ABB
ASEA BROWN BOVERI

April 2, 1993
LD-93-058

Docket No. 52-002

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: System 80+™ Fire Protection and Revised DSER Responses

Dear Sirs:

Attached to this letter is information requested by the NRC staff on fire protection and other DSER items. The Attachment 1 material on fire protection was discussed at the meeting on March 3, 1993, and in subsequent telephone calls. The material in this attachment was sent directly to Mr. J. Holmes on March 26, 1993. The marked-up CESSAR-DC revisions will be printed as part of Amendment O. It is, therefore, expected that the open items indicated in Attachment 1 can be closed.

Attachment 2 provides a revision to open item 6.2.3-3 (SPLB) as a result of the increased power rating for System 80+. The results did not change significantly, and the corresponding revision to CESSAR-DC is being printed in Amendment N.

Attachment 3 provides revised responses for six items being reviewed by ECGB. The corresponding CESSAR-DC revisions have already been printed or are currently in the printing process.

If you have any questions, please call me or Mr. Stan Ritterbusch at (203) 285-5206.

Very truly yours,

COMBUSTION ENGINEERING, INC.

Stanley E. Ritterbusch for
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ATTACHMENT 1

Revised

DSER Open Item 9.5.1.1-1

The applicant must identify any deviations from the National Fire Protection Association codes and standards and describe measures taken to ensure equivalent protection.

Proposed Open Item 9.5.1.1-1 Resolution

It is expected that there will be very few Code deviations in the fire protection design of the System 80+. One expected deviation is with respect to travel distance and exit arrangement from the Reactor Building when compared to the requirements of NFPA 101 Life Safety Code (LSC). The reactor building is unique and does not really "fit" any of the occupancy categories of the LSC, but a mix of the requirements for Industrial and Special Occupancies (LSC Chapters 28 and 30) will be applied. Because of nuclear safety reasons, exit arrangement cannot meet the strict requirements of the LSC, however, due to the very limited combustible loading, and the strict administrative controls and procedures, a level of life safety equivalent to that required by the LSC will be achieved.

Another known deviation concerns the containment isolation valves for the fire protection piping. These nuclear safety related valves are not available that have been tested and approved or listed by a nationally recognized testing laboratory for fire protection purposes. Again, the nuclear safety aspects override the fire protection requirements; however, these valves will meet or exceed the construction requirements of listed/approved fire protection valves.

In most plant areas the fire hose system will be used rather than fire extinguishers for ordinary combustible fires. In high radiation areas, which have a low quantity of combustible materials, fire extinguishers will be located at the entrance, rather than throughout the area. This is consistent with ALARA principles.

Other code deviations may be identified during later detailed design after design certification, and will be addressed in the Fire Hazards Analysis. It was not the intent that the Fire Hazards Assessment address these deviations.

As additional code deviations are identified, they will be submitted to ONRR for review.

Revised

DSER Open Item 9.5.1.2.1-1

The staff does not accept the concept of radiant heat shield and 20 ft. of separation. Each such deviation inside containment must be fully justified.

Proposed Open Item 9.5.1.2.1-1 Resolution

CESSAR-DC Section 9.5.1.1.2.C will be revised to state that for inside containment or the annulus safe shutdown following a fire is ensured by separation of redundant divisions by quadrant to provide sufficient spatial separation, as proven by engineering analysis. Separation for safe shutdown cables is provided through use of mineral insulated cables which qualify as a three hour rated barrier.

CESSAR-DC Section 9.5.1.3.9 will be revised to provide an analysis of protection of redundant functions. This analysis is attached and describes arrangements for which location and spatial separation assure that fire inside containment will not damage redundant functions.

DSER Open Item 9.5.1.2.1-2

The Applicant must clearly state how the redundant shutdown trains are separated in the System 80+ design.

Proposed Open Item 9.5.1.2.1-2 Resolution

Outside of containment the system 80+ plant configuration separates the plant redundant safety related divisions on either side of column line 17. Division 1, consisting of channels A and C, is located (plan) north of column line 17. Division 2, consisting of channels B and D is located (plan) south of column line 17. An exception is the Control Room and the Remote Shutdown Panel which are physically separated and electrically isolated. These control stations are essentially redundant to each other.

The proposed resolution to Open Item 9.5.1.2.1-1 provides the Fire Protection Safe Shutdown Analysis.

DSER Open Item 9.5.1.2.2-2

The applicant should provide more information regarding the HVAC system that is to be used for smoke removal.

Proposed Open Item 9.5.1.2.2-2 Resolution

The amendment J of CESSAR-DC in Section 9.4 states the following:

> Ventilation Systems are division-specific so that fire or smoke in an area containing a safety related division of equipment cannot migrate through the ventilation ducts to an area containing the redundant division of safety related equipment. Fire dampers are installed in fire rated barriers and have the same fire resistance rating as the barrier. Exceptions are the Containment Purge Pressure Control Systems and Annulus Ventilation System which must function following some plant design basis accidents to prevent release of radioactivity. Fire dampers are not installed in these systems because failure or spurious actuation would interfere with system safety function. Portions of the Nuclear Annex Control Complex Smoke Control System motor operated smoke control dampers are installed in lieu of thermally operated, automatic closing fire dampers. In addition, the five multi-level stairwells in the nuclear annex have roof-mounted pressuring fans. The fans are individually energized in response to a signal in order to provide a safe haven and safe exit for plant personnel.
>
> In the event of a fire, area fire detectors will sound an alarm in the control room and the supply fan may be deactivated manually if required. Smoke removal is then manually initiated from the Control Room or the Remote Shutdown Room by a smoke exhaust fan, outside makeup air and associated ductwork and control dampers.
>
> The containment, the Subsphere area, the Fuel Building, the Nuclear Annex, and the two Diesel Buildings are ventilated, heated and cooled with 100% outside air systems. The supply and exhaust fans are available for smoke control. The Control Building area has dedicated smoke control fans. The turbine Building ventilating fans are available for smoke control.

The amendment J of CESSAR-DC in Section 9.4.1.1 states the following:

> Continuous pressurization of the control room and the connecting offices is provided to prevent entry of dust, dirt,

smoke, and radioactivity originating outside the pressurized zones in accordance with the intent of NUREG-0700 requirements. Pressurization is maintained slightly positive relative to the pressure outdoors and in surrounding areas.

Each outside air intake location is monitored for the presence of radioactivity, toxic gases, e.g., chlorine, and products of combustion. Isolation of the outside air intake occurs automatically upon indication of high radiation level, high chlorine concentration or smoke concentration in the intake. Should both intakes close, the operator can override the intake monitors and by inspection of the control room readouts select the least contaminated intake. This will ensure pressurization of the control room.

The amendment J of CESSAR-DC in Section 9.4.1.2 states the following:

The Technical Support Center air-handling system consists of an air-handling unit, return air and smoke purge fans, and an emergency filter unit. The TSC is maintained at 1/8" water gauge positive pressure with respect to surrounding areas during post-accident conditions. A common supply air header is shared by the TSC and the control room. Upon detection of radiation, toxic gas or smoke at the outside air intake, the dampers on the outside air intake are closed and the air is recirculated through TSC filter unit. Should both intakes close, the operator can override the intake monitors and, by inspection of the control room readouts, select the least contaminated intake.

The system descriptions for Annulus Ventilation System, Control Complex Ventilation System, Fuel Building Ventilation System, Diesel Building Ventilation System, Subsphere Building Ventilation System, Containment Cooling Ventilation System and Nuclear Annex Ventilation System are contained in Sections 6.2.3, 9.4.1, 9.4.2, 9.4.4, 9.4.5, 9.4.6 and 9.4.9 respectively in Amendment J of CESSAR-DC.

Table 9.4-1 in Amendment J of CESSAR-DC provides the HVAC system design parameters.

The amendment J of CESSAR-DC in Section 9.5.1.3.3 states the following:

Ventilation systems are designed to provide smoke control capabilities which are necessary to preclude the possibility of redundant safety related equipment from being damaged by

fire and spread of products of combustion. The ventilation system for each area is arranged to ventilate products of combustion without spread to other areas.

The control building ventilation system is provided with separate outside air intakes for the control room separate from the remainder of the control complex including the remote shutdown room. Separate ductwork is utilized for smoke migration between the two areas.

The Control Complex has a smoke control system which utilizes dedicated smoke exhaust fans, smoke dampers and 100% outside air supplied by the Control Complex air-handling units. The smoke purge fans are sized to exhaust three cfm per sq. ft. The smoke purge system is manually activated by the control room operator.

In the subsphere, electrical equipment rooms A, B, C and D on elevation 50+0 are separated by channel with 3 hour fire resistance barriers. The two channels within a division share a common ventilation system, but are separated by fire dampers. Smoke purge fans are utilized to prevent smoke migration from one channel to the other in the same division.

Smoke ventilation systems handle smoke purge by isolation of supply air in the area in which the fire occurred. The normal exhaust system for the area will purge the smoke providing a slight negative pressure to the area in relation to surrounding areas still receiving supply air. The exhaust filter unit is bypassed in the smoke purge mode. This mode of operation is manually activated by the control room. The recirculation cooling units in an area with smoke will need a maintenance check to see if the prefilter needs replacing and the cooling coils need to be cleaned after the smoke purge is completed.

The amendment J of CESSAR-DC in Section 9.5.1.3.5 states the following:

There are stairs in each quadrant of the Nuclear Annex enclosed by three-hour fire rated walls. Each stair tower is pressurized by a dedicated fan mounted at the top of the tower.

The amendment J of CESSAR-DC in Section 9.5.1.6.2 states the following:

Fire and smoke control are recognized as important elements of the overall fire protection program. The ventilation systems

are designed in accordance with NFPA 90A, "Air Conditioning and Ventilation Systems" and NFPA 204M, "Smoke Control Systems."

Ventilation Systems are division-specific so that fire or smoke in an area containing a safety related division of equipment cannot migrate through the ventilation ducts to an area containing the redundant division of safety related equipment. Fire dampers are installed in fire rated barriers and have the same fire resistance rating as the barrier. Exceptions are the Containment Purge and Pressure Control Systems and Annulus Ventilation System which must function following some plant design basis accidents to prevent release of radioactivity. Fire dampers are not installed in these systems because failure or spurious actuation would interfere with system safety function. Portions of the Nuclear Annex Control Complex Smoke Control System motor operated smoke control dampers are installed in lieu of thermally operated, automatic closing fire dampers as described below.

The smoke control philosophy is to allow for smoke venting from any plant area without spreading to adjacent areas, to maintain plant habitability for operator protection and to ensure protection of the public. The containment, subsphere, fuel pool, nuclear annex and two diesel buildings are each served by 100% outside air and 100% exhaust ventilation systems.

Smoke Control and exhaust is accomplished by aligning the ventilation to supply 100% outside air and to exhaust directly to the outside. Smoke and gases containing radioactive materials are routed through a filter train to the unit vent if a radioactive signal is received. The control complex has smoke exhaust fans to remove smoke from specific areas as determined by control operators utilizing signals from smoke detectors located in exhaust and return air ducts. The control operator aligns dampers to exhaust an area where fire occurs while isolating exhaust and return air in the adjacent area.

During smoke purge mode of operation, the filter units are isolated and the smoke is bypassed around the filter units to the atmosphere. The smoke purge is manually activated by the control room after the fire is extinguished completely. Recirculation cooling units in the smoke filled areas will need a maintenance check to see if the prefilters need replacing and the cooling coils need to be cleaned after the smoke purge is completed.

Fresh air intakes are located remote from the ventilation system exhaust to preclude the possibility of contaminating

the intake air with products of combustion.

Stairwells in the Nuclear Annex are individually pressurized with roof-mounted fans to preclude smoke infiltration.

The amendment J of CESSAR-DC in Section 9.5.1.7.7 states the following:

Smoke control features of the HVAC system are tested in accordance with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems" and NFPA 204M, "Smoke and Heat Venting."

A. Acceptance Tests

1. Fire dampers are drop tested under anticipated air flow conditions to assure proper operation.

2. The ventilation system for each area is aligned for smoke ventilation (i.e., 100% fresh air intake and 100% exhaust) to assure damper controls function properly.

3. Smoke dampers in return air ducts are actuated to assure proper operation.

The following will be added to section 9.5.1.2 (G)

The fans dedicated for smoke purge are sized to provide a minimum of 3 CFM/square foot of floor area. The ventilation systems are sized to provide an air flow of 1 CFM/square foot of floor area or more depending upon the area served. The layout of the duckwork is such that it ensures ventilation of all corners of the area as much as practical.

DSER Open Item 9.5.1.3.1-1

The applicant must verify the staff's assumptions regarding the design and installation of fire detection capability.

Proposed Open Item 9.5.1.3.1-1 Resolution

The staff's assumptions concerning the capabilities of the fire alarm and detection system's capabilities are verified in CESSAR-DC Section 9.5.1.5.6, Amendment J dated April 30, 1992.

The CESSAR-DC will be revised to state that fire detection is installed in the Nuclear Annex and portions of the Reactor Building. Specifically fire detection will be installed in the following areas:
Areas containing major cable concentrations
Safe shutdown major pump rooms
Switchgear
Motor control centers
Battery and inverter areas
Relay rooms
Fuel areas

Fire detectors will also be installed in other areas containing appreciable in situ or potentially transient combustible materials such as change room storage areas, contaminated area step off pads and laundry rooms.

DSER Open Item 9.5.1.3.2-1

The applicant does not adequately discuss the fire-protection water-supply system in the fire hazards analysis.

Proposed Open Item 9.5.1.3.2-1

The CESSAR-DC will be revised to state that the fire protection water distribution system will be designed to provide the maximum water demand, both volume and pressure, with the hydraulically shortest flow path out of service.

Sectional control valves will be provided so that even with a single impairment, water supply will not be interrupted to both the primary and the secondary protection system in any single fire area.

Fire protection features for the Turbine Building, the main power, unit auxiliary, and reserve transformers will be provided as necessary to meet the overall fire protection goals and objectives outlined in Sections 9.5.1.1.1 and 9.5.1.1.2 of CESSAR-DC. Protection features selected will be consistent with the guidance contained in NFPA 803, Standard for Fire Protection for Light Water Nuclear Power Plants. In addition, protection features will be selected in consideration of property insurer's requirements.

DSER Open Item 9.5.1.3.3-1

Details concerning pressure reducing orifices, exterior hydrants and hose houses, and electrical supervision of control and sectionalizing valves need to be discussed.

Proposed Open Item 9.5.1.3.3-1 Response

CESSAR-DC Section 9.5.1.5.4 states that pressure reducing orifices will be used where necessary to maintain a maximum pressure of 100 psi at hose outlets for fire fighter safety.

CESSAR-DC Section 9.5.1.5.2 discusses in detail the requirements for fire hydrants and hose houses and includes the type and quantities of equipment in the hose houses. A copy of this CESSAR-DC Section is attached to the Proposed Response to Open Item 9.5.1.3.2-1.

Control and sectionalizing valves in the fire protection water distribution system shall be electrically supervised or administratively controlled by locking them in the open position, consistent with Section C.6.c.(2) of BTP CMEB 9.5-1.

The fire protection water distribution system is dedicated for fire protection service. Use for other plant processes or washdown.

The CESSAR-DC will be revised accordingly to discuss supervision of control valves and to prohibit use for non fire protection service.

DSER Open Item 9.5.1.6-1

Several fire areas designated Category 2 by the applicant have no automatic fire suppression provided.

Proposed Open Item 9.5.1.6-1 Resolution

The Fire Hazards Assessment (FHA) describes Categories of risk, which are used to determine the type of fire protection features provided in each fire area.
The FHA will be revised to describe Category 2 as those areas for which BTP CMEB 9.5-1 stipulates specific fire protection features including suppression systems, detection systems and fire barriers. For areas which are classified as Category 2, will be protected in accordance with the BTP CMEB 9.5-1.

DSER Open Item 9.5.1.6-2

Some category 2 fire areas state that automatic fire suppression is to be determined.

Proposed Open Item 9.5.1.6-2 Resolution

The Fire Hazards Assessment (FHA) describes Categories of risk, which are used to determine the type of fire protection features provided in each fire area.
The FHA will be revised to describe Category 2 as those areas for which BTP CMEB 9.5-1 stipulates specific fire protection features. including fire suppression systems. Areas which are classified as Category 2, will be protected in accordance with the BTP CMEB 9.5-1.

DSER Open Item 9.5.1.6-3

The applicant must provide justification for using an engineering analysis vice laboratory testing for qualifying structural members, doors, dampers, and penetration seals.

Proposed Open Item 9.5.1.6-3 Resolution

It is expected that the qualification for the structural members (walls, floors, and ceilings), doors, dampers, and penetration seals will be verified through laboratory testing. However, in the course of detailed design, it may be necessary to utilize components due to nuclear safety or security reasons, that have not been tested for specific fire purposes. For example, the doors used for containment entry that have tested in accordance with ASTM E-119 may not be available. In this case, an engineering analysis would be performed to assure that the entire door assembly meets or exceeds the same construction criteria required of doors that have been tested to ASTM E-119 Standards. The analysis will be conservative and will assure that the appropriate level of fire protection is afforded the component.

If a deviation analysis is required for any component, it will be documented in the Fire Hazards Analysis during detailed design and submitted to ONRR for review.

DSER Open Item 9.5.1.6-4

Some category 2 fire areas state that an engineering analysis will be provided to verify automatic fire suppression is not needed.

Proposed Open Item 9.5.1.6-4 Resolution

Engineering analysis will not be used to determine provision of fire protection features for regulatory compliance.
The Fire Hazards Assessment (FHA) describes Categories of risk, which are used to determine the type of fire protection features provided in each fire area.
The FHA will be revised to describe Category 2 as those areas for which BTP CMEB 9.5-1 stipulates specific fire protection features including suppression systems, detection systems and fire barriers. For areas which are classified as Category 2, will be protected in accordance with the BTP CMEB 9.5-1.

Engineering analysis will only be used to determine if it is benificial to install fire protection, in addition to those features provided for Regulatory compliance, to meet other plant design objectives such as personnel safety and unit availability.

## 9.5 OTHER AUXILIARY SYSTEMS

### 9.5.1 FIRE PROTECTION SYSTEM

#### 9.5.1.1 Design Basis

The design basis of the System 80+ Standard Design fire protection system employs defense-in-depth systems approach in combination with an integrated program including operational surveillance, testing, maintenance, administrative controls, and Quality Assurance to provide a fire safe plant consistent with NUREG-0800, Section 9.5.1, "Standard Review Plan", and SECY-90-16 "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements."

##### 9.5.1.1.1 Goals

A. Prevent release of radioactive contamination in excess of 10 CFR Part 100 limits.

B. Prevent loss of ability to achieve safe shutdown following fire.

C. Prevent fire from threatening more than any one ~~electrical channel or mechanical~~ division of equipment or components required to achieve cold shutdown.

D. Prevent fire from damaging more than any one ~~electrical channel or mechanical~~ division of safety related structures, equipment, or components.

E. Mitigate the potential of personnel injury due to fire.

F. Preserve unit availability by limiting potential fire damage to an acceptable level.

G. Protect capital investment in the facility.

##### 9.5.1.1.2 Objectives

A. Station design and layout to prevent the possibility of fire affecting redundant ~~channels and~~ divisions of equipment required for cold shutdown. Safe shutdown as defined in the Standard Review Plan pertains to cold shutdown as part of the System 80+ design philosophy. This includes potential interaction with other plant systems and to prevent a fire induced LOCA.

B. Plant layout to assure adequate access and egress routes for personnel protection.

C. Outside Containment and the Annulus: Provision of three-hour fire rated barriers between redundant divisions of safety-related equipment. Exceptions are control room and the remote shutdown panel room which are physically separated and electrically isolated from each other as described herein. I J

Safe cold shutdown can be achieved following fire in any area assuming all equipment in the fire area (or inside containment; at the specific location) is rendered inoperable and that reentry into the fire area for repairs and operator actions is not possible. I

INSERT #1

~~Inside Containment and Annulus: Separation of redundant divisions by quadrant to provide sufficient spatial separation, as proven by engineering analysis in the annulus and at containment penetrations. Another option for separation is through use of mineral insulated jacketed cables which qualify as either a three hour rated barrier or a radiant heat shield. If it qualifies as a radiant heat shield, engineering analysis will verify that the heat shield coupled with minimum 20 ft. separation between redundant divisions with no intervening combustibles, and/or augmented with sprinklers and automatic fire detectors, will withstand any credible fire occurrence. Where redundant divisions of equipment normally used to achieve cold shutdown, by necessity, converge, an engineering analysis will be conducted (when sufficient design detail is available) to assure that cold shutdown can be achieved utilizing equipment which would not be affected by fire at the specific location. The engineering analysis will be maintained as part of the System 80+ design basis.~~ J

D. Fire detection and alarm systems to provide prompt detection and notification of fire.

E. Fixed automatic sprinkler systems to assure prompt fire suppression consistent with design objectives. I

F. Manual fire fighting equipment for early fire suppression and for structural fire fighting.

G. HVAC systems to ~~mitigate~~ (keep) smoke migration beyond the area of fire origin. K

H. A fire prevention program including housekeeping control of combustible materials, control of potential ignition sources, and a program of management inspections, audits and reviews. I

I. A fire response program consisting of well trained and equipped plant personnel prepared at all times to assume fire fighting responsibilities.

J. Operations and maintenance programs for surveillance, testing and maintenance of fire protection systems and features. I

K. A Quality Assurance program to assure design methods and features are properly implemented. The Quality Assurance program also verifies that operations, maintenance, and surveillance programs are properly implemented.

L. Sufficient fire area compartmentation to preclude the presence of Category 1 risks. A Category 1 risk is defined in the Fire Hazards Assessment as an area where equipment or component damage and electrical faulting are unacceptable. An example would be a location where redundant equipment and components required for safe shutdown are susceptible to damage by a single fire. K

M. A fire protection program that complies with NUREG 0800 Standard Review Plan and CMEB 9.5-1, Rev. 2, July 1981: "Guidelines for Fire Protection of Nuclear Power Plants" and SECY Letter 90-16, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationships to Current Regulatory Requirements." Specific deviations and technical justification are included in the fire hazards analysis.

The Design Basis Goals and Objectives as stated above will mitigate the potential of fire, provide for prompt detection should fire occur, provide automatic suppression and/or manual fire suppression capabilities as determined by the Fire Hazards Analysis, provide fire resistant barriers to mitigate fire propagation, protect redundant safety related trains of equipment from damage due to a common fire exposure, and preclude the potential release of radioactivity to the environment. I

### 9.5.1.2 General Design Guidelines

A. Outside containment redundant divisions of safety related electrical equipment are separated from each other by three-hour fire rated fire barriers. Exceptions are control room and remote shutdown panel room which are physically separated, electrically isolated, and provide redundant shutdown capability. ~~Individual~~ Transfer switches which transfer control from the Control Room to the Remote Shutdown Panel, are ~~separated from each other by three-hour fire rated barriers.~~ located in the control room. J I K

INSERT #2

B. Separation of redundant divisions by quadrant provide sufficient spatial separation in the annulus and at containment penetrations as proven by engineering analysis. Another option for separation is through use of mineral insulated jacketed cables which qualify as either a three hour rated barrier or a radiant heat shield. If it qualifies as a radiant heat shield, engineering analysis will verify that the heat shield coupled with minimum 20 ft. separation between redundant divisions with no intervening combustibles, and/or augmented with sprinklers and automatic fire detectors, will withstand any credible fire occurrence. Where redundant divisions of equipment normally used to achieve cold shutdown, by necessity, converge, an engineering analysis will be conducted (when sufficient design detail is available) to assure that cold shutdown can be achieved utilizing equipment which would not be affected by fire at the specific location. The engineering analysis will be maintained as part of the System 80+ design basis. J

C. A fire protection water supply is installed, with redundancy and reliability to meet provisions of BTP CMEB 9.5-1.

D. Fixed automatic suppression systems are installed, engineered for the specific hazard to be protected in accordance with the design objectives as determined by the Fire Hazards Analysis. I

E. Portable fire extinguishers, fire hydrants, fire hose stations and supporting equipment are provided to facilitate manual fire fighting.

