SNUPPS
Standardized Nuclear Unit Power Plant System

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February 1, 1984

Nicholas A. Petrick
Executive Director

SLNRC 84-0014 FILE: 0278
SUBJ: Fire Protection Review

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket Nos. STN 50-482 and STN 50-483

Dear Mr. Denton:

The NRC Chemical Engineering Branch conducted a fire protection site audit at the Callaway Plant during the week of October 17, 1983. Completion of a fire protection audit is required by licensing Confirmatory Issue 25 for the Callaway Plant and Confirmatory Issue A.6 for the Wolf Creek Generating Station. The fire protection audit at the Wolf Creek Generating Station is scheduled for the week of February 6, 1984.

Enclosed are the SNUPPS responses to the Callaway Plant fire protection audit concerns as expressed at the audit exit meeting. As all of the concerns apply to standardized features of the SNUPPS design, the responses likewise are applicable to the Wolf Creek Generating Station.

Very truly yours,

N A Petrick

Nicholas A. Petrick

NHF/nld7b22
Enclosures

cc:				
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Rec'd 7/5/84 DCD B002 1/1

Enclosure

RESPONSES TO NRC FIRE PROTECTION

AUDIT CONCERNS

1. FIRE HOSE LENGTH IN CABLE SPREADING ROOMS

The NRC Fire Protection Audit Team expressed a concern that the 75 foot hoses for firefighting in the cable spreading rooms were not long enough to reach from the hose reels to the far side of the rooms considering potential obstacles in the rooms.

The SNUPPS Utilities agreed to replace the 75 foot hoses with 100 foot hoses. The necessary documentation has been completed to effect the installation of 100 foot hoses at both SNUPPS plants.

Enclosure

2. SPRINKLER COVERAGE BENEATH DIESEL GENERATOR BUILDING DUCTWORK

NFPA 13 (1975) paragraph 4-4.13 requires that sprinklers be installed beneath ducts that are over 4 feet in width unless the ceiling sprinklers can be spaced in accordance with Table 4-2.4.6.

Large HVAC ducts, below the ceiling sprinklers in the Diesel Generator Building, reduce the effectiveness of the suppression system. The subject ducting is 84 inches wide. The top of the duct varies from 2033'-10" to 2037'-6"; the bottom of the duct is at elevation 2030'-6". The center line elevation of the existing sprinkler branch lines is approximately 2044'-2". This arrangement locates the sprinklers 13'-8" above the bottom of ducting.

Design modifications have been developed to provide additional sprinklers consisting of small pipe extensions off the existing piping network underneath the HVAC ducts. The design modification adds 18 sprinkler heads per diesel room below the HVAC ducts at both SNUPPS plants.

Enclosure

3. DIESEL GENERATOR DAY TANK DIKE

The NRC fire protection auditors expressed a concern that the day tank dike is located below the day tank and does not extend above the bottom of the tank. Thus leakage from a tank may escape from the confines of the dike and spread into its respective diesel room.

The day tanks are located above a diked area with a free volume of greater than 110% of the tank volume. The diked area is provided with a floor drain which drains to a sump within the room. The sump is provided with a solid cover plate and class 1E level indication in the control room (Refer to FSAR Figure 9.3-5 sheet 5).

The area adjacent to the day tank contains no hot surfaces or ignition sources. Any fuel oil on the general floor area will enter the floor drain system and be routed to the sump. Duplex sump pumps are provided to evacuate the sump. The nearest floor drain is approximately 10' outside of the dike.

The day tank and all piping associated with the pressure boundary is Seismic Category I and not postulated to fail due to an earthquake. Also, following an accident, no passive piping failures are postulated in accordance with current licensing practices. The day tanks are unpressurized tanks vented to the outdoors via piping equipped with flame arrestors. The NRC previously questioned (Q430.12) the design of the fuel oil piping from the day tank to the diesel engine and accepted the response provided, see attached FSAR page 430.12-1.

The day tank is also provided with Class 1E level indication which alarms in the control room when the 4" stand pipe volume/level decreases by less than 3 gallons when the diesel is not operating; therefore, any loss in fuel oil would be readily detected during normal plant operating. Also, security personnel make tours of all safety related areas during each shift.

Diesel generator testing is conducted from the control panel within the diesel room. Any leakage occurring during diesel operation would be detected by test personnel.

The potential for missile generation by an operating diesel was similarly questioned by the NRC (Q430.8). The response provided by the diesel manufacturer was accepted by the NRC staff. Refer to FSAR page 430.8-1, attached. In addition, the NRC staff has previously requested additional information regarding the design of the day tank dike and has indicated that the design is adequate (Refer to FSAR pages 9.5C-56 and 9.5D-12 attached).

