-B Air Cooled Condenser Unit 2B-B	Provides refrigerant to AHU 2B-B	Fails to run; Stops while running	Mechanical failure; Train A power failure; Start signal failure.	Motor running light on MCC	Loss of cooling to 480V Board Room 2B. The Battery Room IV will be ventilated by the air supply from the Pressurizing Fan to provide Hydrogen ventilation.	None. (See Remarks)	1. Failure of the condenser envelopes failure of its fan, coils and motor. 2. The Condenser is interlocked to automatically start or stop with the AHU and compressor start or stop. 3. The condenser is interlocked to automatically open 2-FSV-31-289 when running and close it when stopped. 4. Board Room 2A and Battery Room III provide the redundancy. 5. Train A components located in Board Room 2B will be cooled by Train A.

TABLE 9.4-5 (Sheet 9 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
9	1-FCO-31-290 Exhaust Damper for AHU 1A-A	Provides exhaust flow path for Condensing Unit 1A-A	Fails to open (stuck closed)	Mechanical failure	Indicating lights in MCR (1-ZS-31-290)	Loss of ability to exhaust from condensing Unit 1A-A	None. (See Remarks)	1. Interlocked with Condensing Unit 1A-A via 1-FSV-31-290 to automatically open on ACU start. 2. A review of the Control Air flow diagrams shows that nonsafety control air is supplied to both 1-FCO-31-290 and 289. 3. The exhaust damper is air operated and fails open upon loss of air or Train A power. 4. Board Room 1B and Battery Room II provide the redundancy.
10	2-FCO-31-290 Exhaust Damper for AHU 2A-A	Provides exhaust flow path for Condensing Unit 2A-A	Fails to open (stuck closed)	Mechanical failure	Indicating lights in MCR (2-ZS-31-290)	Loss of ability to exhaust from condensing unit 2A-A	None. (See Remarks)	1. Interlocked with Condensing Unit 2A-A via 2-FSV-31-290 to automatically open on ACU start. 2. A review of the Control Air flow

TABLE 9.4-5 (Sheet 10 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								diagrams shows that nonsafety control air is supplied to both 2-FCO-31-290 and 289. 3. The exhaust damper is air operated and fails open upon loss of air or Train A power. 4. Board Room 2B and Battery Room IV provide the redundancy.
11	1-FAN-31-462-A Pressurizing Supply Fan 1A1-A (Train A)	Provides pressurizing air flow to 480 V Board Room 1A Battery Room I, and partial makeup air to the Fifth Vital Battery Room.	Fails to start; Fails while running	Mechanical failure; Train A power failure; Control signal failure; Operator error (handswitch in wrong position)	Indicating lights in MCR (1-HS-31-462A). Locally, 1-HS-31-462B. ANN 19-9 low flow from Press. Fans	Loss of redundancy in pressurizing air supply to 480 V Board Room 1A Battery Room I and V. Low flow on 1-FS-31-463-B will automatically stop Fan 1A1-A and Battery Board Room Exhaust fan 1A1-A and, will	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 1A1-A is interlocked with Battery Board Room I Exhaust Fan 1A2-B and 480 V Room 1A Fan 1A2-B such that when Fan 1A1-A is in auto-standby, low flow on

TABLE 9.4-5 (Sheet 11 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						automatically start Fan 1A2-B and Battery Room Exhaust fan 1A2-B. (See Remark #2.)		either of the 1A2-B Fans will start 1-FAN-31-462-A and stop 1-FAN-31-463-B. 3. A review of the schematics establishes the separation and redundancy of the train A and B fans. The loss of nondivisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to stop when Train B fan starts	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (1-HS-31-462A).	Over-pressurization of 480 V Board Room 1A. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 1A and Mechanical Equipment Room 1A. Battery room I will not be overpressurized without second failure.
12	1-FAN-31-463-B	Provides pressurizing air flow to 480	Fails to start; Fails while	Mechanical failure; Train B power	Indicating lights in MCR (1-HS-31-	Loss of redundancy in pressurizing air	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Pressurizing Supply Fan 1A2-B (Train B)	V Board Room 1A Battery Room I, and partial makeup air to the FVBR.	running	failure; Control signal failure; Operator error (handswitch in wrong position)	463A). Locally, 1-HS-31-463B. ANN 19-9 low flow from Press. Fans	supply to 480 V Board Room 1A and Battery Room I and V. Low flow on 1-FS-31-462-A will automatically stop Fan 1A2-B and Battery Board Room Exhaust fan 1A2-B and, will automatically start Fan 1A1-A and Battery Room Exhaust fan 1A1-A. (See Remark #2.)		stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 1A2-B is interlocked with Battery Board Room I Exhaust Fan 1A1-A and 480 V Room 1A Fan 1A1-A such that when Fan 1A2-B is in auto-standby, low flow of either of the 1A1-A Fans will start 1-FAN-31-463B and stop 1-FAN-31-462A. 3. A review of the schematics establishes the separation and redundancy of the Train A and B fans. The loss of nondivisional train associated power supply for the separation relay will not prevent the switchover from a

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								failed pressurizing fan to the standby fan.
			Failure to stop when Train A fan starts.	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (1-HS-31-463A).	Over-pressurization of 480 V Board Room 1A. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 1A and Mechanical Equipment Room 1A. Battery room I will not be overpressurized without a second failure.
13	1-FAN-31-478-A Pressurizing Supply Fan 1B1-A (Train A)	Provides pressurizing air flow to 480V Board Room 1B and Battery Room II and partial makeup air to the FVBR.	Fails to start; Fails while running	Mechanical failure; Train B power failure; Control signal failure; Operator error (handswitch in wrong position)	Indicating lights in MCR (1-HS-31-478A). Locally, 1-HS-31-478B. ANN 19-11 low flow from Press. Fans	Loss of redundancy in pressurizing air supply to 480 V Board Room 1B and Battery Room II Low flow on 1-FS-31-477-B will automatically stop Fan 1B1-A and Battery Board Room Exhaust fan 1B1-A and, will automatically start Fan 1B2-B and Battery	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 1B1-A is interlocked with Battery Room I Exhaust Fan 1B-A and 480 V Room 1B pressurizing Fan 1B2-B such that when Fan 1B1-A is in auto-standby, low flow on either of the 1B2-B Fans will start 1-FAN-31-478-A and stop 1-

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						Room Exhaust fan 1B2-B. (See Remark #2.)		FAN-31-477-B. 3. A review of the schematics establishes the separation and redundancy of the Train A and B fans. The loss of nondivisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to stop when Train B fan starts.	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (1-HS-31-478A).	Over-pressurization of 480 V Board Room 1B. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 1B and Mechanical Equipment Room 1B. Battery room I will not be overpressurized without second failure.
14	1-FAN-31-477-B Pressurizing Supply Fan	Provides pressurizing air flow to 480V Board Room 1B and	Fails to start; Fails while running	Mechanical failure; Train B power failure; Control signal	Indicating lights in MCR (1-HS-31-477-A). Locally, 1-HS-31-477B.	Loss of redundancy in pressurizing air supply to 480 V Board Room 1B	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start

TABLE 9.4-5 (Sheet 15 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	1B2-B (Train B)	Battery Room II, and partial makeup air to the FVBR.		failure; Operator error (handswitch in wrong position)	ANN 19-11 low flow from Press. Fans	and Battery Room II Low flow on 1-FS-31-478-A will automatically stop Fan 1B2-B and Battery Room Exhaust fan 1B2-B and, will automatically start Fan 1B1-A and Battery Room Exhaust fan 1B1-A. (See Remark #2.)		switches in MCR. 2. Pressurizing Fan 1B2-B is interlocked with Battery Room II Exhaust Fan 1B2-B and 480 V Room 1B Pressurizing Fan 1B1-A such that when Fan 1B2-B is in auto-standby, low flow on either of the 1B1-A Fans will start 1-FAN-31-477-B and stop 1-FAN-31-478-A. 3. A review of the schematics establishes the separation and redundancy of the Train A and B fans. The loss of non-divisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Failure to stop when Train A fan starts.	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (1-HS-31-477A-B).	Over-pressurization of 480 V Board Room 1B. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 1B and Mechanical Equipment Room 1B. Battery room II will not be overpressurized without a second failure.
15	1-FAN-31-287-A Exhaust Fan 1A1- A for Battery Room 1 (Train A).	Exhausts air from Battery Room 1 to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; spurious low flow signal.	Local indicating light for Damper 1-FCO-31-287-A closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room 1. On low flow from pressurizing or Battery Room Exhaust Fan 1A1-A, the Train B Pressurizing Fan 1A2-B and the Battery Room Exhaust Fan 1A2-B will automatically start. Damper 1-FCO-31-288-B will open.	None. (See Remarks)	1. Interlocked with Pressurizing Fan 1A1-A such that the Battery Room Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.
16	1-FAN-31-	Exhausts air	Fails to	Mechanical	Local	Loss of	None. (See	1. Interlocked with

TABLE 9.4-5 (Sheet 17 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	288-B Exhaust Fan 1A2-B for Battery Room 1 (Train B).	from Battery Room 1 to prevent hydrogen build-up.	start; Fails while running.	failure; Train B power failure; spurious low flow signal.	indicating light for damper 1-FCO-31-288-B closure. Motor running light on MCC.	redundancy in exhausting Battery Room 1. On low flow from Pressurizing or Battery Room Exhaust Fan 1A2-B, the Train A Pressurizing Fan 1A1-A and the Battery Room Exhaust Fan 1A2-B will automatically start. Damper 1-FCO-31-287-A will open.	Remarks)	Pressurizing Fan 1A2-B such that the Battery Room Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.
17	1-FAN-31-285-A Exhaust Fan 1B1-A for Battery II (Train A)	Exhausts air from Battery Room II to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; spurious low flow signal.	Local indicating light for damper 1-FCO-31-285-A closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room II. On low flow from Pressurizing or Battery Room Exhaust Fan 1B1-A, the Train B Pressurizing Fan 1B2-B and the Battery	None. (See Remarks)	1. Interlocked with Pressurizing Fan 1B1-A such that the Battery Room Exhaust Fan starts and stops when the Pressurizing Fan starts. 2. A review of the schematics reestablishes the independence of the Train A and B fans.

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FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						Room exhaust fan will automatically start. Damper 1-FCO-31-286-A will open.		
18	1-FAN-31-286-B Exhaust Fan 1B2-B for Battery Room II (Train B).	Exhausts air from Battery Room II to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train B power failure; spurious low flow signal.	Local indicating light for Damper 1-FCO-31-286-B closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room II. On low flow from pressurizing or Battery Room Exhaust Fan 1B2-B, the Train A Pressurizing Fan 1B1-A and the Battery Room Exhaust Fan 1B1-A will automatically start. Damper 1-FCO-31-285-B will open.	None. (See Remarks)	1. Interlocked with Pressurizing Fan 1B2-B such that the Battery Room Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.
19	2-FAN-31-462-A Pressurizing Supply Fan	Provides pressurizing air flow to 480 V Board Room 2A and	Fails to start; Fails while running	Mechanical failure; Train A power failure; Control signal	Indicating lights in MCR (2-HS-31-462A). Locally, 2-HS-31-462B.	Loss of redundancy in pressurizing air supply to 480 V Board Room 2A	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	2A1-A (Train A)	Battery Room IV.		failure; Operator error (handswitch in wrong position)	ANN 19-9 low flow from Press. Fans	and Battery Room IV Low flow on 2-FS-31-462-A will automatically stop Fan 2A1-A and Battery Room Exhaust fan 2A1-A; and, will automatically start Fan 2A2-B and Battery Room Exhaust fan 2A2-B. (See Remark #2.)		switches in MCR. 2. Pressurizing Fan 2A1-A is interlocked with Battery Room IV Exhaust Fan 2A2-B and 480 V Room 2A Fan 2A2-B such that when Fan 2A1-A is in auto-standby, low flow on either of the 2A2-B Fans will start 2-FAN-31-462-A and stop 2-FAN-31-463-B. 3. A review of the schematics establishes the separation and redundancy of the Train A and B fans. The loss of non-divisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to	Spurious low	Indicating	Over-	None. (See	Insignificant increase

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			stop when Train B fan starts.	flow signal; Hot short in control wiring; Operator error.	lights in MCR (2-HS-31-462A).	pressurization of 480 V Board Room 2A. (See 'Remarks')	Remarks)	in air flow to 480 V Board Room 2A and Mechanical Equipment Room 2A. Battery room IV will not be overpressurized without a second failure.
20	2-FAN-31-463-B Pressurizing Supply Fan 2A2-B (Train B)	Provides pressurizing air flow to 480 V Board Room 2A and Battery Room IV.	Fails to start; Fails while running	Mechanical failure; Train B power failure; Control signal failure; Operator error (handswitch in wrong position)	Indicating lights in MCR (2-HS-31-463A). Locally, 2-HS-31-463B. ANN 19-9 low flow from Press. Fans	Loss of redundancy in pressurizing air supply to 480 V Board Room 2A and Battery Room IV Low flow on 2-FS-31-463-B will automatically stop Fan 2A2-B and Battery Room Exhaust fan 2A2-B and, will automatically start Fan 2A1-A and Battery Room Exhaust fan 2A1-A. (See Remark #2.)	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 2A2-B is interlocked with Battery Room IV Exhaust Fan 2A1-A and 480 V Room 2A Fan 2A1-A such that when Fan 2A2-B is in auto-standby, low flow on either of the 2A1-A Fans will start 2-FAN-31-463-B and stop 2-FAN-31-462-A. 3. A review of the schematics establishes the

TABLE 9.4-5 (Sheet 21 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								separation and redundancy of the Train A and B fans. The loss of non-divisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to stop when Train A fan starts.	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (2-HS-31-463A).	Over-pressurization of 480 V Board Room 2A. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 2A and Mechanical Equipment Room 2A. Battery room IV will not be overpressurized without a second failure.
21	2-FAN-31-478-A Pressurizing Supply Fan 2B1-A (Train A)	Provides pressurizing air flow to 480 V Board Room 2B and Battery Room III.	Fails to start; Fails while running	Mechanical failure; Train A power failure; Control signal failure; Operator error	Indicating lights in MCR (2-HS-31-478A). Locally, 2-HS-31-478B. ANN 19-11 low flow from Press. Fans	Loss of redundancy in pressurizing air supply to 480 V Board Room 2B and Battery Room III Low flow on 2-	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 2B1-A is interlocked

TABLE 9.4-5 (Sheet 22 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				(handswitch in wrong position)		FS-31-478-A will automatically stop Fan 2B1-A and Battery Room Exhaust fan 2B1-A and, will automatically start Fan 2B2-B and Battery Room Exhaust Fan 2B2-B. (See Remark #2.)		with Battery Room IV Exhaust Fan 2B2-B and 480 V Room 2B Fan 2B2-B such that when Fan 2B1-A is in auto-standby, low flow on either of the 2B2-B Fans will start 2-FAN-31-478-A and stop 2-FAN-31-477-B. 3. A review of the schematics establishes the separation and redundancy of the train A and B fans. The loss of non-divisional train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to stop when Train B fan starts.	Spurious low flow signal; Hot short in control wiring;	Indicating lights in MCR (2-HS-31-478A).	Over-pressurization of 480 V Board Room 2B.	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 2B and Mechanical Equipment

TABLE 9.4-5 (Sheet 23 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				Operator error.		(See 'Remarks')		Room 2B. Battery room III will not be overpressurized without second failure.
22	2-FAN-31-477-B Pressurizing Supply Fan 2B2-B (Train B)	Provides pressurizing air flow to 480 V Board Room 2B and Battery Room III.	Fails to start; Fails while running	Mechanical failure; Train B power failure; Control signal failure; Operator error (handswitch in wrong position)	Indicating lights in MCR (2-HS-31-477A). Locally, 2-HS-31-477B. ANN 19-11 low flow from Press. Fans	Loss of redundancy in pressurizing air supply to 480 V Board Room 2B and Battery Room III Low flow on 2-FS-31-477-B will automatically stop Fan 2B2-B and Battery Room Exhaust fan 2B2-B and, will automatically start Fan 2B1-A and Battery Room Exhaust fan 2B1-A. (See Remark #2.)	None. (See Remarks)	1. Fan is controlled by locally mounted stop-start push button stations in conjunction with auto-start switches in MCR. 2. Pressurizing Fan 2B2-B is interlocked with Battery Room III Exhaust Fan 2B1-A and 480 V Room 2B Fan 2B1-A such that when Fan 2B2-B is in auto-standby, low flow on either of the 2B1-A Fans will start 2-FAN-31-477-B and stop 2-FAN-31-478-A. 3. A review of the schematics establishes the separation and redundancy of the train A and B fans. The loss of non-divisional

TABLE 9.4-5 (Sheet 24 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								train associated power supply for the separation relay will not prevent the switchover from a failed pressurizing fan to the standby fan.
			Failure to stop when Train A fan starts.	Spurious low flow signal; Hot short in control wiring; Operator error.	Indicating lights in MCR (2-HS-31-477A).	Over-pressurization of 480 V Board Room 2A. (See 'Remarks')	None. (See Remarks)	Insignificant increase in air flow to 480 V Board Room 2B and Mechanical Equipment Room 2B. Battery room III will not be overpressurized without a second failure.
23	2-FAN-31-287-A Exhaust Fan 2A1- A for Battery Room IV (Train A).	Exhausts air from Battery Room IV to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; spurious low flow signal.	Local indicating light for Damper 2-FCO-31-287-A closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room IV. On low flow from pressurizing or Battery Room Exhaust Fan 2A1-A, the Train B Pressurizing Fan 2A2-B and the Exhaust Fan	None. (See Remarks)	1. Interlocked with Pressurizing Fan 2A1-A such that the Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.

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FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						2A2-B will automatically start. Damper 2-FCO-31-288-B will open.		
24	2-FAN-31-288-B Exhaust Fan 2A2-B for Battery Room IV (Train B).	Exhausts air from Battery Room IV to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train B power failure; spurious low flow signal.	Local indicating light for damper 2-FCO-31-288-A closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room IV. On low flow from Pressurizing or Battery Room Exhaust Fan 2A2-B, the Train A Pressurizing Fan 2A1-A and the Exhaust Fan 2A1-A will automatically start. Damper 2-FCO-31-287-A will open.	None. (See Remarks)	1. Interlocked with Pressurizing Fan 2A2-B such that the Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.
25	2-FAN-31-285-A Exhaust Fan 2B1-A for Battery III	Exhausts air from Battery Room III to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; spurious low flow signal.	Local indicating light for damper 2-FCO-31-285-A closure. Motor running light	Loss of redundancy in exhausting Battery Room III.	None. (See Remarks)	1. Interlocked with Pressurizing Fan 2B1-A such that the Exhaust Fan starts when the Pressurizing Fan starts and stops

TABLE 9.4-5 (Sheet 26 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	(Train A).				on MCC.	On low flow from Pressurizing or Battery Room Exhaust Fan 2B1-A, the Train B Pressurizing Fan 2B2-B and the Exhaust Fan 2B2-B will automatically start. Damper 2-FCO-31-286-A will open.		when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.
26	2-FAN-31-286-B Exhaust Fan 2B2-B for Battery Room III (Train B).	Exhausts air from Battery Room III to prevent hydrogen build-up.	Fails to start; Fails while running.	Mechanical failure; Train B power failure; spurious low flow signal.	Local indicating light for Damper 2-FCO-31-286-B closure. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room III. On low flow from pressurizing or Battery Room Exhaust Fan 2B2-B, the Train A Pressurizing Fan 2B1-A and the Battery Room Exhaust Fan 2B1-A will automatically	None. (See Remarks)	1. Interlocked with Pressurizing Fan 2B2-B such that the Exhaust Fan starts when the Pressurizing Fan starts and stops when the Pressurizing Fan stops. 2. A review of the schematics establishes the independence of the Train A and B fans.

TABLE 9.4-5 (Sheet 27 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						start. Damper 2-FCO-31-285-A will open.		
27	1-FCO-31-287-A Tornado Damper (Exhaust Fan 1A1-A.)	Provides air flow to Exhaust Fan 1A1-A in Battery Room I.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (1-ZS-31-287B-A).	Loss of redundancy in exhausting Battery Room I. Low flow from 1A1-A Fans will automatically stop the fan from Train A, start Train B Press. Fan 1A2-B and Exhaust Fan 1A2-B which will open 1-FCO-31-288-B.	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room I Exhaust Fan 1A1-A. A review of the schematics establishes the independence of the control of the Dampers 1-FCO-31-288-B, and 1-FCO-31-287-A.
28	1-FCO-31-288-B Tornado Damper (Exhaust Fan 1A2-B)	Provides air flow to Exhaust Fan 1A2-B in Battery Room I.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (1-ZS-31-288A-B).	Loss of redundancy in exhausting Battery Room I. Low flow from 1A2-B Fans will automatically stop the fan from Train B,	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room I Exhaust Fan 1A2-B. A review of the schematics establishes the independence of the

TABLE 9.4-5 (Sheet 28 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						start Train A Press. Fan 1A1-A and Exhaust Fan 1A1-A which will open 1-FCO-31-287-A.		control of the Dampers 1-FCO-31-287-A and 1-FCO-31-288-B.
29	1-FCO-31-285-A Tornado Damper (Exhaust Fan 1B1-A)	Provides air flow to Exhaust Fan 1B1-A in Battery Room II.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (1-ZS-31-285B-A).	Loss of redundancy in exhausting Battery Room II. Low flow from 1B1-A Fans will automatically stop the fan from Train A, start Train B Press. Fan 1B2-B and Exhaust Fan 1B2-B which will open 1-FCO-31-286-B.	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room II Exhaust Fan 1B1-A. A review of the schematics establishes the independence of the control of the Dampers 1-FCO-31-285-A and 1-FCO-31-286-B.
30	1-FCO-31-286-B Tornado Damper (Exhaust	Provides air flow to Exhaust Fan 1B2-B in Battery Room	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator	Mechanical Equipment Room damper status lights (1-ZS-31-	Loss of redundancy in exhausting Battery Room II. Low flow from	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room II

TABLE 9.4-5 (Sheet 29 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Fan 1B2-B).	II.		error (handswitch placed in wrong position).	286A-B).	1B2-B Fans will automatically stop the fan from Train B, start Train A Press. Fan 1B1-A and Exhaust Fan 1B1-A which will open 1-FCO-31-285-A.		Exhaust Fan 1B2-B. A review of the schematics establishes the independence of the control of the Dampers 1-FCO-31-285-A and 1-FCO-31-286-B.
31	2-FCO-31-287-A Tornado Damper (Exhaust Fan 2A1-A).	Provides air flow to Exhaust Fan 2A1-A in Battery Room IV.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (2-ZS-31-287B-A).	Loss of redundancy in exhausting Battery Room IV. Low flow from 2A1-A Fans will automatically stop the fan from Train A, start Train B Press. Fan 2A2-B and Exhaust Fan 2A2-B which will open 2-FCO-31-288-B.	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room IV Exhaust Fan 2A1-A. A review of the schematics establishes the independence of the control of the Dampers 2-FCO-31-287-A and 2-FCO-31-288-B.

TABLE 9.4-5 (Sheet 30 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
32	2-FC0-31-288-B Tornado Damper (Exhaust Fan 2A2-B.	Provides air flow to Exhaust Fan 2A2-B in Battery Room IV.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (2-ZS-31-288A-B).	Loss of redundancy in exhausting Battery Room IV. Low flow from 2A2-B Fans will automatically stop the fan from Train B, start Train A Press. Fan 2A1-A and Exhaust Fan 2A1-A which will open 2-FCO-31-287-A.	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room IV Exhaust Fan 2A2-B. A review of the schematics establishes the independence of the control of the Dampers 2-FCO-31-287-A and 2-FCO-31-288-B.
33	2-FCO-31-285-A Tornado Damper (Exhaust Fan 2B1-A).	Provides air flow to Exhaust Fan 2B1-A in Battery Room III.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (2-ZS-31-285B-A).	Loss of redundancy in exhausting Battery Room III. Low flow from 2B1-A fans will automatically stop the fan from Train A,	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room III Exhaust Fan 2B1-A. A review of the schematics establishes the independence of the control of the Dampers

TABLE 9.4-5 (Sheet 31 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						start Train B Press. Fan 2B2-B and Exhaust Fan 2B2-B which will open 2-FCO-31-286-B.		2-FCO-31-285-A and 2-FCO-31-286-B.
34	2-FCO-31-286-B Tornado Damper (Exhaust Fan 2B2-B).	Provides air flow to Exhaust Fan 2B2-B in Battery Room III.	Spuriously closes.	Mechanical failure; Hot short in control wiring; Operator error (handswitch placed in wrong position).	Mechanical Equipment Room damper status lights (2-ZS-31-286A-B).	Loss of redundancy in exhausting Battery Room III. Low flow from 2B2-B fans will automatically stop the fan from Train B, start Train A Press. Fan 2B1-A and Exhaust Fan 2B1-A which will open 2-FCO-31-285-A.	None. (See Remarks)	Damper is motor operated, and fails as is. Automatically controlled to open by Battery Room III Exhaust Fan 2B2-B. A review of the schematics establishes the independence of the control of the Dampers 2-FCO-31-285-A and 2-FCO-31-286-B.
35	0-FAN-31-493A-A Fifth Vital Battery	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place.

TABLE 9.4-5 (Sheet 32 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Supply Fan 1A1-A.							
36	0-FC-31-487A Battery Room V Intake Fan 1A1-A Hydramotor Controller.	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place.
37.	0-FCO-31-483-A Tornado damper for intake fan 1A1-A FVBR.	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place in “closed” position.
38	0-FAN-31-493B-A Fifth Vital Battery Room Exhaust Fan 1B1-A.	Provides exhaust from Battery Room	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Auto-start signal failure.	ANN 19-8 for low flow from intake fan or exhaust fan from either train. Motor running light on MCC.	Loss of redundancy in exhausting Battery Room V. The Train B fan is available to provide exhausting of Battery Room V, and will	None. (See Remarks)	The fifth Vital Battery is housed in its own separate room, and functions as a spare to any of the four vital batteries during periodic testing and maintenance or cell failure during operation. The two trains of the ventilation

TABLE 9.4-5 (Sheet 33 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						automatically start on low flow sensed in Train A exhaust duct.		system are 100% redundant. Upon low flow from Train A exhaust fan, the opposite train fans will start automatically and its dampers will open. Auto-start of the standby train is independent of the other train. Schematic diagrams were reviewed and it was determined that control from the opposite train flow element does not violate separation of redundant train.
39	0-FCO-31-485-A Tornado Damper for exhaust Fan 1B1-A Fifth Vital Battery Room.	Provides flow path for exhaust from Exhaust Fan 1B1-A	Fails to open (stuck closed); Spuriously closes.	Mechanical failure; Train A power failure; Operator error.	Local control station indicating lights.	Loss of redundancy in providing exhaust flowpath.	None. The Train B exhaust fan and its associated dampers are automatically controlled to start/open upon low flow from the operating exhaust fan.	Damper is solenoid actuated to fail closed upon loss of Train A power. Interlocked to automatically open upon exhaust Fan 1B1-A start.
40	0-FAN-31-	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place.

TABLE 9.4-5 (Sheet 34 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	496A Fifth Vital Battery Room supply Fan 1A2-B.							
41	0-FC-31-488A-B Battery Room V Intake Fan 1A2-B Hydramotor Controller.	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place
42	0-FCO-31-484-B Tornado Damper for Intake Fan 1A2-B Fifth Vital Battery Room.	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned in place.
43	0-FAN-31-496B Fifth Vital Battery Room	Provides exhaust form Battery Room V for ventilation.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Auto-start signal failure.	ANN 19-8 for low flow from intake fan or exhaust fan from either train.	Loss of redundancy in exhausting Battery Room V. The Train A fan	None. (See Remarks)	The fifth Vital Battery is housed in its own separate room, and functions as a spare to any of the four vital batteries during

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Exhaust Fan 1B2-B.				Motor running light on MCC.	is available to provide exhausting of Battery Room V, and will automatically start on low flow sensed in Train B exhaust duct..		periodic testing and maintenance or cell failure during operation. The two trains of the ventilation system are 100% redundant. Upon low flow from Train B exhaust fan, the opposite train fans will start automatically and its dampers will open. Auto-start of the standby train is independent of the other train. Schematic diagrams were reviewed and it was determined that control from the opposite train flow element does not violate separation of redundant train.
44	0-FCO-31-486-B Tornado Damper for exhaust Fan 1B2-B Fifth	Provides flowpath for exhaust from Exhaust Fan 1B2-B.	Fails to open (stuck closed); Spuriously closes.	Mechanical failure; Train B power failure; Operator error.	Local Control Station indicating lights	Loss of redundancy in providing exhaust flowpath.	None. The Train A exhaust fan and its associated damper is automatically controlled to start/open upon	Low flow switch FS-31-492-B turns on the redundant fan pair (supply/exhaust).

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Vital Battery Room.						low flow from the operating exhaust fan.	
45	1-BKD-31-2502 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 1A1-A when Fan 1A2-B is running.	Fails to backseat.	Mechanical failure;	No direct indication of dampers closing (See Remark #1.)	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 1A2-B running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures.
46	1-BKD-31-2503	Prevents flow of air through Pressurizing	Fails to backseat.	Mechanical failure.	No direct indication of dampers	Loss of pressurizing air to rooms served	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 1A1-A running in

TABLE 9.4-5 (Sheet 37 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Back Draft Damper	Supply Fan 1A2-B when Fan 1A1-A is running.			closing (See Remark #1.)	by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)		MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures.
47	2-BKD-31-2502 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 2A1-A when Fan 2A2-B is running.	Fails to backseat.	Mechanical failure.	See Remark #1. No direct indication of damper closing.	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start	None.	1. ANN low flow. Indicating lights of Fan 2A2-B running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)		dampers is periodically verified in accordance with preventative maintenance procedures.
48	2-BKD-31-2503 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 2A2-B when Fan 2A1-A is running.	Fails to backseat.	Mechanical failure.	No direct indication of damper closing. (See Remark #1.)	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation.	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 2A1-A running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)		procedures.
49	1-BKD-31-2520 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 1B1-A when Fan 1B2-B is running.	Fails to backseat.	Mechanical failure.	No direct indication of damper closing (See Remark #1.)	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 1B2-B running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures.

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						Battery Room exhaust fan and damper. (See Remark #2.)		
50	1-BKD-31-2521 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 1B2-B when Fan 1B1-A is running.	Fails to backseat.	Mechanical failure.	No direct indication of damper closing. (See Remark #1.)	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 1B1-A running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures.

TABLE 9.4-5 (Sheet 41 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						#2.)		
51	2-BKD-31-2520 Back Draft Damper	Prevents flow of air through Pressurizing Supply Fan 2B1-A when Fan 2B2-B is running.	Fails to backseat.	Mechanical failure.	No direct indication of damper closing. (See Remark #1.)	Loss of pressurizing air to rooms served by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)	None. (See remarks)	1. ANN low flow. Indicating lights of Fan 2B2-B running in MCR. Local indication of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures
52	2-BKD-31-2521 Back Draft	Prevents flow of air through Pressurizing Supply Fan	Fails to backseat.	Mechanical failure.	No direct indication of damper	Loss of pressurizing air to rooms served	None. (See Remarks)	1. ANN low flow. Indicating lights of Fan 2B1-A running in MCR. Local indication

TABLE 9.4-5 (Sheet 42 of 42)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BOARD ROOMS AIR CONDITIONING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Damper	2B2-B when Fan 2B1-A is running.			Closing. (See Remark #1.)	by the fan. Bypass flow through the standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. This would result in the total loss of the pressurizing fan and its paired Battery Room exhaust fan and damper. (See Remark #2.)		of damper status resulting from potential low flow from fan(s). 2. Operability of dampers is periodically verified in accordance with preventative maintenance procedures.

TABLE 9.4-6 (Sheet 1 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
1	1-FAN-30-244F-A Exhaust Fan	Exhausts air from 480V Transformer Room 1A.	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Temperature control sensing failure; Control signal failure.	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety- related) in 480V Transformer Room 1A are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. The single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature,

TABLE 9.4-6 (Sheet 2 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				short in control wiring				is analyzed to conclude that the space temperatures remain within allowable limits.
2	1-FAN-30-244G-A Exhaust Fan	Exhausts air from 480 V Transformer Room 1A.	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Temperature control sensing failure; Control signal failure.	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety-related) in 480 V Transformer Room 1A are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control	Indicating lights on MCC for fan motor	None. (See Remarks)	None. (See Remarks)	1. The single failure condition of a fan continuing to run, or spuriously running during accident conditions

TABLE 9.4-6 (Sheet 3 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				sensing failure; Hot short in control wiring.	running.			concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits.
3	1-FAN-30-244H-A Exhaust Fan	Exhausts air from 480 V Transformer Room 1A.	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Temperature control sensing failure; Control signal failure	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety-related) in 480 V Transformer Room 1A are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room Temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure;	Indicating lights on	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a

TABLE 9.4-6 (Sheet 4 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				Temperature control sensing failure; Hot short in control wiring.	MCC for fan motor running.			fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is acceptable.
4	1-FAN-30-244J Exhaust Fan (Non-safety)	Exhausts air from 480 V Transformer Room 1A	Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None.	None. (See Remark #2.)	1. This fan is electrically separate from the 1E circuit for the three safety-related fans. 2. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is acceptable.
5	1-FAN-30-248E-B Exhaust Fan	Exhausts air from 480 V Transformer Room 1B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal failure.	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The three (3) exhaust fans (3 safety-related) in 480 V Transformer Room 1B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
5	1-FAN-30-248E-B (cont'd) Exhaust Fan		Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running	None.	None.	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is acceptable.
6	1-FAN-30-248F-B Exhaust Fan	Exhausts air from 480 V Transformer Room 1B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal failure	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The three (3) exhaust fans (3 safety-related) in 480 V Transformer Room 1B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been

TABLE 9.4-6 (Sheet 6 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
								reviewed and it was determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
6	1-FAN-30-248F-B (cont'd) Exhaust Fan		Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is acceptable.
7	1-FAN-30-248G-B Exhaust Fan	Exhausts air from 480 V Transformer Room 1B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The three (3) exhaust fans (3 safety-related) in 480 V Transformer Room 1B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				failure				running. 3. Schematics have been reviewed and it was determined that rooms 1A and 1B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
7	1-FAN-30-248G-B (cont'd) Exhaust Fan		Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running	None. (See remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits.
8	1-FCO-30-244A and -244B Intake Dampers	Permits flow of air supply from air intake to 480 V Transformer Room 1A.	Spuriously closes; Fails to open.	Mechanical failure; Auto-open signal failure; Hot short in control wiring.	MCR indicating lights (1-ZS-30-244A and -244B).	Loss of redundancy in intake air supply. 100% redundant	None. (See Remark #3.)	1. Both intake dampers are interlocked to automatically open when any of the four (4) exhaust fans are either automatically or manually started.

TABLE 9.4-6 (Sheet 8 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
						intake damper can supply sufficient air.		2. Dampers fail open upon loss of control air or Train A power to 1-FSV-30-244A and -244B. 3. 1-FSV-30-244A and -244B and the air pressure regulators, 1-PREG-30-244A and -244B, that regulate the air pressure to these FSVs are Q-Listed as Quality-related, not safety-related. Failure of the air regulators either by blockage or sticking full open will not impact the capability of the damper to open. Failure of the solenoid to de-energize to close the damper is included in the mechanical failure mode of the damper. The non-safety-related solenoid is properly isolated in the 1E circuit.
9	1-FCO-30-248A and -248B Intake Dampers.	Permits flow of air supply from air intake to 480 V Transformer Room 1B.	Spuriously closes; Fails to open.	Mechanical failure; Auto-open signal failure; Hot short in control wiring.	MCR indicating lights (1-ZS-30-248A and -248B).	Loss of redundancy in intake air supply. 100% redundant intake	None. (See Remark #3.)	1. Both intake dampers are interlocked to automatically open when any of the three (3) exhaust fans are either automatically or manually started. 2. Dampers fail open upon

TABLE 9.4-6 (Sheet 9 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
						damper can supply sufficient air.		loss of control air loss or Train B power to 1-FSV-30-248A and -248B. 3. 1-FSV-30-248A and -248B and the air pressure regulators, 1-PREG-30-248A and -248B, that regulate the air pressure to these FSVs are Q-Listed as Quality-related, not safety-related. Failure of the air regulators either by blockage or sticking full open will not impact the capability of the damper to open. Failure of the solenoid to de-energize to close the damper is included in the mechanical failure mode of the damper. The non-safety-related solenoid is properly isolated in the 1E circuit.
10	2-FAN-30-250E-A Exhaust Fan	Exhausts air from 480 V Transformer Room 2A.	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Temperature control sensing failure;	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The three (3) safety related exhaust fans in 480 V Transformer Room 2A are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				Control signal failure				open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits.
11	2-FAN-30-250F-A Exhaust Fan	Exhausts air from 480 V Transformer Room 2A.	Fails to run; Fails while running.	Mechanical failure; Train A power failure; Temperature	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The three safety related exhaust fans) in 480 V Transformer Room 2A are interlocked to automatically start/stop in staged series by

TABLE 9.4-6 (Sheet 11 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				control sensing failure; Control signal failure				thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits
12	2-FAN-30-250G-B	Exhausts air from 480 V	Fails to run; Fails while	Mechanical Failure; Train	Motor running light	Loss of one safety	None. (See Remarks)	1. The three safety related exhaust fans in 480V

TABLE 9.4-6 (Sheet 12 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Exhaust Fan	Transformer Room 2A.	running.	A power failure; Temperature control sensing failure; Control signal failure	on MCC.	related fan.		Transformer Room 2A are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-368. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits

TABLE 9.4-6 (Sheet 13 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
13	2-FAN-30-246F-B Exhaust Fan	Exhausts air from 480 V Transformer Room 2B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal failure	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety-related) in 480 V Transformer Room 2B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature,

TABLE 9.4-6 (Sheet 14 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				control wiring				is analyzed to conclude that the space temperatures remain within allowable limits
14	2-FAN-30-246G-B Exhaust Fan	Exhausts air from 480 V Transformer Room 2B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal failure	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety-related) in 480 V Transformer Room 2B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.
			Spuriously runs.	Control signal failure; Temperature control	Indicating lights on MCC for fan motor	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during

TABLE 9.4-6 (Sheet 15 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
				sensing failure; Hot short in control wiring.	running.			accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits
15	2-FAN-30-246H-B Exhaust Fan	Exhausts air from 480 V Transformer Room 2B.	Fails to run; Fails while running.	Mechanical failure; Train B power failure; Temperature control sensing failure; Control signal failure	Motor running light on MCC.	Loss of one safety related fan.	None. (See Remarks)	1. The four (4) exhaust fans (3 safety-related) in 480 V Transformer Room 2B are interlocked to automatically start/stop in staged series by thermostatic control. 2. The inlet dampers are interlocked to automatically open when any fan is running. 3. Schematics have been reviewed and it was determined that rooms 2A and 2B, containing redundant electrical equipment, are independent of each other. 4. Room temperature is indicated on Local Panel L-362. 5. Two of the three safety-related fans are sufficient to adequately ventilate each 480V Transformer Room.

TABLE 9.4-6 (Sheet 16 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None. (See Remarks)	None. (See Remarks)	1. Analysis shows that the single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits
16	2-FAN-30-246J Exhaust Fan (Non-safety)	Exhausts air from 480 V Transformer Room 2B	Spuriously runs.	Control signal failure; Temperature control sensing failure; Hot short in control wiring.	Indicating lights on MCC for fan motor running.	None. (See Remark #2)	None. (See Remark #2.)	1. This fan is electrically separate from the 1E circuit for the three safety-related fans. 2. The single failure condition of a fan continuing to run, or spuriously running during accident conditions concurrent with minimum outside design temperature, is analyzed to conclude that the space temperatures remain within allowable limits
17	2-FCO-30-246A and -246B Intake Dampers	Permits flow of air supply from air intake to 480 V Transformer Room 2B.	Spuriously closes; Fails to open.	Mechanical failure; Auto-open signal failure; Hot short in control wiring.	MCR indicating lights (2-ZS-30-246 A and -246B).	Loss of redundancy in intake air supply. 100% redundant	None. (See Remark #3.)	1. Both intake dampers are interlocked to automatically open when any of the four (4) exhaust fans are either automatically or manually started. 2. Dampers fail open upon

TABLE 9.4-6 (Sheet 17 of 18)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
						intake damper can supply sufficient air.		loss of control air or Train B power to 2-FSV-30-246A and -246B. 3. 2-FSV-30-246A and -246B and the air pressure regulators, 2-PREG-30-246A and -246B, that regulate the air pressure to these FSVs are Q-Listed as Quality-related, not safety-related. Failure of the air regulators either by blockage or sticking full open will not impact the capability of the damper to open. Failure of the solenoid to de-energize to close the damper is included in the mechanical failure mode of the damper. The non-safety-related solenoid is properly isolated in the 1E circuit.
18	2-FCO-30-250A and -250B Intake Dampers.	Permits flow of air supply from air intake to 480V Transformer Room 2A.	Spuriously closes: Fails to open.	Mechanical failure; Auto-open signal failure; Hot short in control wiring.	MCR indicating lights (2-ZS-30-250 A and -250B).	Loss of redundancy in intake air supply. 100% redundant intake damper	None. (See Remark #3.)	1. Both intake dampers are interlocked to automatically open when any of the three (3) exhaust fans are either automatically or manually started. 2. Dampers fail open upon loss of control air or Train A

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: 480 V SHUTDOWN TRANSFORMER ROOM VENTILATION

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
						can supply sufficient air.		power to 2-FSV-30-250A and -250B. 3. 2-FSV-30-250A and -250B and the air pressure regulators, 2-PREG-30-250A and -250B, that regulate the air pressure to these FSVs are Q-Listed as Quality-related, not safety-related. Failure of the air regulators either by blockage or sticking full open will not impact the capability of the damper to open. Failure of the solenoid to de-energize to close the damper is included in the mechanical failure mode of the damper. The nonsafety-related solenoid is properly isolated in the 1E circuit.

TABLE 9.4-7 (Sheet 1 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
1A	Tornado Damper 0-FCO-31-32	Isolation of Train A supply air normal (west) intake during tornado event	Fails to close during tornado event	Mechanical failure Electrical failure	Status indication in Control Room via Limit Switch ZS-31-32	None. (See Remarks)	None. (See Remarks)	Redundant Train B Tornado Damper 0-FCO-31-33 powered from Train B and installed in series accomplished isolation during tornado event
1B	Tornado Damper 0-FCO-31-34	Isolation of Train B supply air normal (west) intake during tornado event	Fails to close during tornado event	Mechanical failure Electrical failure	Status indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-34	None. (See Remarks)	None. (See Remarks)	Redundant Train B Tornado Damper 0-FCO-31-35 powered from Train B and installed in series accomplished isolation during tornado event
			Spuriously closes	Same as Item 1A.	Same as Item 1A.	Same as Item 1A.	None. (See Remarks)	Operator removes power from damper, during non-tornado operation, to prevent spurious closure.
2A	Tornado Damper 0-FCO-31-33	Isolation of Train A supply air normal (west) intake during tornado event	Fails to close during tornado event	Mechanical failure Electrical failure	Status indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-33	None. (See Remarks)	None. (See Remarks)	Redundant Train A Tornado Damper 0-FCO-31-32 powered from Train A and installed in series accomplished isolation during tornado event
2B	Tornado Damper 0-FCO-31-35	Isolation of Train B supply air normal (west) intake during	Fails to close during tornado	Mechanical failure Electrical	Status indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-	None. (See Remarks)	None. (See Remarks)	Redundant Train A Tornado Damper 0-FCO-31-34 powered from Train A and installed in

TABLE 9.4-7 (Sheet 2 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		tornado event	event	failure	35			series accomplished isolation during tornado event
3A	Isolation Damper 0-FCO-31-1	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This isolation damper all controls are disconnected and the damper is locked in fully open position
3B	Isolation Damper 0-FCO-31-2	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This isolation damper all controls are disconnected and the damper is locked in fully open position
4A	Flow Control Damper 0-FCO-31-1A	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This flow control damper all controls are disconnected and the damper is locked in fully open position
4B	Flow Control Damper 0-FCO-31-2A	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This flow control damper all controls are disconnected and the damper is locked in fully open position
5A	Pressurization Fan A-A	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This pressurization fan is disconnected and abandoned in place
5B	Pressurization	See remarks	See	See remarks	See remarks	See remarks	See remarks	This pressurization fan is

TABLE 9.4-7 (Sheet 3 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Fan B-B		remarks					disconnected and abandoned in place
6A	Backdraft Damper 0-31-2097	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This backdraft damper is locked in open position
6B	Backdraft Damper 0-31-2098	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This backdraft damper is locked in open position
7	Isolation Valve 0-FCV-31-3	Isolates Main Control Room Habitability Zone (MCRHZ) from outside makeup air supply	Open (during CRI)	Mechanical failure Control failure	Status indication in Control Room Panel 1-M-9 via Limit Switch ZS-31-3	None. (See Remarks)	None. (See Remarks)	Redundant safety Train B Isolation Valve installed in series will close to provide isolation
8	Isolation Valve 0-FCV-31-4	Isolates MCRHZ from outside makeup air supply	Open (during CRI)	Mechanical failure Control failure	Status indication in Control Room Panel 1-M-9 via Limit Switch ZS-31-4	None (See Remarks)	None. (See Remarks)	Redundant safety Train A Isolation Valve installed in series will close to provide isolation
9	Fire Damper 0-ISD-31-3934	To maintain fire barrier integrity between Mechanical Equip. Room Floor El 755.0' and Spreading Room El. 729.0' during fire	Open during fire (see remarks Fusible link failure (see remarks)	Mechanical failure Mechanical (fusible link failure)	See remarks Surveillance and Maintenance (see remarks)	See remarks None (see remarks)	See remarks None (see remarks)	Single failures of HVAC system need not be postulated as being concurrent with fire Fire damper has dual fusible links

TABLE 9.4-7 (Sheet 4 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
10	Isolation Valve 0-FCV-31-37	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This valve controls are disconnected
11	Isolation Valve 0-FCV-31-36	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This valve controls are disconnected
11A	Isolation Damper 0-FCO-31-19	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This damper controls are disconnected, and the duct is blanked off.
11B	Isolation Damper 0-FCO-31-20	See remarks	See remarks	See remarks	See remarks	See remarks	See remarks	This damper controls are disconnected, and the duct is blanked off.
12	Fire Damper 0-ISD-31-3938	To maintain fire barrier integrity between Spreading Room El. 729.0' & Unit 1 Aux. Instr. Room El. 708.0' during fire	Open during fire (see remarks)	Mechanical	See remarks	See remarks	See remarks	Single failures of HVAC system need not to be postulated as being concurrent with fire
			Fusible link failure (see remarks)	Mechanical (fusible link failure)	Surveillance and Maintenance	None. (See remarks)	None (see remarks)	Fire damper has dual fusible links
12A	0-XS-31-179	To detect smoke in the Control Building Pressurization Fan Intake	Spurious actuation of smoke detector	Electrical failure	Surveillance Annunciation in MCR of CRI signal	See remarks	None (see remarks)	Upon activation of air intake smoke detectors a CRI is initiated. Operator action will determine if the smoke detector activation was spurious and if so return system to normal operation
			Failure to detect valid smoke	Electrical failure	Smoke detectors in MCRHZ	Abandon MCR	None. Use Auxiliary Control Room.	

TABLE 9.4-7 (Sheet 5 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
12B	0-XS-31-183	To detect smoke in the Control Building Pressurization Fan Intake	Spurious actuation of smoke detector	Electrical failure	Surveillance Annunciation in MCR of CRI signal	See remarks	None (see remarks)	Upon activation of air intake smoke detectors a CRI is initiated. Operator action will determine if the smoke detector activation was spurious and if so return system to normal operation
			Failure to detect valid smoke	Electrical failure	Smoke detectors in MCRHZ	Abandon MCR	None. Use Auxiliary Control Room	
13	Fire Damper 0-ISD-31-3931	Maintain fire barrier between Control Bldg. roof and Main Control Room in case of fire on the roof at the east emergency air intake	Open during fire (see remarks	See remarks	See remarks	See remarks	None. (See remarks)	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during CRI	Mechanical (fusible link)	Loss of Control Room Press. Diff. Common Alarm through switches 0-PDS-31-1B, -2B, 3B & -4B in Control Room	Loss of Control Room pressurization due to loss of emergency press. fan air flow path through east emerg. air intake	None. (See remarks)	Control Bldg. Press. Diff. switches 0-PDS-31-1A, 2A, -3A & -4A start redundant Control Bldg. emergency press. fan A-A with its outdoor air intake (west)
14	Tornado Damper 0-FCO-31-21	Isolation of emergency outdoor air intake for Emergency Press Fan B-B during Tornado	Fails to close during Tornado Event	Mechanical failure	Status indication via Limit Switch ZS-31-21	None. (See remarks)	None. (See Remarks).	Redundant Train B Tornado Damper 0-FCO-31-22 powered from Train B and installed in series accomplishes isolation during Tornado

TABLE 9.4-7 (Sheet 6 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Event						Event
			Spuriously closes	Electrical Failure	Annunciation in MCR on loss of +1/8” w.g. pressure.	Momentary loss of MCRHZ pressurization.	None. Use redundant air intake	Operator removes power from damper, during non-tornado operation, to prevent spurious closure.
15	Tornado Damper 0-FCO-31-22	Isolation of east emergency outdoor air intake for Emergency Press Fan B-B during Tornado Event	Fails to close during Tornado Event	Mechanical failure Electrical failure	Status indication via Limit Switch ZS-31-22	None. (See remarks)	None. (See Remarks).	Redundant Train A Tornado Damper 0-FCO-31-21 powered from Train A and installed in series accomplishes isolation during Tornado Event
16A	Isolation Damper 0-FCV-31-5	Isolates Emerg. Pressurization Fan B-B from emerg. outdoor air intake (east) supply air	Closes during Emerg. Press. Fan B-B operation	Mechanical failure Electrical & aux. control air failure	The Loss of Control Room Press. Diff. Common Alarm through switches 0-PDS-31-1B, -2B, -3B & -4B and status indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-5	Loss of air flow through Emerg. Press. Fan B-B	None (see remarks)	Redundant Train A emerg. press. Fan A-A starts upon signal from the Control Room Press. Diff. switches 0-PDS-31-1A, -2A, -3A and -4A

TABLE 9.4-7 (Sheet 7 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Fails to close during standby operation	Mechanical failure	The Loss of Control Room Press. Diff. Common Alarm through switches 0-PDS-31-1B, -2B, 3B & -4B and status indication in Control Room via Limit Switch ZS-31-5	May reduce the outside air supply and cause loss of pressurization	None (see remarks)	Same as above
17A	Control Bldg. Emergency Air Press. Fan B-B	Pressurize Main Control Room Habitability Zone (MCRHZ) during CRI	Fails to start Stops	Mechanical failure Electrical failure Control failure	The Loss of Control Room Press. Diff. Common Alarm through switches 0-PDS-31-1B, -2B, 3B and 4B in Control Room	Loss of Control Room pressurization due to loss of air flow path through Train B	None. (See Remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1A, -2B, -3A and -4A start the Control Bldg. redundant Train A Emergency Air Press. Fan A-A
17B	Control Bldg. Emergency Air Press. Fan A-A	Pressurize Main Control Room Habitability Zone (MCRHZ) during CRI	Fail to start Stops	Mechanical failure Electric failure Control failure	The Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1A, -2A, 3A & -4A in Control Room	Loss of Control Room pressurization due to loss of air flow path through Train A	None. (See Remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B and -4B start the Control Bldg. redundant Train B Emergency Air Press. Fan B-B

TABLE 9.4-7 (Sheet 8 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
18A	Fire Damper 0-ISD-31-4608	To prevent a fire or smoke from entering the Control Bldg. Emergency Air Cleanup Unit A-A	Open during fire	Mechanical failure	See remarks	See remarks	See remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during CRI	Mechanical failure (fusible link)	Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1A, -2A, 3A & -4A in Control Room	Loss of air flow through the Train A Air Cleanup Unit and loss of MCR pressurization	None. (See Remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B and -4B start redundant Train B Air Cleanup Unit with its Fan B-B. (Existing dual fusible link is left in place)
18B	Fire Damper 0-ISD-31-3958	To prevent a fire or smoke from entering the Control Bldg. Emergency Air Cleanup Unit B-B	Open during fire	Mechanical failure	See remarks	See remarks	See remarks	Single failures of HVAC system need not to be postulated as being concurrent with fire
			Closed during CR	Mechanical failure(fusible link)	Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1B, -2B, -3B & -4B	Loss of air flow through the Train B Air Cleanup Unit and loss of MCR pressurization	None. (See Remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1A, -2A, -3A and -4A start redundant Train A Air Cleanup Unit with its Fan A-A. (Existing dual fusible link is left in place)

TABLE 9.4-7 (Sheet 9 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
19A	Isolation Damper FCO-31-8	Isolation of Emergency Air Cleanup Unit A-A	Closed during operation of Emergency Air Cleanup Unit Fan A-A	Mechanical failure Electrical & Aux Control Air Failure	In Control Room Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1A, -2A, -3A and -4A and Damper Status Indication via Limit Switch ZS-31-8	Loss of air flow path for Emergency Air Cleanup Unit Fan A-A and loss of MCR pressurization	None. (See remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B and -4B start redundant Train B Fan B-B with its emerg. air cleanup unit
			Open during standby	Mechanical failure Electrical failure	Damper Status Indication via Limit Switch ZS-31-8	Air flow path is open through Air Cleanup Unit during standby	None. (See remarks)	Pressurization Air is still adequately filtered and Control Room Pressurization is still maintained
19B	Isolation Damper FCO-31-7	Isolation of Emergency Air Cleanup Unit B-B	Closed during operation of Emergency Air Cleanup Unit Fan B-B	Mechanical failure Electrical & Aux Control Air Failure	In Control Room Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1B, -2B, -3B and -4B and Damper Status Indication via Limit Switch ZS-31-7	Loss of air flow path for Emergency Air Cleanup Unit Fan B-B and loss of MCR pressurization	None (See remarks)	The Control Room Press. Diff. Switches 0-PDS-31-1A, -2A, -3A and -4A start the Control Bldg. redundant Train A Fan A-A with its emerg. air cleanup unit

TABLE 9.4-7 (Sheet 10 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Open during standby	Mechanical failure Electrical failure	Damper Status Indication via Limit Switch ZS-31-7	Air flow path is open through Air Cleanup Unit during standby	None (See remarks)	Pressurization Air is still adequately filtered and Control Room Pressurization is still maintained
20A	Control Bldg. Emergency Air Cleanup Unit A-A	Filters potentially contaminated outside air prior to MCRHZ during CRI	Blocked	Dirty filters	Loss of Control Room Press. Diff. common Alarm through Switches 0-PDS-31-1A, -2A, -3A, and -4A	Reduced or no air flow through emergency air cleanup unit and loss of MCR pressurization	None. (See Remarks)	Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B and -4B start redundant Train B Emerg. Air Cleanup Unit Fan B-B
20B	Control Bldg. Emergency Air Cleanup Unit B-B	Filters potentially contaminated outside air prior to introducing it into MCRHZ during CRI	Blocked	Dirty filters	Loss of Control Room Press. Diff. common Alarm through Switches 0-PDS-31-1B, -2B, -3B, and -4B	Reduced or no air flow through emergency air cleanup unit and loss of MCR pressurization	None. (See remarks)	Control Room Press. Diff. Switches 0-PDS-31-1A, -2A, -3A and -4A start redundant Train A Emerg. Air Cleanup Unit Fan A-A
21A	Control Bldg. Emergency Air Cleanup Unit Fan A-A	Draws recirc. and outside air through air cleanup unit during CRI	Fails to start Stops	Mechanical failure Electrical failure	Loss of Control Room Press. Diff. common Alarm through Switches 0-PDS-31-1A, -2A, -3A, and -4A	Loss of air flow path through Train A and loss of MCR pressurization	None. (See Remarks)	Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B and -4B start redundant Train B Emerg. Air Cleanup Unit Fan B-B
21B	Control Bldg.	Draws recirc. and	Fails to start	Mechanical	Loss of Control	Loss of air	None. (See	Control Room Press.

TABLE 9.4-7 (Sheet 11 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Emergency Air Cleanup Unit Fan B-B	outside air through air cleanup unit during CRI	Stops	failure Electrical failure	Room Press. Diff. common Alarm through Switches 0-PDS-31-1B, -2B, -3B, and -4B	flow path through Train B and loss of MCR pressurization	Remarks)	Diff. Switches 0-PDS-31-1A, -2A, -3A and -4A start redundant Train A Emerg. Air Cleanup Unit Fan A-A
22A	Fire Damper 0-ISD-31-3935	Fire barrier at the Control Bldg. Emerg. Air Cleanup Unit (ACU) Fan A-A discharge. (Prevents fire spreading downstream of the Fan A-A)	Open during fire Closed during CRI	Mechanical failure Mechanical failure.(fusible link)	See remarks The Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1A, -2A, -3A, and -4A	See remarks Loss of air flow through the Train A ACU and loss of MCR pressurization	See remarks None. (See remarks)	Single failure of HVAC system need not be postulated as being concurrent with fire The Control Room Press. Diff. Switches 0-PDS-31-1B, -2B, -3B, and -4B start Redundant Train B Emerg. Air Cleanup Unit with its Fan B-B
22B	Fire Damper 0-ISD-31-3936	Fire barrier at the Control Bldg. Emerg. Air Cleanup Unit (ACU) Fan B-B discharge. (Prevents fire spreading downstream of the Fan B-B)	Open during fire Closed during CRI	Mechanical failure Mechanical failure (fusible link)	See remarks The Loss of Control Room Press. Diff. Common Alarm through Switches 0-PDS-31-1B, -2B, -3B, and -4B	See remarks Loss of air flow through the Train B ACU and loss of MCR pressurization	See remarks None. (See remarks)	Single failure of HVAC system need not be postulated as being concurrent with fire The Control Room Press. Diff. Switches 0-PDS-31-1A, -2A, -3A, and -4B start Redundant Train A Emerg. Air Cleanup Unit with its Fan A-A

TABLE 9.4-7 (Sheet 12 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
23	Fire Damper 0-XFD-31-75	Fire barrier between Conference Room and Technical Support Center	Open during fire	Mechanical failure Electrical failure	See remarks	See remark	See remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close during other modes of operation	ETL Link failure	Surveillance and Maintenance	May result in overheating of Technical Support Center	None (see remarks)	These areas are not essential for safe shutdown
24	Fire Damper 0-XFD-31-83	Fire barrier between Relay Room and Main Control Room	Open during fire	Mechanical failure Electrical failure	See Remarks	See Remarks	See remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close during other modes of operation	ETL Link failure	Surveillance and Maintenance	None. (See remarks)	None. (See remarks)	The transfer opening with fire Damper 0-XFD-31-153 provides alternate return air flow path
25	Fire Damper 0-XFD-31-153	Fire barrier between Relay Room and Main Control Room	Open during fire	Mechanical failure Electrical failure	See Remarks	See Remarks	See remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	ETL Link failure	Surveillance and Maintenance	None. (See remarks)	None. (See remarks)	This fire damper has two ETL

TABLE 9.4-7 (Sheet 13 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
26	Fire Damper 0-XFD-31-99	To prevent smoke or fire from the Shift Eng Office and Conference Room from being introduced into the air recirculation system.	Open during fire.	Mechanical failure Electrical failure	See remarks.	See remarks.	See remarks.	Single failure of HVAC system need not be postulated as being concurrent with fire.
			Closed during other modes of operation.	ETL link failure.	Surveillance and Maintenance.	May result in overheating of Shift Eng Office and Conference Room.	None. (See remarks).	These areas are not essential for safe shutdown.
27A	Isolation Damper 0-FCO-31-12	Isolate Main Control Room (MCR) Air Handling Unit (AHU) A-A during standby or maintenance.	Close during Air Handling Unit A-A operation.	Mechanical failure Electrical failure	Annunciation in MCR of MCR Air Conditioning Safety train switchover, via Switches O-PDS-31-161, O-FS-31-84 & O-TS-31-88B	Loss of air flow path through AHU A-A.	None (see remarks).	Redundant AHU B-B starts on low air flow signal from AHU A-A via Flow Switch FS-31-84..
			Open during standby operation	Mechanical failure Electrical &- Auxiliary Control Air Failure			None (see remarks).	Backdraft Damper 0-31-2105 prevents backflow

TABLE 9.4-7 (Sheet 14 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
27B	Isolation Damper 0-FCO-31-11	Isolate Main Control Room (MCR) Air Handling Unit (AHU) B-B during standby or maintenance.	Close during Air Handling Unit B-B operation.	Mechanical failure Electrical failure	Annunciation in MCR of MCR Air Conditioning Safety train switchover via Switches O-PDS-31-186, O-FS-31-94 & O-TS-31-89B	Loss of air flow path through AHU B-B.	None (see remarks).	Redundant AHU A-A starts on low air flow signal from AHU A-A via Flow Switch FS-31-94.
			Open during standby operation.	Mechanical failure Electrical &-Auxiliary Control Air Failure		None (see remarks).	None (see remarks).	Backdraft Damper 0-31-2104 prevents backflow.
28A	Modulating Damper 0-FCO-31-82	Modulates the air flow through cooling coil and bypass to maintain the temperature at thermostat O-TE-31-82 setpoint	Closed (coil section).	Mechanical failure Control Air failure	Annunciation in MCR of MCR Air Conditioning Safety train switchover via Switches O-PDS-31-161, O-FS-31-84 & O-TS-31-88B	Air bypasses the cooling coil and increase of space temperature.	None (see remarks)	Temp. Switch TS-31-88B start the redundant AHU B-B upon high return temp.
			Spurious modulation	Control failure		Space temperature is not maintained at thermostat setting	None (see remarks).	Temp. Switch TS-31-88B starts the redundant AHU B-B upon high return temp.

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
28B	Modulating Damper 0-FC0-31-91	Modulates the air flow through cooling coil and bypass to maintain the temperature at thermostat O-TE-31-91 setpoint	Closed (coil section).	Mechanical failure Control Air failure	Annunciation in MCR of MCR Air Conditioning Safety train switchover via Switches O-PDS-31-186, O-FS-31-94 & O-TS-31-89B	Air bypasses the cooling coil and increase of space temperature.	None (see remarks).	Temp. Switch TS-31-89B starts the redundant AHU A-A upon high return temp.
			Spurious modulation	Control failure		Space temperature is not maintained at thermostat setting.	None (see remarks).	Temp. Switch TS-31-89B start the redundant AHU A-A upon high return temp.
29A	Main Control Room Air Handling Unit A-A							
	Filter	Filters the air	Clogged	Accumulation of dirt	Surveillance (PDI-31-87) and Maintenance and Annunciation in MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-161, 0-FS-31-84 & 0-TS-31-88B	Reduced Air flow may result in rise of space temperature	None (See Remarks)	Surveillance (PDI-31-87) & Maintenance of filters in accordance with maintenance procedures. Either Temp. Switch 0-TS-31-88B or Flow Switch O-FS-31-84 starts redundant Air Handling Unit B-B
	Cooling Coil	Cools the supply air to maintain design	Cooling coil tube break or crack	-Mechanical failure	Annunciation in MCR Air conditioning Safety	Temperature increase in the MCRHZ	None (See Remarks)	Redundant AHU B-B starts upon signal from AHU A-A high

TABLE 9.4-7 (Sheet 16 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		temperature in the MCRHZ			Train Switchover via Switches 0-PDIS-31-161, 0-FS-31-84 & 0-TS-31-88B			temperature switch O-TS-31-88B
	Humidifier	Provides moisture to maintain the design relative humidity in MCRHZ during normal operation mode	No humidification	Steam Boiler failure Steam Control Valve closes Mechanical failure Electrical failure	Moisture Indicator MI-31-176 on Panel L-529	Decrease of Relative Humidity	None (See Remarks)	Maintenance of the relative humidity is not required for safe shutdown of plant
			Humidifica-tion Control Valve fails open	Mechanical failure Electrical failure	Moisture Indicator MI-31-176 on Panel L-529	None. (See remarks)	None (See remarks)	MCR moisture level will not exceed design requirements
	Fan	Circulates the air	Fails to start Stops	Mechanical failure Electrical failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-161, 0-FS-31-84 & 0-TS-31-88B	Loss of air flow through AHU A-A	None (see remarks)	Redundant AHU B-B starts upon signal from AHU A-A Air flow Switch FS-31-84
			Fails to stop	-Electrical	Annunciation in	Increased	None (see	When both AHUs are

TABLE 9.4-7 (Sheet 17 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			or, starts	failure	MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-161, 0-FS-31-84 &0-TS-31-88B	pressure in duct	remarks)	operating the common ductwork static pressure does not exceed 6 inches W.G. safety-related duct design pressure
29B	Main Control Room Air Handling Unit B-B							
	Filter	Filters the air	Clogged	Accumulation of dirt	Surveillance (PDI-31-97) and Maintenance and Annunciation in MCR Air Conditioning Safety Train Switchover via Switches O-PDIS-31-186, O-FS-31-94 & O-TS-31-89B	Reduced Air flow may result in rise of space temperature	None (see remarks)	Surveillance (PDI-31-97) & Maintenance of filters in accordance with maintenance procedures. Either Temp. Switch O-TS-31-89B or flow switch 0-FS-31-94 starts redundant Air Handling Unit A-A.
	Cooling Coil	Cools the supply air to maintain design temperature in the MCRHZ	Cooling coil tube break or crack	Mechanical failure	Annunciation in MCR Air conditioning Safety Train Switchover via Switches O-PDIS-31-186, O-FS-31-94 & O-TS-31-89B	Temperature increase in the MCRHZ	None. (See Remarks)	Redundant AHU A-A starts upon signal from AHU B-B high temperature switch O-TS-31-89B

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	Humidifier	Provides moisture to maintain the design relative humidity in MCRHZ during normal operation mode	No humidification	Steam Boiler failure Steam Control Valve closes Mechanical failure Electrical failure	Moisture Indicator MI-31-201 on Panel L-530	Decrease of Relative Humidity	None (see remarks)	Maintenance of the relative humidity is not required for safe shutdown of plant
			Humidification Control Valve fails open	Mechanical failure Electrical failure	Moisture Indicator MI-31-201 on Panel L-530	None. (See remarks)	None. (See remarks)	MCR moisture level will not exceed design requirements
	Fan	Circulates the air	Fails to start Stops	Mechanical failure Electrical failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches O-PDIS-31-186, O-FS-31-94 & O-TS-31-89B	Loss of air flow through AHU A-A	None (see remarks)	Redundant AHU A-A starts upon signal from AHU B-B Air flow Switch FS-31-94
			Fails to stop or, starts	Electrical failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches O-PDIS-31-186, O-FS-31-94 & O-TS-31-89B	Increased pressure in duct	None (see remarks)	When both AHU are operating the common ductwork static pressure does not exceed 6 inches W.G. safety-related duct design pressure

TABLE 9.4-7 (Sheet 19 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
30A	Backdraft Damper 0-BKD-31-2105	Prevent backflow from AHU B-B through AHU A-A when on standby	Fails to open Fails to close (AHU A-A on Standby)	Mechanical Failure Mechanical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-31-161, 0-FS-31-84, and O-TS-31-88B	Loss of flow through AHU A-A None (See Remarks)	None (See Remarks) None. (See Remarks)	Redundant AHU B-B start upon signal from AHU A-A Air Flow Switch FS-31-84 Isolation Damper 0-FCO-31-12 prevents the backflow
30B	Backdraft Damper 0-BKD-31-2104	Prevent backflow from AHU A-A through AHU B-B when on standby	Fails to open Fails to Close (AHU B-B on Standby)	Mechanical Failure Mechanical failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches O-PDIS-31-186, O-FS-31-94, and 0-TS-31-89B	Loss of air flow through AHU B-B None (See Remarks)	None (See Remarks) None. (See Remarks)	Redundant AHU A-A starts upon signal from AHU B-B Air Flow Switch FS-31-94 Isolation Damper 0-FCO-31-11 prevents the backflow
30C	Backdraft Damper 0-BKD-31-2103	See Remarks	See Remarks	See Remarks	See Remarks	See Remarks	See Remarks	This backdraft damper is not required and is locked in open position.
31	Fire Damper 0-XFD-31-98	To prevent smoke spreading to Conference Room, Shift Eng. Office, Lockers,	Open during fire	Mechanical failure Electrical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire

TABLE 9.4-7 (Sheet 20 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Toilet, and Kitchen	Close during other modes of operation	ETL Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	This fire damper has two ETL links
32	Fire Damper 0-XFD-31-86	Fire barrier between Relay Room and Main Control Room	Open during fire	Mechanical failure Electrical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close during other modes of operation	ETL Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	This fire damper has two ETL Links
33	Fire Damper 0-ISD-31-4402	Prevent fire spreading to Conference Room	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	Loss of supply air to room	None (See Remarks)	Maintenance of the room design temperature is not essential to the Control Building Safety Function
34	Fire Damper 0-ISD-31-4404	Prevent fire spreading to NRC Office	Open during fire	Mechanical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire

TABLE 9.4-7 (Sheet 21 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Close during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	Loss of supply air to room	See Remarks	Maintenance of the room design temperature is not essential to the Control Building Safety Function
35	Fire Damper 0-XFD-31-76	Fire barrier to Technical Support Center (TSC)	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	Loss of supply air to the room	See Remarks	Maintenance of the room design temperature is not essential to the Control Building Safety Function
36A	MCR Water Chiller A-A	Cooling of Chilled Water	Fails to start Stops	Mechanical Failure Electrical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-161, 0-FS-31-84 & 0-TS-31-88B	Increase in chilled water temperature	None. (See Remarks)	Redundant MCR Air Conditioning Train B is started by any of Switches 0-PDIS-31-161, 0-FS-31-84 & 0-TS-31-88B
36B	MCR Water Chiller B-B	Cooling of Chilled Water	Fails to start Stops	Mechanical Failure Electrical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-31-186, 0-FS-31-94 and	Increase in chilled water temperature	None. (See remarks)	Redundant MCR Air Conditioning Train A is started by any of Switches 0-PDIS-31-186, 0-FS-31-94, and 0-TS-31-89B

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
					0-TS-31-89B			
37A	MCR Chilled Water Circulation Pump A-A	Circulate the chilled water	Fails to start Stops	Mechanical Failure Electrical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switch 0-PDIS-31-1 61	Loss chilled water flow	None. (See remarks)	Redundant MCR Air Conditioning Train B is started by any of Switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B
			Leakage through seals	Mechanical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-3 1-161, 0-FS-31-84, and 0-TS-31-88B	Decrease of water content in the system	None. (See remarks)	Redundant MCR Air Conditioning Train B is started by any of Switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B
37B	MCR Water Chiller B-B	Circulate the chilled water	Fails to start stops	Mechanical Failure Electrical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switch 0-PDIS-31-1 86	Loss of chilled water flow	None. (See Remarks)	Redundant MCR Air Conditioning Train A is started by any of Switches 0-PDIS-31-186, 0-FS-31-94, and 0-TS-31-89B
			Leakage through seals	Mechanical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-3 1-186, 0-FS-31-94, and 0-TS-31-89B	Decrease of water content in the system	None. (See remarks)	Redundant MCR Air Conditioning Train A is started by any of Switches 0-PDIS-31-186, 0-FS-31-94, and 0-TS-31-89B

TABLE 9.4-7 (Sheet 23 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
38A	DELETED							
38B	DELETED							
39	Chilled Water Piping	Provide chilled water system flow path	Pipe break or crack	Mechanical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B for Train A and 0-PDIS-31-186, 0-FS-31-94, and 0-TS-31-89B for Train B.	Decrease of water content in the system	None. (See Remarks)	Redundant MCR air conditioning subsystems are started by any of the associated switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B for Train A and 0-PDIS-31-186, 0-FS-31-96, and 0-TS-31-89B for Train B
40	Chilled Water System Manual Shut-off Valves	Provides shut-offs	Leakage	Mechanical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train switchover via Switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B for Train A and 0-PDIS-31-186, 0-FS-31-94, and 0-TS-31-89B for Train B.	Decrease of water content in the system	None. (See Remarks)	Redundant MCR air conditioning subsystems are started by any of the associated switches 0-PDIS-31-161, 0-FS-31-84, and 0-TS-31-88B for Train A and 0-PDIS-31-186, 0-FS-31-96, and 0-TS-31-89B for Train B

TABLE 9.4-7 (Sheet 24 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
41	Fire Damper 0-ISD-31-3978	Fire barrier between Secondary Alarm Station Room and Communications Room	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
42	Fire Damper 0-ISD-31-2037	Fire barrier between Communications Room and Mechanical Equipment Room 692.0-C10	Open during fire	Mechanical Failure	See Remarks	None (See Remarks)	None (See Remarks)	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
43	Fire Dampers (4) 0-ISD-31-2036 0-ISD-31-2038, and	Fire barrier between Communication Room and	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	0-ISD-31-2039, and 0-ISD-31-3951	Mechanical Equipment Room 692.0-C10 and Communication Room and corridor, respectively	Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
44	Fire Damper (2) 0-ISD-31-4617 and 0-ISD-31-3941	Fire barrier between corridor and Mechanical Equipment Room 692.0-C2	Open during fire	Mechanical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	See Remarks	Fire damper has dual fusible links
45	Fire Damper 2-ISD-31-2058	Fire barrier and isolation between Unit 2 Auxiliary Instrument Room and Computer Room	Open during fire	Mechanical Failure Electrical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire. See Item 69B for CO_2 system spurious actuation
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links

TABLE 9.4-7 (Sheet 26 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
46	Fire Damper 0-ISD-31-3968	Fire barrier between Computer Room and Unit 1 Auxiliary Instrument Room	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has two independent fusible links installed
47	Fire Damper (2) 0-ISD-31-3957 and 0-ISD-31-3956 (CO_2 actuated)	Fire barrier and isolation between Computer Room and Unit 1 Auxiliary Instrument Room	Open during fire	Mechanical Failure Electrical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire See Item 69B for CO_2 system spurious activation.
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
48	Fire Dampers (3) 1-ISD-31-3958, 1-ISD-31-3959, and 1-ISD-31-3961	Isolation of the Unit 1 Auxiliary Instrument Room	Open during fire	Mechanical Failure Electrical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire See Item 69B for CO_2 system spurious actuation

TABLE 9.4-7 (Sheet 27 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Closed during other modes of operation	Fusible Link Failure		None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
49	Fire Damper 0-ISD-31-4297	Prevent spreading of fire	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during other modes of operation	Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
50	Backdraft Damper 0-BKD-31-2086	See Remarks	See Remarks	See Remarks	See Remarks	See Remarks	See Remarks	This backdraft damper is not required since the air flow can be controlled by Balancing Damper 0-31-2087 and is locked in open position
51	Fire Damper 0-ISD-31-3971	To maintain fire barrier integrity between Unit 1 Auxiliary Instrument Room Elev. 708.0 and Mechanical Equipment Room 692.0-C2, Elev. 692.0	Open during fire (See Remarks)	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Fusible link failure (See Remarks)	Mechanical (fusible link failure)	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	This fire damper has two independent fusible links

TABLE 9.4-7 (Sheet 28 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
52A	Isolation Damper 0-FCO-31-30	Isolate Electrical Board Room AHUs A-A and B-B while on standby	Close during AHUs A-A and B-A operation Open when AHUs are on standby	Mechanical Failure Electrical Failure Mechanical Failure Electrical and Auxiliary Control Air Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B	Loss of air flow path through AHUs A-A and B-A None (See Remarks)	None None (See Remarks)	Redundant Train B AHUs C-B and D-B start on low air flow signal from AHUs A-A and B-A Air Flow Switches FS-31-117 or FS-31-123 Backdraft dampers 0-31-2001A and 0-31-2001B prevents backflow
52B	Isolation Damper 0-FCO-31-31	Isolate Electrical Board Room AHUs C-B and D-B while on standby	Close during AHUs C-B and D-B operation Open when AHUs are on standby	Mechanical Failure Electrical Failure Mechanical Failure Electrical and Auxiliary Control Air Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B	Loss of air flow path through AHUs C-B and D-B None (See Remarks)	None. (See Remarks) None (See Remarks)	Redundant Train A AHUs A-A and B-A start on low air flow signal from AHUs C-B and D-B Air Flow Switches FS-31-126 or FS-31-154 Backdraft Dampers 0-31-3972 and 0-31-3973 prevents backflow

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
53A	Modulating Dampers (2) 0-FCO-31-335 & 0-FCO-31-336	Modulates the air flow through cooling coil and bypass of AHUs A-A & B-A to maintain the temperature at thermostat 0-TE-31-335 and 0-TE-31-336 setpoint	Open	Mechanical Failure Control Air Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-FS-31-117 & -123 and 0-TS-31-150B	Air bypasses the cooling coil and results in increase of space temperature	None (See Remarks)	Temperature Switch TS-31-150B starts the redundant AHUs upon Temp. Element TE-31-150B sensing high return air temperature
			Spurious modulation	Control Failure		Space is not maintained at set temperature	None (See Remarks)	Same as above
53B	Modulating Dampers (2) 0-FCO-31-337 and 0-FCO-31-338	Modulates air flow through cooling coil and bypass of AHUs C-B and D-B to maintain the temperature at thermostat 0-TE-31-337 and 0-TE-31-338 setpoint	Open	Mechanical Failure Control Air Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-FS-31-126 and -154, and 0-TS-31-157B	Air bypasses the cooling coil and results in increase of space temperature	None (See Remarks)	Temperature Switch TS-31-157B starts the redundant AHUs upon Temp. Element TE-31-157B sensing high return air temperature
			Spurious modulation	Control Failure		Space is not maintained at set temperature	None (See Remarks)	Same as above
54A	Electrical Board Rooms (EBR) Air Handling Units							

TABLE 9.4-7 (Sheet 30 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	(AHU) A-A and B-A							
	- Filters	Filters the air	Clogged	Accumulation of dirt	Surveillance PDI-31-120 & -121 and Maintenance and Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-FS-31-117 and -123, and 0-TS-31-150B	Reduced air flow	None (See Remarks)	Surveillance (PDI-31-120 and -121) and maintenance of filters in accordance with maintenance procedures. Either Temp. Switch 0-TS-31-150B or Flow Switches 0-FS-31-117 and -123 starts redundant AHUs C-B and D-B
	- Cooling Coil	Cools the supply air	Cooling coil tube break or crack	- Mechanical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B	Temperature increases in the EBR spaces.	None (See Remarks)	Redundant AHUs C-B and D-B starts upon signal from AHUs A-A and B-A High Temp Switch TS-31-150B
	- Humidifier	Provides moisture to maintain the design Relative Humidity in EBR spaces during normal operation mode	No humidification	- Steam Boiler Failure - Steam Control Valve Closes - Mechanical Failure- - - Electrical Failure	Moisture Indicator MI-31-231 on Local Panel L-523	None (See Remarks)	None. (See Remarks)	Maintenance of the relative humidity is not required for safe shutdown of plant

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	- Fan	Circulates the air	- Fails to start - Stops	- Mechanical Failure - Electrical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-FS-31-117 and -123 and 0-TS-31-150B	Loss of air flow through AHU	None (See Remarks)	Redundant AHUs C-B and D-B starts upon signal from AHUs A-A or B-A Air Flow Switches FS-31-117 or FS-31-123
			- Fails to stop or start	Electrical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-FS-31-117 and -123, and 0-TS-31-150B	Increased pressure in duct	None (See Remarks)	When both AHUs are operating, the common ductwork static pressure does not exceed 6 inches W.G. safety-related duct design pressure
54B	Electrical Board Rooms (EBR) Air Handling Units (AHU) C-B and D-B							
	- Filters	Filters the air	Clogged	Accumulation of dirt	Surveillance PDI-31-125 and PDI-31-152 and Maintenance and Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches	Reduced air flow may result in rise of space temperatures	None (See Remarks)	Surveillance (PDI-31-125 and -152) and maintenance of filters in accordance with maintenance procedures. Either Temp. Switch 0-TS-31-157B of Flow Switches 0-FS-31-126

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
					0-FS-31-126, 0-FS-31-154 and 0-TS-31-157B			and -154 starts redundant AHUs A-A and B-A
	- Cooling Coil	Cools the supply air	Cooling coil tube break or crack	- Mechanical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B	Temperature increases in the EBR space	None (See Remarks)	Redundant AHUs A-A and B-A starts upon signal from AHUs C-B and D-B High Temp Switch TS-31-157B
	- Humidifier	Provides moisture to maintain the design Relative Humidity in EBR spaces during normal operation mode	No humidification	- Steam Boiler Failure - Steam Control Valve Closes - Mechanical Failure - Electrical Failure	Moisture Indicator MI-31-261 on Local Panel L-524	None (See Remarks)	None. (See Remarks)	Maintenance of the relative humidity is not required for safe shutdown of plant
	- Fan	Circulates the air	- Fails to start - Stops	- Mechanical Failure - Electrical Failure	Annunciation in MCR of MCR Air Conditioning Safety Train Switchover via Switches 0-FS-31-126 and -154 and 0-TS-31-157B	Loss of air flow through AHU's C-B and D-B	None (See Remarks)	Redundant AHUs A-A and B-A starts upon signal from AHUs C-B or D-B Air Flow Switches FS-31-126 or FS-31-154
			- Fails to stop or	Electrical Failure	Annunciation in MCR of MCR Air	Increased pressure in	None (See Remarks)	When both AHUs are operating, the common

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			start		Conditioning Safety Train Switchover via Switches 0-FS-31-126 and -154, and 0-TS-31-157B	duct		ductwork static pressure does not exceed 6 inches W.G. safety-related duct design pressure
55A	Backdraft Dampers (2) 0-BKD-31-2001A and 0-BKD-31-2001B	Prevent backflow from Train B AHUs through Train A air handling units when on standby	Fails to open	- Mechanical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B	Loss of air flow through AHUs A-A and B-A	None (See Remarks)	Redundant AHUs C-B and D-B starts upon signal from AHUs A-A or B-A Air Flow Switches FS-31-117 and FS-31-123, respectively.
			Fails to close (AHUs A-A and B-A on standby)	- Mechanical Failure		None (See Remarks)	None. (See Remarks)	Isolation Damper 0-FCO-31-30 prevents the backflow
55B	Backdraft Dampers (2) 0-BKD-31-3972 and 0-BKD-31-3973	Prevent backflow from Train A AHUs through Train B air handling units when on standby	Fails to open	- Mechanical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-PDIS--31-241, 0-FS-31-126 and -154, and	Loss of air flow through AHUs A-A and B-A	None (See Remarks)	Redundant AHUs A-A and B-A starts upon signal from AHUs C-B or D-B Air Flow Switches FS-31-126 and FS-31-154, respectively

TABLE 9.4-7 (Sheet 34 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Fails to close (AHUs C-B and D-B on standby)	- Mechanical Failure	0-TS-31-157B	None (See Remarks)	None (See Remarks)	Isolation Damper 0-FCO-31-31 prevents the backflow
56	Fire Damper 0-ISD-31-3942	Fire barrier between Mechanical Equipment Room 692.0-C2 and 250V Battery Room #1	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
57	Fire Damper 0-ISD-31-3943	Fire barrier between 250V Battery Room #1 and 250V Battery Board Room #1	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Fusible Link Failure	Surveillance and maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links

TABLE 9.4-7 (Sheet 35 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
58	Fire Damper 0-ISD-31-3944	Fire barrier between 250V Battery Board Room #1 and 250V Battery Board Room #2	Open during fire	- Mechanical failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
59	Fire Damper 0-ISD-31-3947	Fire barrier between 250V Battery Board Room #2 and 250V Battery Room #2	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	See Remarks	Fire damper has dual fusible links
60	Fire Damper 0-ISD-31-3948	Fire barrier between 250V Battery Room #2 and 24V and 48V Battery Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Fusible Link Failure	None (See Remarks)	None (See Remarks)	See Remarks	Fire damper has dual fusible links

TABLE 9.4-7 (Sheet 36 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
61	Fire Damper 0-ISD-31-3949	Fire barrier between 24V and 48V Battery Room and 24V and 48V Battery Board and Charge Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	See Remarks	Fire damper has dual fusible links
62	Fire Damper 0-ISD-31-3950	Fire barrier between 24V and 48V Battery Board and Charge Room and Secondary Alarm Station Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	See Remarks	Fire damper has dual fusible links
63	Fire Dampers (2) 0-ISD-31-3976 and 0-ISD-31-3977	Fire barrier between Secondary Alarm Station Room and	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire

TABLE 9.4-7 (Sheet 37 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Communications Room	Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	See Remarks	Fire damper has dual fusible links
64	Fire Damper 0-ISD-31-3970	Fire barrier between Unit 1 Auxiliary Instrument Room and the Mechanical Equipment Room 692.0-C2	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC systems need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	This fire damper has two independent fusible links
65	Fire Damper 0-ISD-31-3969	Fire barrier between Unit 1 Auxiliary Instrument Room and Computer Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Closed during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has two independent fusible links installed
66	Fire Damper 2-ISD-31-3955	Fire barrier between Computer Room and Unit 2	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.