F. Ventilation systems are installed, including provisions for controlling spread of fire and smoke beyond the area of origin. HVAC systems are division specific; therefore, there are no dampers in barriers which separate redundant divisions of safety-related equipment. The exception to this is that there is a single opening in the divisional fire wall that separates the redundant air handling units. An air intake duct which supplies make-up air to the redundant Control Room Systems passes through this opening. This arrangement enables make-up air to be drawn from either side of the facility and is necessary for nuclear safety reasons. This opening is protected with a combination fire and smoke damper. Smoke control capability is provided as part of HVAC system design to mitigate smoke spread beyond the area of origin. K

G. Smoke control capability is provided as part of HVAC system design to mitigate smoke migration beyond the area of origin. INSERT A

H. Multiplexed instrument and control signals by fiberoptic cables are provided to minimize the quantity of combustible exposed cable insulation in the plant.

I. Where fixed fire suppression systems are installed, provisions for control and drainage of water are included.

J. Systems and equipment are designed to mitigate the potential for fire due to equipment failure during the design basis seismic event. An example is the reactor coolant pump motor oil collection and drain system.

K. Fire protection (suppression and detection) equipment is designed to mitigate possible interaction with safety related equipment during the design basis seismic event. Interaction includes the potential for water spray or flood due to pipe failure. I

L. Fire hose standpipe system and a water supply in the Nuclear Annex are designed to withstand a design basis earthquake. Provide a water supply (250 gpm) to at least one hose station for at least 2 hours.

M. Respond to specific requirements of BTP CMEB 9.5-2, Rev. 1, July 1981.

N. ~~9.5.1.2 Safety Related Fire Areas, Rooms, and Zones~~

Fire areas, rooms, zones and other areas containing equipment important to safety are identified in fire barrier drawings to establish the scope of the Fire Hazards Analysis and to assure compliance with Regulatory Guidance (see Figures 9.5.1-2 to 9.5.1-9. K

~~9.5.1.2.1 Description~~

~~A. Elevation 50+0 (Figure 9.5.1-2)~~ I

~~1. Nuclear Annex~~

~~a. Vital Instrumentation and Equipment Rooms, Division I, Channels A&C; Division II, Channels B&D.~~

9.5.1.3 Safe Shutdown Analysis

{See following pages}

Insert A:

The following will be added to section 9.5.1.2 (G)

The fans dedicated for smoke purge are sized to provide a minimum of 3 CFM/square foot of floor area. The ventilation systems are sized to provide an air flow of 1 CFM/square foot of floor area or more depending upon the area served. The layout of the duckwork is such that it ensures ventilation of all corners of the area as much as practical.

## 9.5.1.3 FIRE PROTECTION SAFE SHUTDOWN ANALYSIS

### 9.5.1.3.1 ASSUMPTIONS

- The Fire Protection Safe Shutdown Analysis includes the effects of one worst case spurious actuation.
- Fire is postulated with or without loss of offsite power (which ever is the most severe challenge to the ability to achieve safe shutdown).
- Inside containment, cables for safe shutdown valve motor operators and instruments are three hour fire rated.
- Fire is not postulated concurrent with simultaneous, coincidental failures of safety systems, other plant accidents or the most severe natural phenomena.

### 9.5.1.3.2 FIRE PROTECTION SAFE SHUTDOWN DESIGN BASIS GOALS

- Achieve and maintain subcritical reactivity conditions in the primary system.
- Maintain reactor coolant inventory.
- Achieve primary system temperature and pressure conditions.
- Maintain Reactor Coolant System (RCS) process variables within those predicted for loss of AC power.
- Prevent fuel clad damage, failure of the primary system pressure boundary, or rupture of the containment boundary.

### 9.5.1.3.3 FIRE PROTECTION SAFE SHUTDOWN DESIGN BASIS OBJECTIVES

The following Design Basis Objectives are met in order to assure the Design Basis Goals stated above are satisfied:

- Maintain RCS pressure boundary integrity (i.e., reactor coolant pump seal integrity, CVCS letdown isolation, Safety Depressurization System isolation and RCS sample line isolation).
- Assure the reactivity control function maintains the available shutdown margin at greater than 1% $\Delta k/k$ with the highest worth control element assembly (CEA) fully withdrawn.
- Assure reactor coolant make up is available to maintain

reactor coolant in the pressurizer within prescribed limits.

- Maintain RCS decay heat removal function and cool down the RCS to cold shutdown conditions.

- Provide direct reading of process variables necessary to perform and control negative reactivity, reactor coolant pressurizer level and decay heat removal.

- Maintain support functions (process cooling, lubrication, etc.) for equipment required for safe shutdown.

9.5.1.3.4 SYSTEMS REQUIRED FOR SAFE SHUTDOWN

- The RCS provides reactivity control by control element assembly (CEA) insertion and also removes decay heat from the core through natural circulation.

- Emergency Feedwater System (EFW) provides secondary side decay heat removal capability.

- Atmospheric Dump Valves provides secondary side pressure control capability.

- Shutdown Cooling System (SCS) provides residual heat removal function for cooldown from hot shutdown to cold shutdown conditions.

- Safety Injection System (SIS) provides makeup capability for inventory control and boron addition for reactivity control.

- Safety Depressurization System (SDS) provides primary system pressure control capability.

- Essential Chilled Water System (ECWS) provides chilled water for HVAC heat removal to all safety related room recirculation cooling units.

- Component Cooling Water System (CCWS) provides decay heat removal capability and equipment cooling for the Shutdown Cooling System, Safety Injection System, Essential Chillers, Emergency Diesel Generator Coolers, etc., as well as other non safe shutdown functions.

- Station Service Water System (SSWS) takes suction from the ultimate heat sink and provides cooling water flow to the CCWS heat exchangers for cooling and decay heat removal.

- The Control Building, Nuclear Annex, Subsphere and Diesel Generator Building Ventilation Systems provide ambient temperature control within parameters required to assure components function as intended to achieve safe shutdown conditions.

- Reactor coolant pump seal cooling is provided by either seal injection from the CVCS charging pumps or direct cooling from the CCWS.

- The Pool Cooling and Purification System provides decay heat removal from the spent fuel pool.

- The onsite Emergency Diesel Generators provide power for 1E busses for equipment power, control and instrumentation required to achieve safe shutdown conditions.

- The Combustion Turbine (AAC) provides onsite power to the permanent non-safety busses which provide power to the CVCS Charging Pumps and associated valves and controls.

Each of these systems includes adequate controls and instrumentation in the Control Room and at the Remote Shutdown Panel to assure safe shutdown can be achieved.

9.5.1.3.5 SYSTEMS WHICH REQUIRE ISOLATION

- SCS pressure isolation valves until RCS is cooled and depressurized to SCS entry conditions.

- SDS to prevent uncontrolled blowdown of the RCS.

- CVCS letdown to prevent uncontrolled letdown of the RCS.

- RCS sample lines to prevent uncontrolled letdown of the RCS.

- Main Steam System to prevent uncontrolled blowdown of the steam generators.

- Atmospheric Dump Valves to prevent uncontrolled blowdown of the steam generators.

- Main Feedwater System to prevent uncontrolled blowdown of the steam generators and steam generator over fill.

- Steam Generator Blowdown System and steam generator sample lines to prevent uncontrolled blowdown of the steam generators.

- EFW to prevent steam generator over fill.

Each of these systems includes adequate controls and instrumentation in the Control Room and at the Remote Shutdown Panel.

9.5.1.3.6 ASSOCIATED CIRCUITS

The potential for electrical interaction due to fire mandates that

a study be conducted to assure that redundant safe shutdown systems are not damaged by a single fire. Generic Letter 81-12 Rev. 1 defines Associated Circuits and provides guidance for documenting the Associated Circuits Study.

Outside of containment the System 80+ plant configuration provides complete separation of redundant safety related divisions by three hour fire rated barriers. Division 1 is located (plan) north of column line 17. Division 2 is located (plan) south of column line 17. An exception is the Control Room and the Remote Shutdown Panel room which are physically separated and electrically isolated and provide redundant shutdown capability. Transfer switches which transfer control from the Control Room to the Remote Shutdown Panel are located in the Control Room. Transfer switches are arranged such that when power is transferred from the Control Room to the Remote Shutdown Panel, manual operations in all four Vital Switchgear rooms are required to return control capability to the Control Room. Thus associated circuit interaction in the Control Room will not affect the ability to achieve safe shutdown from the Remote Shutdown Panel.

9.5.1.3.7 SAFE SHUTDOWN FOLLOWING FIRE OUTSIDE OF CONTAINMENT

As discussed in section 9.5.1.3.7, "Associated Circuits", redundant safe shutdown divisions are separated by column line 17. Each fire area is enclosed in three hour fire rated barriers. Three hour fire rated barrier walls are located along Column Line 17, except at elevations 115+6 and 130+6 where the Control Room is located. The exception to complete divisional separation is the Control Room and the Remote Shutdown Panel room which have redundant control function capability. They are physically separated and electrically isolated from each other. CESSAR-DC Figure 9.5.1 depicts the separation of redundant electrical divisions outside of containment.

Thus a fire in any fire area outside of containment will not affect redundant safe shutdown systems, equipment, or components.

9.5.1.3.8 SAFE SHUTDOWN FOLLOWING FIRE INSIDE CONTAINMENT

The Containment and Annulus are a single fire area. The only components inside the Containment and Annulus which are required for safe shutdown are motor operated valves and instruments associated with safe shutdown systems.

Inside the Annulus and Containment, three hour fire rated cable protective systems (i.e., mineral insulated cables) are used for cables associated with safe shutdown functions. An exception to the three hour fire resistance rating may be containment penetrations which are currently commercially available with a one hour fire resistance rating. Three hour fire rated containment penetrations will be purchased if available.

The only in situ combustible material inside containment that may be exposed to a fire is insulation of cables that are not associated with safe shutdown functions. Redundant trains of valves and instruments analyzed as an assured method of achieving safe shutdown are physically separated such that a potential fire will not affect redundant equipment as stated in section 9.5.1.3.9.

In situ combustible material inside containment is limited to those materials which are essential for unit operation (i.e., cable insulation, lubricants, etc.). The largest quantity of combustible materials is RCP motor lubrication oil. All potential leak points are enclosed in a seismically designed oil collection system which drains to a seismically designed oil collection tank. If oil were to escape from any reactor coolant pump, it would drain into the containment holdup volume. There are no safe shutdown components located in the containment holdup volume which may be damaged due to a fire at this location.

Transient combustible material will be administratively controlled to avoid unacceptable fire hazards.

9.5.1.3.9 PROTECTION OF REDUNDANT FUNCTIONS

1. OBJECTIVE: Maintain primary system pressure boundary integrity (i.e., reactor coolant pump seal integrity, CVCS letdown isolation , SCS isolation, SDS isolation and RCS sample line isolation).

   ANALYSIS:

   A. RCP seal integrity is maintained by either seal injection from the CVCS charging pumps or direct cooling from the CCWS. The CVCS is discussed in CESSAR-DC Section 9.3.4, and is shown in Figure 9.3.4-1. The CCWS is discussed in CESSAR-DC Section 9.2.2 and is shown in Figure 9.2.2-1. The RCP seals are discussed in CESSAR-DC Section 5.4.1 and are shown in Figure 5.1.2-2.

      Outside containment the two divisions of CCWS are separated by a three hour fire rated barrier. In addition, the redundant CVCS charging pumps are separated by a three hour fire rated barrier. However, each division of CCWS provides seal cooling for two of the four RCPs. Should one CCWS division be lost from a fire outside of containment, RCP seal integrity of the two RCPs cooled by the CCWS division is maintained through seal injection from the CVCS charging pump in the unaffected division. The seal injection line penetrating containment is located 90 degrees apart from each containment penetration for the CCWS supply and return line to the RCPs. Each of the CCWS supply and return lines to the RCPs has two isolation valves, (For division 1, the isolation valve located inside containment has

control power supplied from channel B and the isolation valve located outside of containment has control power supplied from channel A. For division 2, the isolation valve located inside containment has control power supplied from channel A and the isolation valve located outside of containment has control power supplied from channel B.). There is an isolation valve in the seal injection line located outside of containment. This valve has control power supplied from Channel C. Thus a fire outside containment cannot simultaneously isolate both seal cooling means.

Inside containment isolation and control valves on the CVCS seal injection, RCP controlled seal bleedoff and CCWS supply and return lines for the RCP seal coolers are protected such that spurious signals from a fire inside containment can not simultaneously isolate both RCP seal cooling means. Seal injection isolation valves on each side of the high pressure seal coolers are normally open with power removed from the valve operator. The CCW supply and return line isolation valves to each RCP are also normally open with power removed from the valve. The seal injection flow control and controlled seal bleedoff line valves are located near each associated RCP inside the Reactor Building crane wall. These valves are powered from the permanent non-safety electrical power busses. The containment isolation valves for the RCP seal cooler CCWS supply and return lines and the RCP controlled seal bleedoff line are powered from Class 1E busses. These valves are located close to the containment vessel and outside of the Reactor Building crane wall. Therefore, the containment isolation valves associated with the CCWS supply and return lines to the RCPs and the primary RCP controlled seal bleedoff line will not spuriously close from a fire which causes the seal injection flow control valves and controlled seal bleedoff valves near the RCPs to close and vise versa. Should both the RCP controlled seal bleedoff and CCWS containment isolation valves spuriously close, a relief valve located inside containment opens and allows continued RCP controlled seal bleedoff to the reactor drain tank.

B. The CVCS letdown line is discussed in CESSAR-DC Section 9.3.4 and is shown in Figure 9.3.4-1. The letdown line has two power operated valves in series. Each isolation valve is powered from a different division of Class 1E power and is separated and protected such that a fire inside containment can not prevent both isolation valves from closing.

C. Each division of SCS has two RCS pressure isolation valves in series. These pressure isolation valves are shown in CESSAR-DC Figure 6.3.2-1C and are discussed in

Section 5.4.7. Each valve has power supplied from a dif erent Class 1E channel. In addition, the power is removed from one of the valves in series. This prevents spurious opening of both valves from a fire inside containment.

D. Each division of SDS from the pressurizer to the In Containment Refueling Water Storage Tank (IRWST) has two power operated valves in series. Each valve has power supplied from a different Class 1E channel. In addition, power is removed from one of the valves in series. Each of the redundant valves are located above the pressurizer where there is no potential fire exposure. Each division of SDS from the pressurizer to the reactor drain tank and from the top of the reactor vessel to the reactor drain tank has two power operated valves in series. Each valve has power supplied from a different Class 1E channel. The valves and cables are adequately separated and protected to prevent spurious opening of any two valves in series from a fire inside of containment. The SDS is discussed in CESSAR-DC Section 6.7 and is shown in Figure 5.1.2-3.

E. Primary sampling lines have a flow reducing orifice which restricts the flow to less than the normal makeup capacity. In addition, each sample line has a normally closed isolation valve inside containment and a normally closed isolation valve outside containment. Each containment isolation valve associated with a sample line penetration is powered from a different division of Class 1E power. Thus, a fire inside containment can only affect the operation of one of these valves. The sample system is discussed in CESSAR-DC Section 9.3.2, Containment Isolation is discussed in CESSAR-DC Section 6.2.4, and the containment isolation valves are shown on Figure 6.2.4-1.

2. <u>OBJECTIVE</u>: Assure the reactivity control function maintains the available shutdown margin at greater than 1% $\Delta k/k$ with the highest worth CEA fully withdrawn.

<u>ANALYSIS</u>: Reactivity control is maintained by the CEAs and by boration. The Safety Injection System (SIS) is the primary method of injecting boron into the primary system. The SIS is discussed in CESSAR-DC Section 6.3 and is shown in Figure 6.3.2-1. The SIS pumps and power operated valves are located outside containment. There are no power operated valves inside containment. Thus a fire inside containment will not affect the ability to maintain reactivity control. Each division of SIS outside of containment is separated by a three hour fire rated barrier.

3. <u>OBJECTIVE:</u> Assure reactor coolant make up is available to maintain reactor coolant in the pressurizer within prescribed

limits.

ANALYSIS: The Safety Injection System (SIS) is used for make up to the RCS. See item 2, "reactivity control", above for description and protection.

4. OBJECTIVE: Maintain reactor coolant decay heat removal function and cool down the RCS to cold shutdown conditions.

ANALYSIS:

A. Emergency Feedwater System (EFWS) provides decay heat removal from hot standby to hot shutdown conditions by supplying feedwater to each steam generator. The EFWS is discussed in CESSAR-DC Section 10.4.9 and is shown in Figure 10.4.9-1. Each division has a motor driven and a steam driven EFW pump. Each of these pumps is sized for full capacity so that only one pump per division is necessary to achieve safe shutdown. Each pump discharge line has two motor operated valves in series. The motor driven and steam driven EFW pump of each division feed into a common supply header. All pumps and power operated valves are located outside of the containment. Thus a fire inside of containment will not affect the EFW function. Outside of containment each EFW train is separated by a three hour fire rated barrier. In order to prevent steam generator over fill, the motor operated control valve at the discharge of each pump has power supplied from a different Class 1E channel compared to the associated pump controls. The valve and pump along with associated cables are located and routed through different fire areas to prevent losing both pump and valve control due to spurious signals.

B. Steam Generator pressure control is maintained by the atmospheric dump valves which are part of the Main Steam Supply System. These valves are discussed in CESSAR-DC Section 10.3 and are shown on Figure 10.3.2-1. Each of the four main steam lines has an atmospheric dump valve (ADV) and its associated block valve located upstream of the main steam isolation valves. These valves are located outside containment in the main steam valve houses (MSVH). Thus a fire inside containment cannot affect their operation. Each MSVH, which contains two of the four ADVs, is located on opposite sides of the Reactor Building and is separated by a three hour fire rated barrier. Only one steam generator and one of the ADVs associated with that steam generator are required for decay heat removal and cooldown. Each ADV in a division has power supplied from a different Class 1E channel in its respective division. Therefore, a fire outside containment can only affect the operation of the ADVs located in the division in which the fire occurs. Thus, the ADVs in the unaffected division will be

available to control pressure in the steam generator performing the cooldown function.

C. In order to prevent uncontrolled blowdown of the steam generator and steam generator overfeed, the main steam, main feedwater, and steam generator blowdown systems and the steam generator sample lines require isolation.

The Main Steam System is discussed in CESSAR-DC Section 10.3 and is shown in Figure 10.3.2-1. Each steam generator has two main steam lines. Each main steam line has a main steam isolation valve. Each main steam isolation valve has redundant solenoids powered from different Class 1E channels. In addition, these valves fail closed on loss-of-power. The main steam isolation valves are located outside of containment in their associated main steam valve house. Thus, a fire inside containment does not affect the operation of these valves.

The Main Feedwater System is discussed in CESSAR-DC Section 10.4.7 and is shown in Figure 10.4.7-1. Each steam generator has a economizer feedwater line and a downcomer feedwater line. Uncontrolled blowdown of a steam generator is prevented by two check valves in series on each of these lines. Steam generator over feed is prevented by closing the two feedwater isolation valves located in series on each of these lines. Each feedwater isolation valve in series has power supplied from a different Class 1E channel. In addition, these valves fail closed on loss of power. The feed water isolation valves are located outside of containment in their associated main steam valve house. Thus, a fire inside containment does not affect the operation of these valves.

The Steam Generator Blowdown System and the Process Sample System are discussed in CESSAR-DC Sections 10.4.8 and 9.3.2 respectively. The Steam Generator Blowdown System is shown in Figure 10.4.8-1. Each steam generator blowdown line and each steam generator sample line can be isolated by their associated containment isolation valves. Each containment penetration has a containment isolation valve located inside containment and a containment isolation valve located outside of containment. Each valve associated with a containment penetration is powered from a different division of Class 1E power. Thus, a fire inside containment can only affect the operation of one valve.

D. The Shutdown Cooling System (SCS) provides decay heat removal and cooldown after the primary system is cooled and depressurized to the point that allows opening of the RCS pressure isolation valves. The SCS cools the RCS

from hot shutdown to cold shutdown conditions. The SCS is described in CESSAR-DC Section 5.4.7 and is shown in Figure 6.3.2-1. The SCS has redundant divisions. Each division takes suction from a different RCS hot leg and returns the RCS after it is cooled directly to the reactor vessel. The majority of the SCS system is located outside of containment and the redundant divisions outside of containment are separated by a three hour fire rated barrier. Only the motor operated RCS pressure isolation valves are located inside containment. There are two valves in series in each of the redundant flow paths which are located by division 180 degrees apart. These valves are located near the crane wall on either side of containment such that they are over 100 feet apart. They are located at elevation 101+8 which is 10 feet above the floor elevation of 91+6. This distance is sufficient to ensure that one division of SCS is available to perform the cooldown function.

In addition, one of the valves in series in each flow path is normally deenergized during power operation to prevent potential spurious actuations from opening both valves in a division prior to reaching SCS entry conditions.

E. The Component Cooling Water System (CCWS) and the Station Service Water System (SSWS) transfer decay heat from the SCS to the ultimate heat sink. In addition, they provide process cooling to equipment and components required for safe shutdown. These systems are discussed in CESSAR-DC Sections 9.2.2 and 9.2.1 respectively and are shown in Figures 9.2.2-1 and 9.2.1-1 respectively. Each of these systems are located outside of containment and would not be affected by a fire inside containment. Outside of containment each division is separated by a three hour fire rated barrier. An exception is the CCWS cooling to the RCP seals which has valves located inside containment. See item 1A above for analysis of this item.

5. <u>OBJECTIVE</u>: Provide depressurization of the RCS to allow Shutdown Cooling System to be placed in service to obtain cold shutdown conditions.

<u>ANALYSIS</u>: RCS depressurization is accomplished utilizing the Safety Depressurization System (SDS). The SDS is described in CESSAR-DC Section 6.7 and is shown in Figure 5.1.2-3. Depressurization is accomplished by opening the valves and controlling flow from the pressurizer to the reactor drain tank. These valves are located inside containment. Two divisions of valves located in parallel are provided. Each division is powered from a different Class 1E division. Each division of SDS from the pressurizer to the reactor drain tank has two power operated valves in series. Each valve has power

supplied from a different Class 1E channel. One of the redundant lines is routed inside the pressurizer cavity, the other is routed outside of the pressurizer cavity. The valves and cables are adequately separated and protected (i.e. one division is inside the pressurizer cavity and one division is outside of the pressurizer cavity) to ensure one division of SDS is available for RCS depressurization in the event of a fire inside of containment.