In summary, as described above, the design of the day tank dike complex is completely adequate.

Q430.12 (9.5.4) **Discuss what precautions have been taken in the design of the fuel oil system in locating the fuel oil day tank and connecting fuel oil piping in the diesel generator room with regard to possible exposure to ignition sources such as open flames and hot surfaces. (SRP 9.5.4, Part III, Item 6).**

RESPONSE

The fuel oil day tank is located more than 20 feet horizontally from the diesel engine and well below the insulated diesel exhaust piping and, therefore, will not be exposed to any high temperature surfaces.

There is no elevated fuel oil piping adjacent to the engine. The fuel oil piping between the engine and the day tank drops down from the tank and runs along the floor until it reaches the engine. The diesel engine itself sets on a 6-inch skid and therefore elevated above the floor.

There are no open flames in the diesel generator room.

Open flames in the diesel generator area as well as in other plant areas are controlled by plant administrative procedures.

Q430.8 (9.5.4) The diesel generator structures are designed to seismic and tornado criteria and are isolated from one another by a reinforced concrete wall barrier. Describe the barrier (including openings) in more detail and its capabilityto withstand the effects of internally generated missiles resulting from a crankcase explosion, failure of one or all of the starting air receivers, or failure of any high or moderate energy line and initial flooding from the cooling system so that the assumed effects will not result in loss of an additional generator. (SRP 9.5.4, Part III, Item 2).

RESPONSE

The barrier separating the two diesel generators is a 2-foot-thick reinforced concrete wall. The wall reinforcement is such that the wall is capable of withstanding the impact of all the externally generated missiles identified in Table 3.5-1 of the Standard Plant FSAR.

There are four openings in the wall, but they are located within 3 feet of the north end of the building. This location and the small size of the openings (1 foot square or smaller) will effectively prevent any internally generated missiles from passing through the openings and damaging equipment in the adjacent area. In addition, these openings actually serve as penetrations for piping and are sealed.

SNUPPS diesel engine is a low speed (514 rpm) engine which has a vented crank case. The engine manufacturer has never experienced nor knows of any crank case explosions or engine failures which resulted in missiles.

As noted above, the internal wall separating the two diesel engines is designed to withstand a tornado missile impact. In the highly unlikely event that the engine did generate an external missile, the energy of that missile would be significantly less than that of the tornado missile.

The air tanks are seismically mounted on their skids, which are in turn seismically anchored to the floor. Rupture of a tank would not generate missiles whose energy exceeds that of a tornado missile.

There are no high energy lines in the diesel generator building. The only moderate energy lines are those directly associated with each diesel engine. Therefore, a postulated failure of a moderate energy line would be considered the diesel single failure. There are no open penetrations between rooms, and therefore, flooding of one room will not degrade the opposite diesel engine.

Item 40. (Table 9.5-5, Sheet 56)

(RSP) The emergency fuel oil day tanks are not in a separate enclosure. Appendix A to BTP 9.5-1 permits the day tanks to be installed in the diesel generator area only if they are located in a separate enclosure and protected by an automatic fire suppression system. Therefore, we require that you comply with Appendix A in this regard or provide justification for deviating from Appendix A.

Response:

The fuel oil day tank arrangement for SNUPPS exceeds the recommendations of BTP 9.5-1, Appendix A for plants which received a construction permit before July 1, 1976. The entire diesel building is protected by a closed head, automatic, preaction sprinkler system. In addition, the day tank in each room is surrounded by a concrete dike sized to contain the full volume of the day tank.

Refer to item 29 of Appendix 9.5D for a discussion of the drainage to the sumps and the fire barrier in the trench connecting the two diesel generator rooms.

Item 11. (Page 9.5A-39a)

It is our position, as stated in Section F10 of Appendix A, that the diesel generator day tanks be limited to a maximum of 1100 gal. and that if a diked enclosure is provided, that it have sufficient capacity to hold 110% of the contents of the day tank and drained to a safe location. Also, hose stations should be provided for secondary protection for the diesel generator area in case of failure of the primary system (the pre-action system). Revise your design accordingly.

Response:

The diesel fuel oil day tank has a nominal capacity of 550 gallons. The dike around the base of the tank will hold at least 110 percent of the tank contents. The dike area is drained by gravity to a 900 gallon, covered sump in the same diesel generator room. The oil can be pumped outdoors to a truck connection for removal from the building. As indicated in Paragraph D.2.4.3 of the SNUPPS Fire Hazard Analysis, a hose station is provided just outside the interior access doorway into the diesel generator rooms.