TABLE 9.4-7 (Sheet 38 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Auxiliary Instrument Room	Closed during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	See Item 69B for CO_2 system spurious actuation Fire damper has dual fusible links
67	Fire Damper 0-ISD-31-4296	Fire Barrier in EBR supply to computer room.	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
68	Fire Damper 0-ISD-31-3956	Fire barrier between Unit 1 Auxiliary Instrument Room and Computer Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire. See Item 69B for CO_2 system spurious failure
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
69A	Fire Damper	Provide isolation	Open during	- Mechanical	See Remarks	See Remarks	See	Single failures of HVAC

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	1-ISD-31-3960	of Unit 1 Auxiliary Instrument Room during CO_2 fire extinguishing	fire	Failure			Remarks	system need not be postulated as being concurrent with fire. See Item 69B for CO_2 system spurious failure. This fire damper has CO_2 actuator without fusible link See Item 69B for CO_2 system spurious failure
69B	Fire Damper 2-ISD-31-2058 2-ISD-31-3955 0-ISD-31-3956 0-ISD-31-3657 1-ISD-31-3958 1-ISD-31-3959 1-ISD-31-3960 1-ISD-31-3961	Provide isolation of Unit #1 and Unit #2 Auxiliary Instrument Rooms and Computer Room during CO_2 fire extinguishing.	Closed during a spurious actuation of the CO_2 system	- Electrical Failure	Annunciation in MCR following a CO_2 discharge	Loss of cooling in Unit #1 and Unit #2 Auxiliary Instrument Rooms and Computer Room	None. (See Remarks)	Plant can be shut down from Auxiliary Control Room
70A	EBR Water Chiller A-A	Cooling of chilled water	Fails to start Stops	Mechanical Failure Electrical Failure	Annunciation in MCR of EBR Air Conditioning Safety Train Switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and O-TS-31-150B	Increase in chilled water temperature	None. (See Remarks)	Redundant EBR air conditioning subsystem is started by any of Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
70B	EBR Water Chiller B-B	Cooling of chilled water	Fails to start Stops	Mechanical Failure Electrical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switches 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B	Increase in chilled water temperature	None. (See Remarks)	Redundant EBR air conditioning subsystem is started by any of Switches 0-PDIS-31-241, 0-FS-31-126 and -156, and 0-TS-31-157B
71A	EBR Chilled Water Circ. Pump A-A	Circulate the chilled water	- Fails to start	- Mechanical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switch 0-PDIS-31-211	Loss of chilled water flow	None. (See Remarks)	Redundant EBR air conditioning Train B is started by any of Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B
			- Stops Leakage through seals	- Electrical Failure - Mechanical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B	Decrease of water content in the system	None. (See Remarks)	Same as above
71B	EBR Chilled Water Circ. Pump B-B	Circulate the chilled water	- Fails to start	- Mechanical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switch	Loss of chilled water flow	None. (See Remarks)	Redundant EBR air conditioning Train A is started by any of Switches 0-PDIS-31-241, 0-FS-31-126 and -154,

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
					0-PDIS-31-241			and 0-TS-31-157B
			- Stops	- Electrical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switches 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B	Decrease of water content in the system	None. (See Remarks)	Same as above
			Leakage through seals	- Mechanical Failure		None. (See Remarks)		
72A	DELETED							
72B	DELETED							
73	Chilled Water Piping	Provide chilled water system flow path	Pipe break or crack	- Mechanical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switches 0-PDIS-31-211,	Decrease of water content in the system	None. (See Remarks).	Redundant EBR air conditioning subsystem is started by any of Switches 0-PDIS-31-177 and -123, 0-TS-31-150B for Train A, and

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
					0-FS-31-117 and -123, and 0-TS-31-150B for Train A, and 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B for Train B.			0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B for Train B
74	Chilled Water System manual shut-off valves	Provide Shut-Offs	- Leakage	- Mechanical Failure	Annunciation in MCR of EBR air conditioning safety train switchover via Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B for Train A, and 0-PDIS-31-241, 0-FS-31-126 and -154, 0-TS-31-157B for Train B	Decrease of water content in the system	None. (See Remarks).	Redundant EBR Air Conditioning Subsystems are started by any of the associated Switches 0-PDIS-31-211, 0-FS-31-117 and -123, and 0-TS-31-150B for Train A, and 0-PDIS-31-241, 0-FS-31-126 and -154, and 0-TS-31-157B for Train B
75	Fire Dampers (3) 0-ISD-31-2013, 0-ISD-31-2018, and	Fire barrier between Battery Board Rooms and Corridor	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	0-ISD-31-2029		Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links.
76	Fire Dampers (3) 0-ISD-31-2010, 0-ISD-31-2021, and 0-ISD-31-2028	Fire barrier between Battery Rooms and Corridor	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links.
77	Fire Damper 0-ISD-31-2024	Fire barrier between 24V and 48V Battery Room and 250V Battery Room #2	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
78	Fire Damper 0-ISD-31-2019	Fire barrier between 250V Battery Room #2 and 250 Battery	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Board Room #2	Close during other modes of operation	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
79	Fire Damper 0-ISD-31-3945	Fire barrier between 250V Battery Board Room #2 and 250V Battery Board Room #1	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
80	Fire Damper 0-ISD-31-2012	Fire barrier between 250V Battery Board Room #1 and 250V Battery Room #1	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links.
81	Fire Damper 0-ISD-31-2007	Fire barrier between Battery Room #1 and Mechanical	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire.

TABLE 9.4-7 (Sheet 45 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Equipment Room 692.0-C2	Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
82A	Battery Room Exhaust Fan A-A	Battery rooms exhaust to prevent hydrogen buildup	- Fails to start -Stops	- Mechanical Failure - Electrical Failure	Alarm in MCR via Airflow Switch 0-FS-31-402	Loss of battery rooms exhaust	None (See Remarks)	Redundant Battery Exhaust Fan B-B starts on Low Air Flow signal from Fan A-A Air Flow Switch 0-FS-31-402
82B	Battery Room Exhaust Fan B-B	Battery rooms exhaust to prevent hydrogen buildup	- Fails to start -Stops	- Mechanical Failure - Electrical Failure	Alarm in MCR via Airflow Switch 0-FS-31-401	Loss of battery rooms exhaust	None (See Remarks)	Redundant Battery Exhaust Fan A-A starts on Low Air Flow signal from Fan B-B Air Flow Switch 0-FS-31-401
83A	Backdraft Damper 0-BKD-31-2163	Prevents backflow	Fails to open Fails to close	- Mechanical Failure - Mechanical Failure	Alarms in MCR via Airflow Switch 0-FS-31-402	Loss of airflow path through Exhaust Fan B-B None. (See Remarks)	None (See Remarks) None. (See Remarks)	Redundant Battery Exhaust Fan B-B starts on Low Air Flow signal from Fan A-A Air Flow Switch 0-FS-31-402 Isolation Damper 0-FCO-31-28 prevents backflow

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
83B	Backdraft Damper 0-BKD-31-2162	Prevents backflow	Fails to open	- Mechanical Failure	Alarms in MCR via Airflow Switch 0-FS-31-401	Loss of airflow path through Exhaust Fan B-B	None (See Remarks)	Redundant Battery Exhaust Fan A-A starts on Low Air Flow signal from Fan B-B Air Flow Switch 0-FS-31-401
			Fails to close	- Mechanical Failure		None (See Remarks)	None. (See Remarks)	Isolation Damper 0-FCO-31-29 prevents backflow
84A	Isolation Damper 0-FC0-31-28	Isolates Fan A-A when on standby	Close during Fan A-A operation	- Mechanical Failure - Electrical Failure	Alarm in MCR via Airflow Switch 0-FS-31-402	Loss of Airflow Path through Exhaust Fan A-A	None. (See Remarks).	Redundant Battery Exhaust Fan B-B starts on Low Air Flow signal from Fan A-A Air Flow Switch 0-FS-31-402.
			Open when Fan A-A is on Standby	- Mechanical Failure - Electrical Failure	Damper Status Indication on Panel 1-M-9 in MCR via Limit Switch ZS-31-28	None (See Remarks)	None. (See Remarks).	Backdraft Damper 0-BKD-31-2163 will prevent backflow through fan.
84B	Isolation Damper 0-FC0-31-29	Isolates Fan B-B when on standby	Close during Fan B-B operation	- Mechanical Failure - Electrical Failure	Alarm in MCR via Airflow Switch 0-FS-31-401	Loss of Airflow Path through Exhaust Fan A-A	None. (See Remarks).	Redundant Battery Exhaust Fan A-A starts on Low Air Flow signal from Fan B-B Air Flow Switch 0-FS-31-401.

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
			Open when Fan B-B is on Standby	- Mechanical Failure - Electrical Failure	Damper Status Indication on Panel 1-M-9 in MCR via Limit Switch 0-MTR-31-29/BRE-B	None (See Remarks)	None. (See Remarks)	Backdraft Damper 0-BKD-31-2163 will prevent backflow through fan.
85	Fire Damper 0-ISD-31-3940	Fire Barrier between Mechanical Equipment Room 692.0-C2 and Unit #1 Aux. Instr. Rm 708.0 C1	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
86	Fire Damper 0-ISD-31-3939	Fire Barrier between Unit #1 Aux. Instr. Room 708.0 C1 and Spreading Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as concurrent with fire.
			Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
87	Fire Damper 0-ISD-31-3932	Fire Barrier between Spreading Room	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as concurrent with fire.

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		and MCRHZ	Close during other modes of operation	- Fusible Link Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Fire damper has dual fusible links
88	Tornado Damper 0-FC0-31-14	Isolation during Tornado Event	Fails to close during Tornado Event	Mechanical failure Electrical Failure	Status Indication in Equip. Rm. Via Limit Switch ZS-31-14	None (See Remarks)	None. (See Remarks).	Redundant Tornado Damper 0-FC0-31-13 powered from Train A and installed in series accomplishes isolation during Tornado Event
		Isolates exhaust from Battery Room exhaust fans A-A and B-B1	Spuriously closes	Electrical failure	Loss of flow alarm in MCR zone switches ZS-31-13 and -14	Loss of ventilation for Battery Rooms	None. (See Remarks).	Operator turns on redundant exhaust fan C-B
89	Tornado Damper 0-FC0-31-13	Isolation during Tornado Event	Fails to close during Tornado Event	Mechanical Failure Electrical Failure	Status Indication in Mechanical Equip. Rm. Via Limit Switch ZS-31-13	None (See Remarks)	None. (See Remarks).	Redundant Tornado Damper 0-FC0-31-14 powered from Train B and installed in series accomplishes isolation during Tornado Event
		Isolates exhaust from Battery Room exhaust fans B-B and B-B1	Spuriously closes	Electrical failure	Loss of flow alarm in MCR zone switches ZS-31-13 and -14	Loss of ventilation for Battery Rooms	None. (See Remarks).	Operator turns on redundant exhaust fan C-B
90	Spreading Room Supply Fan	Supply of Ventilation Air to	Fails to Stop on CRI	Electrical Failure		Non (See Remarks)	None (See Remarks)	Isolation Damper 0-=FCO-31-9 & -10 are

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Spreading Room	signal					closed during CRI and no air is supplied to Spreading Room.
90A	Spreading Room non-safety Supply Fan and Isolation Damper 0-FC0-31-10 or 0-FC0-31-9	Fan: Supply ventilation air to spreading room dampers: Provide isolation of MCRHZ from spreading room	Failure of the nonsafety related fan to stop concurrent with failure of one of the two dampers failing to close on a CRI signal	Mechanical Failure Electrical Failure	Surveillance and Maintenance for fan. Status indication in MCR on Panel 1-M-9 for dampers.	None (See Remarks)	None (See Remarks)	Amount of outleakage generated by this failure will not increase the total MCRHZ outleakage beyond the maximum allowable make-up air quantity. Therefore, the positive pressure of 1/8" wg minimum is maintained even under this failure condition
91	Isolation Damper 0-FC0-31-10	Isolation of MCRHZ from Spreading Room	Open during CRI	Mechanical Failure Electrical Failure	Status Indication in MCR on Panel 1-M-9 via Limit Switch ZS-31-10	None (See Remarks)	None (See Remarks)	Redundant Safety Train B Isolation Valve 0-FC0-31-9 installed in series will be closed during CRI to provide isolation
92	Isolation Damper 0-FC0-31-9	Isolation of MCRHZ from Spreading Room	Open during CRI	Mechanical Failure Electrical Failure	Status Indication in MCR on Panel 1-M-9 via Limit Switch ZS-31-9	None (See Remarks)	None (See Remarks)	Redundant Safety Train A Isolation Valve 0-FC0-31-10 installed in series will be closed during CRI to provide isolation

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
93	Fire Damper 0-ISD-31-3933	Fire barrier between Mechanical Equipment Room and Spreading Room	Open during fire	Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire
			Close	Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Spreading Room ventilation is isolated during CRI
94	Spreading Room Exhaust Fans (2-100%) A-A & B-B	Exhaust of Spreading Room	Fails to stop during CRI	- Electrical Failure		None (See Remarks)	None (See Remarks)	Isolation Dampers 0-FC0-31-9 and 0-FC0-31-10 are closed during CRI
95	Isolation Dampers 0-FC0-31-25 for Fan A-A and 0-FC0-31-26 for Fan B-B	Isolation of Spreading Room from outside	Open during CRI	- Mechanical Failure - Electrical Failure	Status Indication in MCR on Panel 1-M-9 via Limit Switches ZS-31-25 & ZS-31-26	None (See Remarks)	None (See Remarks)	The fans are stopped during CRI
96	Backdraft Damper 0-BKD-31-2152	Prevent backflow to Spreading Room	Open during CRI	- Mechanical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Isolation Dampers 0-FC0-31-25 and 0-FC0-31-26 are closed during CRI
97	Fire Damper 0-ISD-31-3953	Fire barrier between Spreading Room and Turbine	Open during fire	- Mechanical Failure	See Remarks	See Remarks	See Remarks	Single failures of HVAC system need not be postulated as being concurrent with fire

TABLE 9.4-7 (Sheet 51 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		Room	Closed during other modes of operation	Surveillance and Maintenance	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Spreading Room ventilation is isolated during CRI
98	Tornado Damper 0-FC0-31-24 (Train B)	Isolation during Tornado Event	Fails to close during Tornado Event	Mechanical Failure Electrical Failure	Status Indication in Mech Equip Room via Limit Switch ZS-31-24	None (See Remarks)	None (See Remarks)	Redundant Tornado Damper 0-FC0-31-23 powered from Train A and installed in series accomplishes isolation during Tornado Event
		Isolates Battery Room exhaust fans C-B and spreading room exhausts	Closes spuriously	Electrical failure	Loss of flow alarm in MCR, zone switches ZS-31-23, -24	Loss of ventilation for spreading room (Battery Rm fan C-B is idle)	None (See Remarks	Spreading Room ventilation is not essential and battery Rm exhaust Fan C-B does not normally run.
99	Tornado Damper 0-FC0-31-23 (Train A)	Isolation during Tornado Event	Fails to close during Tornado Event	Mechanical Failure Electrical Failure	Status Indication in Mech Equip Room via Limit Switch ZS-31-23	None (See Remarks)	None (See Remarks)	Redundant Tornado Damper 0-FC0-31-24 powered from Train B and installed in series accomplishes isolation during Tornado Event
		Isolates Battery Room exhaust fans C-B and spreading room exhausts	Closes spuriously	Electrical failure	Loss of flow alarm in MCR, zone switches ZS-31-23, -24	Loss of ventilation for spreading room (Battery Rm fan C-B is idle)	None (See Remarks	Spreading Room ventilation is not essential and battery Rm exhaust Fan C-B does not normally run.

TABLE 9.4-7 (Sheet 52 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
100	Toilet & Locker Room Exhaust Fan	Provide exhaust of toilets and lockers	Fails to stop during CRI	Electrical Failure	Surveillance and Maintenance	None (See Remarks)	None (See Remarks)	Isolation Dampers 0-FC0-31-16 and -17 will close during CRI and prevent exhaust air flow during CRI
100A	Toilet & Locker Room non-safety Exhaust Fan & Isolation Damper 0-FCO-31-17 or 0-FCO-31-16	Fan: Provides exhaust of toilets & lockers. Dampers: Provide isolation of MCRHZ from outside during CRI	Failure of the nonsafety related fan to stop concurrent with failure of one of the two dampers failing to close on a CRI signal	Mechanical Failure Electrical Failure	Maintenance for fan. Status indication in MCR on Panel 1-M-9 for dampers	None (See Remarks)	None (See Remarks)	Amount of outleakage generated by this failure will not increase the total MCRHZ outleakage beyond the maximum allowable make-up air quantity. Therefore, the positive pressure of 1/8" wg minimum is maintained even under this failure condition
101	Isolation Damper 0- FCO-31-17	Isolation of MCRHZ during CRI from outside	Open during CRI	Mechanical Failure Electrical Failure	Status Indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-17	None (See Remarks)	None (See remarks)	Redundant Safety Train B Isolation Damper 0-FCO-31-16 will be closed during CRI
102	Tornado Damper 0-FCO-31-16	Isolation of MCRHZ during CRI from outside	Open during CRI	Mechanical Failure Electrical Failure	Status Indication in Control Room on Panel 1-M-9 via Limit Switch ZS-31-16	None (See Remarks)	None (See Remarks)	Redundant Safety Train A Isolation Damper 0-FCO-31-17 will be closed during CRI

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FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
103	Tornado Damper 0-FCO-31-18 (Train B)	Isolation of MCRHZ during Tornado Event	Fails to close during Tornado Event	Mechanical Failure Electrical Failure	Status Indication via Limit Switch ZS-31-18	None (See Remarks)	None (See Remarks)	Redundant Tornado Damper 0-FCO-31-15 powered from Train A and installed in series accomplishes isolation during Tornado Event
104	Tornado Damper 0-FCO-31-15 (Train A)	Isolation of MCRHZ during Tornado Event	Fails to close during Tornado Event	Mechanical Failure Electrical Failure	Status Indication via Limit Switch ZS-31-15	None (See Remarks)	None (See Remarks)	Redundant Tornado Damper 0-FCO-31-18 powered from Train B and installed in series accomplishes isolation during Tornado Event
105A	Emergency Power to Train A	Provide power to the Control Building HVAC System Train A	Power Train A fails	Mechanical Failure (Diesel Generator Failure) Electrical Failure	Alarm/indication in MCR	Loss of Train A Control Building HVAC Systems	None (See Remarks)	Redundant Train B Control Building HVAC System with its Train B electrical power is available
105B	Emergency Power to Train B	Provide power to the Control Building HVAC System Train B	Power Train B fails	Mechanical Failure (Diesel Generator Failure) Electrical Failure	Alarm/indication in MCR	Loss of Train B Control Building HVAC Systems	None (See Remarks)	Redundant Train A Control Building HVAC System with its Train A electrical power is available
106A	Auxiliary Control Air System Train	Provide safety related control air	Loss of Auxiliary Air	Mechanical Failure	Alarm/indication in MCR	Loss of Train A Control	None (See Remarks)	Redundant Train B Control Building HVAC

TABLE 9.4-7 (Sheet 54 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	A	to Train A valves, dampers and instruments	System Train A	Electrical Failure		Building HVAC Systems		System with Train B Aux. Control Air System is available
106B	Auxiliary Control Air System Train B	Provide safety related control air to Train B valves, dampers and instruments	Loss of Auxiliary Air System Train B	Mechanical Failure Electrical Failure	Alarm/indication in MCR	Loss of Train B Control Building HVAC Systems	None (See Remarks)	Redundant Train A Control Building HVAC System with Train A Aux. Control Air System is available
107	Roof ventilators 1-FAN-30-912, -913, -916, -917 & -918 on Board 1A 1-FAN-30-909, -910, -911, -914, & -915 on Board 1B 2-FAN-30-912, -913, -916, -917 & -918 on Board 2A 2-FAN-30-909, -	Provide Turbine Building El 755' ventilation	Loss of power to Board 1A	Electrical	Surveillance and maintenance	None (See Remarks)	None. (See Remarks)	Loss of power to Board 1A stops five roof ventilators and north supply Fan 1, and results in operation of 15 roof ventilators @ 28,500 cfm each and north supply Fan 2 @ 68,000 cfm and 2 south supply fans @ 35,000 cfm each resulting in lower than atmospheric pressure (68,000 + 2x35,000 - 15X28,500 = -289,500 cfm)

TABLE 9.4-7 (Sheet 55 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	910, -911, -914, & -915 on Board 2B North El 755 Supply Fan 1, 1-FAN-30-924 on Board 1A South El 755 Supply Fan 1, 1-FAN-30-921 on Board 1B North El 755 Supply Fan 2, 2-FAN-30-924 on Board 2A South El 755 Supply Fan 2, 2-FAN-30-921 on Board 2B		Loss of power to Board 1B		Surveillance and maintenance	None. (See Remarks)	None. (See Remarks)	Loss of power to Board 1B stops five roof ventilators and south supply Fan 1, and results in operation of 15 roof ventilators @ 28,500 cfm each and 2 north supply fans @ 68,000 cfm each and one South supply fan @ 35,000 cfm resulting in lower than atmospheric pressure (2x68,000 cfm + 35,000 - 15X28,500 cfm = - 256,500 cfm)
			Loss of power to Board 1B and 2B		Surveillance and maintenance	None. (See Remarks)	None. (See Remarks)	Loss of power to Board 1B and 2B stops 10 roof vents and 2 south supply fans and results in operation of 10 roof vents @ 28,500 cfm each and 2 north supply fans @ 35,000 cfm each resulting in lower than atmospheric pressure (2x68,000 cfm - 10-28,500 = -149,000 cfm)

TABLE 9.4-7 (Sheet 56 of 56)

FAILURE MODES AND EFFECTS ANALYSIS CONTROL BUILDING HVAC

Note:

1. Refer to TVA Calculation No. TI-639.

TABLE 9.4-8 (Sheet 1 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
01	1-FAN-30-103 Aux. Bldg. General Supply Fan 1A and associated isolation Dampers 1-FCO-30-86, -87, -106 and -107.	Fan to stop and remain stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of supply air to the Aux. Bldg. after an ABI signal.	Fan fails to stop and one damper fails to close during an ABI emergency	Fan: Spurious operation, ABI or RAD detection high temperature signal failure, hot short in control wiring. Operator error (handswitch placed in wrong position). Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	Indicating lights in MCR for Fan 1A running indicating lights in MCR for damper.	Increased in-leakage within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Potential loss of duct/ damper pressure integrity.	None. (See Remarks)	1.Supply fan is not safety-related but is required to stop running during a DBE. 2.The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3.If the additional in-leakage through the fan/damper disturbs the system to a point that one ABGTS filtration unit cannot maintain the design negative pressure level, the standby ABGTS filtration unit will start in order to handle the additional in-leakage and to maintain the required negative pressure level. 4.Pressure differential across the duct/damper assembly is acceptable. 5. The spurious operation of the supply fans and failure of one damper will not affect the safe shutdown of the plant, in accordance with analyses and test results.
			Fan fails to stop with one safety-related	Same as above, plus the non-safety building heating system is not	Same as above.	AB air intake room temperature may reach	None. (See Remarks)	An analysis has shown that the low temperature condition inside the AB air intake room would have no adverse impact on the

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
			isolation damper failed open during the minimum outside design conditions	operating.		the minimum outside design temperature of 13°F.		ability of the plant to cope with an accident situation.
2	1-FAN-30-103 Aux. Bldg. General Supply Fan 1A and ABGTS Exhaust Fan A-A or B-B	Supply fan to stop and to remain stopped during DBE's. To prevent flow of supply air to the AB. by stopping on an ABI signal. ABGTS fan operates to maintain a negative pressure in the ABSCE relative to the outside environ.	Supply fan fails to stop; spuriously operates. One ABGTS fan fails to start or fails to run.	For Supply Fan: spurious operation, ABI or RAD detection high temperature signal failure, hot short in control wiring. Operator error (handswitch placed in wrong position). For ABGTS Fan: Mechanical failure, train power failure, train signal failure.	Indicating lights in the MCR.	Increase in in-leakage within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Loss of redundancy in the ABGTS.	None. (See Remarks)	1.Supply fan is not safety-related but is required to stop running during a DBE. Therefore, the only failure having a potential effect on the safety functions of the Aux. Bldg. HVAC system is spurious operation or failure to stop. 2. Supply fan failure concurrent with an ABGTS failure during a LOCA and FHA has been determined not to be credible. In addition, an analysis has shown that ABGTS safety functions will not be impeded by failures in ABI signals or spurious actuation of AB general supply fans.
3	2-FAN-30-105	Fan to stop and remain	Fan fails to stop and	Fan: Spurious operation, ABI or	Indicating lights	Increased in-leakage	None. (See	1. Supply fan is not safety-related but is required to stop

TABLE 9.4-8 (Sheet 3 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
	Aux. Bldg. General Supply Fan 2B and associated isolation Dampers 2-FCO-30-21, -22, -108, -109.	stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of supply air to the Aux. Bldg. after an ABI signal.	one damper fails to close during an ABI emergency.	RAD detection, high temperature signal failure, hot short in control wiring, Operator error (handswitch placed in wrong position). Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	in MCR for Fan 2B running indicating lights in MCR for damper.	within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Potential loss of duct/damper pressure integrity.	Remarks)	running during a DBE. 2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. If the additional in-leakage through the fan/damper disturbs the system to a point that one ABGTS filtration unit cannot maintain the design negative pressure level, the standby ABGTS filtration unit will start in order to handle the additional in-leakage and to maintain the required negative pressure level. 4. Pressure differential across the duct/damper assembly is acceptable. 5. The spurious operation of the supply fans and failure of one damper will not affect the safe shut down of the plant, in accordance with analyses and test results.
			Fan fails to stop with one safety-related isolation damper	Same as above, plus the non-safety building heating system is not operating.	Same as above	AB air intake room temperature may reach the minimum	None. (See Remarks)	An analysis has shown that the low temperature condition inside the AB air intake room would have no adverse impact on the ability of the plant to cope with an accident situation.

TABLE 9.4-8 (Sheet 4 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
			failed open during the minimum outside design conditions			outside design temperature of 13°F.		
4	2-FAN-30-105 Aux. Bldg. General Supply Fan 2B and ABGTS Exhaust Fan A-A or B-B	Supply fan to stop and to remain stopped during DBE's. To prevent flow of supply air to the Aux. Bldg. by stopping on an ABI signal. ABGTS Fan operates to maintain a negative pressure in the ABSCE relative to the outside environment.	Supply fan fails to stop; spuriously operates. One ABGTS fan fails to start or fails to run.	For Supply Fan: spurious operation. ABI or RAD detection, high temperature signal failure, hot short in control wiring, Operator error (handswitch placed in wrong position). For ABGTS Fan: Mechanical failure, train power failure, train signal failure.	Indicatin g lights in the MCR.	Increase in in-leakage within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Loss of redundancy in the ABGTS.	None. (See Remarks)	1. Supply fan is not safety-related but is required to stop running during a DBE. Therefore, the only failure having a potential effect on the safety functions of the Aux. Bldg. HVAC system is spurious operation or failure to stop. 2. Supply fan failure concurrent with an ABGTS failure during a LOCA or FHA has been determined not to be credible. Also, see remark No. 2 for Item 2.
5	1-FAN-30-102	Fan to stop and remain stopped	Fan fails to stop and one	Fan: Spurious operation, ABI or RAD detection,	Indicatin g lights in MCR	Increased in-leakage within the	None. (See Remarks)	1. Supply fan is not safety-related but is required to stop running during a DBE.

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
	Aux. Bldg. General Supply Fan 1B and associated isolation Dampers 1-FCO-30-86, -87, -106 and -107	during DBE's. Dampers to close and remain closed during DBE's to prevent flow of supply air to the Aux. Bldg. after an ABI signal.	damper fails to close during an ABI emergency.	high temperature signal failure, hot short in control wiring, Operator error (handswitch placed in wrong position). Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	for Fan 1B running indicating lights in MCR for damper.	ABSCE. Potential loss of the required negative pressure level within the ABSCE. Potential loss of duct/damper pressure integrity.		2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. If the additional in-leakage through the fan/damper disturbs the system to a point that one ABGTS filtration unit cannot maintain the design negative pressure level, the standby ABGTS filtration unit will start in order to handle the additional in-leakage and to maintain the required negative pressure level. 4. Pressure differential across the duct/damper assembly is acceptable. 5. The spurious operation of the supply fans and failure of one damper will not affect the safe shut down of the plant, in accordance with analyses and test results.
			Fan fails to stop with one safety-related isolation damper failed open during the	Same as above, plus the non-safety building heating system is not operating	Same as above.	AB air intake room temperature may reach the minimum outside design	None. (See Remarks)	An analysis has shown that the low temperature condition inside the AB air intake room would have no adverse impact on the ability of the plant to cope with an accident situation.

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
			minimum outside design conditions			temperature of 13°F.		
6	1-FAN-30-102 Aux. Bldg. General Supply Fan 1B and ABGTS Exhaust Fan A-A or B-B	Supply fan to stop and to remain stopped during DBE's. To prevent flow of supply air to the Aux. Bldg. by stopping on an ABI signal. ABGTS Fan operates to maintain a negative pressure in the ABSCE relative to the outside environment.	Supply fan fails to stop; spuriously operates. One ABGTS fan fails to start or fails to run.	For Supply Fan: spurious operation, ABI or RAD detection, high temperature signal failure, hot short in control wiring, Operator error (handswitch placed in wrong position). For ABGTS Fan: Mechanical failure, train power failure, train signal failure.	Indicating lights in the MCR.	Increase in in-leakage within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Loss of redundancy in the ABGTS.	None. (See Remarks)	1. Supply fan is not safety-related but is required to stop running during a DBE. Therefore, the only failure having a potential effect on the safety functions of the Aux. Bldg. HVAC system is spurious operation or failure to stop. 2. Supply fan failure concurrent with an ABGTS failure during a LOCA or FHA has been determined not to be credible. Also, see remark No. 2 for Item 2.
7	2-FAN-30-104 Aux. Bldg. General	Fan to stop and remain stopped during DBE's.	Fan fails to stop and one damper fails to	Fan: Spurious operation, ABI or RAD detection, high temperature signal failure, hot	Indicating lights in MCR for Fan 2A	Increased in-leakage within the ABSCE.	None. (See Remarks).	1. Supply fan is not safety-related but is required to stop running during a DBE. 2. The fan and isolation dampers separately receive

TABLE 9.4-8 (Sheet 7 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
	Supply Fan 2A and associated isolation Dampers 2-FCO-30-21, -22, -108 and -109	Dampers to close and remain closed during DBE's to prevent flow of supply air to the Aux. Bldg. after an ABI signal.	close during an ABI emergency.	short in control wiring, Operator error (handswitch placed in wrong position). Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	running indicating lights in MCR for damper.	Potential loss of the required negative pressure level within the ABSCE. Potential loss of duct/ damper pressure integrity.		independently trained ABI or RAD detection signals. 3. If the additional in-leakage through the fan/damper disturbs the system to a point that one ABGTS filtration unit cannot maintain the design negative pressure level, the standby ABGTS filtration unit will start in order to handle the additional in-leakage and to maintain the required negative pressure level. 4. Pressure differential across the duct/damper assembly is acceptable. 5. The spurious operation of the supply fans and failure of one damper will not affect the safe shut down of the plant, in accordance with analyses and test results.
			Fan fails to stop with one safety-related isolation damper failed open during the minimum	Same as above, plus the non-safety building heating system is not operating.	Same as above.	AB air intake room temperature may reach the minimum outside design temperature	None. (See Remarks)	An analysis has shown that the low temperature condition inside the AB air intake room would have no adverse impact on the ability of the plant to cope with an accident situation.

TABLE 9.4-8 (Sheet 8 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
			outside design conditions			of 13°F.		
8	2-FAN-30-104 Aux. Bldg. General Supply Fan 2A and ABGTS Exhaust Fan A-A or B-B	Supply fan to stop and to remain stopped during DBE's. To prevent flow of supply air to the Aux Bldg by stopping on an ABI signal. ABGTS Fan operates to maintain a negative pressure in the ABSCE relative to the outside environment.	Supply fan fails to stop; spuriously operates. One ABGTS fan fails to start or fails to run.	For Supply Fan: spurious operation, ABI or RAD detection, high temperature signal failure, hot short in control wiring, Operator error (handswitch placed in wrong position). For ABGTS Fan: Mechanical failure, train power failure, train signal failure.	Indicating lights in the MCR.	Increase in in-leakage within the ABSCE. Potential loss of the required negative pressure level within the ABSCE. Loss of redundancy in the ABGTS.	None. (See Remarks)	1. Supply fan is not safety-related but is required to stop running during a DBE. Therefore, the only failure having a potential effect on the safety functions of the Aux. Bldg. HVAC system is spurious operation or failure to stop. 2. Supply fan failure concurrent with an ABGTS failure during a LOCA or FHA has been determined not to be credible. Also, see remark No 2 for Item 2.
9	1-FAN-30-159 Aux. Bldg. General Exhaust Fan	Fan to stop and remain stopped during DBE's. Dampers to	One damper fails to close during an ABI	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return	Indicating lights in MCR for dampers.	None. (See Remarks).	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers. 2. The fan and isolation

TABLE 9.4-8 (Sheet 9 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
	1A and associated isolation Dampers 1-FCO-30-160,-161	close and remain closed during DBE's to prevent flow of unfiltered exhaust air from Aux. Bldg. to outside, after an ABI signal.	emergency (exhaust fan is shutdown see remark 1).	from open to A-Auto.				dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable (closed) damper prevents release by fan flow path.
10	2-FAN-30-274 Aux. Bldg. General Exhaust Fan 2A and associated dampers 2-FCO-30-271, -272	Fan to stop and remain stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of unfiltered exhaust air from the Aux. Bldg. to outside, after an ABI signal.	One damper fails to close during an ABI emergency. (Exhaust fan is shutdown see remark 1).	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	Indicating lights in MCR for dampers.	None. (See Remarks).	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers. 2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable (closed) damper prevents release by fan flow path.

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
11	1-FAN-30-162 Aux. Bldg. General Exhaust Fan 1B and associated dampers 1-FCO-30-166, -167	Fan to stop and remain stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of unfiltered exhaust air from the Aux. Bldg. to outside, after an ABI signal.	One damper fails to close during an ABI emergency. (Exhaust fan is shutdown see remarks).	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	Indicating lights in MCR for dampers.	None. (See Remarks).	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers. 2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable (closed) damper prevents release by fan flow path.
12	2-FAN-30-278 Aux. Bldg. General Exhaust Fan 2B and associated dampers 2-FCO-30-275, -276	Fan to stop and remain stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of	One damper fails to close during an ABI emergency. (Exhaust fan is shutdown see remark 1).	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	Indicating lights in the MCR.	None. (See Remarks).	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers. 2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable

TABLE 9.4-8 (Sheet 11 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
		unfiltered exhaust air from the Aux. Bldg. to outside, after an ABI signal.						(closed) damper prevents release by fan flow path.
13	0-FAN-30-136 Fuel Handling Area Exhaust Fan A-A and associated dampers 0-FCO-30-137, -138	Fan to stop and remain stopped during DBE's. Dampers to close and remain closed during DBE's to prevent flow of unfiltered exhaust air from the Aux. Bldg. to outside, after an ABI signal.	One damper fails to close during an ABI emergency. (Exhaust fan is shutdown see remark 1).	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure to spring return from open to A-Auto.	Indicating lights in the MCR.	None. (See Remarks.)	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers. 2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable (closed) damper prevents release by fan flow path.
14	0-FAN-30-139 Fuel Handling	Fan to stop and remain stopped during DBE's.	One damper fails to close during an	Damper: Mechanical failure, control wiring or contact failures. Handswitch failure	Indicating lights in the MCR for damper.	None. (See Remarks).	None. (See Remarks)	1. Exhaust fan is not safety-related but is required to stop running during a DBE. Fan motor is equipped with safety-related redundant breakers.

TABLE 9.4-8 (Sheet 12 of 12)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: AUXILIARY BUILDING GENERAL VENTILATION

Item No.	Component Identification	Function	Failure Mode	Potential Cause	Method of Failure Detection	Effect on System	Effect on Plant	Remarks
	Area Exhaust Fan B-B and associated dampers 0-FCO-30-140, -141	Dampers to close and remain closed during DBE's to prevent flow of unfiltered exhaust air from the Aux. Bldg. to outside, after an ABI signal.	ABI emergency. (Exhaust fan is shutdown see Remark 1).	to spring return from open to A-Auto.				2. The fan and isolation dampers separately receive independently trained ABI or RAD detection signals. 3. Ventilation space maintained below outside pressure. Reverse flow through operable (closed) damper prevents release by fan flow path.

TABLE 9.4-8A (Sheet 1 of 3)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES FOR COMPONENTS COMMON TO THE AUX BLDG HVAC SUBSYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	Auxiliary Building Isolation (ABI) signal Train A.	Deenergizes solenoid valves to close associated dampers; stops AB general ventilation fans; starts various ESF room coolers.	Signal fails.	Train A vital ac bus failure; Relay VKA 1 failure; Train A initiating signal (Phase A containment isolation, high rad in refueling area) failure.	MCR indication of only one train of ABGTS fan starting and one train of ABSCE dampers closing.	Loss of redundancy in ABSCE isolation and ESF coolers actuation.	None. (See Remarks)	Train A and Train B ABI initiating signals are derived from independent (train separated) qualified devices. Either train signal will stop all general supply and exhaust fans, and fuel handling area exhaust fans. An analysis has shown that the failure of an ABI signal will not have an adverse effect on the ABGTS safety function.
			Spurious signal.	Operator error, spurious initiating signal (initiating signals listed above.)	None.	Unnecessary isolation of ABSCE, initiation of ESF coolers and startup of ABGTS.	None. (See Remarks)	

TABLE 9.4-8A (Sheet 2 of 3)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES FOR COMPONENTS COMMON TO THE AUX BLDG HVAC SUBSYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
2	Auxiliary Building Isolation (ABI) signal Train B.	Deenergizes solenoid valves to close associated dampers; stops AB general ventilation fans; starts various ESF room coolers.	Signal fails.	Train B vital ac bus failure; Relay VKB1 failure; Train B initiating signal (Phase A containment isolation, high rad in refueling area) failure.	MCR indication of only one train of ABGTS fan starting and one train of ABSCE dampers closing.	Loss of redundancy in ABSCE isolation and ESF coolers actuation.	None. (See Remarks)	Train A and Train B ABI initiating signals are derived from independent (train separated) qualified devices. Either train signal will stop all general supply and exhaust fans, and fuel handling area exhaust fans. An analysis has shown that the failure of an ABI signal will not have an adverse effect on the ABGTS safety function.
			Spurious signal.	Operator error, spurious initiating signal (initiating signals listed above.)	None.	Unnecessary isolation of ABSCE, initiation of ESF coolers and startup of ABGTS.	None.	

TABLE 9.4-8A (Sheet 3 of 3)

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES FOR COMPONENTS COMMON TO THE AUX BLDG HVAC SUBSYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
3	Train A Emergency Power.	Provides Class 1E diesel-backed power supply to active components of Train A of AB HVAC subsystems.	Loss of or inadequate voltage.	Diesel generator failure; bus fault (Train A), Operator error.	Alarm and indication in MCR.	Loss of redundancy in safety-related HVAC system.	None. (See Remarks)	Redundant Train B HVAC system available.
4	Train B Emergency Power.	Provides Class 1E diesel-backed power supply to active components of Train B of AB HVAC subsystems.	Loss of or inadequate voltage	Diesel generator failure; bus fault (Train B); Operator error.	Alarm and indication in MCR.	Loss of redundancy in safety-related HVAC system.	None. (See Remarks)	Redundant Train A HVAC system available

TABLE 9.4-8B (Sheet 1 of 2)

FAILURE MODES AND EFFECTS ANALYSIS FOR AUXILIARY BUILDING HVAC SUBSYSTEM PASSIVE FAILURES

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	Intake opening (one for each of two dampers in each Transformer Room).	Provides air supply intake to 480V Transformer Room 1A, 1B, 2A, and 2B.	Blockage	Mechanical Failure. Foreign Object.	-----------------	Loss of Redundancy in providing air supply.	None. (See Remarks)	Redundant intake opening will supply sufficient air to the room.
2	Refrigerant Piping and Valves for Chiller or Condensing Unit	Provides flowpath for refrigerant from Chiller to AHU and back to Chiller.	Leakage	Cracks	No direct indication of leakage.	Loss of effectiveness of one Chiller and associated AHUs redundant loop. Opposite Train Chiller and AHUs are independent and remain available.	None. (See Remarks)	Redundant chillers and AHUs are provided.
3	Fire Dampers	Close in the event of fire.	Spurious closure	See Remarks	See Remarks	None. (See Remarks)	None. (See Remarks)	1. Double fusible links will prevent spurious closure. 2. An analysis has shown that fire dampers have no identifiable realistic failure mechanisms as passive components. 3. Single active

TABLE 9.4-8B (Sheet 2 of 2)

FAILURE MODES AND EFFECTS ANALYSIS FOR AUXILIARY BUILDING HVAC SUBSYSTEM PASSIVE FAILURES

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								failure is not postulated per WB-DC-40-64 "Design Basis Events Design Criteria."
			Fails to close	See Remarks	See Remarks	None. (See Remarks)	None. (See Remarks	Fire Protection Report postulates no failures other than those directly attributable to the fire.
4.	Ductwork in the Auxiliary Building Gen. Vent and A/C subsystems.	Provides containment for air flow path and controlled distribution and exhausting of cooling/ventil ating air.	Leakage	Cracks	-----------------	Minimal localized reduction of negative pressure and minimized effect on temperature of areas.	None. (See Remarks)	Only small cracks are postulated due to seismic qualification of ductwork. Most of air leaking from flow path will enter the areas for which it is intended. Loss of fluid (air) is not a concern since the system is in the same fluid.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
1	0-CHR-31-36 /2-A Chilled Water Package A-A (Train A)	Provides chilled water to Train A AHUs.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; Control signal failure from 0-PDIS-31-1 01-A; 0-FS-31-43-A; 0-FS-31-38-A; 0-TS-31-40B -A; and O-TS-31-48B -A.	Annunciation of Shutdown Board Room HVAC System A-A Abnormal. Indicating lights in MCR (0-HS-31-400A). Compressor running light on MCC.	See Remarks	None See Remarks	1. Equipment includes CW pump and motor and compressor and motor. 2. Control of the CWCP, 0-PMP-31-36/1-A, and AHUs A-A and B-A is interlocked with Chiller A-A. 3. The system design intent is such that loss of one chiller results only in the loss of redundancy in providing chilled water for cooling Unit 1 and Unit 2 Shutdown Board Rooms. The redundant train chiller serves AHUs C-B and D-B. Chiller A-A will stop automatically and Chiller B-B will start automatically on: • Low DP at Circulating Water Cooling Pump for Chiller A-A. • T > Setpoint at air inlet to Train A
	0-CHR-31-36/2-A Chilled Water Package A-A (Train A) (cont'd)		Reduction of cooling capacity	Loss of refrigerant; Chiller freeze up; Control signal failure.	Inlet temperature indication on L-551 or L-538 for AHU air intake in 6.9 kV Shutdown Board Room. See remark #1.	Loss of redundancy in cooling air flow. See remark #3.	None. (See Remarks)	

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								AHUs. • Low air flow at AHU A-A or B-A. • 4. The switchover to the standby chiller uses separation relays in a non-divisional Train A associated power supply
2	0-CHR-31-49/2-B Chilled Water Package B-B (Train B) 0-CHR-31-49/2-B Chilled Water Package B-B	Provides chilled water to Train B AHUs.	Fails to start; Fails while running Reduction of cooling capacity.	Mechanical failure; Train B power failure; Control signal failure from 0-PDIS-31-131-B, 0-FS-31-51-B, 0-FS-31-57-B, 0-TS-31-60B-B, 0-TS-31-52B-B. Loss of refrigerant; chiller freeze up; Control signal failure.	Annunciation of Shutdown Board Room Hvac System B-B Abnormal. Indicating lights in MCR (0-HS-31-49A) . Compressor running light on MCC. Inlet temperature indication on L-540 or L-537 for AHU air intake in 6.9	Loss of Redundancy Loss of redundancy in cooling air flow.	None. (See Remarks) None. (See Remarks)	1. Equipment includes CW pump & motor and compressor & motor. 2. Control of the CWCP, 0-PMP-31-49/1-B, and AHUs C-B and D-B is interlocked with Chiller B-B. 3. The system design intent is such that loss of one chiller results only in the low of redundancy in providing chilled water for cooling Unit 1 and Unit 2 Shutdown Board Rooms. The redundant train chiller serves AHUs A-A and

TABLE 9.4-9 (Sheet 3 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	(Train B) (cont'd)				kV Shutdown Board Room.			B-A. Chiller B-B stops automatically and Chiller A-A starts automatically on: • Low DP at Chilled Water Circulating Pump for Chiller B-B. • T > Setpoint at air inlet to Train B AHUs. • Low air flow at AHU C-B or D-B. 4. The switchover to the standby chiller uses separation relays in a non-divisional Train B associated power supply.

TABLE 9.4-9 (Sheet 4 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
3	0-AHU-31-45 Air Handling Unit A-A (Train A)	Provides cooling air to maintain required temperatures for Shutdown Board Rooms safety-related equipment on the Unit 1 side.	Fails to start; Fails while running.	Mechanical Failure; Train A power failure; control signal failure; sensing failure for 0-TS-31-40A or 0-TS-31-48A.	Annunciation of Shutdown Board Room HVAC System A-A Abnormal. Indicating lights in MCR (0-HS-31-400A-A). AHU A-A running light on MCC.	Loss of redundancy in cooling air to Unit 1 side Shutdown Board rooms.	None. Redundant Train B Chiller B-B and AHU C-B on Unit 1 side will automatically start on: • Low DP at Circulating Chilled Water Pump. • Low Air flow at AHU A-A or • T > Setpoint at inlet to Train A AHU.	Review of the schematics establishes that the AHUs A-A and C-B (on Unit 1 side) are independent. AHU A-A is interlocked to automatically start on Chiller A-A start. Either train of AHUs (Train A AHUs A-A and B-A or Train B AHUs C-B and D-B) is capable of providing cooling air to the Aux. Control Room.

TABLE 9.4-9 (Sheet 5 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop or starts while unit C-B is operating.	Electrical Failure	Annunciation in the MCR.	Increased pressure in supply duct.	None (See Remarks)	When both Air Handling Units are operating the common ductwork static pressure does not exceed 6 in. wg. duct design pressure.
4	0-AHU-31-44 Air Handling Unit B-A (Train A)	Provides cooling air to maintain required temperatures for Shutdown Board Rooms Safety-related equipment on the Unit 2 side.	Fails to start; Fails while running.	Mechanical Failure; Train A power failure; control signal failure; sensing failure for 0-TS-31-40A or 0-TS-31-48A.	Annunciation of Shutdown Board Room HVAC System A-A Abnormal. Indicating lights in MCR (0-HS-31-400A-A). AHU B-A running light on MCC.	Loss of redundancy in cooling air to Unit 2 side Shutdown Board rooms.	None. Redundant Train B Chiller B-B and AHU D-B on Unit 2 side will automatically start on: • Low DP at Circulating Chilled Water Pump. • Low Air flow at AHU B-A or • T > Setpoint at inlet to Train A AHU.	Review of the schematics establishes that the AHUs B-A and D-B (on Unit 2 side) are independent. AHU B-A is interlocked to automatically start on Chiller A-A start. Either train of AHUs (Train A AHUs A-A and B-A or Train B AHUs C-B and D-B) is capable of providing cooling air to the Aux. Control Room.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop or starts while unit D-B is operating.	Electrical Failure	Annunciation in the MCR.	Increased pressure in supply duct.	None (See Remarks)	When both Air Handling Units are operating, the common ductwork static pressure does not exceed 6 in. wg. duct design pressure.
5	0-AHU-31-55 Air Handling Unit C-B (Train B)	Provides cooling air to maintain required temperatures for Shutdown Board Rooms safety-related equipment on the Unit 1 side.	Fails to start; Fails while running.	Mechanical Failure; Train B power failure; . control signal failure; sensing failure for 0-TS-31-52A or 0-TS-31-60A.	Annunciation of Shutdown Board Room HVAC System B-B Abnormal. Indicating lights on MCR (0-HS-31-49A-B). AHU C-B running light on MCC.	Loss of redundancy in cooling air to Unit 1 side Shutdown Board rooms.	None. Redundant Train A Chiller A-A and AHU A-A on Unit 1 side will automatically start on: • Low DP at Circulating Chilled Water Pump. • Low Air flow at AHU C-B or • T > Setpoint at inlet to Train B AHU.	Review of the schematics establishes that the AHUs A-A and C-B (on Unit 1 side) are independent. AHU C-B is interlocked to automatically start on Chiller B-B start. Either train of AHUs (Train A AHUs A-A and B-A or Train B AHUs C-B and D-B) is capable of providing cooling air to the Aux. Control Room.

TABLE 9.4-9 (Sheet 7 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop or starts while unit A-A is operating.	Electrical Failure	Annunciation in the MCR.	Increased pressure in supply duct.	None (See Remarks)	When both Air Handling Units are operating, the common ductwork static pressure does not exceed 6 in. wg. duct design pressure.
6	0-AHU-31-61 Air Handling Unit D-B (Train B)	Provides cooling air to maintain required temperatures for Shutdown Board Rooms safety-related equipment on the Unit 2 side.	Fails to start; Fails while running.	Mechanical Failure; Train B power failure ; control signal failure; sensing failure for 0-TS-31-52A or 0-TS-31-60A.	Annunciation of Shutdown Board Room HVAC System B-B Abnormal. Indicating lights in MCR (0-HS-31-49A-B). AHU D-B running light on MCC.	Loss of redundancy in cooling air to Unit 2 side Shutdown Board rooms and 480V Shutdown Board Room Unit 2 side.	None. Redundant Train A Chiller A-A and AHU A-A on Unit 2 side will automatically start on: • Low DP at Circulating Chillled Water Pump. • Low Air flow at AHU D-B or • T > Setpoint at inlet to Train B AHU. •	Review of the schematics establishes that the AHUs B-A and D-B (on Unit 2 side) are independent. AHU D-B is interlocked to automatically start on Chiller B-B start. Either train of AHUs (Train A AHUs A-A and B-A or Train B AHUs C-B and D-B) is capable of providing cooling air to the Aux. Control Room.

TABLE 9.4-9 (Sheet 8 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop or starts while unit A-A is operating.	Electrical Failure	Annunciation in the MCR.	Increased pressure in supply duct.	None (See Remarks)	When both Air Handling Units are operating, the common ductwork static pressure does not exceed 6 in. wg. duct design pressure.
7	0-PMP-31-36/1-A Chilled Water Package A-A Cooling Water Circulating Pump	Provides water to the Water Chiller A-A loop.	Fails to start; Fails while running.	Mechanical failure; Train A power failure; Control signal failure; start signal failure; operator error (handswitch placed in wrong position).	Annunciator 2-113 for 0-PDIS-31-101-A. Indicating lights for 0-HS-31-400A in MCR. Chilled water Temperature and Pressure indication on L-541.	Loss of redundancy in supplying cooling air to the Shutdown Board Rooms of both units.	None. Redundant Train B Chiller B-B will automatically start on Lo DP at the pump and will provide cooling water to AHUs C-B and D-B.	Control of 0-PMP-31-36/1-A is interlocked with Chiller A-A to automatically start after chiller start. Review of the control and schematic diagrams establishes the redundancy and independence of the Train A and Train B pumps.
8	0-PMP-31-49/1-B Chilled Water Package B-B Cooling Water Circulating Pump	Provides water for to the Water Chiller B-B loop.	Fails to start; Fails while running	Mechanical failure; Train B power failure; Control signal failure; start signal failure; operator	Annunciator 2-120 for 0-PDIS-31-131-B. Indicator lights for 0-HS-31-49A in MCR. Chilled Water	Loss of redundancy in supplying cooling air to the Shutdown Board Rooms of both units.	None. Redundant Train A Chiller A-A will automatically start on Lo DP at the pump and	0-PMP-31-49/1-B is interlocked to automatically start after Chiller B-B start. Review of the control and schematic diagrams establishes the redundancy and independence of the

TABLE 9.4-9 (Sheet 9 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				error (handswitch placed in wrong position).	Temperature and Pressure indication on L-542.		will provide cooling water to AHUs A-A and B-A.	Train A and Train B pumps.
9	TCV-31-112 Temperature Control Valve for AHU A-A.	Provides control of water temperature to AHU A-A from Chiller A-A by regulating the flow of chilled water to AHU.	Spuriously bypass too much flow.	Mechanical failure; Control Air failure; Sensor failure.	See Remark #1.	Potential loss of redundancy of Train A Chiller A-A and AHU A-A resulting in air temperature rise in Shutdown Board Room.	None. Redundant Train B Chiller B-B and associated AHUs C-B and D-B can provide cooling air supply. See Remark #2.	1. Local indication on L-551 of inlet air temperature to AHU A-A. 2. Temp. rise in Shutdown Bd. rooms > Setpoint will automatically cause Train A Chiller with AHUs A-A and B-A to stop, and Train B with AHUs C-B and D-B to start. 3. The temperature control valves for the AHUs are served by the Aux. Air Supply. The trains are separate.
10	0-TCV-31-108 Temperature Control Valve for AHU B-A.	Provides control of water temperature to AHU B-A from	Spuriously bypass too much flow.	Mechanical failure; Control Air failure; Sensor failure.	See Remark #1.	Potential loss of redundancy of Train A Chiller A-A and AHU B-	None. Redundant Train B Chiller B-B and associated AHUs C-B	1. Local indication on L-538 of inlet air temperature to AHU B-A. 2. Temp. rise in Shutdown Bd. rooms > Setpoint will

TABLE 9.4-9 (Sheet 10 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Chiller A-A by regulating the flow of chilled water to AHU.				A resulting in air temperature rise in Shutdown Board Room.	and D-B can provide cooling air supply. See Remark #2.	automatically cause Train A Chiller with AHUs A-A and B-A to stop, and Train B with AHUs C-B and D-B to start. 3. The temperature control valves for the AHUs are served by the Aux. Air Supply. The trains are separate.
11	0-TCV-31-142 Temperature Control Valve for AHU C-B.	Provides control of water temperature to AHU C-B from Chiller B-B by regulating the flow of chilled water to AHU.	Spuriously bypass too much flow.	Mechanical failure; Control Air failure; Sensor failure.	See Remark #1.	Potential loss of redundancy of Train B Chiller B-B and AHU C-B resulting in air temperature rise in Shutdown Board Room.	None. Redundant Train A Chiller A-A and associated AHUs A-A and B-A can provide cooling air supply. See Remark #2.	1. Local indication on L-537 of inlet air temperature to AHU C-B. 2. Temp. rise in Shutdown Bd. rooms > Setpoint will automatically cause Train B Chiller with AHUs C-B and D-B to stop and Train A with AHUs A-A and B-A to start. 3. The temperature control valves for the AHUs are served by the Aux. Air Supply. The trains are

TABLE 9.4-9 (Sheet 11 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
								separate.
12	0-TCV-31-138 Temperature Control Valve for AHU D-B.	Provides control of water temperature to AHU D-B from Chiller B-B by regulating the flow of chilled water to AHU.	Spuriously bypass too much flow.	Mechanical failure; Control Air failure; Sensor failure.	See Remark #1.	Potential loss of redundancy of Train B Chiller B-B and AHU D-B resulting in air temperature rise in Shutdown Board Room.	None. Redundant Train A Chiller A-A and associated AHUs A-A and B-A can provide cooling air supply. See Remark #2.	1. Local indication on L-540 of inlet air temperatures to AHU D-B. 2. Temp. rise in Shutdown Bd. rooms > Setpoint will automatically cause Train B Chiller with AHUs C-B and D-B to stop and Train A with AHUs A-A and B-A to start. 3. The temperature control valves for the AHUs are served by the Aux. Air Supply. The trains are separate.

TABLE 9.4-9 (Sheet 12 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
13	0-BKD-31-2706 Backdraft Damper	Prevents backflow of cooling air through standby AHU C-B when AHU A-A is running.	Fails to backseat	Mechanical failure.	See Remarks Local position indicators on the damper will indicate if damper is stuck open.	A) Loss of cooling air to room served by the AHU B) Bypass flow through the standby unit can cause standby fan to rotate in reverse. Due to loss of cooling to room. Standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. C) This would result in the total loss of cooling air in the Shutdown Board Rooms	None. (See Remarks)	1. Indirect indication of functional failure of AHU; MCR indication of AHU A-A and B-A motors running; local indication on L-551 of high inlet temp. to AHU A-A. 2. Operability of the dampers is periodically verified.

TABLE 9.4-9 (Sheet 13 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Provide flow path for air flow from AHU.s	Fails to open (Stuck closed) when AHU C-B is running (Train B)	Mechanical failure.	See Remark #2.	Loss of redundancy in cooling air flow from Shutdown Board Room.	None. (Low flow from AHU will automatically initiate Train "A" chiller and AHUs.)	1. Normally open when AHU is running. 2. Indirect indication of functional failure of AHU; local indication on L-537 of inlet temperature to AHU C-B.

TABLE 9.4-9 (Sheet 14 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
14	0-BKD-31-2761 Backdraft Damper	Prevents backflow of cooling air through standby AHU D-B when AHU B-A is running.	Fails to backseat.	Mechanical failure.	See Remark #1. Local position indicators on the damper will indicate if damper is stuck open when the fan is idle.	A) Loss of cooling air to room served by the AHU. B) Bypass flow through the standby unit can cause standby fan to rotate in reverse. Due to loss of cooling to room, Standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. C) This would result in the total loss of cooling air in the Shutdown Board Rooms.	None. (See Remarks)	1. Indirect indication of functional failure of AHU; MCR indication of AHU B-A and A-A motors running; local indication on L-538 of high inlet temperature to AHU B-A. 2. Operability of the dampers is periodically verified.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Provide flow path for air flow from AHU.	Fails to open (Stuck closed) when AHU D-B is running (Train B)	Mechanical failure	See Remark #2.	Loss of redundancy in cooling air flow from Shutdown board Room.	None. (Low flow from AHU will automatically initiate Train "A" Chiller and AHUs.)	1. Normally open when AHU is running. 2. Indirect indication of functional failure of AHU; local indication on L-540 of inlet temp. to AHU D-B.
15	0-BKD-31-2705 Backdraft Damper	Prevents backflow of cooling air through standby AHU A-A when AHU C-B is running.	Fails to backseat.	Mechanical failure.	See Remark #1. Local position indicators on the damper will indicate if damper is stuck open.	A) Loss of cooling air to room served by the AHU. B) Bypass flow through the standby unit can cause standby fan to rotate in reverse. Due to loss of cooling to room, Standby unit is required to start but may fail as a result of	None. (See Remarks)	1. Indirect indication of functional failure of AHU; MCR indication of AHU C-B and D-B motors running; local indication on L-537 of inlet temperature to AHU C-B. 2. Operability of the dampers is periodically verified.

TABLE 9.4-9 (Sheet 16 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
						motor overload to overcome the reverse rotation. C) This would result in the total loss of cooling air in the Shutdown Board Rooms.		
		Provide flow path for air flow from AHU.	Fails to open (Stuck closed) when AHU A-A is running.	Mechanical failure.	See Remark #2.	Loss of redundancy in cooling air flow from Shutdown Board Room.	None. (Low flow from AHU will automatically initiate Train B Chiller and AHUs.)	1. Normally open when AHU is running. 2. Indirect indication of functional failure of AHU; local indication on L-551 of inlet temperature to AHU A-A.

TABLE 9.4-9 (Sheet 17 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
16	0-BKD-31-2760 Backdraft Damper	Prevents backflow of cooling air through standby AHU B-A when AHU D-B is running.	Fails to backseat.	Mechanical failure.	See Remark #1. (Local position indicators on the damper will indicate if damper is stuck open.)	A) Loss of cooling air to room served by the AHU. B) Bypass flow through the standby unit can cause standby fan to rotate in reverse. Due to loss of cooling to room, Standby unit is required to start but may fail as a result of motor overload to overcome the reverse rotation. C) This would result in the total loss of cooling air in the Shutdown Board Rooms.	None. (See Remarks)	1. Indirect indication of functional failure of AHU; MCR indication of AHU D-B and C-B motors running; local indication on L-540 of inlet temperature to AHU D-B. 2. Operability of the dampers is periodically verified.

TABLE 9.4-9 (Sheet 18 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Provide flow path for air flow from AHU.	Fails to open (Stuck closed) when AHU B-A is running.	Mechanical failure.	See Remarks	Loss of redundancy in cooling air flow from Shutdown Board Room.	None. (Low flow from AHU will automatically initiate Train "B" chiller and AHUs.)	1. Normally open when AHU is running. 2. Indirect indication of functional failure of AHU; local indication on L-538 of inlet temperature to AHU B-A.
17	0-FAN-31-62-A Pressurizing Air Supply Fan A-A	Provides pressurization to maintain 6.9kV Shutdown Board Room at slightly positive pressure with respect to atmosphere.	Fails to start, fails while running.	Mechanical failure; Train A power failure; Control signal failure.	Indicating lights in MCR (1-HS-31-64A) and CISP indicating lights in MCR (1-HS-31-64A)	Loss of redundancy in providing pressurization to 6.9 kV Shutdown Board Room. (See Remark #1.)	None. (After trip due to lo suction flow to Fan A-A, the redundant Train B Fan C-B will automatically start.)	1. The pressurizing fans are not required to mitigate the effects of a DBE. 2. Fans can be restarted after reset after Phase A CIS from Unit 1. Review of the schematics establishes the separation and independence of the Train A and Train B fans.

TABLE 9.4-9 (Sheet 19 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop.	Mechanical failure; Hot short in control wiring; Control signal failure; CIS Phase A Control signal failure. CRI Control Room Isolation signal - Train A fails.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-64A). Alarm in MCR when ΔP between MCRHZ and ABSDBR is <1/8-inch w.g	See Remark #2.	None.(See Remark #3).	1. Fans can be stopped via HS-31-64 A or B. 2. Over pressurization of 6.9 kV Shutdown Board Room A with respect to MCR. 3. Differential pressure switches will alarm if the DP is not adequate and start standby CB emergency pressurizing fan during CRI mode to restore MCR DP with respect to Shutdown Bd. Rooms.

TABLE 9.4-9 (Sheet 20 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
18	0-FAN-31-67-B Pressurizing Air Supply Fan C-B	Provides pressure-zation to maintain 6.9 kV Shutdown Board Room at slightly positive pressure with respect to atmosphere.	Fails to start, fails while running.	Mechanical failure; Train B power failure; Control signal failure.	Indicating lights in MCR (1-HS-31-64A) and CISP indicating lights in MCR (1-HS-31-64A)	Loss of redundancy in providing pressurizati on to 6.9 kV Shutdown Board Room. (See Remark #1.)	None. (After trip due to lo suction flow to Fan C-B, the redundant Train A Fan A-A will automatically start.)	1. The pressurizing fans are not required to mitigate the effects of a DBE. 2. Fan can be restarted after reset after Phase A CIS from Unit 1. Review of the schematics establishes the separation and independence of the Train A and Train B fans.
			Fails to stop.	Mechanical failure; Hot short in control wiring; Control signal failure; CIS Phase A Control signal failure. CRI Control Room Isolation signal - Train A fails.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-64A). Alarm in MCR when ΔP between MCRHZ and ABSDBR is <1/8-inch w.g.	See Remark #2. Over pressurizati on of 6.9 kV Shutdown Board Room A.	None. (See Remark #3).	1. Fans can be stopped via HS-31-67 A or B. 2. Differential pressure switches will alarm if the DP is not adequate and start standby CB emergency pressurizing fan during CRI mode to restore MCR DP with respect to Shutdown Bd. Rooms..

TABLE 9.4-9 (Sheet 21 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
19	0-FAN-31-64-A Pressurizing Air Supply Fan B-A	Provides pressurization to maintain 6.9 kV Shutdown Board Room at slightly positive pressure with respect to atmosphere.	Fails to start, fails while running.	Mechanical failure; Train A power failure; Control signal failure.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-62A).	Loss of redundancy in providing pressurization to 6.9 kV Shutdown Board Room. (See Remark #1.)	None. (After trip due to lo suction flow to Fan B-A, the redundant Train B Fan D-B will automatically start.)	1. The pressurizing fans are not required to mitigate the effects of a DBE. 2. Fan can be restarted after reset after Phase A CIS from Unit 1. Review of the schematics establishes the separation and independence of the Train A and Train B fans.
			Fails to stop.	Mechanical failure; Hot short in control wiring; Control signal failure; CIS Phase A Control signal failure.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-62A).	See Remark #2.	None. (See Remark #3).	1. Fans can be stopped via HS-31-62 A or B. 2. Differential pressure switches will alarm if the DP is not adequate and start standby CB emergency pressurizing fan during CRI mode to restore MCR. DP with respect

TABLE 9.4-9 (Sheet 22 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				CRI Control Room Isolation signal - Train A fails.	Alarm in MCR when ΔP between MCRHZ and Aux Bldg. SDBR is <1/8-inch w.g.	Over pressurization of 6.9 kV Shutdown Board Room B.		to Shutdown Bd. Rooms.
20	0-FAN-31-68-B Pressurizing Air Supply Fan D-B	Provides pressurization to maintain 6.9 kV Shutdown Board Room at slightly positive pressure with respect to atmosphere.	Fails to start, fails while running.	Mechanical failure; Train B power failure; Control signal failure.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-68A).	Loss of redundancy in providing pressurization to 6.9 kV Shutdown Board Room. (See Remark #1.)	None. (After trip due to lo suction flow to Fan D-B, the redundant Train A Fan B-A will automatically start.)	1. The pressurizing fans are not required to mitigate the effects of a DBE. 2. Fan can be restarted after reset after Phase A CIS from Unit 1. Review of the schematics establishes the separation and independence of the Train A and Train B fans.

TABLE 9.4-9 (Sheet 23 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to stop.	Mechanical failure; Hot short in control wiring; Control signal failure; CIS Phase A Control signal failure. CRI Control Room Isolation signal - Train A fails.	Indicating lights in MCR and CISP indicating lights in MCR (1-HS-31-68A). Alarm in MCR when ∆P between MCRHZ and Aux. Bldg. SDBR is <1/8-inch w.g.	See Remark #2. Over pressurization of 6.9 kV Shutdown Board Room B.	None. (See Remark #3).	1. Fans can be stopped via HS-31-68 A or B. 2. Differential pressure switches will alarm if the ÎP is not adequate and start standby CB emergency pressurizing fan during CRI mode. To restore MCR DP with respect to Shutdown Bd. Rooms.

TABLE 9.4-9 (Sheet 24 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
21	0-BKD-31-2756 Backdraft Damper	Permits airflow to Pressurizing Fan C-B.	Fails to open (when Fan C-B is running).	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	No air flow to fan C-B. Loss of redundancy in providing pressurizing air flow to Shutdown Board Rooms. Lo flow at FS-31-66 will be detected and automatically start fan A-A. See Remark #2.	None. (Train A Fan A-A will supply the pressurizing air.)	1. Indicating lights of Fan C-B powered and running (HS-31-67A) in MCR and CISP. 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.

TABLE 9.4-9 (Sheet 25 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Isolates idle Fan C-B from running Fan A-A.	Fails to backseat	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	Loss of pressurizing air to room served by the fan.	None. (See Remarks #2.)	1. MCR and CISP indication of Fan A-A powered and running (HS-31-64A). 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE. 3. Operability of dampers is periodically verified.
22	0-BKD-31-2755 Backdraft Damper	Permits airflow to Pressurizing Fan A-A.	Fails to open (When Fan A-A is running).	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	No air flow to fan A-A. Loss of redundancy in providing pressurizing air flow to Shutdown Board Rooms. Lo flow at FS-31-65 will be detected and automatically start fan C-B. (See Remark #2.)	None. (Train B Fan C-B will supply the pressurizing air.)	1. Indicating lights of Fan A-A powered and running (HS-31-64A) in MCR and CISP. 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.

TABLE 9.4-9 (Sheet 26 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Isolates idle Fan A-A from running Fan C-B.	Fails to backseat.	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	Loss of pressurizing air to room served by the fan.	None. (See Remark #2.)	1. MCR and CISP indication of Fan C-B powered and running (HS-31-67A). 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.
23	0-BKD-31-2812 Backdraft Damper	Permits airflow to Pressurizing Fan B-A.	Fails to open (When Fan B-A is running).	Mechanical failure.	See Remark #1. (Local position indicators on damper)	No air flow to fan B-A. Loss of redundancy in providing pressurizing air flow to Shutdown Board Rooms. Lo flow on FS-31-63 will be detected and automatically start Fan D-B. (See Remark #2.)	None. (See Remark #2.)	1. Indicating lights of Fan B-A powered and running (HS-31-62A) in MCR and CISP. 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.

TABLE 9.4-9 (Sheet 27 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Isolates idle Fan B-A from running Fan D-B.	Fails to backseat.	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	Loss of pressurizing air to room served by the Fan.	None. (See Remark #2.)	1. MCR and CISP indication of Fan C-B powered and running (HS-31-67A). 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.
24	0-BKD-31-2811 Backdraft Damper	Permits airflow to Pressurizing Fan D-B.	Fails to open (when Fan D-B is running).	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	No air flow to fan D-B. Loss of redundancy in providing pressurizing air flow to Shutdown Board Room. Lo flow at FS-31-69 will be detected and automatically start fan B-A. (See Remark #2.)	None. (Train A Fan B-A will supply the pressurizing air.)	1. Indicating lights of Fan D-B powered and running (HS-31-68A) in MCR and CISP. 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of a DBE.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		Isolates idle Fan D-B from running Fan B-A.	Fails to backseat.	Mechanical failure.	See Remark #1. (Local position indicators on damper.)	Loss of pressurizing air to room served by the Fan.	None. (See Remark #2.)	1. MCR and CISP indication of Fan B-A powered and running (HS-31-62A). 2. The functioning of the Pressurizing Fans is not required for mitigating the effects of DBE.
25	0-FCO-31-276-A Tornado Damper Train A	Provides suction flow path for the 6.9kV/480V shutdown board room pressurizing Fans A-A and C-B.	Spuriously Closes (no tornado)	Mechanical failure; Hot short in electrical supply.	Indicating light in MCR (0-HS-31-34-A). Mechanical Equipment Room indication. Locally, 0-ZS-31-276A-A status indication.	Loss of suction to Shutdown Board Room Press. fans on Unit 1 side. Loss of pressurization function to 6.9 kV Shutdown Board Room A.	None. (See Remark #2.)	1. Fails as is. Normally open. 2. Pressurizing fans are not required to mitigate the effects of a DBE.
			Fails to close when required for Tornado protection.	Mechanical failure, electrical failure, Operator error (hand	Indicating lights in MCR (0-HS-31-34). Mechanical equipment room	Loss of tornado isolation redundancy.	There is no effect on the plant with the failure of the damper to close.	Pressurizing fans are not required during a tornado event.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
				switch placed in wrong position).	indication. Locally, 0-ZS-31-276A-A status indication.		Redundant isolation components are installed which would prevent the pressure differential from affecting the components downstream of this device.	
26	0-FCO-31-275-B Tornado Damper Train B	Provides suction flow path for the 6.9kV/480V Shutdown Board Rooms Pressurizing Fans A-A and C-B	Spuriously Closes (no tornado).	Mechanical failure; Hot short in electrical supply.	Indicating lights in MCR (0-HS-31-35-B). Mechanical Equipment Room indication. Locally, 0-ZS-31-275A-B status indication.	Loss of suction due to Shutdown Board Room Press. fans on Unit 1 side. Loss of pressurization function to 6.9 kV Shutdown Board Room A.	None. (See Remark #2.)	1. Fails as is. Normally open. Motor operated valve. 2. Pressurizing fans are not required to mitigate the effects of a DBE.

TABLE 9.4-9 (Sheet 30 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
			Fails to close when required for Tornado protection	Mechanical failure, electrical failure, Operator errors (hand switch placed in wrong position).	Indicating lights in MCR (0-HS-31-35). Mechanical equipment room indication. Locally, 0-ZS-31-275A-B status indication.	Loss of tornado isolation redundancy.	There is no effect on the plant with the failure of the damper to close. Redundant isolation components are installed which would prevent the pressure differential from affecting the components downstream of this device.	Pressurizing fans are not required during a tornado event.
27	0-FCO-31-278-A Tornado Damper Train A	Provides suction flow path for the 6.9kV/480V Shutdown Board Rooms Pressurizing Fans B-A	Spuriously Closes (no tornado)	Mechanical failure; Hot short in electrical supply.	Indicating lights in MCR (0-HS-31-32-A). Mechanical Equipment Room indication. Locally, 0-ZS-31-278A-	Loss of suction due to Shutdown Board Room Press. fans on Unit 2 side. Loss of pressurizati	None. (See Remark #2.)	1. Fails as is. Normally open. 2. Pressurizing fans are not required to mitigate the effects of a DBE.