6. OBJECTIVE: Provide direct reading of process variables necessary to perform and control negative reactivity, reactor coolant pressurizer level and decay heat removal.

ANALYSIS: Instrumentation (Incore instrumentation, T-Hot, T-Cold, S\G Pressure, S\G Level, Pressurizer Pressure, Pressurizer Level, Neutron Flux): Cables for all of these instruments are three hour fire rated.

A. Neutron Flux instrumentation, T-Hot and T-Cold are located inside the primary system and are not susceptible to fire damage.

B. Pressurizer Pressure and Level instruments are located at the pressurizer. There are four channels of pressurizer pressure and level instrumentation. Each channel is located in a different quadrant around the pressurizer.

C. S\G Pressure and Level instruments: Fire at either steam generator may damage instruments associated with that steam generator. However the other steam generator would not be affected and would be available to achieve safe shutdown. In addition, there are four channels of steam generator pressure and level instrumentation and each channel is located in a different quadrant around the steam generator.

7. OBJECTIVE: Maintain support functions (process cooling, lubrication, etc.) for equipment required for safe shutdown.

ANALYSIS:

A. Component Cooling Water System (CCWS) and Station Service Water System (SSWS) are discussed in , item 4E above.

B. Lubrication: There is no equipment inside containment which requires lubrication for safe shutdown. Lubrication requirements outside of containment are divisionalized and separated by a three hour fire rated barrier.

C. Ambient cooling:

- The Essential Chilled Water System (ECWS) provides cooling water to area room coolers located outside

containment. These coolers are contained in the Control Complex, Reactor Building Subsphere, and Nuclear Annex Ventilation Systems. These systems are discussed in CESSAR-DC Sections 9.2.9, 9.4.1, 9.4.5, and 9.4.9 respectively, and are shown in Figures 9.2.9-1, 9.4-2, 9.4-5, and 9.4-8 respectively. Each of these system has two divisions which are entirely located outside of containment and are separated by a three hour fire rated barrier.

- The Diesel Generator Building Ventilation System maintains the ambient conditions within the diesel generator rooms to ensure operation of the diesel generators and controls. This system is discussed in CESSAR-DC Section 9.4.4 and is shown in Figure 9.4-7. This system is located outside of containment and each division is separated by a three hour fire rated barrier.

- Equipment located inside containment is qualified for high post accident temperatures. Therefore, containment cooling is not required to ensure operation of safe shutdown equipment following a fire.

8. <u>OBJECTIVE</u>: Remove decay heat from the spent fuel pool.

   <u>ANALYSIS</u>: Decay heat is removed from the spent fuel pool by the Pool Cooling and Purification System. The Pool Cooling and Purification System is discussed in CESSAR-DC Section 9.1.3 and is shown in Figure 9.1-3. All components associated with the spent fuel pool cooling function are located outside of containment and each division is separated by a three hour fire rated barrier.

9. <u>OBJECTIVE</u>: Provide an assured source of on-site electrical power to equipment and components required for safe shutdown.

   <u>ANALYSIS</u>: The assured source of electrical power is either of the emergency Diesel Generators for equipment and components powered from the Class 1E busses. The electrical distribution system is discussed in CESSAR-DC Section 8.3 and is shown in Figures 8.3.1-1 and 8.3.1-2. The emergency Diesel Generators and associated Class 1E busses are located outside containment and each division is separated by a three hour fire rated barrier. The Class 1E busses are separated from the non-1E busses by two isolation breakers in series. The CVCS charging pumps are powered from the permanent non-safety busses. Emergency on-site power is supplied to these busses by the combustion turbine. The permanent non-safety busses are located in the turbine building. The Turbine Building is separated from the Nuclear Annex by a three hour fire rated barrier. The combustion turbine is located in its own

structure which is separated from the Turbine Building and Nuclear Annex. Cables from the permanent non-safety busses are separated by the divisional three hour fire rated barrier after they enter the Nuclear Annex.

b. Vital Battery Rooms, Division I, Channels A&C; Division II, Channels B&D.

c. Instrument Air Rooms.

d Unassigned Equipment Rooms.

e Charging Pump Rooms.

f. Chemical and Volume Control Equipment Room.

g. Component Cooling Water Pumps.

2. Reactor Building Subsphere

a. Turbine Driven Emergency Feedwater Pump Rooms, Divisions I and II.

b. Motor Driven Emergency Feedwater Pump Rooms, Divisions I and II.

c. HVAC equipment areas (located in each quadrant).

NOTE: Fire rated walls are located along azimuths 0° to 180° and 90° to 270° to provide fire separation for the four quadrants.

3. Diesel Generator Buildings

a. Diesel Generator Rooms, Divisions I and II.

B. Elevation 70+0 (Figure 9.5.1-3)

1. Nuclear Annex

a. Essential Battery Rooms, Division I, Channels A&C; Division II, Channels B&D.

b. Electrical Equipment Rooms, Division I, Channels A&C; Division II, Channels B&D.

c. Remote Shutdown Panel Room.

d. Cable chase, Division I, Channels A&C; Division II, Channels B&D.

e. Essential Chiller Room, Division I, Channels A&C; Division II, Channels B&D.

f. Emergency Feedwater Tank Rooms, Division I, Channels A&C; Division II, Channels B&D. I

2. Reactor Building Subsphere

1. Fuel Pool Coolant Pump Rooms, Divisions I and II.

C. Elevation 91+9 (Figure 9.5.1-5) K

1. Nuclear Annex

a. 125 VDC Battery Rooms, Non-Essential N1 and N2 Equipment Rooms I

b. Unassigned Equipment Rooms.

c. Diesel Generator Building Vent 1 & 2 Rooms. K

d. Motor Control Centers.

e. RCP Switchgear. I

f. Emergency Feedwater Tank Rooms. K

2. Reactor Building I

a. Annulus.

b. Reactor Coolant Pumps Motor Oil Drain Tank.

c. Reactor Drain Tank.

d. Cable concentrations, Division I, Channels A&C; Division II, Channels B&D. K

e. Incore thermocouple cable concentrations.

f. Control Rod Drive Cable Concentrations.

D. Elevation 115+6 (Figure 9.5.1-6) I

1. Nuclear Annex

a. Control Room. K

b. Document Room.

c. HVAC (storage) Room.

d. Unassigned Equipment Room. I

e. Main Steam Valve House, Division I & II. K

f. Spent Fuel Pool. I

g. Subsphere Exhaust Equipment Room, Division I & II. K

h. Computer Room.

2. Reactor Building I

a. Control Element Drive Mechanism (CEDM) K

b. Steam Generators, I and II. I

c. Reactor Coolant Pumps A, B, C, D K

E. Elevation 130+6 (Figure 9.5.1-7)

1. Nuclear Annex I

a. Control Room HVAC Room, Division I. K

b. Control Room HVAC Room, Division II.

c. New Fuel Storage Area. I

d. Unassigned Equipment Room.

e. Annulus Exhaust Equipment Room, Division I & II.

f. Nuclear Annex Vent. Equip. Room, Division I & II. K

g. Nuclear Annex Exhaust Equip. Room, Division II.

F. Elevation 146+0 (Figure 9.5.1-8)

1. Nuclear Annex I

a. Unassigned Equipment Room. K I

b. Hot Tool Crib Rooms. K

2. Reactor Building I

a. Pressurizer. K

b. Containment Auxiliary Carbon Filter Units. I

c. CEDM Cooling Units.

d. Reactor Vessel. K

G. Elevation 170+0 (Figure 9.5.1-9)

1. Nuclear Annex I

a. Containment Purge Equipment Room.

b. Nuclear Annex Exhaust Equipment Room, Division I.

c. Fuel Pool Ventilation Equipment Room, Division I. K

d. Fuel Pool Ventilation Equipment Room, Division II.

e. CCW Surge Tanks.

### 9.5.1.~~3.2~~ 4 Fire Rated Barriers

### 9.5.1.~~3.2.1~~ 4.1 Components of Fire Barriers

Fire barriers consist of architectural and structural features (walls, floors, and ceilings), assemblies to seal openings in fire barriers (doors, dampers, and penetration seal assemblies), and fire rated insulation material, ~~(cable wrap and radiant energy shields).~~ Each fire barrier component is tested in accordance with nationally recognized codes and standards to assure adequate fire resistance rating. INSERT #3

### 9.5.1.~~3.2.2~~ 4.2 Architectural and Structural Features I

Walls, floors, and ceiling assemblies designated as fire barriers meet the acceptance criteria of ASTM E119, "Fire Tests of Building and Construction Materials."

### 9.5.1.~~3.2.3~~ 4.3 Door Units

Door units installed in designated fire barriers meet the acceptance criteria of ASTM E152, "Fire Tests of Door Assemblies" and NFPA 80, "Fire Doors and Windows." Door units include components (i.e., door leafs, frames, latches, closures, hinges, astragal strips, and kick plates).

Door units which are provided to meet multiple design criteria such as fire, flood, pressure, and security are reviewed and analyzed to assure they will withstand the potential fire exposure. Where possible, fire barrier doors with security (or other speciality) hardware are Listed or Approved as a fire rated door unit with the hardware as part of the door unit.

### 9.5.1.4.4 Fire Dampers

Ventilation dampers installed in designated fire barriers meet the acceptance criteria of UL 555, "Fire Dampers" and NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

To allow damper inspection and maintenance, access opening in ductwork is provided adjacent to each fire barrier.

### 9.5.1.4.5 Penetration Seals

Penetration seals in fire barriers for electrical and mechanical systems meet the acceptance criteria of ASTM E814, "Fire Tests of Through Penetration Fire Stops." Conduits which penetrate fire barriers are sealed in accordance with Edison Electric Institute, "Conduit Fire Protection Research Program," report dated 6/1/87. Where cable trays and HVAC ducts penetrate fire barriers, hangers on each side (or top side) of the barrier are designed to restrain the cable tray and ducts so that failure of hangers and collapse of cable trays or ducts on either side of the barrier will not pull the penetration seal assembly out of the opening.

### 9.5.1.4.6 Fire Insulating Material

The design philosophy of the System 80+ is to provide system/equipment ~~channel and~~ division separation to preclude the need for fire rated insulating material and radiant energy heat shields. In the course of detailed design and development of the Fire Hazards Analysis, it may be necessary to use these materials to assure fire safety in accordance with the Standard Review Plan. ~~If necessary, fire rated insulating material will be rated in accordance with ASTM E119 for architectural features. Components which may be protected by fire rated insulating material include structural steel, redundant safety related cables, and safety related components.~~

INSERT #4

Electrical components protected by fire insulating material have ampacity derated based on insulating material property.

### 9.5.1.5 FIRE MITIGATING FEATURES

### 9.5.1.5.1 Isolation/Containment of Flames, Heat, Smoke, and Hot Gases

Isolation/containment of fire and products of combustion are achieved by implementing elements of the defense-in-depth concepts.

The System 80+ minimizes the available quantity of combustible material by use of fiber optic cable which reduces the number of control and signal cables (by an estimated order of magnitude

from that which would otherwise be required). Equipment location and separation by fire barriers as stated above serves to provide inherent containment of fire spread. Penetrations in fire barriers are designed to contain combustion products as well as prevent fire spread. Ventilation systems are designed to provide smoke control capabilities which are necessary to preclude the possibility of redundant safety related equipment from being damaged by fire and spread of products of combustion. The ventilation system for each area is arranged to ventilate products of combustion without spread to other areas. I

The control building ventilation system is provided with separate outside air intakes for the control room separate from the remainder of the control complex including the remote shutdown room. Separate ductwork is utilized for the control room and the remote shutdown room to eliminate smoke migration between the two areas.

INSERT #5

The Control Complex has a smoke control system which utilizes dedicated smoke exhaust fans, smoke dampers and 100% outside air supplied by the Control Complex air-handling units. The smoke purge fans are sized to exhaust three cfm per sq. ft. The smoke purge system is manually activated by the control room operator.

In the subsphere, electrical equipment rooms A, B, C and D on elevation 50+0 are separated by channel with 3 hour fire resistance barriers. The two channels within a division share a common ventilation system, but are separated by fire dampers. Smoke purge fans are utilized to prevent smoke migration from one channel to the other in the same division. J

Smoke migration between divisions in the nuclear annex is prevented by providing a 3 hour fire resistance wall between divisions with all penetrations sealed to maintain the 3 hour fire resistance barrier. No HVAC ducts will penetrate the divisional wall. Separate HVAC systems are provided for each side of the divisionally separated building. The stairwells are pressurized to prevent smoke from entering and migrating between elevations.

The ventilation systems handle smoke purge by isolation of supply air in the area in which the fire occurred. The normal exhaust system for the area will purge the smoke providing a slight negative pressure to the area in relation to surrounding areas still receiving supply air. The exhaust filter unit is bypassed in the smoke purge mode. This mode of operation is manually activated by the control room. The recirculation cooling units in an area with smoke will need a maintenance check to see if the prefilter needs replacing and the cooling coils need to be cleaned after the smoke purge is completed.

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### 9.5.1.5.2 Interior Finish Materials I

Structural materials are classified as noncombustible or fire resistive. K I

Interior finish, exposed thermal insulation, radiation shielding, and acoustical materials meet the following criteria in the installed configuration: K I

A. Flame spread of 25 or less

B. Smoke development of 450 or less

Floor coverings meet the following criterion in the installed configuration: K

- Minimum critical radiant flux of 0.45W/cm$^2$

Flame spread and smoke developed are measured in accordance with ASTM E-84, "Test for Surface Burning Characteristics of Building Materials." Critical radiant flux is measured in accordance with ASTM E-648, "Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source." K

If it is necessary to select a specific material which does not meet or has not been tested to the above qualifications (in the installed configuration), an engineering analysis will confirm that the General Design Guidelines are met and there is no reduction in the fire safe quality of the plant. I

### 9.5.1.5.3 Means of Egress

Personnel egress in the Nuclear Annex is arranged to meet provisions of NFPA 101, "Life Safety Code" or NFPA 101m, "Alternative Approaches to Life Safety." K

There are stairs in each quadrant of the Nuclear Annex enclosed by two-hour fire rated walls. Each stair tower is pressurized by a dedicated fan mounted at the top of the tower. Exit pathways are clear and unobstructed, allowing personnel egress/access. I K K

Access/egress into the Containment Building is through two personnel air locks, one located on elevation 115+6 and one located on elevation 146+0. I

Sealed beam, battery powered emergency lighting units are installed to illuminate emergency egress paths in accordance with standards of NFPA 101, "The Life Safety Code." I K

INSERT #6

Sealed beam, 8-hour minimum battery powered emergency lighting units are provided for all areas and access to areas that must be occupied for safe shutdown of the plant following a fire. J

→ 9.5.1.6

~~9.5.1.4~~ ~~Safe Shutdown Following Fire~~

The System 80+ plant arrangement and layout provides inherent separation of safety related systems, equipment and components, divisions and channels. The plant arrangement permits the unit to be taken to cold shutdown following a fire without the need to implement repairs or for operators to perform extraordinary manual actions outside of the control room or remote shutdown panel room. I

In the Nuclear Annex, each division of safety related equipment are separated by three-hour fire rated barriers. Exceptions are the control room and the remote shutdown panel room which contain safety related equipment of each division and channel. The control room and the remote shutdown panel room are essentially redundant to each other so that fire in either room will not affect the ability to achieve cold shutdown from the unaffected control system. K I

Electrical power, control, and instruments are separated and electrically independent to preclude electrical interaction and associated circuit failures in accordance with IEEE 384-1, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits." Associated circuits, as defined in Revision 1 to Generic Letter 81-12, will be avoided. J

Cables of redundant safety related divisions and channels enter the Reactor Building on elevation 91+9. Division 1, which consists of Channels A and C, enters the Reactor Building from opposite sides, as does Division 2, which consists of Channels B and D. Channels A and B, which enter the Reactor Building in close proximity, are separated by a three-hour fire rated barrier. Likewise, Channels C and D, which enter the Reactor Building in close proximity, are separated by a three-hour fire rated barrier. These cables then transgress the annulus. Each safety related channel enters the annulus in a separate quadrant and is separated from the other safety related channels by at least 20 feet, without intervening combustibles. Where it is not possible to maintain 20 feet without intervening combustibles, cables are enclosed in three-hour fire rated barriers or heat shields until 20 feet separation is achieved. Heat shields and separation distance will be justified by engineering analysis. In addition, separation will be augmented with sprinklers and automatic fire detectors if required by the analysis. Cable ampacity will be derated in accordance with the characteristics of the insulating material. I J I J

~~Inside containment, safety related cables generally are confined to their respective quadrants. Where redundant divisions of safety related cables normally used for cold shutdown converge inside containment, an engineering analysis confirms that cold shutdown can be achieved utilizing systems and equipment which would not be affected by fire at that location. In each potential Reactor Building fire scenario, cold shutdown is assured by operation from the control room or remote shutdown panel without repairs or extraordinary operator action outside of the control room or remote shutdown panel room.~~

### 9.5.1.~~6~~ 7 Fire Protection/Detection/Alarm Systems

The fire ~~penetration~~ protection water supply and distribution system configuration is as shown in Figure 9.5.1-1, "Fire Protection Water Distribution System."

### 9.5.1.~~6.1~~ 7.1 Fire Pumps and Water Supply

The fire protection water supply is provided by two, 300,000 gallon ground level storage tanks designed in accordance with NFPA 22, "Standard for Water Tanks for Private Fire Protection." Each tank is equipped with a roof vent, roof access hatch, inside and outside ladder, overflow pipe, and a water level indication instrument.

Each tank has an automatic fill system supplied from the plant treated water system. Use of treated water will preclude potential system problems and deterioration associated with raw water (i.e., biological organism invasion such as Asiatic clams and microbiologically induced corrosion). The fill system is designed to refill either tank within eight hours. Water storage tanks are heated as necessary to preclude freezing. Where heating is not practical, pumps are designed to automatically begin recirculation through tanks when ambient temperature approaches the point where freezing obstructs water flow to the pumps. I

There are two full capacity fire pumps. Each fire pump is sized to provide both the maximum water volume and system pressure demand. One pump is electric motor driven and one is diesel engine driven. Each pump is arranged to take suction from either tank. Each fire pump unit is UL Listed for the specific application. Fire pumps are designed in accordance with NFPA 20, "Standard for Installation of Centrifugal Fire Pumps." Each fire pump includes an air release valve, set of suction and discharge gauges, and main relief valve. The electric motor driven pump has a recirculation relief valve. The diesel engine driven pump is equipped with an adjustable speed governor, overspeed protection, and redundant battery units including chargers. Controllers for each pump are

UL Listed and include adjustable time delay starters and a mercury pressure switch with high and low pressure settings. The following alarms are provided:

A. Electric driven pump

1. Pump running

2. Loss of power

B. Diesel driven pump

1. Engine running

2. Controller in "manual position"

3. Low engine oil pressure

4. High engine coolant temperature

5. Failure to start

6. Shutdown from overspeed

7. Battery failure

8. Battery charger failure

The diesel fuel oil storage tank is sized to provide an eight-hour fuel supply to the diesel engine driven fire pump. The tank is located in the diesel driven pump room for environmental control and to assure fuel quality.

The motor driven fire pump and the diesel engine driven fire pump are separated by a three-hour fire rated barrier to assure that both pumps would not be damaged by a single fire. Each fire pump room is protected by an automatic sprinkler system to further reduce fire exposure.

Discharge piping of each pump is interconnected so that either pump can supply either connection to the underground water distribution system.

The fire pump test header includes a flow meter to facilitate fire pump testing and a hose header to facilitate system flushing.

Fire pump and storage tank piping is designed to provide a fully adequate water supply to sprinkler and fire hose standpipe

I

systems with one fire pump and one water storage tank out of service.

The electric motor driven fire pump is powered by the unit auxiliary power supply. Back-up power is provided by the site alternate AC power supply combustion turbine and electrically protected so that fire in the power house will not interrupt pump operation. I

A jockey pump provides system pressure maintenance to avoid starting of the main fire pumps under nonfire conditions. K

### 9.5.1.7.2 Water Distribution System, Hydrants, and Hose Houses

Underground water distribution piping is cement lined ductile iron or plastic which is UL Listed or Factory Mutual Approved for fire service. Interior and above ground pipe is galvanized carbon steel which complies with ASTM A53, "Standard Specification for Welded Pipe, Steel, Black and Hot Dipped, Zinc Coated and Seamless Steel Pipe." Piping is "looped" around the power block and cross- connected within the Nuclear Annex so that sprinkler systems have redundant water supply flow paths. Two pipes penetrate containment, to provide redundant water supplies to primary and back-up fire protection systems.

Piping is sized based on water flow with the shortest flow path out of service. Calculations are based on anticipated internal pipe roughness after 60 years of service. I

Sprinkler systems and hose station connections to the water distribution system are arranged so that a single impairment will not isolate primary and secondary protection for any area.

Fire hydrants are located about 250 feet apart around the yard loop. Hydrants are provided with individual isolation valves so that they can be individually isolated for repair. Each hydrant has 2-2½ inch outlets individually controlled by gate valves. Fire hose houses are located near alternate fire hydrants. Hose house equipment includes:

A. 350 ft of 2½ inch fire hose

B. 150 ft of 1½ inch fire hose

C. 2-2½ inch x 1½ inch gated wye connectors

D. 2-2½ inch adjustable spray nozzles

E. 2-1½ inch adjustable spray nozzles

F. 2-2½ inch hose coupling gaskets

G. 2-1½ inch hose coupling gaskets

H. 4 coupling spanner wrenches

I. 1 hydrant wrench

Where hydrants or hose houses are subject to damage by vehicle damage, appropriate guards and barriers are provided for protection.

Sectional isolation valves are located throughout the water distribution system to assure that any portion of the distribution system that serves buildings containing safety related systems, equipment, and components can be ~~impaired~~ repaired without isolating primary and secondary fire protection.

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The fire protection water distribution system complies with NFPA 24, "Standard for Private Fire Service Mains."

Piping, valves, fittings, and fire hydrants are designed for 175 psi operating pressure.

### 9.5.1.7.3 Automatic Sprinkler Systems

A. Description

Automatic preaction sprinkler systems are utilized for fixed fire protection in the Nuclear Annex, Reactor Building, and the alternate AC source - Combustion Turbine, as determined by the Fire Hazard Analysis. Wet pipe automatic sprinkler systems are used where preaction type systems are not mandated by the plant Design Basis.