4. FIRE STOP DESIGN AND LOCATION DESCRIPTION

A concern was identified regarding the cable trays on elevation 2026' of the Auxiliary Building which extend between areas containing redundant safe shutdown equipment. The cable trays could constitute an intervening combustible by which fire could propagate between areas. The SNUPPS Utilities have agreed to install a fire stop in each of the intervening cable trays.

The fire stop consists of Dow Corning Silicone RTV Foam as installed in SNUPPS wall and floor penetrations. This is installed in the cable tray and is then enclosed by sheet metal tray covers. TSI Thermo-Lag 330-1 prefabricated panels are then installed on the cable tray, on each side of the Silicone RTV Foam, to provide a three foot minimum overall fire stop.

The fire stop is located in each of the cable trays which traverse between the redundant CCW trains in the Auxiliary Building El. 2026' - 0" between column lines A6 and A7, and column lines AK and AL. The fire stops are located vertically above each other in their respective cable trays.

Enclosure

5. AUXILIARY BUILDING CORRIDOR SPRINKLER COVERAGE

The NRC fire protection auditors indicated a general concern that certain auxiliary building corridors were too congested to allow the sprinklers located above cable trays to provide adequate coverage of the general floor area. Thus the cable trays were potentially lacking adequate protection from transient fires. The auditors suggested that additional sprinklers may be required below the lowest obstruction.

The concerns raised have been reviewed along with each auxiliary building corridor. Based on this review, it has been determined that no additional sprinklers are necessary. The following descriptions provide the bases for this determination.

SPRINKLER LOCATION CRITERIA: In general, sprinklers are located to provide fixed automatic suppression where cable tray concentrations occur. The ability to manually fight a fire at the cable tray elevation is considered and has resulted in providing sprinklers for the non-safety related trays along the west corridor of Elevation 1974. Typically, sprays are provided where two or more stacks of trays are present with 2 or more trays in each stack. Also considered are the safety classification of the tray contents, the congestion in the area, and the height of the trays above the floor. The auxiliary building corridors have been reviewed and the coverage presently provided has been again determined to be adequate. Certain sections of each corridor do not require protection (e.g., elevation 2047 does not have any sprays in the corridors).

SPRINKLER/SPRAY HEADS: Water spray nozzles with 165°F fusible closures are installed to provide a .30 gpm per sq. ft. over the remote 300 sq. ft. This far exceeds the NFPA 13 density guidelines for Ordinary-Group 3 Hazards per Table 2-2.1B. Occupancies classified as Ordinary-Group 3 per NFPA 13 include paper mills, repair garages and warehouses having moderate to higher combustibility of content. Installed combustibles combined with anticipated transients will not approach this level of hazard in the SNUPPS plants.

The spray nozzles provided for the subject systems are Star Model E spray nozzles with a 120° discharge spray pattern. The spray nozzles produce a high velocity directional spray of small diameter droplets for efficient cooling and protection. The area around the cable trays will be pervaded with water spray which will provide cooling for the trays and their contents. There are no obstructions between the spray nozzles and the tray surfaces.

DETECTOR AND HEAD LOCATIONS: Detectors and spray heads are located at high points in the corridors where smoke and heat collect. This ensures rapid detection, early charging of the sprinkler system, and early melting of fusible elements. The present locations provide optimum protection for the structural steel and the cable trays.

Enclosure

The sprinkler heads are located to provide coverage of the corridor beam pocket areas; therefore, the heads are generally not located immediately above a stack of trays. Typically 4 heads are provided in each beam pocket.

The distance between branch lines and between sprinklers on the branch lines does not exceed 12 feet. The protection area per sprinkler does not exceed 80 sq. ft. for any protected area. These meet the NFPA 13 spacing and location criteria for extra hazard occupancies.

DESCRIPTION OF PHYSICAL LAYOUT/OBSTRUCTIONS: The layout of the contents of each auxiliary building corridor is similar. The corridor is generally 12 to 15 feet wide with cable trays suspended from overhead steel. The trays are a maximum of 2 feet wide with a minimum of 3 feet horizontal separation between stacks. No other components are routed at the elevation of the cable trays (except fire headers and sprinklers).

The cable trays are the only installed combustibles by which a localized transient fire could spread beyond its area of origin. The fire protection provided for these areas would prevent propagation of an exposure fire beyond its point of origin.

Compared to other plants, the SNUPPS corridors have very few piping runs, have virtually no HVAC ducts, and are relatively uncongested. Two design features account for the lack of piping and HVAC ducts in the corridors. The first is the horizontal pipe chase at elevation 1988 which is an entire floor dedicated strictly to piping. The second is the existence of a separate radwaste building. The separate radwaste building eliminates many large HVAC ducts and numerous pipes.