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		and D-B (Unit 2)			A status indication.	on function to 6.9 kV Shutdown Board Room B.		
			Fails to close when required for tornado protection	Mechanical failure, electrical failure, Operator errors (hand switch placed in wrong position).	Indicating lights in MCR (0-HS-31-32). Mechanical equipment room indication. Locally, 0-ZS-31-278A-A status indication.	Loss of tornado isolation redundancy.	There is no effect on the plant with the failure of the damper to close. Redundant isolation components are installed which would prevent the pressure differential from affecting the components downstream of this device.	Pressurizing fans are not required during a tornado event.
28	0-FCO-31-277-B Tornado Damper	Provides suction flow path for the 6.9kV/480V	Spuriously Closes (no tornado)	Mechanical failure; Hot short in electrical supply.	Indicating lights in MCR (0-HS-31-33-B). Mechanical	Loss of suction due to Shutdown Board Room	None. (See Remark #2.)	1. Fails as is. Normally open. 2. Pressurizing fans are not required to mitigate the effects of

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
	Train B	Shutdown Board Rooms Pressurizing Fans B-A and D-B (Unit 2)			Equipment Room indication. Locally, 0-ZS-31-277A-B status indication.	Pressurization fans on Unit 2 side. Loss of pressurization function to 6.9 kV Shutdown Board Room B.		a DBE.
			Fails to close when required for tornado protection	Mechanical failure, electrical failure, Operator errors (hand switch placed in wrong position).	Indicating lights in MCR (0-HS-31-33). Mechanical equipment room indication. Locally, 0-ZS-31-277A-B status indication.	Loss of tornado isolation redundancy.	There is no effect on the plant with the failure of the damper to close. Redundant isolation components are installed which would prevent the pressure differential from affecting the components downstream of this device.	Pressurizing fans are not required during a tornado event.

TABLE 9.4-9 (Sheet 33 of 34)

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
29	0-BKD-31-590	Provides flow path for return air from 480V Shutdown Board Room to 6.9kV Shutdown Board Room	Failure to open	Mechanical Failure	Surveillance walk-downs & Maintenance	None (see remark 1)	None (see remark 1)	The dampers open when the fans are started (pre-event). There are two dampers that provide return air back from the 480V Shutdown Board Room 2A to the 6.9kV Shutdown Board Room. Should one of the dampers fail closed, a single damper is adequately sized to provide return air.
30	0-BKD-31-591	Provides flow path for return air from 480V Shutdown Board Room to 6.9kV Shutdown Board Room	Failure to open	Mechanical Failure	Surveillance walk-downs & Maintenance	None (see remark 1)	None (see remark 1)	The dampers open when the fans are started (pre-event). There are two dampers that provide return air back from the 480V Shutdown Board Room 2A to the 6.9kV Shutdown Board Room B. Should one of the dampers fail closed, a single damper is adequately sized to provide return air.
31	0-BKD-31-592	Provides flow path	Failure to open	Mechanical Failure	Surveillance walk-downs &	None (see remark	None (see remark	The dampers open when the fans are started

FAILURE MODES AND EFFECTS ANALYSIS
SUBSYSTEM: SHUTDOWN BOARD ROOM AIR CONDITIONING AND VENTILATION

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Detection	Effect on System	Effect on Plant	Remarks
		for return air from 480V Shutdown Board Room to 6.9kV Shutdown Board Room			Maintenance	1)	1)	(pre-event). There are two dampers that provide return air back from the 480V Shutdown Board Room 1B to the 6.9kV Shutdown Board Room A. Should one of the dampers fail closed, a single damper is adequately sized to provide return air.
32	0-BKD-31-593	Provides flow path for return air from 480V Shutdown Board Room to 6.9kV Shutdown Board Room	Failure to open	Mechanical Failure	Surveillance walk-downs & Maintenance	None (see remark 1)	None (see remark 1)	The dampers open when the fans are started (pre-event). There are two dampers that provide return air back from the 480V Shutdown Board Room 1B to the 6.9kV Shutdown Board Room A. Should one of the dampers fail closed, a single damper is adequately sized to provide return air.

TABLE 9.4-10

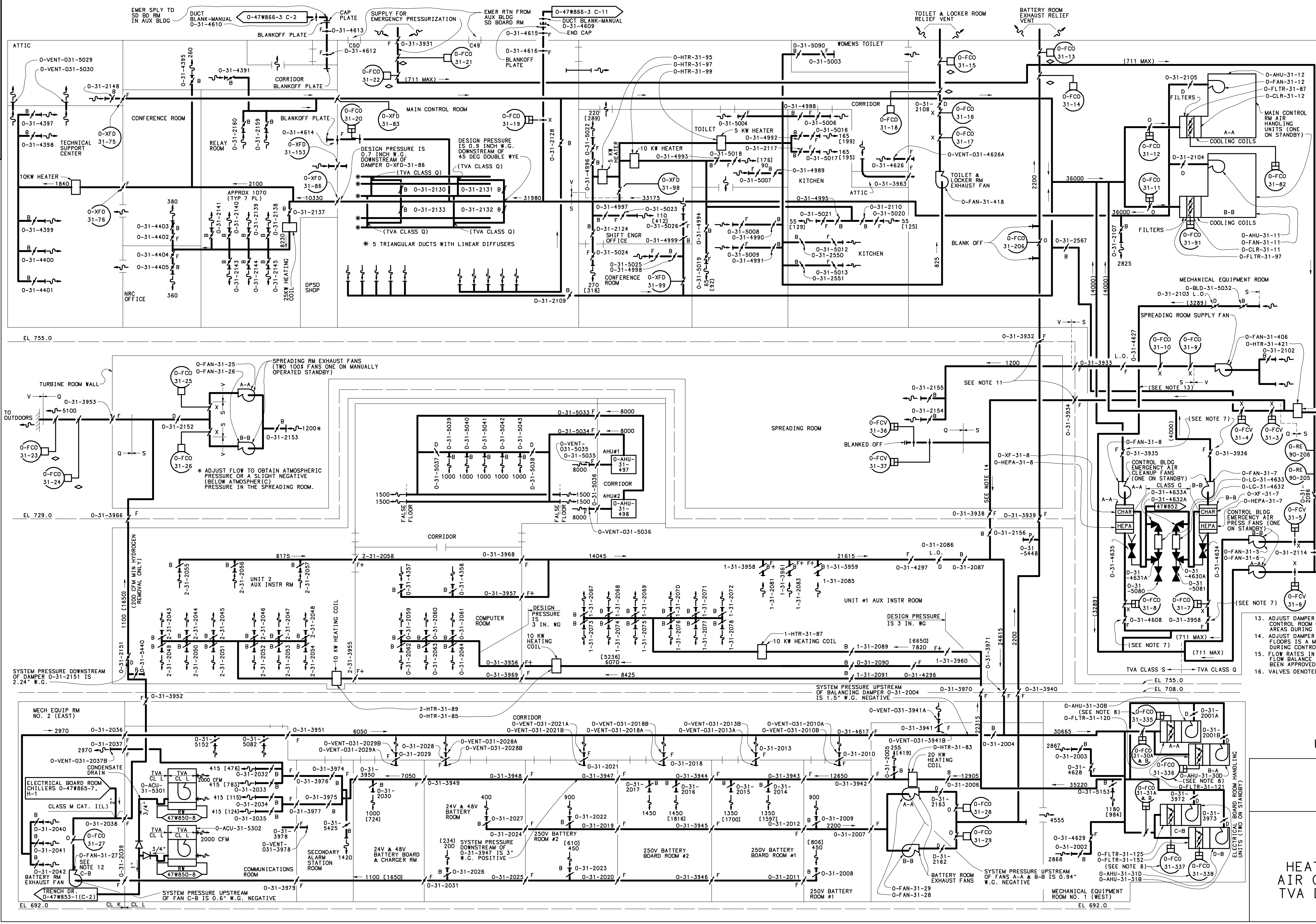
FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: MAIN STEAM VALVE VAULT VENTILATION SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Destruction	Effect on System	Effect on Plant	Remarks
1.	1-FAN-30-26 and 1-FAN-30-302	Provides outside air for cooling of the South Steam Valve Vault.	Continues to run after shutdown command is given or spuriously starts after shutdown. This failure if of concern during periods when the ambient temp. is at the design minimum.	Electrical control failure, operator error (switch left in incorrect position).	No direct detection method for the fan, the indicating lights and hand switch are local devices.	None, see remarks.	None, see remarks.	System Description and Freeze protection procedure require that door and ventilation covers be installed on both the north and south main steam valve vaults should the outside temperature drop below 35°F. With the covers installed there would be little if any air flow produced as a result of the fans continuing to run. Therefore this failure would have no adverse impact on the plant.
2.	1-FAN-30-25 and 301.	Provides outside air for cooling of the North Steam Valve Vault.	Continues to run after shutdown command is given or spuriously starts after shutdown. This failure is of concern during periods when the ambient temp. is at the design minimum.	Electrical control failure, operator error (switch left in incorrect position).	No direct detection method for the fan, the indicating lights and hand switch are local devices.	None, see remarks.	None, see remarks.	1. System Description and Freeze protection procedure require that door and ventilation covers be installed on both the north and south main steam valve vaults should the outside air temperature drop below 35°F. With the covers installed there would be little if any air flow produced as a result of the fans continuing to run. Therefore this failure would have no adverse impact on the plant.

TABLE 9.4-10A

FAILURE MODES AND EFFECTS ANALYSIS FOR ACTIVE FAILURES
SUBSYSTEM: POST ACCIDENT SAMPLING SYSTEM

Item No.	Component	Function	Failure Mode	Potential Cause	Method of Destruction	Effect on System	Effect on Plant	Remarks
1.	1-FAN-31-318A1	Provides heated (if required) outside air to the post accident sampling facility during periods of times that a post accident sample is required.	Continues to run after shutdown command is given or spuriously starts after shutdown. One of the redundant isolation dampers fails open (1-FCO-31-350 or 365). Heater (1-HTR-31-479) fails off. Outside temperature at minimum design value.	Electrical control failure, operator error (switch left in incorrect position).	No direct detection method for the fan, the indicating lights and hand switch are local devices.	None, see remarks.	None, see remarks.	1. An analysis was performed to show that the space temperatures would remain within allowable limits. 2. Post accident, this system is manually energized. Post accident sampling ventilation is controlled by procedures. These procedures control operation of this system and require the ventilation system be shut down after sampling is complete.



NOTES:

1. NOT USED
2. ONE BATTERY ROOM EXHAUST FAN SHALL BE IN OPERATION WITH THE OTHER TWO ON STANDBY.
3. AIR QUANTITIES INDICATED THUS (711 MAX) ARE FLOW QUANTITIES FOR EMERGENCY OPERATION.
4. ALL DUCTWORK ON THIS DRAWING IS TVA CLASS S EXCEPT WHERE NOTED AS CLASS Q OR V. ALL PIPING ON THIS DRAWING IS TVA CLASS M CAT. I(L) OR G, AS NOTED.
5. DESIGN PRESSURE IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE EXCEPT AS NOTED ON DRAWINGS. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
6. NOT USED
7. THESE DAMPERS ARE NOT REQUIRED FOR OPERATION.
8. THE FACE DAMPER PORTION OF EACH AHU "FACE & BYPASS" DAMPER WAS REMOVED PRIOR TO STARTUP PER DCN M02693-A.
9. NOT USED
10. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION"):
    N3-30CB-4002---CONTROL BUILDING HEATING, VENTILATING, AIR CONDITIONING AND AIR CLEANUP SYSTEM
    WB-DC-40-40----TECHNICAL SUPPORT CENTER HABITABILITY & ENVIRONMENTAL CONTROL SYSTEM.
11. A SPECIAL TOOL (47A900-199) IS REQUIRED FOR TESTING THESE FIRE DAMPERS.
12. BATTERY ROOM FAN C-B SHALL BE KEPT IN THE STANDBY MODE. FAN C-B WILL ONLY BE USED IF HYDROGEN CAN NOT BE REMOVED BY FANS A-A & B-B.

REFERENCE DRAWINGS:

47W865-3,7------------CHILLED WATER FLOW DIAGRAMS
47W610-SERIES---------CONTROL DIAGRAMS
47B601-31 SERIES------INSTRUMENT TABULATIONS

DAMPER LEGEND:

NORMALLY OPEN
NORMALLY CLOSED
FAILS CLOSED
FAILS OPEN
FAILS AS IS
PRESS RELIEF
BALANCE
BACKDRAFT
FIRE
FIRE-CO2 TRIP

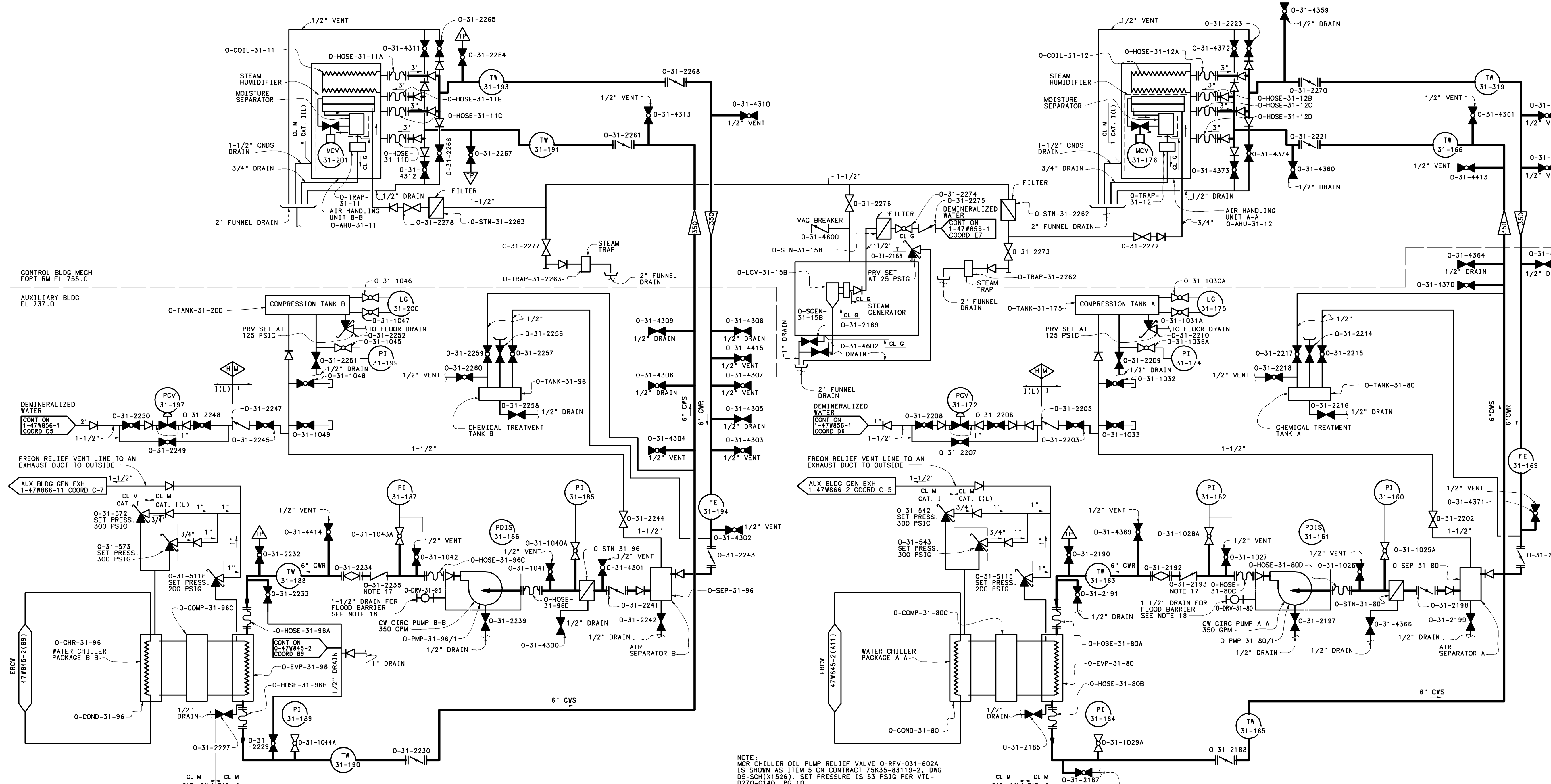
13. ADJUST DAMPER 0-31-2567 TO OBTAIN A MINIMUM PRESSURE IN THE MAIN CONTROL ROOM OF +1/8-INCH WG WITH RESPECT TO OUTSIDE AND ALL ADJACENT AREAS DURING NORMAL OPERATION.
14. ADJUST DAMPER 0-31-2156 TO ASSURE THAT THE PRESSURE IN THE LOWER TWO FLOORS IS A MINIMUM OF 1/8-INCH WG LOWER THAN THE MAIN CONTROL ROOM DURING CONTROL ROOM ISOLATION (CRI).
15. FLOW RATES IN BRACKETS [1650] ARE FLOWS OBTAINED DURING THE AIR FLOW BALANCE THAT ARE OUTSIDE THE G-37 ACCEPTANCE CRITERIA, BUT HAVE BEEN APPROVED BY NUCLEAR ENGINEERING.
16. VALVES DENOTED AS L.O. ARE LOCKED OPEN DURING NORMAL PLANT OPERATION.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

CONTROL BUILDING
UNITS 1 & 2
FLOW DIAGRAM
HEATING VENTILATING AND
AIR CONDITIONING AIR FLOW
TVA DWG NO. 0-47W866-4 R1
FIGURE 9.4-1

CAD MAINTAINED DRAWING



NOTE:
MCR CHILLER OIL PUMP RELIEF VALVE O-RFV-031-602B
IS SHOWN AS ITEM 5 ON CONTRACT 75K35-83119-2, DWG
D5-SCH(X1526). SET PRESSURE IS 53 PSIG PER VTD-
D270-0140, PG 10.

EL 755.0 MAIN CONTROL ROOM AIR-CONDITIONING SYSTEMS A-A & B-B
(ONE SYSTEM IS STANDBY)

NOTES:

1. AIR CONDITIONING SYSTEM CODE NO. 31.
2. SYSTEM IDENTIFICATION SYMBOLS SHOWN THUS (PI 31-304) ARE ABBREVIATED FORMS OF O-PI-31-304 UNLESS OTHERWISE NOTED.
3. NUMBERS SHOWN THUS (450) INDICATE WATER FLOW IN GPM.
4. FOR SYSTEM DESCRIPTION OF CONTROL BUILDING HEATING, VENTILATING, AIR CONDITIONING AND AIR CLEANUP SYSTEM, SEE N3-30CB-4002.
6. PIPING DESIGN PRESSURE AND TEMPERATURE ARE 65 PSIG AND 110°F, HYDROSTATICALLY TEST SYSTEM AT 1.50 X 65 PSIG. UNLESS OTHERWISE NOTED, PIPING DOWNSTREAM OF A DRAIN OR VENT VALVE IS AT ATMOSPHERIC CONDITIONS. HYDROSTATIC TEST PRESSURE DATA IS HISTORICAL INFORMATION AND NO LONGER MAINTAINED AS DESIGN OUTPUT.
7. PUMP HEAD PRESSURE SHALL BE CHECKED VS MEASURED FLOW IN PUMP CIRCUIT, AND BALANCING VALVE ON PUMP DISCHARGE SHALL BE USED TO THROTTLE FLOW TO GET THE TOTAL DESIGN FLOW RATE.
8. FOR IDENTIFICATION OF SYMBOLS REFER TO "INSTRUMENTATION SYMBOLS AND IDENTIFICATION."
9. HYDROSTATIC TESTING SHALL BE IN ACCORDANCE WITH APPLICABLE CODE CASES WITH CASE BY CASE APPLICATION REQUIRING PRIOR APPROVAL BY NUCLEAR ENGINEERING.
10. ALL CHILLED WATER PIPING ON THIS DRAWING IS TVA CLASS M, SEISMIC CATEGORY I UNLESS OTHERWISE NOTED.
11. ALL STEAM PIPING IS TVA CLASS G SEISMIC CATEGORY I (L).
12. THE DESIGN FLOW RATES SHOWN ON THIS FLOW DIAGRAM ARE THE MINIMUM ALLOWABLE: FLOW RATES MAY BE A MAXIMUM 17% ABOVE THE DESIGN FLOW RATE.
13. ALL DRAIN AND VENT LINES FOR SHUTDOWN BOARDROOM AND MAIN CONTROL ROOM CHILLED WATER SYSTEMS SHALL BE SUPPORTED USING CATEGORY I CRITERIA THROUGH THE PRESSURE BOUNDARY OR THE FIRST NORMALLY CLOSED VALVE. ALL SUCCEEDING PIPE MAY BE SUPPORTED USING CATEGORY I (L) CRITERIA.
14. FOR NON QA VALVE AND DAMPER MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISC VALVE REPORT-009. FOR QA VALVE AND DAMPER MARKER TABULATIONS SEE 47B920-31X1 THRU 47B920-31X4.
15. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS. "PIPING SYSTEM CLASSIFICATION."):
    N3-30-CB-4002---------HVAC CONTROL BUILDING
    WB-DC-40-40-----------TECHNICAL SUPPORT CENTER-HABITABILITY AND ENVIRONMENTAL CONTROL SYSTEM
16. DEMINERALIZED WATER PIPING (MAKE-UP TO CHILL WATER SYS) IS SEISMIC CATEGORY I(L) AS IDENTIFIED ON THE DRAWING.
17. CHECK VALVE INTERNALS HAVE BEEN REMOVED.
18. FLOOD BARRIER DRAIN PIPING IS 1-1/2" SCH 80 A106 GR. B, TVA CLASS G.

REFERENCE DRAWINGS:

47B601-31---------------INSTRUMENT TABULATION
47W611-31---------------LOGIC DIAGRAM
47W866-4----------------AIR FLOW DIAGRAM
47W610-31---------------CONTROL DIAGRAM
47B920-31X1 THRU -31X4-MASTER VALVE STATUS REPORT
47W865-103--------------MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY AIR CONDITIONING CHILLED WATER

COMPANION DRAWINGS:

47W865-7----CHILLED WATER FLOW DIAGRAM
47W856-1----DMNRLZ WATER FLOW DIAGRAM
47W845-2----ERCW FLOW DIAGRAM

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

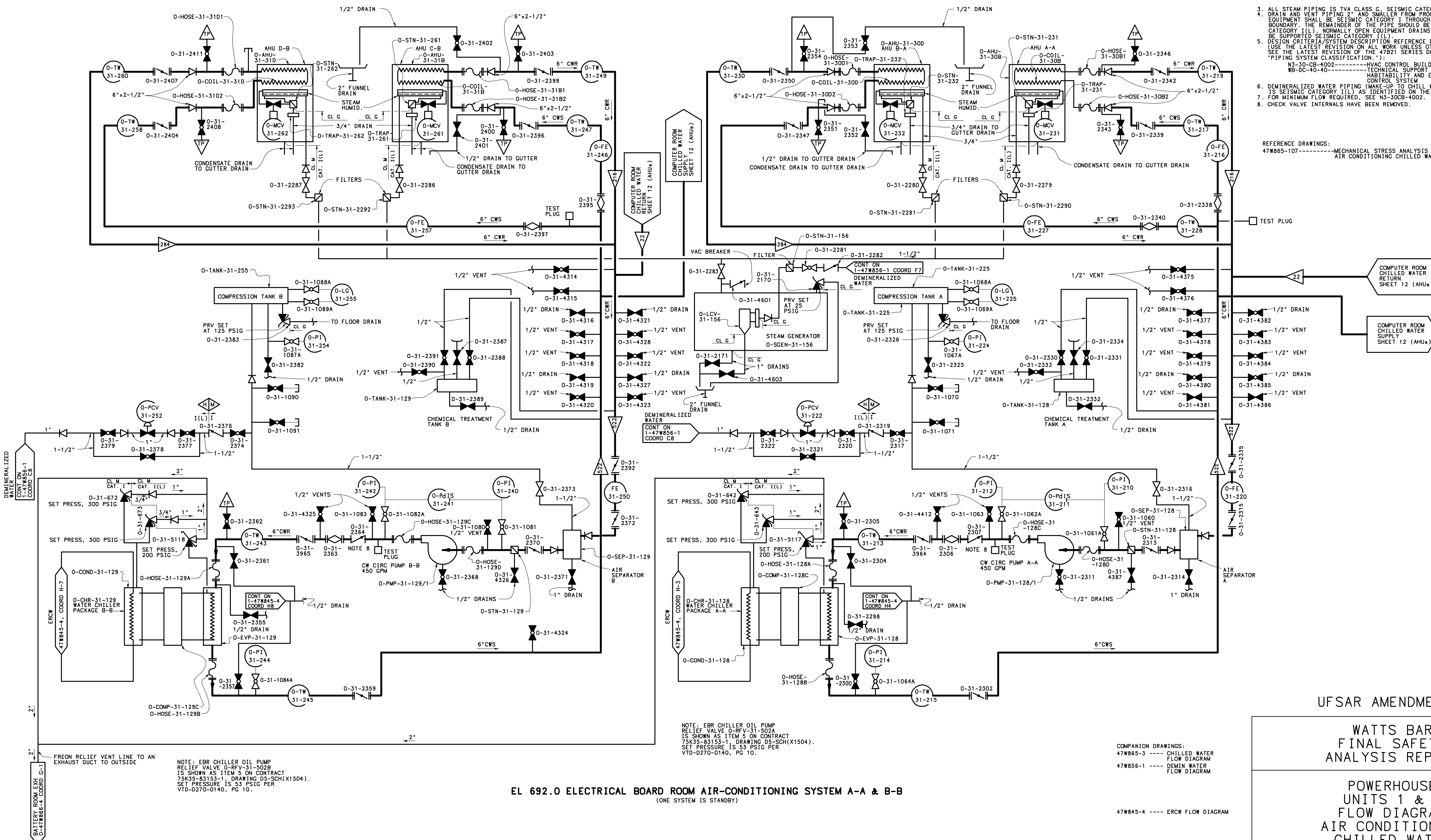
POWERHOUSE
UNITS 1 & 2
FLOW DIAGRAM
AIR CONDITIONING
CHILLED WATER
TVA DWG NO. 0-47W865-3 R2
FIGURE 9.4-2

CAD MAINTAINED DRAWING

NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS SEE 47W865-3.
2. ALL CHILLED WATER PIPING ON THIS DRAWING IS TVA CLASS M, SEISMIC CATEGORY I UNLESS OTHERWISE NOTED.
3. ALL STEAM PIPING IS TVA CLASS G, SEISMIC CATEGORY I(L).
4. DRAIN AND VENT PIPING 2" AND SMALLER FROM PROCESS PIPE AND EQUIPMENT SHALL BE SEISMIC CATEGORY I THROUGH THE PRESSURE BOUNDARY. THE REMAINDER OF THE PIPE SHOULD BE SUPPORTED SEISMIC CATEGORY I(L). NORMALLY OPEN EQUIPMENT DRAINS SHOULD ALSO BE SUPPORTED SEISMIC CATEGORY I(L).
5. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOUCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
   N3-30-CB-4002---------HVAC CONTROL BUILDING
   WB-DC-40-40-----------TECHNICAL SUPPORT CENTER-HABITABILITY AND ENVIRONMENTAL CONTROL SYSTEM
6. DEMINERALIZED WATER PIPING (MAKE-UP TO CHILL WATER SYSTEM) IS SEISMIC CATEGORY I(L) AS IDENTIFIED ON THE DRAWING.
7. FOR MINIMUM FLOW REQUIRED, SEE N3-30CB-4002.
8. CHECK VALVE INTERNALS HAVE BEEN REMOVED.

REFERENCE DRAWINGS:
47W865-107----------MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY AIR CONDITIONING CHILLED WATER



NOTE: EBR CHILLER OIL PUMP RELIEF VALVE O-RFV-31-502B IS SHOWN AS ITEM 5 ON CONTRACT 75K35-83153-1, DRAWING D5-SCH(X1504). SET PRESSURE IS 53 PSIG PER VTD-D270-0140, PG 10.

NOTE: EBR CHILLER OIL PUMP RELIEF VALVE O-RFV-31-502A IS SHOWN AS ITEM 5 ON CONTRACT 75K35-83153-1, DRAWING D5-SCH(X1504). SET PRESSURE IS 53 PSIG PER VTD-D270-0140, PG 10.

EL 692.0 ELECTRICAL BOARD ROOM AIR-CONDITIONING SYSTEM A-A & B-B
(ONE SYSTEM IS STANDBY)

COMPANION DRAWINGS:
47W865-3 ---- CHILLED WATER FLOW DIAGRAM
47W856-1 ---- DEMIN WATER FLOW DIAGRAM
47W845-4 ---- ERCW FLOW DIAGRAM

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
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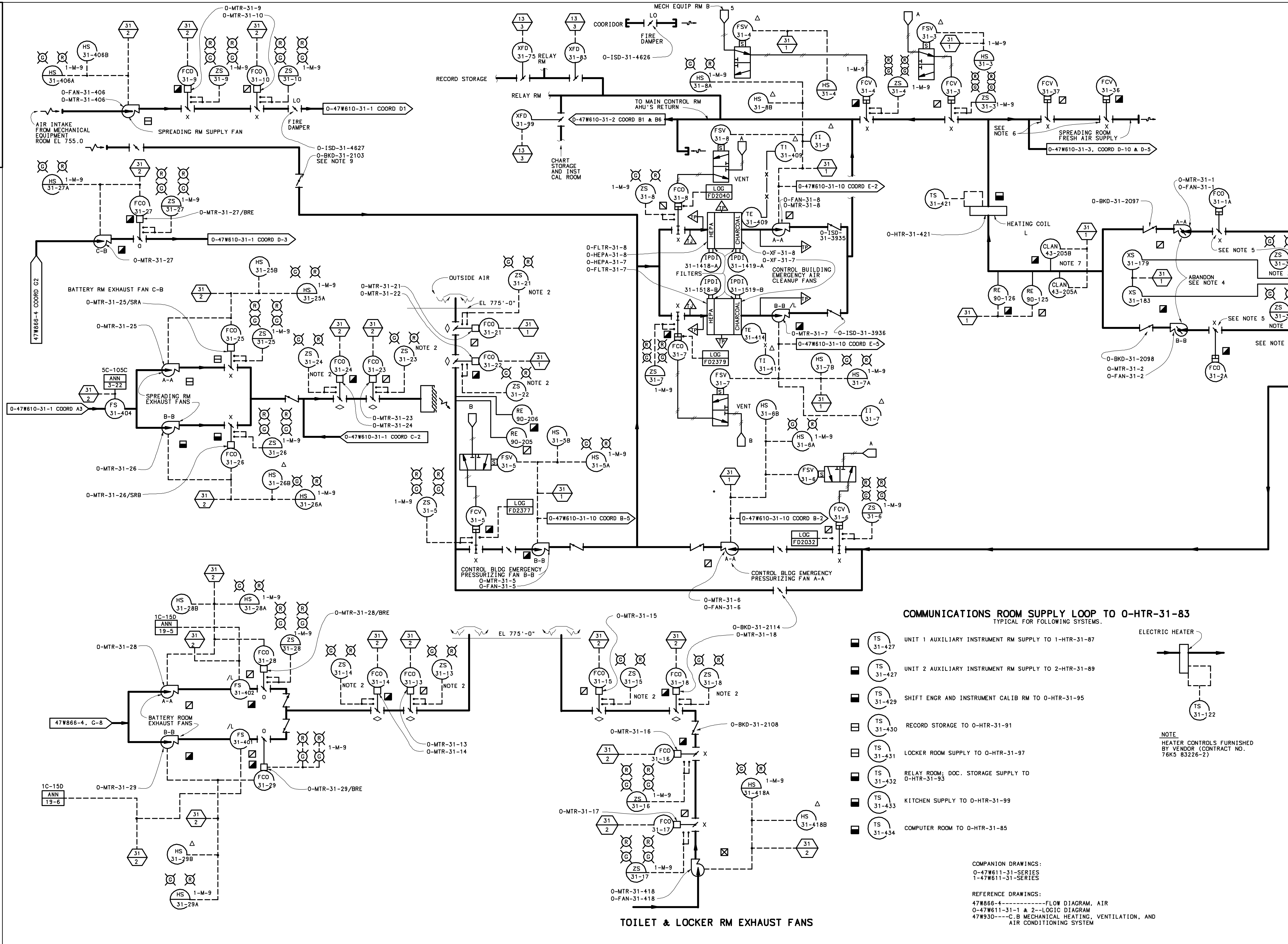
POWERHOUSE
UNITS 1 & 2
FLOW DIAGRAM
AIR CONDITIONING
CHILLED WATER
TVA DWG NO. 0-47W865-7 R2
FIGURE 9.4-3



NOTES:

1. MONITOR LIGHTS ARE LOCATED ON PANEL 1-M-9.
2. ALL TORNADO DAMPERS ACTIVATED BY MCR HANDSWITCHES, HS-31-32, HS-31-34(TR-A) & HS-31-33, HS-31-35 (TR-B), MUST BE CLOSED BEFORE THE HANDSWITCH INDICATOR LIGHT (GREEN) WILL INDICATE CLOSED. ALSO, ALL TORNADO DAMPERS MUST BE OPEN BEFORE THE HANDSWITCH INDICATOR LIGHT (RED) WILL INDICATE OPEN. VITAL BATTERY ROOM TORNADO DAMPER POSITION WILL INDICATE ONLY IN THE MECHANICAL EQUIPMENT ROOM, EL 775.0 (NOT ON HS-31-32, 33, 34 & 35). EACH TORNADO DAMPER POSITION IS INDIVIDUALLY INDICATED IN THE MECHANICAL EQUIPMENT ROOM. POWER IS REMOVED FROM ALL TORNADO DAMPERS CONTROLLED BY MCR HANDSWITCHES HS-31-32, HS-31-34, HS-31-33 & HS-31-35 DURING NORMAL OPERATION, EXCEPT DURING TESTING OR TORNADO WARNINGS. REMOVAL OF POWER FROM O-HS-31-34 IS REQUIRED BECAUSE O-HS-31-34 CLOSES BOTH TORNADO DAMPERS O-FCO-31-21 & O-FCO-31-34. A FAILURE OF O-HS-31-34 DURING NON-TORNADO OPERATION COULD CAUSE CLOSURE OF BOTH DAMPERS, THUS, DISABLING BOTH TRAINS OF CONTROL ROOM EMERGENCY PRESSURIZATION. OTHER FCO'S CONTROLLED BY MCR HANDSWITCHES HS-31-32, HS-31-34, HS-31-33 & HS-31-35 ARE ALSO NOT POWERED DURING NORMAL OPERATION, EXCEPT FOR TESTING OR TORNADO WARNINGS, DUE TO OPERATOR PREFERENCES. REFER TO WBPER 98-014870-000.
3. ALL UNID NUMBERS PREFIXED BY "O" UNLESS OTHERWISE SPECIFIED.
4. CONT BLDG PRESSURIZING FANS A-A & B-B ARE ABANDONED IN PLACE & BLADE SETTINGS OF EACH FAN ADJUSTED TO PROVIDE MAXIMUM FREE AREA TO MINIMIZE AIR PRESSURE DROP THROUGH EACH IDLE FAN.
5. DAMPERS FCO-31-1, -2, -1A & -2A SHALL BE ADMINISTRATELY LOCKED IN THE FULL OPEN POSITION.
6. POWER FOR FSV-31-36 & -37 HAS BEEN REMOVED AND DAMPERS LEFT IN THE CLOSED POSITION.
7. THE CHLORINE DETECTORS (O-CLAN-43-205A & 205B) ARE INSTALLED BUT ARE NOT OPERATIONAL DUE TO CABLES/WIRES BEING REMOVED.
8. REFER TO TABLE A2 FOR ADDITIONAL COMPUTER POINTS (POWER AVAILABLE, SWITCH POSITION, FAN RUNNING, ETC.).
9. DAMPER LOCKED IN OPEN POSITION.

WATTS BAR
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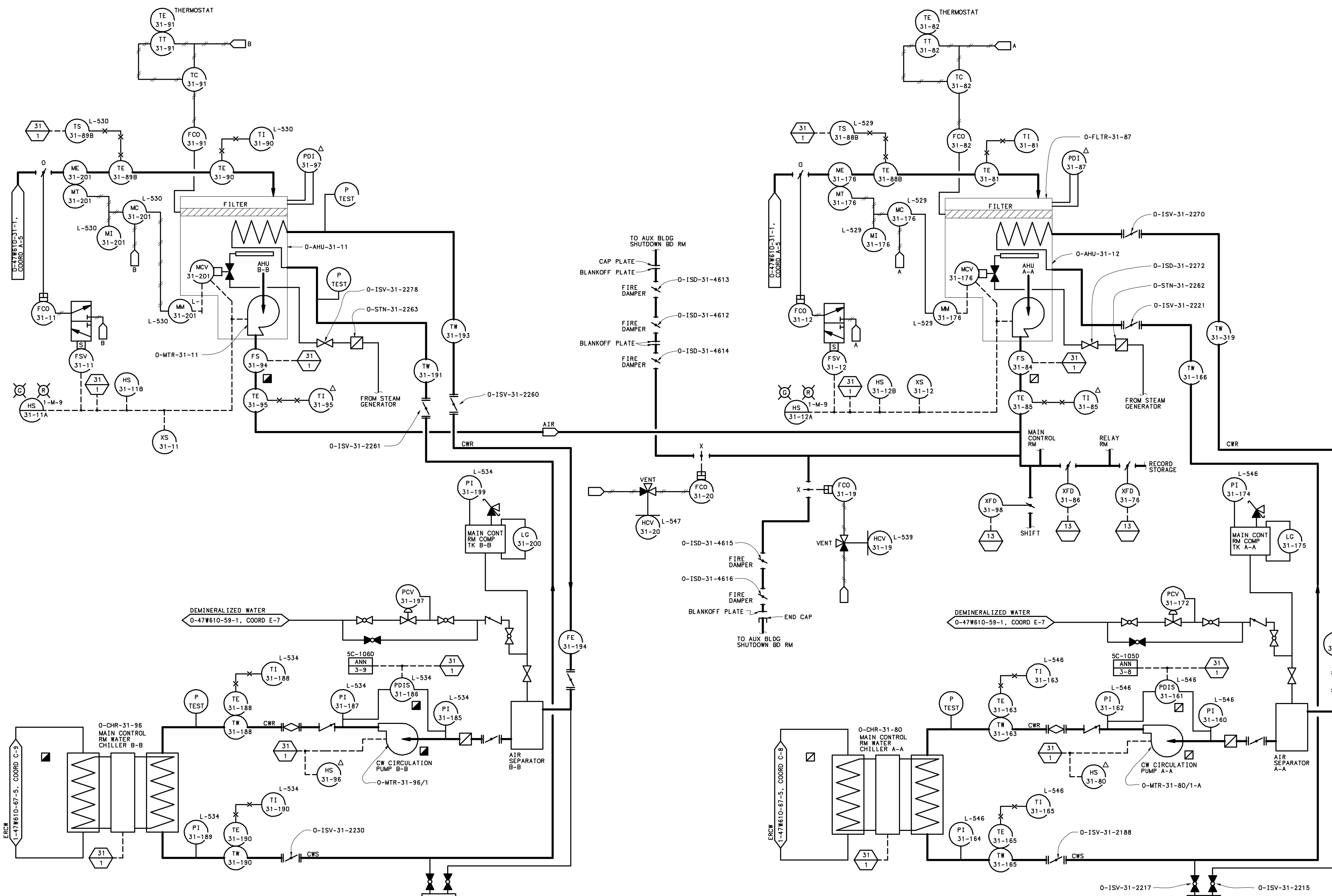
ANALYSIS REPORT

POWERHOUSE
CONTROL BUILDING UNITS 1 & 2
ELECTRICAL
AIR CONDITIONING
CONTROL DIAGRAM
TVA DWG NO. O-47W610-31-1 RO
FIGURE 9.4-4



MAIN CONTROL ROOM AIR CONDITIONING SYSTEM
EL 755.0'

TABLE A2
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
0-FAN-031-0005	XD2063	CONT BLDG EMERG PRESS FAN B-B
0-FAN-031-0005	XD2062	CONT BLDG EMERG PRESS FAN B-B
0-FAN-031-0006	XD2012	CONT BLDG EMERG PRESS FAN A-A
0-FAN-031-0006	XD2011	CONT BLDG EMERG PRESS FAN A-A
0-FAN-031-0007	XD2067	CONT BLDG EMERG AIR CU FAN B-B
0-FAN-031-0007	XD2066	CONT BLDG EMERG AIR CU FAN B-B
0-FAN-031-0008	XD2016	CONT BLDG EMERG AIR CU FAN A-A
0-FAN-031-0008	XD2015	CONT BLDG EMERG AIR CU FAN A-A
0-HS-031-0005A	HD2068	0-HS-31-5A OR 7A
0-HS-031-0006A	HD2034	0-HS-31-6A OR 8A
0-HS-031-0011A	HD2065	VENT SYS HS-11A, 31A
0-HS-031-0012A	HD2031	VENT SYS HS-12A, 30A

SEE SHEET 1 FOR ASSOCIATED INSTRUMENTATION

REFERENCE DRAWINGS:
47W865-3 --------------- CHILLED WATER FLOW DIAGRAM
47W866-4 --------------- AIR FLOW DIAGRAM
0-47W610-67 SERIES ---- ERCW CONTROL
1-47W610-67 SERIES ---- ERCW CONTROL
2-47W610-67 SERIES ---- ERCW CONTROL
0-47W611-31 SERIES ---- LOGIC DIAGRAM
1-47W611-31 SERIES ---- LOGIC DIAGRAM
2-47W611-31 SERIES ---- LOGIC DIAGRAM
47W920-31, 38 ---------- AUX BLDG HV, AC SYSTEM
47W930-SERIES ---------- CONTROL BLDG HV, AC SYSTEM

ALL UNID NUMBERS PREFIXED BY "0-" UNLESS OTHERWISE SPECIFIED.

COMPANION DRAWINGS:
0-47W610-31 SERIES
1-47W610-31 SERIES
2-47W610-31 SERIES

WATTS BAR
FINAL SAFETY
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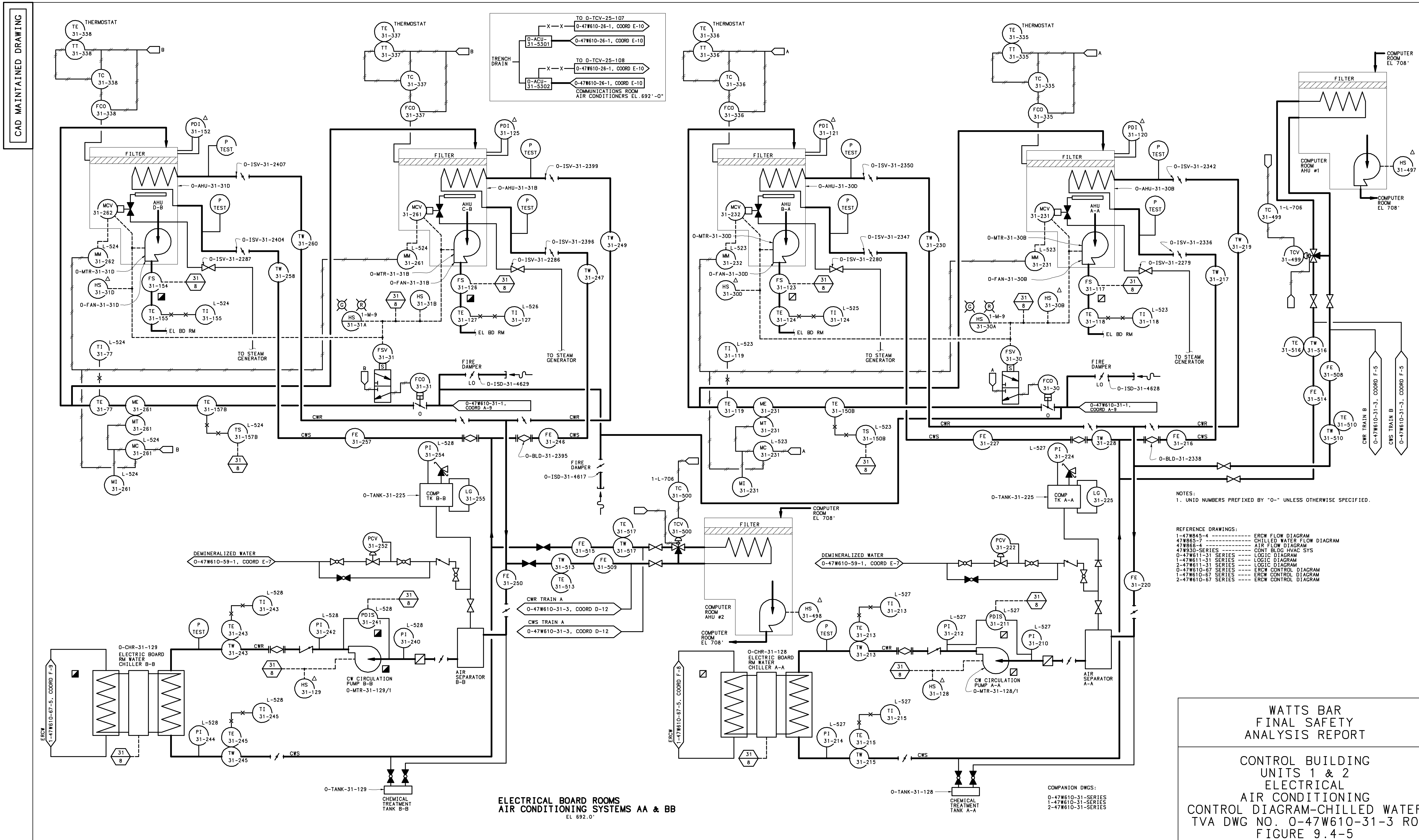
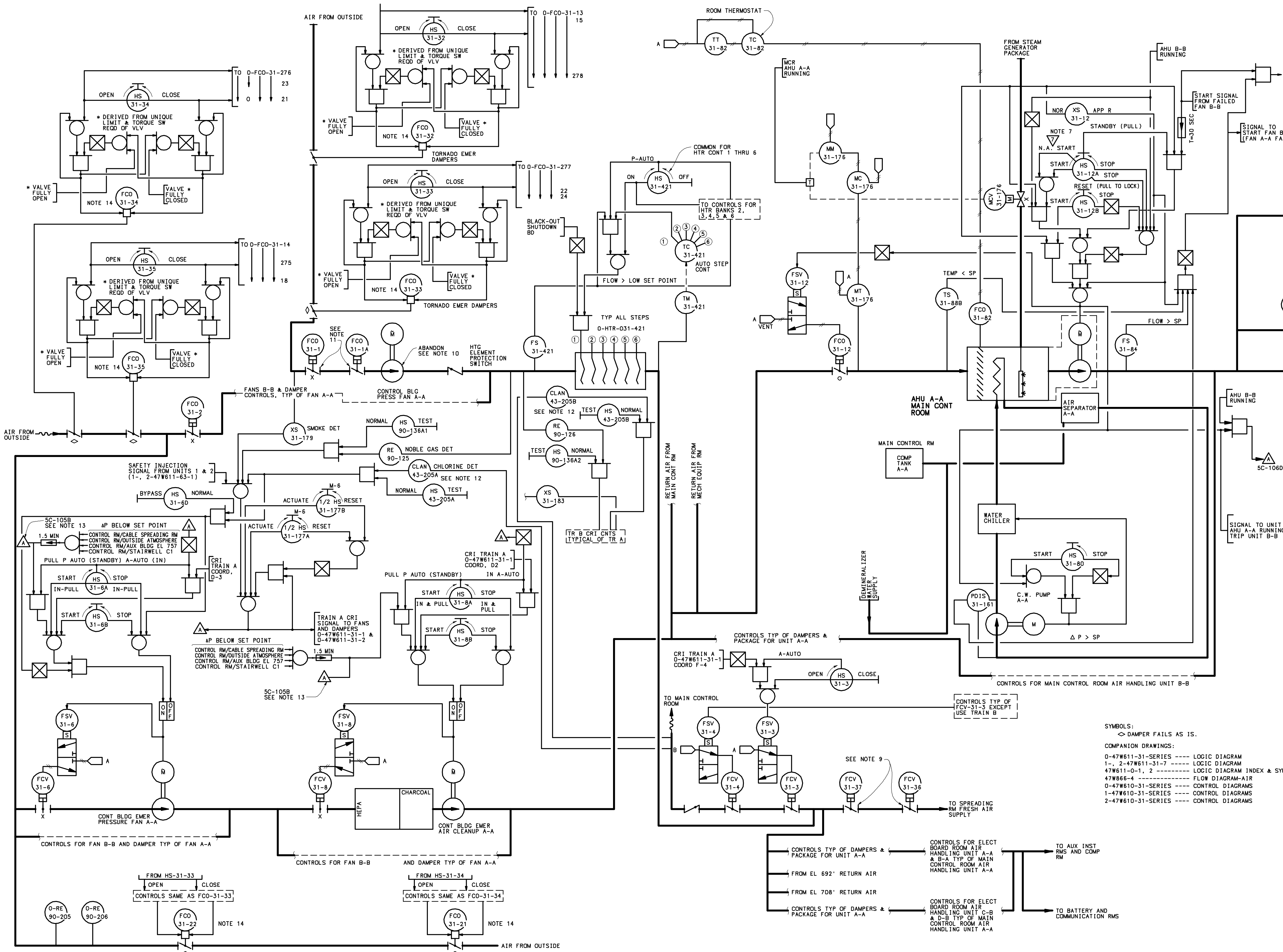
CONTROL BUILDING
UNITS 1 & 2
ELECTRICAL
AIR CONDITIONING
CONTROL DIAGRAM - CHILLED WATER
TVA DWG NO. 0-47W610-31-2 R0
FIGURE 9.4-4A



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

CONTROL BUILDING
UNITS 1 & 2
ELECTRICAL
AIR CONDITIONING
CONTROL DIAGRAM-CHILLED WATER
TVA DWG NO. 0-47W610-31-3 R0
FIGURE 9.4-5

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTED BELOW SEE INSTRUMENTATION STANDARDS. LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIGRAMS.
3. REDUNDANT ELEMENTS MUST HAVE SEPARATE POWER AND AIR SUPPLY.
4. RADIATION MONITOR LOCATED IN CONTROL BUILDING.
5. COMMUNICATIONS ROOM SUPPLY HEATER CONTROLS TYPICAL FOR:
   INSTRUMENT LOOP 31-427 UNIT 1 AUX INST ROOM SUPPLY
   31-428 UNIT 2 AUX INST ROOM SUPPLY
   31-429 SHIFT ENGR INST CALIB RM
   31-430 RECORD STORAGE SUPPLY
   31-431 LOCKER ROOM SUPPLY
   31-432 RELAY RM & DOC STORAGE SUPPLY
   31-433 KITCHEN SUPPLY
   31-434 COMPUTER ROOM
6. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
7. N.A. START = START SIGNAL IS MAINTAINED AFTER HANDSWITCH IS RETURNED TO THE CENTER (NORMAL) POSITION.
8. NOT USED.
9. POWER FOR FSV-31-36 & 37 HAS BEEN REMOVED & DAMPERS LEFT IN THE CLOSED POSITION.
10. CONT BLDG PRESS FANS A-A & B-B ARE ABANDONED IN PLACE & BLADE SETTING OF EACH FAN ADJUSTED TO PROVIDE MAXIMUM FREE AREA TO MINIMIZE AIR PRESSURE DROP THROUGH EACH IDLE FAN.
11. DAMPERS FCO-31-1 & -1A SHALL BE ADMINISTRATIVELY LOCKED IN THE FULL OPEN POSITION.
12. THE CHLORINE DETECTORS (0-CLAN-43-205A & 205B) ARE INSTALLED BUT ARE NOT OPERATIONAL DUE TO CABLES/WIRES BEING REMOVED.
13. ANNUNCIATION WINDOWS 5C-105B (FOR TRAIN A) AND 5C-106B (FOR TRAIN B) HAVE 65.536 SECONDS ALARM AND NORMAL TIME CONSTANTS.
14. POWER IS REMOVED FROM ALL TORNADO DAMPERS CONTROLLED BY MCR HANDSWITCHES HS-31-32, HS-31-34, HS-31-33 & HS-31-35 DURING NORMAL OPERATION, EXCEPT DURING TESTING OR TORNADO WARNINGS. REMOVAL OF POWER FROM 0-HS-31-34 IS REQUIRED BECAUSE OF 0-HS-31-34 CLOSES BOTH TORNADO DAMPERS 0-FCO-31-21 & 0-FCO-31-34. A FAILURE OF 0-HS-31-34 DURING NON-TORNADO OPERATION COULD CAUSE CLOSURE OF BOTH DAMPERS, THUS, DISABLING BOTH TRAINS OF CONTROL ROOM EMERGENCY PRESSURIZATION. OTHER FCO'S CONTROLLED BY MCR HANDSWITCHES HS-31-32, HS-31-34, HS-31-33 & HS-31-35 ARE ALSO NOT POWERED DURING NON-TORNADO OPERATION, EXCEPT FOR TESTING OR TORNADO WARNINGS, DUE TO OPERATOR PREFERENCES. REFER TO WBPER 98-014870-000.
15. THE DUCT LINES FROM THE MCR HVAC SYSTEM TO THE SDBR HVAC SYSTEM HAVE BEEN SEALED USING BLANKOFF PLATES AND CAPS (REF. DCN M-15802-A).
16. ALL UNIDS ON DRAWING ARE "0-" PREFIX UNLESS OTHER WISE NOTED.

SYMBOLS:

◇ DAMPER FAILS AS IS.

COMPANION DRAWINGS:

0-47W611-31-SERIES ---- LOGIC DIAGRAM
1-, 2-47W611-31-7 ------ LOGIC DIAGRAM
47W611-0-1, 2 ---------- LOGIC DIAGRAM INDEX & SYMBOLS
47W866-4 --------------- FLOW DIAGRAM-AIR
0-47W610-31-SERIES ---- CONTROL DIAGRAMS
1-47W610-31-SERIES ---- CONTROL DIAGRAMS
2-47W610-31-SERIES ---- CONTROL DIAGRAMS

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

CONTROL BUILDING
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
AIR CONDITIONING SYSTEM
TVA DWG NO. 0-47W611-31-1 R1
FIGURE 9.4-6

NOTES:
1. SEE DRAWING 0-47W611-31-1 FOR GENERAL NOTES AND SYMBOLS.
2. BATTERY ROOM FAN C-B SHALL BE KEPT IN THE STANDBY MODE. FAN C-B WILL ONLY BE USED IF HYDROGEN CANNOT BE REMOVED BY FANS A-A OR B-B.

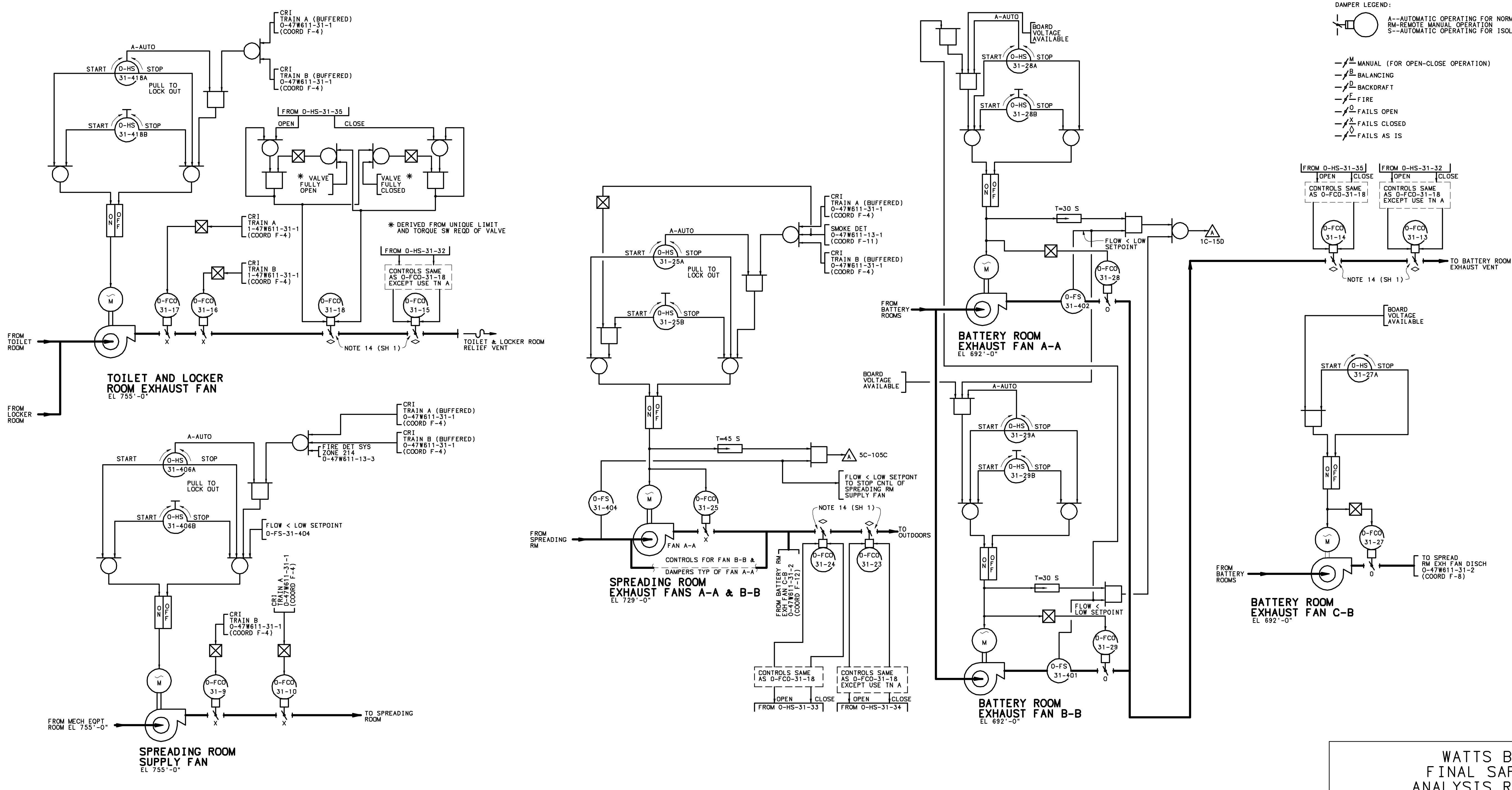
REFERENCE DRAWINGS:

1-47W866-4 - - - - - - - - - - - - HVAC FLOW DIAGRAM
0-47W611-13-1- - - - - - - - - - - FIRE DET LOGIC DIAGRAM
1-45W600-57-32 - - - - - - - - - - WIRING DIAGRAM
1-45W760-31-7,-8, & -16- - - - - WIRING DIAGRAMS
1-45W600-31-1,-2,-3, & -5- - - - WIRING DIAGRAMS

DAMPER LEGEND:

A--AUTOMATIC OPERATING FOR NORMAL SERVICE
RM-REMOTE MANUAL OPERATION
S--AUTOMATIC OPERATING FOR ISOLATION

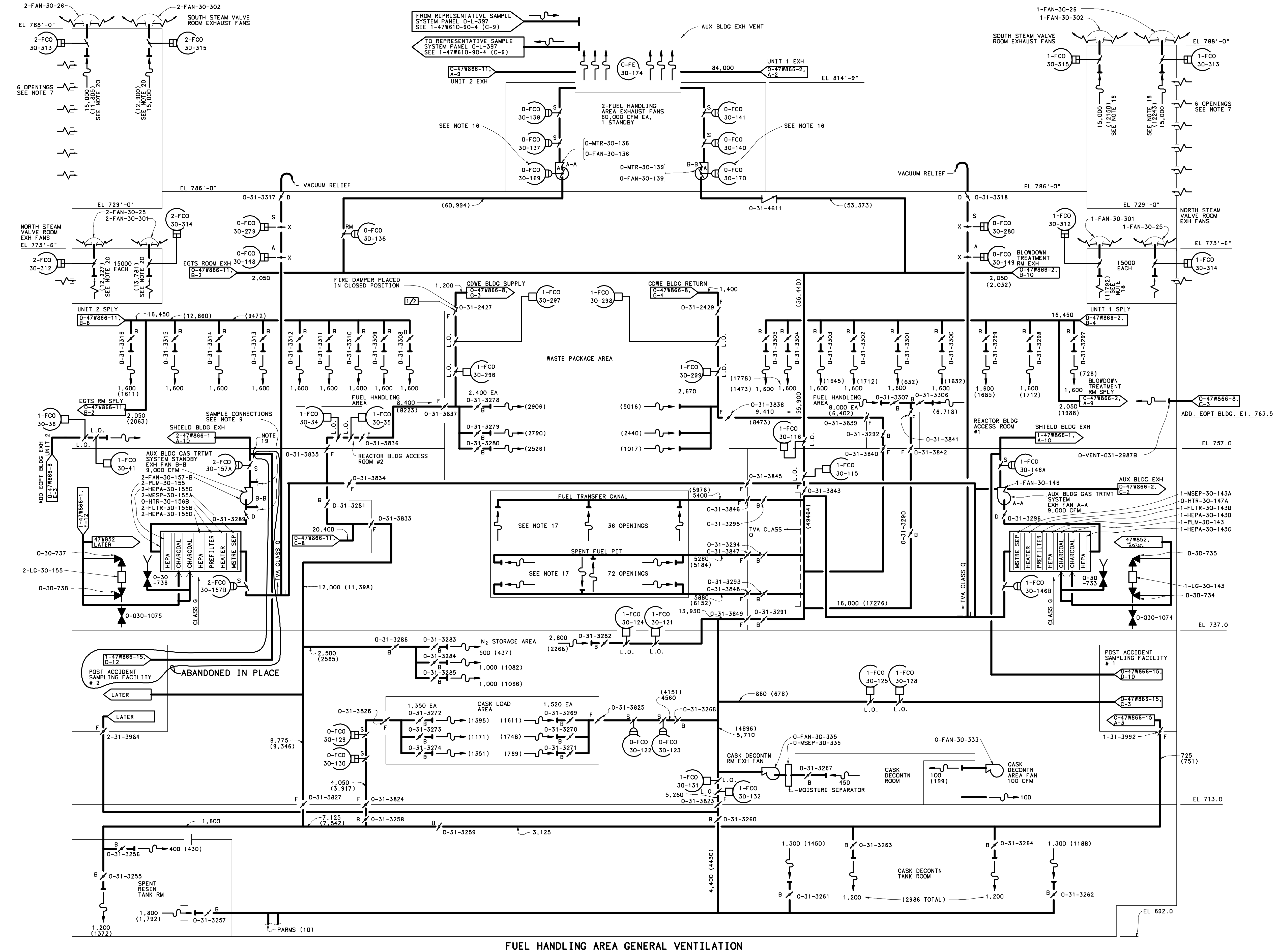
M MANUAL (FOR OPEN-CLOSE OPERATION)
B BALANCING
D BACKDRAFT
F FIRE
O FAILS OPEN
X FAILS CLOSED
◊ FAILS AS IS



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

CONTROL BUILDING
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 0-47W611-31-2 R1
FIGURE 9.4-7

CAD MAINTAINED DRAWING



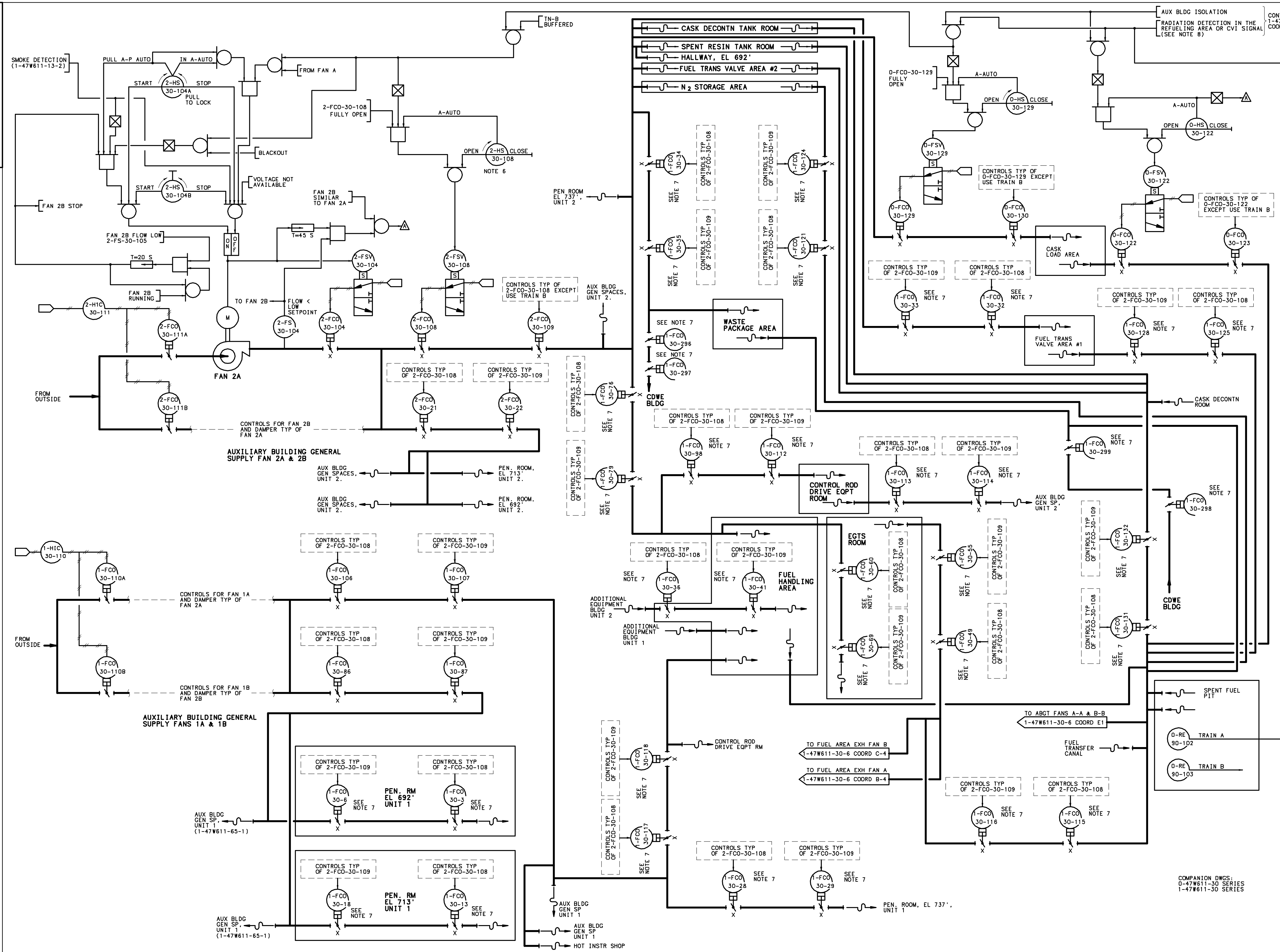
NOTES:

1. FOR NOTES, COMPANION DRAWINGS, AND REFERENCE DRAWINGS SEE 47W866-2.
2. DESIGN PRESSURE ABOVE ELEVATION 690.0 IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE. DESIGN PRESSURE FOR DUCT WORK BELOW ELEVATION 690.0 IS 2 IN-WG IN ACCORDANCE WITH SMACNA LOW VELOCITY DUCT CONSTRUCTION STANDARDS. DUCT WORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
3. PARMS (X) INDICATES A TEMPORARY SAMPLE POINT FOR THE PORTABLE AIRBORNE RADIOACTIVITY MONITORING SYSTEMS, PARMS. THERE ARE 18 POINTS. POINT 16 HAS THE RETURN LINE ABANDONED IN PLACE. THE SAMPLE LINE IS NOT INSTALLED. POINT 17 HAS THE DUCT CONNECTION FOR THE RETURN LINE CAPPED. THE SAMPLE LINE IS NOT INSTALLED. THE REMAINING 16 POINTS HAVE THE SAMPLE LINE AND THE RETURN LINE ABANDONED IN PLACE. SEE SHEETS 2 AND 11 FOR THE REMAINDER OF THE POINTS AND 47W600-108 FOR CONNECTION DETAILS.
4. FOR VALVE MARKER TABULATIONS SEE MEL.
5. ALL DUCTWORK IN THE AUXILIARY BUILDING IS TVA CLASS Q (ROUND) OR CLASS S (RECTANGULAR).
6. FOR SEISMIC REQUIREMENT FOR PIPING AND DUCT WORK SEE DETAILED CONSTRUCTION DRAWINGS (47W920 SERIES).
7. EACH OF 6 OPENINGS EQUIPPED WITH BLANK-OFF PLATE DAMPERS. EACH DAMPER SHALL BE CLOSED ANYTIME THE REACTOR IS IN A SHUTDOWN MODE AND THERE IS A POSSIBILITY OF THE OUTSIDE AIR TEMPERATURE DROPPING BELOW 35°F. ALL DAMPERS MUST BE OPENED JUST PRIOR TO EACH UNIT STARTUP.
8. FLOWRATES SHOWN WITHOUT PARENTHESES ARE THE DESIGN FLOW RATES. CONSTRUCTION SPECIFICATION G-37 ALLOWS A TOLERANCE OF ± 10% TO BE APPLIED TO THE DESIGN FLOW RATES FOR SYSTEM BALANCING. FLOW RATES SHOWN IN PARENTHESES REFLECT PREOP AIR BALANCE TEST RESULTS. THESE FLOWRATES ARE DEEMED ACCEPTABLE BASED ON MEETING THE CRITERION THAT THE AIRFLOW DIRECTION BE FROM THE CLEANER AREAS TO AREAS OF PROGRESSIVELY GREATER CONTAMINATION POTENTIAL, AND THE FACT THAT COOLING OF SAFETY-RELATED EQUIPMENT AREAS IS ACCOMPLISHED BY THE THERMOSTATICALLY CONTROLLED ESF EQUIPMENT ROOM/AREA COOLERS (SEE EX-G-37-WBN-1 REV. 1).
9. GRAB SAMPLE CONNECTIONS FOR TEMPORARY ANALYSIS OF EXHAUST EMISSIONS TO UNIT 2 STACK. ROUTE TO SYSTEM 90 PROBE STATION NUMBER 9 (47W600-108).
10. FOR DESIGN REQUIREMENTS REFER TO DESIGN CRITERIA: WB-DC-40-36.1 "THE CLASSIFICATION OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS".
11. FOR FUNCTION DESCRIPTION, REFER TO WATTS BAR NUCLEAR PLANT SYSTEM DESCRIPTION, N3-30AB-4001 "SYSTEM DESCRIPTION FOR AUXILIARY BUILDING-HEATING, VENTILATION AND AIR CONDITIONING SYSTEM".
12. ALL PIPING ON THIS DRAWING IS CLASS G, CAT. I(L).
13. SEISMIC CATEGORY I (L) DUCTWORK, ATTACHED TO THE CATEGORY I SUCTION-SIDE ABGTS DUCTWORK LOCATED IN THE SAME ROOM AS THE ABGTS FILTER TRAIN AND BOUNDED BY THE ISOLATION DAMPERS 1-FCO-30-116, 122, 124, 128, AND 132, SHALL BE ANALYZED TO SHOW THAT IT WILL NOT ADVERSELY AFFECT THE SAFETY FUNCTION OF THE ABGTS SYSTEM (REF. WB-DC-40-36.1, TABLE 3.3-1, NOTE 7).
14. SECONDARY CONTAINMENT ISOLATION DAMPERS 1-FCO-30-34, -35, -36, -41, -115, -116, -121, -124, -125, -128, -131, -132, -296, -297, -298, -299 ARE LOCKED IN THE FULLY OPEN POSITION.
15. (1|2) & [1/2] DENOTE UNIT 1 & UNIT 2 INTERFACE POINTS. THE STRUCTURAL BOUNDARY IS THE FIRST ANCHORED EQUIPMENT OR PIPE ANCHOR ON THE UNIT 2 SIDE OF THE INTERFACE POINT. BECAUSE OF TEES, SOME INTERFACE POINTS WILL HAVE MORE THAN ONE STRUCTURAL TERMINATION.
16. THIS SHAFT SHOULD BE EXTENDED AS NECESSARY TO PREVENT THE MODULATING DAMPER FROM CLOSING COMPLETELY.
17. WHEN PERFORMING MAINTENANCE ACTIVITIES IN EITHER FTC OR SFP SEE SD N3-30AB-4001, SECTION 4.26 FOR SPECIAL OPERATION FOR ALTERNATE CONFIGURATION REQUIREMENTS.
18. FLOWRATES IN PARENTHESES ARE MEASURED DATA OBTAINED DURING RFO5 (WO # 03-010366-001, -002 & -003). FOR ACCEPTANCE REFER TO EDC 51619A. THE TOTAL ACCEPTABLE AIR FLOW RATE (FROM BOTH FANS) IS 87% OF THE TOTAL DESIGN VALUE FOR THE NORTH MSVV ROOM AND 81.3% FOR THE SOUTH MSVV ROOM.
19. 2-PL-31-426 BLANK-OFF PLATE INSTALLED TO ISOLATE ABANDONED PASF UNIT 2.
20. FLOW RATES SHOWN IN PARENTHESES WERE RECORDED IN CONSTRUCTION TEST G-37 (TEST PACKAGE 0-03-AB-BT-TVA9C AND 2-30-01207-M05-000) AND APPROVED BY ENGINEERING. FLOW RATES NOT IN PARENTHESES ARE DESIGN FLOW RATES.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
HEATING & VENTILATING
AIR FLOW
TVA DWG NO. 0-47W866-10 R1
FIGURE 9.4-8



NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAM 1-47W610-30-SERIES.
3. ALL DAMPERS OPERATED FROM CONTROL ROOM WILL HAVE POSITION INDICATING LIGHTS.
4. CHANNEL SEPARATION REQUIRES SEPARATE AIR AND POWER TO REDUNDANT ELEMENTS.
5. ALL MISALIGNMENT ANNUNCIATION WILL BE COMMON TO A SINGLE ANNUNCIATOR ON THE MAIN CONTROL BOARD.
6. ALL INTERIM AUXILIARY BUILDING SECONDARY CONTAINMENT ENCLOSURE (ABSCE) DAMPERS HAVE HS POSITIONS OF "CLOSE-AUTO-OPEN" INSTEAD OF "CLOSE-A AUTO-OPEN" AS SHOWN FOR 2-HS-30-108. THIS IS DUE TO THE LOCATIONS; THE ABSCE HS'S ARE MOUNTED AT LOCAL CONTROL STATIONS AND 2-HS-30-108 IS MOUNTED IN THE MAIN CONTROL ROOM.
7. DAMPERS LOCKED IN THE OPEN POSITION FOR FULL ABSCE.
8. CVI IS USED AS AN INPUT SIGNAL ONLY DURING REFUELING OUTAGES. USING THIS INPUT WILL MAINTAIN THE ABSCE IN THE EVENT OF A HIGH RADIATION SIGNAL DURING REFUELING OPERATIONS WHILE CONTAINMENT AND/OR THE ANNULUS IS OPEN TO THE AUXILIARY BUILDING.

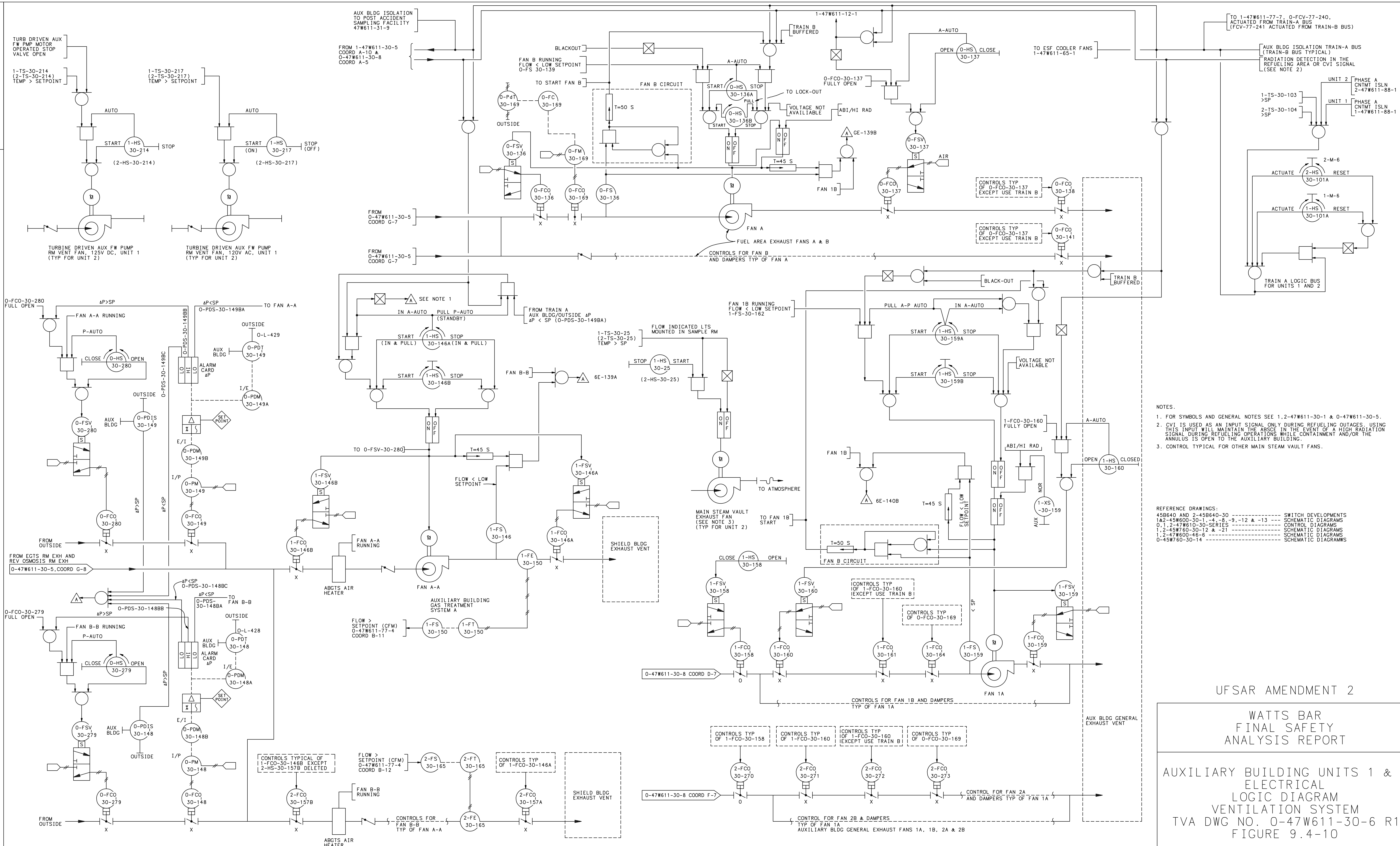
REFERENCE DRAWINGS:

1-47W611-65-1 ------------------- LOGIC DIAGRAM
1-47W611-0-1 -------------------- LOGIC DIAGRAM INDEX AND SYMBOLS
1-47W610-30-3 ------------------- CONTROL DIAGRAM
47B601-30 SERIES ---------------- INSTRUMENTATION TABULATION
47W251-13 ----------------------- FLOW DIAGRAM
45B640-181 ---------------------- SWITCH DEVELOPMENTS
1-45W600-30-2,3,4,8,10 & 13 ---- SCHEMATIC DIAGRAMS
1-45W600-57-11 & 27 ------------- SCHEMATIC DIAGRAMS
1-45W760-30-11 ------------------ SCHEMATIC DIAGRAMS
1-47W866-2,8,10 & 11 ------------ FLOW DIAGRAMS

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 0-47W611-30-5 R0
FIGURE 9.4-9

CAD MAINTAINED DRAWING



NOTES.