A preaction sprinkler system consists of a piping distribution system which supplies water to sprinkler heads which are located based on engineering analysis and requirements of NFPA 13, "Standard for Installation of Automatic Sprinkler Systems," to assure adequate water distribution and to preclude the possibility of interference with the water distribution pattern due to obstruction by other plant equipment and components. Sprinkler heads are normally closed and are actuated by heat sensitive elements. Actuation temperatures of these elements are based on the individual location and application. Distribution piping between the system control station and sprinkler heads is

normally dry and supervised with air or nitrogen. Water is held at a speciality "preaction valve" at the system control station. The system includes a fire detection subsystem activated by fire or smoke detection devices, selected by engineering analysis for the specific location and application based on the Fire Hazards Analysis. Upon activation of a fire detection device, the automatic preaction control valve opens, allowing water into the piping system. J

Water is then discharged only through sprinkler heads in which the heat sensitive element has actuated, thereby applying water only to the area involved in fire. Each preaction sprinkler system has a manual control valve immediately upstream of the preaction control valve and mechanical trim to accommodate testing and maintenance. Alarms monitor system air pressure and water flow. Each system alarms and annunciates locally and in the control room to alert station personnel to actuation. The main control station is located outside of the protected area. I

Two inch drains and inspector's test connections are provided to test system water flow and alarm operation. Each drain and test connection is arranged to discharge into a station drain for water control.

B. Coverage

INSERT # 8

The following areas are protected by automatic preaction sprinkler systems:

1. Elevation 50+0, Nuclear Annex

   a. Janitorial/Health Physics Storage/Work Area.

   b. Maintenance Work Areas.

   c. Personnel Aisles.

   d. General Storage Areas. K

   e. Diesel Generator Buildings.

   f. Primary Chemistry Lab Area.

   g. Chemical and Volume Control Pump Room.

   h. Chemical and Volume Control Equipment Room.

2. <u>Elevation 50+0, Reactor Building</u> I

   a. Turbine Driven Emergency Feedwater Pump Rooms, Divisions I and II.

3. <u>Elevation 70+0, Nuclear Annex</u> K

   a. Channel A, B, C, D Personnel Access Aisles.

   b. Essential Chilled Water Areas.

4. <u>Elevation 91+9, Nuclear Annex</u> I

   a. Personnel Access Areas. K

   b. Radiation Access Control.

   c. Maintenance Areas - (Hot Machine Shop, Decontamination Room and Truck Bay). I

5. <u>Elevation 115+6, Nuclear Annex</u>

   a. Storage Room. K

   b. Maintenance Area. I

   c. Tool Storage Room.

   d. Personnel Decontamination Areas. K

   e. Break Room. I

6. <u>Elevation 115+6, Reactor Building</u> K

   a. Reactor Coolant Pump Motors.

7. <u>Elevation 130+6, Nuclear Annex</u> I

   a. Technical Support Center. K

   b. Maintenance Area. I

8. <u>Elevation 146+0, Nuclear Annex</u> K

   a. Maintenance Area. I

   b. Hot Tool Crib Rooms. K

   c. Personnel Decontamination Areas.

Sprinkler system design specifications (i.e., design density over the designed operating area) is determined by the Fire Hazards Analysis. Each system is designed based on the available water supply with 750 gpm reserved for hose streams.

C. Systems Interaction

1. Sprinkler system piping is seismically restrained to avoid interaction with systems, equipment, and components which must function following the design basis seismic event.

2. Sprinkler head locations are selected and analyzed to assure that water spray does not expose redundant equipment required to achieve cold shutdown or high voltage electrical equipment which may result in a personnel hazard.

3. Sprinkler systems are analyzed to assure that pipe break/water spray does not potentially expose redundant equipment required for cold shutdown.

4. Sprinkler system drains and test connections are routed to unit drains to control water discharge.

5. In areas where equipment is subject to damage by water accumulation, floor drains are provided or equipment is installed on elevated platforms to avoid damage.

6. Sprinkler heads are located as required by NFPA 13. Other plant equipment and components are located so that they do not obstruct the designed sprinkler water discharge pattern. If obstruction is unavoidable, additional sprinkler heads are installed to assure proper water distribution.

7. Where installed, automatic sprinkler systems are considered primary protection. Portable extinguishers and fire hose stations are provided for back-up protection.

INSERT #9

Sprinkler system components including manual isolation valves, preaction control valves, pipe, fittings, hangers, sprinkler heads, and detectors are Underwriter's Laboratories Listed or Factory Mutual Approved for use in fire protection systems. An exception to listed or Approved equipment is containment isolation valves which are not available as listed or Approved.

tank supplying a 150gpm seismically designed pump

## 9.5.1.7.4 Fire Hose and Standpipe Systems

Fire hose and standpipe systems consists of piping connections to the water distribution system, manual isolation valves, and 1½ inch fire hose. These systems are installed in accordance with NFPA 14, "Installation of Fire Hose and Standpipe Systems."

Fire hose and standpipe systems are designed to be operational following the design basis earthquake. The primary water supply to the standpipe system is from the fire protection water distribution system. Each connection of the standpipe system to the fire protection water distribution system includes a manual isolation and a back flow prevention check valve which are seismically qualified. A 18,000 gallon seismically designed pressurized water storage located in the Nuclear Annex is connected to the fire hose standpipe system downstream of the check valves. The water storage tank will provide 75 gpm at a minimum of 65 psi to any two fire hose stations in the Nuclear Annex or Reactor Building for two hour duration. In the event of loss of the fire protection water distribution system following a seismic event, the fire hose standpipe system can supply the specified volume and pressure to two fire hoses in the safety related portions of the station.

Fire hose stations are designed for Class III service (for use by building occupants and a fully trained structural fire brigade) as defined by NFPA 14, "Fire Hose and Standpipe Systems." I

Standpipe system piping is sized to supply 500 gpm at a minimum 65 psi pressure from the primary water supply and 150 gpm from the seismically designed back-up water supply. Each hose connection to the standpipe includes a 1½ inch and a 2½ inch connection. Connections have pressure reducing orifices if necessary to maintain a maximum system pressure at 100 psi for firefighter safety.

Hose stations are located so that any location where safety related equipment may be damaged by fire can be reached with at least one effective hose stream.

Hose stations are equipped with 1½ inch fire hoses which are a maximum of 100 feet long. Hose stations which protect electrical equipment have adjustable spray nozzles qualified for use on energized electrical equipment.

Fire hoses, isolation valves, and hose nozzles are Underwriter's Laboratories Listed or Factory Mutual Approved for use in fire service. An exception is containment isolation valves which are not available as listed or Approved.

### 9.5.1.~~5.5~~ 7.5 Portable Fire Extinguishers

Portable fire extinguishers are located and arranged in accordance with NFPA 10, "Standard for Installation and Use of Portable Fire Extinguishers." An exception is that fire hose stations are utilized for Class A fires except in the control room and computer room where a water based extinguisher rated at 2A is installed.

Portable extinguishers are located such that extinguisher can be reached with a maximum of 75 feet of travel from any protected location. An exception is that in high radiation areas where the Fire Hazards Analysis determines that there is a minimum of combustible materials and a minimum of risk to safety related equipment or equipment necessary to maintain unit availability, fire extinguishers are located outside of the area where responding fire brigade members can obtain an extinguisher and carry it into the area for use. This is consistent with ALARA principles.

Due to the potential for chemical corrosion of safety related equipment and components, dry chemical extinguishers are not installed in safety related portions of the station. Dry chemical extinguishers are located in the fire brigade equipment room and are used at the discretion of the fire brigade captain.

Inside containment, during power operation, fire extinguishers are located near the personnel access portals (rather than throughout containment). During maintenance outages, additional fire extinguishers will be moved into containment to support maintenance activities.

Fire extinguishers are located to be accessible. Locations are clearly marked to be prominently visible.

Fire extinguishers are Underwriter's ~~Laboratory~~ Laboratories Listed or Factory Mutual Approved for use in fire protection service.

### 9.5.1.~~5.6~~ 7.6 Fire Detection and Alarm System

INSERT #10

~~A fixed automatic fire detection system is installed in the Nuclear Annex and portions of the Reactor Building. Areas covered by the fire detection system are established by the Fire Hazards Analysis based on the potential hazard risk to safety related equipment and equipment necessary to maintain unit availability, potential detector effectiveness (based on engineering technique of NFPA 72, "Fire Detection and Alarm Systems"), and ALARA concerns. The fire detector system design~~

philosophy is to cover areas which contain major electrical equipment and components (such as control rooms, system transfer switches, computers, switchgear, motor control centers, battery, inverters, and technical cabinets), major safety related pumps, ventilation equipment areas, and areas containing substantial quantities of combustible material such as change room storage, contaminated area step off pads, and laundry areas. I

The type of fire detectors considered for use in the System 80+™ are as follows: K

A. Heat detectors - designed to operate at predetermined ambient temperature.

B. Ionization and photoelectric smoke detectors - designed to operate in the presence of particles of combustion.

C. Flame detectors - designed to operate by detection of infrared, visible, or ultraviolet radiation.

D. Continuous line type detection - designed to operate when exposed to a predetermined ambient temperature. ~~rate-of-rise~~.

Detectors are specifically selected for each location based on potential fire hazard, need for timely actuation, ambient conditions, ventilation and ceiling height, as determined in the Fire Hazards Analysis. I

~~Detectors~~ Spot type detectors are "addressable." The central control panel is a microprocessor based "intelligent" system. This arrangement allows detector sensitivity and function to be determined at the control panel.

Manual pull stations are addressable and are located as determined by the Fire Hazards Analysis. Either manual pull stations or individual fire detectors can activate the central control panel which initiates alarm and annunciation in the control room and locally in the vicinity of the activated device.

The control panel is located in the control room for operator convenience.

The fire detection and alarm system is powered from the station auxiliary, safety grade, power distribution system. The control panel contains back-up batteries capable of supplying power to detection system for 24 hours consistent with requirements of NFPA 72, "Fire Detectors and Alarm Systems."

Failure of the fire detection and alarm system would not affect operation of other plant systems.

Fire detectors, control panels, and manual pull stations are Underwriter's ~~Laboratory~~ Listed or Factory Mutual Approved for fire protection service.

## 9.5.1.~~8~~ System Interfaces

### 9.5.1.~~8.1~~ Emergency Lighting

Sealed beam, battery powered lights are located, as determined by the Fire Hazards Analysis, for personnel egress in accordance with NFPA 101, "Life Safety Code," as well as in the control room, Technical Support Center, Operations Support Center, the Remote Shutdown Panel Room, and the stairway which provides access from the Control Room on elevation ~~70+0~~ and to elevation ~~50+0~~ where the ~~reactor trip switchgears are located. Emergency lights will also be provided along the pathways between the Control Room and the transfer switches which are used to transfer control of the~~ Remote Shutdown Panel Room.

Batteries of these emergency lights are designed for eight hours continuous operation following loss of station auxiliary power. Bulbs are located so that adequate illumination is provided and is not obstructed by plant equipment and components.

Battery powered, emergency lighting units are Underwriter's Laboratory Listed.

### 9.5.1.~~8.2~~ Ventilation Systems

Fire and smoke control are recognized as important elements of the overall fire protection program. The ventilation systems are designed in accordance with NFPA 90A, "Air Conditioning and Ventilation Systems" and NFPA 204M, "Smoke Control Systems."

Ventilation Systems are division-specific so that fire or smoke in an area containing a safety related division of equipment cannot migrate through the ventilation ducts to an area containing the redundant division of safety related equipment. Fire dampers are installed in fire rated barriers and have the same fire resistance rating as the barrier. Exceptions are the Containment Purge and Pressure Control Systems and Annulus Ventilation System which must function following some plant design basis accidents to prevent release of radioactivity. Fire dampers are not installed in these systems because failure or spurious actuation would interfere with system safety function. ~~Portions of~~ The Nuclear Annex Control Complex Smoke ~~Control~~ System motor operated smoke control dampers ~~are~~ installed in lieu of thermally operated, automatic closing fire dampers as described below.

The smoke control design philosophy is to allow for smoke venting from any plant area without spreading to adjacent areas, to maintain plant habitability for operator protection and to ensure protection of the public. The containment, subsphere, fuel pool, nuclear annex and two diesel buildings are each served by 100% outside air and 100% exhaust ventilation systems.

Smoke control and exhaust is accomplished by aligning the ventilation to supply 100% outside air and to exhaust directly to the outside. Smoke and gases containing radioactive materials are routed through a filter train to the unit vent if a radioactive signal is received. The control complex has smoke exhaust fans to remove smoke from specific areas as determined by control operators utilizing signals from smoke detectors located in exhaust and return air ducts. The control operator aligns dampers to exhaust an area where fire occurs while isolating exhaust and return air in adjacent areas while supply dampers remain open to create a slight positive pressure in adjacent areas. I

During the smoke purge mode of operation, the filter units are isolated and the smoke is bypassed around the filter units to the atmosphere. The smoke purge is manually activated by the control room after the fire is extinguished completely. Recirculation cooling units in the smoke filled areas will need a maintenance check to see if the prefilters need replacing and the cooling coils need to be cleaned after the smoke purge is completed. J

A moisture eliminator is provided in each exhaust filter unit upstream of the charcoal and HEPA filters to remove entrained particulate water in the airstream. Electric heaters are provided downstream of the moisture eliminators to vaporize the water particles not removed by the moisture eliminators.

Fresh air intakes are located remote from the ventilation system exhaust to preclude the possibility of contaminating the intake air with products of combustion.

Stairwells in the Nuclear Annex are individually pressurized with roof-mounted fans to preclude smoke infiltration.

Carbon and high energy particulate air (HEPA) do not represent a potential exposure fire hazard to nearby safety related components. Carbon, used in carbon filters, has a minimum ignition temperature of 625°F. HEPA filters have a minimum ignition temperature of 600°F. Normal heating system air temperature is about 105°F. If the air temperature approaches 200°F, carbon will begin to release any adsorbed radioactive iodine. If an air temperature excursion occurs in the safety related ventilation system with carbon or HEPA filters, the heat sensor will cut off the filter train fan and the redundant fan I

serving the redundant division will begin to serve the area involved; therefore, the fire will be isolated. I

### 9.5.1.8.3 [redacted] Equipment Water Shields

Protection of equipment susceptible to water damage required for safe shutdown of the plant from inadvertent or advertent discharge of water from fire protection systems will be through use of water shields, conduit seals, curbs and drains, and equipment pedestals.

[redacted] It is not expected that shielding from the effects of water spray from overhead sprinkler systems will be necessary. Sprinklers in safety related areas will be of the automatic pre-action type that requires the activation of an automatic fire detector and fusing of a sprinkler head prior to releasing water. A pipe break downstream of the pre-action control valve will not release water. Shielding from spray from manual fire fighting operations will not be required outside of containment. Redundant safety related equipment is separated with 3-hour fire rated barriers which will confine the fire and fire fighting operations to a single area. From a safe shutdown standpoint it is assumed that the fire will render the equipment in the affected area inoperable, and safe shutdown will be of no consequence. All penetration seals in floors and walls up to a height of 24 inches will be waterproofed to prevent water from the affected area from migrating to adjacent areas. J

Safety related equipment in close proximity to fittings in the standpipe and interior fire hose system will be shielded as necessary to prevent damage from inadvertent discharge. Shielding location will be finalized following as-built walkdowns.

Inside containment, where redundant division equipment is located in close proximity, (i.e, within 20 feet of each other), such as the motor operated depressurization valves located at the pressurizer, shielding will be provided as deemed necessary following interaction review during detailed design and as-built walkdowns.

[redacted] The open ends of all vertical conduit, and the open ends of all horizontal conduit that terminate within 18 inches of a floor, will be sealed to prevent water infiltration.

### 9.5.1.8.4 [redacted] Curbs and Drains

Where fixed fire protection systems are installed, floor drains are provided, sized to collect water discharge. In areas where drains are not installed due to pressure boundary constraints, I

equipment susceptible to water damage is installed on six-inch elevated curbs.

Floor drains installed in areas where radioactive material may be entrained in water discharge are routed to the radioactive water sump so that it can be analyzed and treated if necessary before release to the environment.

In areas containing combustible liquids, floor drains are designed with water seal traps so that burning liquids cannot flow into adjacent safety related areas through the drainage system.

### 9.5.1.3.5 Reactor Coolant Pump Motor Oil Collection System

Each reactor coolant pump motor contains about 250 gallons of oil used as a heat exchanger medium for motor cooling and for bearing I
lubrication. To preclude the potential for oil escaping from the motor, an oil collection shroud is installed. When combustible oil is used, the oil collection shroud is designed to withstand the design basis earthquake. Where fire resistant oil (similar to that commonly used in turbine governor control systems) is used, the system is not seismically qualified but is seismically restrained to prevent falling on other safety related equipment. The shroud encloses the upper and lower oil reservoirs and related piping so that any potential pressurized and nonpressurized leakage points are contained. The shroud is drained through a collection pipe to the reactor coolant pump motor oil drain tank, located in the lowest level of containment elevation 91+9. Each drain tank is located within a dike, sized to contain the full inventory of the motor oil. The vent for each tank has a flame arrestor to prevent the possibility of burning oil vapor propagating into the tank. Each tank will be provided with inventory level indication which is alarmed and J
annunciated in the control room.

### 9.5.1.3.6 Fire Brigade Radios

The station radio system includes a dedicated frequency for fire brigade use. Dedicated radio units for fire brigade use are located in the fire brigade equipment storage room. Radios are stored in the charger base to assure they are fully charged when needed. The frequency is selected to assure that plant security I
communication and protective relay systems are not affected. There are an adequate number of units for at least five fire brigade members, leaders, and spare units for additional brigade members and operators.

The fire brigade radio system has fixed repeaters located so that fire brigade members can communicate with each other and the control room from any location of the plant. Fixed repeaters are

located and wiring routed so that radio communication is available following fire in any area of the plant.

### 9.5.1.8.7 Fire Brigade Breathing Air System

Fire brigade personnel protective equipment includes breathing air cylinders. There is an adequate quantity of cylinders for each fire brigade member (and a quantity of spare cylinders as determined appropriate by the Fire Brigade Leader) located in the Fire Brigade Equipment Storage room. In addition, a breathing air compressor is provided in an area which would not be susceptible to fire in a safety related area, and that is free of airborne contaminants under normal conditions. The compressor will be oil free or equipped with high temperature and carbon monoxide alarms in accordance with 29 CFR 1910.134 (OSHA) Section 1910.134, Respiratory Protection. The breathing air compressor is powered from the Alternate AC Source - Combustion Turbine. Power and control cables for the breathing air compressor are routed and protected to assure that fire in a safety related portion of the station which requires the use of fire brigade Self-Contained Breathing Air (SCBA) units will not interrupt operation of the breathing air compressor.

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### 9.5.1.9 Startup and Recurring System Tests and Inspections

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### 9.5.1.9.1 Fire Pumps

A. Acceptance Test Criteria

1. Hydrostatic Tests

   Pump suction piping (except short lengths between suction tanks and pumps) and discharge piping (up to the pump discharge isolation valve) are pressure tested at 200 psi or at 50 psi in excess of the maximum static pressure if the maximum static pressure is in excess of 150 psi for two hours. Maximum allowable leakage is two quarts per hour per 100 gaskets or joints.

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2. Performance Tests

   Fire pumps are performance tested in accordance with NFPA 20, "Standard for Centrifugal Fire Pumps."

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   a. Pumps are tested at minimum flow, rated flow, and 150% of rated flow. Performance shall be within ± 5% of the manufacturer's characteristic performance curve for flow and pressure. Voltage shall be within 5% below or 10% above the rated nameplate voltage.

b. Pumps are started and brought up to speed without interruptions under rated flow conditions.

c. Fire pump controllers shall perform at least 10 automatic and 10 manual starts, with the pump driver operating for at least five minutes at full speed during each operation. Controller operation is initiated by each starting feature (i.e., pressure switch, manual start button, remote start switch). Test of controllers of diesel engine driven pumps shall be divided between redundant battery sets. Each pump operates continuously for at least one hour without overheating or excessive vibration.

d. Local and remote alarms are verified during acceptance testing.

e. The transfer switch which aligns the motor driven fire pump to the Alternate AC Source - Combustion Turbine shall be verified. At least half of the manual and automatic pump operations during the acceptance test are performed with the pump power source aligned to the Alternate AC Source - Combustion Turbine bus. I

f. Proper operation of the jockey pump, motor controller, and pressure switch is confirmed.

B. Recurring Test

1. Annual Test

Fire pumps are performance tested in accordance with NFPA 20, "Standard for Centrifugal Fire Pumps."

a. Fire pump controllers each perform at least one start by each automatic and manual starting feature. The fire pump driver operates at full speed for at least five minutes.

b. Pumps are flow tested at minimum flow, rated flow, and 150% of rated flow. Flow and pressure performance shall be within 5% of the manufacturer's characteristic pump curve.

c. Pressure settings for relief valves and pressure switches are tested to assure performance at set points.

d. The diesel engine driven fire pump controller is started with both sets of batteries. The motor driven fire pump is transferred under load from the primary to the back-up power supply.

e. Test relief valves for actuation at the proper setting.

f. Proper operation of the jockey pump unit is verified.

2. Weekly Tests

Pumps are tested weekly to assure automatic starting upon system pressure drop. The diesel engine driven pump runs for at least 15 minutes, and the motor driven pump operates at least five minutes without excessive vibration or leakage at the packing. Diesel fuel tank levels are checked to assure an adequate supply. I

### 9.5.1.9.2 Water Distribution System

The water distribution system is tested in accordance with NFPA 24, "Standard for Private Fire Service Underground Mains."

A. Acceptance Tests

1. Hydrostatic Tests

The water distribution system is hydrostatically tested at 200 psi or at 50 psi in excess of the maximum static pressure if the maximum static pressure is in excess of 150 psi for at least two hours. Allowable leakage is up to 2 quarts per hour per 100 pipe joints. J

2. Flow Tests

a. Flow tests are conducted to assure adequate and unobstructed flow through each flow path of the water distribution system. The minimum acceptable flow rates are as follows: I

- 12 inch pipe 3520 gpm
- 10 inch pipe 2440 gpm
- 8 inch pipe 1560 gpm
- 6 inch pipe 880 gpm

These flow rates result in flow velocity of at least 10 feet per second.

Each fire hydrant is operated to assure that distribution piping is unobstructed.

b. Water flow is conducted through each flow path of the water distribution system to assure that the minimum calculated flow and pressure is available.

c. Manual control valves are cycled to assure proper operation.

d. Hose house equipment is inspected to assure there is no visible damage to equipment and hose hydrostatic tests are current.

B. Annual Tests

Flow tests are conducted for each flow path of the water distribution system to assure the minimum flow and pressure (based on engineering calculations) is available.

### 9.5.1.9.3 Automatic Sprinkler Systems

Automatic sprinkler systems are tested in accordance with NFPA-13, "Standard for Installation of Sprinkler Systems." I

A. Acceptance Tests

1. Hydrostatic Tests

Automatic sprinkler systems are hydrostatically tested at 200 psi or 50 psi above the maximum operating pressure for at least two hours with no visible leakage.

2. Performance Tests

a. Preaction valves are functionally tested by a simulated signal on a detector actuation device and by remote and local manual actuation devices.

b. Air pressure maintenance devices and flow switches are tested to assure proper operation.

c. Inspector's test connections and two inch drains of each system are flow tested to assure piping is unobstructed and remote and local alarms operate properly.

d. Each branch line and cross main is flushed to assure that piping is unobstructed.

B. Annual Tests

1. Control valves are cycled to verify proper operation.

2. Inspector's test connections are flow tested to assure that piping is unobstructed and remote and local alarms operate properly.