Below the trays the obstructions, if any, consist of piping runs. The pipes are generally small diameter and widely spaced. They do not constitute a significant blockage. There are very limited quantities of horizontal HVAC ducting. In the few places where it does exist, it is generally not wider than 2'-0". In summary, significant blockages do not exist in the auxiliary building corridors. None of the blockages are wider than 2'-0" and the cable trays are well separated (3'-0") and not wider than 2'-0". NFPA 13 requires sprinklers to be installed beneath ducts, gratings etc. over 4 ft. wide.

The particular area of concern as noted during the Callaway Site Fire Protection Audit was the west side of elevation 1974'. All cable trays located in this fire area are non-1E.

DETECTION: All areas of the Auxiliary Building corridors are protected with ionization dtectors to detect a fire during its incipient stage. This permits the fire brigade to quickly locate and extinguish the fire.

FIRE LOADING AND TRANSIENT FIRE FIGHTING: In general, the only fire loading above floor level are the cables in the cable trays. All cables routed in the auxiliary building are qualified to IEEE-383 and are not susceptible to burning from electrically generated fires. Nor are they expected to propagate fire if exposed to a transient fire when sprays are actuated. This will confine an exposure fire to its point of origin.

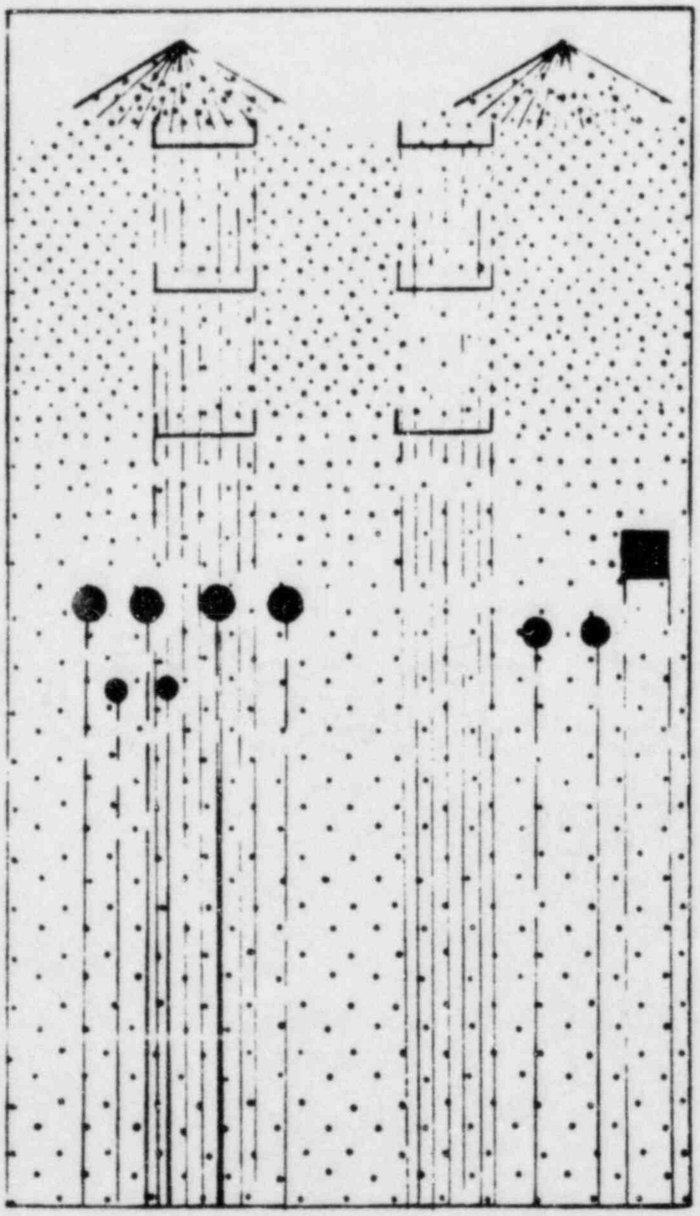
Enclosure

The ceiling level sprinklers will provide general suppression and control of a transient fire and allow the fire brigade to extinguish the fire manually using portable extinguishers and/or fire hoses.

The piping runs do not prevent hose stream penetration to the cable tray elevation.

As noted during the Callaway Site Fire Protection Audit, the fire brigade has fire fighting/response procedures for each area of the plant. The fire brigade is trained to effectively extinguish fires in any auxiliary building corridor.