1. FOR SYMBOLS AND GENERAL NOTES SEE 1,2-47W611-30-1 & 0-47W611-30-5.
2. CVI IS USED AS AN INPUT SIGNAL ONLY DURING REFUELING OUTAGES. USING THIS INPUT WILL MAINTAIN THE ABSCE IN THE EVENT OF A HIGH RADIATION SIGNAL DURING REFUELING OPERATIONS WHILE CONTAINMENT AND/OR THE ANNULUS IS OPEN TO THE AUXILIARY BUILDING.
3. CONTROL TYPICAL FOR OTHER MAIN STEAM VAULT FANS.

REFERENCE DRAWINGS:

45B640 AND 2-45B640-30	SWITCH DEVELOPMENTS
1&2-45W600-30-1,-4,-8,-9,-12 & -13	SCHEMATIC DIAGRAMS
0,1,2-47W610-30-SERIES	CONTROL DIAGRAMS
1,2-45W760-30-12 & -21	SCHEMATIC DIAGRAMS
1,2-47W600-46-6	SCHEMATIC DIAGRAMS
0-45W760-30-14	SCHEMATIC DIAGRAMS

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 0-47W611-30-6 R1
FIGURE 9.4-10

CAD MAINTAINED DRAWING

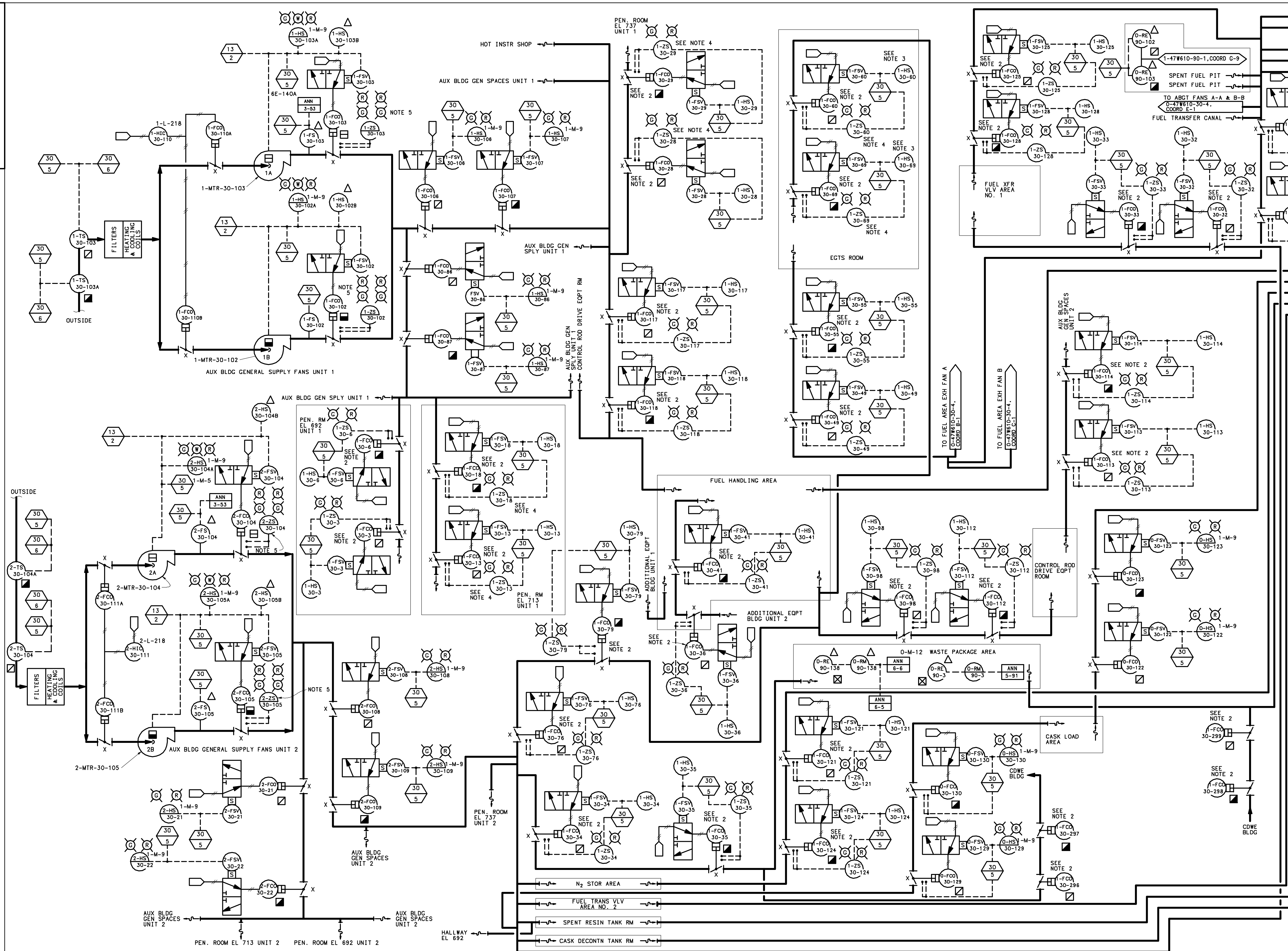


TABLE A3
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
1-HS-030-0122	HD2033	CASK LOADING AREA EXCH DMPR SW
1-HS-030-0123	HD2067	CASK LOADING AREA EXCH DMPR SW

NOTES:

1. FOR SYMBOLS, NOTES AND REF DWGS SEE 1-47W610-30-1.
2. DAMPER LOCKED IN THE OPEN POSITION FOR FULL ABSCE.
3. HAND SWITCHES 1-HS-30-60 & -69 ARE ABANDONED IN PLACE.
4. POSITION SWITCHES 1-ZS-30-13, -18, -28, -29, -60, -69, -116 & -118 ARE ABANDONED IN PLACE.
   SOLENOID VALVES 1-FSV-30-116 & -118 ARE ABANDONED IN PLACE.
5. REFER TO TABLE A3 FOR DIGITAL COMPUTER POINTS (SWITCH POSITION).

COMPANION DRAWINGS:

0-47W610-30 SERIES
1-47W610-30 SERIES
2-47W610-30 SERIES

WATTS BAR
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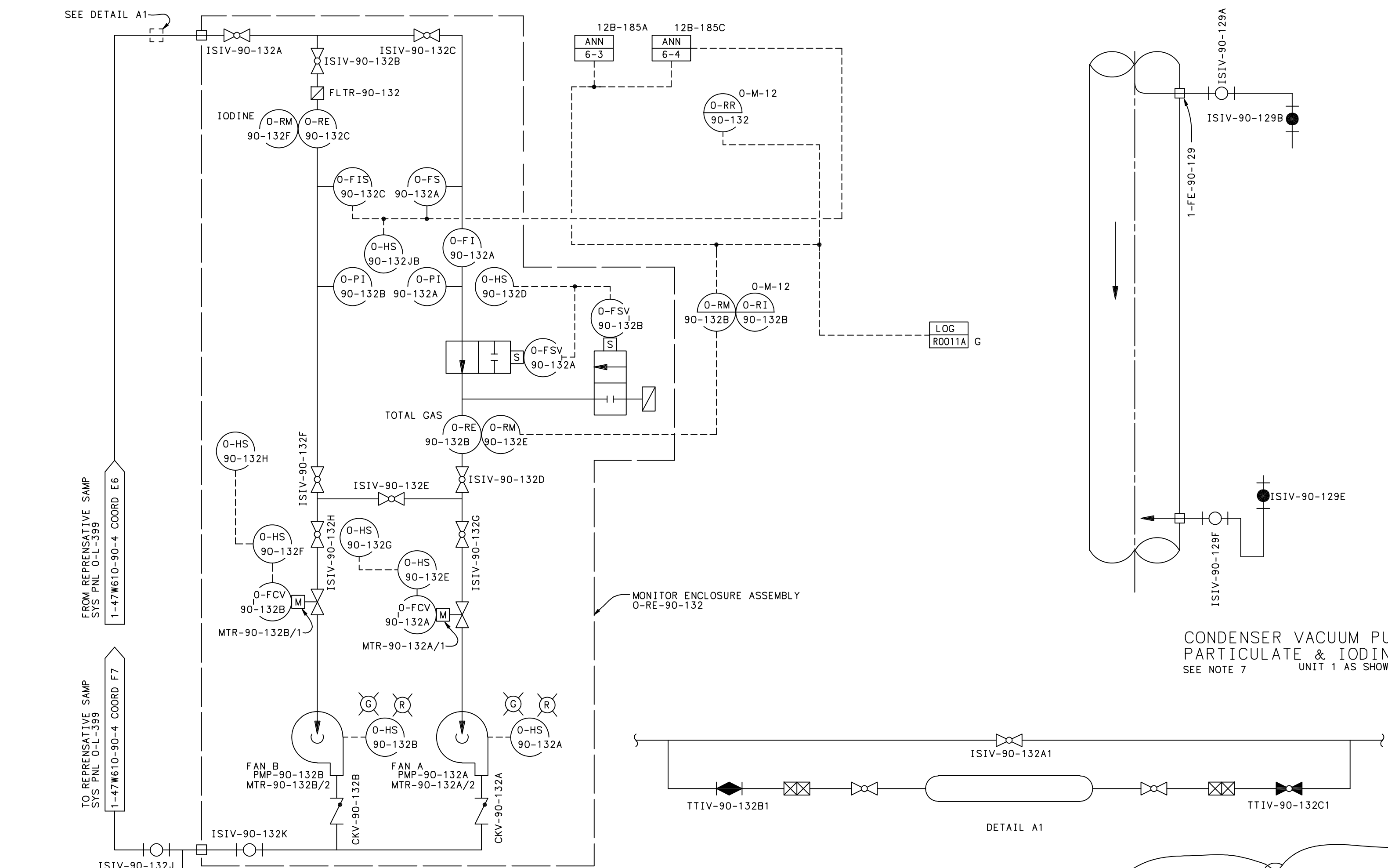
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYSTEM
TVA DWG NO. 0-47W610-30-3 RO
FIGURE 9.4-11

CAD MAINTAINED DRAWING



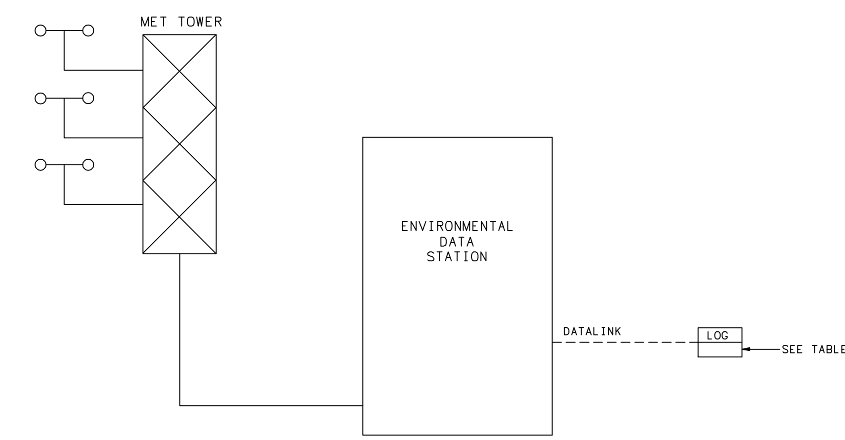
CONDENSER VACUUM PUMP AIR EXHAUST
PARTICULATE & IODINE SAMPLER
SEE NOTE 7 UNIT 1 AS SHOWN

DETAIL A1

SERVICE BLDG VENT MONITOR

TABLE A1
ENVIRONMENTAL DATA STATION
COMPUTER POINTS

POINT ID	DESCRIPTION
M9000	EDS MET DATA 10 METER WIND DIRECTION
M9001	EDS MET DATA 46 METER WIND DIRECTION
M9002	EDS MET DATA 91 METER WIND DIRECTION
M9003	EDS MET DATA 10 METER WIND SPEED
M9004	EDS MET DATA 46 METER WIND SPEED
M9005	EDS MET DATA 91 METER WIND SPEED
M9006	EDS MET DATA 10 METER TEMPERATURE
M9007	EDS MET DATA 46 METER TEMPERATURE
M9008	EDS MET DATA 91 METER TEMPERATURE
M9009	EDS MET DATA 10M HRZ-SIGMA-THETA
M9010	EDS MET DATA 46M HRZ-SIGMA-THETA
M9011	EDS MET DATA 91M HRZ-SIGMA-THETA
M9012	EDS MET DATA 10M DEW POINT
M9013	EDS MET DATA RAINFALL INCHES/HR
M9014	EDS MET DATA SOLAR RADIATION
M9015	AIR TEMPERATURE-DELTA T 46-10M
M9016	AIR TEMPERATURE-DELTA T 91-10M
M9017	AIR TEMPERATURE-DELTA T 91-46M

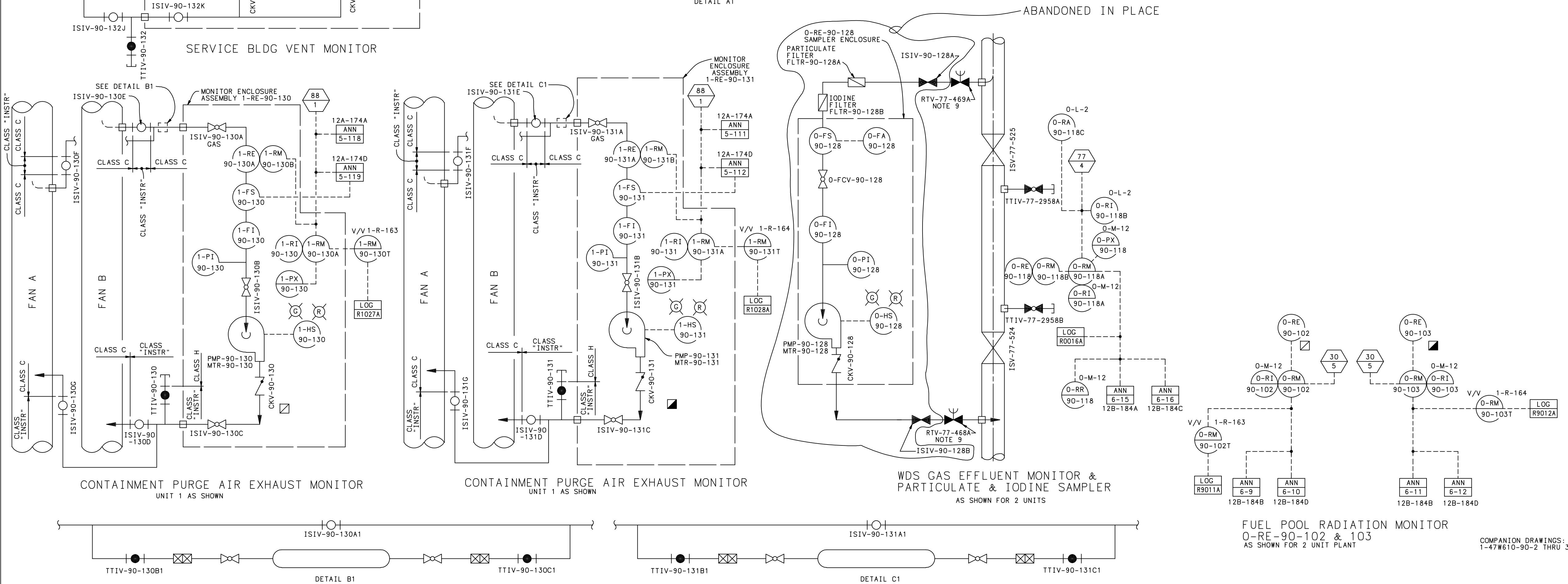


DETAIL D1
METEOROLOGICAL/ENVIRONMENTAL
DATA STATION
CONFIGURATION

NOTES:

1. THE RADIATION MONITORING SYSTEM SHALL MONITOR THE RELEASE OF FLUIDS AND GASES TO CONTROL THE DISCHARGE OF RADIOACTIVE MATERIALS INTO THE ENVIRONS TO WITHIN PERMISSIBLE RATES AND MONITOR RADIATION LEVELS AS A BASIS FOR PLANT OPERATIONS.
2. AREA RADIATION MONITORS AND AIR PARTICULATE MONITORS SHALL BE LOCATED THROUGHOUT THE PLANT TO ALERT PLANT PERSONNEL OF THE RADIATION LEVEL AND THE AMOUNT OF AIRBORNE RADIOACTIVE MATERIAL.
3. THE COMMON COMPONENT COOLING SYSTEM LIQUID EFFLUENT MONITOR IS RECORDED ON THE UNIT 1 RECORDER (1-RR-90-123).
4. THE INSTRUMENTS SHOWN IN EACH MONITOR ENCLOSURE ASSEMBLY IS A REPRESENTATION OF THE INSTRUMENTATION THE CONTRACTOR WILL FURNISH.
5. THE INLET AND OUTLET SAMPLE LINES OF RE-90-120/121 FEED INTO A MANIFOLD IN THE STEAM GENERATOR BLOWDOWN RADIATION MONITORING LINE. REFER TO 47W600-106, DETAIL J106.
6. REFER TO DETAIL D1 FOR MET STATION CONFIGURATION.
7. CHEMISTRY HAS CAPABILITY TO MANUALLY TAKE A SAMPLE.
8. 0-RE-90-132C & 0-RM-90-132F ARE NO LONGER IN THE CIRCUIT, BUT REMAIN INSTALLED DUE TO SAMPLE FLOW CONSIDERATIONS.
9. 0-RTV-77-468A AND -469A ARE CLOSED FOR ISOLATION PER 0-47W830-4.

REFERENCES:
1-47W600-1 THRU 11---INSTRUMENT AND CONTROL DRAWINGS
1-47W610-43 SERIES---SAMPLING CONTROL DIAGRAM
SQN-DC-9.0-----------DESIGN CRITERIA FOR RADIATION MONITORING SYSTEMS
47W600-100 THRU-109--I & C DRAWINGS (INSTALLATION DRAWINGS)



CONTAINMENT PURGE AIR EXHAUST MONITOR
UNIT 1 AS SHOWN

CONTAINMENT PURGE AIR EXHAUST MONITOR
UNIT 1 AS SHOWN

WDS GAS EFFLUENT MONITOR &
PARTICULATE & IODINE SAMPLER
AS SHOWN FOR 2 UNITS

FUEL POOL RADIATION MONITOR
0-RE-90-102 & 103
AS SHOWN FOR 2 UNIT PLANT

DETAIL B1

DETAIL C1

COMPANION DRAWINGS:
1-47W610-90-2 THRU 3

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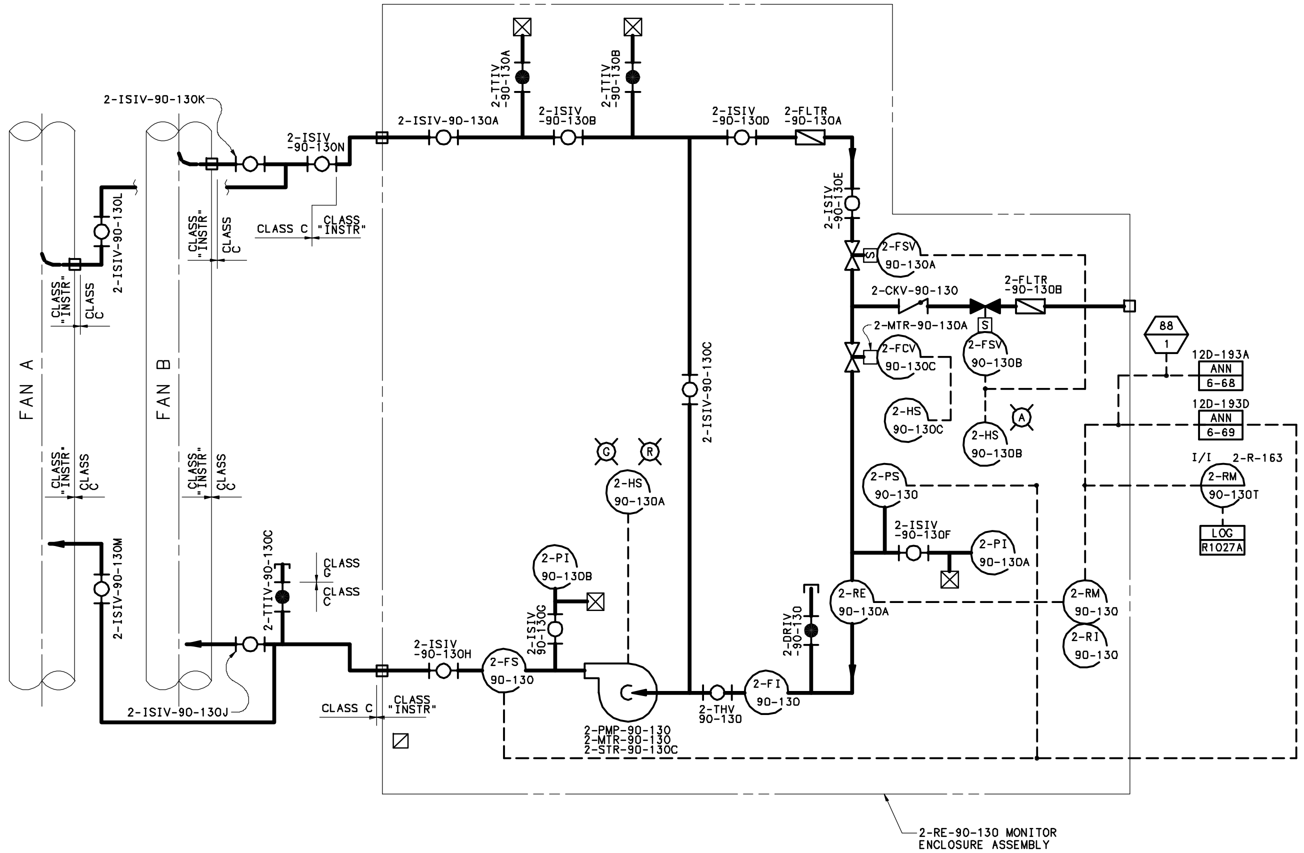
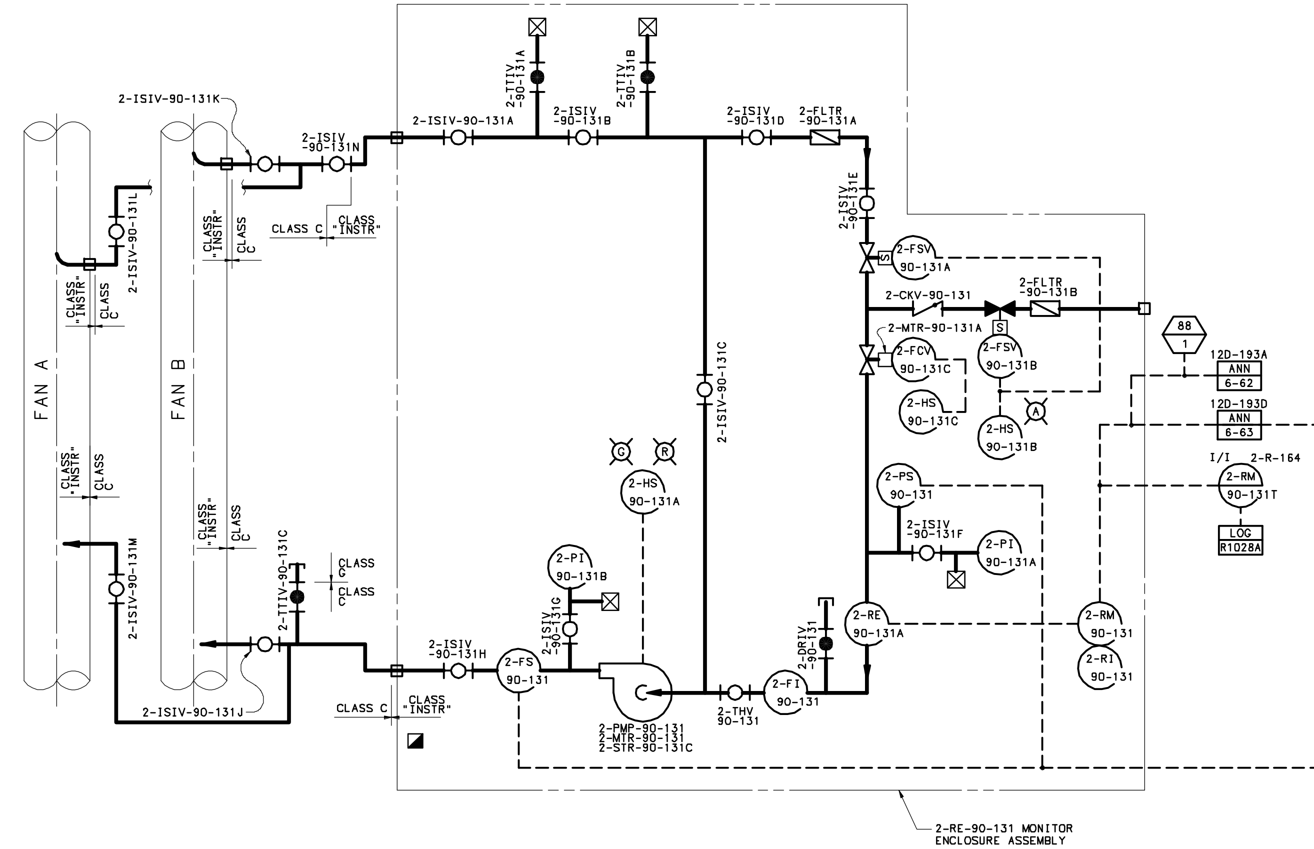
POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
RADIATION MONITORING SYSTEM
TVA DWG NO. 1-47W610-90-1 R39
FIGURE 9.4-12

CAD MAINTAINED DRAWING



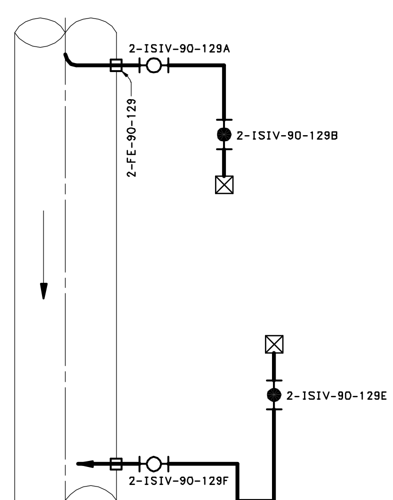
CONTAINMENT PURGE AIR EXHAUST MONITOR
UNIT 2



CONTAINMENT PURGE AIR EXHAUST MONITOR
UNIT 2

NOTES:
1. THE RADIATION MONITORING SYSTEM SHALL MONITOR THE RELEASE OF FLUIDS AND GASES TO CONTROL THE DISCHARGE OF RADIOACTIVE MATERIALS INTO THE ENVIRONS TO WITHIN PERMISSIBLE RATES AND MONITOR RADIATION LEVELS AS A BASIS FOR PLANT OPERATIONS.
2. AREA RADIATION MONITORS AND AIR PARTICULATE MONITORS SHALL BE LOCATED THROUGHOUT THE PLANT TO ALERT PLANT PERSONNEL OF THE RADIATION LEVEL AND THE AMOUNT OF AIRBORNE RADIOACTIVE MATERIAL.
3. THE INSTRUMENTS SHOWN IN EACH MONITOR ENCLOSURE ASSEMBLY IS A REPRESENTATION OF THE INSTRUMENTATION THE CONTRACTOR WILL FURNISH.
4. CHEMISTRY HAS CAPABILITY TO MANUALLY TAKE SAMPLES.

REFERENCES:
WB-DC-40-24 ------------- DESIGN CRITERIA FOR RADIATION MONITORING SYSTEMS
2-47W600-100 SERIES ----- I & C DRAWINGS (INSTALLATION DRAWINGS)

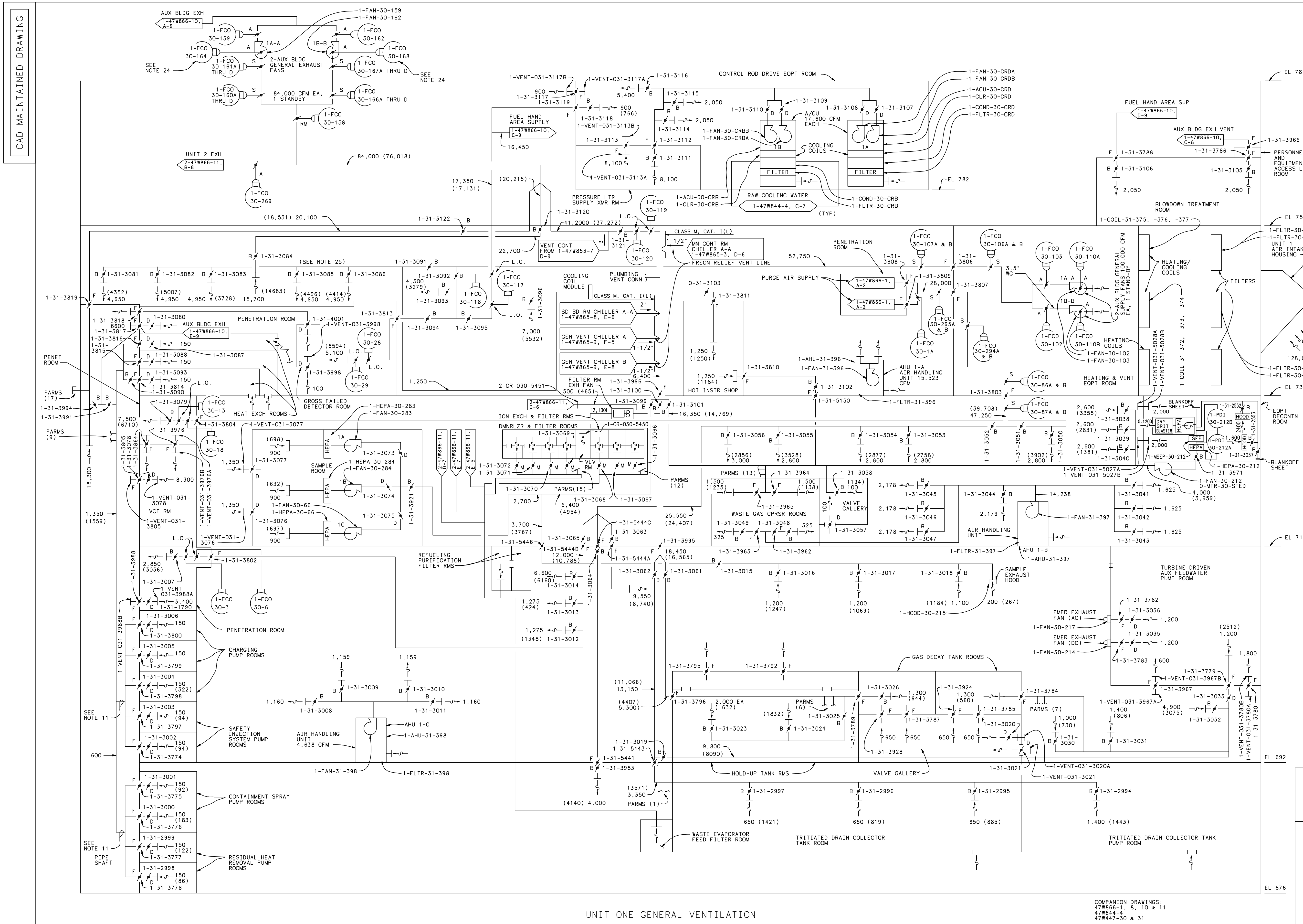


CONDENSER VACUUM PUMP AIR EXHAUST PARTICULATE & IODINE SAMPLER
SEE NOTE 4

COMPANION DRAWINGS:
2-47W610-90-2,-3,-4 & -5

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
RADIATION MONITORING SYSTEM
TVA DWG NO. 2-47W610-90-1 R13
FIGURE 9.4-12(U2)



NOTES:

1. FOR SEISMIC REQUIREMENTS FOR PIPING AND DUCTWORK SEE DETAILED CONSTRUCTION DRAWINGS (47W920 SERIES).
3. SYSTEM IDENTIFICATION NUMBERS ARE 30 AND 31.
4. FOR IDENTIFICATION OF SYMBOLS, REFER TO "INSTRUMENTATION SYMBOLS AND IDENTIFICATION".
5. EQUIPMENT IDENTIFIED THUS A-A IS POWERED FROM SEPARATE POWER TRAINS. THE FIRST LETTER IS A UNIQUE EQUIPMENT IDENTIFICATION NUMBER, AND THE SECOND LETTER IS THE POWER TRAIN (A, B, NONDIVISIONAL A OR NONDIVISIONAL B).
6. NUMBERS SHOWN THUS (1-FS 30-197) REPRESENT INSTRUMENTS IN UNIT 1.
7. NUMBERS SHOWN THUS 1-31-614 ARE VALVE MARKER TAGS FOR UNIT 1. UNIT 2 NUMBERS ARE PREFIXED BY 2. "0" PREFIX INDICATES ONE VALVE PER PLANT.
8. NUMBERS SHOWN THUS 3,500 INDICATE FLOW IN CFM.
9. FLOWS SHALL BE BALANCED TO THE RATES SHOWN ON THE DIAGRAM PER DED CONSTRUCTION SPECIFICATION NO. G-37, TESTING AND BALANCING OF HV & AC SYSTEMS.
10. (FCO 30-203) S - AUTOMATIC OPERATING FOR ISOLATION.
    - B — BALANCING (MANUAL)
    - D — BACKDRAFT DAMPER
    - F — FIRE DAMPER
    - GRILLE
11. FULL FLOW VENTILATION WILL OCCUR ONLY WHEN PUMP ROOM DOORS ARE OPEN.
12. DESIGN PRESSURE ABOVE ELEVATION 690.0 IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE, DESIGN PRESSURE FOR DUCTWORK BELOW ELEVATION 690.0 IS 2 IN-WG IN ACCORDANCE WITH SMACNA LOW VELOCITY DUCT CONSTRUCTION STANDARDS, EXCEPT AS NOTED ON DRAWINGS. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
13. ALL DUCTWORK IN THE AUXILIARY BUILDING IS TVA CLASS Q (ROUND) OR CLASS S (RECTANGULAR).
14. PARMS (X) INDICATES A TEMPORARY SAMPLE POINT FOR THE PORTABLE AIRBORNE RADIOACTIVITY MONITORING SYSTEMS, PARMS. THERE ARE 18 POINTS. POINT 16 HAS THE RETURN LINE ABANDONED IN PLACE. THE SAMPLE LINE IS NOT INSTALLED. POINT 17 HAS THE DUCT CONNECTION FOR THE RETURN LINE CAPPED. THE SAMPLE LINE IS NOT INSTALLED. THE REMAINING 16 POINTS HAVE THE SAMPLE LINE AND THE RETURN LINE ABANDONED IN PLACE. SEE SHEETS 10 AND 11 FOR THE REMAINDER OF THE POINTS AND 47W600-108 FOR CONNECTION DETAILS.
15. FLOW RATES SHOWN IN BRACKETS OCCUR ONLY WITH A FILTER ROOM HATCH REMOVED.
16. FOR NON QA VALVE AND DAMPER MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISCELLANEOUS VALVE REPORT -009. FOR QA VALVE AND DAMPER MARKER TABULATIONS SEE 47B920-31X1 THRU 47B920-31X4.
17. FLOWRATES SHOWN WITHOUT PARENTHESIS ARE THE DESIGN FLOW RATES. CONSTRUCTION SPECIFICATION G-37 ALLOWS A TOLERANCE OF ±10% TO BE APPLIED TO THE DESIGN FLOW RATES FOR SYSTEM BALANCING. FLOW RATES SHOWN IN PARENTHESIS REFLECT PREOP AIR BALANCE TEST RESULTS. THESE FLOWRATES ARE DEEMED ACCEPTABLE BASED ON MEETING THE CRITERION THAT THE AIRFLOW DIRECTION BE FROM THE CLEANER AREAS TO AREAS OF PROGRESSIVELY GREATER CONTAMINATION POTENTIAL, AND THE FACT THAT COOLING OF SAFETY-RELATED EQUIPMENT AREAS IS ACCOMPLISHED BY THE THERMOSTATICALLY CONTROLLED ESF EQUIPMENT ROOM/AREA COOLERS (SEE EX-G-37-WBN-1 REV. 1).
18. FOR FUNCTION DESCRIPTION, REFER TO WATTS BAR NUCLEAR PLANT SYSTEM DESCRIPTION N3-30AB-4001, "SYSTEM DESCRIPTION FOR AUXILIARY BUILDING-HEATING, VENTILATION AND AIR CONDITIONING SYSTEM".
19. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):

    N3-65-4001---------EMERGENCY GAS TREATMENT
    N3-30AB-4001--------HVAC-AUXILIARY BLDG
20. ALL PIPING ON THIS DRAWING IS CLASS M, CAT. I(L).
21. DURING UNIT 1 OPERATION 2-FCO-30-294 AND 2-FCO-30-295 SHALL BE LOCKED CLOSED.
22. SECONDARY CONTAINMENT ISOLATION DAMPERS 1-FCO-30-3, -6, -13, -18, -28, -29, -117, -118, -119 AND -120 ARE LOCKED IN THE FULLY OPEN POSITION.
23. FOR ELECTRIC UNIT HEATERS' CIDS AND LOCATIONS, REFER TO THE FOLLOWING PHYSICAL DRAWINGS:

47W920-1	FOR EL 676.0
47W920-2, -3	FOR EL 692.0
47W920-4	FOR EL 713.0
47W920-6	FOR EL 729.0
47W920-5	FOR EL 737.0
47W920-7, -8	FOR EL 757.0
47W920-9	FOR EL 772.0
47W920-10, -28	FOR EL 782.0 & 786.0

24. THIS SHAFT SHOULD BE EXTENDED AS NECESSARY TO PREVENT THE MODULATING DAMPER FROM CLOSING COMPLETELY.
25. BALANCING DAMPER 1-31-3085 MAY BE ADJUSTED FROM THE BALANCED POSITION TO REDUCE OR ELIMINATE VENTILATION AIR TO THE SUPPLY GRILLE.

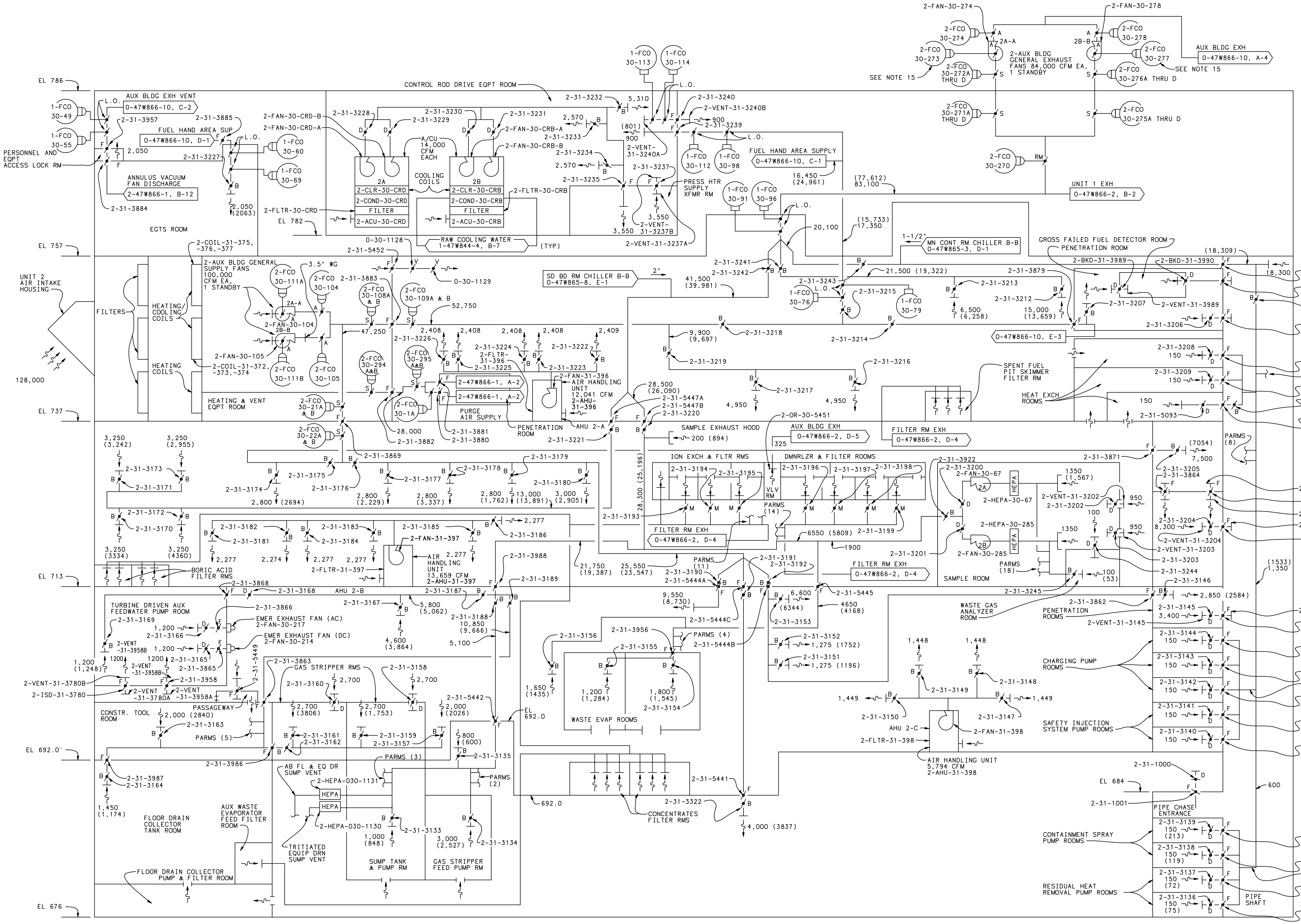
REFERENCE DRAWINGS:
47B920-31X1 THRU 31X4
47B601-30 SERIES
47B601-31 SERIES
47W610-30 SERIES
47W611-30 SERIES
47W865-1, 2 & 9
47W867 SERIES
47W920 SERIES
47W921-1 & 2

COMPANION DRAWINGS:
47W866-1, 8, 10 & 11
47W844-4
47W447-30 & 31

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
HEATING, COOLING AND
VENTILATING AIR FLOW
TVA DWG NO. 0-47W866-2 R1
FIGURE 9.4-13



UNIT TWO GENERAL VENTILATION

NOTES:

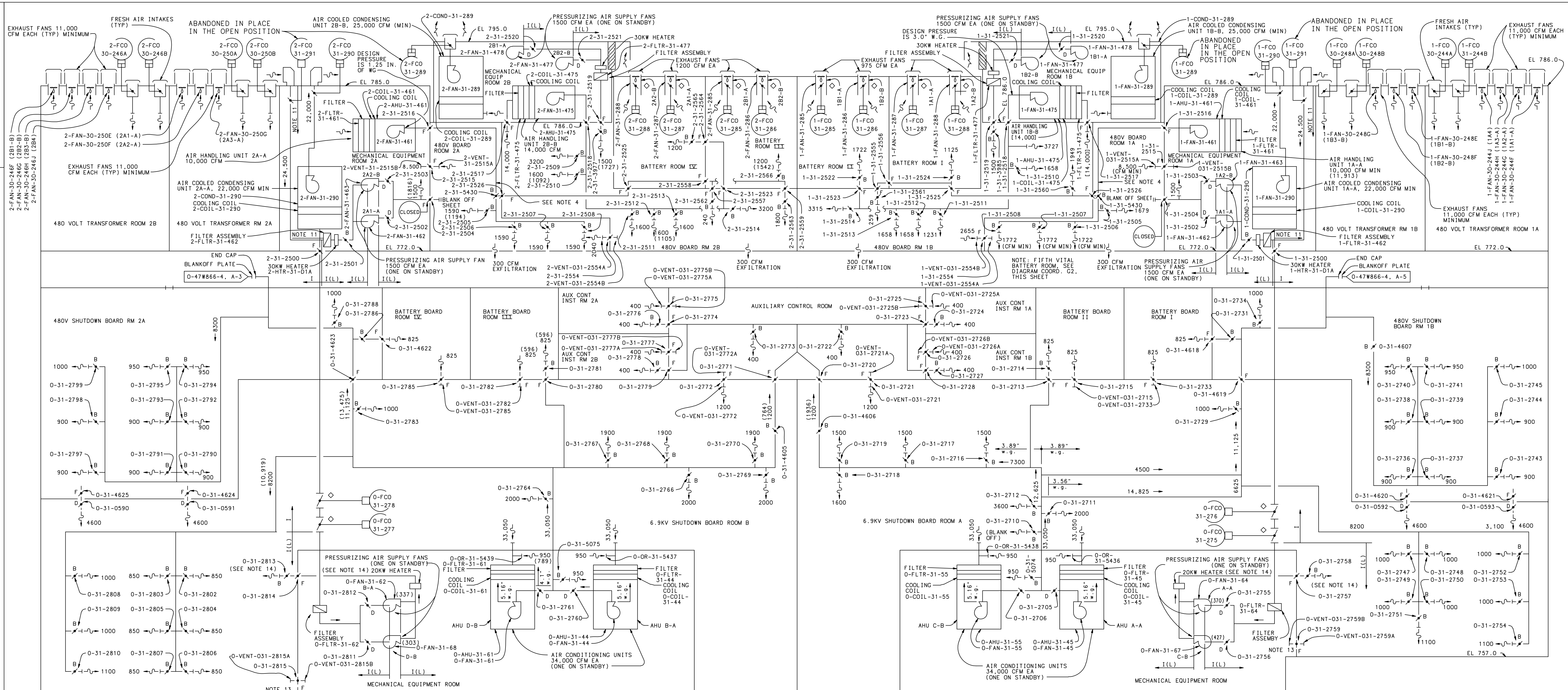
1. FOR NOTES, COMPANION DRAWINGS, AND REFERENCE DRAWINGS SEE 0-47W866-2.
2. FULL FLOW VENTILATION WILL OCCUR ONLY WHEN PUMP ROOM DOORS ARE OPEN.
3. DESIGN PRESSURE ABOVE ELEVATION 690.0 IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE, PRESSURE FOR DUCTWORK BELOW ELEVATION 690.0 IS A 2 IN-WG IN ACCORDANCE WITH SMACNA LOW VELOCITY DUCT CONSTRUCTION STANDARDS, EXCEPT AS NOTED ON DRAWINGS. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
4. PARMS (X) INDICATES A TEMPORARY SAMPLE POINT FOR THE PORTABLE AIRBORNE RADIOACTIVITY MONITORING SYSTEMS, PARMS. THERE ARE 18 POINTS. POINT 16 HAS THE RETURN LINE ABANDONED IN PLACE. THE SAMPLE LINE IS NOT INSTALLED. POINT 17 HAS THE DUCT CONNECTION FOR THE RETURN LINE CAPPED. THE SAMPLE LINE IS NOT INSTALLED. THE REMAINING 16 POINTS HAVE THE SAMPLE LINE AND THE RETURN LINE ABANDONED IN PLACE. SEE SHEETS 2 AND 10 FOR THE REMAINDER OF THE POINTS AND 47W600-108 FOR CONNECTION DETAILS.
5. NOT USED.
6. ALL DUCTWORK IN THE AUXILIARY BUILDING IS TVA CLASS Q (ROUND) OR CLASS S (RECTANGULAR).
7. FOR SEISMIC REQUIREMENT FOR PIPING AND DUCTWORK SEE DETAILED CONSTRUCTION DRAWINGS (47W920 SERIES).
8. FLOWRATES SHOWN WITHOUT PARENTHESES ARE THE DESIGN FLOW RATES. CONSTRUCTION SPECIFICATION G-37 ALLOWS A TOLERANCE OF ±10% TO BE APPLIED TO THE DESIGN FLOW RATES FOR SYSTEM BALANCING. FLOW RATES SHOWN IN PARENTHESES REFLECT PREOP AIR BALANCE TEST RESULTS. THESE FLOWRATES ARE DEEMED ACCEPTABLE BASED ON MEETING THE CRITERION THAT THE AIRFLOW DIRECTION BE FROM THE CLEANER AREAS TO AREAS OF PROGRESSIVELY GREATER CONTAMINATION POTENTIAL, AND THE FACT THAT COOLING OF SAFETY-RELATED EQUIPMENT AREAS IS ACCOMPLISHED BY THE THERMOSTATICALLY CONTROLLED ESF EQUIPMENT ROOM/AREA COOLERS (SEE EX-G-37-WBN-1 REV. 1).
9. FOR DESIGN REQUIREMENTS, REFER TO DESIGN CRITERIA: WB-DC-40-36.1 "THE CLASSIFICATION OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS".
10. FOR FUNCTION DESCRIPTION, REFER TO WATTS BAR NUCLEAR PLANT SYSTEM DESCRIPTION, N3-30AB-4001 "SYSTEM DESCRIPTION FOR AUXILIARY BUILDING HEATING, VENTILATION AND AIR CONDITIONING SYSTEM".
11. NOT USED.
12. NOT USED.
13. SECONDARY CONTAINMENT ISOLATION DAMPERS 1-FCO-30-49, -55, -60, -69, -76, -79, -91, -96, -98, -112, -113 AND -114 ARE LOCKED IN THE FULLY OPEN POSITION.
14. NOT USED.
15. THIS SHAFT SHOULD BE EXTENDED AS NECESSARY TO PREVENT THE MODULATING DAMPER FROM CLOSING COMPLETELY.

UFSAR AMENDMENT 2

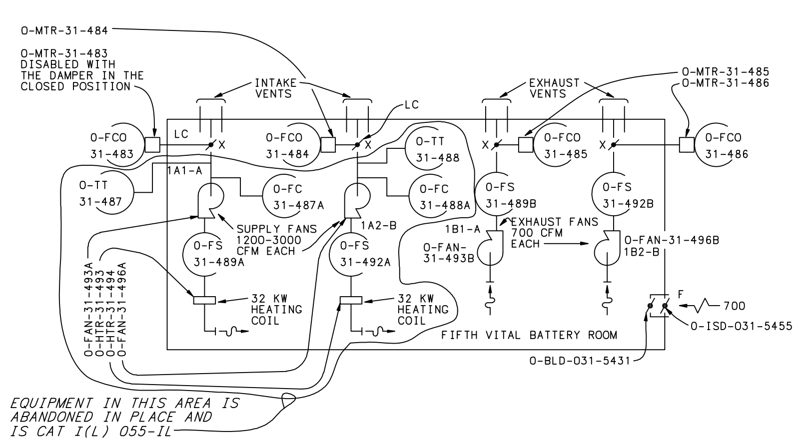
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
HEATING, COOLING & VENTILATING
AIR FLOW
TVA DWG NO. 0-47W866-11 R1
FIGURE 9.4-14

CAD MAINTAINED DRAWING



AIR FLOW DIAGRAM
AUXILIARY BOARD ROOMS EL 772.0
SHUTDOWN BOARD ROOMS EL 757.0



NOTES:

1. FOR GENERAL NOTES, REFERENCE DRAWINGS, AND DAMPER LEGEND SEE 47W866-1.
2. FOR CHILLED WATER SUPPLY TO AIR HANDLING UNITS SEE 47W865-8.
3. SYSTEM IDENTIFICATION NUMBERS 30 AND 31.
4. IF DESIGN PRESSURE EXCEEDS 2" WG DOWNSTREAM OF THIS POINT, REVIEW OF DCN F-27263-A IS REQUIRED TO ASSURE CONTINUED QUALIFICATION OF THE SUPPORTS AND DUCTWORK.
5. DESIGN PRESSURE IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
6. FOR VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISCELLANEOUS VALVE REPORT-009 & -010.
7. ALL DUCTWORK ON THIS DRAWING IS TVA CLASS S, SEISMIC CATEGORY I

   EXCEPTIONS TO THIS ARE DUCTWORKS SPECIFIED AS TVA CLASS S, SEISMIC CATEGORY I(L).
8. FLOW RATES SHOWN WITHOUT PARENTHESES ARE THE DESIGN FLOW RATES. FLOW RATES SHOWN IN PARENTHESES ARE THE FLOWS MEASURED ON AIRFLOW BALANCE PACKAGE AB-31D-01 FOR THE SHUTDOWN BOARD ROOM AND AB-31E-01 FOR THE 480V BOARD ROOM HVAC SYSTEMS THAT ARE NOT WITHIN THE LIMITS SPECIFIED IN GENERAL ENGINEERING SPECIFICATION G-37. THESE FLOW RATES HAVE BEEN APPROVED BY NUCLEAR ENGINEERING (N3-30AB-4001, APPENDIX A). FLOW RATES SHOWN IN BRACKETS [] ARE DESIGN FLOW RATES WHICH HAVE BEEN EVALUATED TO +10% / -15% BY EDC-50490-A.
9. FOR FUNCTIONAL DESCRIPTION REFER TO WATTS BAR NUCLEAR PLANT SYSTEM DESCRIPTION N3-30AB-4001, "SYSTEM DESCRIPTION FOR AUXILIARY BUILDING-HEATING, VENTILATION AND AIR CONDITIONING SYSTEM".
10. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):

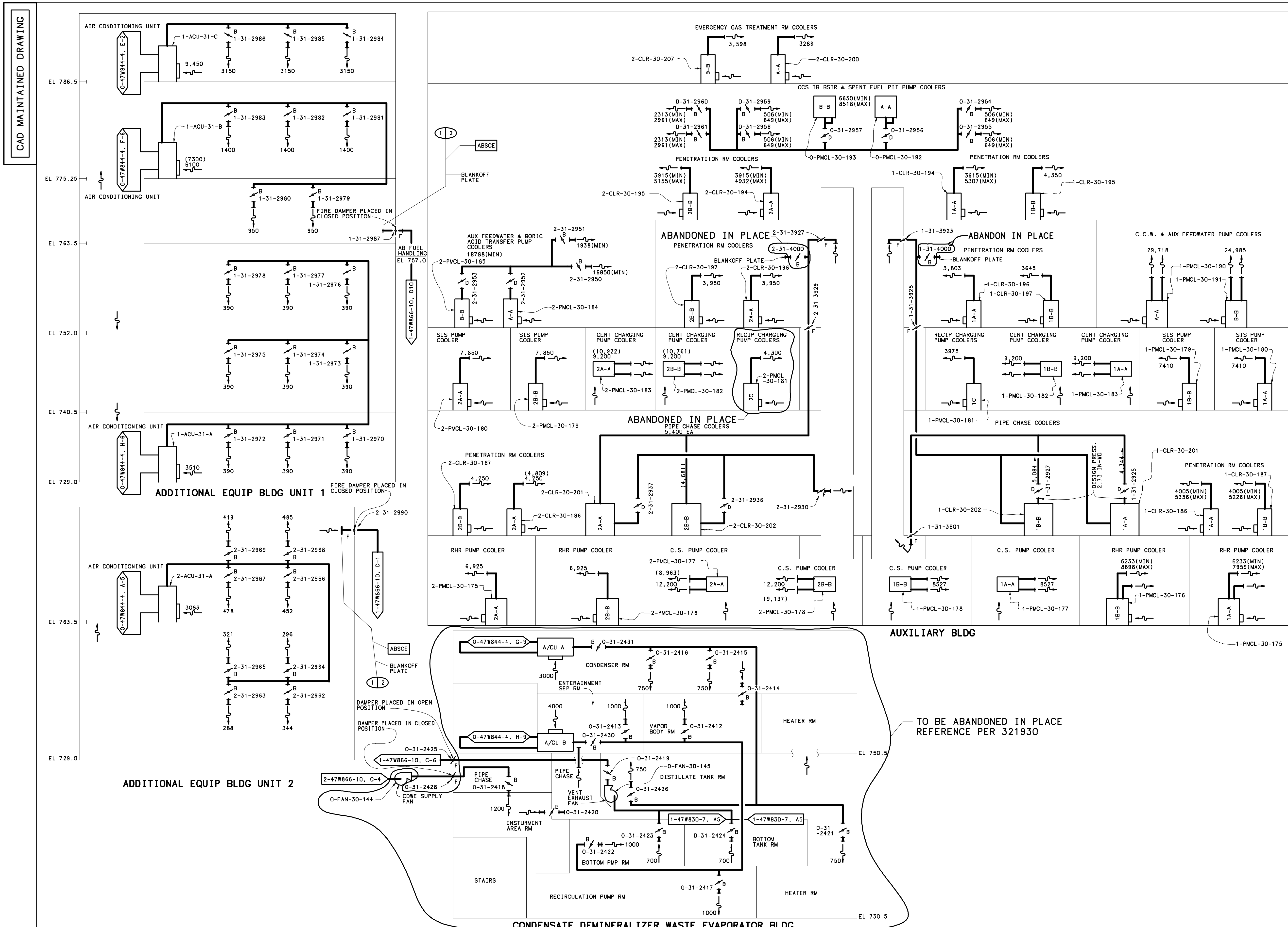
    N3-30AB-4001-------HVAC AUXILIARY BUILDING
11. DURING CONDENSING UNIT (CONTRACT #83237) OPERATION THIS DUCT EXPERIENCES A MAXIMUM 1.25 IN. W.G. VACUUM PRESSURE.
12. EXCEPTION TO NOTE 5 ACCEPTABLE DESIGN PRESSURE IS SHOWN ON FLOW DIAGRAM.
13. THESE FIRE DAMPERS TO BE CLOSED AND LATCHED.
14. ADJUST FLOW TO OBTAIN ATMOSPHERIC PRESSURE OR A SLIGHT POSITIVE PRESSURE WITH RESPECT TO THE ABSCE AND A MINIMUM OF 1/8 INCH W.G. NEGATIVE PRESSURE WITH RESPECT TO THE MAIN CONTROL ROOM.

COMPANION DRAWINGS:
0-47W866-4

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
FLOW DIAGRAM
HEATING, VENTILATION &
AIR COND AIR FLOW
TVA DWG NO. 0-47W866-3 R3
FIGURE 9.4-15



NOTES:

1. FOR NOTES, COMPANION DRAWINGS, AND REFERENCE DRAWINGS SEE 0-47W866-2.
2. DESIGN PRESSURE IN THE ADDITIONAL EQUIPMENT BUILDING IS 2 IN-WG IN ACCORDANCE WITH SMACNA LOW VELOCITY DUCT CONSTRUCTION STANDARDS. DESIGN PRESSURE FOR AUXILIARY BUILDING ESF COOLER DUCTWORK IS 6 IN-WG, OR UNLESS OTHERWISE NOTED, IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION G-37.
3. NOT USED.
4. ALL DUCTWORK FOR THE AUXILIARY BUILDING, ESF COOLERS IS CLASS Q (ROUND) OR S (RECTANGULAR), SEISMIC CATEGORY I PER WB-DC-40-36.1. DUCTWORK FOR THE ADDITIONAL EQUIPMENT BUILDINGS AND THE CONDENSATE DEMINERALIZER WASTE EVAPORATOR BUILDING HAS NO TVA CLASS.
5. FLOW RATES SHOWN WITHOUT PARENTHESES ARE THE DESIGN FLOW RATES. CONSTRUCTION SPECIFICATION G-37 ALLOWS A TOLERENCE OF ±10% TO BE APPLIED TO THE DESIGN FLOW RATES FOR SYSTEM BALANCING. FLOW RATES SHOWN IN PARENTHESES WERE RECORDED PER G-37 (TEST PACKAGE 2-030-01168-M05-000) AND APPROVED BY NUCLEAR ENGINEERING. THESE FLOW RATES, ALTHOUGH THEY ARE OUTSIDE G-37 ACCEPTABLE CRITERIA, REPRESENT THE MAXIMUM OR MINIMUM (AS APPLICABLE) ACCEPTABLE FLOW RATES FOR USE IN ANY FUTURE TESTING/BALANCING OF THE SYSTEM (REFERENCE PER'S 877745, 885290, 918026, AND 957985).
6. FOR DESIGN REQUIREMENTS REFER TO DESIGN CRITERIA: WB-DC-40-36.1 "THE CLASSIFICATION OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS".
7. FOR FUNCTION DESCRIPTION, REFER TO WATTS BAR NUCLEAR PLANT SYSTEM, DESCRIPTION, N3-30AB-4001 "SYSTEM DESCRIPTION FOR AUXILIARY BUILDING HEATING, VENTILATION AND AIR CONDITIONING SYSTEM".
8. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):
N3-30AB-4001- - - - -HVAC AUXILIARY BUILDING
9. ALL FLOWS ARE ±10% UNLESS IDENTIFIED AS MINIMUM OR MAXIMUM, OR OTHERWISE NOTED.
10. (1|2) DENOTES A UNIT 1/UNIT 2 INTERFACE POINT WHICH MUST REMAIN CLOSED.
11. [ABSCE] DENOTES ITEM IS REQUIRED TO REMAIN IN DESIGN CONFIGURATION AS SHOWN TO PROTECT THE PRESSURE BOUNDARY INTEGRITY OF THE ABSCE.

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE UNITS 1 & 2
AUX BLDG & ADDITIONAL EQUIP BLDG
FLOW DIAGRAM
HEATING COOLING & VENTILATION
AIR FLOW
TVA DWG NO. 0-47W866-8 R1
FIGURE 9.4-16

CAD MAINTAINED DRAWING

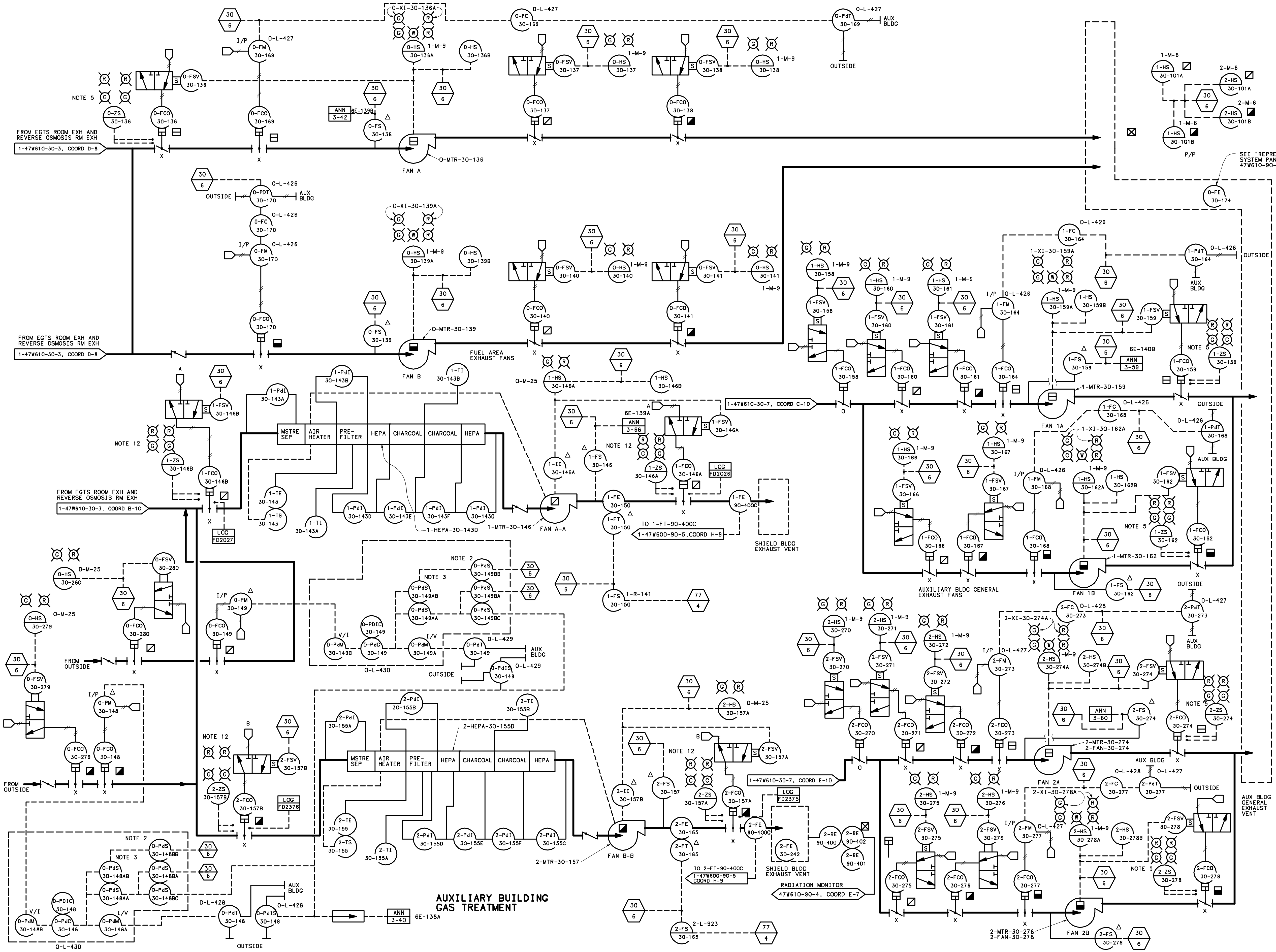


TABLE A4
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
1-FAN-030-0146	XD2010	AUX BLDG GAS TREATMENT FAN A-A
1-FAN-030-0146	XD2009	AUX BLDG GAS TREATMENT FAN A-A
2-FAN-030-0157	XD4008	AUX BLDG GAS TREATMENT FAN B-B
2-FAN-030-0157	XD4007	AUX BLDG GAS TREATMENT FAN B-B
1-HS-030-0146	HD2036	AB GAS TMT FAN A-A SW

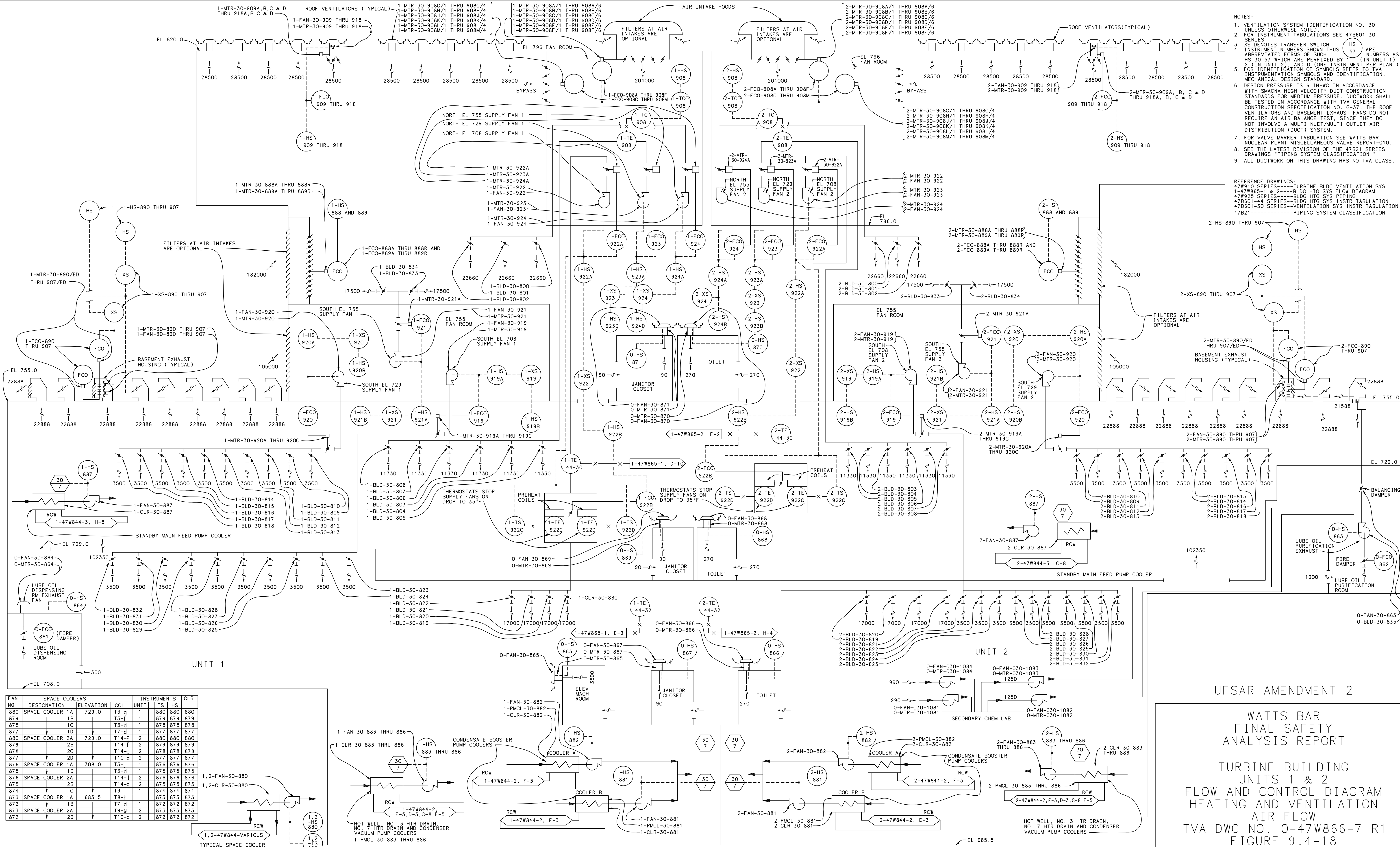
NOTES:
1. FOR SYMBOLS, NOTES, AND REFERENCE DRAWINGS SEE 1-47W610-30-1.
2. OUTPUT RELAY CARD IN FOXBORO PROCESS CONTROL SYSTEM.
3. ALARM CARD IN FOXBORO PROCESS CONTROL SYSTEM FOR SETPOINT ADJUSTMENT.
4. REFER TO TABLE A4 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, SWITCH POSITION, FAN RUNNING).

COMPANION DRAWINGS:
0-47W610-30 SERIES
1-47W610-30 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 0-47W610-30-4 RO
FIGURE 9.4-17

CAD MAINTAINED DRAWING



NOTES:

1. VENTILATION SYSTEM IDENTIFICATION NO. 30 UNLESS OTHERWISE NOTED.
2. FOR INSTRUMENT TABULATIONS SEE 47B601-30 SERIES.
3. XS DENOTES TRANSFER SWITCH.
4. INSTRUMENT NUMBERS SHOWN THUS (HS 57) ARE ABBREVIATED FORMS OF SUCH NUMBERS AS HS-30-57 WHICH ARE PERFIXED BY 1 (IN UNIT 1) 2 (IN UNIT 2), AND 0 (ONE INSTRUMENT PER PLANT).
5. FOR IDENTIFICATION OF SYMBOLS REFER TO TVA INSTRUMENTATION SYMBOLS AND IDENTIFICATION, MECHANICAL DESIGN STANDARD.
6. DESIGN PRESSURE IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE. DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37. THE ROOF VENTILATORS AND BASEMENT EXHAUST FANS DO NOT REQUIRE AN AIR BALANCE TEST, SINCE THEY DO NOT INVOLVE A MULTI NLET/MULTI OUTLET AIR DISTRIBUTION (DUCT) SYSTEM.
7. FOR VALVE MARKER TABULATION SEE WATTS BAR NUCLEAR PLANT MISCELLANEOUS VALVE REPORT-010.
8. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."
9. ALL DUCTWORK ON THIS DRAWING HAS NO TVA CLASS.

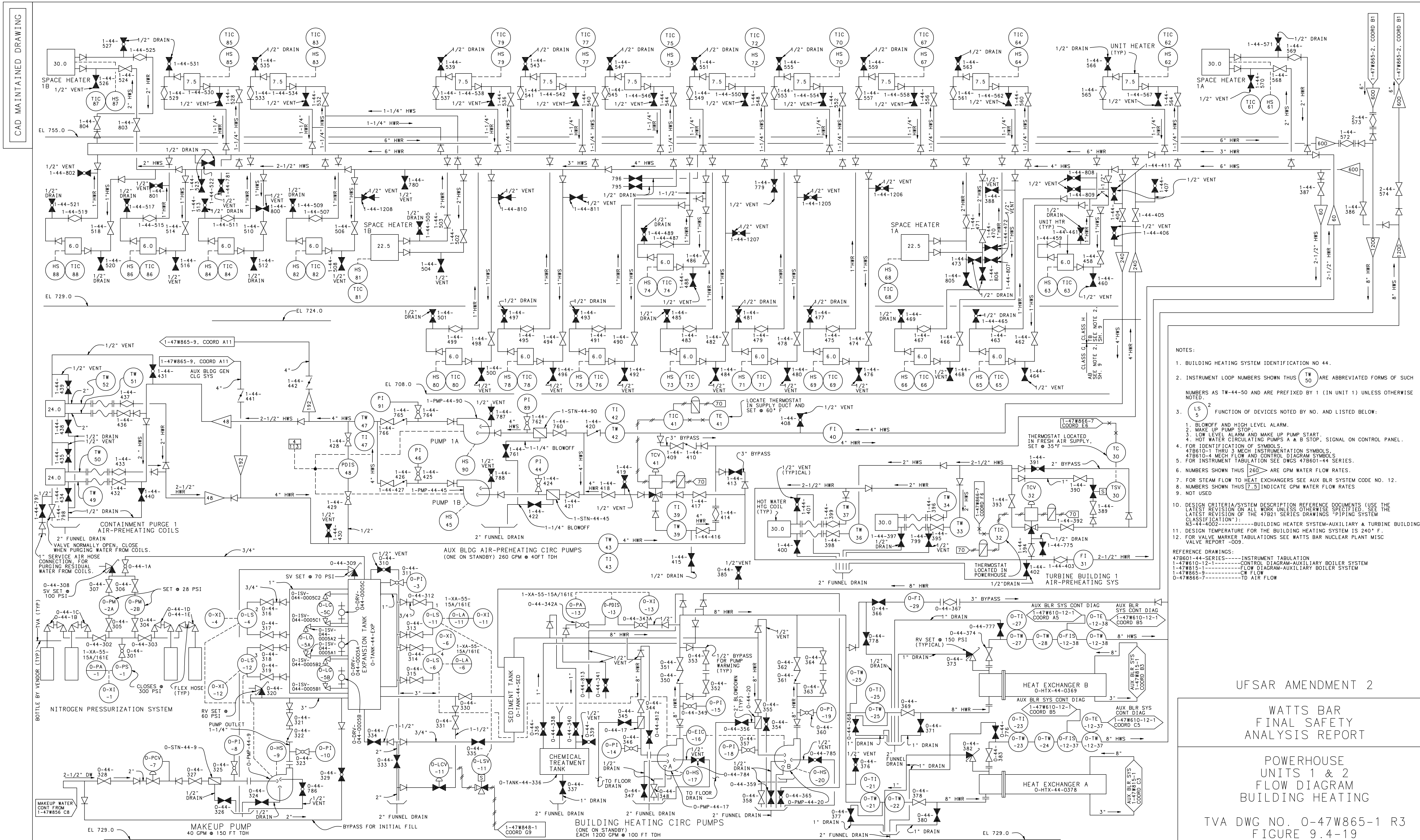
REFERENCE DRAWINGS:
47W910 SERIES-----TURBINE BLDG VENTILATION SYS
1-47W865-1 & 2----BLDG HTG SYS FLOW DIAGRAM
47W925 SERIES-----BLDG HTG SYS PIPING
47B601-44 SERIES--BLDG HTG SYS INSTR TABULATION
47B601-30 SERIES--VENTILATION SYS INSTR TABULATION
47B21-------------PIPING SYSTEM CLASSIFICATION

FAN	SPACE COOLERS			INSTRUMENTS				CLR
NO.	DESIGNATION	ELEVATION	COL	UNIT		TS	HS	
880	SPACE COOLER 1A	729.0	T3-g	1		880	880	880
879	↓ 1B	↓	T3-f	1		879	879	879
878	1C		T3-d	1		878	878	878
877	1D		T7-d	1		877	877	877
880	SPACE COOLER 2A	729.0	T14-g	2		880	880	880
879	↓ 2B	↓	T14-f	2		879	879	879
878	2C		T14-d	2		878	878	878
877	2D		T10-d	2		877	877	877
876	SPACE COOLER 1A	708.0	T3-j	1		876	876	876
875	↓ 1B	↓	T3-d	1		875	875	875
876	SPACE COOLER 2A		T14-j	2		876	876	876
875	↓ 2B		T14-d	2		875	875	875
874	C		T9-j	1		874	874	874
873	SPACE COOLER 1A	685.5	T8-h	1		873	873	873
872	↓ 1B	↓	T7-d	1		872	872	872
873	SPACE COOLER 2A		T9-g	2		873	873	873
872	↓ 2B		T10-d	2		872	872	872

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

TURBINE BUILDING
UNITS 1 & 2
FLOW AND CONTROL DIAGRAM
HEATING AND VENTILATION
AIR FLOW
TVA DWG NO. 0-47W866-7 R1
FIGURE 9.4-18



NOTES:

1. BUILDING HEATING SYSTEM IDENTIFICATION NO 44.
2. INSTRUMENT LOOP NUMBERS SHOWN THUS (TW 50) ARE ABBREVIATED FORMS OF SUCH NUMBERS AS TW-44-50 AND ARE PREFIXED BY 1 (IN UNIT 1) UNLESS OTHERWISE NOTED.
3. (LS 5) 2 FUNCTION OF DEVICES NOTED BY NO. AND LISTED BELOW:
   1. BLOWOFF AND HIGH LEVEL ALARM.
   2. MAKE UP PUMP STOP.
   3. LOW LEVEL ALARM AND MAKE UP PUMP START.
   4. HOT WATER CIRCULATING PUMPS A & B STOP, SIGNAL ON CONTROL PANEL.
4. FOR IDENTIFICATION OF SYMBOLS, 47B610-1 THRU 3 MECH INSTRUMENTATION SYMBOLS, 47B610-4 MECH FLOW AND CONTROL DIAGRAM SYMBOLS
5. FOR INSTRUMENT TABULATION SEE DWGS 47B601-44 SERIES.
6. NUMBERS SHOWN THUS 260 ARE GPM WATER FLOW RATES.
7. FOR STEAM FLOW TO HEAT EXCHANGERS SEE AUX BLR SYSTEM CODE NO. 12.
8. NUMBERS SHOWN THUS 7.5 INDICATE GPM WATER FLOW RATES
9. NOT USED
10. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION"):
    N3-44-4002-----------BUILDING HEATER SYSTEM-AUXILIARY & TURBINE BUILDING
11. DESIGN TEMPERATURE FOR THE BUILDING HEATING SYSTEM IS 240° F.
12. FOR VALVE MARKER TABULATIONS SEE WATTS BAR NUCLEAR PLANT MISC VALVE REPORT -009.