3. Preaction valves are actuated by local manual actuation device which is part of the valve body trim.

4. Detector circuits which actuate preaction systems are functionally tested by simulated signal to assure circuit continuity.

C. Monthly Tests

Two inch drains are flow tested to assure that piping is unobstructed and remote and local alarms operate properly.

<u>NOTE</u>: Automatic sprinkler systems in the containment building (and other areas which are inaccessible during power operation) are inspected and tested during maintenance and refueling outages. I

### 9.5.1.9.4 Hose Station and Standpipe Systems

Hose station and standpipe systems are tested in accordance with NFPA 14, "Standard for the Installation of Hose Station and Standpipe Systems."

A. Acceptance Tests

1. Hose station and standpipe system piping is hydrostatically tested at 200 psi or at least 50 psi above normal system pressure for at least two hours with no visible leakage.

2. Hose stations and standpipe systems are flushed with a sufficient volume of water so as to remove all construction debris and trash that may accumulate during installation.

3. A flow test is conducted at the hydraulically most remote outlet to assure that at least 500 gpm is available at 65 psi.

B. Triennial Tests

Interior fire hoses are hydrostatically tested in accordance

C. Annual Tests

1. Exterior fire hoses are hydrostatically tested in accordance with manufacturer's instructions.

2. Hose stations are visually inspected to assure that there is no visible degradation.

### 9.5.1.9.5 Fire Detection and Alarm Systems

Fire detection and alarm systems are tested in accordance with NFPA 72, "Fire Detector and Alarm Systems."

A. Acceptance Test

1. Detectors are actuated by simulated signal to assure that sensitivity is within Listed or Approved tolerances.

2. The system is tested to assure that each manual pull station and detector device and activation circuit properly actuates local alarm and remote alarm and annunciation.

3. Loss of primary system power is simulated to assure that the back-up battery power supply assumes the load. Alarm conditions are simulated while the system is powered by the back-up battery to assure proper operation.

4. System trouble alarm is simulated by removing detectors from the circuit. The test assures that a trouble alarm does not incapacitate the unaffected portions of the system.

B. Annual Tests

Detectors are actuated by simulated signal to assure that sensitivity is within Listed or Approved tolerances.

### 9.5.1.9.6 Portable Fire Extinguishers

Portable fire extinguishers are tested in accordance with NFPA 10, "Portable Fire Extinguishers."

A. Acceptance Tests

Portable fire extinguishers are visually inspected to assure there is no obvious defects and that the extinguisher is properly charged.

B. Five Year Intervals

Water fire extinguishers are discharged and cylinders are hydrostatically tested.

C. Twelve Year Intervals

Carbon dioxide fire extinguishers are discharged and cylinders are hydrostatically tested.

### 9.5.1.[redacted] 9.7 Smoke Control

Smoke control features of the HVAC system are tested in accordance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems" and NFPA 204M, "Smoke and Heat Venting."

A. Acceptance Tests

1. Fire dampers are drop tested under anticipated air flow conditions to assure proper operation.
2. The ventilation system for each area is aligned for smoke ventilation (i.e., 100% fresh air intake and 100% exhaust) to assure damper controls function properly.
3. Smoke dampers in return air ducts are actuated to assure proper operation. I

### 9.5.1.[redacted] 9.8 Emergency Lighting

A. Acceptance Tests

1. Lighting units are inspected to assure that each bulb is properly directed and unobstructed.
2. Ten percent of the lighting units are tested utilizing battery power to assure operation for the designated duration.

B. Annual Tests

1. Lighting units are inspected to assure that each bulb is properly directed and unobstructed.
2. Ten percent of the lighting units are tested utilizing battery power to assure operation for the designated duration.

### 9.5.1.9.9 Fire Brigade Radios

A. Fire brigade radios are functionally tested, during preoperation testing, in each area of the plant to assure proper operation.

B. Fire brigade radios are tested as part of station fire drills to assure continued proper operation.

### 9.5.1.10 Control of Combustible Materials

A program is established control of storage, use and disposal of combustible material. Combustible materials are defined as those materials which will ignite, burn, support combustion, or release combustible vapors when exposed to fire or heat in the installed configuration. I

### 9.5.1.10.1 Structures, Equipment, and Components

A. Structures

Structures are comprised of noncombustible material. Some interior finish materials are of limited combustible construction with the following fire resistive characteristics:

1. Maximum flame spread of 25
2. Maximum smoke development of 450
3. Minimum critical radiant flux of .45W/cm$^2$

Notes 1 and 2 are acceptance criteria of ASTM E-84, "Test for Surface Burning Characteristics of Building Materials" Note 3 is obtained from [illegible], "Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source." ASTM E-643 K

B. Equipment

Some plant equipment contains synthetic materials such as neoprene plastic and nylon parts. These quantities are not present in concentrations which would create a significant fire hazard. Locations containing significant quantities of plastic material such as cable insulation are evaluated in the Fire Hazards Analysis to consider the potential affects of combustion such as heavy smoke production and generation of corrosive and toxic gases. I

Bulk hydrogen storage cylinders are located outside of the Nuclear Annex within the protected area. In safety related areas of the plant, hydrogen piping is designed to Seismic Category 1 requirements.

Reactor coolant pump motors each contain about 250 gallons of oil for cooling and lubrication. Potential leak points are enclosed in a seismically designed oil collection shroud which drains to a full capacity, seismically designed tank in the basement of the Reactor Building. Thus, oil escaping from the reactor coolant pump motor would not create a potential fire hazard. (An option under consideration is use of fire retardant oil similar to that commonly used in turbine governor systems, which would reduce the potential for ignition and severity of a fire. An oil collection and drain system would be provided but would not be seismically qualified).

Some safety related pumps contain small quantities of lubricating oil or grease. These pumps are reviewed on an individual basis in the Fire Hazards Analysis. Fire protection features are provided as determined appropriate. I

C. Components

The majority of in situ combustible materials in safety related areas of the plant consists of plastic insulation of power, control, and instrumentation cables. Use of fiber optic cables from the control room and individual multiplexer panels in designated train-specific areas, reduces the quantity of combustible cable insulation by an estimated order of magnitude. Further, locations containing significant quantities of combustible materials are investigated in the Fire Hazards Analysis to consider the potential affects of burning, such as heavy smoke production and generation of corrosive and toxic gases.

Some piping and HVAC insulation consists of synthetic rubber type products, where moisture control is a significant concern.

### 9.5.1.~~9.2~~ 10.2 Flammable and Combustible Liquids

Two above ground diesel fuel oil storage tanks (typically 67,500 gallons each) are located on either side of the Nuclear Annex, Diesel Generator Rooms. Storage complies with NFPA 30, "Flammable and Combustible Liquids Code."

There is a diesel fuel oil day tank (typically 900 gallons) in each diesel generator room. Each tank is surrounded by a full height (of the tank) concrete dike sized to contain 110% of the tank capacity. Penetrations in the dike are sealed. Drains are provided within the dike to remove spillage to a safe location. Tank vents are routed outside of the room.

The Alternate AC Source - Combustion Turbine (CT) is located remote from the Nuclear Annex such that fire involving the CT will not affect nuclear safety related equipment. Fire protection features are provided for the Combustion Turbine, consistent with the Fire Protection Design objectives as determined appropriate by the Fire Hazards Analysis.

Storage of flammable and combustible liquids complies with NFPA 30, "Flammable and Combustible Liquids." Cleaning fluids and solvents are normally used in quantities of one gallon or less.

### 9.5.1.10.3 Combustible Contents

#### 9.5.1.10.3.1 Combustible Furnishings

In areas designated as personnel work stations, change rooms, break rooms and combustible material storage areas, combustible furnishings, and work related material are present. In these areas, the Fire Hazards Analysis assesses the potential for fire ignition, growth, and consequences.

Based on this assessment, fire protection features are provided to assure that the Fire Protection Design Basis Goals and Objectives are met.

#### 9.5.1.10.3.2 Transient Combustible Material

An administrative control program assures the amount of transient combustible material in safety related areas are properly managed and that additional fire protection features provided as appropriate. When specific tasks are completed or at the end of each shift, combustible waste material is collected and moved to the designated waste collection area.

Portable cylinders of flammable and combustible gases are used in the Nuclear Annex and Reactor Building. An administrative control program implements a permit system to assure control of use and storage of these cylinders.

Storage and disposal of anticontamination clothing at radiation control zone (RCZ) step-off pads is recognized as a potentially significant transient combustible fire hazard. Therefore, anticontamination clothing is stored in enclosed storage cabinets. Cabinet doors are normally closed as required by station directives. Used anticontaminated clothing is placed in metal drums which have fusible link actuated or otherwise Listed or Approved covers. Fire protection and detection features are provided for step-off pad areas based on conclusions of the Fire Hazards Analysis.

### 9.5.1.11 Fire Protection Program

#### 9.5.1.11.1 Fire Prevention

A. Control of Hot Work

Cutting, welding, and grinding operations are governed by a permit system as required by station administrative controls. Each task is reviewed and an adequate number of trained and qualified fire watch patrols established to assure that hot slag or sparks do not ignite nearby in situ combustible material and that transient combustible materials are relocated outside the vicinity. Fire watch is maintained for at least 30 minutes after completion of hot work to assure that residual hot material does not ignite nearby combustible material.

B. Housekeeping

Station directives, developed based on the Fire Hazards Analysis, determine an appropriate quantity of combustible material that can be located in any area of the plant. Where it is necessary to exceed the allowable quantity of combustible material in an area, a permit system is established to determine appropriate additional fire protection features and the allowable duration of the variation.

Designate plant functional groups have material responsibility for specific plant areas and are responsible for housekeeping in these designated plant areas.

Plant management conducts regular housekeeping inspections to assure that the housekeeping program is being properly implemented and that violations are promptly corrected.

## 9.5.1.11.2 Personnel Qualifications

A. Fire Protection Engineer

The individual responsible for developing and implementing the overall fire protection program is designated as the Fire Protection Engineer. The Fire Protection Engineer is a ~~Registered Professional Engineer and~~ graduate of an ~~accredited~~ engineering curriculum of acceptable standing with at least six years of engineering experience, three of which have been in responsible charge of fire protection engineering activities.

B. Fire Chief

The individual designated as Fire Chief has certification as a firefighter training instructor. In addition, the Fire Chief has experience in organizing, instructing, training, drilling, and critiquing an industrial fire brigade.

C. Fire Brigade Members I

Fire brigade members have completed an initial 40 hours training consisting of a 40-hour course which includes classroom instruction and practical fire fighting training. Each member has passed a physical examination to assure ability to participate in fire brigade activities.

Fire brigade members receive annual requalification training and physical examination.

D. Fire Protection System Operation, Testing, and Maintenance

Functional groups responsible for fire protection system operation, maintenance, and testing are qualified by training and experience and understand functions of the system.

## 9.5.1.11.3 Fire Brigade Organization, Training, and Records

The plant fire brigade is fully qualified for structural fire fighting. There are at least five fire brigade members on duty at all times. J

Fire brigade members receive annual physical examinations to assure ability to perform fire fighting activities.

Fire brigade members are provided with the following personnel protective equipment:

A. Turnout coats

B. Boots

C. Gloves

D. Helmets

E. Self-contained breathing apparatus (SCBA) with full-face, positive pressure mask rated for 60 minute duration.

In addition, the fire brigade organization is provided with the following equipment:

A. Breathing air compressor

B. Radio communication system

C. Portable battery powered lights

D. Portable smoke ~~purge fans~~ ejectors and/or positive pressure ventilation fans

E. Portable fire extinguisher J

F. Additional lengths of 2-1/2 inch and 1-1/2 inch fire hose with nozzles, couplings, fitting, gaskets, spanner wrenches, etc.

G. Spare breathing air cylinders

H. First aid kit

There are at least 10 SCBAs reserved for fire brigade use. Each has two 60-minute reserve cylinders. The breathing air compressor is powered from the station emergency power combustion turbine.

Fire brigade training consists of initial classroom and practical training. Initial classroom training consists of:

A. Instruction concerning the fire fighting plan and member's responsibility.

B. Review of the prefire plan which includes type and location of fire hazards.

C. Instruction of potential effects of fire, flame, hot gases, and products of combustion.

D. Familiarization with plant layout, equipment functions and potential hazards, location of fire protection equipment, location of power supply controls, operation of ventilation and smoke ~~control~~ removal systems, and access/egress routes for each area.

E. Use of available fire fighting equipment and correct method of fighting fires in energized electrical equipment, fires in cables, and cable trays, hydrogen fires and other types of flammable and combustible liquids, and fires involving ordinary combustible materials.

F. Use of fire brigade radios, portable emergency lighting, smoke control equipment including portable smoke ejectors, and other manual fire fighting equipment.

G. Procedures for fire attack in buildings and confined spaces.

H. Instruction regarding fire fighting strategy for each fire area, room, or zone.

I. Fire fighting activities are coordinated with the local ~~volunteer~~ fire department to assure adequate back-up fire fighting capability can be provided if necessary.

J. Operational precautions for fighting fire on nuclear power sites including radiological protection and special hazards associated with a nuclear power plant. J

Refresher and requalification training consists of the following activities:

A. Meetings with the local fire department are held annually to review significant plant modifications and changes to fire fighting strategies.

B. Periodic refresher training sessions are held so that each brigade member participates in training at least every two years.

C. Practice sessions are held for each brigade member in proper fire fighting techniques and use of fire brigade equipment. Each fire brigade member participates in at least one drill per year.

D. Drills are performed in the plant at least once per quarter for each shift. Each fire brigade member participates in at least two drills per year. At least one drill per year, per

shift, is unannounced, and at least one drill per year for each shift occurs on the back shift. At least once per year, the local fire department participates in station drills.

E. At least every three years, drills are critiqued by qualified individuals independent of the corporate staff. J

F. Drill critiques include: fire alarm effectiveness, time required for notification, fire brigade response, fire fighting strategies, use of fire fighting equipment and suppression techniques, assessment of members' knowledge of roles and equipment use, and strategies and equipment use.

The station prefire plan details fire fighting strategies for each area of the station including known hazards, location of fire fighting equipment, location of controls for power supply and ventilation systems, and other pertinent information. I

Drill scenarios are based on realistic potential fire events in various areas of the plant. Scenarios include fire growth, effect on safety-related and safe shutdown functions, and availability of ventilation.

Records of fire brigade member physical examination, training drills, and critiques are maintained on file. J

NFPA 600, "Standard for Private Fire Brigades" is used as guidance in organization and training of the fire brigade.

### 9.5.1.~~10~~ 12 Fire Hazards Analysis

A Fire Hazards Analysis is conducted for each room area or zone of the plant. Containing safety related equipment or equipment important to safety. It considers the function of major equipment in the area, location and number of redundant equipment or functions, known and anticipated quantity and configuration of combustible material, ventilation and smoke control, presences of predetermined fire protection features, and consequences of fire with and without fire protection features functioning properly. I Where the Fire Hazards Analysis determines that Design Objectives are met in accordance with Section 9.5.1.1, fire protection is considered adequate. The Fire Hazards Analysis is maintained as part of the Plant Design Basis.

### 9.5.1.~~11~~ 13 Fire Protection Quality Assurance Program

The Fire Protection Quality Assurance Program implements a "graded" approach focusing attention to features that assure that design, procurement, installation, testing, operation,

maintenance, and repair are conducted as appropriate. The program assures that systems, equipment, components, and procedures produce the fire protection function as intended. The program complies with the intent of NUREG 0800, Section 9.5.1, "Standard Review Plan."

The program applies to features addressed in the Fire Hazards Analysis as follows:

A. Features provided to separate or protect redundant systems and equipment required to achieve cold shutdown.

B. Features which provide defense-in-depth for protection of safety related systems, equipment, and components.

Program objectives are to assure that fire protection features, including mechanical and electrical systems, fire barrier components and fire insulating material, are properly designed, installed, operated, and maintained in accordance with regulatory requirements, industry standards, and National Fire Protection Association codes and standards. Objectives are achieved as follows: I

A. Fire protection specialty items are tested and approved by a nationally recognized testing laboratory.

B. Control design documents, procurement, and installation of fire protection features.

C. Receipt inspection of specialty items to assure receipt of proper materials.

D. As-built inspections to assure proper material installation and layout.

E. Operational tests of completed installations to assure that systems function as intended.

Records of Quality Assurance activities are maintained on file for future review.

Annual fire protection audits are conducted by a team of off-site personnel including a QA Qualified Lead Auditor, fire protection engineer, and an individual knowledgeable of plant systems. Every third year, the Quality Assurance audit includes an independent fire protection engineer who is not a direct employee of the licensee.

## REFERENCE FOR SECTION 9.5.1


1. NFPA 10, "Portable Fire Extinguishers, Installation, Maintenance, and Use"
2. NFPA 13, "Sprinkler Systems"
3. NFPA 14, "Standpipe and Hose Systems"
4. NFPA 15, "Water Spray Fixed Systems"
5. NFPA 20, "Centrifugal Fire Pumps"
6. NFPA 22, "Water Tanks for Private Fire Protection"
7. NFPA 24, "Private Fire Service Mains"
8. NFPA 26, "Supervision of Valves"
9. NFPA 30, "Flammable Combustible Liquids Code"
10. NFPA 51B, "Cutting and Welding Processes"
11. NFPA 70, "National Electric Code"
12. NFPA 72, "Fire Detection and Alarm Systems" I
13. NFPA 80, "Fire Doors and Windows"
14. NFPA 92M, "Waterproofing and Draining of Floors"
15. NFPA 101, "Life Safety Code"
16. NFPA 204M, "Smoke and Heat Venting Guide"
17. NFPA 220, "Types of Building Construction"
18. NFPA 232, "Protection of Records"
19. NFPA 251, "Fire Tests, Building Construction and Materials"
20. NFPA259, "Test Method for Potential Heat of Building Materials"
21. NFPA 600, "Private Fire Brigades"
22. NFPA 802, "Recommended Fire Protection Practice for Nuclear Reactors"

23. NFPA 803, "Fire Protection of Nuclear Power Plants"

24. NUREG-0050, "Recommendations Related to Browns Ferry Fire," Report by Special Review Group, February 1976.

25. WASH-1400 (NUREG-75/014), "Reactor Safety Study - An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," October 1985.

26. NUREG-75/087, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants."

Section 9.5.1, "Fire Protection Program."

Section 3.6.1, "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment

Section 6.4, "Habitability Systems." I

27. Appendix A "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities" General Design Criterion 3, "Fire Protection."

28. Regulatory Guide 1.6, "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems."

29. Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants."

30. Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Engineered Safety Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

31. Regulatory Guide 1.75, "Physical Independence of Electrical Systems."

32. Regulatory Guide 1.88, "Collection, Storage and Maintenance of Nuclear Power Plant Quality Assurance Records."

33. Regulatory Guide 1.101, "Emergency Planning for Nuclear Power Plants."

34. ANSI Standard B31.1-1973, Power Piping."

35. ASTM D-3286, "Test for Gross Calorific Value of Solid Fuel by the Isothermal-Jacket Bomb Calorimeter (1973)

36. ASTM E-84, "Surface Burning Characteristics of Building Materials (1976)."

37. ASTM E-119, "Fire Test of Building Construction and Materials (1976)."

39. IEEE Std. 383-1974, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations," April 15, 1974

40. IEEE Std. 384-1981, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits."

41. MAERP-NELPIA, "Specifications for Fire Protection of New Plants."

42. Factory Mutual System Approval Guide - Equipment, Materials, Services for Conservation of Property. I

43. "International Guidelines for the Fire Protection of Nuclear Power Plants," National Nuclear Risks Insurance Pools, 2nd Report (IGL).

44. NFPA Fire Protection Handbook.

45. SFPE Handbook of Fire Protection Engineering.

46. Underwriters Laboratories Rating List.

47. Underwriters Laboratories, "Building Materials Directory."

38. ASTM E-648, "Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source"

ALWR CESSAR INSERTS

INSERT #1: SECTION 9.5.1.1.2.C (Third paragraph) Delete existing, Insert: Inside Containment and the Annulus: Cables used for safe shutdown functions will be three hour fire rated cable protective systems (i.e., mineral insulated cable or equivalent). A potential exception is containment penetrations installed in the containment vessel to transition between inner and outer containment. These penetrations are currently available as one hour fire rated. Three hour fire rated containment penetrations will be purchased if available.

The only in situ combustible material inside containment that may be exposed to a fire is insulation of cables that are not associated with safe shutdown functions. Redundant trains of valves and instruments analyzed as an assured method of achieving safe shutdown are physically separated such that a potential fire will not affect redundant equipment. This will be documented in the "Fire Protection Safe Shutdown Analysis" and maintained as part of the plant Design Basis.

INSERT #2: SECTION 9.5.1.2.B Inside containment:
The Fire Protection Safe Shutdown Analysis (which will be maintained as part of the System 80+ design basis) will assure that fire at any specific location inside containment will not affect redundant safe shutdown components. It will also assure that redundant safe shutdown components such as instruments and valves will be separated to the extent practicable as stipulated in SECY-90-016," Evolutionary Light Water Reactor (LWR)Certification Issues and Their Relationship to Current Regulatory Requirements".

As stated in section 9.5.1.1.2.C, cables used for safe shutdown functions inside containment will be three hour fire rated cable protective systems (i.e., mineral insulated cables or equivalent). An exception to the three hour fire resistance rating may be containment penetrations which are currently commercially available with one hour fire resistance rating. Three hour fire rated containment penetrations will be purchased if available.

INSERT #3: SECTION 9.5.1.3.2.1: Where it is not practical to provide laboratory tested components, engineering analysis will assure that an acceptable quality of fire safety is provided. The engineering analysis will be submitted to NRC for review.

INSERT #4: SECTION 9.5.1.4.6, Third sentence: Components that may be protected by fire rated insulating material include structural steel, cables and safe shutdown components. If any of these features must be protected with fire rated insulating material, the material will be qualified by test to acceptance criteria that has been adopted by the Nuclear Regulatory Commission.

INSERT #5: SECTION 9.5.1.5.1 Fourth paragraph: The control complex has a dedicated smoke removal system. The smoke removal system serves the following areas:

Channels A, B, C, D Vital Instrument and Equipment Rooms
Divisions 1 & 2 Essential Electrical Equipment Rooms
Remote Shutdown Panel Room
Divisions 1 & 2 Non-Essential Equipment Rooms
CAS and Security Equipment Rooms
Computer Room and its Mechanical Equipment Room
Control Room
OSC Equipment Room
OSC
TSC
TSC Mechanical Equipment Room
Control Room Mechanical Equipment Room

The Control Complex Smoke Removal System utilizes dedicated smoke exhaust fans for each safety related division. Dampers are three hour fire rated, normally closed, motor operated smoke dampers. The dampers are remotely actuated from the control room. Motor operators and power and control cables are located on the opposite side of the fire barrier from which smoke is to be exhausted. The system uses 100% outside air supplied by the Control complex air-handling units. The smoke purge fans are sized to exhaust three cfm per square foot.

INSERT #6: SECTION 9.5.1.6 <u>LOCATION OF FIRE PROTECTION FEATURES</u>

Fire suppression and detection systems are provided in the Nuclear Annex and the Reactor Building as stipulated by BTP CMEB 9.5-1 and as determined by the Fire Hazards Analysis.