The attached figure provides an elevation view of a typical corridor with two stacks of trays and a pictorial presentation of the head locations and sprinkler coverage. As shown the heads are located within inches of the ceiling and the 120° discharge cone of fine mist sized droplets pervades the cable tray area. The concentration of spray below the trays will be influenced by spray impingement on the walls, cable trays and any pipes which are present below the trays; however, due to the spray flow rate, the size of the droplets and turbulence due to the fire, a sufficient density of spray droplets will exist below the trays to control postulated transient fires until the fire brigade arrives.



TYPICAL ELEVATION VIEW
AUXILIARY BUILDING CORRIDOR
CABLE TRAY SPRAY COVERAGE

Enclosure

6. CABLE TRAY SUPPORTS FOR THROUGH-WALL TRAYS

The NRC auditors were concerned that failure of cable tray supports resulting from the high temperatures in a fire area may cause the tray to sag and break the vertical wall seal between fire zones.

To provide additional information regarding the adequacy of the SNUPPS cable tray penetration seal design, a through-wall penetration seal test on a seal design similar to the SNUPPS seal design was made available to the NRC staff reviewer. This test is Factory Mutual Research report number J.I. 1A5Q5.AC dated April 26, 1978. The particular test in the report which provides additional assurance of the adequacy of the SNUPPS design is tray #7 vertical test #1. As indicated in the test report, the applicable tray successfully passed the 3 hour fire exposure and hose stream tests.

Enclosure

7. UL APPROVAL OF SNUPPS DAMPER DESIGN

A concern was identified regarding the UL approval of the ganged dampers in the HVAC ducts supplying the control room.

Several documents and drawings have been provided to the NRC staff auditor to document UL approval of SNUPPS damper design. These documents and drawings are listed below:

Documents: M-627B-114, M-627B-141, M-627B-124, M-627B-113, M-627B-111, M-627B-107

Drawings: M-627B-142, M-627B-138, M-627B-123, M-627B-112, M-627B-110, M-627B-109, M-627B-108, M-627B-106, M-627B-105. M-627B-104, M-627B-120, M-627B-119, M-OH1905, M-OH1904

As substantiated by the documents and drawings, the SNUPPS dampers are UL listed and the installation details are UL approved.

Enclosure

8. PENETRATION SEALS/TRAY WRAP TEST INFORMATION

1. PENETRATION SEALS

The purpose of the comprehensive test program for SNUPPS penetration seals is to provide documented evidence that penetration seals used on SNUPPS will satisfactorily withstand an ASTM E 119-80 fire exposure and conclusively demonstrate that these seals will provide an effective 3-hour fire barri .

All fire rated penetration seals were tested by an independent testing laboratory utilizing the following for test guidance:

a. ASTM E 119-80, Standard Methods of Fire Tests of Building Construction and Materials.

b. ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops.

c. IEEE 634-1978, Cable Penetration Fire Stop Qualification Test.

The test program, procedures and results were approved by ANI.

The acceptance criteria is consistant with the test standards identified above. They include:

1. Fire shall not propagate to the unexposed side of the test assembly nor shall any visible flaming occur.

2. No individual thermocouple of the unexposed surface of the fire stop shall exceed 325°F above ambient temperature.

3. No opening developes that permits a projection of water from the stream beyond the unexposed surface during the hose stream test.

All penetration seals used on SNUPPS meet or exceed those seals successfully tested as detailed above.

The following are vendor print register numbers to establish traceability of the reports in the plant filing system:

10466-M-663-0024
10466-M-663-0060
10466-M-663-0061
10466-M-663-0062
10466-M-663-0082
10466-M-663-0083

These documents have been made available to the NRC staff fire protection auditor.

2. TRAY AND CONDUIT WRAP

The SNUPPS Utilities are using tray and conduit wrap manufactured by TSI. The test program, for the tray and conduit wraps used, evaluated the wrap system based on one hour and three hour ASTM E 119 fire endurance tests.

The test articles were exposed to the standard time/temperature curve of ASTM E-119 for the appropriate duration, followed by a water hose stream test. The system meets all the requirements and performance criteria of ANI's Bulletin #5 (79) entitled: "ANI/MAERP Standard Fire Endurance Test Method to Qualify a Protective Envelope for Class 1E Electrical Circuits" as documented in ANI letters W. Bornhoeft (ANI) to R. Feldman (TSI) dated December 2, 1982 with enclosed reports 82-11-80 and 82-11-81, "ANI/MAERP Protective Envelope for Class 1E Electrical Circuits Acceptance Form". These documents have been made available to the NRC staff fire protection auditor.