REFERENCE DRAWINGS:

47B601-44-SERIES-----INSTRUMENT TABULATION
1-47W610-12-1---------CONTROL DIAGRAM-AUXILIARY BOILER SYSTEM
1-47W815-1-----------FLOW DIAGRAM-AUXILIARY BOILER SYSTEM
1-47W865-9-----------CW FLOW
0-47W866-7-----------TD AIR FLOW

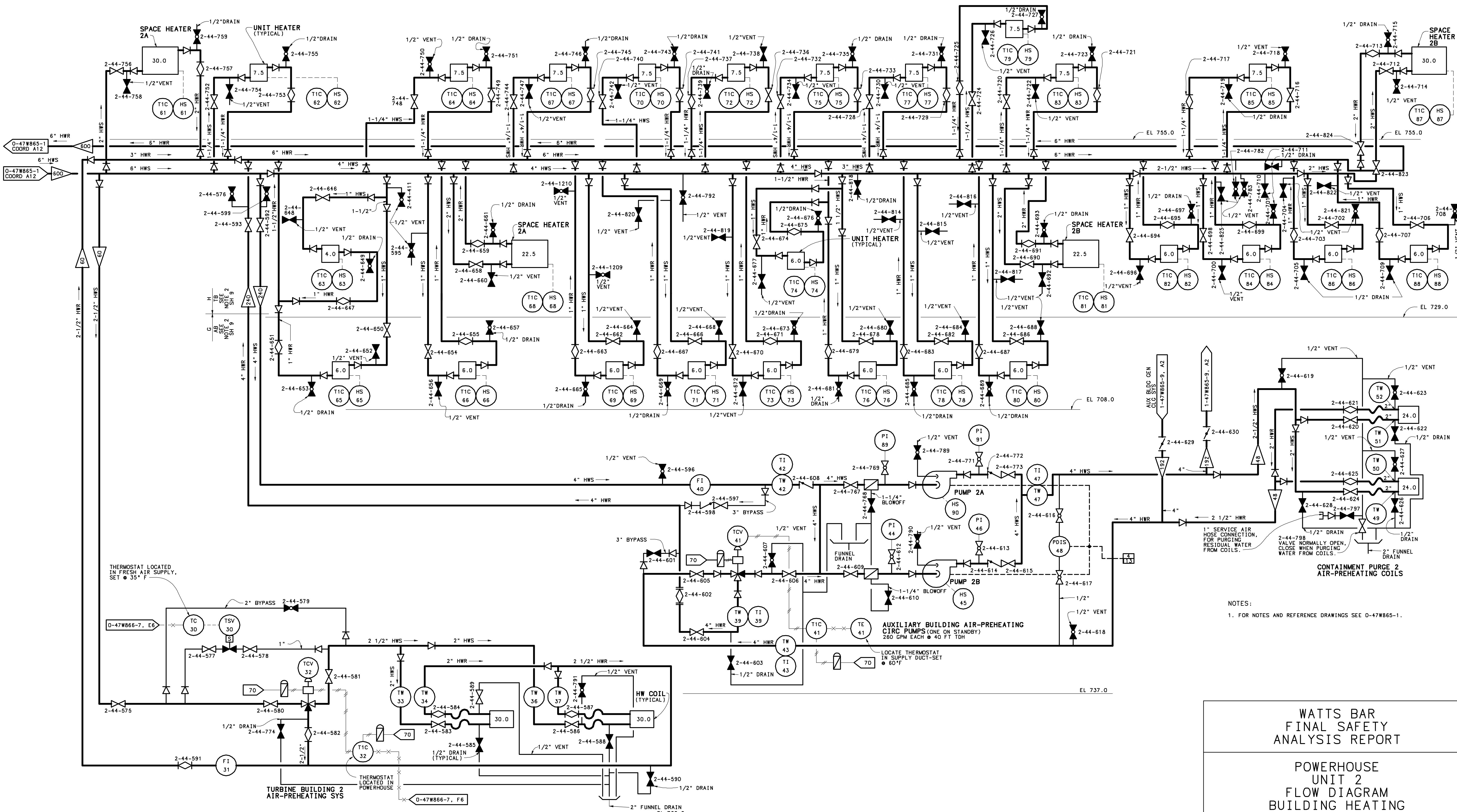
UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
FLOW DIAGRAM
BUILDING HEATING

TVA DWG NO. 0-47W865-1 R3
FIGURE 9.4-19

CAD MAINTAINED DRAWING



NOTES:

1. FOR NOTES AND REFERENCE DRAWINGS SEE 0-47W865-1.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
FLOW DIAGRAM
BUILDING HEATING

TVA DWG NO. 2-47W865-2 RO
FIGURE 9.4-20

SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390

FIGURE 9.4-21

SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390

FIGURE 9.4-22

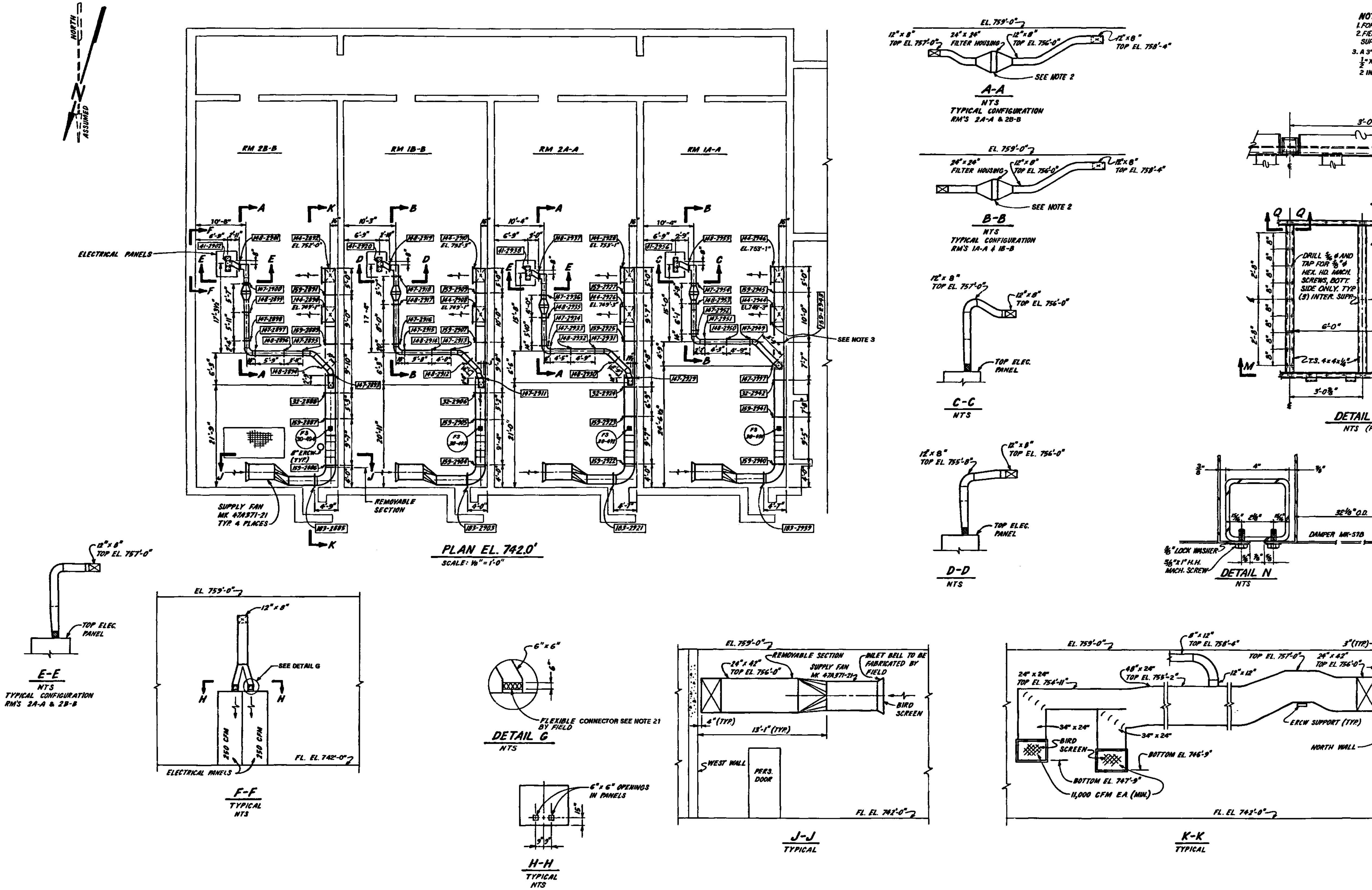
SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390

FIGURE 9.4-23

SECURITY-RELATED INFORMATION, WITHHELD UNDER 10CFR2.390

FIGURE 9.4-24

CAD MAINTAINED DRAWING



NOTES:

1. FOR GEN. NOTES SEE 17W910-1
2. FIELD TO PROVIDE A 30 % (NBS RATED) FILTER FOR THE ELECTRICAL PANEL SUPPLY DUCTWORK.
3. A 3"X3" PIECE OF 20 GAUGE GALVANIZED SHEET METAL IS ATTACHED ON HOLE SIZE $\frac{1}{2}$" X 1$\frac{3}{8}$" BY MEANS OF (6) $\frac{3}{16}$" Ø GALV. STEEL BLIND RIVETS EVENLY SPACED ON A 2 INCH DIA PITCH CIRCLE. REF. MARK NO. 144-2908.

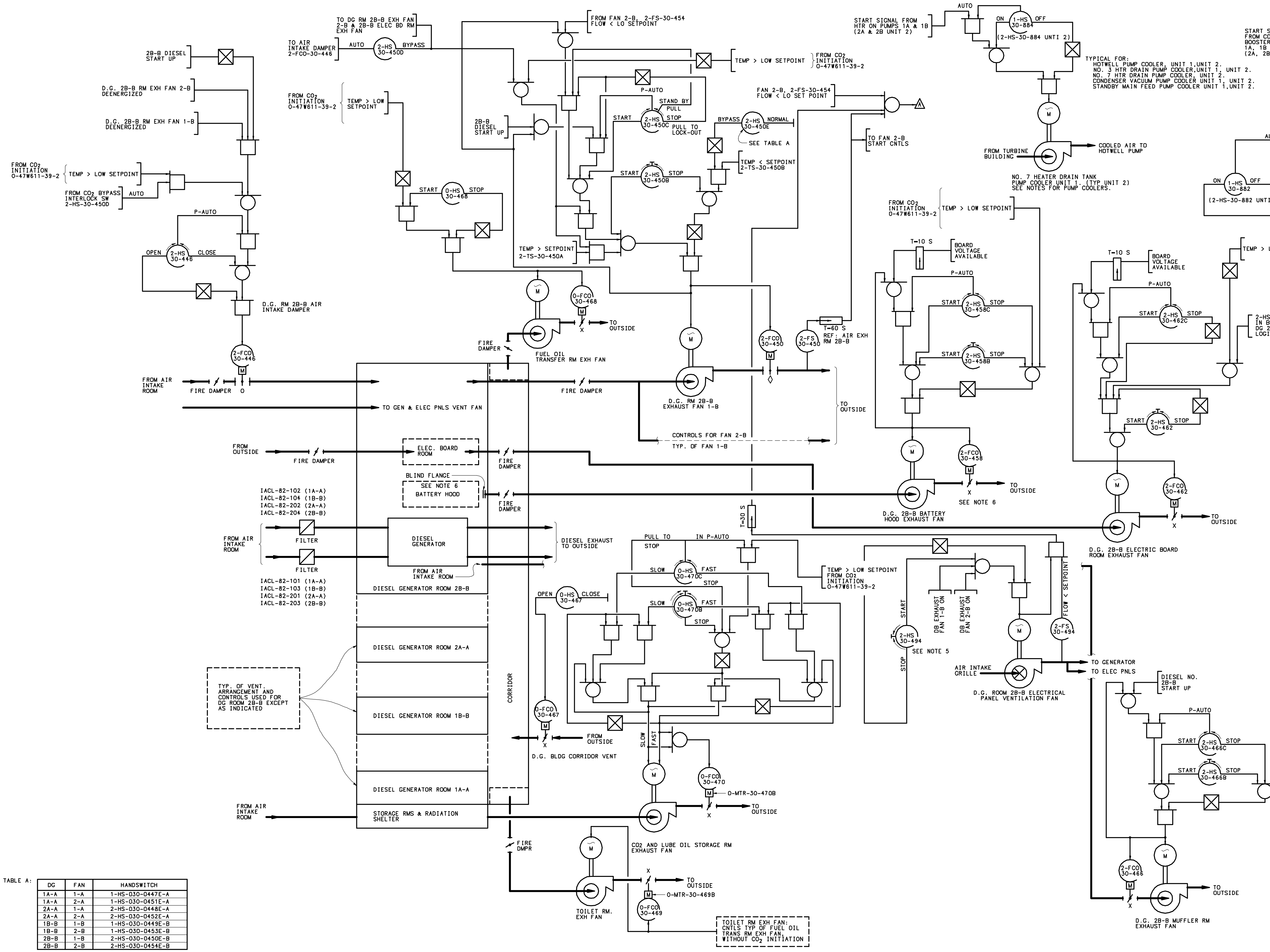
ECN 3898
COMPANION DRAWINGS: 17W910-1, 2, & 3

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

DIESEL GENERATOR BUILDING
MECHANICAL
HEATING & VENTILATION

TVA DWG NO. 17W910-4 RF
FIGURE 9.4-24A

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTES ABOVE SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAM, 0-47W866-9.
3. LOGIC SHOWN FOR UNIT 2. TYPICAL FOR UNIT 1 EXCEPT AS NOTED.
4. NOTE DELETED.
5. 2-HS-30-494 WILL BE USED AS A TESTING FUNCTION.
6. FAN OVERLOADS REMOVED AND DAMPER POWER REMOVED (FAN AND DAMPER ABANDONED IN PLACE).

REFERENCE DRAWINGS:

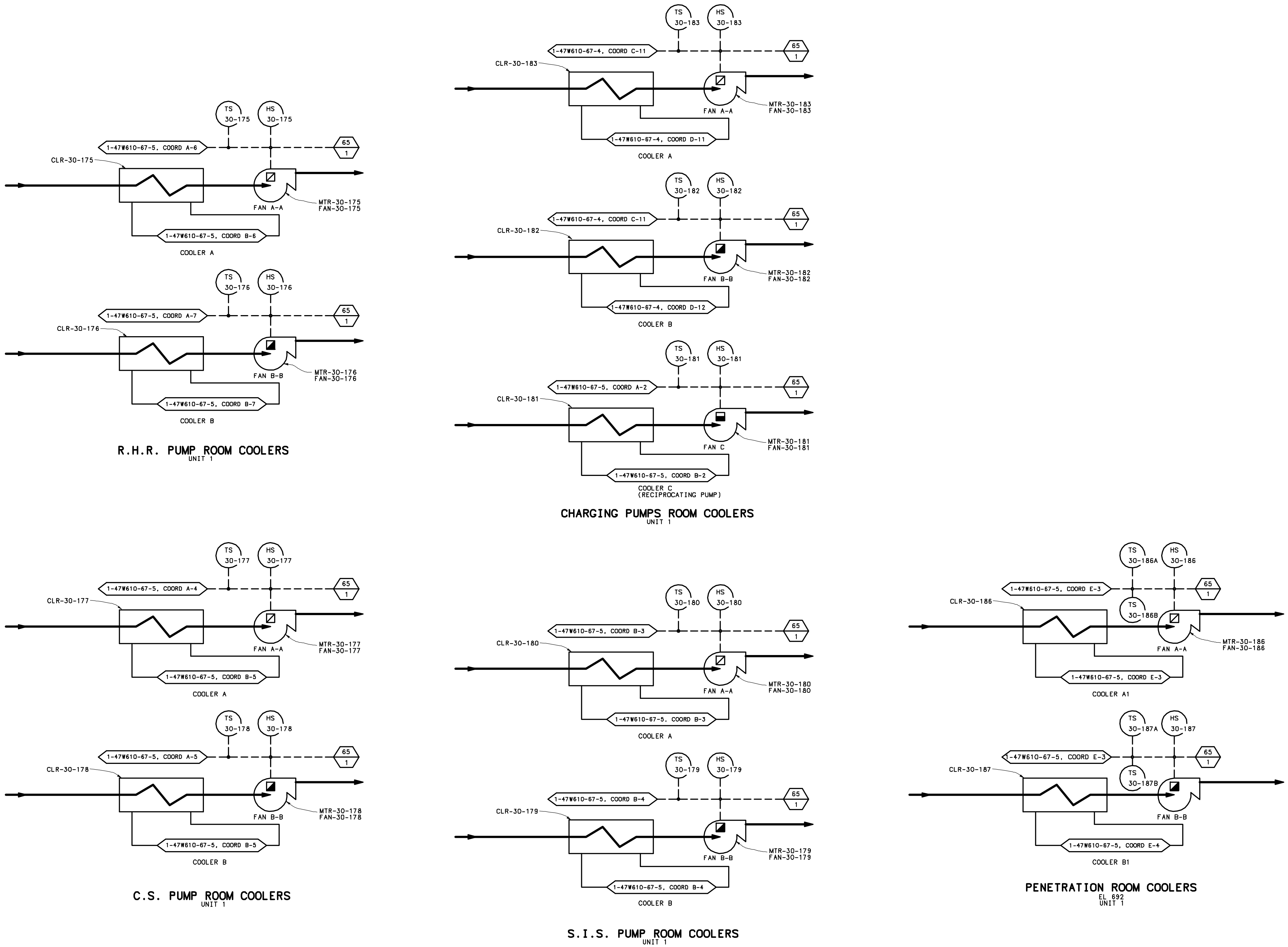
0-47W611-39-2 ------------------ LOGIC DIAGRAM
1,2-47W611-0-1 ------------------ LOGIC DIAGRAM INDEX & SYMBOLS
0-47W866-7 & -9 ---------------- FLOW DIAGRAM
17W910-1,2 --------------------- MECH HV & AC DWGS
1,2-45W760-30-7,-22 & -25 ------ SCHEMATIC DIAGRAMS

TABLE A:

DG	FAN	HANDSWITCH
1A-A	1-A	1-HS-030-0447E-A
1A-A	2-A	1-HS-030-0451E-A
2A-A	1-A	2-HS-030-0448E-A
2A-A	2-A	2-HS-030-0452E-A
1B-B	1-B	1-HS-030-0449E-B
1B-B	2-B	1-HS-030-0453E-B
2B-B	1-B	2-HS-030-0450E-B
2B-B	2-B	2-HS-030-0454E-B

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

DIESEL BUILDING
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 0-47W611-30-7 RO
FIGURE 9.4-25



NOTES:
1. FOR SYMBOLS, NOTES, AND REFERENCE DRAWINGS SEE 1-47W610-30-1.

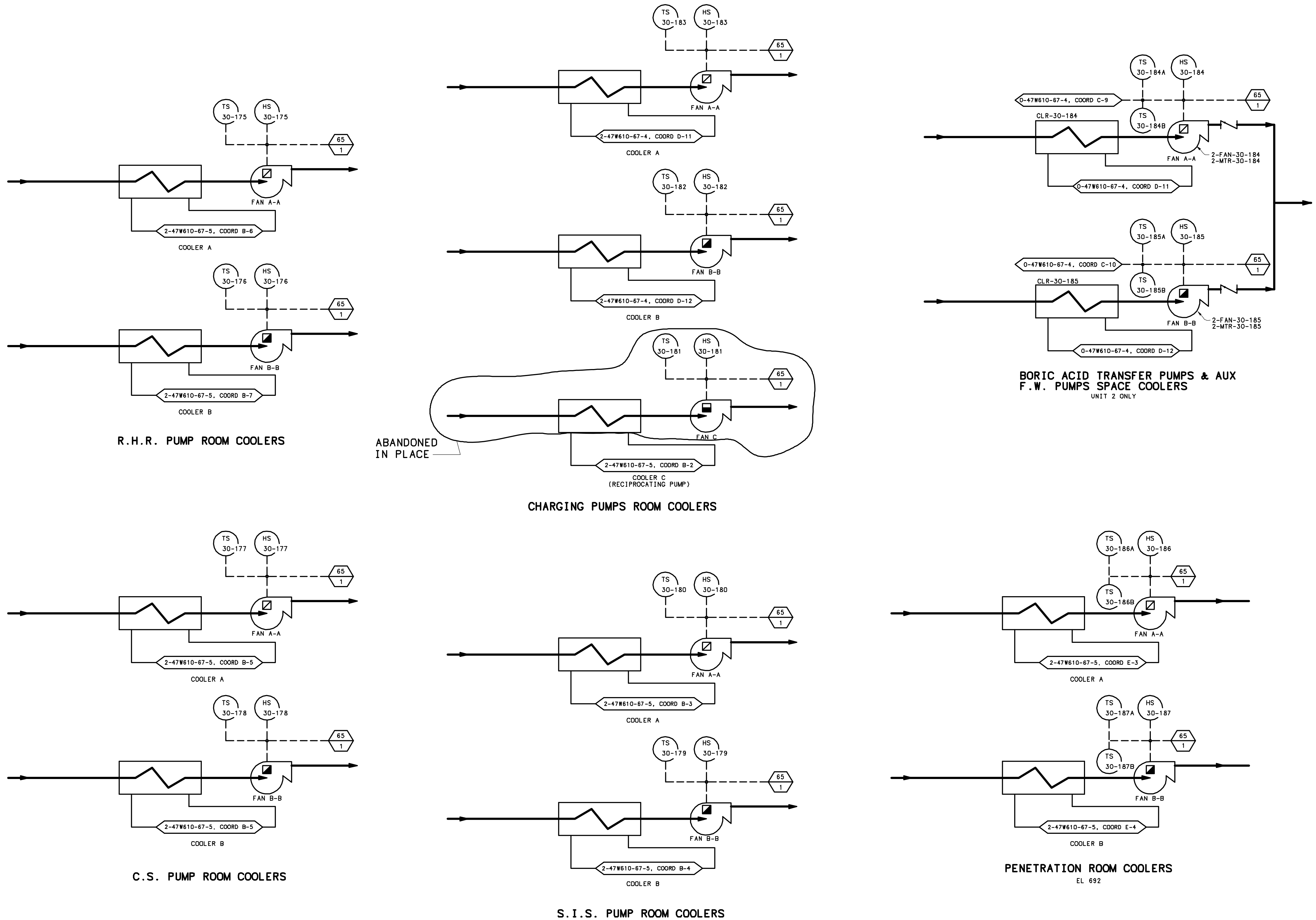
COMPANION DRAWINGS:

1-47W610-30 SERIES
0-47W610-30 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 1-47W610-30-5 R3
FIGURE 9.4-26

CAD MAINTAINED DRAWING



NOTES:

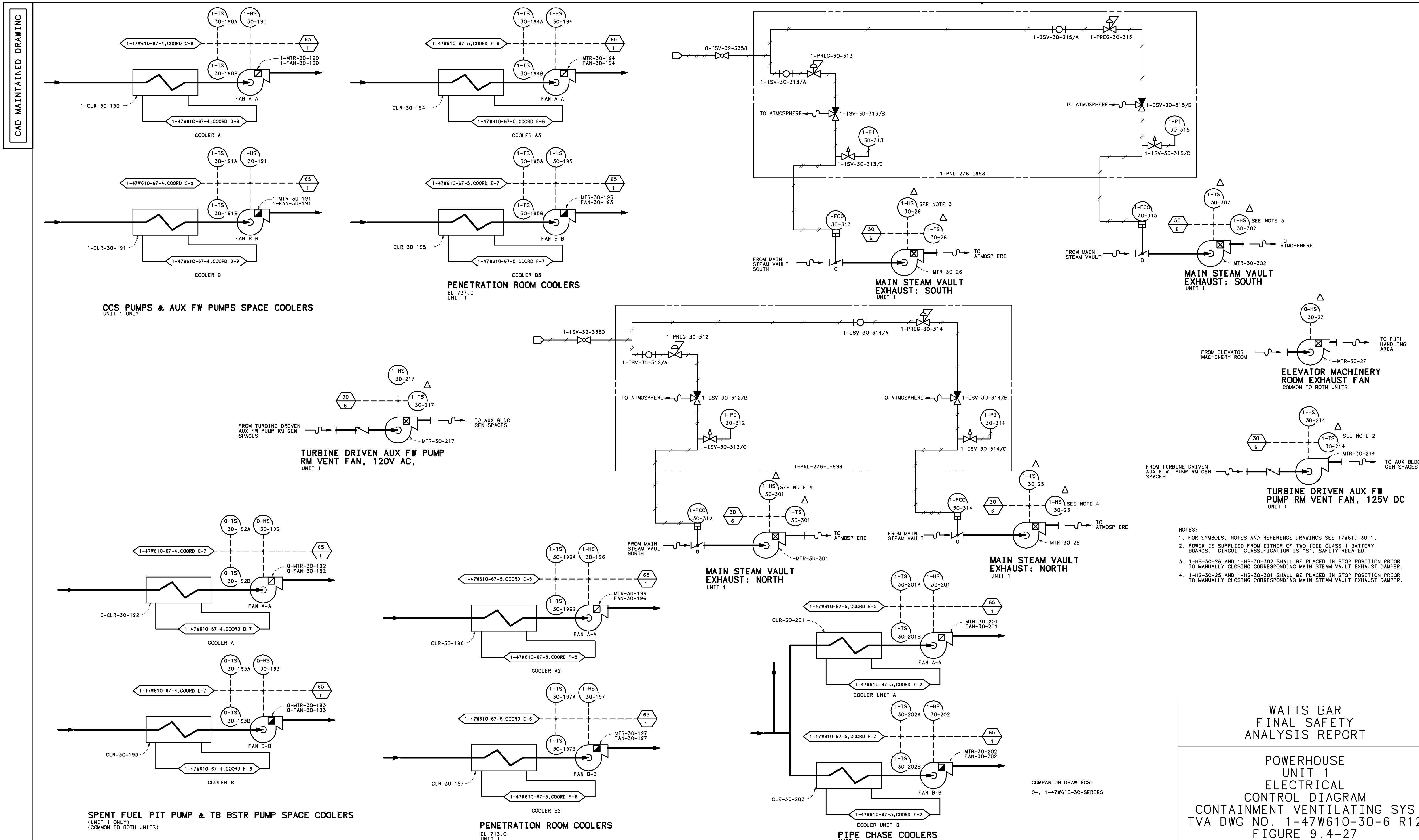
1. FOR SYMBOLS, GENERAL NOTES, AND REFERENCE DRAWINGS SEE 2-47W610-30-1.

COMPANION DRAWINGS:

2-47W610-30 SERIES
0-47W610-30 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
VENTILATION SYS
TVA DWG NO. 2-47W610-30-5 R5
FIGURE 9.4-26(U2)



NOTES:

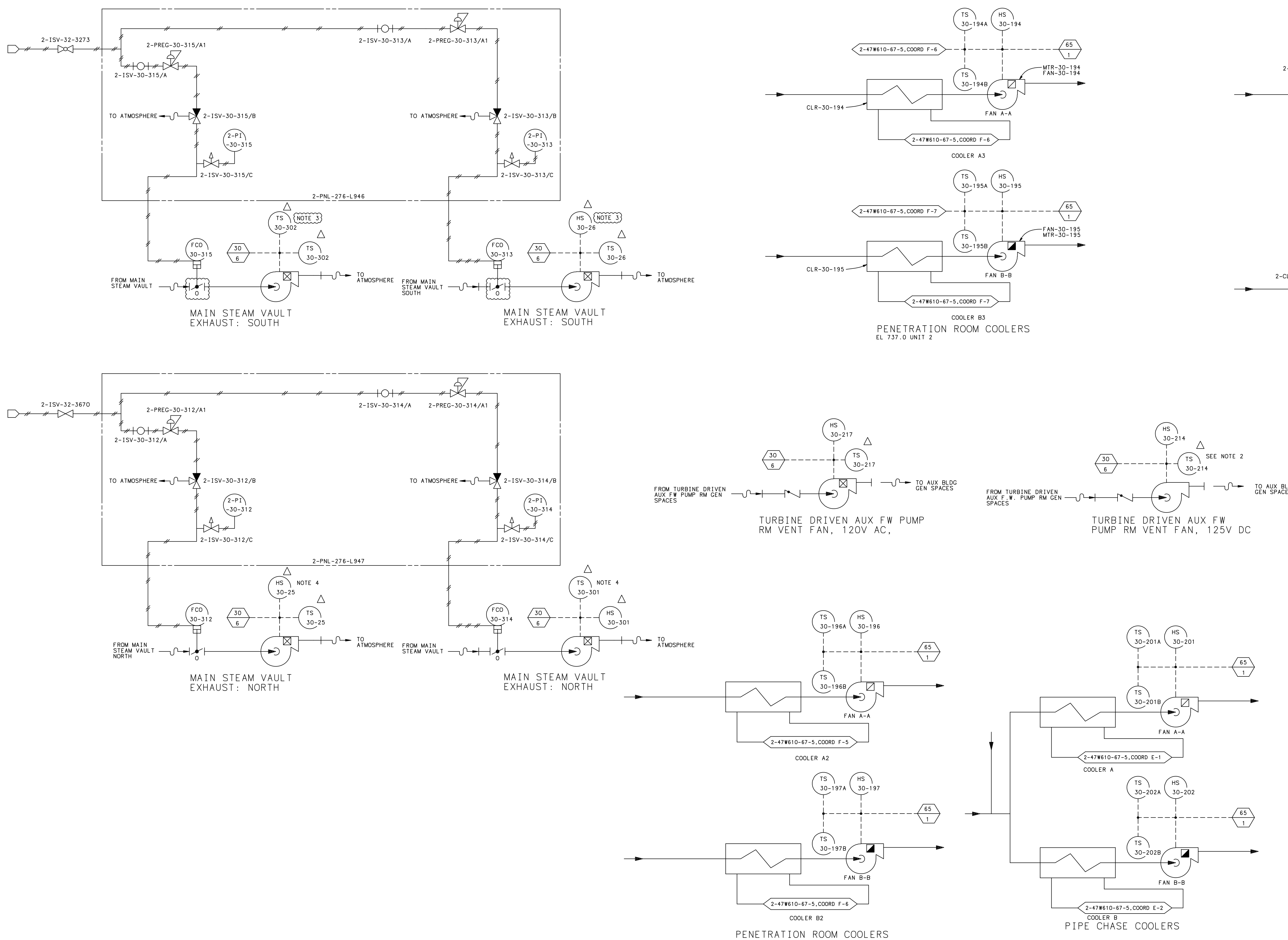
1. FOR SYMBOLS, NOTES AND REFERENCE DRAWINGS SEE 47W610-30-1.
2. POWER IS SUPPLIED FROM EITHER OF TWO IEEE CLASS 1 BATTERY BOARDS. CIRCUIT CLASSIFICATION IS "S", SAFETY RELATED.
3. 1-HS-30-26 AND 1-HS-30-302 SHALL BE PLACED IN STOP POSITION PRIOR TO MANUALLY CLOSING CORRESPONDING MAIN STEAM VAULT EXHAUST DAMPER.
4. 1-HS-30-25 AND 1-HS-30-301 SHALL BE PLACED IN STOP POSITION PRIOR TO MANUALLY CLOSING CORRESPONDING MAIN STEAM VAULT EXHAUST DAMPER.

COMPANION DRAWINGS:
0-, 1-47W610-30-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 1-47W610-30-6 R12
FIGURE 9.4-27

CAD MAINTAINED DRAWING



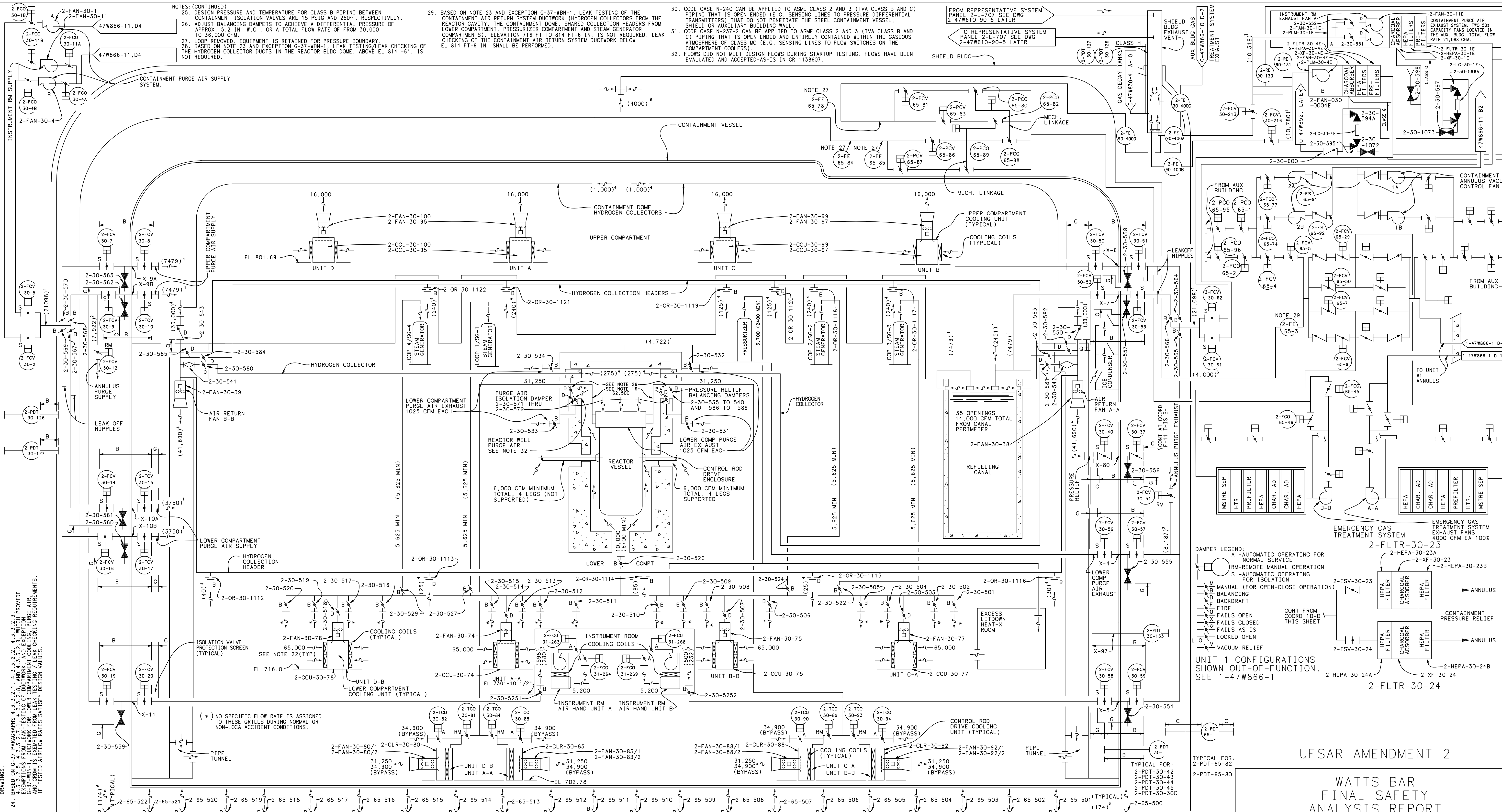
NOTES:
1. FOR SYMBOLS, GENERAL NOTES AND REFERENCE DRAWINGS SEE 2-47W610-30-1.
2. POWER IS SUPPLIED FROM EITHER OF TWO IEEE CLASS 1 BATTERY BOARDS. CIRCUIT CLASSIFICATION IS "S", SAFETY RELATED.
3. 2-HS-30-26 AND 2-HS-30-302 SHALL BE PLACED IN STOP POSITION PRIOR TO MANUALLY CLOSING CORRESPONDING MAIN STEAM VAULT EXHAUST DAMPER.
4. 2-HS-30-25 AND 2-HS-30-301 SHALL BE PLACED IN STOP POSITION PRIOR TO MANUALLY CLOSING CORRESPONDING MAIN STEAM VAULT EXHAUST DAMPER.

UFSAR AMENDMENT 2

WATTS BAR FINAL SAFETY ANALYSIS REPORT

POWERHOUSE UNIT 2 ELECTRICAL CONTROL DIAGRAM VENTILATION SYSTEM
TVA DWG NO. 2-47W610-30-6 R9
FIGURE 9.4-27(U2)

CAD MAINTAINED DRAWING



NOTES: (CONTINUED)

25. DESIGN PRESSURE AND TEMPERATURE FOR CLASS B PIPING BETWEEN CONTAINMENT ISOLATION VALVES ARE 15 PSIG AND 250°F, RESPECTIVELY.
26. ADJUST BALANCING DAMPERS TO ACHIEVE A DIFFERENTIAL PRESSURE OF APPROX. 5.2 IN. W.G., OR A TOTAL FLOW RATE OF FROM 30,000 TO 36,000 CFM.
27. LOOP REMOVED. EQUIPMENT IS RETAINED FOR PRESSURE BOUNDARY.
28. BASED ON NOTE 23 AND EXCEPTION G-37-WBN-1, LEAK TESTING/LEAK CHECKING OF THE HYDROGEN COLLECTOR DUCTS IN THE REACTOR BLDG DOME, ABOVE EL 814'-6", IS NOT REQUIRED.
29. BASED ON NOTE 23 AND EXCEPTION G-37-WBN-1, LEAK TESTING OF THE CONTAINMENT AIR RETURN SYSTEM DUCTWORK (HYDROGEN COLLECTORS FROM THE REACTOR CAVITY, THE CONTAINMENT DOME, SHARED COLLECTION HEADERS FROM LOWER COMPARTMENT, PRESSURIZER COMPARTMENT AND STEAM GENERATOR COMPARTMENTS), ELEVATION 716 FT TO 814 FT-6 IN. IS NOT REQUIRED. LEAK CHECKING OF THE CONTAINMENT AIR RETURN SYSTEM DUCTWORK BELOW EL 814 FT-6 IN. SHALL BE PERFORMED.
30. CODE CASE N-240 CAN BE APPLIED TO ASME CLASS 2 AND 3 (TVA CLASS B AND C) PIPING THAT IS OPEN ENDED (E.G. SENSING LINES TO PRESSURE DIFFERENTIAL TRANSMITTERS) THAT DO NOT PENETRATE THE STEEL CONTAINMENT VESSEL, SHIELD OR AUXILIARY BUILDING WALL.
31. CODE CASE N-237-2 CAN BE APPLIED TO ASME CLASS 2 AND 3 (TVA CLASS B AND C) PIPING THAT IS OPEN ENDED AND ENTIRELY CONTAINED WITHIN THE GASEOUS ATMOSPHERE OF CLASS MC (E.G. SENSING LINES TO FLOW SWITCHES ON THE COMPARTMENT COOLERS).
32. FLOWS DID NOT MEET DESIGN FLOWS DURING STARTUP TESTING. FLOWS HAVE BEEN EVALUATED AND ACCEPTED-AS-IS IN CR 1138607.

NOTES: (CONTINUED)

23. LEAK TESTING / LEAK CHECKING OF DUCTWORK INSIDE CONTAINMENT AND ANNULUS SHALL BE IN ACCORDANCE WITH G-37, EXCEPT AS NOTED ON DRAWINGS.
24. BASED ON G-37 PARAGRAPHS 4.3.3.2.1, 4.3.3.2.2, 4.3.3.2.3, 4.3.3.2.5, 4.3.3.2.7, 4.3.3.2.8, AND 4.3.3.2.9, WHICH PROVIDE EXEMPTIONS FOR LEAK TESTING OF DUCTWORK, AND EXCEPTION G-37-WBN-1, DUCTWORK FOR LOWER COMPARTMENT COOLING, PURGE AIR, AND CRDM IS EXEMPT FROM LEAK TESTING / LEAK CHECKING REQUIREMENTS, IF TESTED AIRFLOW RATES SATISFY DESIGN VALUES.

NOTES:

1. NUMBERS SHOWN THUS —∿→ 4800 INDICATE AIR FLOW IN CFM.
2. NOT USED.
3. FLOWS SHOWN WITHOUT PARENTHESIS ARE FOR NORMAL OPERATION.
4. ( )[1] INDICATES MINIMUM FLOW IN PURGE MODE.
5. ( )[2] INDICATES ALTERNATE MODE OF DIVERTING SOME PURGE FLOW THRU ANNULUS.
6. ( )[3] INDICATES MINIMUM SUPPLY AND MAXIMUM EXHAUST FLOW TO MAINTAIN A POSITIVE PRESSURE WHEN THE INSTRUMENT ROOM ONLY IS BEING PURGED.
7. ( )[4] INDICATES MINIMUM FLOW WHEN AIR RETURN FANS ARE OPERATED.
8. NOT USED.
9. ( )[6] INDICATES FLOW FROM ANNULUS, OR ENGINEERED SAFEGUARDS WHEN EMERGENCY GAS TREATMENT SYSTEM IS OPERATED.
10. NUMBERS SHOWN THUS 1-30-506 ARE VALVE MARKER TAG NUMBERS FOR UNIT 1. UNIT 2 NUMBERS ARE PREFIXED BY 2.
11. FLOWS SHALL BE BALANCED TO THE RATES SHOWN ON THE DIAGRAM PER DED CONSTRUCTION SPECIFICATION NO. G-37. TESTING AND BALANCING OF HV AND AC SYSTEMS.
12. DESIGN PRESSURE IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE (EXCEPT AS NOTED), DUCTWORK SHALL BE TESTED IN ACCORDANCE WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO, G-37.
13. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS PIPING SYSTEM CLASSIFICATION.
14. ALL DUCTWORK IS CLASS Q (ROUND) OR S (RECTANGULAR), EXCEPT WHERE NOTED AS B OR C. ALL PIPING ON THIS DRAWING IS CLASSIFIED AS TVA CLASS B, C, G, OR H AS NOTED.
15. ALL DUCTWORK FOR THE SHIELD BUILDING EXHAUST VENT AND EMERGENCY GAS TREATMENT (EGT) MUST BE LEAK TESTED TO THE MOST STRINGENT REQUIREMENTS SPECIFIED IN SECTION 4.12.1 OF ANSI-509-1976, EXCEPT AS FOLLOWS. BASED ON NOTE 23 AND EXCEPTION G-37-WBN-1, THE EGT DUCT SEGMENTS LOCATED DOWNSTREAM OF 2-PCV-65-86 & -87 TO THE MULTIPLE OUTLET GRILLES LOCATED AT THE BOTTOM ELEVATION OF THE ANNULUS AND THE EGT SUCTION FROM THE DUCT PENETRATION THROUGH THE SHIELD WALL TO ELEVATION 830', AND THE DUCT BETWEEN THE DISCHARGE OF THE ANNULUS VACUUM CONTROL FANS AND BACK DRAFT DAMPERS 0-BKD-65-527, AND -529 CAN BE LEAK CHECKED IN LIEU OF A LEAK TEST. NO LEAK CHECKING/TESTING IS REQUIRED FOR THE EGT SUCTION DUCT ABOVE ELEVATION 830'.
16. DUCT WORK IN THIS AREA REMOVABLE TO ALLOW ACCESS TO REACTOR VESSEL HEAD.
17. THE PURGE AIR EXHAUST FILTER HOUSINGS AND ALL SYSTEM DUCTWORK EXCEPT INSIDE CONTAINMENT VESSEL SHALL BE TESTED TO LEAKAGE CLASS II PER ANSI N509.
18. NOT USED.
19. ALL DUCTWORK SERVING THE AIR RETURN FANS AND LCC COOLERS IS SAFETY CLASS 2b AND SEISMIC CATEGORY 1.
20. ALL PURGE DUCTWORK INSIDE THE CONTAINMENT UP TO THE INBOARD CONTAINMENT ISOLATION VALVES IS NON-SAFETY CLASS AND SEISMIC CATEGORY I (L). ALSO, THE SUPPLY DUCT BETWEEN THE DOWNSTREAM ABSCE ISOLATION VALVE AND SHIELD BUILDING ISOLATION VALVES IS NON-SAFETY CLASS AND SEISMIC CATEGORY I (L).
21. ALL PURGE EXHAUST DUCTWORK DOWNSTREAM OF THE OUTBOARD CONTAINMENT ISOLATION VALVES IS SAFETY CLASS 2b AND SEISMIC CATEGORY I.
22. MINIMUM TOTAL FLOWRATE DURING NORMAL OPERATION WITH 3 LOWER COMPARTMENT COOLER UNITS IS 146,000 CFM. MINIMUM TOTAL FLOWRATE DURING NON-LOCA ACCIDENT CONDITIONS IS 112,000 CFM WITH 2 COOLERS OPERATING. MINIMUM REQUIRED FLOWRATES FOR NON-LOCA ACCIDENT CONDITIONS ARE SHOWN IN PARENTHESES().

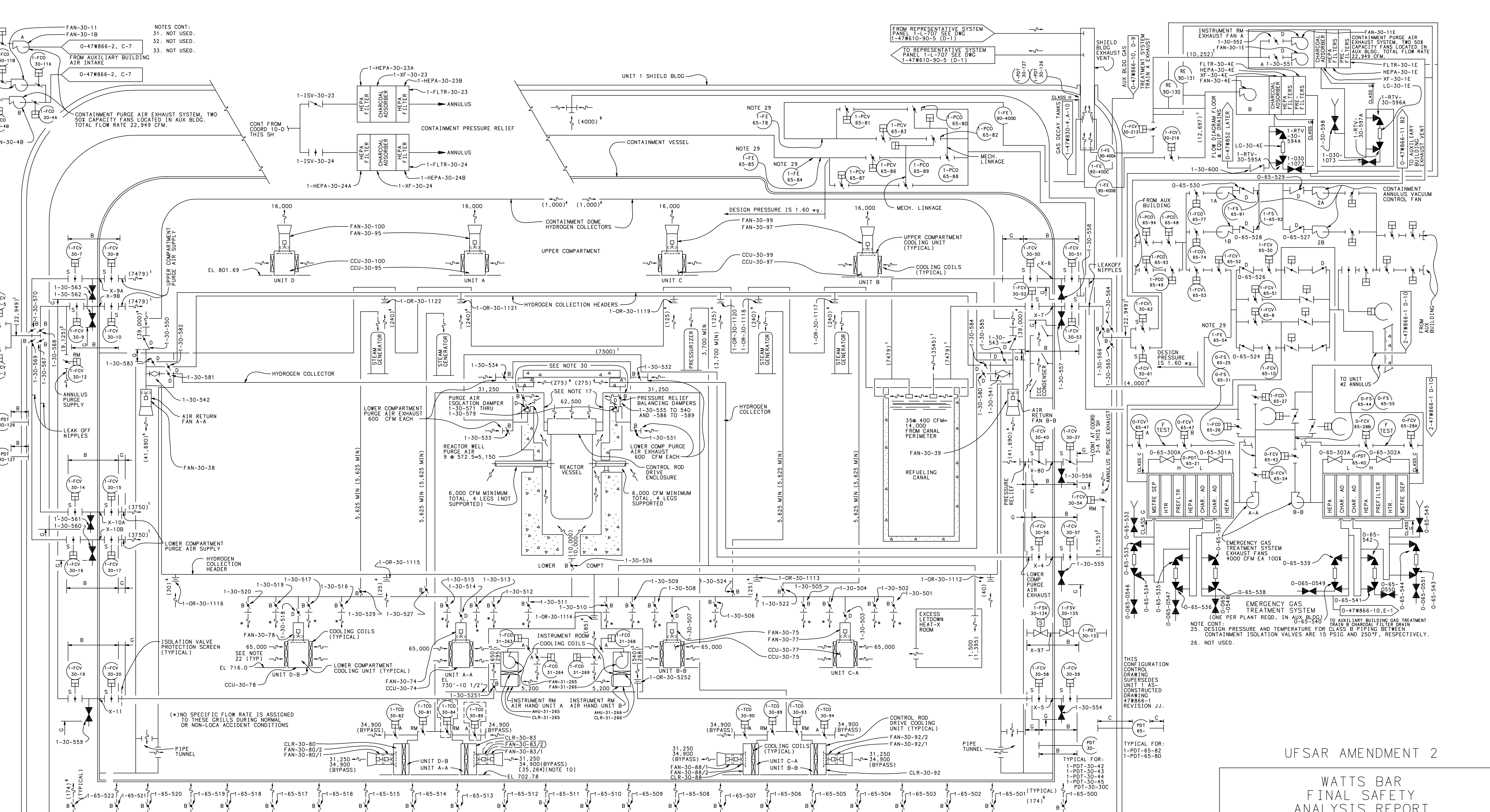
DESIGN CRITERIA AND SYSTEM DESCRIPTION REFERENCE
WB-DC-40-31.8-SEISMICALLY QUALIFYING ROUND AND RECTANGULAR DUCT.
WB-DC-40-34---CONTAINMENT ISOLATION SYSTEM.
WB-DC-40-36.1-THE CLASSIFICATION OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS.
WBN2-30RB-4002-REACTOR BUILDING VENTILATION SYSTEM.
WBN2-65-4001---EMERGENCY GAS TREATMENT SYSTEM.
WBN2-83-4001---COMBUSTIBLE GAS CONTROL SYSTEM.

REFERENCE DRAWINGS:
47W610-30-1 THRU 8
2-47W610-65-1
47W611-30-1, 3 & 2-47W611-30-4
47W611-65-1, 2 & 3
47W844-4
1-47W866-1
47W866-10 & 11
2-47W865-5
47W852
47W830-4
47W915 SERIES
47W920 SERIES
2-47W866-101

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

REACTOR BUILDING
UNIT 2
FLOW DIAGRAM
HEATING AND VENTILATION
AIR FLOW
TVA DWG NO. 2-47W866-1 R43
FIGURE 9.4-28 SH A



NOTES CONT:
31. NOT USED.
32. NOT USED.
33. NOT USED.

NOTE CONT:
25. DESIGN PRESSURE AND TEMPERATURE FOR CLASS B PIPING BETWEEN CONTAINMENT ISOLATION VALVES ARE 15 PSIG AND 250°F, RESPECTIVELY.
26. NOT USED.

NOTE CONT:
27. NOT USED.
28. NOT USED.
29. LOOP IS DISABLED. EQUIPMENT IS RETAINED FOR PRESSURE BOUNDARY.
30. ADJUST BALANCING DAMPERS TO ACHIEVE A DIFFERENTIAL PRESSURE OF APPROXIMATELY 5.2 IN. W.G., OR A TOTAL FLOW RATE OF FROM 30,000 TO 36,000 CFM.

NOTES:
1. NUMBERS SHOWN THUS —∿→ 4800 INDICATE AIR FLOW IN CFM.
2. FOR IDENTIFICATION OF SYMBOLS SEE 30B617-1 THRU -5.
3. FLOWS SHOWN WITHOUT PARENTHESIS ARE FOR NORMAL OPERATION.
4. ( )[1] INDICATES MINIMUM FLOW IN PURGE MODE.
5. ( )[2] INDICATES ALTERNATE MODE OF DIVERTING SOME PURGE FLOW THRU ANNULUS.
6. ( )[3] INDICATES MINIMUM SUPPLY AND MAXIMUM EXHAUST FLOW TO MAINTAIN A POSITIVE PRESSURE WHEN THE INSTRUMENT ROOM ONLY IS BEING PURGED.
7. ( )[4] INDICATES MINIMUM FLOW WHEN AIR RETURN FANS ARE OPERATED.
8.
9. ( )[6] INDICATES FLOW FROM ANNULUS, OR ENGINEERED SAFEGUARDS WHEN EMERGENCY GAS TREATMENT SYSTEM IS OPERATED.
10. FLOW RATE IN BRACKETS, [35,264], WAS MEASURED WITH ALL FOUR LCC'S OPERATING. IT IS OUTSIDE THE G-37 ACCEPTANCE CRITERIA BUT HAS BEEN EVALUATED AND APPROVED AS DOCUMENTED IN CALCULATIONS WBNOSG4130 AND EPMAMP122289.
11. FLOWS SHALL BE BALANCED TO THE RATES SHOWN ON THE DIAGRAM PER CONSTRUCTION SPECIFICATION NO. G-37. TESTING AND BALANCING OF HV AND AC SYSTEMS.
12. DESIGN PRESSURE IS 6 IN-WG IN ACCORDANCE WITH SMACNA HIGH VELOCITY DUCT CONSTRUCTION STANDARDS FOR MEDIUM PRESSURE (EXCEPT AS NOTED). DUCTWORK SHALL BE TESTED IN ACCORDANCES WITH TVA GENERAL CONSTRUCTION SPECIFICATION NO. G-37.
13. FOR VALVE MARKER TABULATIONS SEE MEL.
14. ALL DUCTWORK IS CLASS Q (ROUND) OR S (RECTANGULAR), EXCEPT WHERE NOTED AS B OR C. ALL PIPING ON THIS DRAWING IS CLASSIFIED AS TVA CLASS B, C, G, OR H AS NOTED.
15. ALL DUCTWORK CONNECTED TO THE SHIELD BUILDING EXHAUST VENT SHALL BE LEAK TESTED TO THE MOST STRINGENT REQUIREMENTS SPECIFIED IN SECTION 4.12.1 OF ANSI-N509.
16. PURGE AIR FILTER HOUSINGS SHALL BE LEAK-TESTED PER ANSI N509-1976. ALLOWABLE LEAKAGE RATES FOR HOUSINGS 1A AND 1B SHALL BE 7.3 CFM AND 6.7 CFM, RESPECTIVELY (REF. NCR 4234R).
17. DUCT WORK IN THIS AREA REMOVABLE TO ALLOW ACCESS TO REACTOR VESSEL HEAD.
18. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS PIPING SYSTEM CLASSIFICATION."): N3-30RB-4002-------REACTOR BUILDING VENTILATION SYSTEM
19. ALL DUCTWORK SERVING THE AIR RETURN FANS AND LCC COOLERS IS SAFETY CLASS 2b AND SEISMIC CATEGORY I.
20. ALL PURGE DUCTWORK INSIDE THE CONTAINMENT UP TO THE INBOARD CONTAINMENT ISOLATION VALVES IS NON-SAFETY CLASS AND SEISMIC CATEGORY I(L). ALSO, THE SUPPLY DUCT BETWEEN THE DOWNSTREAM ABSCE ISOLATION VALVE AND SHIELD BUILDING ISOLATION VALVES IS NON-SAFETY CLASS AND SEISMIC CATEGORY I(L).
21. ALL PURGE EXHAUST DUCTWORK DOWNSTREAM OF THE OUTBOARD CONTAINMENT ISOLATION VALVES IS SAFETY CLASS 2b AND SEISMIC CATEGORY I.
22. MINIMUM TOTAL FLOWRATE DURING NORMAL OPERATION WITH 3 LOWER COMPARTMENT COOLER UNITS IS 146,000 CFM. MINIMUM TOTAL FLOWRATE DURING NON-LOCA ACCIDENT CONDITIONS IS 112,000 CFM WITH 2 COOLERS OPERATING. DUCTWORK AND GRILLE FLOWRATES FOR NON-LOCA ACCIDENT CONDITIONS ARE SHOWN IN PARENTHESIS ().
23. LEAK TESTING/LEAK CHECKING OF DUCTWORK INSIDE CONTAINMENT AND ANNULUS SHALL BE IN ACCORDANCE WITH G-37, EXCEPT AS NOTED ON DRAWINGS.
24. BASED ON G-37 PARAGRAPHS 4.3.3.2.1, 4.3.3.2.2, 4.3.3.2.3, 4.3.3.2.5, 4.3.3.2.7.1, 4.3.3.2.8, AND 4.3.3.2.9, WHICH PROVIDE EXEMPTIONS FROM LEAK-TESTING OF DUCTWORK, AND EXCEPTION G-37-WBN-1, DUCTWORK FOR LOWER COMPARTMENT COOLING, PURGE AIR, AND CRDM IS EXEMPTED FROM LEAK-TESTING/LEAK-CHECKING REQUIREMENTS, IF TESTED AIRFLOW RATES SATISFY DESIGN VALUES.

DAMPER LEGEND:
A -AUTOMATIC OPERATING FOR NORMAL SERVICE
RM-REMOTE MANUAL OPERATION
S -AUTOMATIC OPERATING FOR ISOLATION
M MANUAL (FOR OPEN-CLOSE OPERATION)
B BALANCING
D BACKDRAFT
F FIRE
O FAILS OPEN
X FAILS CLOSED
◇ FAILS AS IS
L.O. LOCKED OPEN
V VACUUM RELIEF

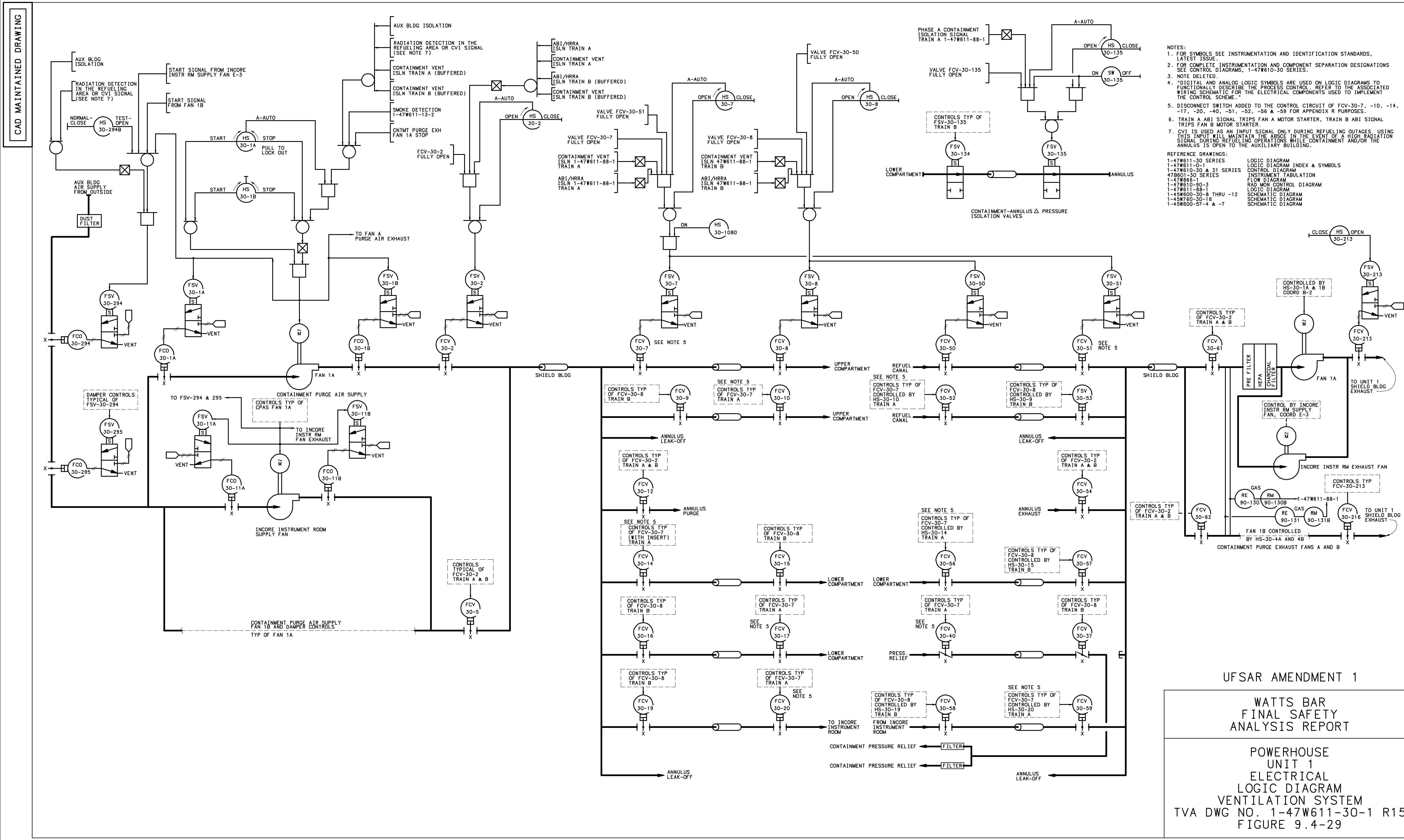
REFERENCE DRAWINGS:
1-47W610-30-1 THRU 7
1-47W610-65-1
47W611-30-1 THRU 4
47W611-65-1, 2 & 3
47W844-4
47W865-5
0-47W866-2, 10 & 11
47W852 SERIES
47W830-4
47B920-30X1 THRU 30X4
2-47W866-1
47W915 SERIES
47B920 SERIES
47B601-30 SERIES
47B601-65 SERIES
47B915-65 X 1 THRU -65 X 4
47W866-101 STRESS ANALYSIS PROBLEM BOUNDARY

CAD MAINTAINED DRAWING

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

REACTOR BUILDING
UNIT 1
FLOW DIAGRAM
HEATING AND VENTILATION
AIR FLOW
TVA DWG NO. 1-47W866-1 R69
FIGURE 9.4-28



NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAMS, 1-47W610-30 SERIES.
3. NOTE DELETED.
4. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
5. DISCONNECT SWITCH ADDED TO THE CONTROL CIRCUIT OF FCV-30-7, -10, -14, -17, -20, -40, -51, -52, -56 & -59 FOR APPENDIX R PURPOSES.
6. TRAIN A ABI SIGNAL TRIPS FAN A MOTOR STARTER, TRAIN B ABI SIGNAL TRIPS FAN B MOTOR STARTER.
7. CVI IS USED AS AN INPUT SIGNAL ONLY DURING REFUELING OUTAGES. USING THIS INPUT WILL MAINTAIN THE ABSCE IN THE EVENT OF A HIGH RADIATION SIGNAL DURING REFUELING OPERATIONS WHILE CONTAINMENT AND/OR THE ANNULUS IS OPEN TO THE AUXILIARY BUILDING.

REFERENCE DRAWINGS:

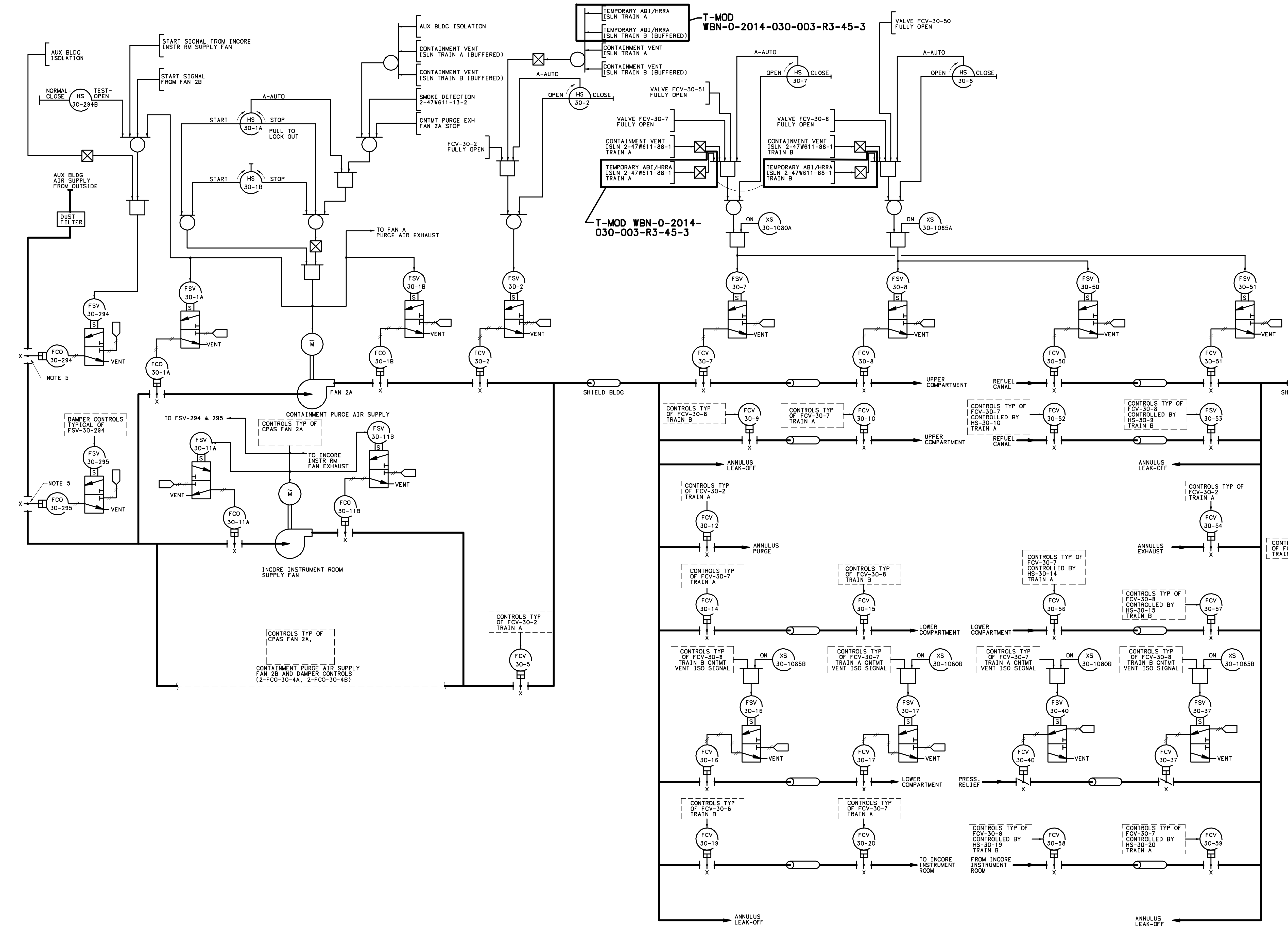
1-47W611-30 SERIES	LOGIC DIAGRAM
1-47W611-0-1	LOGIC DIAGRAM INDEX & SYMBOLS
1-47W610-30 & 31 SERIES	CONTROL DIAGRAM
47B601-30 SERIES	INSTRUMENT TABULATION
1-47W866-1	FLOW DIAGRAM
1-47W610-90-3	RAD MON CONTROL DIAGRAM
1-47W611-88-1	LOGIC DIAGRAM
1-45W600-30-8 THRU -12	SCHEMATIC DIAGRAM
1-45W760-30-16	SCHEMATIC DIAGRAM
1-45W600-57-4 & -7	SCHEMATIC DIAGRAM

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 1-47W611-30-1 R15
FIGURE 9.4-29

CAD MAINTAINED DRAWING



NOTES:

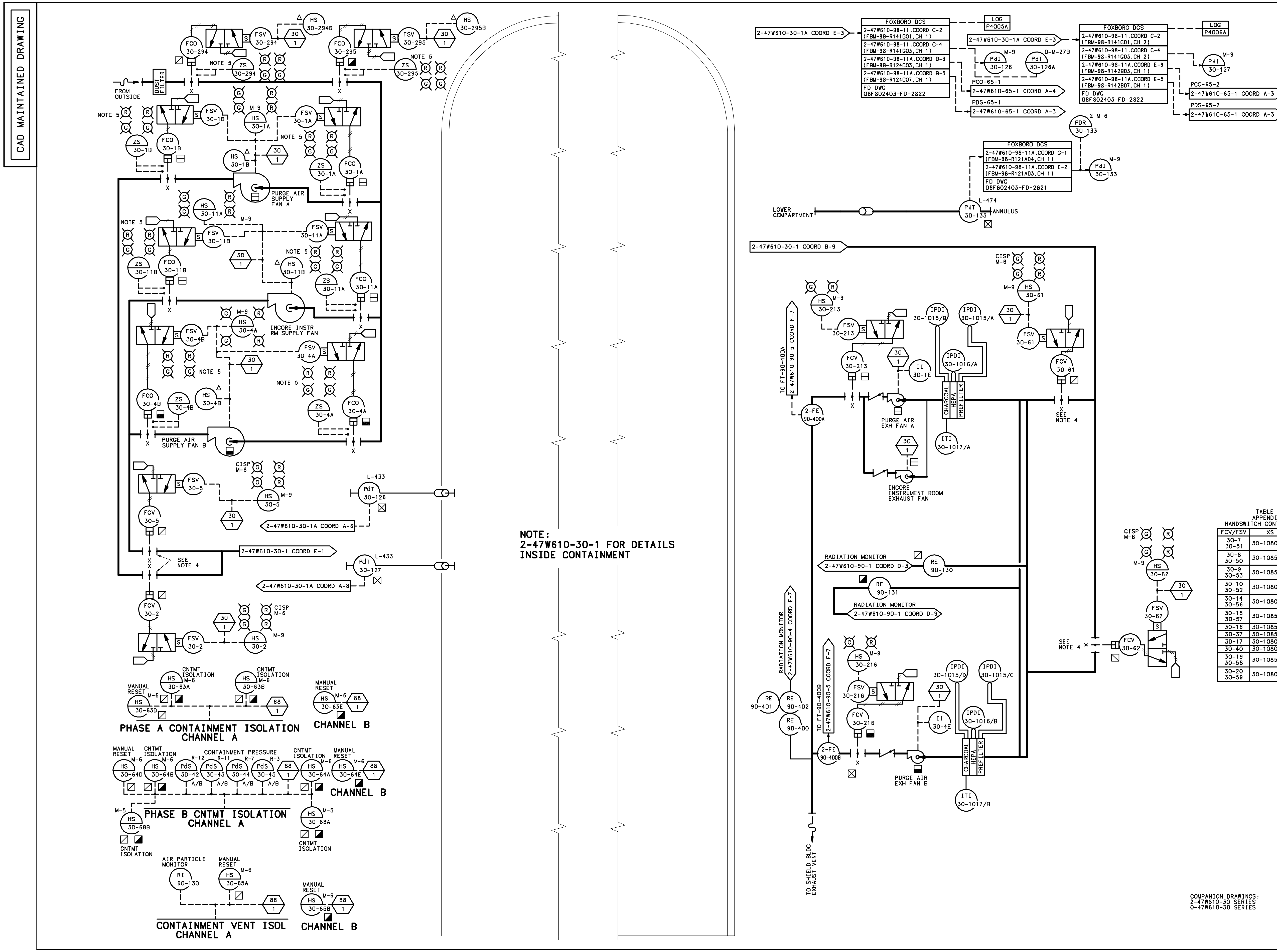
1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS, LATEST ISSUE.
2. FOR COMPLETE INSTRUMENTATION AND COMPONENT SEPARATION DESIGNATIONS SEE CONTROL DIAGRAMS, 2-47W610-30 SERIES.
3. NOTE DELETED.
4. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
5. UNIT INTERFACE SEPARATION BOUNDARIES ARE CONTROLLED BY INSTRUCTION TI-12.08 CONTROL OF UNIT SEPARATION.

REFERENCE DRAWINGS:

2-47W611-30 SERIES	LOGIC DIAGRAM
2-47W611-0-1	LOGIC DIAGRAM INDEX & SYMBOLS
2-47W610-30 & 31 SERIES	CONTROL DIAGRAM
1-47W866-1	FLOW DIAGRAM
2-47W610-90-3	RAD MON CONTROL DIAGRAM
2-47W611-88-1	LOGIC DIAGRAM
1-45W600-30-8 THRU -12	SCHEMATIC DIAGRAM
1-45W760-30-16	SCHEMATIC DIAGRAM
1-45W600-57-4 & -7	SCHEMATIC DIAGRAM

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 2-47W611-30-1 R9
FIGURE 9.4-29(U2)



NOTES:

FOR NOTES AND REFERENCE DRAWINGS SEE 2-47W610-30-1.

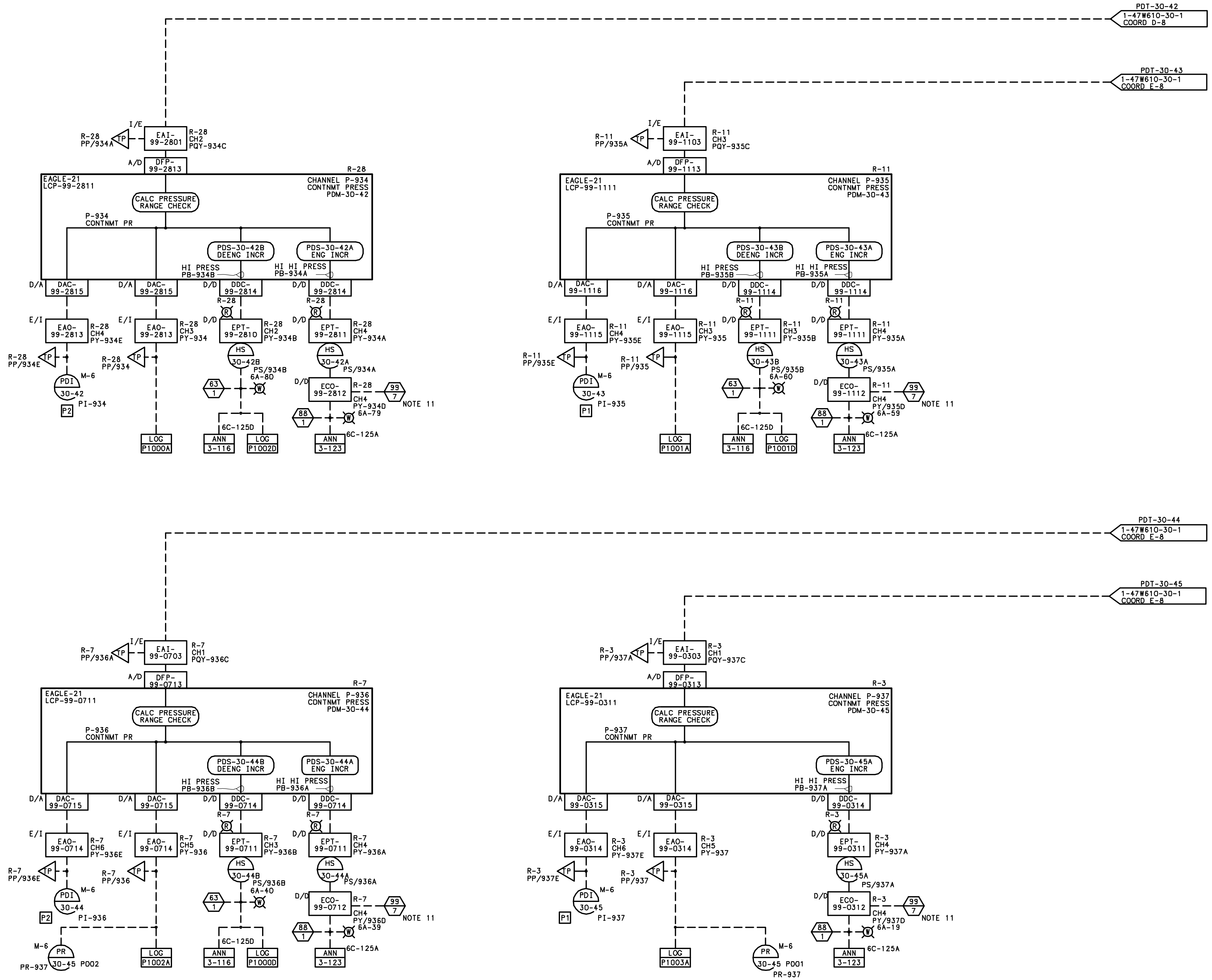
TABLE A2
APPENDIX R
HANDSWITCH CONTROL MATRIX

FCV/FSV	XS	HS
30-7 30-51	30-1080A-A	30-7
30-8 30-50	30-1085A-B	30-8
30-9 30-53	30-1085A-B	30-9
30-10 30-52	30-1080A-A	30-10
30-14 30-56	30-1080A-A	30-14
30-15 30-57	30-1085A-B	30-15
30-16	30-1085B-B	30-16
30-37	30-1085B-B	30-37
30-17	30-1080B-A	30-17
30-40	30-1080B-A	30-40
30-19 30-58	30-1085A-A	30-19
30-20 30-59	30-1080A-A	30-20

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 2-47W610-30-1A R16
FIGURE 9.4-30 SH A

CAD MAINTAINED DRAWING



NOTES:

1. FOR GENERAL NOTES SEE 1-47W610-30-1.
2. TO OBTAIN THE COMPUTER POINT IDENTIFIER FOR A CORRESPONDING EAGLE-21 TEST POINT OR TVA UNID SEE TABLE 15 ON 1-47W610-99-6.

COMPANION DRAWINGS:
0-, 1-47W610-30-SERIES

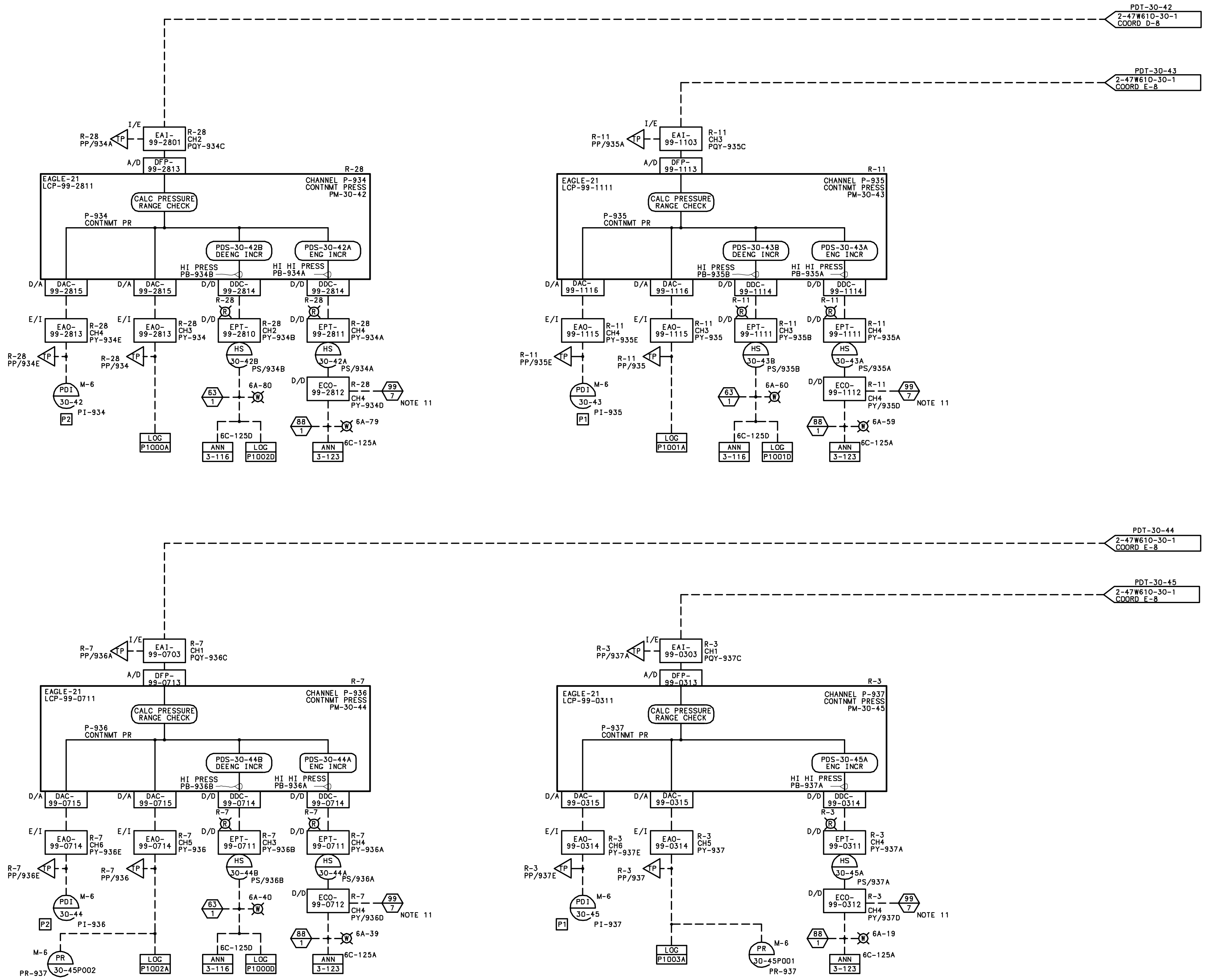
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 1-47W610-30-1B R5
FIGURE 9.4-30 SH B

CAD MAINTAINED DRAWING

NOTES:

1. FOR GENERAL NOTES SEE 2-47W610-30-1.
2. TO OBTAIN THE COMPUTER POINT IDENTIFIER FOR A CORRESPONDING EAGLE-21 TEST POINT OR TVA UNID SEE TABLE 15 ON 2-47W610-99-6.