Fire protection features will be provided in the turbine building to ensure that the plant design basis goals and objectives are met. Turbine lube oil tanks are located in a separate room enclosed in three hour fire rated barriers. The turbine lube oil system is protected by a fixed automatic fire suppression system.

Main, auxiliary and reserve transformers are protected by fixed fire suppression systems. Fire rated barrier shield walls

will be provided between transformers and between individual transformers and the turbine building. Oil Containment and collection capability is provided for transformer areas.

The diesel generator fuel oil tanks are located inside concrete structures and protected by preaction sprinkler systems.

The Onsite combustion turbine and fuel facility is separated from other plant facilities. The gas generator and the control room are protected by gaseous fire suppression systems.

The fire pump house is separated from other plant facilities. Each fire pump room is protected by an automatic sprinkler system.

Other plant structures such as the radwaste building, component cooling water heat exchanger building will be protected as appropriate to comply with plant design basis goals and objectives.

Insert #7 SECTION 9.5.1.7.2 Fire protection control valves will be either locked or electrically supervised to assure they remain in the open position. Administrative controls will assure that the fire protection water supply system is not used for non fire protection purposes.

INSERT #8: SECTION 9.5.1.7.3.B: Delete existing: Automatic sprinkler systems will be installed in areas as stipulated in BTP CMEB 9.5-1. Sprinklers will be installed in other areas, as determined necessary to meet Fire Protection Program Design Basis Goals and Objectives as stated in Sections 9.5.1.1.1 & 9.5.1.1.2;

INSERT #9: SECTION 9.5.1.7.3.C: CESSAR-DC Section 3.4.4.1 contains a discussion of internal flood protection methods. These flood protection methods will protect safe shutdown equipment from internal flooding including flooding due to water released during fire suppression activities.

INSERT #10: SECTION 9.5.1.7.6: A fixed automatic fire detection system is installed in the Nuclear Annex and portions of the Reactor building. Fire detection will be installed in the following areas:

- Areas containing major cable concentrations
- Safe shutdown major pumps
- Switchgear
- Motor control centers
- Battery and Inverter areas
- Relay rooms
- Fuel areas

Fire detectors will also be installed in other areas containing appreciable in situ or potentially transient combustible materials such as change room storage, contaminated area step off pads, and laundry rooms.

Fire Hazards Assessment Report (not CESSAR-DC)

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## EXECUTIVE SUMMARY

The protection of the System 80+™ facility from the effects of fire is of utmost importance. The fire hazards assessment verifies that the fire protection features required to assure; 1) compliance with regulatory requirements and expectations, 2) an acceptable level of reactor safety, 3) protection of personnel, and 4) protection of capital investment are identified and/or incorporated in the engineering and design activities associated with Design Certification.

To that end, the fire hazards assessment evaluates each fire area in the Nuclear Annex and the Reactor Building and considers, construction and architectural features, occupancy, required fire protection features, and compliance with the fire protection design basis goals and objectives.

INSERT #1

The fire hazards assessment is the first step in the development of a detailed fire hazard analysis which will evolve concurrently with the plant design, construction, and operation. In turn, the fire hazards analysis will be the cornerstone of a comprehensive fire protection program for the System 80+™ facility.

## 1.0 INTRODUCTION

### 1.1 PURPOSE

The purpose of the fire hazards assessment is to verify that the fire protection features for the System 80+™ facility which will assure compliance with regulatory requirements and expectations, an acceptable level of reactor safety, protection of personnel, and protection of capital investment, are identified and/or incorporated in the engineering and design activities associated with the Design Certification Program. The fire hazards assessment will later be expanded during detailed engineering, construction, and plant start-up, resulting in a complete fire hazards analysis.

### 1.2 SCOPE

The scope of this assessment includes all fire areas in the Nuclear Annex and the Reactor Building. Fire areas are identified in CESSAR-DC Section 9.5.1, Figures 9.5.1-2 through 9.5.1-9. An assessment for each of the fire areas is included in Attachment A of this document.

### 1.3 REGULATORY COMPLIANCE

The fire hazards assessment assures compliance with NUREG 0800, Standard Review Plan, Section 9.5.1, Fire Protection Program (which adopts Branch Technical Position CMEB 9.5-1) and SECY 90-16, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationships to Current Regulatory Requirements", to the extent possible for the Design Certification Program.

### 1.4 ASSESSMENT ELEMENTS

Elements considered in the fire hazards assessment are construction and architectural features, occupancy, and associated required fire

protection features.

### 1.4.1 Construction and Architectural Features

These features are evaluated to assure that the structural materials have proper fire resistance rating; that interior finishes are non-combustible or fire retardant; and that the plant is adequately subdivided into separate fire areas. In addition, the plant arrangement is carefully evaluated to ensure adequate means of personnel egress and fire brigade access are provided.

### 1.4.2 Occupancy

Each fire area is evaluated to determine:

- Function and importance of the associated equipment and components.
- Combustible materials present.
- Ignition sources.
- Potential for fire ignition due to operation, maintenance, and testing.
- Potential for radiological and toxic hazards.

All of these are considered based upon the information available in the Design Certification stage. These issues will be addressed in much greater depth and detail when the fire hazards analysis is conducted.

### 1.4.3 Fire Protection Features

Each fire area is evaluated to assure that:

- Fire barriers and fire insulation materials have proper fire resistance rating.
- Automatic fire detection is provided for prompt notification of fire.
- Fixed automatic suppression systems, manual fire hose systems, and portable fire extinguishers, are available for fire control and suppression.
- Smoke control measures can be employed to mitigate unacceptable migration of products of combustion.
- Communication equipment and lighting is available to facilitate fire control and suppression and mitigate damage.

Again, final determination of all fire protection features will be based on the completed Fire Hazards Analysis.

### 1.4.4 Design Basis Compliance

The assessment for each fire area is concluded with a review to ensure compliance with all fire protection design basis goals and objectives.

## 1.5 FIRE HAZARDS ANALYSIS

### 1.5.1 Detailed Engineering

As engineering progresses, the fire hazards assessment will be expanded. Detailed engineering analysis will be conducted to aid in selecting fire protection features for each fire area, and to verify that features selected are appropriate. These engineering analysis will be part of, or will be referenced in the fire hazards analysis. For each fire area, the fire hazards analysis postulates fire ignition (by plant equipment or exposure fire); evaluates potential damagability prior to detection and suppression; and evaluates the consequences of damage to reactor safety, unit availability, capital investment, and personnel safety. The fire hazards analysis will be an integral part of the engineering process and will evolve concurrent with the plant design.

### 1.5.2 Plant Construction and Start-Up

As the plant construction progresses, the fire hazards analysis will be continually reviewed and updated based on plant as-built configurations. Assumptions made prior to construction will be verified based on plant walkdown and review of equipment literature.

### 1.5.3 Completed Analysis

The completed fire hazards analysis confirms that regulatory requirements and safety objectives are met, and that fire protection features and programs are adequate to protect unit availability, capital investment, and personnel safety. The fire hazards analysis will be a controlled engineering document and will be reviewed and revised as necessary throughout the life of the plant.

The station fire prevention and protection administrative programs and pre-fire planning will be based in part on the fire hazard analysis.

1.5.4 Additional Analysis

As a separate task, a Probabalistic Risk Assessment will be conducted, during which fire will be analyzed as a potential core melt initiating event. This assessment will be used to reduce the risk of reactor core damage due to fire, and will complement the fire hazards analysis.

2.0 COMPANION DOCUMENTS

2.1 SAFETY ANALYSIS REPORT

The Safety Analysis Report (Section 9.5-1 of CESSAR-DC) is a summary document which provides a substantive report of the Fire Protection Design Bases, General Design Guidelines, System concepts and an overview of fire prevention and protection programs.

2.2 RESPONSE TO NUREG 0800, STANDARD REVIEW PLAN

The Nuclear Regulatory Commission, NUREG 0800, Standard Review Plan, Section 9.5.1, Fire Protection Program, provides guidance for fire protection programs for commercial light water reactors. This section adopts Branch Technical Position CMEB 9.5-1 which provides specific regulatory guidance for fire protection.

The response to the Standard Review Plan for the System 80+™ Design will be included in "Response to NUREG 0800 Standard Review Plan," report for fire protection.

2.2 Response To SECY-90-16

The Nuclear Regulatory Commissions's SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," outlines regulatory requirements for various fire protection issues for new lightwater facilities. These requirements enhance those already included in NUREG 0800, Standard Review Plan.

The response to SECY-90-016, for the System 80+™ Design will be included in the "Response to NUREG 0800, Standard Review Plan", report for fire protection.

### 2.3 PRE-FIRE PLAN

The Pre-Fire Plan will be a document developed by the Station Fire Chief to provide summary guidance to station operators and fire brigade members in the event of fire. The Pre-Fire Plan will be based in part on information provided in the fire hazards analysis. Station fire fighting strategies will be developed based on identified potential fire hazards, risks and engineered fire protection concepts.

### 2.4 SELECTED LICENSEE COMMITMENTS

Selected Licensee Commitments will be included in the Safety Analysis Report and contain surveillance, operability and compensatory action requirements for fire protection systems, equipment and components including fire protection water supplies, water flow paths, fire detection systems, fixed automatic and manual fire suppression systems and fire barriers.

### 2.5 FIRE PROTECTION SAFE SHUTDOWN ANALYSIS

~~2.5 Fire Protection Safe Shutdown Analysis~~

The Fire Protection Safe Shutdown Analysis demonstrates that safe shutdown can be achieved following fire in any are outside of Containment and that safe shutdown equipment and components inside Containment are separated and protected in accordance with BTP CMEB 9.5-1.

## 3.0 FIRE PROTECTION DESIGN BASIS

### 3.1 DESIGN BASIS GOALS

The Design Basis Goals of the fire protection program are as follows:

- Prevent radioactive release as a result of fire in accordance with 10CFR50 Part 100 guidelines.

- Prevent the possibility of core melt due to fire and loss of ability to achieve safe shutdown following a fire.

- Prevent the presence of Category 1 risks (as defined in Section 6.0).

- Mitigate the potential of personnel injury due to fire.

- Protect unit availability by limiting potential fire damage to an acceptable level.

- Protect capital investment in the facility.

### 3.2 DESIGN BASIS OBJECTIVES

The Design Basis Objectives of the fire protection program are as follows:

- Station design and layout to prevent the possibility of fire affecting redundant divisions of equipment required for cold shutdown, prevent a fire-induced loss of coolant accident (LOCA), and prevent interaction with other systems which could lead to a fire-induced LOCA. Safe Shutdown as defined in the Standard Review Plan pertains to Cold Shutdown as part of the System 80+™ Design philosophy.

- Station layout to assure adequate access and egress routes for personnel protection.

- Provision of sufficient fire area compartmentation to preclude the presence of Category 1 risks. (See Section 6.0)

- Provision of fixed systems to provide prompt fire detection and fire suppression consistent with design basis goals.

- Provision of manual fire fighting equipment for early fire suppression and for structural fire fighting.

- Provision of smoke removal capability to facilitate manual fire fighting and mitigate smoke migration beyond the area of fire origin.

- A fire prevention program including housekeeping control of combustible materials, control of potential ignition sources and a program of management inspection, audit and review.

- A fire response program consisting of well trained and equipped plant fire brigade personnel prepared at all times to assume fire fighting responsibilities.

- A quality assurance program to assure design methods and features are properly implemented. The quality assurance program also verifies that operations, maintenance, and surveillance programs are properly implemented.

- A fire protection program that complies with NUREG 0800 Standard Review Plan and BTP CMEB 9.5-1, Rev. 2, July 1981: "Guidelines for Fire Protection of Nuclear Power Plants" and SECY Letter 90-16, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationships to Current Regulatory Requirements." Specific deviations and technical

justification are included in the fire hazards analysis.

- Operations and maintenance program for surveillance, testing, and maintenance of fire protection systems, equipment and features.

## 4.0 FIRE PROTECTION GENERAL GUIDELINES FOR PLANT DESIGN

## 4.1 SEPARATION OF SAFE SHUTDOWN SYSTEMS

### 4.1.1 Outside Containment And The Annulus

Safety related divisions are separated from each other by three-hour fire rated barriers. Exceptions are the Control Room and Remote Shutdown Panel Room. The Control Room and Remote Shutdown Panel Room are physically separated and electrically isolated from each other so that fire in either room will not affect the ability to achieve Safe Shutdown in the unaffected room. [redacted]

### 4.1.2 Inside Containment And The Annulus

INSERT #2

Redundant divisions are separated by quadrant to provide sufficient spatial separation, as proven by engineering analysis in the annulus and at containment penetrations. Another option for separation is through use of mineral insulated jacketed cables which qualify as either a three hour rated barrier or a radiant heat shield. If it qualifies as a radiant heat shield, engineering analysis will verify that the heat shield coupled with minimum 20 foot separation between redundant divisions with no intervening combustibles, and/or augmented with sprinklers and automatic fire detectors, will withstand any credible fire occurrence. Where redundant divisions of equipment normally used to achieve Safe Shutdown, by necessity, converge, an engineering analysis will be conducted (when sufficient design detail is available) to assure that cold shutdown can be achieved utilizing equipment which would not be affected by fire at the specific location. The engineering analysis will be maintained as part of the System 80+™ Design Basis, and will be referenced in the fire hazards analysis.

## 4.2 GENERAL FIRE PROTECTION FEATURES

- Three-hour fire rated barriers are provided as necessary to prevent the presence of Category 1 risks (as defined in Section 6.2.1).

- A fire protection water system is installed, including water supply, pumps and distribution system, with redundancy and reliability to meet provisions of BTP CMEB 9.5-1.

- Fixed automatic suppression systems are engineered and installed for the specific hazard in accordance with the design objectives as determined by the fire hazards analysis.

- Portable fire extinguishers, fire hydrants, fire hose stations and supporting equipment are provided to facilitate manual fire fighting.

- Ventilation systems are installed, including provisions for controlling spread of fire and smoke beyond the area of origin. HVAC systems are division specific; therefore, there are no dampers in barriers which separate redundant divisions of safety-related equipment. The exception to this is that there is a single opening in the divisional fire wall that separates the redundant air handling units. An air intake duct which supplies make-up air to the redundant Control Room Systems passes through this opening. This arrangement enables make-up air to be drawn from either side of the facility and is necessary for nuclear safety reasons. This opening is protected with a combination fire and smoke damper. Smoke control capability is provided as part of HVAC system design to mitigate smoke spread beyond the area of origin.

~~The Control complex has a dedicated smoke exhaust system with dedicated smoke and purge fans. This system has Normally closed, 3 hour fire rated, motor operated smoke dampers. The motors and associated cables are located on the opposite side of the barrier from the area where smoke is being removed.~~

INSERT #3

- Multiplexed instrument and control signals by fiber optic cable are provided to minimize the quantity of exposed combustible cable insulation in the plant.

- Where fixed fire suppression systems are installed, provisions for control of water drainage and features to mitigate damage due to water discharge are included.

- Equipment and systems are designed to mitigate the potential for fire due to equipment failure during the Design Basis Seismic Event. An example is the Reactor Coolant Pump Motor Oil Collection and Drain System.

- Fire protection (suppression and detection) equipment is designed to mitigate possible interaction with safety-related equipment during the design basis seismic event. Interaction includes the potential for impact of spray or flood due to pipe failure.

- Fire hose standpipe system in the Nuclear Annex and a water supply that provides 75 gpm to at least two hose stations for at least two hours are seismically designed.

## 5.0 FIRE PROTECTION SYSTEMS DESIGN PHILOSOPHY

### 5.1 DEFENSE-IN-DEPTH

Fire Protection Systems are conceived, designed, and installed based on defense-in-depth concepts such that:

- Failure of one water source (i.e., fire pump and suction tank) will not impair delivery of an adequate water supply to any fixed fire suppression system (including the quantity of water reserved for hose streams).

- Impairment of any portion of the exterior fire protection water distribution system will not affect delivery of adequate water supply to any fixed fire suppression system (including the quantity of water reserved for hose streams).

- Impairment of any portion of the interior fire protection distribution system will not impair both primary and backup fire protection systems.

- Impairment of any primary fire protection system will not impair the backup fire protection equipment for the area.

- Impairment or inoperability of any fire detection system circuit will not affect operability of other circuits of the system.

- Inoperability of any fire rated barrier in the Nuclear Annex is addressed by administrative controls which assure inspection and surveillance of potential fire hazards in the vicinity and prompt repair to restore operability.

## 5.2 DETECTION AND SUPPRESSION SYSTEMS

### 5.2.1 Detection Systems

The fire detection system is conceived, designed and installed to provide notification of incipient fire consistent with Design Basis Goals and Objectives. The fire detection philosophy is that detector sensitivity is ~~arranged~~ engineered to detect an incipient fire. Fire detector alarm and annunciation is arranged for prompt notification so that fire brigade personnel can respond and extinguish fire with manual fire fighting equipment.

### 5.2.2 Sprinkler Systems

stipulated by BTP CMEB 9.5-1 and

The fixed automatic fire sprinkler systems are installed where the fire hazards analysis determines that detection alone will not achieve Design Basis Goals and Objectives. The systems are conceived, designed and installed to suppress and control fire (prior to propagation) to a size (heat release) which would not cause unacceptable damage. Automatic sprinkler heads are located and sensitivity selected to actuate and discharge an adequate quantity of water in an effective distribution pattern to provide cooling of the area, protection of plant features and fire suppression and control consistent with Design Basis Goals and Objectives.

### 5.2.3 Hose, Nozzle And Extinguisher Selection and Location

Fire hose stations are located to assure accessibility to fire brigade members and complete coverage to any plant area with a length of fire hose consistent with NFPA 14 or, if additional hose lengths are required, they are provided to assure that they can be deployed in a reasonable time period and will provide an adequate water supply.

Fire hose material is selected based on hydraulic characteristics as well as other important parameters such as ALARA, ease of handling and maintenance requirements. Fire hose nozzles are selected based on the anticipated fire hazard. Nozzles in areas containing electrical equipment are UL Listed or FM Approved for use on energized electrical equipment. In other areas, nozzles are selected based on required water flow, pressure and desired distribution patterns.

Portable fire extinguishers are located to assure accessibility by fire brigade members and to provide adequate coverage in accordance with NFPA 10. An exception is that fire hose stations provide suppression capability for Class A fire hazards in lieu of portable fire extinguishers unless the Fire Hazard Analysis determines Class A portable fire extinguishers are necessary [illegible] for a specific hazard.

INSERT #4

Dry chemical extinguishers which are potentially corrosive to plant systems, equipment and components are not used unless specifically determined to be appropriate by the FHA, for a specific hazard.

Wheeled 50 lb. or 100 lb. carbon dioxide extinguishers are located as determined appropriate.

### 5.2.4 Alarm And Annunciation Strategies

Alarm and annunciation strategies are consistent with human factors engineering principles. In areas protected by automatic fire detection and/or suppression systems, local alarms are provided for occupant notification. Annunciators are provided in the control room to alert operators to system trouble and actuation conditions. Alarms are provided for fire suppression systems as part of the central fire protection control system.

## 5.3 HUMAN FACTORS CONSIDERATIONS

### 5.3.1 Valve Accessibility

Fire protection control valves are located such that they would be accessible for emergency operation. Valves which control fixed fire suppression systems are not located in the area protected by the system.

### 5.3.2 Drains And Inspector's Test Connections

Valves for drains and inspector's test connections are located in accessible areas. Locations are selected based on ALARA principles and provision of plant system drains to remove water discharge.

### 5.3.3 Local Audible And Visual Alarms

Local audible and visual alarms are unique signals so that they will not be confused with other station signals. The alarms for each area are located and selected based on background noise level, degree of obstruction and other pertinent considerations.

### 5.3.4 Manual Pull Stations

Manual pull stations are located in designated paths of egress, normally adjacent to exit doors. The location is identified by signs, arrows or other visible means.

### 5.3.5 Fire Hose Stations

Fire hose stations are located so that they are accessible at the entrance to each fire area (either outside or inside the area). Where possible, hose stations are located to provide adequate coverage with 75 feet of hose. Flow restriction orifices are provided when necessary to maintain pressure at a maximum of 100 psi. For personnel safety, nozzles are selected based on the hazard protected. Nozzles in electrical equipment areas are qualified for use on high voltage equipment.

### 5.3.6 Portable Fire Extinguishers

Portable fire extinguishers are located so that they are accessible at the entrance of each fire area. They are selected for each area based on the potential fire hazard.

### 5.3.7 Fire Detection Systems

Fire detection systems are engineered for remote circuit continuity and sensitivity testing. Accessibility is a factor in selecting detector locations.

### 5.3.8 Emergency Lights

Emergency lighting is provided for personnel egress and fire brigade access to each fire area.

## 6.0 STRATEGIES FOR DEFINING AN ACCEPTABLE LEVEL OF RISK

### 6.1 GENERAL

The strategies for defining an acceptable level of risk are based on the extent of damage that is acceptable consistent with the Design Basis Goals and Objectives (Sections 3.1 and 3.2). Each fire area is analyzed to determine the level of acceptable risk.

### 6.2 CATEGORIES OF RISK

#### 6.2.1 Category 1

Equipment or component damage and electrical faulting are unacceptable. Control of particles of combustion is essential.

Examples

- Locations containing redundant equipment, components and cables which are analyzed and documented as an assured method of Safe Shutdown.
- Sensitive equipment or high value areas where fire damage and residue would cause unacceptable economic loss due to property damage or loss of unit availability.

A Fire Protection Design Basis Goal of the System 80+™ Design is to avoid Category 1 occupancies, outside of containment.

EXCEPTION: The reactor building contains redundant safe shutdown equipment. Redundant divisions are separated and protected as required in BTP CMEB 9.5-1.C.5.b.

6.2.2 Category 2

INSERT #5

Equipment, component or cable damage is acceptable, but failure or electrical faulting due to fire is unacceptable, or control of particles of combustion is important to protect redundant equipment and personnel.

Examples

- Locations containing ~~a single~~ channel ~~of~~ equipment required for Safe Shutdown.

- Nuclear Safety related equipment, components and cables which provide support for Safe Shutdown or accident mitigation functions.

- Equipment, components and cables which provide emergency functions such as DC power, turbine lube oil, hydrogen seal oil, cooling pumps, etc. (emergency functions are essential to meet design basis goals).

- Equipment, components and cables which must function to maintain unit availability.

- Equipment, components and cables are required to function following fire so that they can be repaired or replaced at the next unit outage (or following an orderly shutdown at an acceptable rate of cooldown

6.2.3 Category 3

Equipment, component or cable failure is acceptable, but fire propagation or generation of appreciable products of combustion are unacceptable.

Examples

- Equipment which provides noncritical function, failure will not affect unit availability, repair and replacement can be accomplished within a reasonable time and expense to support unit availability.

- Hazardous areas where damage is acceptable but early fire suppression and containment is important to limit the extent of property damage and/or for personnel safety.

6.2.4 Category 4

Equipment, component and cable failures are acceptable. The risk of fire propagation is acceptable or low hazard does not merit protection when evaluated against ALARA, expense of installation or other design basis concerns.

Examples

- Areas where damage and significant fire spread, and release and/or spread of particles of combustion are acceptable.