Enclosure

9. CONTROL ROOM FIRE DETECTOR LOCATIONS

The NRC fire protection auditors indicated a concern that fire detectors located at ceiling elevation in the rear area of the control room may not detect smoke from the cabinets in the area prior to its removal by the ventilation exhaust grills. The NRC recommended that consideration be given to the addition of additional detectors in the vicinity of the top of the cabinets and/or near or in the ventilation return grills.

The following discussions present information on 1) the location of the fire detectors, 2) the ventilation and cooling system configuration, 3) the expected air flow patterns in the rear of the control room as they affect detector performance and 4) a summary of why the existing detection scheme does not require any modifications to provide proper detection capabilities.

1. DETECTOR LOCATIONS - Ionization detectors have been located in each major beam pocket in the rear area (3500 ft^2) of the control room where the ceiling is approximately 25' high. The beam pockets are formed by 27" and 36" deep beams. These detectors, (a total of 13) will alarm the presence of smoke which has risen to the ceiling.

   The front console area (900 ft^2) of the control room is provided with a dropped acoustical ceiling in which 4 additional detectors are located. Below the acoustical ceiling (and detectors) a light diffusion grid has been provided to reduce glare from the overhead lights. This plenum space is also the location at which cooled recirculation (6,100 cfm) air is provided for the control console area. These detectors will alarm the presence of smoke in the plenum space which may have originated from a source in the console area or which was introduced by the air recirculation system.

2. VENTILATION AND COOLING SYSTEM CONFIGURATION - During normal operation, two separate HVAC systems operate to provide a suitable environment for the control room. The first is a cooling system which provides for the removal of heat generated in the control room. It recirculates and distributes 24,000 cfm to the front console area (6,400 cfm) and the rear area (17,600 cfm). Although this cooling system has the provisions for post-accident filtration of 2,000 cfm of the recirculation flow, the filter system is not in operation during normal operation and therefore does not remove any smoke from the recirculation flow.

   A separate ventilation system introduces fresh air (1950 cfm) to and exhausts (1750 cfm) from the front area of the control room. The front and rear areas of the control room are separated by the drop ceiling and walls in a manner which precludes unwanted air flow communication between the 2 areas.

3. AIR FLOW PATTERNS IN THE REAR AREA - HVAC design principles state that room air flow patterns are dictated by the location of supply registers and are only minimally affected by the location of exhaust registers. This is due to the ability to direct the high velocity discharge from supply registers and the "throw" characteristics. Flow approaching an exhaust register is a non-directional migration influenced only by distance from the return grill and the return air flow rate. Essentially, the air velocity at all equal distant points from a return grill will be the same value.

The control room air conditioning supply flow (17,600 cfm) is distributed through 22 radial diffusers (800 cfm each) which discharge between the rows of cabinets at 9.0 feet above the floor. This supply air is blown radially downward from each diffuser and blankers the cabinet area with cooled air. The supply air displaces the air which has been heated and displaced air must rise toward the ceiling beam pockets while migrating slowly toward the exhaust returns. The air space below the supply registers is changed every 1.8 minutes by the cooled air supply.

Two 30" x 60" exhaust grills are located on the southern wall at floor level in a recessed space which is 14' deep by 19' wide and extends to the ceiling.

The return air flow approach velocities have been estimated at several distances, based on the location of the return grills, the return air flow rate (17,600 cfm) and the geometry of the room in the vicinity of the return grills. At a distance of 10.5 feet from the return grills (which corresponds to the start of the recessed area) the uniform approach velocity is approximately 1 fps. At a distance of 20' from the return grills (approximate distance to the nearest beam pocket), the uniform velocity is approximately 0.2 fps.

Since the nearest supply air is being discharged at a distance of greater than 20 feet from the return grills minimal interaction is anticipated. However, air from around the nearest cabinets could be exhausted without first migrating to the ceiling. Air from the more distant cabinets would replace the air drawn from the ceiling area.

4. SUMMARY - The current fire detection system for the control room is adequate and will detect smoke shortly after its release. The location of detectors when taken with the location of supply and return registers ensures that the smoke will be detected prior to being exhausted by the normal ventilation exhaust system which draws air (1750 cfm) from the front areas of the control room.

High velocity supply air is discharged at the top of the cabinets. This air would replace the air containing smoke which is forced to rise while migrating toward the exhaust grills. The detectors in the ceiling beam pockets would detect smoke from most, if not all, cabinets prior to its entry into the exhaust system. However, should smoke be drawn into the recirculation air exhausts it would be returned (without

filtering) to the control room. Of the recirculated air, 25% is discharged to the plenum between the dropped acoustical ceiling and the light diffusion grid. The four detectors in that plenum would detect the smoke in the return air. Those detectors provide the similar function as would detectors in the return ducting without the drawback of being in a high velocity ducted air stream.