COMPANION DRAWINGS:

O-, 2-47W610-30-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYS
TVA DWG NO. 2-47W610-30-1B R11
FIGURE 9.4-30 SH B(U2)

CAD MAINTAINED DRAWING

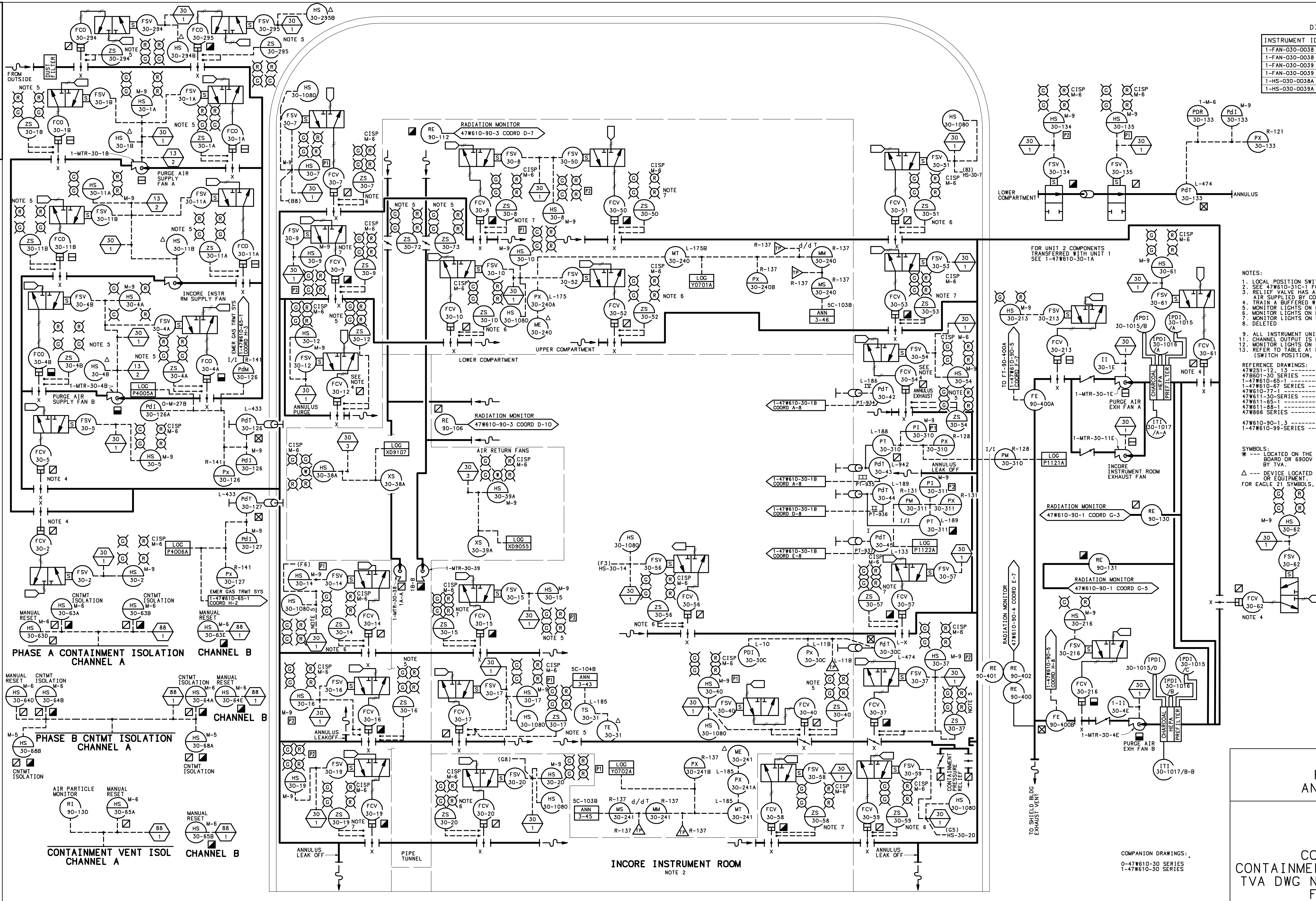


TABLE A1
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
1-FAN-030-0038	XD2037	CNTMT AIR RETURN FAN 1A
1-FAN-030-0038	XD2036	CNTMT AIR RETURN FAN 1A
1-FAN-030-0039	XD2092	CNTMT AIR RETURN FAN 1B
1-FAN-030-0039	XD2091	CNTMT AIR RETURN FAN 1B
1-HS-030-0038A	HD2030	VENT SYS HS-38A, 88A, 74A, 77A, 83A
1-HS-030-0039A	HD2064	VENT SYS HS-39A, 78A, 75A, 92A, 80A

NOTES:

1. LOCAL POSITION SWITCHES PROVIDED BY RELIEF VALVE MANUFACTURER.
2. SEE 47W610-31C-1 FOR INSTRUMENT ROOM VENTILATION DETAILS.
3. RELIEF VALVE HAS AIR PISTON TO CHECK VALVE OPERATION & LIGHTS. AIR SUPPLIED BY CONTROL AIR SYSTEM.
4. TRAIN A BUFFERED WITH TRAIN B.
5. MONITOR LIGHTS ON PANEL I-M-9.
6. MONITOR LIGHTS ON PANEL I-M-9 AND XX-55-6E.
7. MONITOR LIGHTS ON PANEL I-M-9 AND XX-55-6F.
8. DELETED

9. ALL INSTRUMENT UNID'S PREFIXED BY "1-" UNLESS SHOWN OTHERWISE.
11. CHANNEL OUTPUT IS BYPASSED WHEN IN TEST.
12. MONITOR LIGHTS ON PANEL O-M-25.
13. REFER TO TABLE A1 FOR ADDITIONAL DIGITAL COMPUTER POINTS (SWITCH POSITION, FAN RUNNING).

REFERENCE DRAWINGS:
47W251-12, 13 ---------------- FLOW DIAGRAM
47B601-30 SERIES ------------- INSTRUMENT TABULATION
1-47W610-65-1 ---------------- CONTROL DIAGRAM
1-47W610-67 SERIES ----------- CONTROL DIAGRAM
47W610-77-1 ------------------ CONTROL DIAGRAM
47W611-30-SERIES ------------- LOGIC DIAGRAM
47W611-65-1 ------------------ LOGIC DIAGRAM
47W611-88-1 ------------------ LOGIC DIAGRAM
47W866 SERIES ---------------- MECHANICAL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM
47W610-90-1,3 ---------------- CONTROL DIAGRAM
1-47W610-99-SERIES ----------- CONTROL DIAGRAM

SYMBOLS:
✳ --- LOCATED ON THE APPROPRIATE 480V MOV BOARD, 480V SHUTDOWN BOARD OR 6900V SHUTDOWN BOARD. THE DEVICES SHALL BE FURNISHED BY TVA.

△ --- DEVICE LOCATED LOCALLY AT EQUIPMENT OR MOUNTED ON PIPING OR EQUIPMENT.
FOR EAGLE 21 SYMBOLS, SEE 1-47W610-99-1

COMPANION DRAWINGS:
0-47W610-30 SERIES
1-47W610-30 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYSTEM
TVA DWG NO. 1-47W610-30-1 R38
FIGURE 9.4-30

CAD MAINTAINED DRAWING

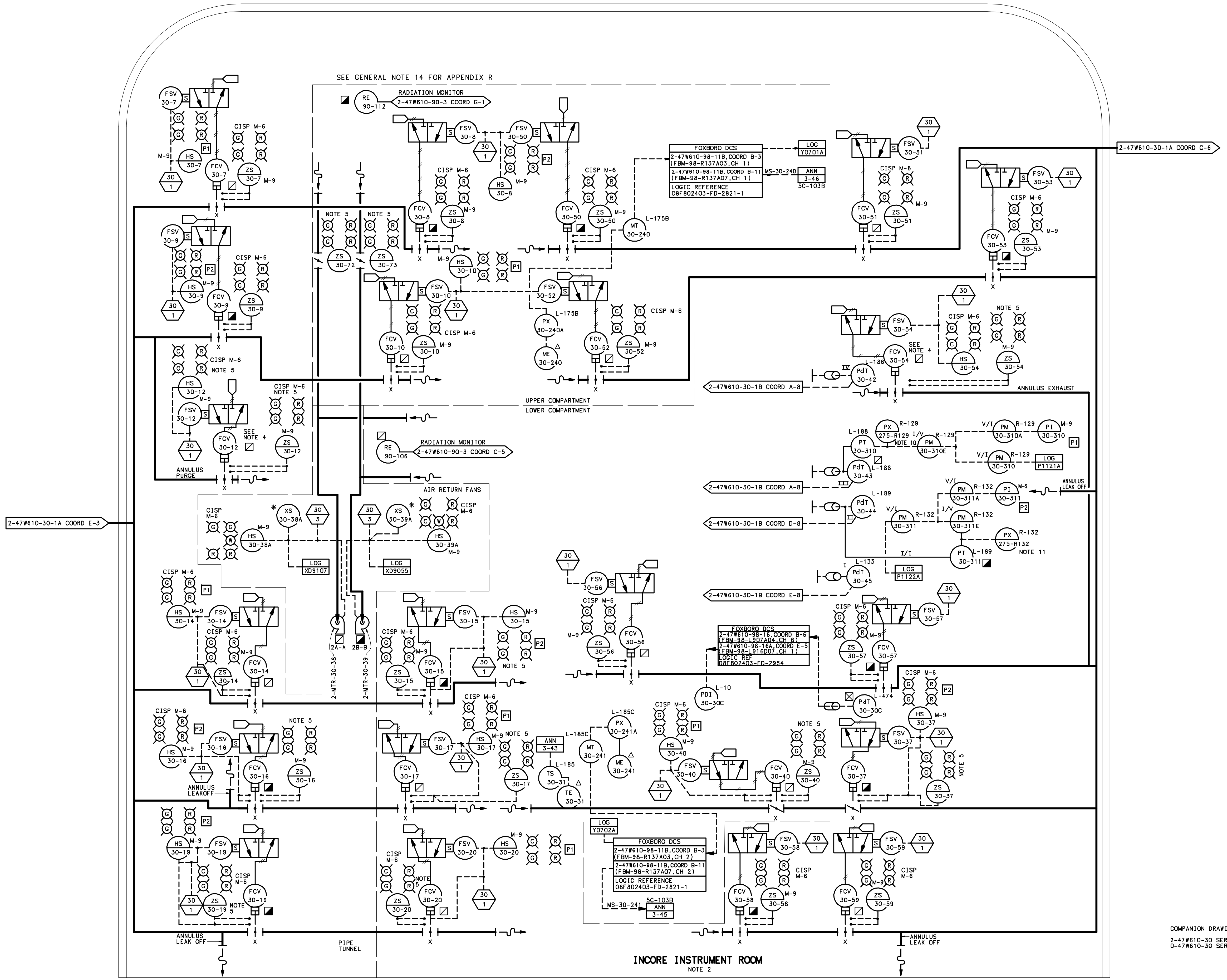


TABLE A1
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
2-FAN-030-0038	XD2037	CNTMT AIR RETURN FAN 2A
2-FAN-030-0038	XD2036	CNTMT AIR RETURN FAN 2A
2-FAN-030-0039	XD2092	CNTMT AIR RETURN FAN 2B
2-FAN-030-0039	XD2091	CNTMT AIR RETURN FAN 2B
2-HS-030-0038A	HD2030	VENT SYS HS-38A, 88A, 74A, 77A, 83A
2-HS-030-0039A	HD2064	VENT SYS HS-39A, 78A, 75A, 92A, 80A

NOTES:
1. LOCAL POSITION SWITCHES PROVIDED BY RELIEF VALVE MANUFACTURER.
2, SEE 2-47W610-31-5 FOR INSTRUMENT ROOM VENTILATION DETAILS.
3. RELIEF VALVE HAS AIR PISTON TO CHECK VALVE OPERATION & LIGHTS. AIR SUPPLIED BY CONTROL AIR SYSTEM.
4. TRAIN A BUFFERED WITH TRAIN B.
5. MONITOR LIGHTS ON PANEL 2-M-9.
6. NOT USED.
7. NOT USED.
8. NOT USED.
9. NOT USED.
10. FOR LOOP POWER SUPPLIES SEE CONTRACT 71252, DWG 08F826663-RL-2101.
11. FOR LOOP POWER SUPPLIES SEE CONTRACT 71252, DWG 08F826663-RL-2201.
14. EACH PURGE AIR SUPPLY/EXHAUST LINE PENETRATING CONTAINMENT IS REQUIRED TO ISOLATE DURING AN APPENDIX R EVENT. EACH ISOLATION VALVE HAS AN APPENDIX R HANDSWITCH PRESENT IN IT'S LOGIC. THIS HANDSWITCH IS NOT SHOWN ON THE CONTROL DIAGRAM DUE TO CONGESTION. SEE TABLE A2 FOR APPENDIX R HANDSWITCH CONTROL MATRIX.
15. REFER TO TABLE A1 FOR ADDITIONAL DIGITAL COMPUTER POINTS (SWITCH POSITION, FAN RUNNING)

REFERENCE DRAWINGS:

2-47W610-65-1 ----------------- CONTROL DIAGRAM
2-47W610-67 SERIES ------------ CONTROL DIAGRAM
2-47W610-77-1 ----------------- CONTROL DIAGRAM
2-47W611-30-SERIES ------------ LOGIC DIAGRAM
2-47W611-65-1 ----------------- LOGIC DIAGRAM
2-47W611-88-1 ----------------- LOGIC DIAGRAM
2-47W866 SERIES --------------- MECHANICAL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM
2-47W610-90-1,3 --------------- CONTROL DIAGRAM

SYMBOLS:

* --- LOCATED ON THE APPROPRIATE 480V MOV BOARD, 480V SHUTDOWN BOARD OR 6900V SHUTDOWN BOARD. THE DEVICES SHALL BE FURNISHED BY TVA.

△ --- DEVICE LOCATED LOCALLY AT EQUIPMENT OR MOUNTED ON PIPING OR EQUIPMENT.

T-MODS WBN-0-2014-030-002-R3-38-0 & -002-R3-39-0 FOR INSTRUMENTATION OUTSIDE INCORE INSTRUMENT ROOM SHOWN ON 2-47W610-30-1A

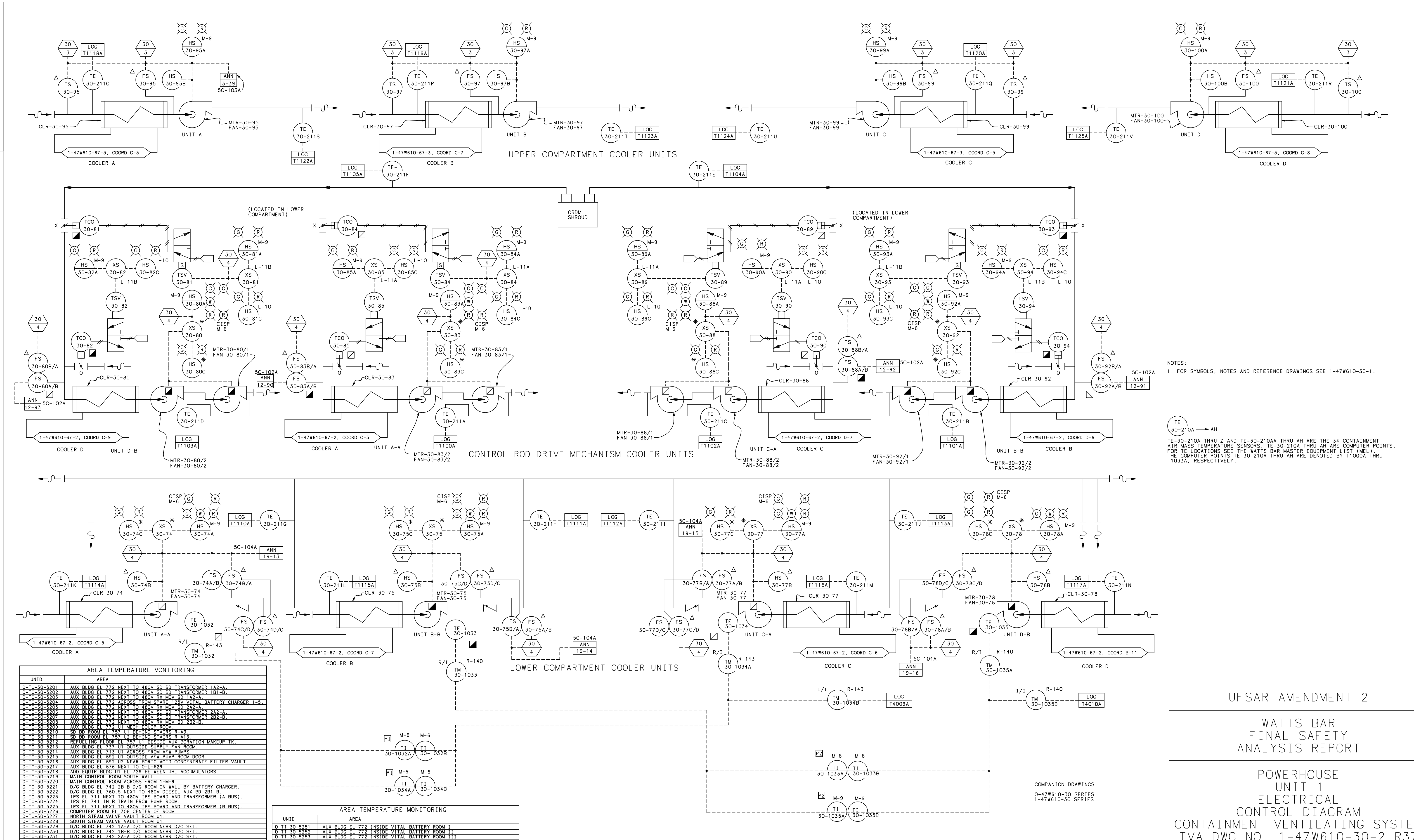
INSTRUMENTATION OUTSIDE INCORE INSTRUMENT ROOM SEE 2-47W610-30-1A

COMPANION DRAWINGS:
2-47W610-30 SERIES
0-47W610-30 SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYSTEM
TVA DWG NO. 2-47W610-30-1 R20
FIGURE 9.4-30(U2)

CAD MAINTAINED DRAWING



AREA TEMPERATURE MONITORING

UNID	AREA
0-TI-30-5201	AUX BLDG EL 772 NEXT TO 480V SD BD TRANSFORMER 1A2-A.
0-TI-30-5202	AUX BLDG EL 772 NEXT TO 480V SD BD TRANSFORMER 1B1-B.
0-TI-30-5203	AUX BLDG EL 772 NEXT TO 480V RX MOV BD 1A2-A.
0-TI-30-5204	AUX BLDG EL 772 ACROSS FROM SPARE 125V VITAL BATTERY CHARGER 1-5.
0-TI-30-5205	AUX BLDG EL 772 NEXT TO 480V RX MOV BD 2A2-A.
0-TI-30-5206	AUX BLDG EL 772 NEXT TO 480V SD BD TRANSFORMER 2A2-A.
0-TI-30-5207	AUX BLDG EL 772 NEXT TO 480V SD BD TRANSFORMER 2B2-B.
0-TI-30-5208	AUX BLDG EL 772 NEXT TO 480V RX MOV BD 2B2-B.
0-TI-30-5209	AUX BLDG EL 772 U1 MECH EQUIP ROOM.
0-TI-30-5210	SD BD ROOM EL 757 U1 BEHIND STAIRS R-A3.
0-TI-30-5211	SD BD ROOM EL 757 U2 BEHIND STAIRS R-A13.
0-TI-30-5212	REFUELING FLOOR EL 757 U1 BESIDE AUX BORATION MAKEUP TK.
0-TI-30-5213	AUX BLDG EL 737 U1 OUTSIDE SUPPLY FAN ROOM.
0-TI-30-5214	AUX BLDG EL 713 U1 ACROSS FROM AFW PUMPS.
0-TI-30-5215	AUX BLDG EL 692 U1 OUTSIDE AFW PUMP ROOM DOOR.
0-TI-30-5216	AUX BLDG EL 692 U2 NEAR BORIC ACID CONCENTRATE FILTER VAULT.
0-TI-30-5217	AUX BLDG EL 676 NEXT TO 0-L-629.
0-TI-30-5218	ADD EQUIP BLDG U1 EL 729 BETWEEN UHI ACCUMULATORS.
0-TI-30-5219	MAIN CONTROL ROOM SOUTH WALL.
0-TI-30-5220	MAIN CONTROL ROOM ACROSS FROM 1-M-9.
0-TI-30-5221	D/G BLDG EL 742 2B-B D/G ROOM ON WALL BY BATTERY CHARGER.
0-TI-30-5222	D/G BLDG EL 760.5 NEXT TO 480V DIESEL AUX BD 2B1-B.
0-TI-30-5223	IPS EL 711 NEXT TO 480V IPS BOARD AND TRANSFORMER (A BUS).
0-TI-30-5224	IPS EL 741 IN B TRAIN ERCW PUMP ROOM.
0-TI-30-5225	IPS EL 711 NEXT TO 480V IPS BOARD AND TRANSFORMER (B BUS).
0-TI-30-5226	COMPUTER ROOM EL 708 CENTER OF ROOM.
0-TI-30-5227	NORTH STEAM VALVE VAULT ROOM U1.
0-TI-30-5228	SOUTH STEAM VALVE VAULT ROOM U1.
0-TI-30-5229	D/G BLDG EL 742 1A-A D/G ROOM NEAR D/G SET.
0-TI-30-5230	D/G BLDG EL 742 1B-B D/G ROOM NEAR D/G SET.
0-TI-30-5231	D/G BLDG EL 742 2A-A D/G ROOM NEAR D/G SET.
0-TI-30-5232	D/G BLDG EL 742 2B-B D/G ROOM NEAR D/G SET.
0-TI-30-5233	AUX. INSTRUMENT ROOM EL 708.
0-TI-030-5245	IPS MECH EQ ROOM A, EL. 727', NEAR JB 2457-A.
0-TI-030-5246	IPS MECH EQ ROOM B, EL. 727', NEAR JB 2459-B.

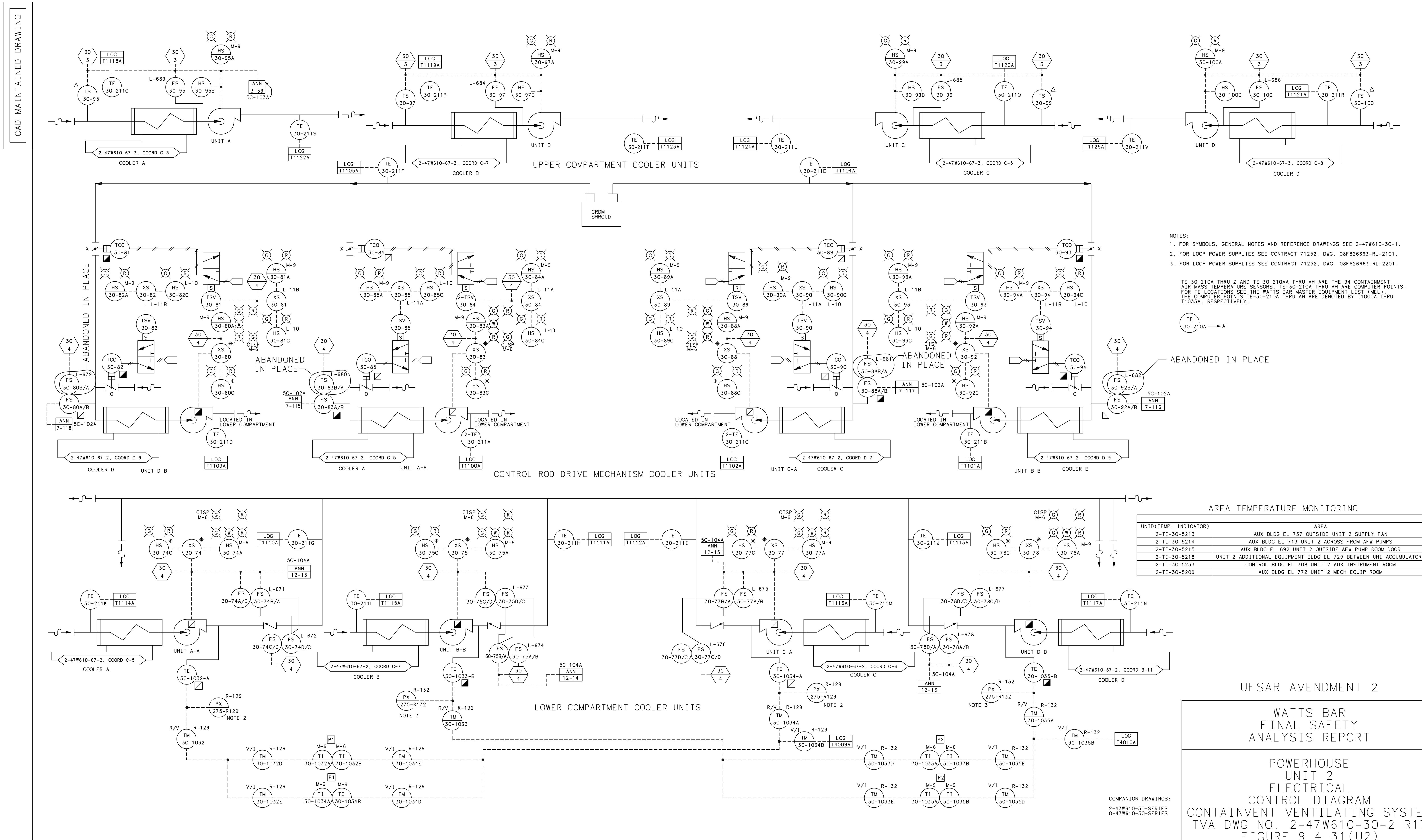
AREA TEMPERATURE MONITORING

UNID	AREA
0-TI-30-5251	AUX BLDG EL 772 INSIDE VITAL BATTERY ROOM I
0-TI-30-5252	AUX BLDG EL 772 INSIDE VITAL BATTERY ROOM II
0-TI-30-5253	AUX BLDG EL 772 INSIDE VITAL BATTERY ROOM III
0-TI-30-5254	AUX BLDG EL 772 INSIDE VITAL BATTERY ROOM IV

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYSTEM
TVA DWG NO. 1-47W610-30-2 R37
FIGURE 9.4-31



NOTES:

1. FOR SYMBOLS, GENERAL NOTES AND REFERENCE DRAWINGS SEE 2-47W610-30-1.
2. FOR LOOP POWER SUPPLIES SEE CONTRACT 71252, DWG. 08F826663-RL-2101.
3. FOR LOOP POWER SUPPLIES SEE CONTRACT 71252, DWG. 08F826663-RL-2201.

TE-30-210A THRU Z AND TE-30-210AA THRU AH ARE THE 34 CONTAINMENT AIR MASS TEMPERATURE SENSORS. TE-30-210A THRU AH ARE COMPUTER POINTS. FOR TE LOCATIONS SEE THE WATTS BAR MASTER EQUIPMENT LIST (MEL). THE COMPUTER POINTS TE-30-210A THRU AH ARE DENOTED BY T1000A THRU T1033A, RESPECTIVELY.

TE 30-210A → AH

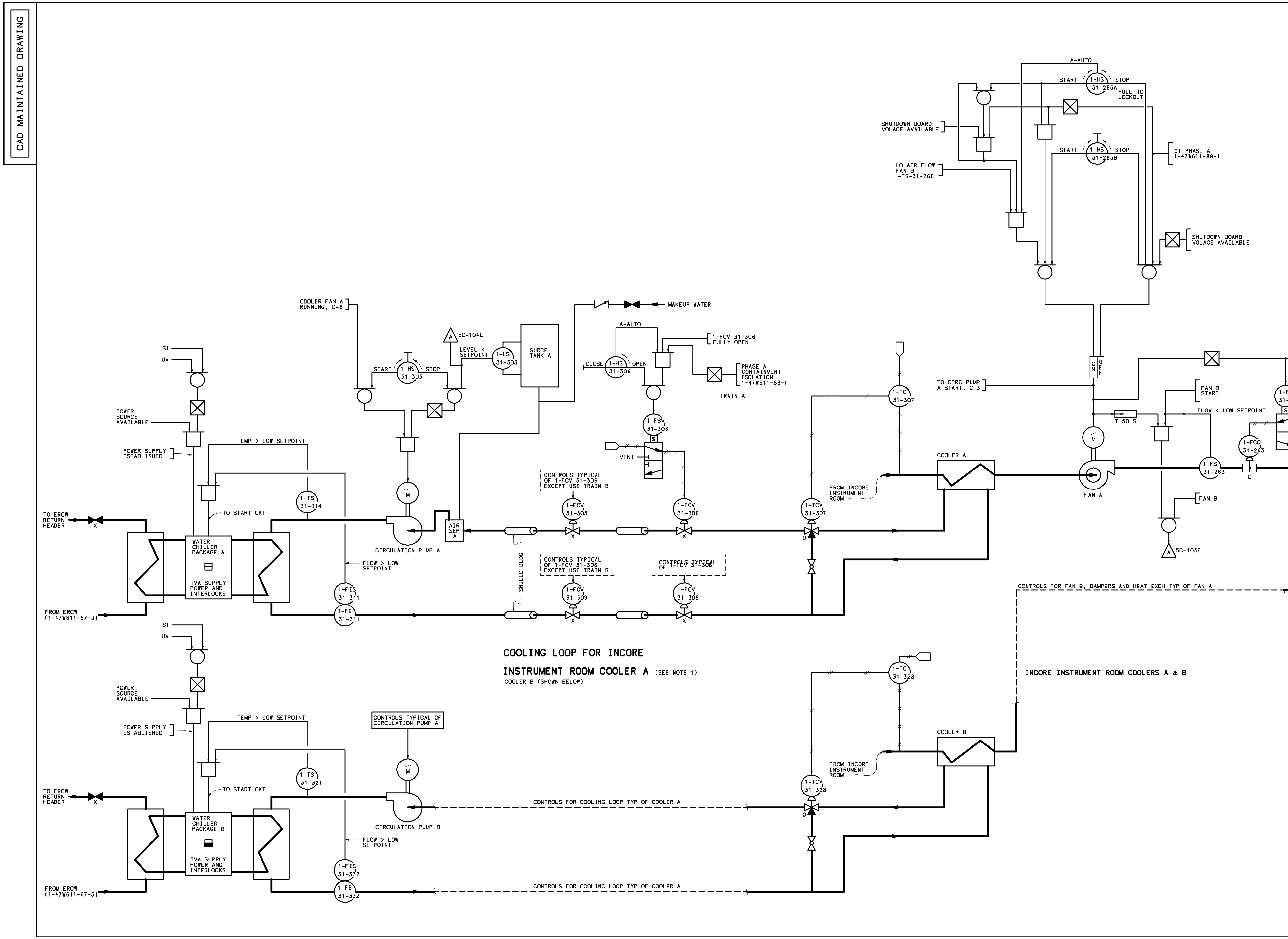
AREA TEMPERATURE MONITORING

UNID(TEMP. INDICATOR)	AREA
2-TI-30-5213	AUX BLDG EL 737 OUTSIDE UNIT 2 SUPPLY FAN
2-TI-30-5214	AUX BLDG EL 713 UNIT 2 ACROSS FROM AFW PUMPS
2-TI-30-5215	AUX BLDG EL 692 UNIT 2 OUTSIDE AFW PUMP ROOM DOOR
2-TI-30-5218	UNIT 2 ADDITIONAL EQUIPMENT BLDG EL 729 BETWEEN UHI ACCUMULATORS
2-TI-30-5233	CONTROL BLDG EL 708 UNIT 2 AUX INSTRUMENT ROOM
2-TI-30-5209	AUX BLDG EL 772 UNIT 2 MECH EQUIP ROOM

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
CONTROL DIAGRAM
CONTAINMENT VENTILATING SYSTEM
TVA DWG NO. 2-47W610-30-2 R17
FIGURE 9.4-31(U2)



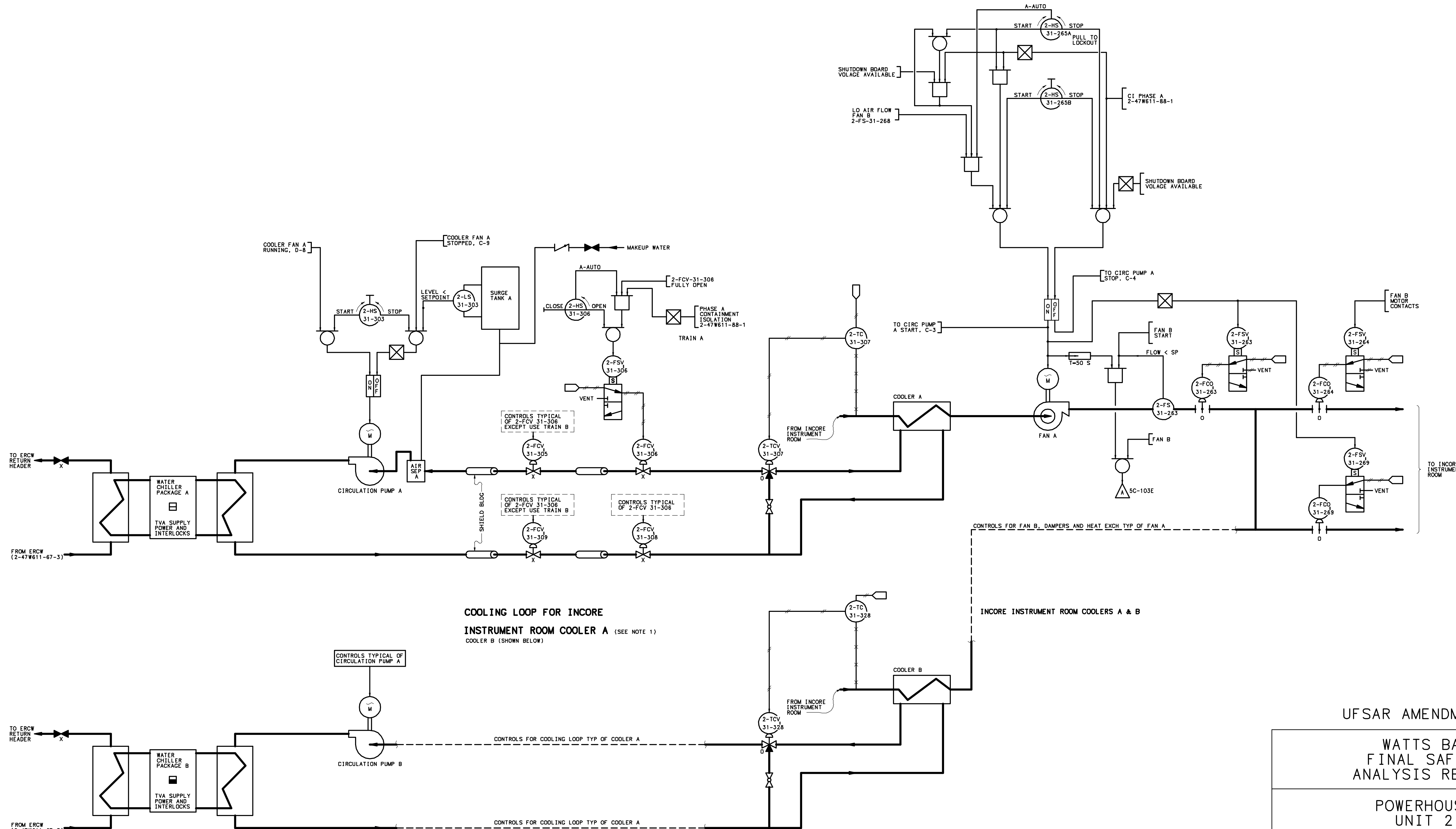
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 1-47W611-31-7 R4
FIGURE 9.4-32

CAD MAINTAINED DRAWING

NOTES.

1. COOLING LOOP FOR INCORE INSTRUMENT ROOM COOLER B AND CONTROLS TYPICAL OF COOLER A.

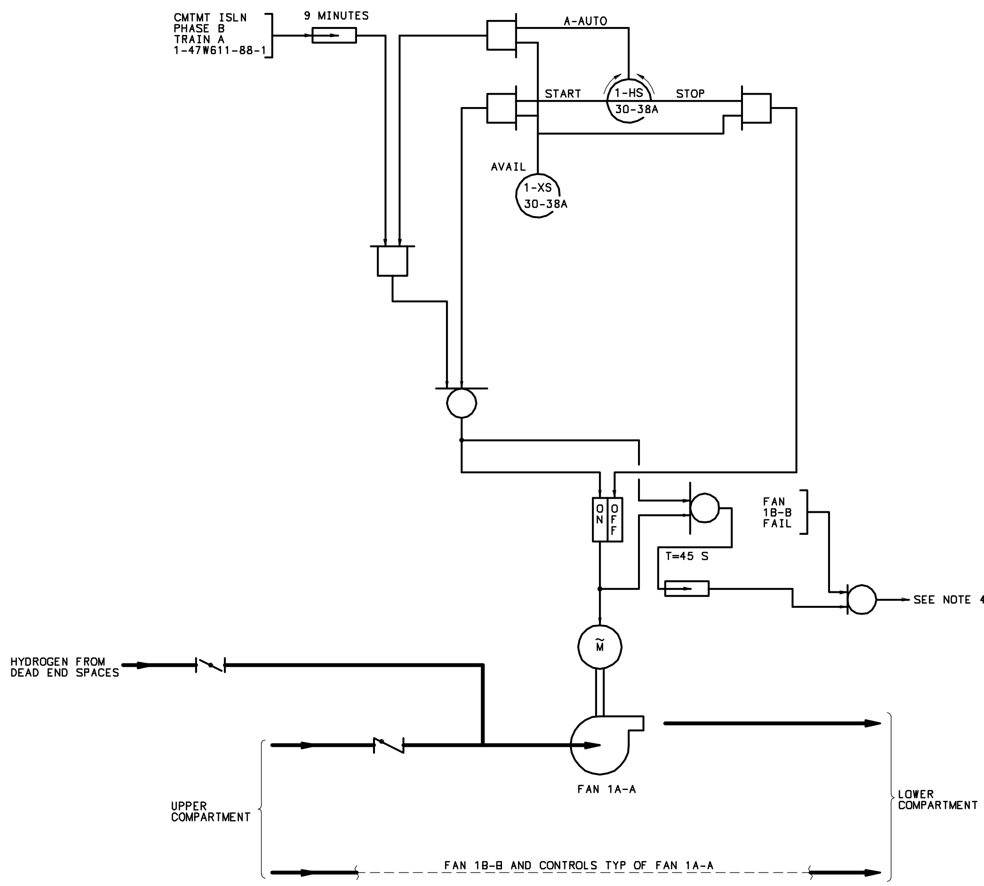


UFSAR AMENDMENT 1

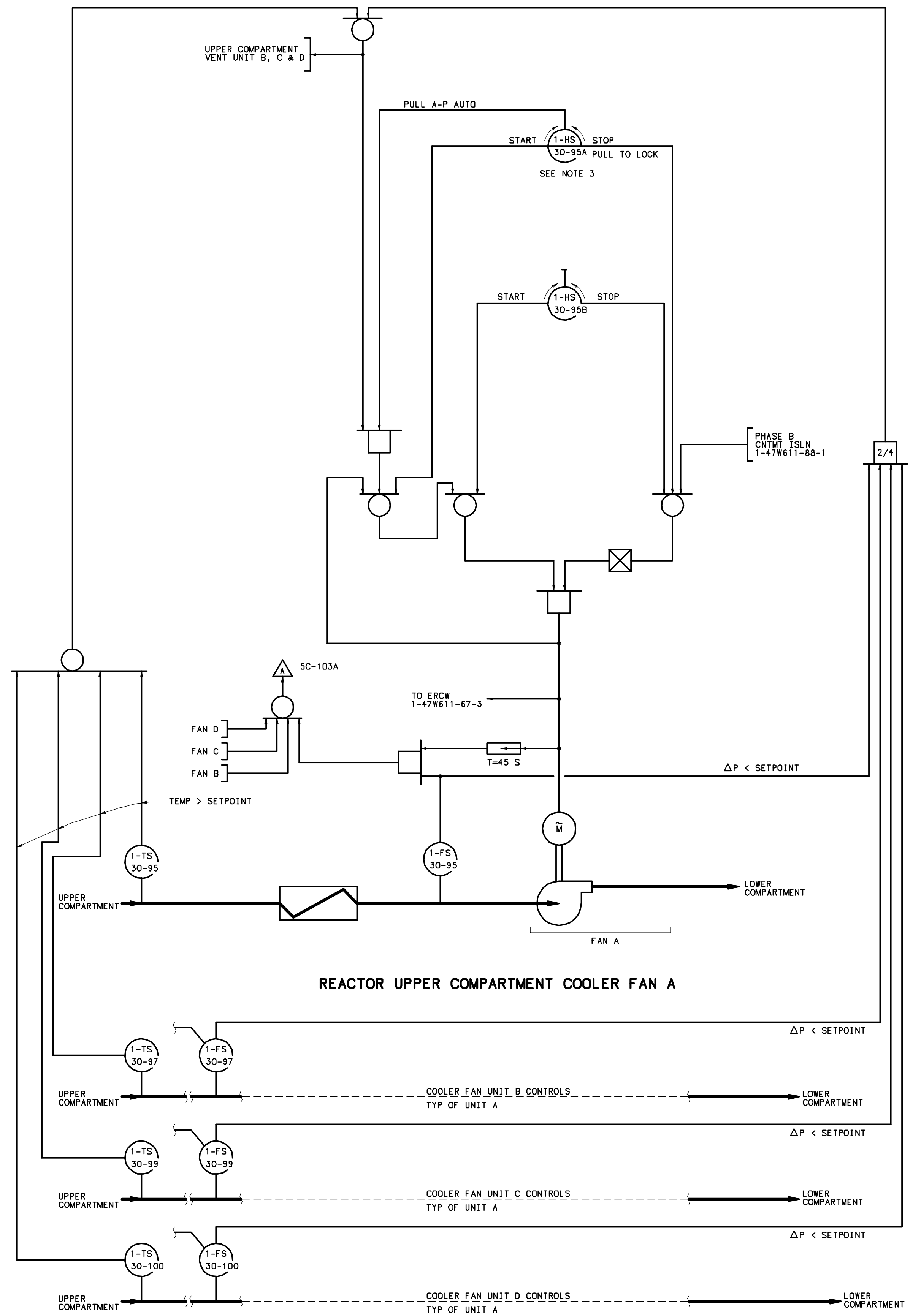
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
AIR CONDITIONING SYSTEM
TVA DWG NO. 2-47W611-31-7 R6
FIGURE 9.4-32(U2)

CAD MAINTAINED DRAWING



CONTAINMENT AIR RETURN FANS 1A-A & 1B-B



REACTOR UPPER COMPARTMENT COOLER FAN A

REACTOR UPPER COMPARTMENT COOLER FANS A,B,C & D

NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTED SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS.
2. FOR SYMBOLS AND GENERAL NOTES SEE 1-47W611-30-1.
3. SWITCHES ARE PLACED IN "A AUTO" IN NORMAL OPERATION TO PREVENT AUTOMATIC LOADING. SEE SDD N3-30RB-4002.
4. ANNUNCIATION (WINDOW 104C ON BOX 1-XA-55-5C) REMOVED BY DCN W-33083-A, HOWEVER COMPONENTS FOR LOGIC REMAIN WIRED AND FUNCTIONAL.

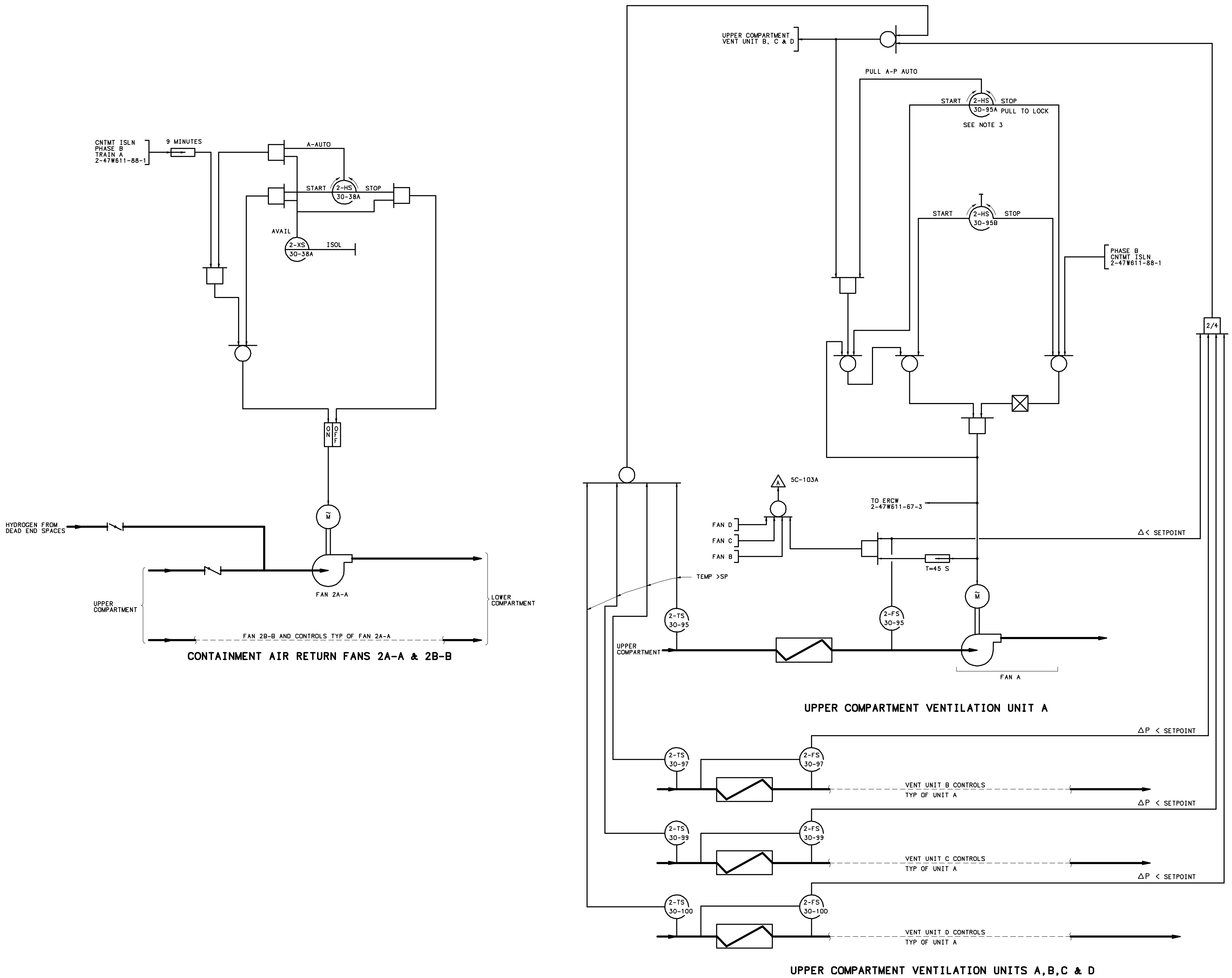
REFERENCE DRAWINGS:

1-45W760-30-13 & -15 - - - - - - - SCHEMATIC DIAGRAM
1-45W600-57-10 - - - - - - - - - - - SCHEMATIC DIAGRAM
1-47W866-1 - - - - - - - - - - - - - FLOW DIAGRAM
45B640-SERIES - - - - - - - - - - - -SWITCH DEVELOPMENT
1-47W611-67-3 - - - - - - - - - - - -LOGIC DIAGRAMS

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 1-47W611-30-3 R9
FIGURE 9.4-33

CAD MAINTAINED DRAWING



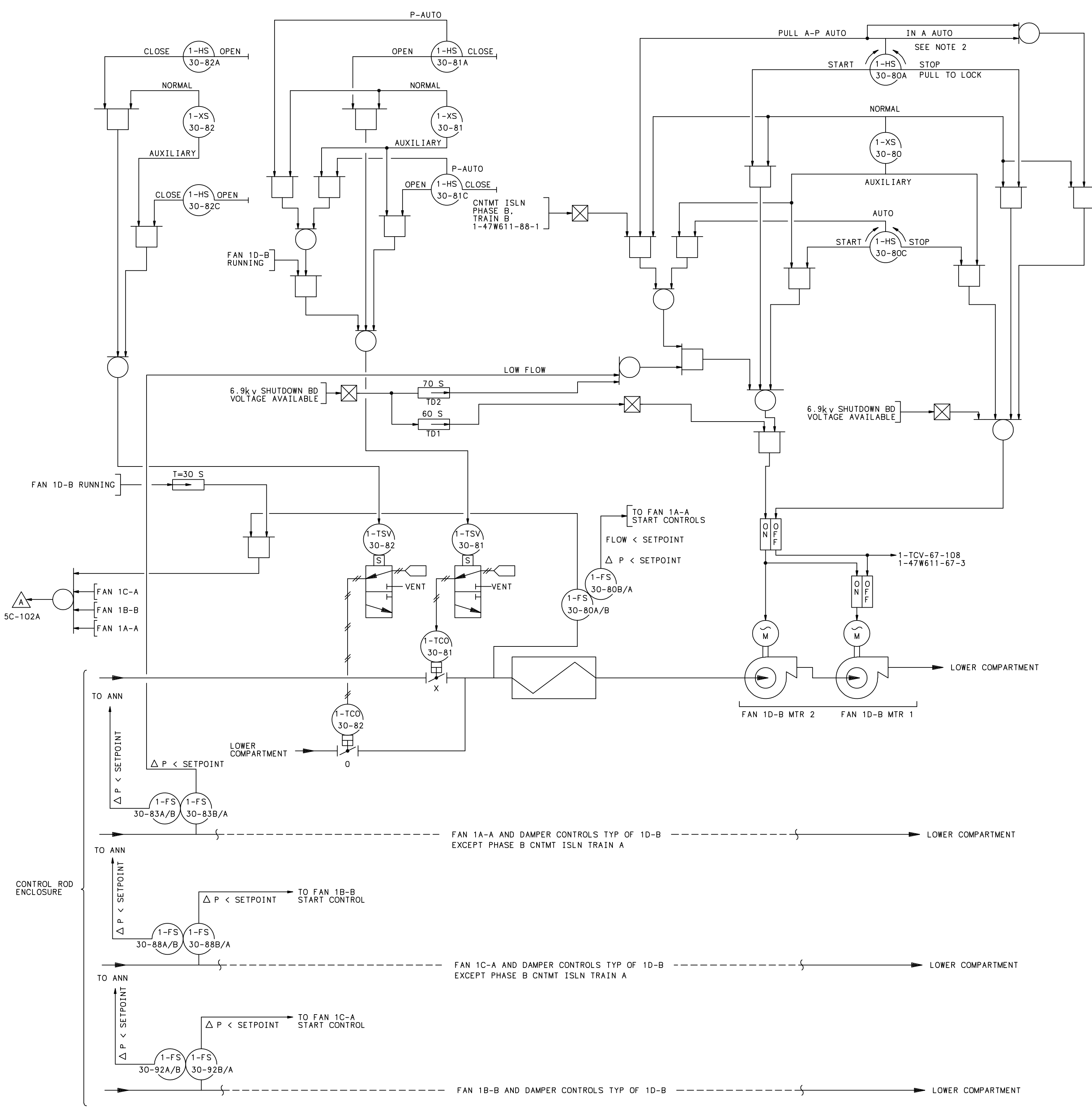
NOTES:

1. FOR SYMBOLS OTHER THAN THOSE NOTED SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS.
2. FOR SYMBOLS AND GENERAL NOTES SEE 2-47W611-30-1.
3. SWITCHES ARE PLACED IN "A AUTO" IN NORMAL OPERATION TO PREVENT AUTOMATIC LOADING. SEE SDD N3-30RB-4002.

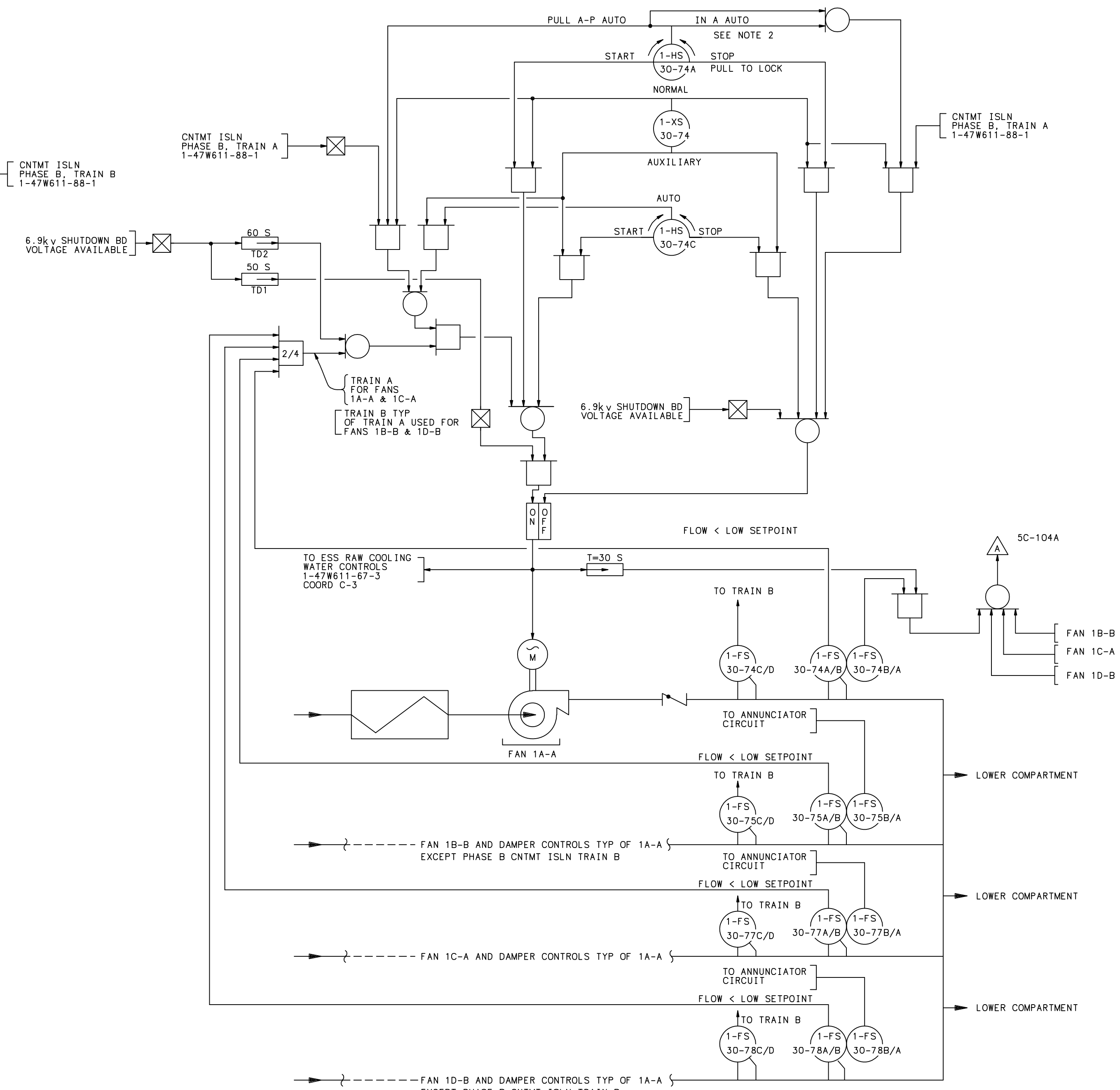
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 2-47W611-30-3 R7
FIGURE 9.4-33(U2)

CAD MAINTAINED DRAWING



CONTROL ROD DRIVE FANS 1A-A, 1B-B, 1C-A & 1D-B



LOW COMPARTMENT COOLING FANS 1A-A, 1B-B, 1C-A & 1D-B

NOTES:
1. FOR SYMBOLS AND GENERAL NOTES SEE 1-47W611-30-1.
2. SWITCHES ARE PLACED IN "A AUTO" IN NORMAL OPERATION TO PREVENT AUTOMATIC LOADING. SEE SDD N3-30RB-4002.

FANS	TD1	TD2
CRDM FAN 1A-A LACC FAN 1A-A	50	60
CRDM FAN 1B-B LACC FAN 1B-B	40	50
CRDM FAN 1C-A LACC FAN 1C-A	70	80
CRDM FAN 1D-B LACC FAN 1D-B	60	70

REFERENCE DRAWINGS:

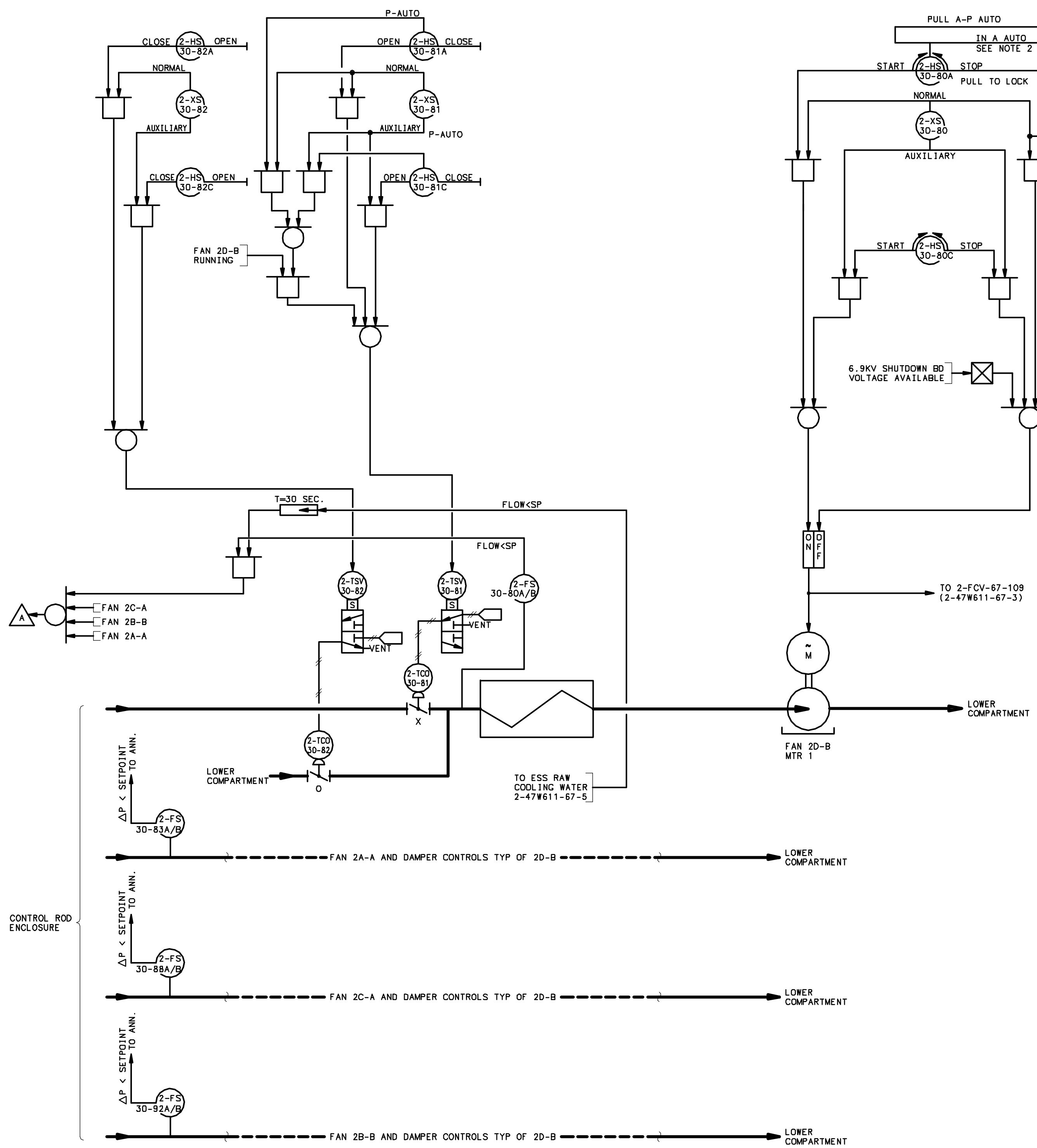
1-45W600-30-1 & -2 - - - -SCHEMATIC DIAGRAMS
1-45W600-57-9 & -18- - - -SCHEMATIC DIAGRAMS
1-45W760-30-8,-9 & -10 -SCHEMATIC DIAGRAMS
1-47W866-1 - - - - - - - -FLOW DIAGRAM
1-47W610-30-2- - - - - - -CONTROL DIAGRAM

UFSAR AMENDMENT 2

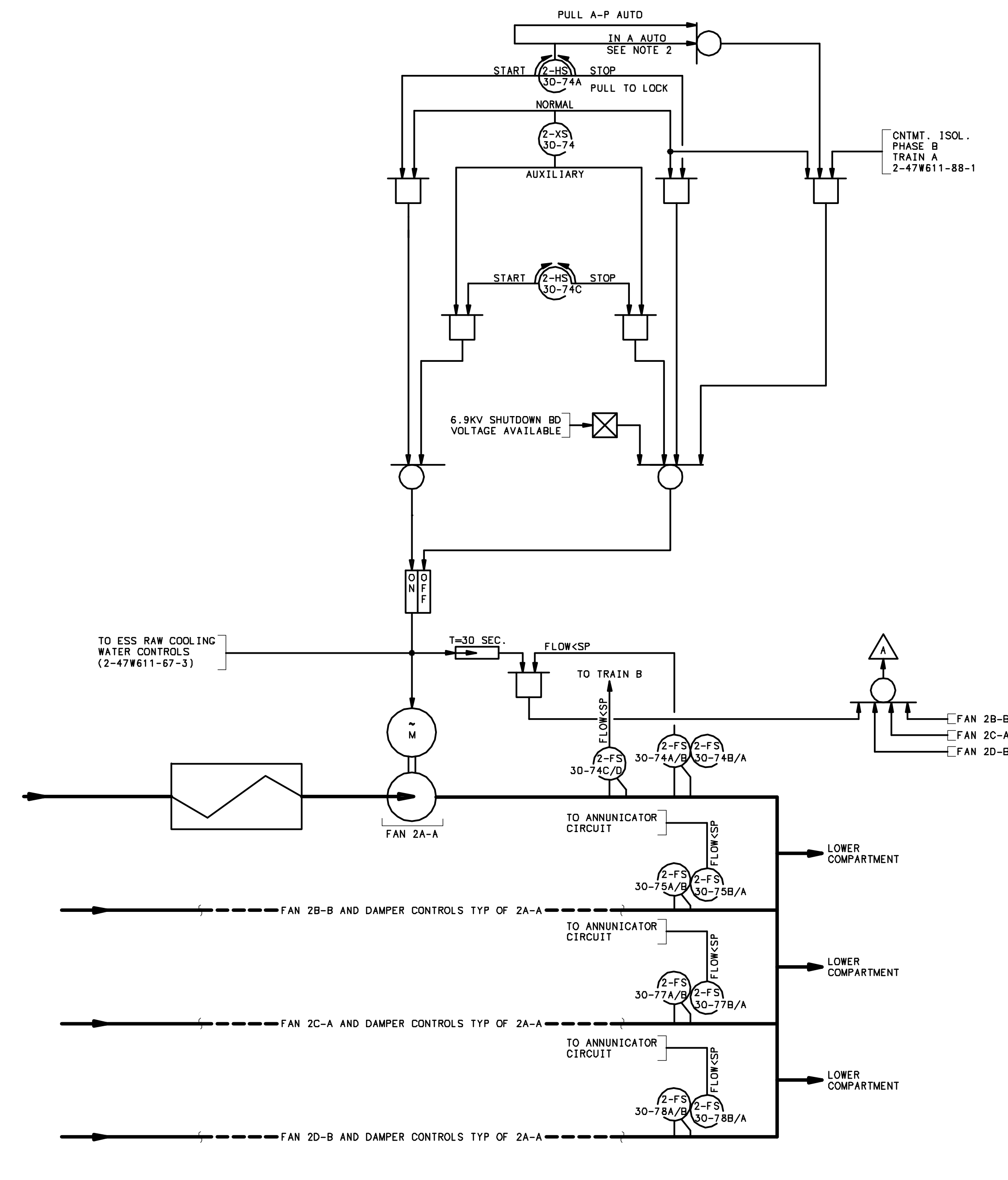
WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 1
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 1-47W611-30-4 R26
FIGURE 9.4-34

CAD MAINTAINED DRAWING



CONTROL ROD DRIVE FANS 2A-A, 2B-B, 2C-A &2D-B

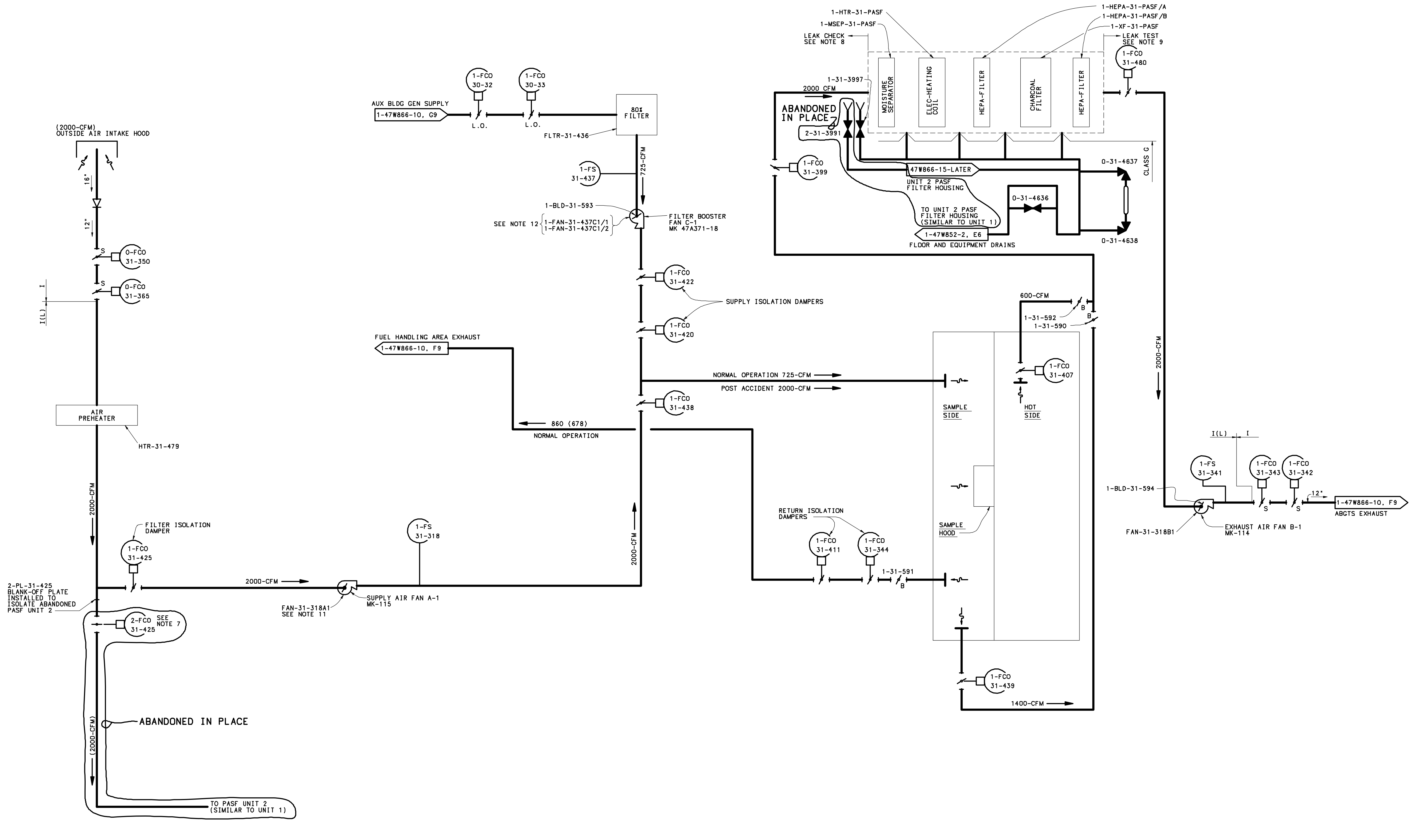


LOWER COMPARTMENT FANS 2A-A, 2B-B, 2C-A, 2D-B

NOTES:
1. FOR SYMBOLS AND GENERAL NOTES SEE 2-47W611-30-1.
2. SWITCHES ARE PLACED IN "A AUTO" IN NORMAL OPERATION TO PREVENT AUTOMATIC LOADING. SEE SDD N3-30RB-4002.

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
LOGIC DIAGRAM
VENTILATION SYSTEM
TVA DWG NO. 2-47W611-30-4 R11
FIGURE 9.4-34(U2)



POST ACCIDENT SAMPLE UNIT NO.1

NOTES:

1. FOR GENERAL NOTES, REFERENCE DRAWINGS AND DAMPER LEGEND SEE 1-47W866-1.
2. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):

   WB-DC-40-41-----POST ACCIDENT SAMPLING FACILITY ENVIRONMENTAL CONTROL SYSTEM
3. ALL DUCTWORK IS CLASS Q (ROUND) OR S (RECTANGULAR), CAT. I.
4. ALL PIPING ON THIS DRAWING IS CLASS G, CAT. I(L).
5. SECONDARY CONTAINMENT ISOLATION DAMPERS 1-FCO-30-32 AND -33 ARE LOCKED IN THE FULLY OPEN POSITION.
6. NOT USED.
7. NOT USED.
8. THE DUCTWORK ON THE SUCTION SIDE OF THE HEPA FILTER HOUSING CAN BE LEAK CHECKED PER G-37 SECTION 4.3.2.
9. THE DUCTWORK ON THE DISCHARGE SIDE OF THE HEPA FILTER HOUSING MUST BE LEAK TESTED PER ANSI N509, G-37 SECTION 4.3.3.
10. FLOWRATES SHOWN WITHOUT PARENTHESES ARE THE DESIGN FLOW RATES. CONSTRUCTION SPECIFICATION G-37 ALLOWS A TOLERANCE OF ± 10% TO BE APPLIED TO THE DESIGN FLOW RATES FOR SYSTEM BALANCING. FLOW RATES SHOWN IN PARENTHESES REFLECT PREOP AIR BALANCE TEST RESULTS. THESE FLOWRATES ARE DEEMED ACCEPTABLE BASED ON MEETING THE CRITERION THAT THE AIRFLOW DIRECTION BE FROM THE CLEANER AREAS TO AREAS OF PROGRESSIVELY GREATER CONTAMINATION POTENTIAL, AND THE FACT THAT COOLING OF SAFETY-RELATED EQUIPMENT AREAS IS ACCOMPLISHED BY THE THERMOSTATICALLY CONTROLLED ESF EQUIPMENT ROOM/AREA COOLERS (SEE EX-G-37-WBN-1 REV.1).
11. DISCONNECT THE LINKAGE BETWEEN THE DAMPER AND CONTROLLER. BOLT THE DAMPER CONTROL ARM IN THE BALANCED POSITION, FAN A-1 ONLY.
12. FUNCTIONAL DEPICTION OF THIS FAN REPRESENTS A DOUBLE FAN ASSEMBLY.

REFERENCE DRAWINGS

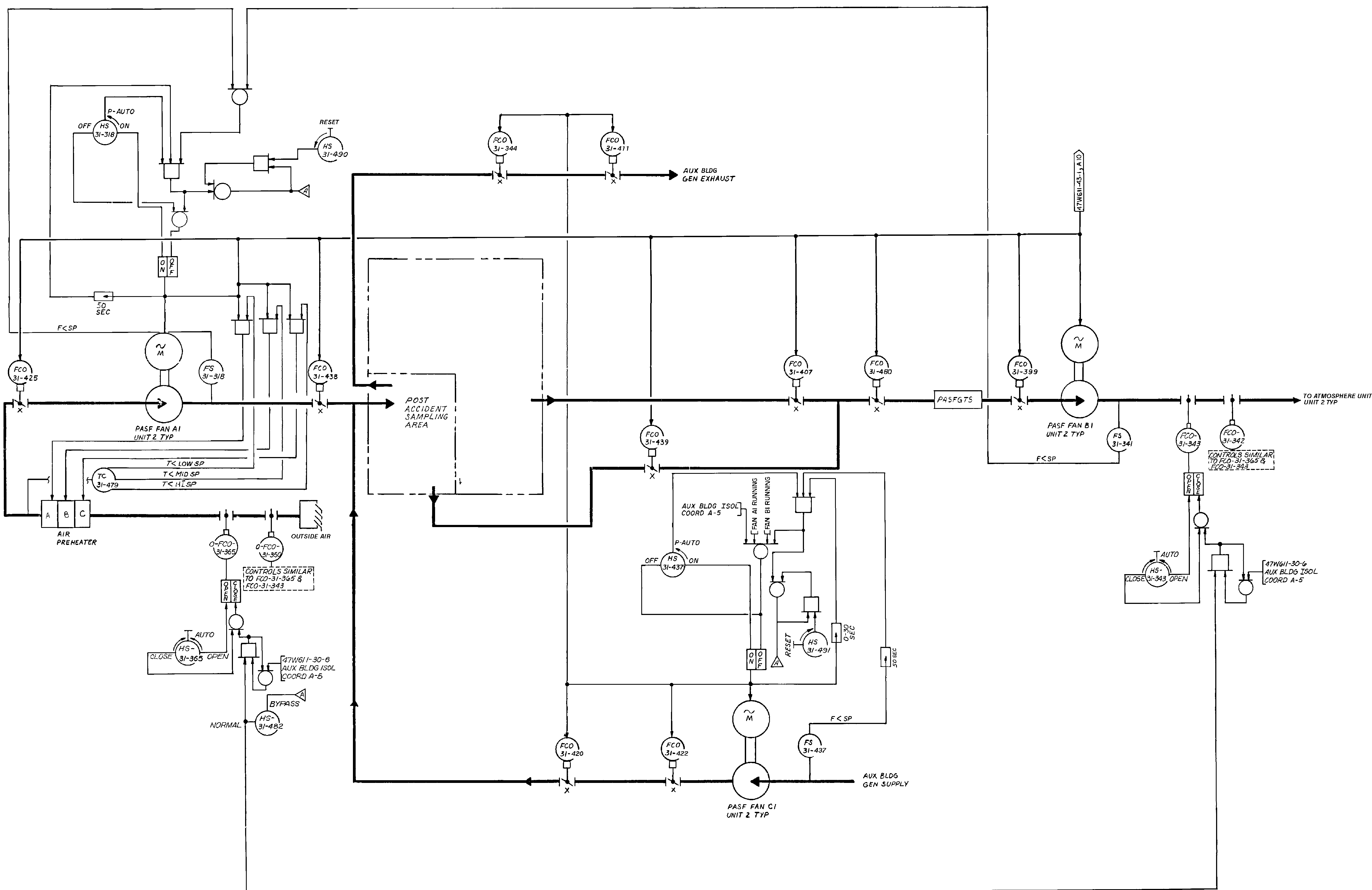
47B601-31 SERIES INSTRUMENT TABULATIONS
47B610-31-1 MECHANICAL-POST ACCIDENT SAMPLING FACILITY CONTROL DIAGRAM
47W920 SERIES
47W852-LATER
1,2-47W866-10

47W866-115--STRESS ANALYSIS PROBLEM BOUNDARY

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNITS 1 & 2
FLOW DIAGRAM
HEATING, VENTILATING AND
AIR CONDITIONING AIR FLOW
TVA DWG NO. 0-47W866-15 R2
FIGURE 9.4-35

CAD MAINTAINED DRAWING



NOTES:

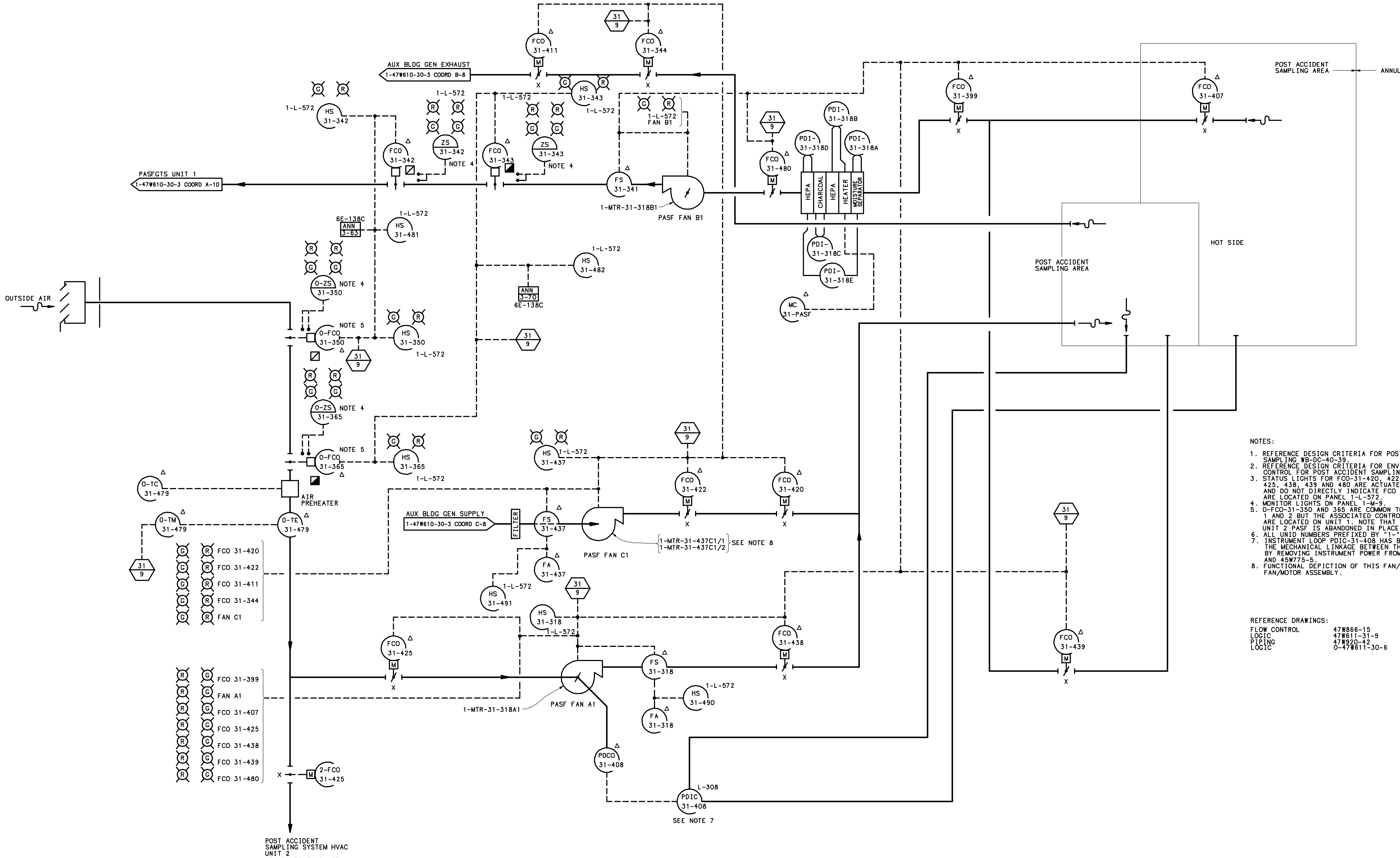
1. REFERENCE DESIGN CRITERIA FOR POST ACCIDENT SAMPLING WB-DC-40-37.
2. REFERENCE DESIGN CRITERIA FOR ENVIRONMENTAL CONTROL FOR POST ACCIDENT SAMPLING WB-DC-40-41.
3. TO START PASF FANS A1 AND B1 DAMPERS FCO-31-342 AND FCO-31-343 MUST BE OPENED BEFORE HS-31-318 IS TURNED ON.
4. 0-FCO-31-350 AND 0-FCO-31-365 ARE CONTROLLED BY UNIT 1 HANDSWITCHES.
5. 0-FCO-31-350 AND 0-FCO-31-365 ARE COMMON TO UNIT 1 AND UNIT 2.
6. UNIT 2 PASF HAS BEEN ABANDONED.