- Areas where small concentrations of insitu and potential transient combustibles are not sufficient to support fire propagation and potential spread of particles of combustion will be contained in the fire area.

- Areas where failure of equipment, components and cables which serve non-critical functions is acceptable.

- Areas where loss of unit availability is an acceptable risk when evaluated against cost of protection, exposure hazard and frequency of fire in the occupancy.

## 6.3 FIRE PROTECTION REQUIREMENTS FOR CATEGORIES

### 6.3.1 Category 1

The occupancies will not be permitted, [except in the reactor building as stated in Section 6.2.1.,] consistent with the Design Basis Goals outlined in Section 3.1.

### 6.3.2 Category 2

These occupancies are protected [as stipulated in BTP CMEB 9.5-1.] ~~by fire detection systems which are designed to detect fire in the early stages and to alert station personnel. Fixed, automatic suppression systems are provided, and are designed to isolate and suppress fire before equipment failure or personal injury occurs due to heat or particles of combustion.~~

### 6.3.3 Category 3

These occupancies are protected by fire detection systems which are designed to detect an incipient fire and alert station personnel. Fire suppression for these areas may be by manual firefighting only. Fixed automatic suppression systems are not provided unless determined necessary to mitigate fire propagation.

### 6.3.4 Category 4

These occupancies do not merit installation of fire detection and suppression systems. Fire control is provided by manual firefighting activities. By classifying an area as Category 4 risk, it is recognized that an area does not have fixed fire detection and/or fixed automatic fire suppression systems. Pre-Fire Plan strategies are developed accordingly.

## 7.0 SAFE SHUTDOWN ANALYSIS

### 7.1 SAFE SHUTDOWN FOLLOWING FIRE CRITERIA

A fundamental premise of the System 80+™ Design and facility layout is that Safe Shutdown can be achieved following fire and loss of all function in any fire area in the Control Complex and Nuclear Annex. Safe Shutdown can be accomplished without re-entry into the affected fire area.

Safe Shutdown following fire is defined as Cold Shutdown as stated in CESSAR-DC, Section 7.4.

Fire is not postulated concurrent with simultaneous, coincidental failures of safety systems, other plant accidents or the most severe natural phenomena.

Fire is postulated with and without loss of offsite power (whichever is the most severe challenge to the ability to achieve Safe Shutdown).

### 7.2 SAFE SHUTDOWN FOLLOWING FIRE DESIGN BASIS GOALS

The Design Basis Goals for Safe Shutdown following a fire are:

- Achieve and maintain subcritical reactivity conditions in the primary system.
- Maintain reactor coolant inventory.
- Achieve primary system temperature and pressure conditions defined as Cold Shutdown.
- Maintain Reactor Coolant System (RCS) process variables within those predicted for loss of AC power.

- Prevent fuel clad damage, failure of the primary system pressure boundary, or rupture the containment boundary.

## 7.3 SAFE SHUTDOWN FOLLOWING FIRE PERFORMANCE OBJECTIVES

Performance Objectives for Safe Shutdown following fire are:

- Maintain RCS pressure boundary integrity (i.e., reactor coolant pump seals, etc.).
- Assure the reactivity control function maintains the available shutdown margin at greater than 1% $\Delta K/k$ with the highest worth control rod fully withdrawn.
- Assure reactor coolant make up is available to maintain reactor coolant in the pressurizer within prescribed levels.
- Maintain reactor coolant system decay heat removal function and cool down the RCS to Safe Shutdown conditions.
- Provide direct readings of process variables necessary to perform and control negative reactivity, reactor coolant pressurizer level and decay heat removal.
- Maintain support functions (process cooling, lubrication, etc.) for equipment required for safe shutdown.

## 7.4 SYSTEMS REQUIRED FOR SAFE SHUTDOWN

- Emergency Feedwater System (EFW) provides secondary side decay heat removal capability.
- Atmospheric Dump System (ADS) provides secondary side pressure control capability.

- Shutdown Cooling System (SCS) provides residual heat removal function for cooldown from hot shutdown to cold shutdown conditions.

- Safety Injection System (SIS) provides makeup capability for inventory and water chemistry control and boron injection.

- Safety Depressurization System (SDS) provides primary pressure control capability.

- Essential Chilled Water System provides chilled water for HVAC heat removal to all safety related room recirculation cooling units.

- Component Cooling Water System (CCWS) provides decay heat removal capability and equipment cooling for the Shutdown Cooling System, Safety Injection System, Essential Chillers, Emergency Diesel Generator Coolers (as well as other non-safe shutdown equipment).

- Station Service Water System (SSWS) takes suction from the ultimate heat sink and provides cooling water flow to the CCWS heat exchangers for cooling and decay heat removal.

- The Control Building, Nuclear Annex, Subsphere, and Emergency Diesel Building HVAC Systems provide ambient temperature control within parameters required to assure components function as intended to achieve Safe Shutdown condition.

- The onsite Emergency Diesel Generators provide power for 1E busses for equipment power, control and instrumentation required to achieve Safe Shutdown conditions.

- Reactor coolant pump seal cooling is provided by either direct cooling by the Component Cooling Water System or seal

INJECTION from the ~~[illegible]~~ Chemical Volume and Control System ~~[illegible]~~.

Each of the above systems includes adequate instrumentation in the Control Room and at the Remote Shutdown Panel to assure that Safe Shutdown can be achieved.

## 7.5 SAFE SHUTDOWN COMPONENTS

The Fire Protection Safe Shutdown ~~Following Fire~~ Analysis will identify the portions of each of the above systems which are required to achieve Safe Shutdown condition in accordance with the criteria for Safe Shutdown following fire. This analysis will determine the specific components of each system required for Safe Shutdown.

## 7.6 ASSOCIATED CIRCUITS

Redundant divisions of 1E electrical power and control circuits are physically separated and electrically independent. Outside of containment Physical separation is provided by three-hour fire rated barriers so that redundant safe shutdown circuits are not located in a common enclosure. ~~Where by necessity, cables from redundant divisions may converge, spatial separation and/or fire resistive cable insulation jacketing or insulation wrap is provided, and supported by engineering analysis.~~ Redundant divisions of 1E circuits are powered by independent busses which are not interconnected. Since the redundant divisions are physically separated and electrically independent, multiple electrical faults on one division will not affect the ability to achieve Safe Shutdown with the unaffected 1E division.

~~In the Reactor Coolant System [illegible] operated valves which serve as pressure boundaries for interconnection to low pressure systems (i.e., "high/low pressure interfaces") and are required to be closed during normal power operation will have the valve motors deenergized during power operation.~~

The Control Room and the Remote Shutdown Panel Room are electrically isolated by fiber optic cables and optical isolators. Fire in either room would not affect the ability to achieve Safe Shutdown from the unaffected control station. Transfer switches ~~for each of the four channels of safety-related electrical equipment are separated by three hour fire rated barriers, so that fire in any single area will not affect the ability to achieve Safe Shutdown from the Control Room with unaffected electrical control channels for the opposite division.~~ which transfer control from the Control Room to the Remote Shutdown Panel are located in the Control Room.

INSERT #6

## 7.7 REDUNDANT FIRE AREAS CONTAINING SAFE SHUTDOWN EQUIPMENT

The following identifies fire areas that contain equipment required for Safe Shutdown following a fire, and the redundant areas for the opposite division.

| FIRE AREA | EQUIPMENT | REDUNDANT AREA |
|---|---|---|
| 1 | Div. 1, Channel A Vital Instrumentation | 3 |
| 2 | Div. 1, Channel C Vital Instrumentation | 4 |
| 3 | Div. 2, Channel B Vital Instrumentation | 1 |
| 4 | Div. 2, Channel D Vital Instrumentation | 2 |
| 9 | Div. 1A, CCW Pump | 12 |
| 10 | Div. 1B, CCW Pump | 11 |
| 11 | Div. 2A, CCW Pump | 10 |
| 12 | Div. 2B, CCW Pump | 9 |
| 15 | Div. 1, Control Room HVAC | 16 |
| 16 | Div. 2, Control Room HVAC | 15 |
| 21 | Div. 1, Channel A Cable | 22 |
| 22 | Div. 2, Channel B Cable | 21 |
| 24 | Div. 2, CCW Piping | 49 |

| FIRE AREA | EQUIPMENT | REDUNDANT AREA |
|---|---|---|
| 32 | Div. 2, Cable | 33 |
| 33 | Div. 1, Cable | 32 |
| 34 | Div. 1, Motor Driven Emergency Feedwater Pump | 35 |
| 35 | Div. 2, Motor Driven Emergency Feedwater Pump | 34 |
| 36 | Div. 1, Turbine Driven Emergency Feedwater Pump | 37 |
| 37 | Div. 2, Turbine Driven Emergency Feedwater Pump | 36 |
| 38 | Div. 1A, SI Pump | 39 |
| 39 | Div. 2A, SI Pump | 38 |
| 40 | Div. 2B, SI Pump and Div. 2, Shutdown Cooling Pump | 41 |
| 41 | Div. 1A, SI Pump and Div. 1, Shutdown Cooling Pump | 40 |
| 42 | Div. 2, Emergency Diesel Generator | 43 |
| 43 | Div. 1, Emergency Diesel Generator | 42 |
| 44 | Div. 1, Charging Pump | 45 |
| 45 | Div. 2, Charging Pump | 44 |
| 49 | Div. 1, CCW Piping | 24 |
| 53 | Div. 2, Cable | 54 |
| 54 | Div. 1, Cable | 53 |
| 55 | Div. 2, Cable | 56 |
| 56 | Div. 1, Cable | 55 |
| 57 | Div. 1, Essential Chilled Water | 58 |
| 58 | Div. 2, Essential Chilled Water | 57 |
| 63 | Div. 1, Channel C Cable | 64 |
| 64 | Div. 2, Channel D Cable | 63 |
| 65 | Div. 1, Channel A Equipment | 66 |
| 66 | Div. 2, Channel B Equipment | 65 |
| 70 | Div. 1, Channel C Switchgear | 71 |
| 71 | Div. 2, Channel D Switchgear | 70 |

| FIRE AREA | EQUIPMENT | REDUNDANT AREA |
|---|---|---|
| 73 | Div. 1, Channel C Equipment | 74 |
| 74 | Div. 2, Channel D Equipment | 73 |
| 77 | Div. 2, Fuel Pool Cooling Equipment | 80 |
| 78 | Div. 2, Valve Gallery | 79 |
| 79 | Div. 1, Valve Gallery | 78 |
| 80 | Div. 1, Fuel Pool Cooling Equipment | 77 |
| 82 | Div. 1, Emergency Feedwater Tank | 83 |
| 83 | Div. 2, Emergency Feedwater Tank | 82 |
| 84 | Div. 1, Main Steam Valve House | 85 |
| 85 | Div. 2, Main Steam Valve House | 84 |
| 95 | Div. 1, Channel A Penetration Room | 96 |
| 96 | Div. 2, Channel B Penetration Room | 95 |
| 97 | Div. 1, Channel C Penetration Room | 98 |
| 98 | Div. 2, Channel D Penetration Room | 97 |
| 166 | Div. 1, CCW Surge Tank | 167 |
| 167 | Div. 2, CCW Surge Tank | 166 |

## 8.0 SUMMARY

The fire hazards assessment is the first step in the development of the complete fire hazards analysis for the System 80+™ Design. It assures that all regulatory regulations and expectations as well as all other Fire Protection Design Basis Goals and Objectives are addressed in the Design Certification process.

# ALWR FIRE HAZARDS ASSESSMENT INSERTS

INSERT #1: Executive summary, third paragraph: The Fire Hazards Assessment is developed during the plant certification process to provide the programmatic framework for the plant fire protection program and the fire hazards analysis that is to be developed during detailed design after design certification.

INSERT #2: SECTION 4.1.2 Delete existing: Inside Containment and the Annulus: Three hour fire rated cable protective systems (i.e., mineral insulated cables) are used for cables associated with safe shutdown functions. An exception to the three hour fire resistance rating may be containment penetrations that are currently commercially available with one hour fire resistance rating. Three hour fire rated containment penetrations will be purchased if available.

The only in situ combustible material inside containment that may be exposed to a fire is insulation of cables that are not associated with safe shutdown functions. Redundant trains of valves and instruments analyzed as an assured method of achieving safe shutdown are physically separated such that a potential fire will not affect redundant equipment. This will be documented in the "Fire Protection Safe Shutdown Analysis" and maintained as part of the plant Design Basis.

INSERT #3: SECTION 4.2 fifth bullet, Add second paragraph: The Control Complex has a dedicated smoke removal system. The smoke removal system serves the following areas:

Channels A, B, C, D Vital Instrument and Equipment Rooms
Divisions 1 & 2 Essential Electrical Equipment Rooms
Remote Shutdown Panel Room
Divisions 1 & 2 Non-essential Equipment Rooms
CAS and Security Equipment Rooms
Computer Room and its Mechanical Equipment Room
Control Room
OSC Equipment Room
OSC
TSC
TSC Mechanical Equipment Room
Control Room Mechanical Equipment Room

The system has a dedicated smoke exhaust for each safety related division. The smoke exhaust system has three hour fire rated, smoke dampers. These dampers are normally closed and are remotely actuated from the control room. Damper motor operators and power and control cables are located on the opposite side of the fire barrier from the area from which smoke is to be exhausted.

INSERT #4: SECTION 5.2.3: Another exception is that in high radiation areas where the Fire Hazards Analysis determines that there is a minimum of combustible materials and a minimum of risk to safety related equipment or equipment necessary to maintain unit availability , fire extinguishers are located outside the

area where responding fire brigade members can obtain an extinguisher and carry it into the area for use. This is consistent with ALARA principles.

INSERT #5: SECTION 6.2.2 Delete existing:

6.2.2 Category 2

Category 2 areas contain equipment and/or components that are analyzed as an assured method of achieving safe shutdown or for which specific fire protection features are stipulated in BTP CMEB 9.5-1.

Examples

* Control Room and Remote Shutdown Panel Room
* Diesel Generator Rooms
* Vital Battery Rooms
* Essential Switchgear Rooms
* Essential Chiller Rooms
* Emergency Feedwater Pump Rooms

INSERT #6: The Fire Protection Safe Shutdown Analysis contains an analysis of separation of equipment and components inside containment. In the reactor coolant system, motor operated valves which serve as pressure boundaries for interconnection to low pressure systems (i.e., high-low pressure interfaces) and are required to be closed during normal power operation will have one of the valve motors in each division deenergized during power operation.

ATTACHMENT 2

SPLB

Revised

Open Item 6.2.3-3:

The radiant heat transfer to the secondary containment has not been included in the applicant's annulus building pressure analysis. The applicant should justify this.

Revised Response to Open Item 6.2.3-3:

This is a revision to the response provided in LD-92-115 dated November 24, 1992. A reanalysis has been performed to determine the effect of radiation heat transfer on the time for the annulus ventilation system to reduce the annulus building pressure to - 0.5 inches of water following a LOCA and to determine the maximum annulus building air temperature. The reanalysis is based on a nominal core power of 3914 MWt. The results show that the annulus pressure is reduced to - 0.5 inches of water in 104 seconds. The annulus air reaches a maximum temperature of 195 degrees F at 43000 seconds. This reanalysis will be included in a future revision to CESSAR DC. A markup of Section 6.2.1.8 is attached.

### 6.2.1.7 Instrumentation Applications

The containment pressure is measured by independent pressure transmitters located at widely separated points within the containment. Refer to Section 7.3 for a discussion of pressure as an input to the engineered safety features actuation system (ESFAS). Refer to Section 7.5 for a discussion of the display instrumentation associated with pressure.

The containment airborne radioactivity is monitored by the airborne radioactivity monitoring system. Hydrogen concentration is monitored in the containment by the hydrogen monitoring system discussed in Section 6.2.5. Temperature sensors are positioned at appropriate locations throughout the containment. The temperature is displayed in the main control room along with high-temperature alarms. G

### 6.2.1.8 Annulus Building Pressure Analysis

The annulus conditions during a loss of coolant accident are calculated to determine the time to reestablish a subatmospheric pressure in the annulus and to ensure that the maximum pressure does not exceed the specified design pressure. As with the containment analyses described in preceding sections, the pressure and temperature conditions within the annulus and the temperature distributions through the heat absorbing structures are predicted by solution of the mass, energy and volume balance equations and the heat conduction equation. The time dependency of the annulus volume resulting from the thermal and pressure expansion of the containment steel structure is considered. H

The convective heat transfer coefficient between the steel surface facing the annulus air and between the walls of the annulus and the annulus air is determined in the CONTRANS code (Reference 1) by:

$$h = 0.2\ (\Delta T)^{1/3}$$

Where:

$h$ = natural convective heat transfer coefficient, Btu/hr-ft$^2$-°F

$\Delta T$ = temperature difference between annulus air and annulus walls, °F

The Annulus Ventilation System is represented by assuming minimum ventilation flow and maximum ventilation initiation time. Leakage into the annulus is considered. The annulus initial free volume, initial temperature and definition of annulus heat conducting surfaces complete the required modeling assumptions.

{Based on a nominal core power of 3800 Mwt, Figure

### 6.2.1.8.1 Containment Annulus Transient Analysis

The CONTRANS digital computer code (Reference 1) is used to predict the annulus transient for post-accident conditions. Following a postulated LOCA, the annulus pressure and temperature are calculated to determine the maximum time to establish a negative pressure in the annulus and to assure that the design conditions are not exceeded.

For the containment pressure analyses, heat transfer into the annulus area is conservatively assumed to be zero. For the annulus transient analyses, however, heat transfer based upon a natural convection heat transfer coefficient between the containment vessel and the annulus air is considered. Insert X

~~For the containment pressure analyses, the liquid which separates from the break flow is added to the containment atmosphere (instantaneous mixing), because this assumption leads to a prediction of maximum containment pressure. For the annulus transient analyses, this liquid is assumed to fall to the sump (division-at-break), because this leads to a higher containment temperature and, therefore, to maximum annulus pressure.~~

The analyses are performed for the double-ended suction leg slot case. Only one of the two Annulus Ventilation System trains is assumed to operate. Insert Y

Table 6.2.1-27 lists the assumptions used in the annulus building transient analyses.

~~Figure~~ 6.2.1-37 shows the annulus pressure and the corresponding containment vessel pressure versus time for the double-ended suction leg case. Figure 6.2.1-38 shows the annulus temperature and the corresponding containment temperature for this case. Figure 6.2.1-39 shows the exhaust rate of the Annulus Ventilation System corresponding to the annulus pressure shown in Figure 6.2.1-37. The annulus pressure reaches a peak of ~~8.80~~ 9.30 inches of $H_2O$ at ~~65~~ 63 seconds and is negative after ~~108~~ 104 seconds. The temperature in the annulus reaches a peak of ~~160°F after 13,750~~ 195°F at 43000 seconds.

The results show that the design criteria for the Annulus Ventilation System in Section 6.2.3 are met. H

Insert X

Radiation heat transfer between the containment steel shell and the annulus building concrete is modeled

Insert Y

The analyses are based on a nominal core power of 3914 MWt.