The addition of detectors immediately above the cabinets is not considered to be advantageous due to the location of supply diffusers in the immediate vicinity. The air at the top of the cabinets will be mainly supply (previously exhausted) air.

In conclusion the present locations of the 17 fire detectors provides adequate protection for the control room area.

Another concern raised by the NRC auditors was the installation of smoke detectors inside control room panels which contain redundant safe shutdown circuits. This is discussed in the NRC's Safety Evaluation Reports for the SNUPPS plants at section 9.5.1.4

As stated in the SNUPPS FSAR Appendix 9.5B, section C.27.4, the SNUPPS Utilities have committed to install ionization type smoke detectors in the control room cabinets which contain redundant trains of safety-related circuits. These detectors will be installed by fuel load at each of the SNUPPS plants.

10. DETECTION SYSTEM POWER SUPPLY

The NRC auditors indicated that the design of the SNUPPS protection system power supply was not in accordance with NFPA 72D and that standby power to remote fire protection panels and multiplexers should consist of 4 hr. rated batteries located at the panel.

The NRC previously questioned the design of the fire and smoke detection system. Refer to FSAR page 9.5D-5, attached. The following expands on the response.

The fire detection control panels provided for SNUPPS consist of four (4) multiplexers and multiple remote fire protection panels. The four multiplexers contain the systems transmitters/receivers which are in communication with a main annunciator/alarm panel. The remote fire protection panels provide the interface between suppression systems and the multiplexers. The following is an analysis of panel primary and backup power supplies. It serves as a basis for taking exception to the NRC interpretation of NFPA 72D requiring that the backup DC system consist of 4 hour rated batteries located at the local panels. A sketch of the power source arrangement is attached (Attachment B).

A. <u>MULTIPLEXERS</u>

1. Primary Power Supply

   The primary power for the multiplexers is the non-Class 1E instrument ac system. The non-Class 1E instrument ac system is continuously supplied by the Class 1E ac emergency power system.

   The preferred and normal source of the Class 1E power system is the offsite power system. Two physically independent sources of offsite power are fed to the onsite power system. SNUPPS exceeds the minimum requirements of NFPA 72D (1979) which permits the primary power supply to consist of a single branch circuit connection to the light and power service.

2. Secondary (Standby) Power Supply

   The standby power for the multiplexers is provided from multiple sources.

   a. Secondary power is provided by the station emergency diesel generator to each 4.16 Kv bus. The arrangement, fuel supply etc. of the SNUPPS station diesel exceeds the minimum requirements of NFPA 72D (1979).

   b. A backup power source is provided by the non-Class 1E 125V dc system. An automatic auctioneering circuit at each multiplexer selects the dc source upon failure of <u>all</u> ac sources, and reverts back to the ac source upon <u>ac</u> source restoration.

c. The non-Class 1E 125 V dc system is supplied through batteries and battery chargers. The battery chargers are sized to carry the total connected load indefinitely. The battery chargers are normally fed from the Class 1E emergency power system. The batteries and chargers are not installed in series. This maintains power to the system upon failure of either the charger or the battery if primary power is normal. Upon failure of a battery charger, each separation group battery can carry the total connected load for 2 hours. Additional load carrying time can be obtained by selective load shedding and/or closing the bus tie switches between the separation group buses.

B. REMOTE (LOCAL) FIRE PROTECTION PANELS

1. Primary Power Supply

The primary power for the remote fire protection panels provided by the non-Class 1E 125V dc system. The multiplexers are utilized as power distribution panels for the remote panels. The non-Class 1E 125V dc system is continuously supplied by the 480V 1E bus via the battery chargers. The reliability of this power supply exceeds the requirements of NFPA 72D. Two physically independent offsite power sources provide the normal and preferred source to this system.

2. Secondary (Standby) Power Supply

The standby power source for the secondary supply to the local panels is provided by the station emergency diesel generators. The arrangement, fuel supply, etc. of the station diesels exceeds the minimum requirements of NFPA 72D.

The non-Class 1E 125V dc system is supplied through batteries and battery chargers. The battery chargers are sized to carry the total connected load indefinitely. The battery chargers are fed from the Class 1E emergency power system. The batteries and chargers are not installed in series. This maintains power to the system upon failure of either the charger or the battery if primary power is normal.

In the event of a battery charger failure, each battery can carry the dc loads for approximately 6 hours. This assumes that ac sources are still available for other non 1E loads. This exceeds the 4 hr. requirement of NFPA 72D.