COMPANION DRAWINGS:
FLOW CONTROL
CONTROL DWG
PIPING
LOGIC

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNITS 1 & 2
ELECTRICAL
POST ACCIDENT SAMPLING SYSTEM
LOGIC DIAGRAM
TVA DWG NO. 47W611-31-9 R8
FIGURE 9.4-36

CAD MAINTAINED DRAWING



NOTES:

1. REFERENCE DESIGN CRITERIA FOR POST ACCIDENT SAMPLING WB-DC-40-39.
2. REFERENCE DESIGN CRITERIA FOR ENVIRONMENTAL CONTROL FOR POST ACCIDENT SAMPLING WB-DC-40-41.
3. STATUS LIGHTS FOR FCO-31-420, 422, 411, 344, 399, 407, 425, 438, 439 AND 480 ARE ACTUATED BY FAN MOTOR CONTACTS, AND DO NOT DIRECTLY INDICATE FCO POSITIONS. THESE ARE LOCATED ON PANEL 1-L-572.
4. MONITOR LIGHTS ON PANEL 1-M-9.
5. 0-FCO-31-350 AND 365 ARE COMMON TO UNITS 1 AND 2 BUT THE ASSOCIATED CONTROLS ARE LOCATED ON UNIT 1. NOTE THAT THE UNIT 2 PASF IS ABANDONED IN PLACE.
6. ALL UNID NUMBERS PREFIXED BY "1-" UNLESS OTHERWISE SPECIFIED.
7. INSTRUMENT LOOP PDIC-31-408 HAS BEEN DISABLED BY DISCONNECTING THE MECHANICAL LINKAGE BETWEEN THE CONTROL LOOP AND THE DAMPER AND BY REMOVING INSTRUMENT POWER FROM THE CONTROL LOOP. SEE 47W920-42 AND 45W775-5.
8. FUNCTIONAL DEPICTION OF THIS FAN/MOTOR REPRESENTS A DOUBLE FAN/MOTOR ASSEMBLY.

REFERENCE DRAWINGS:

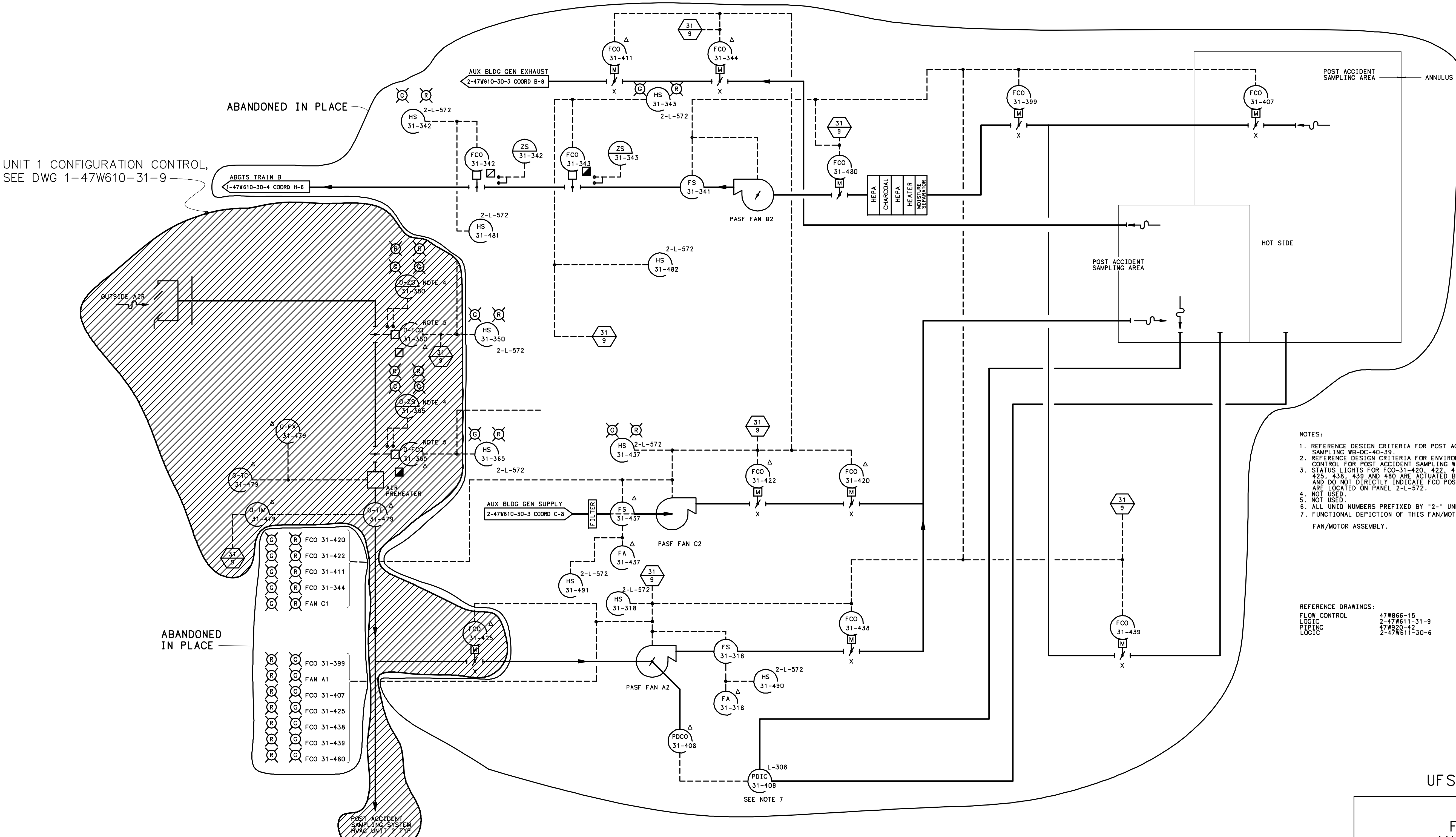
FLOW CONTROL	47W866-15
LOGIC	47W611-31-9
PIPING	47W920-42
LOGIC	0-47W611-30-6

COMPANION DRAWINGS:
0-47W610-31-SERIES
1-47W610-31-SERIES
2-47W610-31-SERIES

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

AUXILIARY BUILDING
UNIT 1
ELECTRICAL
POST ACCIDENT SAMPLING
CONTROL DIAGRAM
TVA DWG NO. 1-47W610-31-9 R15
FIGURE 9.4-37

CAD MAINTAINED DRAWING



NOTES:

1. REFERENCE DESIGN CRITERIA FOR POST ACCIDENT SAMPLING WB-DC-40-39.
2. REFERENCE DESIGN CRITERIA FOR ENVIRONMENTAL CONTROL FOR POST ACCIDENT SAMPLING WB-DC-40-41.
3. STATUS LIGHTS FOR FCO-31-420, 422, 411, 344, 399, 407, 425, 438, 439 AND 480 ARE ACTUATED BY FAN MOTOR CONTACTS, AND DO NOT DIRECTLY INDICATE FCO POSITIONS. THESE ARE LOCATED ON PANEL 2-L-572.
4. NOT USED.
5. NOT USED.
6. ALL UNID NUMBERS PREFIXED BY "2-" UNLESS OTHERWISE SPECIFIED.
7. FUNCTIONAL DEPICTION OF THIS FAN/MOTOR REPRESENTS A DOUBLE FAN/MOTOR ASSEMBLY.

REFERENCE DRAWINGS:

FLOW CONTROL	47W866-15
LOGIC	2-47W611-31-9
PIPING	47W920-42
LOGIC	2-47W611-30-6

UFSAR AMENDMENT 1

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
ELECTRICAL
POST ACCIDENT SAMPLING
CONTROL DIAGRAM
TVA DWG NO. 2-47W610-31-9 R5
FIGURE 9.4-37(U2)

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 Fire Protection System

The bases for NRC's approval of the WBN Fire Protection Program and Fire Protection Report are defined in the Fire Protection license conditions contained in the Unit 1 and Unit 2 Operating Licenses. Interface with the Auxiliary Feedwater System is discussed in Section 10.4.9, “Auxiliary Feedwater System.

9.5.1.1 Deleted
9.5.1.2 Deleted
9.5.1.3 Deleted
9.5.1.4 Deleted
9.5.1.5 Deleted

9.5.2 Plant Communications System

9.5.2.1 Design Bases

Interplant and/or Offsite Systems

The design basis for interplant and/or offsite communications is to provide dependable systems to ensure reliable service during normal plant operation and emergency conditions.

The primary interplant offsite communications systems are microwave radio, fiber optics circuits, telephone systems and radio systems. See Section 9.5.2.3 for a general description of each system.

Intraplant Communications

The design basis for the intraplant communications is to provide sufficient equipment of various types such that the plant has adequate communications to start up, continue safe operation, or shutdown safely.

The primary intraplant communications systems are the Telephone Switching System (TSS), sound powered telephones, two-way UHF/VHF radios, VHF radio paging, codes (code call is not used), alarms (accountability/evacuation and fire/medical), paging and a 400 MHz signal.

See Section 9.5.2.2 for a general description of each system.

9.5.2.2 General Description Intraplant Communications

The plant communications systems are installed and maintained by TVA with the exception of the plant antennas and bi-directional amplifiers (BDA) which are maintained by the vendor. The following paragraphs describe the basic functions of the intraplant communications system.

Telephone System

Telephone Switching System (TSS) - A TSS is installed to provide primary 2-way voice communications and data transmission throughout the Watts Bar Nuclear Plant as well as access to offsite circuits.

The Node 1 and Node 2 TSSs are powered from separate 48V dc systems. Each 48V system consists of battery chargers, a regulating power board, and a 48V battery. Each battery charger is capable of assuming the total load for its respective Node. The selected charger provides 48V dc to its TSS with the battery available as needed. Each battery is sized to carry the load at full capacity for 3 hours without the chargers. The Node 1 chargers are powered by dual ac voltage sources supplied from Train A and Train B diesel-backed boards. The Node 2 chargers are powered by dual ac voltage sources. The main source is the construction sub-station and the other is from the telephone diesel generator unit.

Sound-Powered Telephone Systems

Plant Operation Systems - The primary purpose of these systems is to provide communications for maintenance and operations personnel. There are 7 separate systems provided for each unit.

Backup Control Center System - The primary purpose of this sound powered system is to provide alternative communications between the auxiliary control room and other stations which must be manned to shutdown the reactor if the MCR is abandoned. This system consists of two completely redundant subsystems. Each subsystem is wired directly and independently of all other communications systems. Wiring routes avoid the spreading room, unit control rooms, and auxiliary instrument rooms. Sound-powered equipment and circuits are provided in the Diesel Generator Buildings, the 480V ac shutdown board rooms, the 6.9 kV ac shutdown board rooms, and the auxiliary control room.

Health Physics System - The primary purpose of this sound powered telephone system is to provide an alternate communications link between the health physics office and the MCR. A direct dedicated circuit is provided between the health physics office and the unit control room (physically on the electrical control area desk).

Diesel Building to Main Control Room - The primary purpose of this sound powered telephone system is to provide an alternate communications link between the Diesel Generator Building and main control room. A direct dedicated circuit is provided between the shielded waiting room in the Diesel Generator Building and the MCR at the diesel generator control panel.

Closed-Circuit Television

Portable closed circuit television systems are provided, when necessary, for remotely viewing radwaste packaging operation, refueling operations, area and equipment surveillance, and maintenance activities.

Codes, Alarms, and Paging System

The codes, alarms, and paging (CAP) system is one system that combines assembly and accountability alarm, fire and medical emergency alarm, and paging. Control logic, tone generation, and power and signal distribution equipment is located in the communications room with speakers with solid-state amplifier as end devices located throughout the plant.

All alarms are controlled from the MCR. The assembly/accountability and paging alarms are also controllable from the auxiliary control room.

Paging may be accessed from selected TSS telephones. Paging may also be accessed by paging handsets in the main and auxiliary control room.

The CAP system operational priority sequence is fixed by relay logic as follows:

1. Site Assembly alarm
2. Fire and medical emergency alarm
3. Paging

Paging can be advanced to a higher priority in emergencies by using the evacuation alarm control unit cancel push button.

Design consideration has been given to increase system reliability with the following features provided:

1. Redundant operating centers.

2. Three separate tone generator units.

3. Two physically separate power distribution networks with approximately half of the amplifier-speaker units in each area of the plant fed from each fuse panel via alarm-type fuses.

4. Redundant chargers are used and can be switched into service as required.

5. DC supervision of each individual audio pair.

6. Isolation of evacuation alarm actuating devices.

7. Electrical separation of amplified-speakers in each area into two circuits such that adequate coverage can be maintained in the event of one circuit failure.

Radio System

Onsite Radio Paging System - The primary purpose of this system is to provide onsite paging of key plant personnel. This system is accessible from the TSS telephone system.

Inplant UHF/VHF Radio System - The primary purpose of this system is to provide voice communications throughout the plant for plant operations, maintenance and emergency personnel. This system consists of a trunked UHF/VHF system with base radios, associated controllers, power supply and portable UHF/VHF radios. The trunked system allows individual users or can integrate large groups into specific “talk groups” for coordination (i.e, fire brigade, operations and maintenance and nuclear security, etc).

400 MHz System - The primary purpose of this system is to provide redundant voice communications throughout the plant and owner controlled property for use by operations and maintenance personnel in emergency situations. The system consists of a cell site, power block antenna, bi-direction amplifier and coupler (to interface with the inplant distributed antenna system), and UHF/VHF/800MHz tri-band radios. Nuclear Security and Fire Operations also have access to this system.

9.5.2.3 General Description Interplant System

Microwave Radio

Microwave circuit provides access to the power system control center (PSCC).

Redundant 24V dc-dc converters supplied from the 48V dc telephone power system are installed for the exclusive use of this microwave circuit.

Fiber Optic Circuit

The fiber optic circuit provides high speed digital communication connecting major communication centers and administrative offices through TVA. This fiber optic circuit is integrated into the 161kV insulated shield wire. Electro-optical interface and channel equipment are located in Telecommunications Node 2 Building.

Telephone System

Commercial Telephone Service - Public telephone service is provided to all TSS telephones with proper class of service, to pay telephones, and to dedicated data circuits.

Emergency Notification System (ENS) - The primary purpose of this telephone circuit is to provide a direct circuit from Watts Bar Nuclear Plant to the NRC in the event of a serious emergency as well as ongoing information on plant system, status and parameters at the nuclear plant reactor. A dedicated telephone line that is independent of the public telephone switching network is provided for the NRC.

Radio Systems (continued)

Health Physics Network (HPN) - The primary function of this telephone circuit is to report directly to the NRC on radiological and meteorological conditions as well as assessment of trends and the need for protective measures on-site and off-site. A dedicated telephone line that is independent of public telephone switching network is provided for the NRC.

Transmission & Power Supply - The primary purpose of this system is to provide communications for Transmission & Power Supply, also known as the Energy Delivery (ED) engineers, but it may also be used by plant operations personnel during emergencies. This system is capable of contacting local mobile units and other TVA power generating facilities.

Nuclear Security (NS) Radio - The primary purpose of this system is to provide effective communications between all Nuclear Security officers.

Emergency Preparedness Radio Communication System - This system is a separate VHF system however still uses the inplant distributed antenna system via a “talk group” for coordination with field monitoring teams and other personnel.

Sheriffs' Radio - The primary purpose of this system is to provide communications between Nuclear Security officers and the Meigs and Rhea County sheriffs.

9.5.2.4 Evaluation

The following evaluation is intended to establish adequacy and redundancy of the plant communications systems design.

Interplant Systems

There are four basic types of plant-to-offsite communications: microwave radio, fiber optics circuits, radio, and telephone systems. The availability of these systems during or after an emergency is enhanced by the fact that each enters the plant via different means.

The redundancy of the communications systems is of further significance. The microwave and fiber optics equipment design employs redundancy both in the channelizing and in the RF circuitry. The microwave system is powered from a battery-battery charger system through parallel-connected, redundant dc-dc converters. Each charger is fed from two separate ac sources, and each battery is capable of operating its system for a minimum of three hours without chargers.

The major electronic portions of the microwave are housed in the communications room which is located in the Control Building (Node 1). This building is a Seismic Category I structure.

The commercial telephone lines are terminated in Bell Hut and extend to Node 1 and 2 and from there to instruments located throughout the plant via the TSS. Local central office lines are available in the control room in the event of the loss of the TSS.

The Transmission & Power Supply and Sheriff's radios along with the 400 MHz signal have no components in the communications room and, therefore, would not be affected by the total destruction of this room. The interplant UHF/VHF radio would be affected by the total destruction of the communication room and would be inoperable for offsite communications. Hand held UHF/VHF radios would still be available to communicate form the Secondary Alarm Station (SAS). The emergency preparedness and NS radio communications systems, however, depend on equipment in the communications room and would be inoperative following the total destruction of the communication room.

All of the UHF/VHF radio systems are powered by battery and/or diesel-backed sources and would remain operative following loss of offsite power.

Refer to Figure 9.5-19 for availability of interplant communications during various postulated conditions.

Intraplant System

The automatic telephone equipment is one of the primary systems is designed so that failures in individual switches or lines do not interrupt service. However, such failures are annunciated and repairs are made promptly. The main (Node 1) switching equipment for this system is located in the communications room which is in a Seismic Category I building. Communication between TSS phones within seismic Category I buildings is through Node 1. In times of emergency, the TSS can be programmed to limit access only to key people to ensure that they will always have telephone service.

The codes, alarms (assembly/accountability) and paging system is designed for survivability with the following features:

1. Duplicate operating locations: one in the main control room and the other in the auxiliary control room. Isolation of the duplicate controls is provided in the communications room.

2. Three tone generator consoles powered from two separate sources:

    a. The operating console is normally aligned to the A source.

    b. A standby console which automatically is inserted upon power failure of the operating console. The standby console is normally aligned to the B source. It may also be manually switched at any time.

    c. A third console which may be manually substituted for either of the other consoles.

3. Plug-in features:

    a. The tone generators are solid-state plug-in devices.

    b. The amplifier in the speaker unit is solid-state, easily unplugged and replaced.

4. The power-leads to each speaker-amplifier are fused and annunciated.

5. The signal-leads to each speaker-amplifier are supervised with dc while idle. Any occurrence which causes a short of the signal-leads will cause the fuse to blow and annunciate. The rest of the units will function normally with single or multiple open-circuited signal-leads to individual speaker-amplifiers.

6. There are two sources of 24V dc power distributed to the speaker- amplifiers and approximately half in each area of the plant are supplied from each source. Each source is quite reliable since it is supplied from chargers which are backed up by batteries capable of supplying the load for three hours.

The failure of the TSS equipment will not impair the use of the paging equipment from the local stations located at the unit operator's desk or the auxiliary control room.

The sound-powered telephone systems are completely independent of power, each other, and all other systems provided. As long as a complete metallic path exists between instruments, communications can be maintained since the instruments supplied with these systems are very rugged and will successfully withstand high shocks, negligence, and abuse. If permanently installed wires are rendered unusable for any reason, a temporary pair of wires can be used with the sound-powered instruments.

Neither the Inplant UHF/VHF Radio System nor the Inplant 400 MHz System have any components in the communications room and, therefore, would not be affected by the total destruction of this room. The Onsite Radio Paging System, however, depends on equipment located in the communications room and would be inoperative.

The Inplant UHF/VHF Radio System, the 400 MHz System and the Onsite Radio Paging System are powered by battery- and/or diesel-backed AC sources and would remain operative following loss of offsite power.

Refer to Figure 9.5-19 for availability of intraplant communications during various postulated conditions.

9.5.2.5 Inspection and Tests

The two communication systems are covered by Special Performance Tests (SPT-251-02 and SPT-252-02):

1. The sound-powered telephone systems provided for the backup control center, health physics office, and Diesel Building shielded room;

2. The codes, alarms, and paging system.

All systems are carefully installed and checked for proper operation initially by construction forces. Routine maintenance is performed by operating personnel on a regular basis and includes such items as checking for proper switch operation, checking for proper operating levels, visual inspection, etc.

The most comprehensive testing, however, results from the heavy daily usage of the equipment and the subsequent reports of any of the users. Individual power failures in the equipment are annunciated.

9.5.3 Lighting Systems

9.5.3.1 Design Bases

There are three basic lighting systems in the plant designated as follows: normal, standby, and emergency. These systems are designed in accordance with TVA design guides and standards which use the recommendations of the Illuminating Engineering Society of North America as their basis, and good engineering practice to provide the required illumination necessary for safe conduct of plant operations and under normal conditions to make the plant personnel as comfortable as possible.

The normal lighting system is designed to economically provide the amount and quality of illumination to meet normal plant operations and maintenance requirements.

The standby lighting system upon loss of the normal lighting system, provides adequate illumination for the safe shutdown of the reactor and the evacuation of personnel from vital areas of the plant if the need should occur. It forms an integral part of the normal lighting requirements but is fed from an entirely independent source.

The emergency lighting system is composed of two separate systems: (1) The 125V dc lighting system, which is designed to provide immediately the minimum illumination level in areas vital to the safe shutdown of the reactor for the period required for diesel loading or upon loss of ac auxiliary power for the duration of capacity of the 125V vital dc batteries and (2) an individual

eight-hour battery pack network, which is used to for 10 CFR 50.48, Appendix R. Details regarding compliance with 10CFR50, Appendix R, III.J are provided in the Fire Protection Report.[6] Other battery pack units are provided for building egress for personnel safety purposes.

9.5.3.2 Description of the Plant Lighting System

All plant lighting systems have the following features in common: adequate capacity and rating for the operation of the loads connected to the systems, independent wiring and power supply, overcurrent protection for conductor and equipment using nonadjustable inverse time circuit breakers, copper conductor with 600-volt insulation run in metal raceways.

The insulated cable used inside the primary containment areas is resistant to nuclear radiation and chemical environmental conditions in this area.

The plant lighting system consists of three basic schemes, the first of which is the normal lighting. This system is for general lighting of the plant: the major power supply is through two alternate feeders from the 6.9kV common boards A and B to selective and interrupter switch and 3-phase 6900-120/208-volt ac transformers, feeding a lighting board. These lighting boards are located in the Turbine and Auxiliary Buildings of the main plant. Other lighting boards in the Service Building, Office Buildings, gatehouse, etc., are fed from 480V boards through 3-phase 480-120/208V ac transformers. These lighting boards feed the normal lighting cabinets, designated by the prefix LC___, distributed throughout the main plant. In the MCR, alternate rows of fixtures or alternate fixtures are fed from different lighting boards to prevent total blackout in a particular area in case of failure of one of the other lighting boards or cabinets.

The second system is the standby lighting, which forms a part of the normal lighting requirements and is normally energized at all times. This system is fed from 480V Reactor MOV boards 1A2-A, 1B2-B, 2A2-A, and 2B2-B to 3-phase 480-120/208V ac transformers to each standby lighting cabinet, designated by the prefix LS___ . The Reactor MOV boards have a normal and alternate ac power supply and in event of their failure are fed from the standby diesel generators. The cable feeders to the standby cabinets located in the Seismic Category I structure are routed in redundant raceways and the fixtures are dispersed among the normal lighting fixtures.

The third lighting system is referred to as the emergency system. It consists of two systems as described in Section 9.5.3.1. The 125V dc emergency lighting system is electrically held in the off position until a power failure occurs on the associated standby lighting systems. Then the emergency lighting cabinets, designated by the prefix LD___, are automatically energized from the 125V dc vital battery boards. This system is an essential supporting auxiliary system for the ESF, and the cable feeders to the LD cabinets are routed on the redundant ESF cable tray system or in conduit. The fixtures are incandescent type and are dispersed among the normal and

standby fixtures with alternate emergency fixtures being fed from redundant power trained LD cabinets.

The individual eight-hour battery pack emergency lighting system is automatically held in the de-energized state until loss of the normal ac supply. A charger monitors battery voltage and charges on fast rate when necessary. Solid-state circuits continually monitor both ac and dc current. The transfer switch circuit instantly connects lamps to battery on ac failure and disconnects them when normal power is restored. In some cases, the lamp heads are mounted remote from the units to obtain adequate light distribution.

9.5.3.3 Diesel Generator Building Lighting System

The Diesel Generator Building lighting cabinets are fed through 480-208/120V 3-phase local lighting transformers, which in turn are fed from the diesel 480V auxiliary boards respectively. Each of these auxiliary boards has dual feeders from the 480V shutdown boards during normal operation. In the event of an ac power failure to the 480V shutdown boards, the diesel should start within the prescribed time to provide the 480V ac power requirements for the safe shutdown of the plant through the standby feeders to the 480V shutdown boards, thus supplying power again to the Diesel Generator Building lighting transformers. Each diesel generator unit has a lighting cabinet which supplies the normal lighting for that unit. Low-level lighting required for maintenance or operating procedures and ingress/egress in the event of loss of normal lighting is supplied from fixtures with a self-contained battery and inverter charger and also individual eight-hour battery pack lighting units

9.5.3.4 Safety Related Functions of the Lighting Systems

The lighting system is adequate for the operation and evacuation of the plant to the extent that the supports for the components of the system, that are located in areas of Seismic Category I structures containing safety-related equipment are qualified to prevent failure that could impair the functioning of any safety-related plant feature.

Lighting systems are classified as non-safety related. However, due to their functions, standby and emergency lighting systems shall be of a high reliability design so as to ensure necessary illumination in areas of the plant needed for operation of safe shutdown equipment and in access and egress routes thereto.

9.5.3.5 Inspection and Testing Requirements

Following the complete installation of a lighting system, it will be tested and inspected and short circuits, grounding of potential conductors, other faults, etc. will be eliminated and damaged or nonoperable fixtures replaced or repaired. The operation of the lighting system shall be observed during the initial and periodic testing of the normal and alternate feeder systems and during the

125V dc emergency power tests to the various boards from which these emergency lighting systems are fed. Maintenance and relamping of the normal and standby lighting systems shall be according to routine plant operating procedures.

The 125V dc emergency lighting system shall be tested periodically by tripping the holding coil circuit fed from the LS standby cabinet, thus closing the feeder circuit to the LD emergency cabinet. A written record of dates and results of these tests shall be maintained by plant personnel responsible for these tests.

The individual eight-hour battery pack lighting units will be tested periodically to ensure that the lamps are operational in according with routine plant procedures.

9.5.4 Diesel Generator Fuel Oil Storage and Transfer System

9.5.4.1 Design Basis

The diesel generator fuel oil system provides independent storage and transfer capacity to supply the four diesel generator units operating at continuous ratings with No. 2 Fuel Oil for a period of seven days without replacement.

The buildings are Seismic Category I structures and will withstand the effects of tornadoes, credible missiles, floods, rain, snow, or ice, as defined in Chapter 3, Section 3.3, 3.4, and 3.5.

The design code requirements for the system are as follows:

1. Diesel Generator Building 7-day fuel oil storage tanks - Code for Unfired Pressure Vessels, ASME Section VIII. Division I.

2. Piping from the 7-day fuel oil storage tanks to the interface with the skid-mounted diesel generator unit fuel oil piping - Boiler and Pressure Vessel Code, ASME Section III, Class 3 (Per NFPA Code 30-1973).

Skid mounted piping and components for the fuel oil system were designed, manufactured and installed in accordance with ANSI B31.1. This subsystem performs a primary safety function and is supported to Seismic Category I requirements. The scope of this work was done to meet 10CFR50, Appendix B quality assurance requirements. Future modifications performed on this subsystem piping are required to meet the intent of ASME Section III, Class 3.

3. Remaining piping, valves, pumps, and associated equipment - Power Piping Code, ANSI B31.1-1973.

The 7-day diesel fuel oil storage tanks are designed for embedment within the Diesel Generator Building foundation. The fuel oil day tanks are skid-mounted on the diesel generator units.

The diesel fuel oil system for the diesel generator units meets the single failure criterion. That portion of the system from the 7-day storage tanks to the diesel generator units meets Seismic Category I requirements. The remainder of the system within the Diesel Generator Building meets Seismic Category I (L) requirements.

9.5.4.2 System Description

The flow diagram of the diesel generator fuel oil system is shown in Figure 9.5-20. The control and logic diagrams are shown in Figures 9.5-21 and 9.5-22, respectively.

The diesel generator fuel oil system consists of four 7-day embedded storage tank assemblies, one assembly for each diesel generator unit, with their associated day tanks, pumps, valves, and piping. The 7-day tanks are embedded in the Diesel Generator Building substructure and have a capacity of approximately 70,248 gallons of fuel for each diesel generator unit. The fuel day tanks (one per diesel engine) are mounted to the diesel engine skid and were supplied by the diesel generator vendor. These tanks have a capacity of approximately 550 gallons.

Level transmitters are provided on the 7-day storage tank assemblies to provide the following functions:

1. Provide local fuel level indication.

2. Annunciate an alarm in the MCR when the fuel level approaches a seven-day supply.

3. Annunciate an alarm in the MCR on high level above the pump shut-off setting.

4. Provide an interlock with the outside transfer pump at the yard storage tanks to shut off the pump automatically on high level of any of the four 7-day tanks which is being filled. Provide a high level interlock with the DG transfer pump in the DG Building when transferring fuel to fill any of the 7-day tanks from another 7-day tank within that building. Interlocks are not provided when using the DG transfer pump to transfer fuel to any other tanks.

A truck fill connection, condensate sump suction connection, and inspection dipstick gauge manholes are provided for each 7-day storage tank assembly. The vents to the atmosphere on all tank assemblies, with the exception of the skid-mounted day tanks, are provided with double fire screens to prevent an outside spark from entering the assemblies and igniting the gases within. The National Fire Code (NFC) does not require flame arrestors for Class 2 combustible liquid storage tank vents. Therefore, in order to facilitate the installation of missile protection devices, the skid mounted fuel oil day tank vent lines are not flame-proofed. However, the open vent lines are shielded from the atmosphere and equipped with bird screens. All tank connections and vents are above maximum flood elevation. That portion of the 7-day fuel oil tank vent above the roof level is encased in reinforced concrete for missile protection.

Two skid-mounted, electric motor driven, 15 gpm fuel oil transfer pumps, powered from the 480V diesel auxiliary boards (See Figure 8.3-32), are provided for each generating unit to transfer fuel from the 7-day storage tank assembly to the two skid-mounted day tanks of each generating unit. Each of these pumps supplies fuel to both day tanks.

Two sets of level switches are provided for each day tank and associated transfer pumps to maintain day tank level. An additional set of level switches provide both Main Control Room (MCR) and Auxiliary Control Room (ACR) alarms to indicate high and low fuel oil level in the day tanks.

From each day tank, fuel is supplied to the diesel injectors by a diesel engine driven pump. An electric motor-driven fuel pump is provided as a backup for the engine driven fuel pump. Separate suction and discharge lines serve each pump. Each pump has a suction strainer and dual element fuel filters are provided at each pump discharge. Additional filters at the inlet and outlet of each fuel injector protect the working parts of the injector. Pressure gauges are provided on both sides of the dual element fuel filters to provide a means of determining filter pressure drop. Pressure switches are provided between the fuel pumps and the dual element filters and between the final filters and the fuel injectors. The pressure switches provide ACR and MCR alarms on low pressure. Maintenance procedures call for periodic changing of filters and surveillance test runs verify the cleanliness of these filters.

Screens are provided in the suction lines of the Diesel Generator Building transfer pumps which transfer the fuel from the yard storage tank to the 7-day storage tanks. The 7-day tanks are sloped to collect water and sediment at the low end and can be "dip leg" pumped as necessary. The fuel storage and transfer system is protected against the entry of rain water, and the day tanks and 7-day tanks are not harmed by flood waters.

Each shipment of No. 2 diesel fuel oil can be sampled prior to pumping to the yard tanks. Samples collected may be used for analyses to verify site specific criteria prior to offloading the tanker and to ensure contractual requirements are met if necessary. Shipments of diesel fuel can be held in the yard tanks until the specified criteria are met and the fuel oil is transferred to one of the 7-day storage tanks or the fuel is burned in the auxiliary boilers. If necessary the fuel is discarded. Sampling and analyses of fuel oil that is transferred to or stored in the 7-day storage tanks is completed in accordance with Technical Specifications.

The 7-day storage tanks are inspected in accordance with the Technical Specifications.

The methods for maintaining acceptable levels of fuel quality for the standby diesel generators at Watts Bar Nuclear Plant meet the guidelines set forth by NRC Regulatory Guide 1.137, Revision 1, except for pressure testing required by Section C1.e which was accepted by SER Supplement 5, Section 9.5.4.1 and exceptions to C2, given as follows:

a) C2.a the reference year of ASTM D 975 used is 1990 or later revision instead of the year 1977 which is specified in the Regulatory Guide.

b) C2.b methods for water and particle detection in fuel oil prior to transferring fuel oil to supply tank is specified in the Technical Specifications.

c) C2.b analytical results to be completed after transfer of fuel to supply tanks are completed within time frames given in the Technical Specifications instead of the listed 2 weeks.

d) C2.c fuel oil samples are collected using applicable ASTM method specified in the Technical Specifications instead of the listed ASTM D 270.

A transfer pump located adjacent to the yard fuel oil storage tanks provides the following functions:

1. Transfer fuel oil from a tank truck to either of two yard fuel oil storage tanks.

2. Transfer fuel oil from either yard fuel oil storage tank to the other.

3. Transfer fuel oil from either yard fuel oil tank to any of the four 7-day fuel oil storage tank assemblies.

4. Reject fuel oil from either yard fuel oil tank through a reject connection in the yard.

Seismically qualified fuel oil transfer pumps are also located in the Diesel Generator Building.

The Diesel Generator Building fuel oil transfer pump allows fuel oil to be transferred from any one of the 7-day fuel oil storage tanks in the Diesel Generator Building to any other 7-day fuel oil storage tanks in the Diesel Generator Building or either yard storage tank.

9.5.4.3 Safety Evaluation

With a 7-day supply of diesel fuel in each tank assembly, and each assembly embedded in the concrete substructure of a Seismic Category I building and separated by 18 inches of concrete, the diesel generator units are assured of a sufficient fuel supply for any of the conditions discussed in Section 9.5.4.1. The diesel generator fuel oil tank assemblies, piping, and pumps are so arranged that malfunction or failure of either an active or passive component associated with the source of supply for any one diesel generator unit does not impair the ability of the other sources to supply fuel oil to the other units. Each diesel generator is aligned so as to be able to supply power to its own auxiliaries so that a single failure can not result in loss of more than one diesel generator unit. The system thus meets the requirements of the single failure criterion.

Automatic carbon dioxide fire protection is provided in the Diesel Building fuel oil transfer pump room and the four rooms housing the diesel generator units.

A corrosion allowance is provided in the design wall thickness for the Diesel Generator Building 7-day fuel oil storage tanks. The interiors of the tanks were coated for added corrosion protection. The fuel oil piping and fittings within the Diesel Generator Building have ample corrosion allowance, having been designed per the codes noted in Section 9.5.4.1, and will operate at a pressure considerably below the maximum allowable for the schedule of pipe and fittings used.

It is expected that additional fuel oil beyond that stored onsite can be procured and delivered to the plant site within a reasonable period of time since:

1. The plant site is served by a railroad spur owned by TVA. The yard transfer pump is provided for transferring fuel oil from a tank car to either of the two fuel oil tanks in the yard, or directly to the diesel fuel oil storage tank assemblies.

2. State Route 68 provides vehicle access to the site and intersects: State Route 58 and Interstate 75 (I-75) east of the site and State Route 29 (US 27) west of the site. State Routes 29 (US 27) and 58 pass within 10 miles of the site and I-75 within 30 miles of the site. These thoroughfares provide year round access (extreme weather conditions could interrupt traffic flow for short periods of time) to both Chattanooga and Knoxville. With access to both of these major cities it would be very unlikely that tanker truck deliveries would be interrupted for any significant period of time, even in periods of extreme weather conditions.

3. If rail or road transportation is unavailable, barge or tanker delivery can be accepted at the dock area on the west bank of the Tennessee River near the plant site.

A failure modes and effects analysis for the diesel generator fuel oil storage and transfer subsystem is presented in Table 9.5-2.

9.5.4.4 Tests and Inspections

The engine-mounted, motor and engine-driven fuel oil transfer pumps and day tanks were functionally tested in the vendor's shop in accordance with the manufacturer's standards to verify the performance of the diesel generator units and accessories. The fuel oil transfer pumps in the yard and Diesel Generator Building were tested in the manufacturer's factory to verify their performance. The 7-day fuel oil storage tanks were tested with compressed air to 20 psig prior to shipment to the plant site.

The entire diesel fuel oil system is flushed with oil and is functionally tested at the plant site in accordance with Chapter 14. The diesel fuel oil system will be periodically tested to satisfy the Technical Specifications.

9.5.5 Diesel Generator Cooling Water System

9.5.5.1 Design Bases

A closed-loop circulating water cooling system is furnished for each engine of the four tandem diesel generator units housed within the Diesel Generator Building. The system maintains the temperature of the diesel engine within a safe operating range, under all load conditions, and maintains the coolant pre-heat during stand-by conditions. The heat sink for this system is the ERCW system, which flows through the tube side of the skid-mounted heat exchangers. See Section 9.2.1 for discussion of the ERCW system.

The diesel generator skid-mounted cooling water piping and components between the skid interface connection and the engine interface are vendor supplied, safety-related, ANSI B31.1, Seismic Category I with the exception of the cooling water heat exchangers which are ASME Section III, Class 3. All modifications to the skid-mounted diesel generator cooling water system piping are performed to meet the intent of ASME Section III, Class 3 (TVA Class C).

These buildings are designed to Seismic Category I requirements, and are designed to withstand the effects of tornadoes, credible missiles, hurricanes, floods, rain, snow, or ice as defined in Chapter 3 (Sections 3.3, 3.4, and 3.5).

9.5.5.2 System Description

Each cooling system includes a pump, heat exchanger expansion tank, and all accessories required for a cooling loop. (See Figure 9.5-23).

To preclude long term corrosion or organic fouling the engine cooling water system requires de-ionized water with a corrosion inhibitor. The water chemistry is maintained in conformance with the engine manufacturer's recommendations, Electromotive Division of General Motors Corporation MI 1748. The closed-loop engine cooling water is circulated through the shell side of each skid-mounted heat exchanger by two diesel-engine shaft-driven pumps. Jacket water immersion heaters are provided for each engine to maintain the jacket water within the vendor recommended temperature range in order to reduce thermal stresses and assure the fast starting and load accepting capability of the diesel generator units in performing their required safety function.

Temperature switches are used to control the immersion heater and to annunciate on high or low jacket water temperature. For temperature switch set points, see Figure 9.5-23.

Jacket water flows through the lubrication oil cooler by thermosyphon action when the diesel generators are idle. An electric motor driven lubrication oil circulation pump, powered from the 480V diesel auxiliary board, is also provided for each engine to circulate the lubrication oil through the lubrication oil cooler, which is warmed by the engine jacket water, and return the oil to the engine sump. The jacket water immersion heaters are controlled by thermostats, and the lubrication oil circulation pumps run continuously when the engine is not running. This recirculation ensures the lube-oil temperature is maintained at 85°F (minimum) during the standby mode. (See Figures 8.3-33, -33A, -33B. -33C, and -35).

Each diesel generator unit is provided with two closed engine cooling water loops (one for each engine), for which the heat sink is provided by the ERCW system. (Refer to Section 9.2.1). The ERCW flows through the tube side of the skid-mounted heat exchangers.

9.5.5.3 Safety Evaluation

The cooling water is supplied to the heat exchangers of each diesel generator unit through redundant headers of the ERCW system. The system isolation valves are so arranged as to provide the capability to isolate either cooling source in the event of a component malfunction or excessive leakage from the system. Refer to Figures 9.2-1 and 9.2-4A. These valves are powered from the 480V diesel auxiliary board and closure signals for these valves are manually initiated (See Figures 8.3-33, -33A, -33B, -33C, and -35). Therefore a malfunction (single failure of a component) or loss of one cooling water source can not jeopardize the function of a diesel generator unit. Both the non-skid-mounted air-start piping and fire protection piping located in the vicinity of the diesel generator cooling water system are designed to Seismic Category I(L) to ensure that no seismic event will degrade the functional capability of the diesel generator cooling water system. A failure modes and effects analysis for the diesel generator cooling water system is presented in Table 9.5-2.

9.5.5.4 Tests and Inspections

The ERCW system within the Diesel Generator Building is hydrostatically tested in accordance with the requirements of ASME Section III and is functionally tested in accordance with Chapter 14 . System components are accessible for periodic inspections during operation.

The skid-mounted diesel generator cooling water system components are inspected and serviced as specified in the scheduled maintenance program for the Watts Bar Nuclear Plant diesel generator units.

9.5.6 Diesel Generator Starting System

9.5.6.1 Design Bases

Each diesel engine is equipped with an independent pneumatic starting system to provide reliable, automatic starting of the engines. See Figure 9.5-24. The diesel starting air system components are housed with their respective diesel generator units within the diesel generator rooms in the Diesel Generator Building.

The supply headers from each air compressor to the isolation check valve on its skid-mounted accumulator are designed to Seismic Category I(L) requirements. The supply headers from each loadless start device to the isolation check valve and the normally closed bypass valve at the skid-mounted accumulator are designed to Seismic Category I requirements.

The diesel generator skid-mounted starting air system piping and components are vendor supplied, safety-related, ANSI B31.1, Seismic Category I. All modifications to the skid-mounted starting air system piping are required to be performed to meet the intent of ASME Section III, Class 3 (TVA Class C).

9.5.6.2 System Description

Each diesel engine has two pairs of air starting motor units (hence, there are four pairs per diesel generator unit). A minimum of two pairs of air start motors are needed to start the diesel generator unit. A set of two skid-mounted air accumulators is provided for each diesel engine; four accumulators per diesel generator unit.

The accumulators are designed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII. Each set of accumulators is sized for a compressed air storage capacity sufficient to start the diesel generator unit five times without recharging. Each set of accumulators is equipped with pressure gauges, drains, shutoff valves, safety relief valves, check valves, instrumentation, and controls.

Two 480V ac motor-driven compressors supply compressed air to each of the two sets of accumulators for each diesel generator unit. Controls for the compressors have been designed for automatic start-stop operation. Manual test-start selector switches are also provided for each compressor. Pressure switches are provided on each air starting system for actuating low air pressure alarms both in the MCR and ACR (see Figure 9.5-25A, -25B, and -25C).

To prevent moisture and rust accumulation in the air starting system, a membrane style air dryer has been installed between the air compressor and the accumulators. The air dryer unit contains no moving parts or electrical components. Moisture traps are also located downstream of the dryers to collect any residual moisture. The two air storage systems for each diesel generator unit provide redundancy so that a single failure will not jeopardize the design starting capacity of the system.

9.5.6.3 Safety Evaluation

All equipment necessary to start the diesels upon receipt of a start signal is Seismic Category I.

The diesel air start system is classified as quality group D. Section B of Regulatory Guide 1.26 discusses quality groups A through D and generally the types of equipment falling in each group. Section B also discusses systems and components not covered by groups A-D. Examples of these non-covered items are provided in Regulatory Guide 1.26 and include instrument and service air systems, auxiliary support systems and diesel engines. Part NA-1130, Section III of the ASME code states that drive system and other accessories are not part of the code. Regulatory Guide 1.26 states that non-covered items should be designed, fabricated, erected, and tested to quality standards commensurate with the safety functions performed. As a quality group D system, it is considered to meet quality standards commensurate with the safety function performed.

The piping for the air start system is designed to minimize rust accumulation in the system. Moisture is accumulated at the low points in the system and removed by administrative blowdown procedures. ASME Section III, Class 3 soft-seated check valves are provided downstream of the air accumulators. A strainer is also provided in the air start piping system upstream of the air start motors which prevents carry over of oil or rust, etc., to the motors. An oil mist type lubricator located in the air start system piping downstream of the line strainer and before the air start motors, provides lubrication for the motors. The typical arrangement for each engine is a strainer and lubricator for each pair of air start motors. The diesel starting air system is shown in Figures 9.5-25A, 25B, and 25C. A failure modes and effects analysis for the diesel generator starting air system is presented in Table 9.5-2.

9.5.6.4 Tests and Inspections

The entire diesel generator starting system is functionally tested in accordance with Chapter 14. The system is periodically tested to verify its ability to function as part of the diesel generator unit to satisfy the Technical Specification requirements. Under normal standby conditions, the diesel generator starting system is maintained and inspected at intervals as prescribed in the plant maintenance instructions for the diesel generator units.

9.5.7 Diesel Engine Lubrication System

9.5.7.1 Design Bases

The diesel engine lubrication system for each diesel engine shown in Figure 9.5-26, (this figure depicts the diesel lube oil system for Diesel Generator 1A-A which is representative of the other three diesel generator sets), is a combination of four subsystems: the main lubricating subsystem, the piston cooling subsystem, and the scavenging oil subsystem and the motor-driven circulating pump, and soak back pump system.

The main lubricating subsystem supplies oil under pressure to the various moving parts of the diesel engine. The piston cooling subsystem supplies oil for piston cooling and lubrication of the piston pin bearing surfaces. The scavenging oil subsystem supplies the other systems with cooled and filtered oil. Oil is drawn from the engine sump by the scavenging pump through a strainer in the strainer housing located on the front side of the engine. From the strainer the oil is pumped through oil filters and a cooler. The filters are located on the accessory racks of the engines. The oil is cooled in the lubricating oil cooler (as shown in Figure 9.5-27) by the closed circuit cooling water system in order to maintain proper oil temperature during engine operation. During standby, the lube-oil temperature is maintained at 85°F or greater by the closed cooling-water system.

The required quality of oil is maintained by scheduled maintenance of strainers, separators, and filters and by oil changes in accordance with the engine manufacturer's owner’s group recommendation.

A crankcase pressure detector assembly is provided to cause the engine to shut down in case the normal negative crankcase pressure changes to a positive pressure. This is accomplished by relieving the oil pressure to the engine governor. The crankcase pressure detector shutdown device is operative only during diesel generator testing; see Section 8.3.1.1 under the heading, "Standby Diesel Generator Operation."

An overspeed mechanism is provided to shut down the engine by stopping the injection of fuel into the cylinders should the engine speed become excessive.

The piping and components for the skid-mounted diesel engine lubrication system are vendor supplied, safety-related, ANSI B31.1, Seismic Category I. All modifications to the skid-mounted diesel engine lubrication system are performed to meet the intent of ASME Section III, Class 3 (TVA Class C).

9.5.7.2 System Description

The system is a combination of four separate systems. The four systems are the main lube oil system, piston cooling system, scavenging oil system, and the motor-driven circulating pump and soak-back pump system. Each system has its own pump. The main lube oil pump and piston cooling oil pump, although individual pumps, are both contained in one housing and are driven from a common shaft and are the helical gear type. The main lubricating, piston cooling, and scavenging oil pumps are driven from the accessory gear train at the front of the engine. The auxiliary system has a circulating oil pump and a soak-back oil pump driven from electric motors mounted on the side of engine base. All pumps are mounted on the engines, skid, or Diesel Generator Building floor.

The main lube oil system supplies oil under pressure to the majority of the engine moving parts. The piston cooling system supplies oil for piston cooling lubrication of the piston pin bearing. The scavenging oil system supplies the other systems with cooled, filtered oil.

In the operation of these systems, oil is drawn from the engine sump by the scavenging oil pump through a strainer in the strainer housing. From the strainer, the oil is pumped through the oil filter and the lube oil cooler. The cooler absorbs heat from the jacket water to maintain proper operating temperature during standby operation. The oil then flows to the strainer housing to supply the main lubricating and piston cooling pumps. After being pumped through the engine, the oil returns to the engine sump to be recirculated.

To enhance the reliability of and to minimize wear due to automatic fast starting, each DG has an auxiliary lube oil system driven by two electric motors. The motors drive two pumps, each of which has a separate function. A soak-back pump draws oil from the engine sump and pumps it through the accessory rack-mounted auxiliary turbocharger lube oil filter and through the head of the engine-mounted turbocharger oil filter into the turbocharger bearing area. The auxiliary turbocharger oil filter purifies the oil supplied to the turbocharger. A relief valve allows oil to be bypassed to the circulating pump system when the outlet pressure exceeds 75 psig.

The soak-back system has a two-fold job. It prelubes the turbocharger bearing area so that the bearing will be fully lubricated when the engine receives a start signal requiring rated speed and application of rated load within a matter of seconds. It also removes residual heat from the turbocharger bearing area upon engine shutdown.

The lube oil circulating pump draws oil from the engine sump and pumps it through a check valve, in-line wye strainer, main lube oil filter, lube oil cooler, and returns it to the engine sump through the strainer housing.

This system also serves to continuously prelube the lower portion of the engine. The main engine oil galley stays full and the camshaft area is supplied through a separate exterior line. The pump operates continuously.

The water jacket immersion heater heats the engine cooling water which circulates through the lube oil cooler. As the oil is circulated through the cooler (operating as a heater) it is warmed.

A backup DC lube oil pump provides lube oil to the turbocharger in case the AC pump fails.

Low lube oil pressure alarms are located in the MCR and in the ACR. Lube oil low alarm pressure varies with engine operating conditions. At rated speed, the engine shuts down if lube oil pressure drops below setpoint during non-accident conditions. There are no other interlocks on this system.

9.5.7.3 Safety Evaluation

Each engine crankcase sump contains a sufficient volume of lubricating oil, ample for at least 7 days of diesel generator unit full' load operation without requiring replenishment. The established oil consumption rate is 0.83 gallons per hour. An additional standby oil reserve is stored within the plant's power stores to replenish the engines for longer periods of operation and to "top off" the engines after their periodic test operations as specified in the Technical Specifications. A failure modes and effects analysis for the diesel generator lube oil system is presented in Table 9.5-2.

9.5.7.4 Test and Inspections

As identified in Chapter 14.0, pre-operational testing for Watts Bar Unit 1 included functional testing of the diesel generator lubricating oil system. Any additional required testing of the diesel generator lubricating oil system for Watts Bar Unit 2 preoperational testing is also identified in Chapter 14.0. The diesel generator lubricating oil system components are inspected and serviced as specified in the scheduled maintenance program for the Watts Bar diesel generator units. The inspection and service of the lubricating oil systems include visual checking for, and the correction of, oil leakage. This program sets overall standards and testing instructions to qualify the lubricating oil for use in the diesel generator engines.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

9.5.8.1 Design Bases

Each diesel engine associated with each of the tandem diesel generator units is equipped with an independent combustion air intake and exhaust subsystem. The four subsystems for the plant are housed in physically separated rooms within the Diesel Generator Building. Each of the four diesel generator subsystems has a dedicated air intake and exhaust system. The Diesel Generator Building is designed to Seismic Category I requirements, and is designed to withstand the effects of tornadoes, credible missiles, hurricanes, floods, rain, snow, and ice as defined in Sections 3.3, 3.4, and 3.5. The combustion air intake and exhaust piping, filters, and silencers are so arranged in the individual rooms for each diesel generator unit that a malfunction or failure of any system component associated with any single unit will not impair the operation of the remaining three units. The air intake and exhaust systems thus meet the requirements of the single failure criterion. The piping and components for the diesel generator combustion air intake and exhaust systems are designed in accordance with ANSI B31.1, Seismic Category I..

9.5.8.2 System Descriptions

The general arrangement of the diesel generator combustion air intake and exhaust systems is shown in Figure 8.3-1. The flow diagrams are shown in Figures 9.5-29 and 9.5-30. Each diesel generator combustion intake and exhaust subsystem includes but not limited to an air intake filter, air intake silencers, and piping of the air intake subsystem from the air intake to its connection to the engine; and an exhaust silencer and piping of the exhaust subsystem from its connection to the engine to a point just above the Diesel Generator Building roof level where the exhaust exits to the atmosphere. As shown in Figure 8.3-1, the major components of the diesel generator combustion air and exhaust systems are housed within the Diesel Generator Building which provides protection from missiles, snow, and ice. That portion of the exhaust subsystems exposed above the roof level is short and below the parapet level to reduce the vulnerability to tornado missiles. Drain holes are provided at appropriate points to expel any rainfall that enters the exhaust piping.

9.5.8.3 Safety Evaluation

The diesel generator combustion air intake and exhaust systems are designed to function before, during, and after a SSE, to ensure that a seismic event will not degrade the combustion air intake and exhaust systems to the point that the function of a diesel generator unit is jeopardized.

An analysis of diesel generator exhaust recirculation utilizing a model developed by Halitsky[1] for transverse jet plumes, established that the exhaust plume will be carried well above the level of the air intakes and thus will not degrade the intake air. The diesel generator units can withstand a concentration of 20% carbon dioxide (by volume) in the intake air stream and continue to function at rated, full-load power. The redundancy and separation of the four intake and exhaust subsystems are discussed in Section 9.5.8.1. The protection against missiles, snow, rainfall, and ice are discussed in Section 9.5.8.2.

A failure modes and effects analysis for the Diesel Generator Building ventilation intake and exhaust subsystems is presented in Table 9.4-4. A failure modes and effects analysis for the diesel generator combustion air intake and exhaust systems is presented in Table 9.5-2.

9.5.8.4 Tests and Inspection

As identified in Chapter 14.0, pre-operational testing for Watts Bar Unit 1 included functional testing of the entire installed diesel generator combustion air intake and exhaust system. Any additional required testing of that system for Watts Bar Unit 2 pre-operational testing is also identified in Chapter 14.0.

Each diesel generator combustion air intake and exhaust subsystem is periodically tested to verify its ability to function as part of the diesel generator unit testing in accordance with Technical Specifications.

Under normal standby conditions, the diesel generator combustion air intake subsystem is inspected at intervals as prescribed in the plant maintenance instructions for the diesel generator units. These inspections include the air intake filter oil level, oil viscosity, and sludge accumulation.

The diesel generator combustion air exhaust silencer has a continuous drain to remove any water which may accumulate due to condensation or rain.

REFERENCE

1. James Halitzky, 'A Method for Estimating Concentrations in Transverse Jet Plunes.' Air and Water Pollution Int. J., Pergamon Press. 1966 , Vol. 10, pp. 821-843

2. Letter to NRC dated February 5, 1992, "Watts Bar Nuclear Plant (WBN) - Submittal of TVA Fire Protection Report."

3. Letter to NRC dated June 15, 1995, "Watts Bar Nuclear Plant (WBN) - Fire Protection Report (FPR) Revision (TAC M63648)."

4. Letter to NRC dated September 28, 1995, "Watts Bar Nuclear Plant (WBN) - Submittal of Fire Protection Report (FPR) Revision 4 (TAC M63648)."

5. Letter to NRC dated October 1995, "Watts Bar Nuclear Plant (WBN) - Submittal of Fire Protection Report (FPR) Revision 5 (TAC M63648)"

6. Section 2.7, “Portable Lanterns for Containment, Post Fire Areas and Yard and DG Backed Lighting in Turbine Building” of the Fire Protection Report.

WBN

TABLE 9.5-1

DELETED

TABLE 9.5-2 (Sheet 1 of 4)

FAILURE MODES AND EFFECTS ANALYSIS OF THE STANDBY DIESEL GENERATOR AUXILIARY SYSTEMS

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
1	Fuel oil system from 7-day tank forward to engine on any one of four diesel generator sets in standby service.	Forward fuel to injectors of respective engines.	Delivers insufficient quantity of fuel to engines.	Passive failures such as tank ruptures or piping leaks, clogging of strainers or injectors. See Note 2 in Remarks. Also, failure of instrumentatio n to provide proper signal to pumps and controls.	Control room indication of failure of diesel generator set to start or shuts down.	None: Remaining three diesel generators furnish 100% standby power required by plant.	None	1. Fuel oil systems of each diesel generator set are completely independent of each other. 2. Due to redundant pumps and valving arrangements within each DG FO system, single active failures that disable the system are not credible.
2	Starting air system from diesel generator skid- mounted air accumulator inlet check valve forward to the air starting motors on any one of eight engines in	Crank engine to start diesel generator set.	Either one of two sets of cranking systems fails to crank engines.	Active failure of any one pneumatic valve or air start motor that would prevent all four air motors of one of two	Control room indication of failure of diesel generator to start.	None; Duplicate air start system on other engine in the diesel generator set is	None	Each one of two engines in a diesel generator set includes a cranking system independent of its mate or of the other diesel generator sets.

TABLE 9.5-2 (Sheet 2 of 4)

FAILURE MODES AND EFFECTS ANALYSIS OF THE STANDBY DIESEL GENERATOR AUXILIARY SYSTEMS

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	standby service.			engines to engage and crank diesel generator set, or passive failure due to leakage of air from the accumulator or piping in one of the two cranking systems. Also, failure of instrumentation to provide start signal or failure providing a false signal.		capable of providing 100% cranking power for both engines in the diesel generator set.		
3	Lube oil system of any one of eight engines in standby service.	Lubricate engine wearing surfaces and maintain proper piston	Insufficient lube oil flow or oil temperature exceeds limits.	Failure of any one pump or passive failure such as system leakage or	Control room indication of shutdown of affected	None; Remaining three diesel generator sets are	None	Lube oil system of each individual engine is separate and independent of all others.

TABLE 9.5-2 (Sheet 3 of 4)

FAILURE MODES AND EFFECTS ANALYSIS OF THE
STANDBY DIESEL GENERATOR AUXILIARY SYSTEMS

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
		temperature of respective engine.		filter clogging.	diesel generator set.	capable of furnishing 100% of the required plant standby power.		
4	Jacket cooling water system and heat exchanger of any one of eight engines in standby service.	Provide cooling for lube oil coolers, cylinder liner and heads and turbocharger aftercoolers of respective engine.	Fails to maintain correct engine temperature.	Active failure of either pump, thermostatic control valve or immersion water heater, or passive failure of piping or heat exchanger pressure boundary.	Control room indication of high engine coolant temperatur e in affected engine requiring shutdown of diesel generator set	None; Remaining three diesel generator sets are capable of furnishing 100% standby power required by plant.	None	Jacket cooling water system of each individual engine is separate and independent of all others.
5	Combustion air intake system from intake filter through silencer	Direct filtered air to turbocharger	Insufficient or unfiltered air flow to	Passive failure of either filter silencer or	Control room indication	None; Remaining three	None	Combustion air intake system of each individual

TABLE 9.5-2 (Sheet 4 of 4)

FAILURE MODES AND EFFECTS ANALYSIS OF THE STANDBY DIESEL GENERATOR AUXILIARY SYSTEMS

ITEM NO.	COMPONENT IDENTIFICATION	FUNCTION	FAILURE MODE	POTENTIAL CAUSE	METHOD OF FAILURE DETECTION	EFFECT ON SYSTEM	EFFECT ON PLANT	REMARKS
	and flexible connection up to turbocharger inlet on any one of eight engines in standby service.		respective engine.	flexible connection that would either restrict air flow or induct unfiltered air into engine.	of engine misfunction or shut down.	diesel generator sets are capable of furnishing 100% of standby power required by plant.		engine is separate and independent of all others.
6	Exhaust system from turbocharger through expansion joint and silencer on any one of eight engines in service.	Provide path for exhaust.	Restricts flow.	Passive failure of silencer.	Control room indication of engine malfunction or shut down.	None; Remaining three diesel generator sets are capable of furnishing 100% of standby power required by plant.	None	Exhaust system on each individual engine is separate and independent of all others.

FIGURES 9.5-1 THRU 9.5-18

DELETED

POSTULATED CONDITIONS	INTERPLANT COMMUNICATIONS												
	MICRO WAVE RADIO (MW)	FIBER OPTICS CIRCUITS	PUBLIC TEL LINES	EMER RADIO SYS	TRANS-MISSION & PWR SUPPLY VHF RADIO	NUCLEAR SECURITY VHF RADIO	LOCAL SHERIFF	ONSITE RADIO PAGING	INPLANT RADIO SYSTEM	400 MHz	TELEPHONE SWITCHING SYSTEM (TSS)	SOUND POWERED TELEPHONE SYSTEM	CODE CALL, ALARMS & PAGING SYSTEM
Fire in Communications Room (Total Destruction)					X	Partial	X		X	X	Partial	X	
Fire in Cable Tunnel to Switchyard	X			X	X	X	X	X	X	X	X	X	Partial
Fire in Control Room	X	X	X	X	Partial	X	X	X	X	X	X	Partial	Partial
DBA	X	X	X	X	X	X	X	X	X	X	X	X	X
SSE						Partial (Vehicular & Portable Limits)			Partial (Portable Limits)	Partial (Portable Limits)			
Loss of Offsite Power	X	X	X	X	X	X	X	X	X	X	X	X	X
Loss of All AC Power for up to 3 Hours	X	X	X	X	X	X	X	X	X	X	X	X	X
Maximum Possible Flood					X	X			X	X		Partial	
Tornado (Microwave Antennas & Reflectors Destroyed)			Partial (Equip-ment outside of CATI SSC)					Partial (Equip-ment outside of CATI SSC)	X	X	Partial Loss of MW Trunks	X	Partial (Equip-ment outside of CATI SSC)

NOTES:

1. “X” in block indicates availability of the service during the postulated condition.

2. “Partial” in block indicates the loss of that portion of the system located where the accident occurred. The surviving equipment will remain functional.

AMENDMENT 2

WATTS BAR NUCLEAR PLANT
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Communications Equipment Availability

FIGURE 9.5-19

FIGURE 9.5-20A

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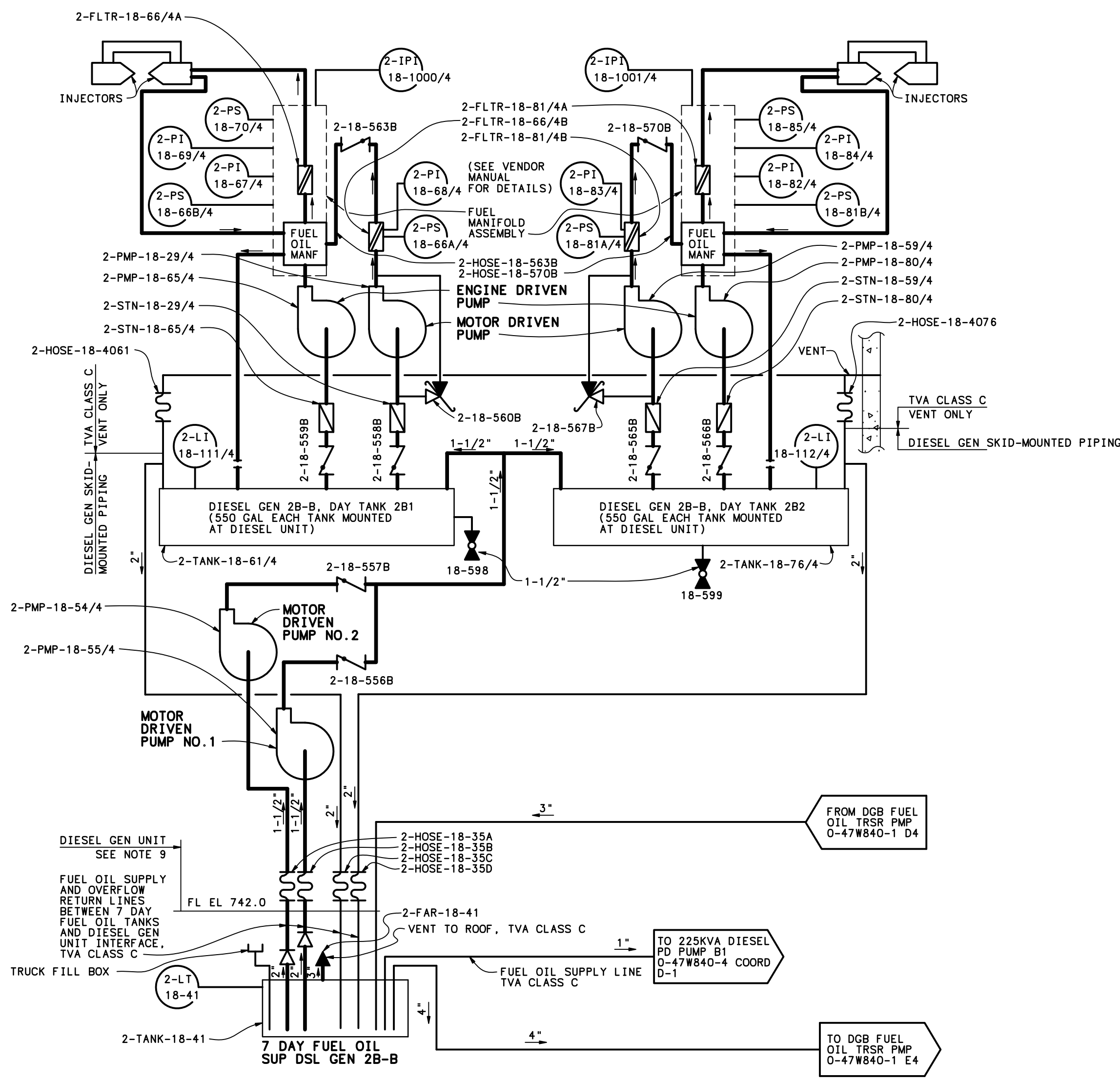
CAD MAINTAINED DRAWING



STANDBY DIESEL OIL SYSTEM
DIESEL GEN 2B-B

NOTES:
FOR GENERAL NOTES AND REFERENCE DRAWINGS SEE 0-47W840-1.

COMPANION DRAWINGS:
0-47W840-1A
1-47W840-2

WATTS BAR
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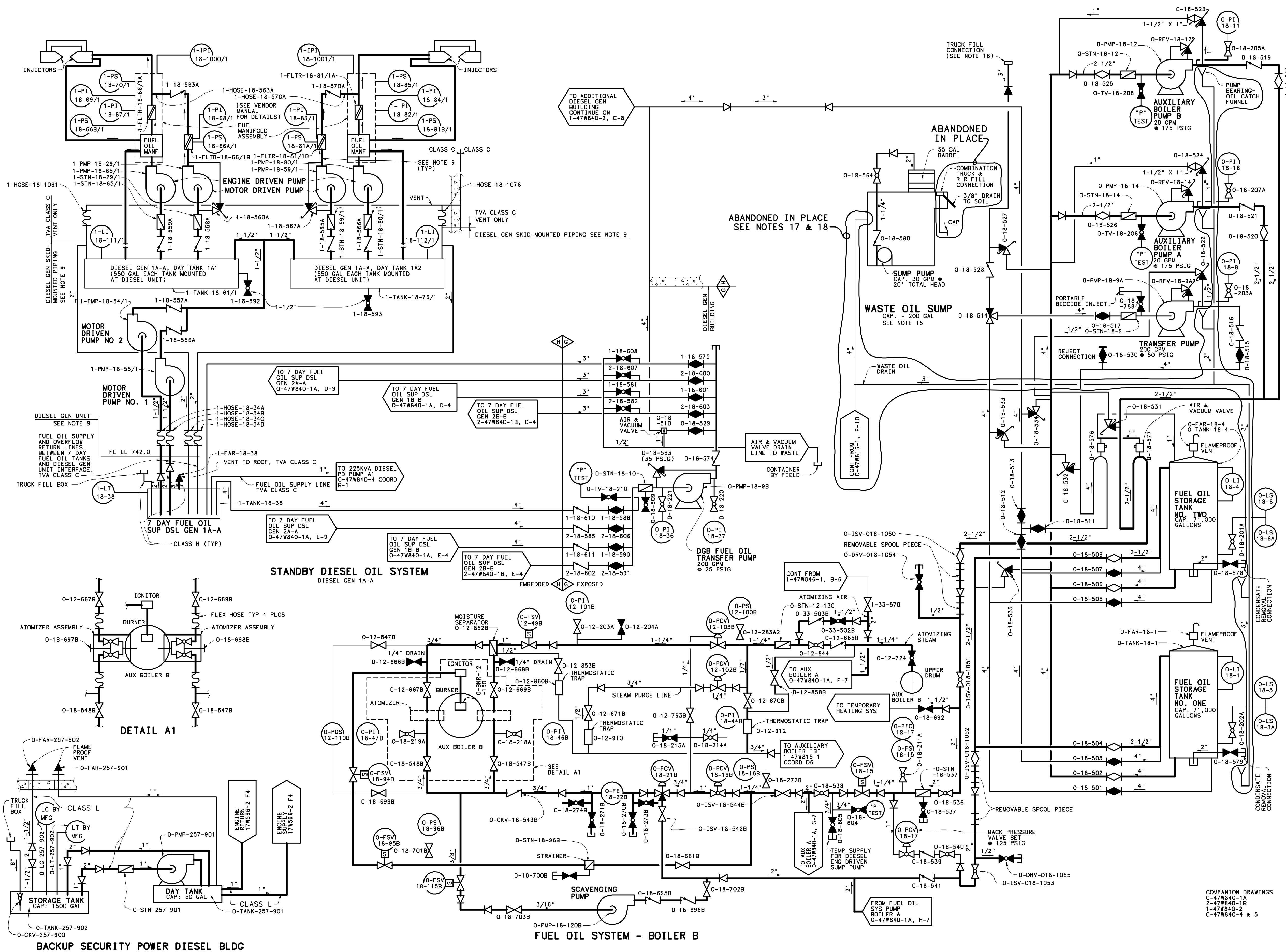
DIESEL GENERATOR BUILDING
UNIT 2
FLOW DIAGRAM
FUEL OIL
ATOMIZING AIR & SYSTEM
TVA DWG NO. 2-47W840-1B R0
FIGURE 9.5-20 SH B

CAD MAINTAINED DRAWING



NOTES:

1. NOT USED
2. ALL VALVES ARE THE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
3. ALL INSTRUMENT CONNECTIONS ARE 1/2" UNLESS OTHERWISE NOTED.
4. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):

   N3-82-4002- - - - -STANDBY DIESEL GENERATOR SYSTEM DESCRIPTION

5. DESIGN PRESSURE AND TEMPERATURE FOR FUEL OIL SYSTEM ON DISCHARGE SIDE OF AUXILIARY BOILER FUEL PUMPS IS 200° PSIG AT 100° F. CLASS C FUEL OIL PIPING IS DESIGNED FOR 16 PSIG AT 100° F. ALL OTHER FUEL OIL PIPING IS DESIGNED FOR 100 PSIG AT 100° F.
6. FOR DESIGN PRESSURE AND TEMPERATURE FOR COMPRESSED AIR SYSTEM SEE 1-47W846-1.
7. DESIGN PRESSURE AND TEMPERATURE FOR ATOMIZING STEAM IS 125 PSIG AT 353°F.
8. ALL CLASS G & H PIPING IN A SEISMIC CATEGORY I STRUCTURE IS SEISMICALLY SUPPORTED TO MAINTAIN PRESSURE BOUNDARY AND THE HYDROSTATIC TEST IS WITHIN THE QA PROGRAM. THE CLASS G PORTION OF THE FUEL OIL PIPING DOES NOT REQUIRE HYDROSTATIC TESTING.
9. ALL PIPING INSIDE THE SKID INTERFACE IS ANSI B31,1 SEISMIC CATEGORY I AND WITHIN THE APPENDIX B QA PROGRAM. ALL PIPING OUTSIDE THE SKID INTERFACE IS CLASSIFIED AS SHOWN ON THE DRAWING. ALL MODIFICATIONS TO PIPING INSIDE THE SKID INTERFACE SHALL BE PERFORMED TO MEET THE INTENT OF ASME III CLASS 3 (TVA CLASS C).
10. LISTED BELOW IS AN EXAMPLE OF VALVE NO. DESIGNATIONS FOR THE DIESEL GENERATORS. 1 - 18 - 556 - A - B

    - 1-UNIT 1, 2-UNIT 2
    - SYSTEM
    - UNIQUE NO.
    - A-SOUTH DIESEL ENGINE, B-NORTH DIESEL ENGINE
    - A-ROOM AA, B-ROOM BB

11. ALL TVA PIPING IS CLASS C,G,H OR L AS INDICATED.(SEE NOTE 9)
12. UNLESS OTHERWISE NOTED, ALL ROOT VALVES HAVE AN "A" SUFFIX IF NOT SHOWN IN THE ADDRESS.
13. IT IS RECOMMENDED THAT AIR OR FUEL OIL BE USED FOR LEAK CHECKING (PRESSURIZING) THE UNDERGROUND FUEL OIL PIPING. THE LEAK CHECK PRESSURE WITH AIR SHOULD BE BETWEEN 1.2 AND 1.25 TIMES THE DESIGN PRESSURE. IF FUEL OIL IS USED AS THE MEDIUM FOR PRESSURIZING THE FUEL OIL PIPING, THE PRESSURE SHOULD BE 1.5 TIMES THE DESIGN PRESSURE. ACCEPTANCE CRITERIA IS ZERO LEAKAGE. FUEL OIL IS NOT TO BE DRAINED TO TURBINE BUILDING DRAIN SYSTEM. A SUITABLE COLLECTION VESSEL (55 GALLON DRUM, FOR EXAMPLE) IS TO BE USED TO COLLECT THE FUEL OIL DRAINED FROM THE PIPING.
14. THE USABLE SUPPLY OF FUEL OIL AVAILABLE CAN BE DETERMINED BY MEASURING THE FUEL OIL LEVEL FROM THE BOTTOM OF ANY TANK (THE FOUR TANKS IN EACH DIESEL ROOM ARE INTERCONNECTED) AT EITHER MANHOLE (17W585-1) IN ACCORDANCE WITH THE FOLLOWING CHART:

MINIMUM AVAILABLE FUEL FOR OPERATION	MANHOLE-NORTH END	MANHOLE-SOUTH END
7-DAYS, 56,754 GALLONS	4'-8"	5'-1 1/2"
6-DAYS, 48,648 GALLONS	4'-1"	4'-6 1/2"

15. 200 GALLONS REFLECTS THE CAPACITY OF THE WASTE OIL SUMP ONLY. ATTACHED WASTE OIL PIPING CONTRIBUTES ADDITIONAL VOLUME TO THE SUMP.
16. A PORTABLE SPILL BERM SHALL BE PLACED UNDER THE TANKER'S OUTLET FITTING TO ACHIEVE SPILL CONTAINMENT WHILE THE TANKER IS OFFLOADING FUEL. THIS SPILLAGE WILL BE REDIRECTED TO THE YARD TANK BERM.
17. ABANDONED IN PLACE PER DCN 60060. LINES FLUSHED AND FILLED WITH FLOWABLE GROUT.
18. A DRIP PAN WITH OIL ABSORBENT PAD WILL BE INSTALLED AT EACH LOCATION WHERE A FUNNEL WAS PREVIOUSLY USED.