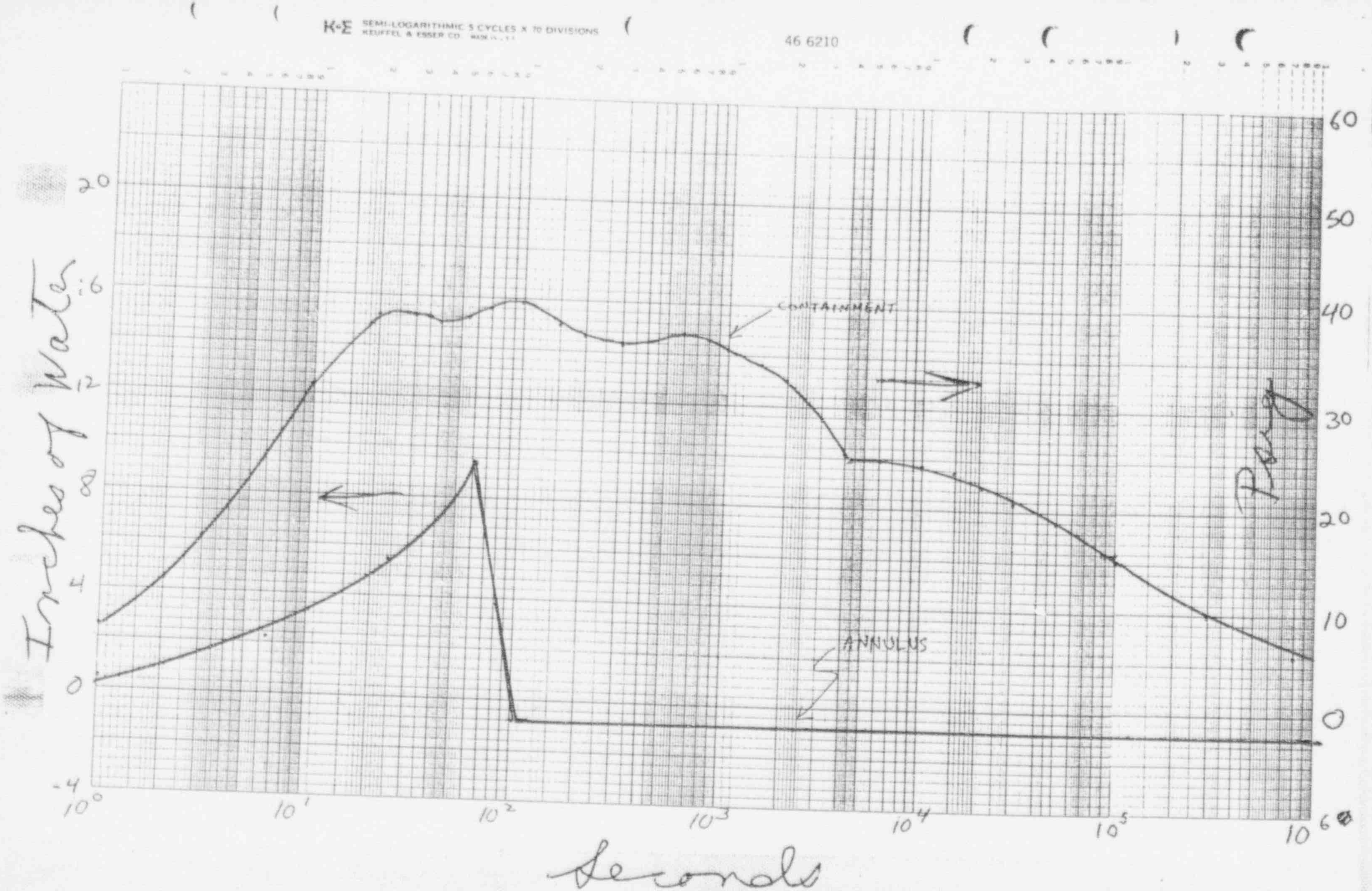


Figure 6.2-37 Pressure vs Time

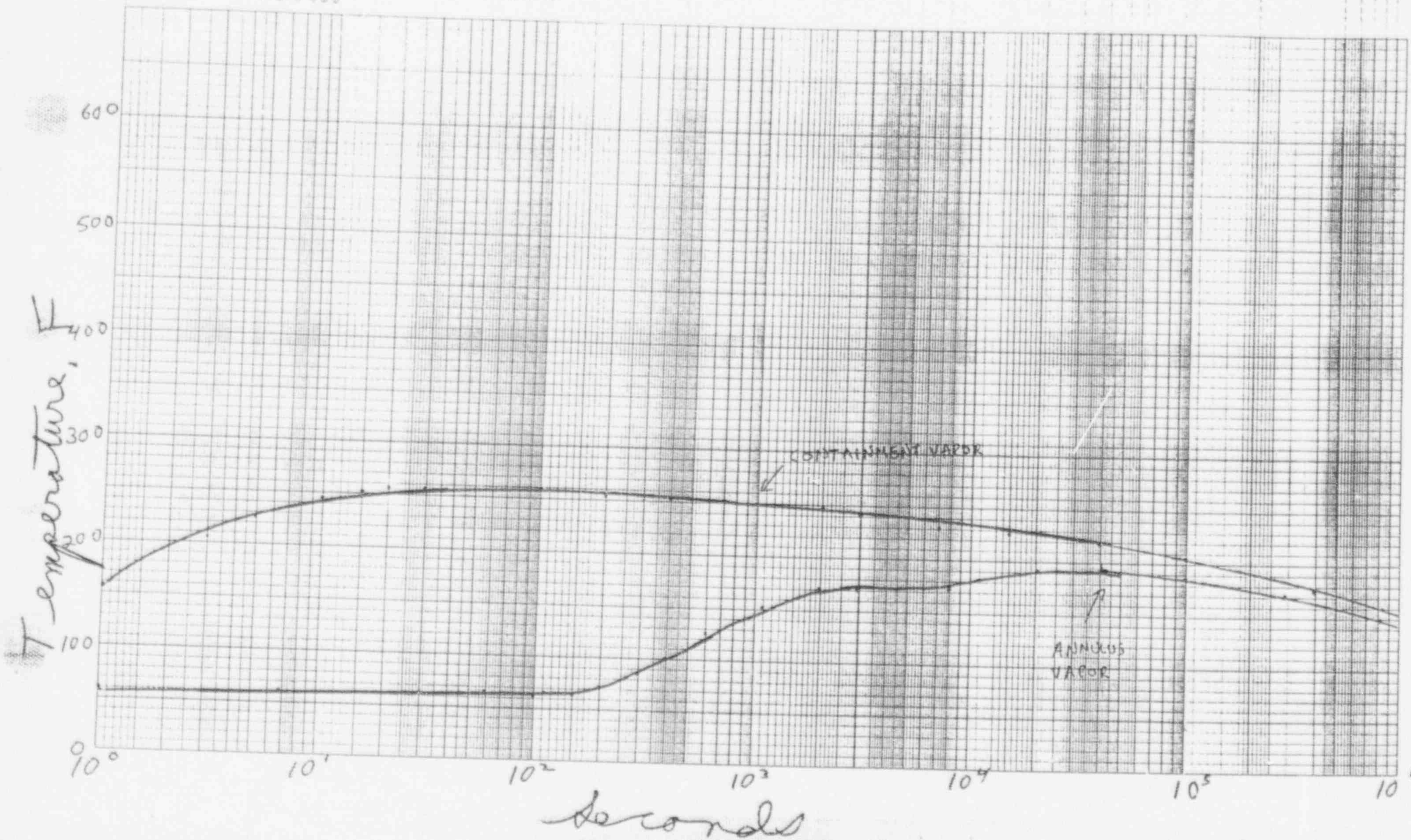


Figure 6.2-38 Temperature vs Time

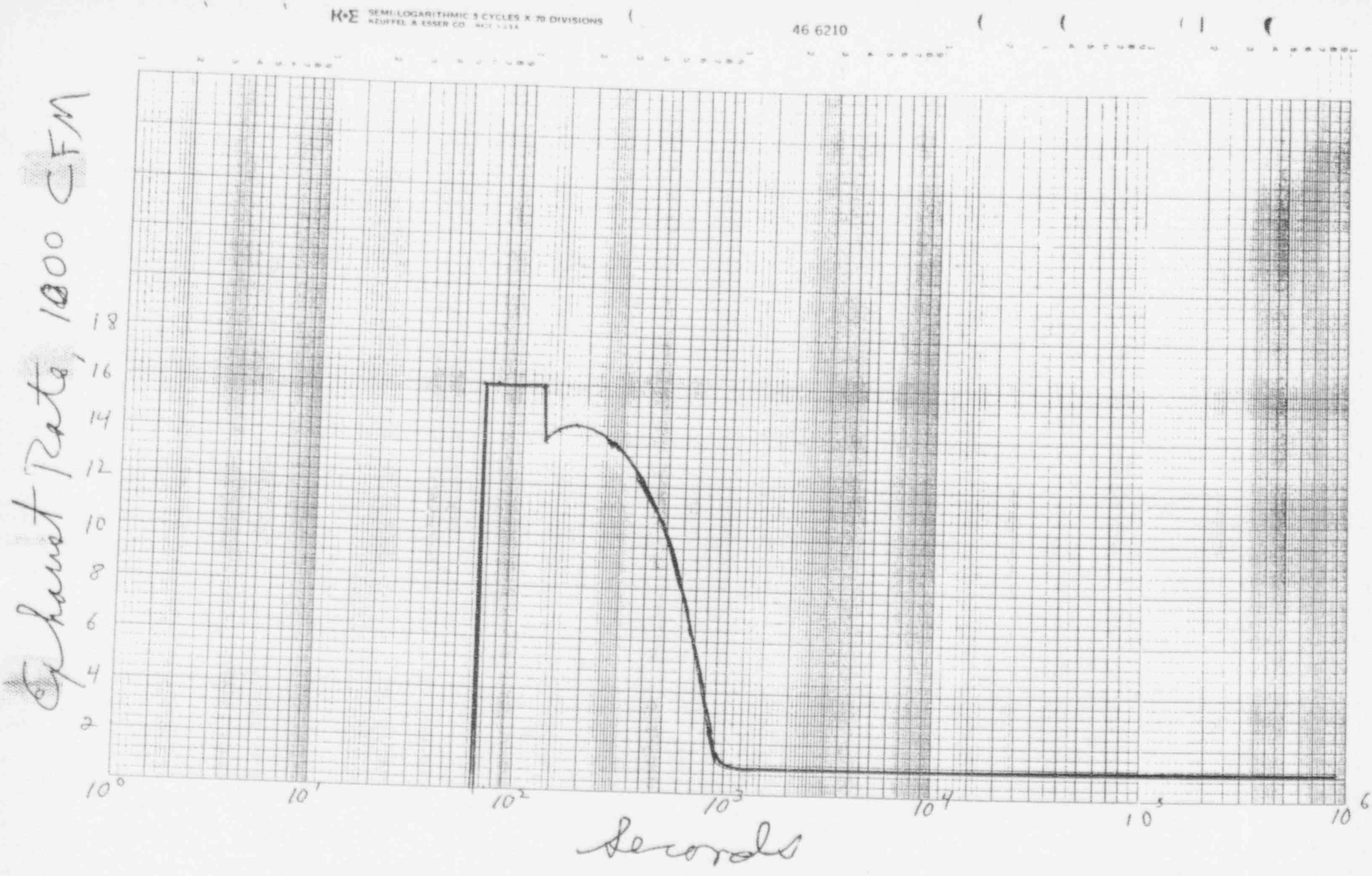


Figure 6.2-39 AVS Flow Vs Time

ATTACHMENT 3

Open Item 5.2.3-1:

The applicant takes exception to the recommendations in Position C.2 of RG 1.50, "Control of Preheat Temperature for Welding Low Alloy Steels," for controls iomposed on preheat temperature for welding ferritic steels. These controls would provide reasonable assurance that components made from low-alloy steels will not crack during fabrication and minimize the possibility of subsequent cracking from residual stresses retained in the weldment. This exception is unacceptable, and the applicant should comply with the guidance in RG 1.50, or should propose an acceptable alternative to the staff position (Open Item 5.2.3-1).

Response to 5.2.3-1: (Revision to response in LD-92-115, November 24, 1992)

Regulatory Guides are not requirements, and, therefore, exceptions are allowed if suitably justified. ABB-CE's basis for taking exception to Position C.2 of RG 1.50 is report, WCAP-8578, Effect of preheat and Post Weld Heat Treat on Hydrogen-Induced Cracking in Pressure Vessel Steels, Sept. 1975. That report documents exhaustive testing to substantiate that there are alternatives to the procedure in Position C.2 which are equally effective in providing reasonable assurance that components made from low alloy steels will not crack during fabrication and which minimize the possibility of subsequent cracking. The report presents three acceptable alternatives for achieving reasonable assurance of freedom from cracks or from development of cracks later on. One of the alternatives is Position C.2, and ABB-CE does utilize this option in specific cases. ABB-CE believes it acceptable to choose either of the remaining alternatives based on specific welds and contractor capabilities.

Open Item 5.3.1-7:

The applicant takes exception to the recommendations offered in Position C.2 of RG 1.50, "Control of Preheat Temperature for Welding Low Alloy Steels," for controls imposed on preheat temperatures for welding ferritic steels. These controls would provide reasonable assurance that components made from low-alloy steels will not crack during fabrication, and minimizes the possibility of subsequent cracking from residual stresses that are retained in the weldment. This exception is unacceptable; the applicant should comply with the guidance in RG 1.50 (Open Item 5.3.1-7).

Response to 5.3.1-7: (Revision to response in LD-92-115, November 24, 1992)

Regulatory Guides are not requirements, and, therefore, exceptions are allowed if suitably justified. ABB-CE's basis for taking exception to Position C.2 of RG 1.50 is report, WCAP-8578, Effect of preheat and Post Weld Heat Treat on Hydrogen-Induced Cracking in Pressure Vessel Steels, Sept. 1975. That report documents exhaustive testing to substantiate that there are alternatives to the procedure in Position C.2 which are equally effective in providing reasonable assurance that components made from low alloy steels will not crack during fabrication and which minimize the possibility of subsequent cracking. The report presents three acceptable alternatives for achieving reasonable assurance of freedom from cracks or from development of cracks later on. One of the alternatives is Position C.2, and ABB-CE does utilize this option in specific cases. ABB-CE believes it acceptable to choose either of the remaining alternatives based on specific welds and contractor capabilities.

Open Item 5.4.1.1-2:

As an alternative to testing the fracture toughness of the actual material, the applicant proposes to use a lower bound fracture toughness curve obtained from testing the same type of material and adjusting the curve to provide a dynamic stress intensity factor of 49 MPa√m (45 ksi√in) at the NDT of the material. This alternative is unacceptable. The actual material should be tested to determine the fracture toughness properties. Further, Figure A-4200-1 in Appendix A to Section XI of the ASME Code shows that the lower bound fracture toughness $K_{IA}$ at $RT_{NDT}$ of the material is approximately 44 MPa√m (40 ksi√in), which is lower that the applicant's proposed lower bound of 49 MPa√m (45 ksi√in). The applicant should remove this alternative from CESSAR.

Response to Open Item 5.4.1.1-2: (Revision to response in LD-92-115, November 24, 1992)

ABB-CE has reevaluated the CESSAR-DC proposed alternate method for establishing the fracture toughness of the actual flywheel material. We have decided to comply with SRP Section 5.4.1.1, Subsection II.2 as stated below:

"The minimum static fracture toughness of the material at the normal operating temperature of the flywheel will be equivalent to a critical stress intensity factor, $K_{IC}$, of at least 150 Ksi√in. Compliance will be demonstrated by either of the following:

a. Testing of the actual material of the flywheel to establish the $K_{IC}$ value at the normal operating temperature, or

b. Determining that the normal operating temperature is at least 100°F above the $RT_{NDT}$.

(This revision was incorporated in CESSAR-DC, Amendment L, page 5.4-2; see attached.)

Ref: Revised response to Open Item 5.4.1.1-2

2. The Charpy V-notch (Cv) upper shelf energy level, in the "weak" (Wr) direction, as obtained per ASTM-A-370 will be no less than 50 ft-lb. A minimum of three Cv specimens will be tested from each plate or forging.

3. The minimum static fracture toughness of the material at the normal operating temperature of the flywheel will be equivalent to a critical stress Intensity factor ($K_{IC}$) of at least 150 ksi$\sqrt{in}$. Compliance will be demonstrated by either of the following: L

   a. Testing of the actual material of the flywheel to establish the $K_{IC}$ value at the normal operating temperature, or L

   b. Determining that the normal operating temperature is at least 100°F above the $RT_{NDT}$. L

4. Each finished flywheel will be subjected to a 100 percent volumetric ultrasonic inspection from the flat surface per ASME BPVC Section III.

   This inspection will be performed on the flywheel after final machining and the overspeed test.

5. If the flywheel is flame cut, at least 1/2 inch of stock will be left on the outer and bore radii, for machining to final dimensions.

6. The flywheel will be subjected to a magnetic particle or liquid-penetrant examination per "Section III" before final assembly. The inspection will be performed on finished machined bores, keyways, splines and drilled holes. L

B. The flywheels will be designed to withstand normal operating conditions, anticipated transients, and the largest mechanistic pipe break size remaining after application of leak before break as described in Section 3.6, combined with the Safe Shutdown Earthquake. D

The following criteria will be satisfied:

1. The combined stress, both centrifugal and interference, at normal operating speed will not exceed one-third of the minimum specified yield strength or 1/3 of the measured yield strength in the weak direction of the I

Open Item 5.4.1.1-7:

The applicant should commit to performing a preservice baseline inspection incorporating all the procedures for inservice inspection as described to establish initial flywheel conditions, accessibility, and practicality of the program. The applicant should also specify that the acceptance criteria are those contained in ASME Section III.

Response to 5.4.1.1-7: (Revision to response in LD-92-115, November 24, 1992)

CESSAR-DC will be revised to require that each flywheel will receive a preservice baseline inspection (PSI) incorporating the methods required for the inservice inspection (ISI) program. Examination procedures and acceptance criteria will be in accordance with the ASME BPVC Section III. (This revision was incorporated in Amendment L, page 5.4-3; see attached.)

Traditionally, the customer (COL applicant) has had responsibility for PSI and ISI. In some cases, the customer has subcontracted this work to ABB-CE. In other cases, the customer has taken full responsibility or has even had a third party perform PSI and ISI. In all cases, the requirements of the regulations will be met.

The PSI and ISI division of responsibility will be provided by the COL applicant in the site specific SAR.

The RCP motors are designed with access space and ports in the motor structure adjacent to the flywheel to allow for in place PSI and ISI. The practicality of the program has been demonstrated by performing these inspections in operating plants, such as Palo Verde.

Ref: Revised response to Open Item 5.4.1.1-7

material if appropriate tensile tests have been performed on the actual material of the flywheel. I

2. The design overspeed of the flywheel will be 125 percent of normal operating speed. L

The design overspeed will be at least 10% above the highest anticipated overspeed of the pump. The highest anticipated overspeed is predicted for the largest break size remaining after application of leak before break as described in Section 3.6. L D

3. The combined centrifugal and interference stresses at the design speed will be limited to two-thirds of the minimum specified yield strength or 2/3 of the measured yield strength in the weak direction if appropriate tensile tests have been performed on the actual material of the flywheel. Design speed is defined as 125 percent of normal operating speed. I

4. The motor and pump shaft or bearings and coupling will withstand any combination of normal operating loads or anticipated transients, and the largest remaining pipe break after application of leak before break as described in Section 3.6, combined with the Safe Earthquake Shutdown. D

Each flywheel will be tested at design speed, 125 percent of normal operating speed, as defined in B.2 above.

The flywheel will be accessible for 100 percent in-place volumetric ultrasonic inspection. The flywheel-motor assembly is designed to allow such inspection with a minimum of motor disassembly. The in-service inspection program will include ultrasonic examinations of the areas of high stress concentration at the bore and keyway at about 3 1/3 year intervals, during the refueling or maintenance shutdown coinciding with the in-service inspection schedule as required by the ASME Code, Section XI. Removal of the flywheel is not required. I

A surface examination of all exposed surfaces and 100% volumetric examination by ultrasonic methods will be conducted at about ten-year intervals during the plant shutdown coinciding with the in-service inspection schedule as required by the ASME Code, Section XI. L I

Each flywheel will receive a preservice baseline inspection incorporating the methods defined above for an inservice inspection. Examination procedures and acceptance criteria will be in accordance with the ASME BPVC Section III. L

Open Item 6.1-1:

In CESSAR Section 5.3.2.2.3.1, the applicant takes exception to the recommendations in Position C.2 of RG 1.50, "Control of Preheat Temperature for Welding Low Alloy Steels," for controls imposed on preheat temperature for welding ferritic steels. These controls would provide reasonable assurance that components made from low alloy steels will not crack during fabrication and minimize the possibility of subsequent cracking because of residual stresses are retained in the weldment. This is unacceptable; the applicant should follow the guidance in RG 1.50 (Open Item 6.1-1).

Response to 6.1-1: (Revision to response in LD-92-115, November 24, 1992)

Regulatory Guides are not requirements, and, therefore, exceptions are allowed if suitably justified. ABB-CE's basis for taking exception to Position C.2 of RG 1.50 is report, WCAP-8578, Effect of preheat and Post Weld Heat Treat on Hydrogen-Induced Cracking in Pressure Vessel Steels, Sept. 1975. That report documents exhaustive testing to substantiate that there are alternatives to the procedure in Position C.2 which are equally effective in providing reasonable assurance that components made from low alloy steels will not crack during fabrication and which minimize the possibility of subsequent cracking. The report presents three acceptable alternatives for achieving reasonable assurance of freedom from cracks or from development of cracks later on. One of the alternatives is Position C.2, and ABB-CE does utilize this option in specific cases. ABB-CE believes it acceptable to choose either of the remaining alternatives based on specific welds and contractor capabilities.

Open Item 20.2-11

The staff requires additional information regarding the applicant's response to Generic Issue 79.

ABB-CE Response: (Revision to response in LD-93-011, Feb. 2, 1993)

Generic Issue 79 addresses the potential relating to an unanalyzed reactor vessel thermal stresses during natural convection cooldown (NCC) of PWR reactors. Specifically, NCC events with subsequent reactor vessel head voiding such as the event which occurred on St. Lucie Unit 1 in 1980 are of concern.

Stress analyses performed for the St. Lucie and System 80 reactor vessels concluded that peak thermal stresses for vessel head voiding and refilling are within ASME Code Section III allowables. Furthermore, the analyses showed that for one NCC event, with 100 drain (void) and fill cycles, the usage factor would be less than 0.0002 for the System 80 reactor vessel.

The System 80 analyses bound System 80+ based on the similarity in reactor vessel materials, dimensions, and geometry. The fluid conditions in the reactor vessel upper head during draining and refilling for NCC are essentially the same. In fact, the stresses on the System 80+ vessel may be less due to a lower initial hot leg and reactor vessel upper head temperature than System 80.

For System 80+, 30 natural convection cooldown events are included in the design bases events for thermal, hydraulic and fatigue analyses. See CESSAR-DC Table 3.9-1, Amendment K. The 30 events are applicable to the 60-year plant design life. Even if all 30 events included the 100 vessel head drain-and-fill cycles described above, the usage factor would be less than 0.006. The 30 NCC events included in the System 80+ design bases are considered conservative in light of the Generic Letter 92-02 statement that NCC events occur infrequently.

CESSAR-DC Appendix A, GSI 079, will be revised as shown on the attached markup.

ECGB

(Formal Printing in Progress)

# 079: UNANALYZED REACTOR VESSEL THERMAL STRESS DURING NATURAL CONVECTION COOLDOWN

## ISSUE

Generic Safety Issue (GSI) 079 in NUREG-0933 (Reference 1), identifies the potential for the stresses in the reactor vessel flange area or studs to exceed the allowable during its design lifetime because of a previously unanalyzed thermal stress introduced by the natural convection cooldown event.

A natural convection cooldown event occurred at the St. Lucie 1 nuclear power generating station. During the course of this event, steam voiding occurred in the reactor vessel head area. Upon analysis, concern was raised over previously unanalyzed reactor vessel thermal stresses. The concern focused on the possible existence of an axial temperature gradient of 150 to 200 degrees F in the vessel flange and studs.

The safety concern arises because this event could produce thermal stresses in the flange area or in the studs that may exceed the ASME B&PV, Section III Code (Reference 2) allowables when added to the stresses already considered. Moreover, the cycling of these temperature gradients over the life of the plant has the potential to cause a reduction in the fatigue margin of the vessel.

## ACCEPTANCE CRITERIA

The acceptance criterion for the resolution of GSI 079 is that the design of the reactor pressure vessel (including the head and studs) shall accommodate the thermal stresses caused by a natural convection cooldown event. These thermal stresses, when added to stresses from events that are presently analyzed, shall not exceed the stress limits specified in the ASME B&PV Code, Section III.

## RESOLUTION

Stress analyses were performed to determine the effects of a natural circulation cooldown event (similar to that of the St. Lucie occurrence) on both the St Lucie "class" reactor vessel and the System 80 "class" reactor vessel. The analyses concluded that should natural circulation cooldown of the reactor coolant system be required and should vessel head voiding subsequently occur, the resulting thermal stresses would not cause any thermal, hydraulic, or fatigue damage to the reactor vessel and its integral components over their design lifetime. The analyses showed that for an NCC event with 100 drain (void) and fill cycles, the usage factor would be less than 0.0002 for the System 80 reactor vessel.

ECGB

Furthermore, the System 80+ reactor vessel, which is designed to the ASME B&PV Code, Section III (see CESSAR-DC, Section 5.3), is essentially identical to the System 80 reactor vessel. Specifically, the vessels have the same material composition and overall dimensions and are of similar geometry (with the exception of the direct vessel injection nozzles) as described in CESSAR-DC, Table 1.3-1, and Figure 3.9-9. Because the reactor vessels for both "classes" of plants are virtually the same and since the stress analyses consider the materials, dimensions and geometry of the vessel, the analyses performed subsequent to the St. Lucie 1 event apply to the System 80+ reactor vessel.

In summary, the addition of the dynamic, thermal and fatigue effects of a natural convection cooldown on the System 80+ reactor vessel does not result in the vessel stresses or fatigue usage factor exceeding the allowable limits specified in the ASME B&PV Code, Section III. Therefore, this issue is resolved for the System 80+ Standard Design.

REFERENCES


1. NUREG-0933, "A Status Report on Unresolved Safety Issues", U.S. Nuclear Regulatory Commission, April 1989.

2. American Society of Mechanical Engineers, Boiler & Pressure Vessel Code, Section III (Nuclear).


The fluid conditions in the reactor vessel upper head during draining and refilling for NCC are essentially the same. In fact, the stresses on the System 80+ vessel may be less due to a lower initial hot leg and reactor vessel upper head temperature than System 80.

For System 80+, 30 natural convection cooldown events are included in the design bases events for thermal, hydraulic and fatigue analyses. See CESSAR-DC Table 3.9-1, Amendment K. The 30 events are applicable to the 60-year plant design life. Even if all 30 events included the 100 vessel head drain-and-fill cycles described above, the usage factor would be less than 0.006. The 30 NCC events included in the System 80+ design bases are considered conservative in light of the Generic Letter 92-02 statement that NCC events occur infrequently.