REFERENCE DRAWINGS:
17W311 SERIES - FUEL OIL PIPING
47W431 SERIES - AUXILIARY BOILER PIPING
47W610-18-1 - - CONTROL DIAGRAM - FUEL OIL SYS
1,2-47W801-1- - FLOW DIAGRAM - MAIN & REHEAT STEAM
17W585 SERIES - EMBEDDED FUEL OIL PIPING DGB
17W586 SERIES - EXPOSED FUEL OIL PIPING DGB
47W840-101- - - MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - ATOMIZING AIR & STEAM
47W840-101A - - MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - ATOMIZING AIR & STEAM
47W840-101B - - MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - ATOMIZING AIR & STEAM
47W840-102 - - MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY - ATOMIZING AIR & STEAM
D379F06001 - - SCHEMATIC DIAGRAM FUEL OIL SYS FOR DIESEL GENS 1A-A, 1B-B, 2A-A, 2B-B (CONTRACT NO. 74C63-83090)
6036F06001 - - SCHEMATIC DIAGRAM FUEL OIL SYS FOR ADDITIONAL DIESEL GEN (CONTRACT NO. 74C63-83090)

COMPANION DRAWINGS
0-47W840-1A
2-47W840-1B
1-47W840-2
0-47W840-4 & 5

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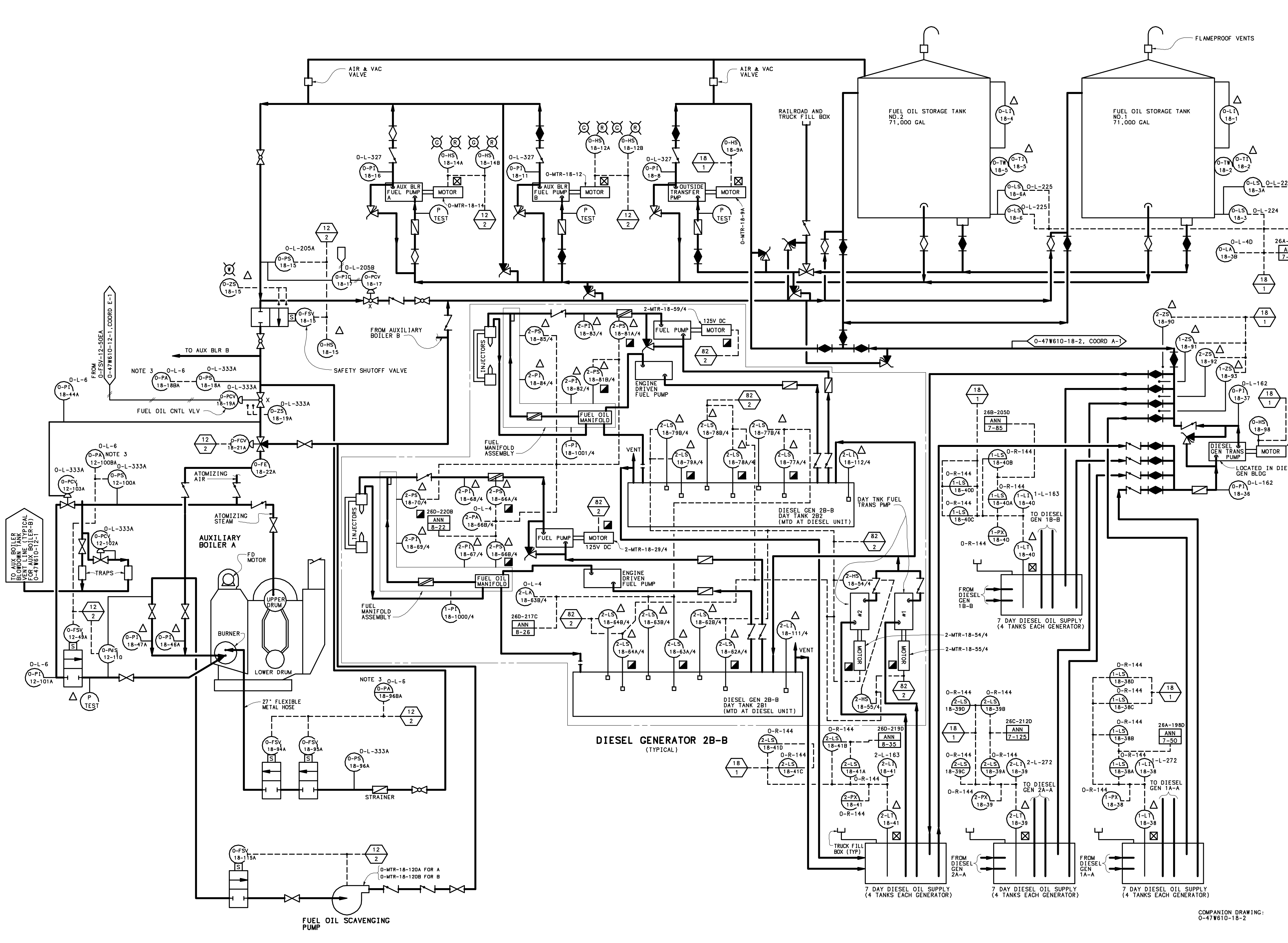
YARD, POWERHOUSE & DIESEL GENERATOR BLDG
UNITS 1 & 2
FLOW DIAGRAM
FUEL OIL
ATOMIZING AIR & STEAM
TVA DWG NO. 0-47W840-1 RO
FIGURE 9.5-20

CAD MAINTAINED DRAWING



NOTES:

GENERAL

1. THE FUEL OIL SYSTEM FURNISHES FUEL FOR THE AUXILIARY BOILERS AND BACKUP FUEL SUPPLY FOR THE EMERGENCY DIESEL GENERATOR UNITS. TRANSFER PUMPS ARE PROVIDED TO TRANSFER OIL BETWEEN ANY OF THE DIESEL GENERATOR 7-DAY STORAGE TANKS AND THE FUEL OIL STORAGE TANKS AND BETWEEN THE RAILROAD FILL BOX AND THE FUEL OIL STORAGE TANKS.

2. INSTRUMENTS WITH LOOP NUMBERS WHICH ARE IDENTICAL FOR EACH DIESEL GENERATOR ARE IDENTIFIED IN THE SUBLOOP PORTION OF THE INSTRUMENT IDENTIFIER FIELD AS FOLLOWS:

DIESEL GENERATOR 1A-A:	XXXX-18-XXXX X/1X
DIESEL GENERATOR 1B-B:	XXXX-18-XXXX X/2X
DIESEL GENERATOR 2A-A:	XXXX-18-XXXX X/3X
DIESEL GENERATOR 2B-B:	XXXX-18-XXXX X/4X

3. XA-12-5A (AUX BLR A) AND XA-12-5B (AUX BLR B) ARE ANNUNCIATORS SERVING SYSTEM 12 INSTRUMENT LOOPS 5,54, 57,58,100, AND SYSTEM 18 INSTRUMENT LOOPS 18,96.

REFERENCE DRAWINGS:

0-47W840-1-----------------FUEL OIL FLOW DIAGRAM
0-47W610-12-1--------------AUXILIARY BOILER CONTROL DIAGRAM
17W311 SERIES--------------FUEL OIL PIPING
0-47W611-12 SERIES---------LOGIC DIAGRAMS - AUXILIARY BOILER
0-47W611-18-1--------------LOGIC DIAGRAM - FUEL OIL

MANUFACTURER'S REFERENCE:

15069-P-3-----------------BURNER PIPING
792385--------------------PANEL DRAWING
15069-W-4-----------------WIRING DIAGRAM
N-A-629438-1--------------MATERIAL LIST

SYMBOLS:

PRESSURE REGULATOR WITH FILTER. PRESSURE SET TO BE DETERMINED BY MANUFACTURER'S REQUIREMENT FOR THE DEVICE BEING SUPPLIED.

⊠ POWER SUPPLIED TO ALL DEVICES ON THIS DRAWING IS NON-DIVISIONAL, UNLESS OTHERWISE NOTED.

△ DEVICE LOCATED LOCALLY AT EQUIPMENT OR MOUNTED ON PIPING OR EQUIPMENT.

ALL UNID NUMBERS PREFIXED BY "0" UNLESS OTHERWISE SPECIFIED.

COMPANION DRAWING:
0-47W610-18-2

WATTS BAR
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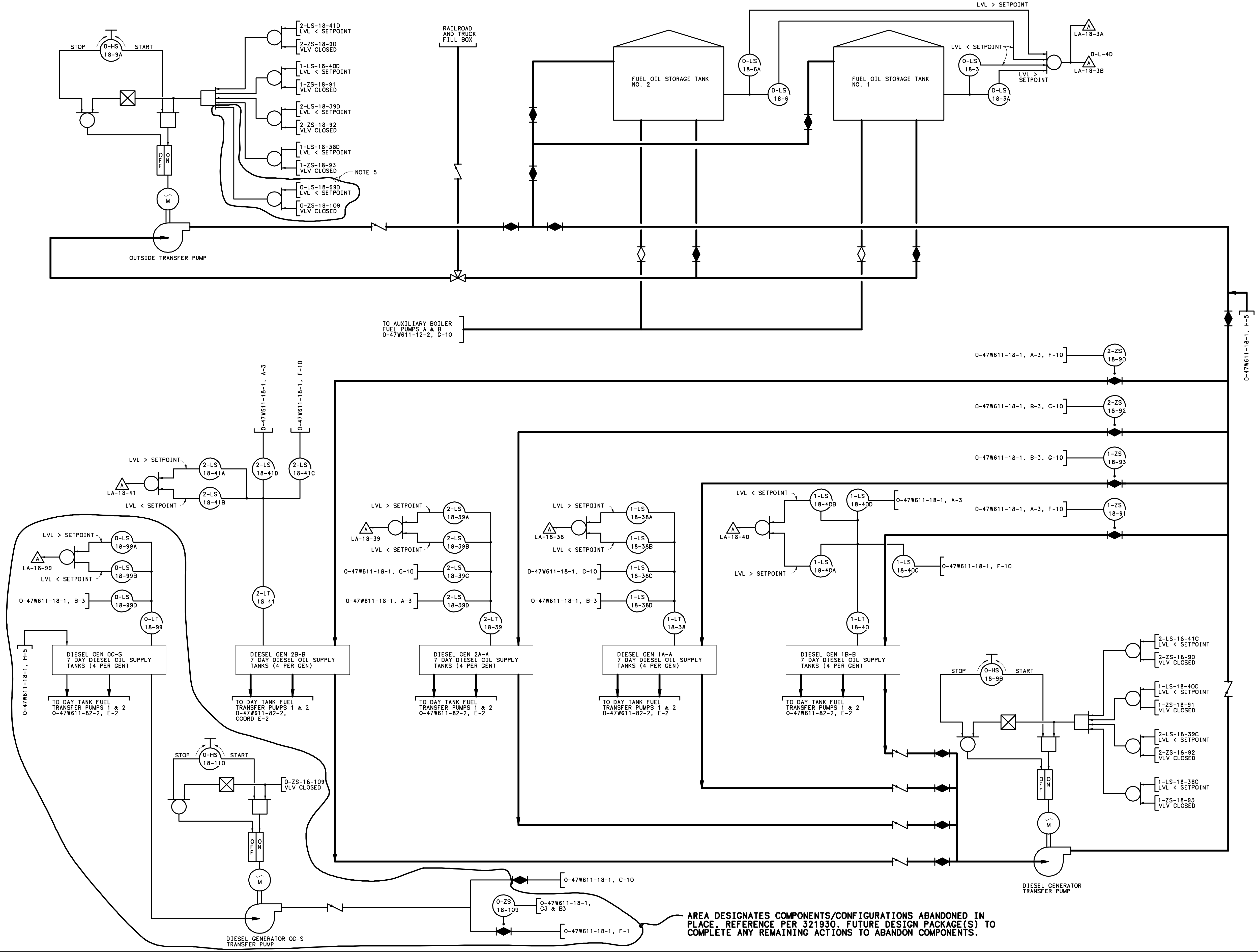
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
FUEL OIL SYSTEM
TVA DWG NO. 0-47W610-18-1 R0
FIGURE 9.5-21

CAD MAINTAINED DRAWING



NOTES:

1. THE FUEL OIL SYSTEM LOGIC FOR THE AUXILIARY BOILER FUEL PUMPS A AND B, WITH ASSOCIATED INSTRUMENTATION, IS SHOWN ON 0-47W611-12-2, COORDINATE H-10.
2. THE FUEL OIL SYSTEM LOGIC FOR THE FUEL TRANSFER PUMPS 1 & 2 (2 PER DIESEL GENERATOR), THE DIESEL GENERATOR DAY TANKS 1 AND 2 (2 PER DIESEL GENERATOR), AND THE MOTOR AND ENGINE DRIVEN FUEL PUMPS (1 EACH DIESEL GENERATOR DAY TANK) IS SHOWN ON 0-47W611-82-2.
3. "DIGITAL AND ANALOG LOGIC SYMBOLS ARE USED ON LOGIC DIAGRAMS TO FUNCTIONALLY DESCRIBE THE PROCESS CONTROL. REFER TO THE ASSOCIATED WIRING SCHEMATIC FOR THE ELECTRICAL COMPONENTS USED TO IMPLEMENT THE CONTROL SCHEME."
4. ALL COMPONENT UNIDS SHOWN ARE UNIT "0", UNLESS OTHERWISE NOTED.
5. THE LEADS TO 0-LS-18-99D AND 0-ZS-18-109 ARE LIFTED AND A JUMPER WIRE INSTALLED IN 0-JB-296-1336 DURING UNIT 2 COMPLETION.

REFERENCE DRAWINGS:

1-47W611-0-1----------------LOGIC DIAGRAM
0-47W611-12-2---------------LOGIC DIAGRAM
0-47W611-82-2---------------LOGIC DIAGRAM
0-47W840-1------------------FLOW DIAGRAM
0-47W610-18-SERIES----------CONTROL DIAGRAM
1-45W760-18-SERIES----------WIRING DIAGRAMS

SYMBOLS:

---------PLUG VALVE, NORMALLY OPEN
---------PLUG VALVE, NORMALLY CLOSED

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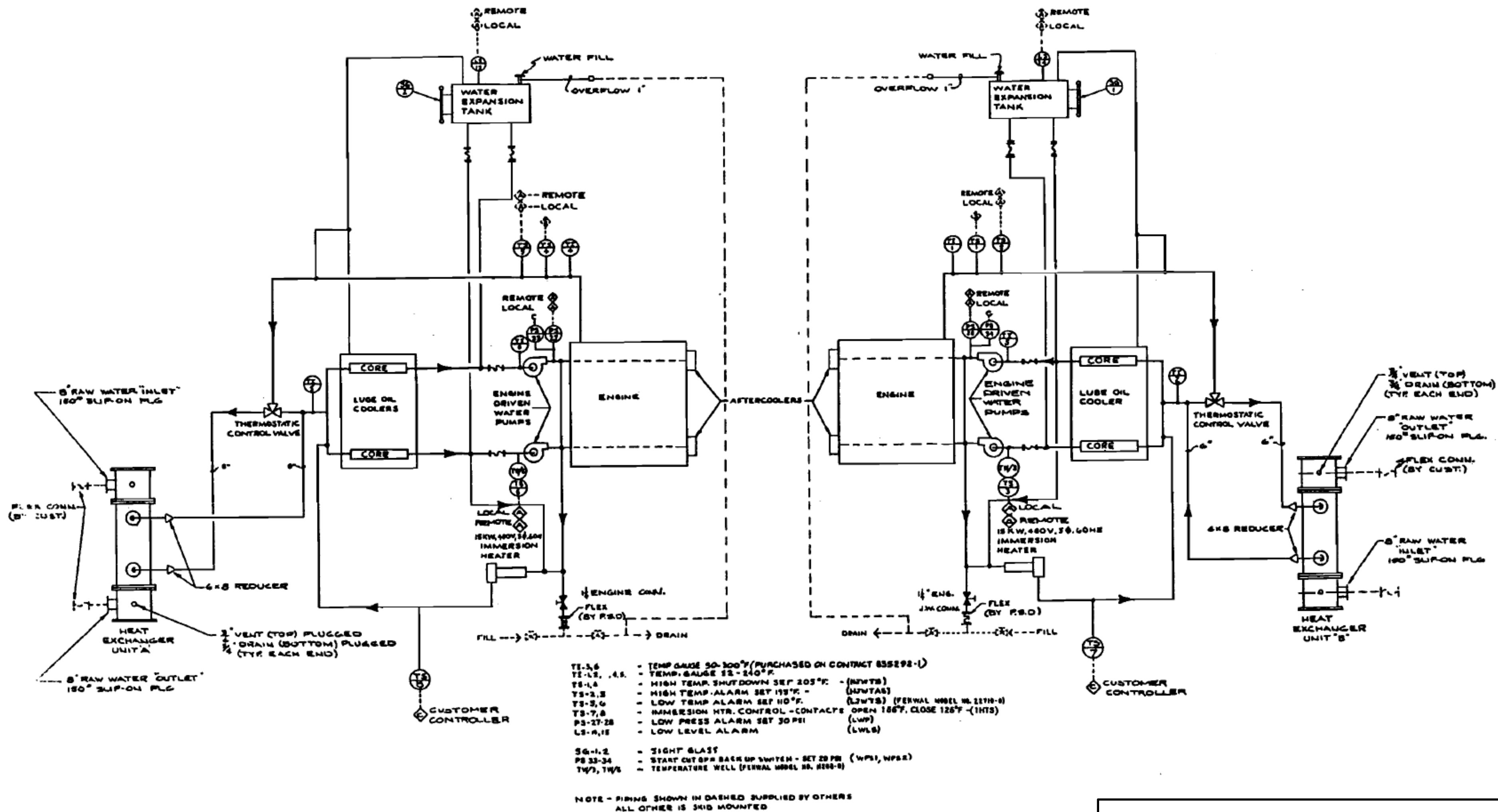
POWERHOUSE
UNITS 1 & 2
ELECTRICAL
LOGIC DIAGRAM
FUEL OIL SYSTEM
TVA DWG NO. 0-47W611-18-1 R0
FIGURE 9.5-22



WATTS BAR NUCLEAR PLANT
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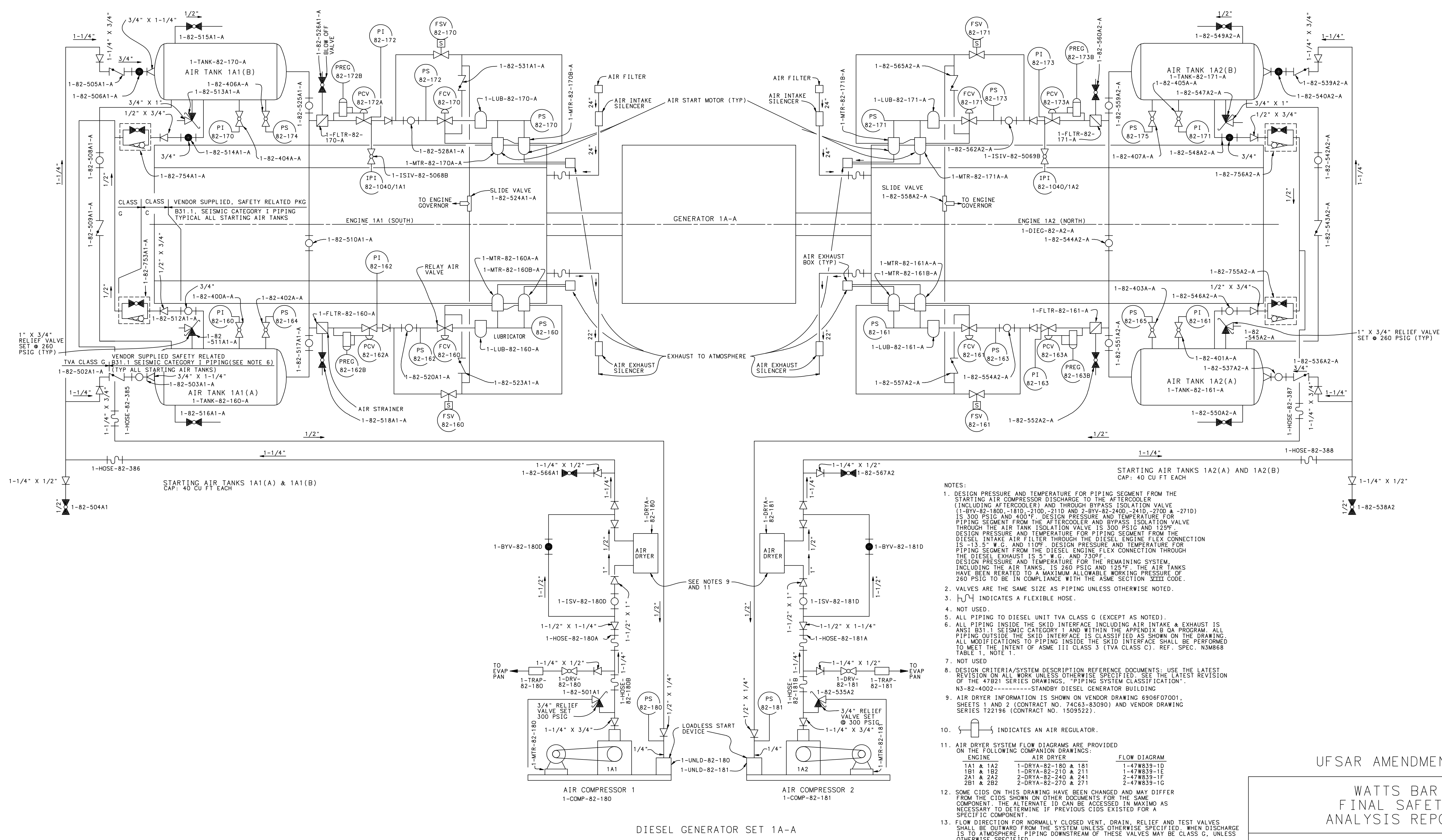
Schematic Diagram – Jacket Water System With Heat Exchanger

FIGURE 9.5-23

CAD MAINTAINED DRAWING



NOTES:

1. DESIGN PRESSURE AND TEMPERATURE FOR PIPING SEGMENT FROM THE STARTING AIR COMPRESSOR DISCHARGE TO THE AFTERCOOLER (INCLUDING AFTERCOOLER) AND THROUGH BYPASS ISOLATION VALVE (1-BYV-82-180D,-181D,-210D,-211D AND 2-BYV-82-240D,-241D,-270D & -271D) IS 300 PSIG AND 400°F. DESIGN PRESSURE AND TEMPERATURE FOR PIPING SEGMENT FROM THE AFTERCOOLER AND BYPASS ISOLATION VALVE THROUGH THE AIR TANK ISOLATION VALVE IS 300 PSIG AND 125°F. DESIGN PRESSURE AND TEMPERATURE FOR PIPING SEGMENT FROM THE DIESEL INTAKE AIR FILTER THROUGH THE DIESEL ENGINE FLEX CONNECTION IS -13.5" W.G. AND 110°F. DESIGN PRESSURE AND TEMPERATURE FOR PIPING SEGMENT FROM THE DIESEL ENGINE FLEX CONNECTION THROUGH THE DIESEL EXHAUST IS 5" W.G. AND 730°F. DESIGN PRESSURE AND TEMPERATURE FOR THE REMAINING SYSTEM, INCLUDING THE AIR TANKS, IS 260 PSIG AND 125°F. THE AIR TANKS HAVE BEEN RERATED TO A MAXIMUM ALLOWABLE WORKING PRESSURE OF 260 PSIG TO BE IN COMPLIANCE WITH THE ASME SECTION VIII CODE.
2. VALVES ARE THE SAME SIZE AS PIPING UNLESS OTHERWISE NOTED.
3. [symbol] INDICATES A FLEXIBLE HOSE.
4. NOT USED.
5. ALL PIPING TO DIESEL UNIT TVA CLASS G (EXCEPT AS NOTED).
6. ALL PIPING INSIDE THE SKID INTERFACE INCLUDING AIR INTAKE & EXHAUST IS ANSI B31.1 SEISMIC CATEGORY 1 AND WITHIN THE APPENDIX B QA PROGRAM. ALL PIPING OUTSIDE THE SKID INTERFACE IS CLASSIFIED AS SHOWN ON THE DRAWING. ALL MODIFICATIONS TO PIPING INSIDE THE SKID INTERFACE SHALL BE PERFORMED TO MEET THE INTENT OF ASME III CLASS 3 (TVA CLASS C). REF. SPEC. N3M868 TABLE 1, NOTE 1.
7. NOT USED
8. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS: USE THE LATEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LATEST REVISION OF THE 47B21 SERIES DRAWINGS, "PIPING SYSTEM CLASSIFICATION".
   N3-82-4002----------STANDBY DIESEL GENERATOR BUILDING
9. AIR DRYER INFORMATION IS SHOWN ON VENDOR DRAWING 6906F07001, SHEETS 1 AND 2 (CONTRACT NO. 74C63-83090) AND VENDOR DRAWING SERIES T22196 (CONTRACT NO. 1509522).
10. [symbol] INDICATES AN AIR REGULATOR.
11. AIR DRYER SYSTEM FLOW DIAGRAMS ARE PROVIDED ON THE FOLLOWING COMPANION DRAWINGS:

ENGINE	AIR DRYER	FLOW DIAGRAM
1A1 & 1A2	1-DRYA-82-180 & 181	1-47W839-1D
1B1 & 1B2	1-DRYA-82-210 & 211	1-47W839-1E
2A1 & 2A2	2-DRYA-82-240 & 241	2-47W839-1F
2B1 & 2B2	2-DRYA-82-270 & 271	2-47W839-1G

12. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
13. FLOW DIRECTION FOR NORMALLY CLOSED VENT, DRAIN, RELIEF AND TEST VALVES SHALL BE OUTWARD FROM THE SYSTEM UNLESS OTHERWISE SPECIFIED. WHEN DISCHARGE IS TO ATMOSPHERE, PIPING DOWNSTREAM OF THESE VALVES MAY BE CLASS G, UNLESS OTHERWISE SPECIFIED.

REFERENCE DRAWINGS:

POWER SYSTEMS DIVISION-MORRISON-KNUDSEN CO. INC-DWG NO. D379F07001
SCHEMATIC DIAGRAM AIR START SYSTEM

47W610-82-1------------ CONTROL DIAGRAM - STARTING AIR SYSTEM
WB-DC-40-28------------DESIGN CRITERIA - DIESEL GEN SYSTEM
17W586-----------------PIPING DRAWINGS
47W839-101------------ MECHANICAL STRESS ANALYSIS PROBLEM BOUNDARY DIESEL STARTING AIR SYSTEM

COMPANION DRAWINGS:
1-47W839-1A
1-47W839-1B
1-47W839-1C
1-47W839-1D
1-47W839-1E
1-47W839-1F
1-47W839-1G
1-47W839-2

UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
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DIESEL GENERATOR BLDG
UNIT 1
FLOW DIAGRAM
DIESEL STARTING AIR
SYSTEM
TVA DWG NO. 1-47W839-1 R23
FIGURE 9.5-24

CAD MAINTAINED DRAWING

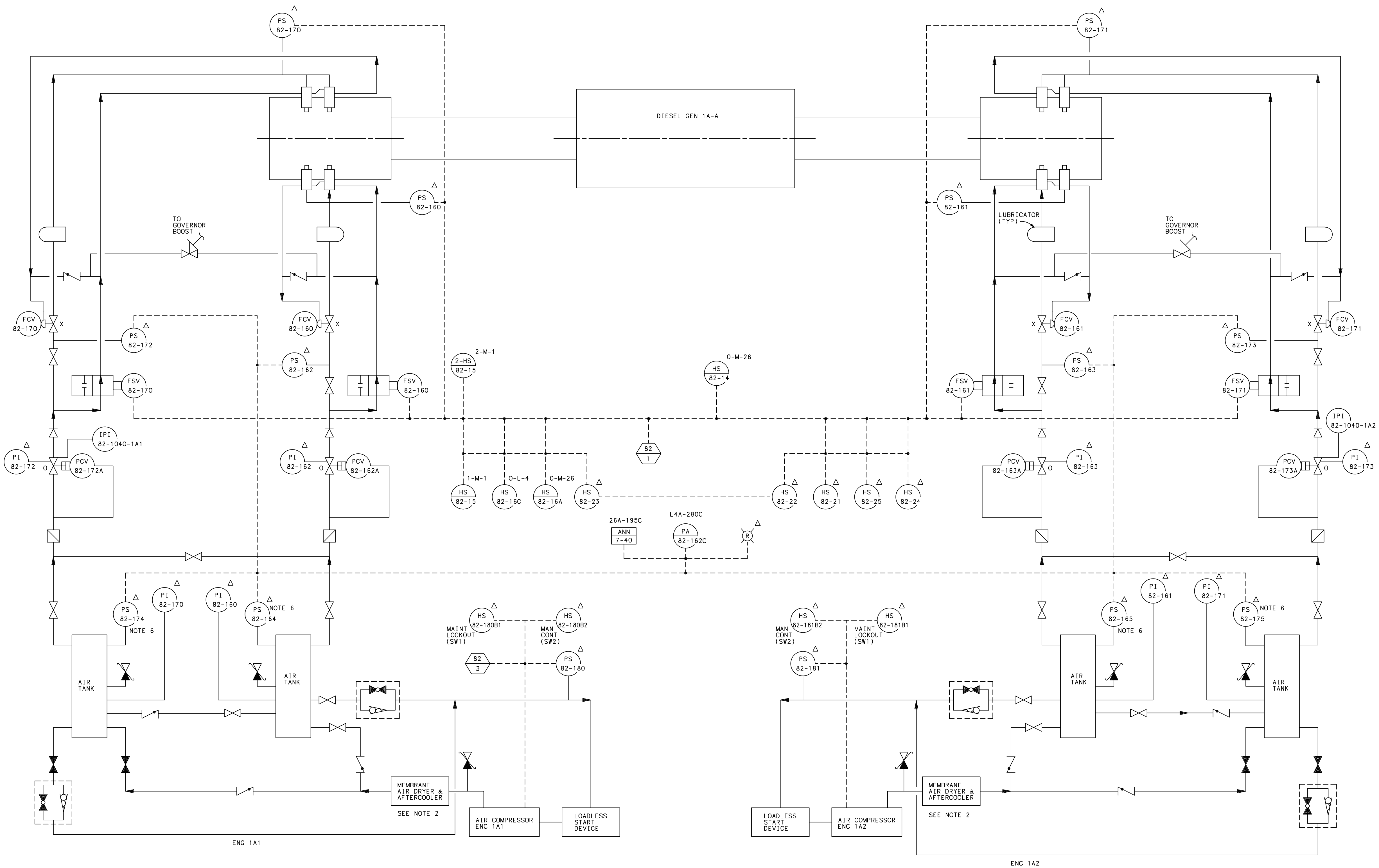

TABLE A1
DIGITAL COMPUTER POINTS

INSTRUMENT ID	POINT ID	DESCRIPTION
1-PA-082-162C	PD2019	DSL GEN 1A ENG START AIR PRESS
1-PA-082-162C	XD2041	DSL GEN AUTO START READY
1-PA-082-192C	PD2094	DSL GEN 1B ENG START AIR PRESS
1-PA-082-192C	XD2096	DSL GEN AUTO START READY
1-PA-082-222C	PD2012	DSL GEN 2A ENG START AIR PRESS
1-PA-082-222C	XD2097	DSL GEN AUTO START READY
1-PA-082-252C	PD2097	DSL GEN 2B ENG START AIR PRESS
1-PA-082-252C	XD2095	DSL GEN AUTO START READY
1-DG1A-082-0043T	XD1002	DSL GEN TEST SWITCH
1-DG1B-082-0043T	XD1003	DSL GEN TEST SWITCH

NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS LATEST ISSUE.
2. AIR DRYER SHOWN ON VENDOR DWG 6906F07001 SHEET 2 CONTRACT NO. 74C63-83090 AND VENDOR DRAWING SERIES T22196 CONTRACT NO. 1509522.
3. DRAWING AS SHOWN IS FOR DIESEL GENERATOR UNIT 1A-A. SEE THE FOLLOWING FOR THE OTHER UNITS:

DIESEL GENERATOR	DRAWING
1B-B	0-45W610-82-2
2A-A	0-45W610-82-3
2B-B	0-45W610-82-4
0C-S	0-45W610-82-5

4. ALL UNID NUMBERS PREFIXED BY "1" UNLESS OTHERWISE SPECIFIED.
5. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
6. TEST TEE CONNECTION MAY BE INSTALLED BETWEEN THE PRESSURE SWITCH AND THE ROOT VALVE. USE MARK NUMBERS 266D, 31, 24, AND 501B (AS APPLICABLE) FROM 47BM600-SERIES. REFERENCE EDC E-50418-A.

SYMBOLS:

△ DEVICE LOCALLY MOUNTED ON ASSOCIATED EQUIPMENT.

REFERENCE DRAWINGS:
LOGIC DIAGRAMS---------0-47W611-82-SERIES
SCHEMATIC DIAGRAMS----0-45W760-82-SERIES

COMPANION DRAWINGS:
0-47W610-82-SERIES

UFSAR AMENDMENT 2

WATTS BAR
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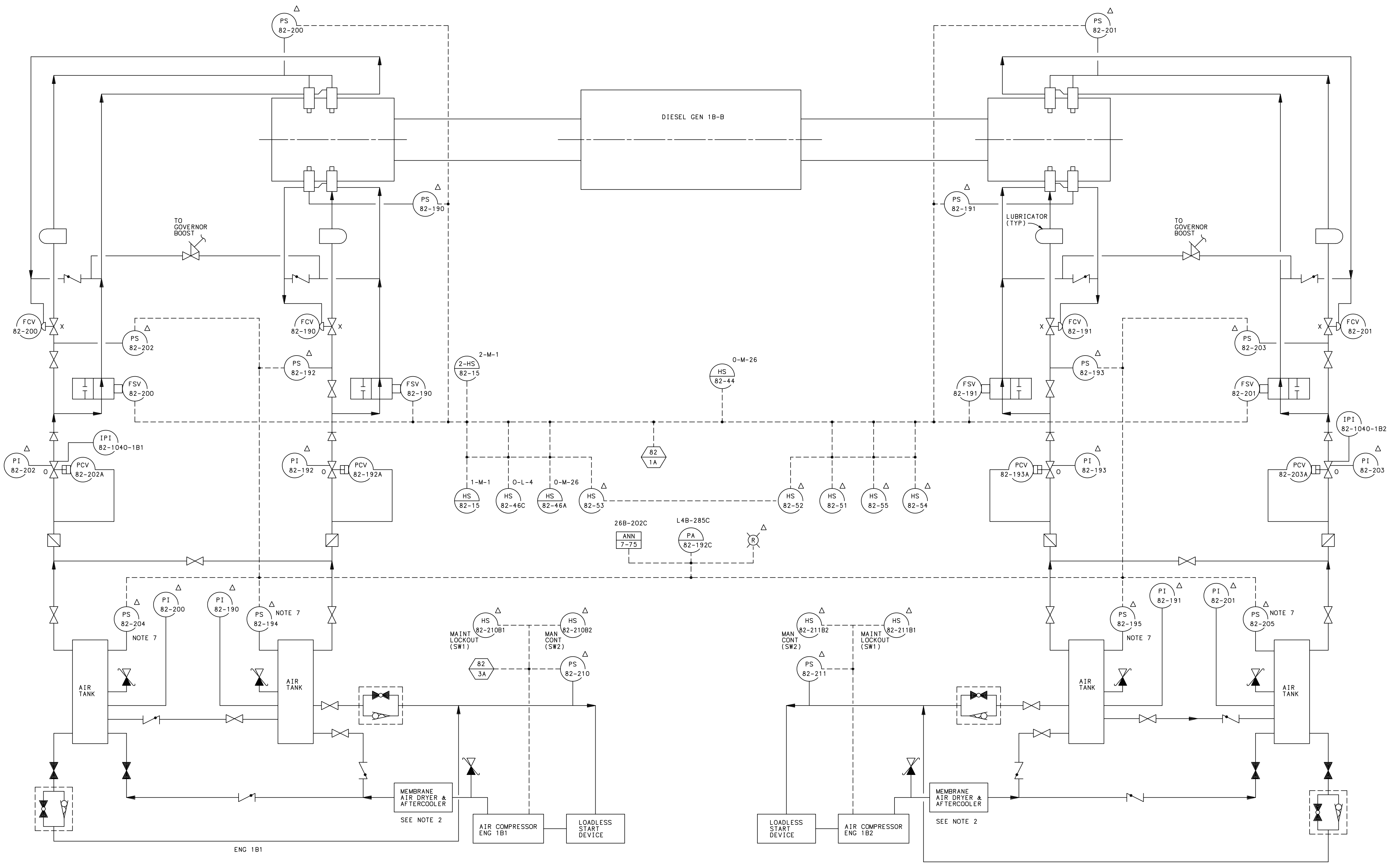
DIESEL GENERATOR BUILDING
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
DIESEL STARTING AIR SYSTEM DG 1A-A
TVA DWG NO. 0-47W610-82-1 R1
FIGURE 9.5-25

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS LATEST ISSUE.
2. AIR DRYER SHOWN ON VENDOR DWG 6906F07001 SHEET 2 CONTRACT NO. 74C63-83090 AND VENDOR DRAWING SERIES T22196 CONTRACT NO. 1509522.
3. DRAWING AS SHOWN IS FOR DIESEL GENERATOR UNIT 1B-B. SEE THE FOLLOWING FOR THE OTHER UNITS:

DIESEL GENERATOR	DRAWING
1A-A	0-47W610-82-1
2A-A	0-47W610-82-3
2B-B	0-47W610-82-4
OC-S	0-47W610-82-5

4. ALL UNID NUMBERS PREFIXED BY "1" UNLESS OTHERWISE SPECIFIED.
5. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.
6. REFER TO TABLE A1 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).
7. TEST TEE CONNECTION MAY BE INSTALLED BETWEEN THE PRESSURE SWITCH AND THE ROOT VALVE. USE MARK NUMBERS 266D, 31, AND 24 FROM 47BM600-SERIES. REFERENCE EDC E-50418-A.

SYMBOLS:

△ DEVICE LOCALLY MOUNTED ON ASSOCIATED EQUIPMENT.

REFERENCE DRAWINGS:
LOGIC DIAGRAMS--------0-47W611-82-SERIES
SCHEMATIC DIAGRAMS----0-45W760-82-SERIES

COMPANION DRAWINGS:
0-47W610-82-SERIES

UFSAR AMENDMENT 2

WATTS BAR
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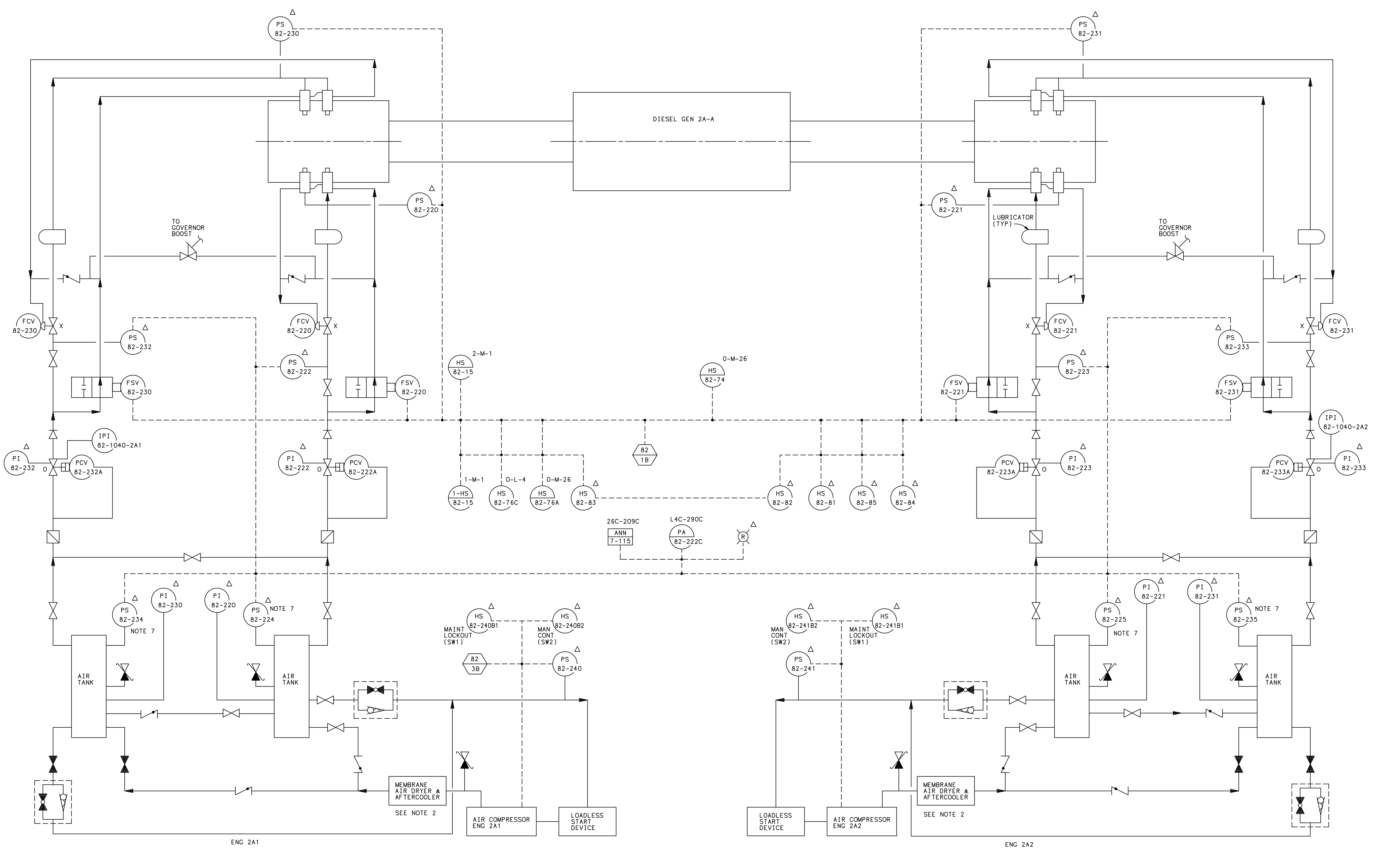
DIESEL GENERATOR BUILDING
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
DSL STG AIR SYS DG 1B-B
TVA DWG NO. 0-47W610-82-2 R1
FIGURE 9.5-25A

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS LATEST ISSUE.

2. AIR DRYER SHOWN ON VENDOR DWG 6906F07001 SHEET 2 CONTRACT NO. 74C63-83090 AND VENDOR DRAWING SERIES T22196 CONTRACT NO. 1509522.

3. DRAWING AS SHOWN IS FOR DIESEL GENERATOR UNIT 2A-A. SEE THE FOLLOWING FOR THE OTHER UNITS:

DIESEL GENERATOR	DRAWING
1A-A	0-47W610-82-1
1B-B	0-47W610-82-2
2B-B	0-47W610-82-4
0C-S	0-47W610-82-5

4. ALL UNID NUMBERS PREFIXED BY "2" UNLESS OTHERWISE SPECIFIED.

5. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

6. REFER TO TABLE A1 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

7. TEST TEE CONNECTION MAY BE INSTALLED BETWEEN THE PRESSURE SWITCH AND THE ROOT VALVE. USE MARK NUMBERS 266D, 31, AND 24 FROM 47BM600-SERIES. REFERENCE EDC E-50418-A.

SYMBOLS:

△ DEVICE LOCALLY MOUNTED ON ASSOCIATED EQUIPMENT.

REFERENCE DRAWINGS:
LOGIC DIAGRAMS--------0-47W611-82-SERIES
SCHEMATIC DIAGRAMS----0-45W760-82-SERIES

COMPANION DRAWINGS:
0-47W610-82-SERIES

UFSAR AMENDMENT 2

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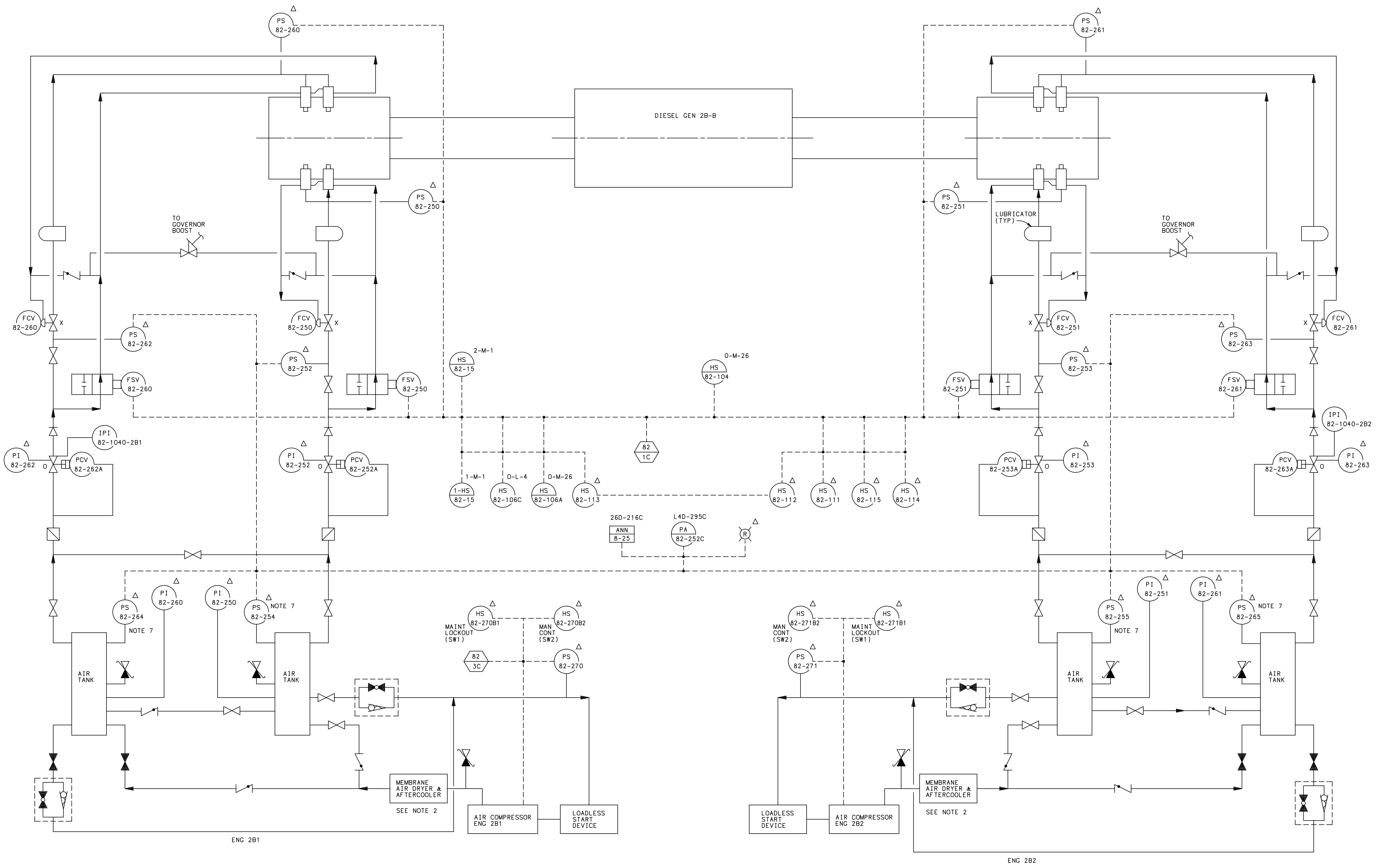
DIESEL GENERATOR BUILDING
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
DSL STG AIR SYS DG 2A-A
TVA DWG NO. 0-47W610-82-3 R1
FIGURE 9.5-25B

CAD MAINTAINED DRAWING



NOTES:

1. FOR SYMBOLS SEE INSTRUMENTATION AND IDENTIFICATION STANDARDS LATEST ISSUE.

2. AIR DRYER SHOWN ON VENDOR DWG 6906F07001 SHEET 2 CONTRACT NO. 74C63-83090 AND VENDOR DRAWING SERIES T22196 CONTRACT NO. 1509522.

3. DRAWING AS SHOWN IS FOR DIESEL GENERATOR UNIT 2B-B. SEE THE FOLLOWING FOR THE OTHER UNITS:

DIESEL GENERATOR	DRAWING
1A-A	0-47W610-82-1
1B-B	0-47W610-82-2
2A-A	0-47W610-82-3
OC-S	0-47W610-82-5

4. ALL UNID NUMBERS PREFIXED BY "2" UNLESS OTHERWISE SPECIFIED.

5. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID SCREEN (AII) IN EMS CAN BE ACCESSED AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.

6. REFER TO TABLE A1 FOR ADDITIONAL DIGITAL COMPUTER POINTS (POWER AVAILABLE, PUMP RUNNING, ETC.).

7. TEST TEE CONNECTION MAY BE INSTALLED BETWEEN THE PRESSURE SWITCH AND THE ROOT VALVE. USE MARK NUMBERS 266D, 31, AND 24 FROM 47BM600-SERIES. REFERENCE EDC E-50418-A.

SYMBOLS:

△ DEVICE LOCALLY MOUNTED ON ASSOCIATED EQUIPMENT.

REFERENCE DRAWINGS:
LOGIC DIAGRAMS---------0-47W611-82-SERIES
SCHEMATIC DIAGRAMS----0-45W760-82-SERIES

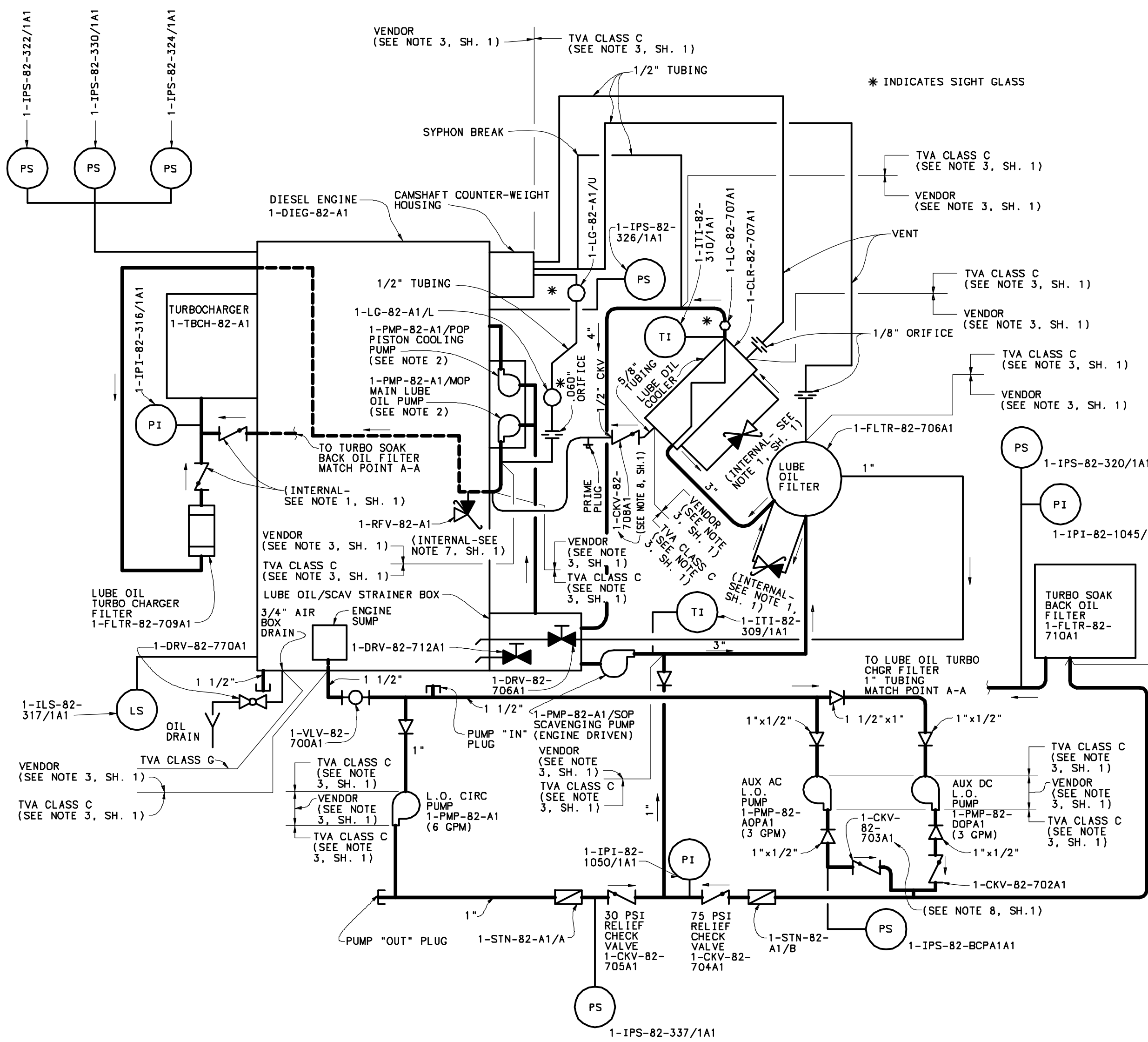
UFSAR AMENDMENT 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

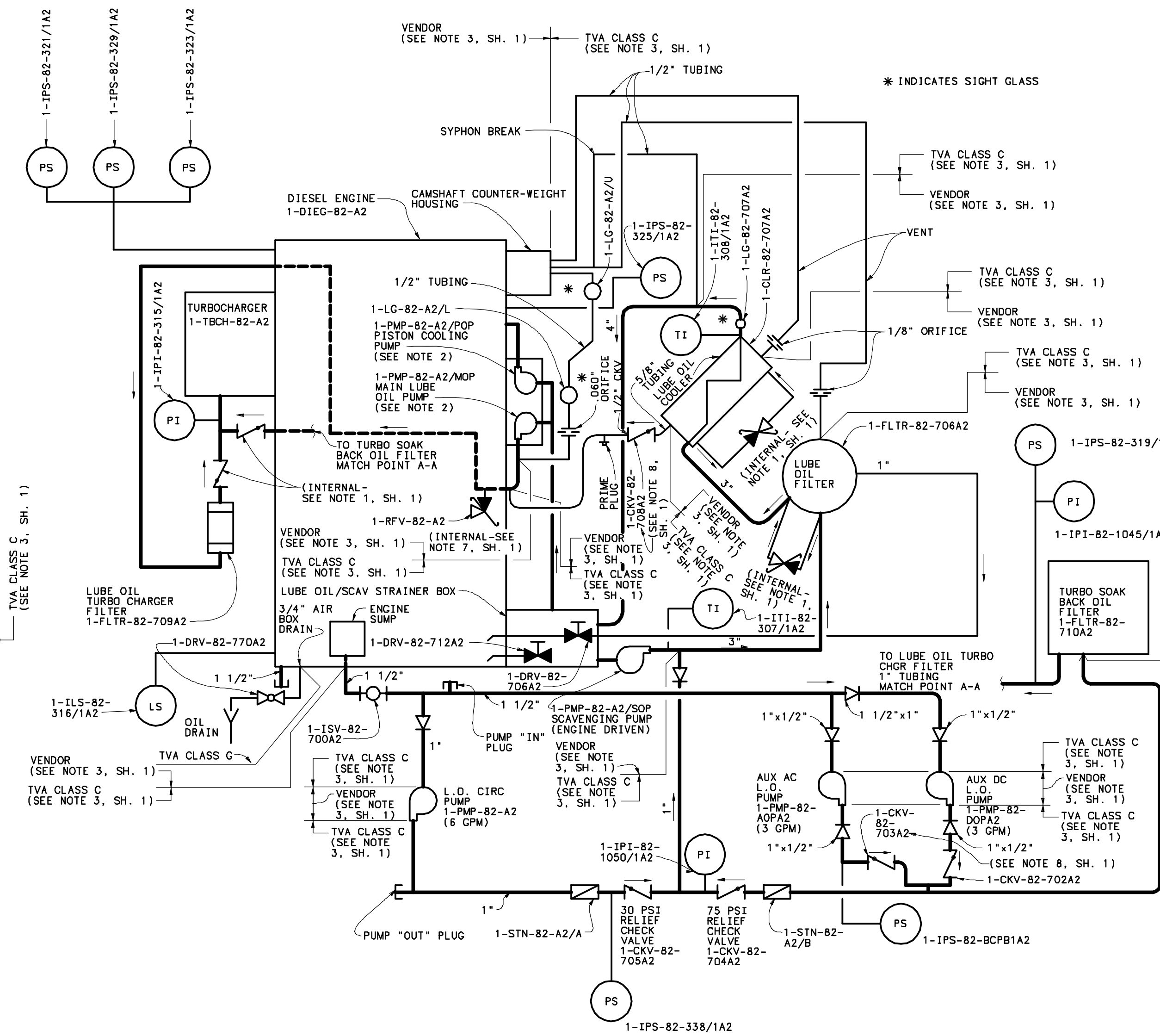
DIESEL GENERATOR BUILDING
UNITS 1 & 2
ELECTRICAL
CONTROL DIAGRAM
DSL STG AIR SYS DG 2B-B
TVA DWG NO. 0-47W610-82-4 R1
FIGURE 9.5-25C

COMPANION DRAWINGS:
0-47W610-82-SERIES

CAD MAINTAINED DRAWING

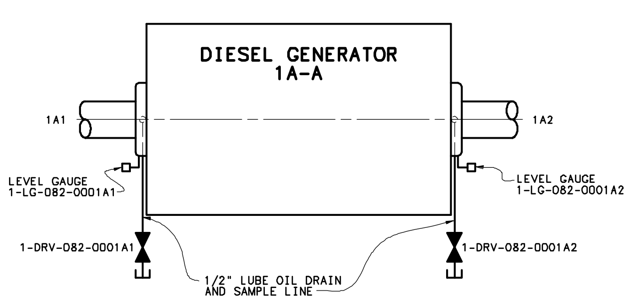


DIESEL ENGINE 1A1



DIESEL ENGINE 1A2

DIESEL GENERATOR 1A-A



NOTES:

1. TWO CHECK VALVES SHOWN AT THE LUBE OIL TURBO CHARGER FILTER, AND RELIEF VALVES AT LUBE OIL FILTER AND COOLER ARE INTERNAL TO AND AN INTEGRAL PART OF THEIR ASSOCIATED COMPONENT.
2. MAIN LUBE OIL AND PISTON COOLING PUMPS ARE CONTAINED IN THE SAME HOUSING AND ARE ENGINE DRIVEN.
3. VENDOR SUPPLIED PIPING & COMPONENTS ARE ANSI B31.1 SEISMIC CATEGORY I AND ARE WITHIN THE 10CFR50 APPENDIX B QA PROGRAM. ALL MODIFICATIONS TO THIS PIPING SHALL BE PERFORMED TO MEET THE INTENT OF ASME SECTION III CLASS 3 (TVA CLASS C), SEE N3M-868, NOTE 1.
4. DESIGN PRESSURE AND TEMPERATURE FOR THE TVA SUPPLIED PORTION OF PIPING (SHOWN AS TVA CLASS C) IS 90 PSIG AND 230°F.
5. ALL VALVES ARE THE SAME SIZE AS PIPE UNLESS OTHERWISE NOTED.
6. DESIGN CRITERIA/SYSTEM DESCRIPTION REFERENCE DOCUMENTS (USE THE LASTEST REVISION ON ALL WORK UNLESS OTHERWISE SPECIFIED. SEE THE LASTEST REVISION OF THE 47B21 SERIES DRAWINGS "PIPING SYSTEM CLASSIFICATION."):

   N3-82-4002 ---- STANDBY DIESEL GENERATOR SYSTEM DESCRIPTION.
7. THE LUBE OIL PRESSURE RELIEF VALVE IS INSTALLED ON THE LUBE OIL MANIFOLD, INSIDE THE ACCESSORY GEAR TRAIN HOUSING. A COVER PLATE PROVIDES ACCESS TO THE VALVE FOR INSPECTION AND ADJUSTMENT. THE VALVE SET PRESSURE IS 125 PSI UNDER COLD OIL CONDITIONS.
8. ORIGINAL JENKINS SWING CHECK VALVES, MODEL NUMBERS 92-A AND 762-A, ARE NO LONGER MANUFACTURED. IF THESE VALVES REQUIRE REPAIR OR REPLACEMENT THEY CAN BE REPLACED USING JENKINS MODEL NUMBERS 4092J OR EQUAL FOR THE 92-A AND 4962J OR EQUAL FOR THE 762-A. FURTHER NOTE THAT JENKINS BROTHERS VALVE COMPANY HAS BEEN PURCHASED BY CRANE VALVES.
9. SOME CIDs ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDs SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDs EXISTED FOR A SPECIFIC COMPONENT.

REFERENCE DRAWINGS:

1608R03001-1 - RECOMMENDED PIPING LAYOUT LUBE OIL MODIFICATION (CONTRACT NO. 74C63-83090)

17W586-SERIES - MECHANICAL EXPOSED OIL, AIR, WATER AND MISC. PIPING

COMPANION DRAWINGS: 1-47W880-2, 3 AND 4

WATTS BAR
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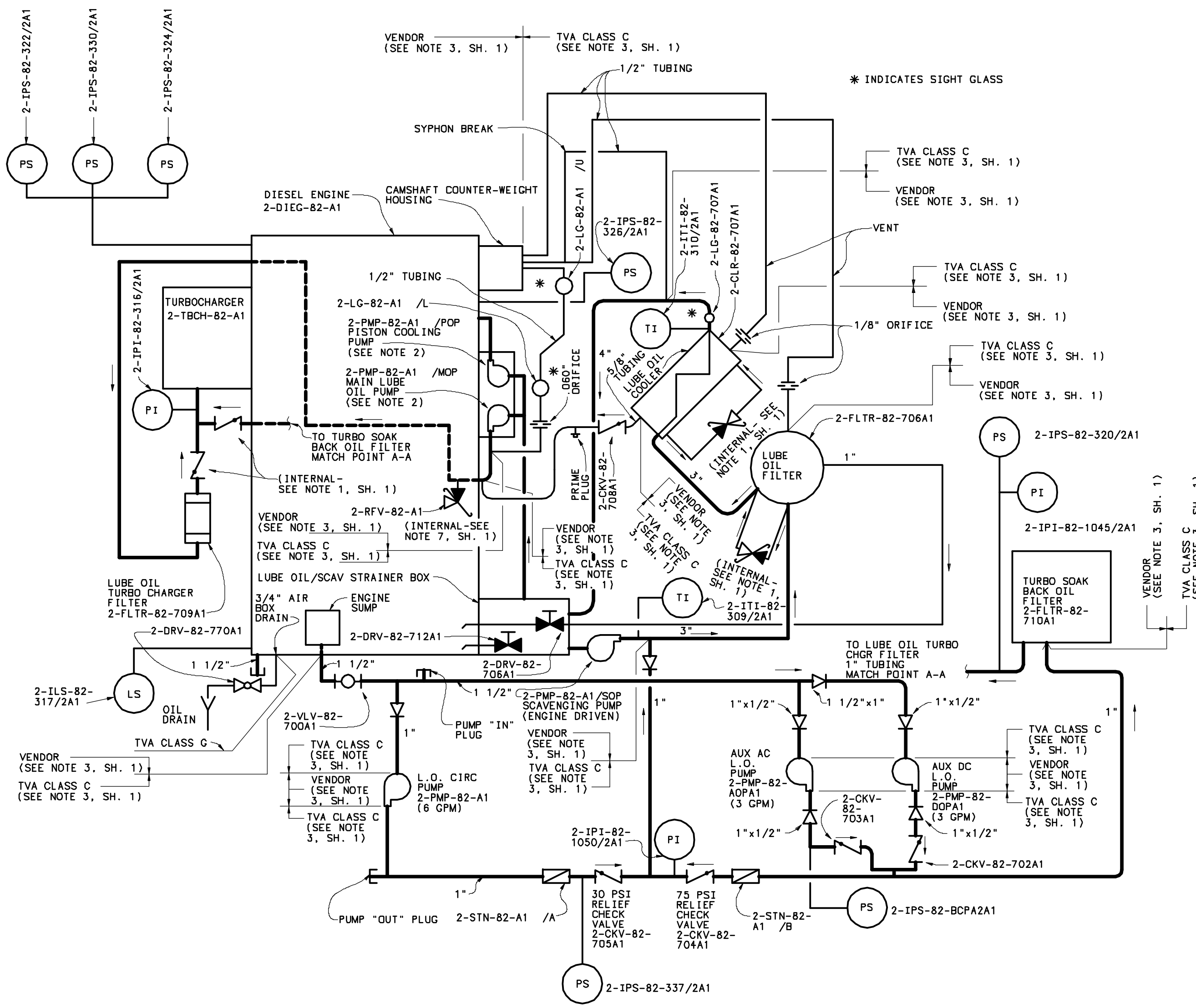
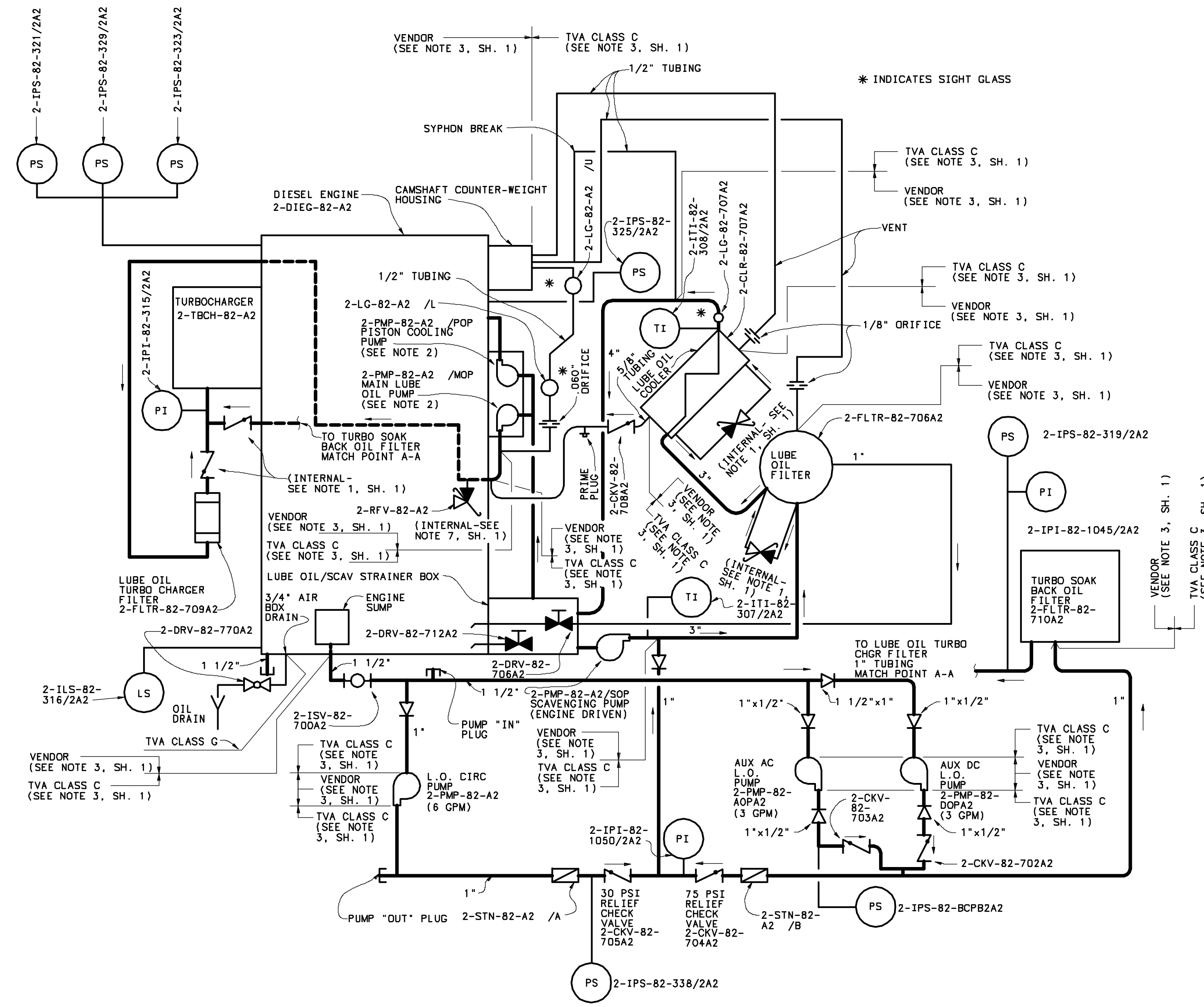
ANALYSIS REPORT

POWERHOUSE
UNIT 1
FLOW DIAGRAM
DIESEL LUBE OIL
SYSTEM
TVA DWG NO. 1-47W880-1 R7
FIGURE 9.5-26

CAD MAINTAINED DRAWING



DIESEL ENGINE 2A1

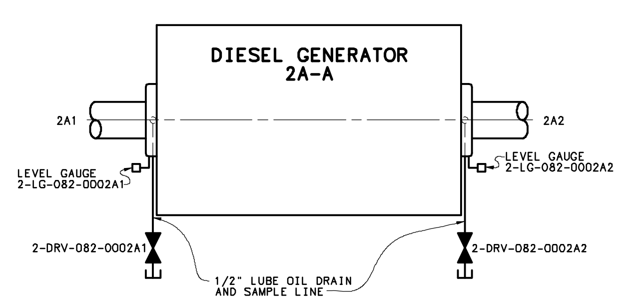


DIESEL ENGINE 2A2

DIESEL GENERATOR 2A-A

NOTES:

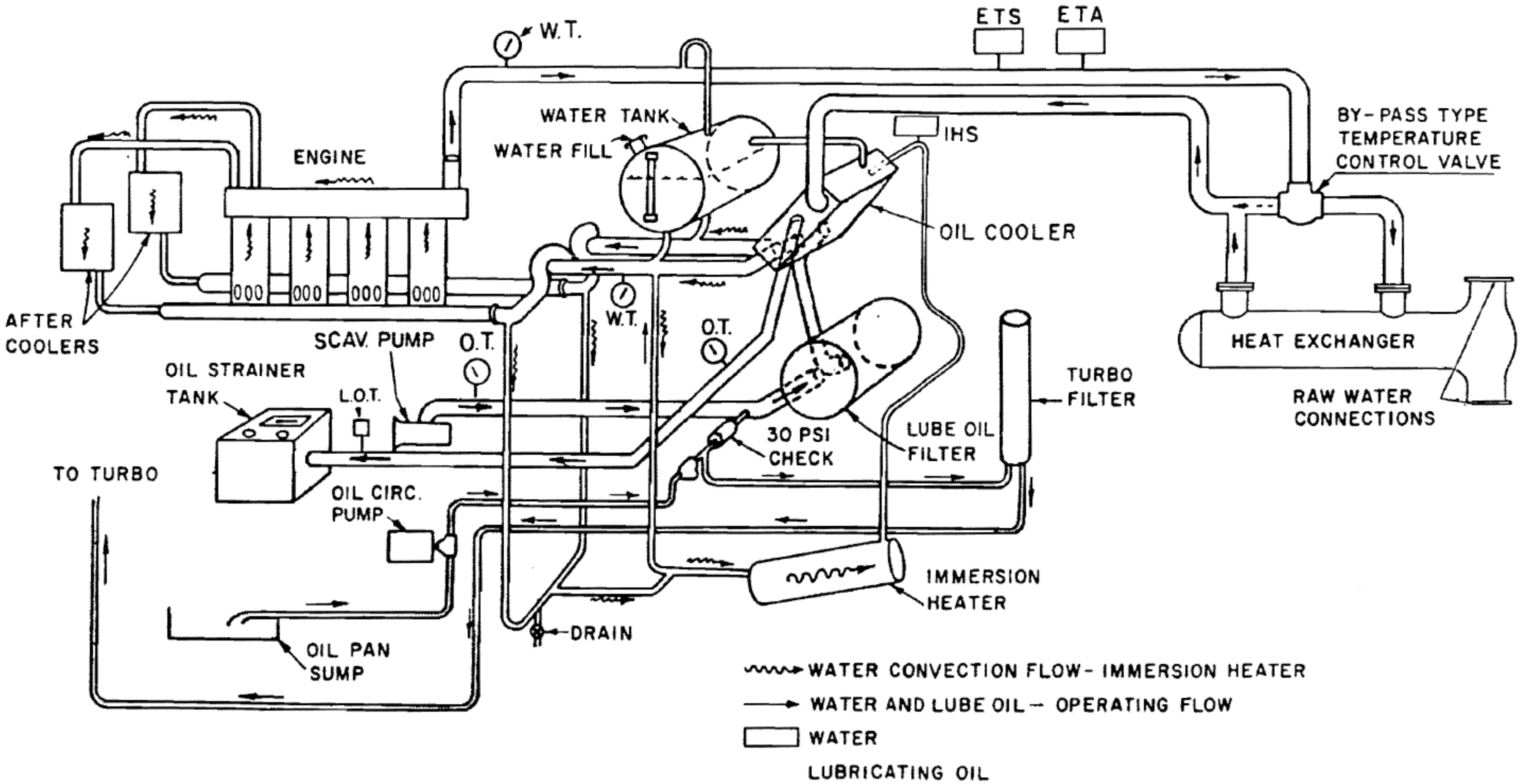
1. TWO CHECK VALVES ARE INTERNAL TO LUBE OIL TURBO CHARGER FILTER.
2. MAIN LUBE OIL AND PISTON COOLING PUMPS ARE CONTAINED IN THE SAME HOUSING AND ARE ENGINE DRIVEN.
3. FOR GENERAL NOTES AND REFERENCES SEE 1-47W880-1.
4. SOME CIDS ON THIS DRAWING HAVE BEEN CHANGED AND MAY DIFFER FROM THE CIDS SHOWN ON OTHER DOCUMENTS FOR THE SAME COMPONENT. THE ALTERNATE ID CAN BE ACCESSED IN MAXIMO AS NECESSARY TO DETERMINE IF PREVIOUS CIDS EXISTED FOR A SPECIFIC COMPONENT.



COMPANION DRAWINGS:
2-47W880-4; 1-47W880-1 AND 2

WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

POWERHOUSE
UNIT 2
FLOW DIAGRAM
DIESEL LUBE OIL
SYSTEM
TVA DWG NO. 2-47W880-3 RO
FIGURE 9.5-26(U2)



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Diesel Engine
Lubrication System

FIGURE 9.5-27

FIGURE 9.5-28

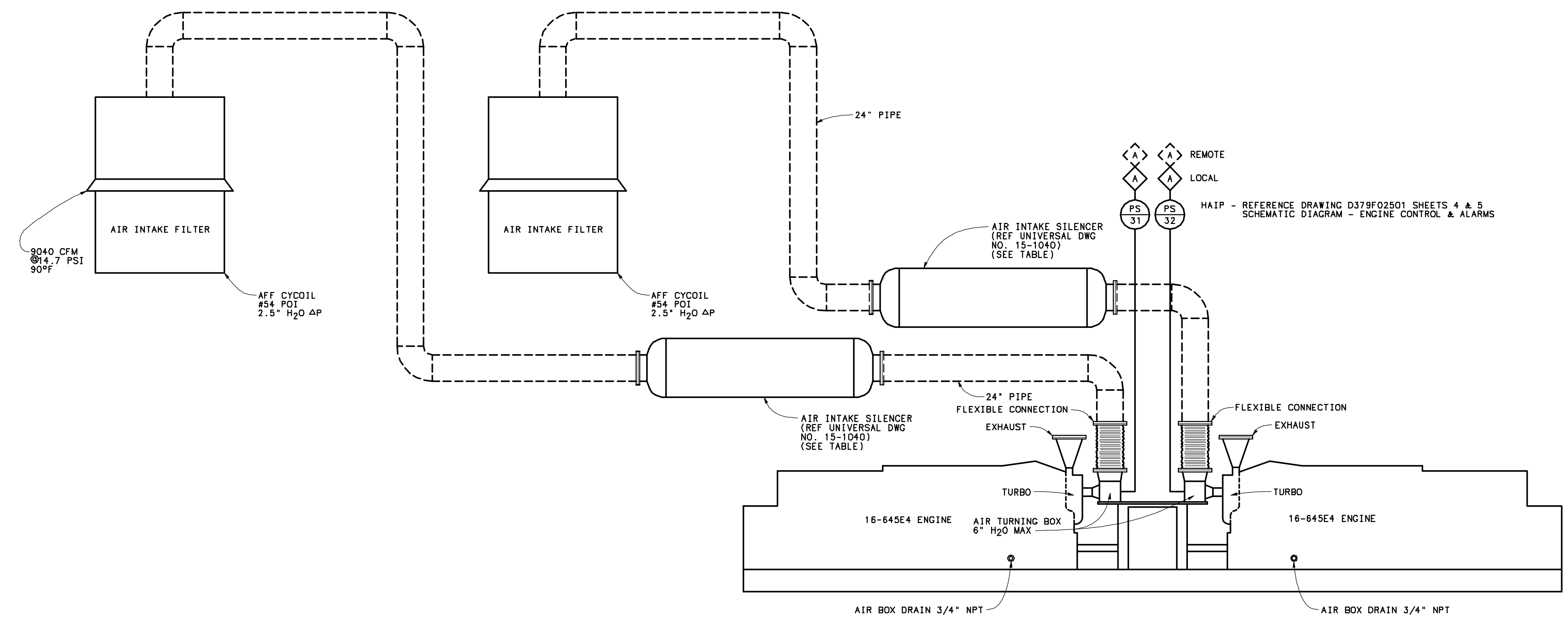
DELETED

CAD MAINTAINED DRAWING

ENG	EXHAUST SILENCER
1A1	SILN-82-101
1A2	SILN-82-102
1B1	SILN-82-103
1B2	SILN-82-104
2A1	SILN-82-201
2A2	SILN-82-202
2B1	SILN-82-203
2B2	SILN-82-204

NOTE:

PS31 & PS32 - VACUUM SW. SET 12" H_2O (HAIP).

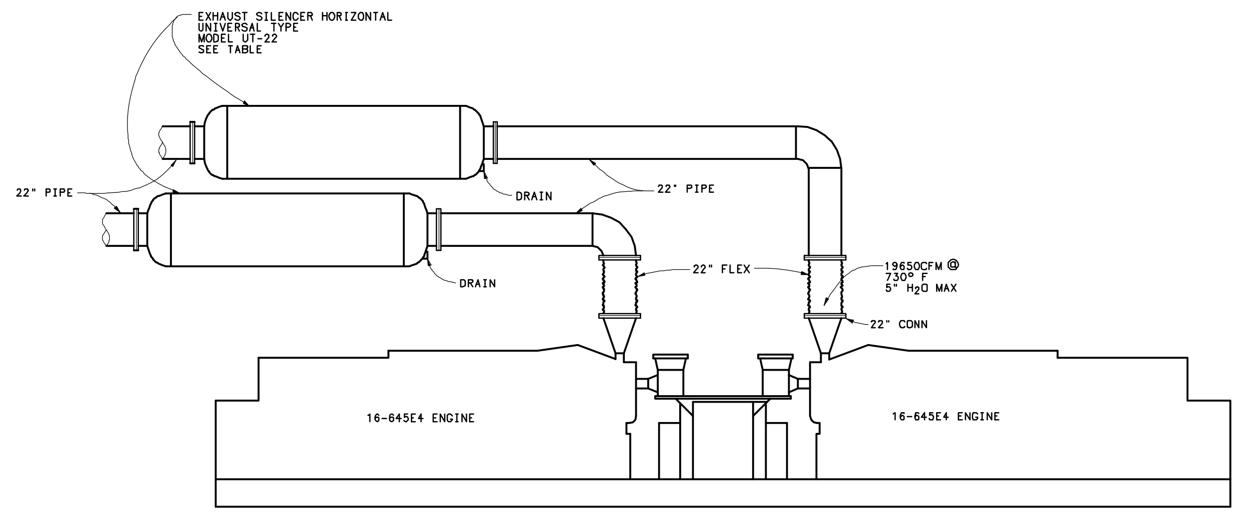


WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

DIESEL AIR INTAKE
PIPING SCHEMATIC
CONTRACT NO.
74C63-83090
DWG NO. D379D08001 R901
FIGURE 9.5-29

CAD MAINTAINED DRAWING

ENG	EXHAUST SILENCER
1A1	SILN-82-105
1A2	SILN-82-106
1B1	SILN-82-107
1B2	SILN-82-108
2A1	SILN-82-205
2A2	SILN-82-206
2B1	SILN-82-207
2B2	SILN-82-208



WATTS BAR
FINAL SAFETY
ANALYSIS REPORT

DIESEL EXHAUST SYSTEM
PIPING SCHEMATIC
CONTRACT NO.
74C63-83090
DWG NO. D379D09003 R901
FIGURE 9.5-30