Furthermore, all cables are routed to local panels in conduit and supervised for integrity. Loss of power to these local panels is immediately alarmed in the control room on the fire protection annunciator. Each local panel is powered through dedicated terminals at the multiplexer. No panels are powered in series.

3. Effects of Loss of dc to Local Panels

The following is an analysis of the effect of dc power loss to local fire protection panels.

a. Loss of dc to Typical Local Panel Types

1. Preaction Local Control Panels Without Detectors

Loss of dc power due to a power feed line break to a Preaction Control Panel that is not directly actuated by an automatic detection device will initiate an immediate trouble signal to the control room. Preaction Systems that incorporate these panels control suppression by a signal generated directly from the appropriate multiplexer. The early warning detection circuits associated with these Preaction Systems is supervised directly by the appropriate Multiplexer. Loss of dc power to the control panel will prevent the automatic activation of the suppression system. System actuation is maintained through direct manual (mechanical) means.

Where these systems are used to service safety related areas or equipment, automatic detection is maintain because the detection circuits are supervised directly by the Multiplexer which is not affected by loss of dc power to the Preaction Control Panel.

2. Preaction Local Control Panels with Thermal Detectors

Loss of dc power due to a power feed line break to a Preaction Control Panel directly actuated by thermal detection devices will initiate an immediate trouble signal in the control room. The panel will lose capability of transmitting a fire alarm signal to the annunciator control board and of automatically actuating the suppression system. System actuation is Maintained through direct manual (mechanical) means.

Where these systems are used to ser safety related areas or equipment, a primary independent detection system is incorporated in the fire detection system. The detection system consists of infrared or ionization early warning devices that are supervised directly by the appropriate Multiplexer. The Multiplexers are not affected by loss of dc power to the Preaction Control Panel; detection is maintained in the safety related area.

3. Local Panel Serving Halon 1301 Systems

Loss of dc power to a local panel serving a Halon 1301 system will not affect the detection capabilities for the area protected. The crossed zoned ionization detectors are fed by the multiplexer which is provided with ac and dc sources.

Loss of dc to the local panel is immediately alarmed in the control room.

Detection capabilities are not lost for any area provided with Halon 1301 systems. This includes both safety and non-safety areas. Remote indication of manual Halon system discharge is maintained.

4. Local Panels Serving Wet Pipe Systems

Loss of dc power due to a power feed line break to a local panel serving a wet pipe system will have minimal effect on system operation. The only functional loss will be the local alarm bell that activates on water flow. Remote alarm of water flow in the control room will not be affected.

Detection provided in safety-related areas protected with wet pipe systems are not affected by loss of dc as they are fed from the multiplexers which have both ac and dc sources.

b. Total Loss of dc

Total loss of dc power is not credible. However, the SNUPPS fire detection and suppression system design minimizes the effects of this event on automatic suppression and detection capabilities for safety-related areas. A review was done disregarding the multiple, independent power sources available for the local fire protection panels and conservatively assuming total loss of all dc power sources. Simultaneous line breaks of each power cable serving a local panel (a total of 42) would cause this.

In this event, total detection is not lost for any safety-related area. Remote indication of suppression system manual actuation is maintained. Loss of power is immediately alarmed in the control room.

Only the following non-safety areas will lose both automatic suppression capabilities and detection:

a. Hydrogen Seal Oil Unit
b. Transformer Systems
c. Fuel Building RR Bay
d. Turbine Building 2000', 2033'

Remote indication of manual actuation is maintained, and loss of dc power is immediately alarmed.

The primary and secondary power supplies provided for all panels in the fire detection system exceed the requirements of NFPA 72D. Also, if total loss of all dc power is conservatively assumed, only isolated, non-safety related areas will lose both automatic suppression capabilities and detection. Detection capabilities will be maintained for all areas containing safety-related equipment or circuits.

C. Compliance with NFPA 72D

The basis for the NRC interpretation of NFPA 72D requiring the battery portion of the backup DC system to consist of 4 hour rated batteries located at the panels is an NFPA official interpretation dated August, 1977. This official interpretation was issued against the 1975 edition of NFPA 72D. A copy of this interpretation is included as Attachment A.

Official Interpretations (O.I.) are issued as a result of a question on a specific code application. They apply to all previous and subsequent code editions in which the text remains substantially unchanged. Per NFPA, due to the substantial rewrite of the power source section of NFPA 72D in 1979, this O.I. was deleted on May 12, 1980 as it was no longer applicable.

Regardless of the status of the subject O.I., the power source configuration questioned is not similar to that provided for SNUPPS. The O.I. system has a secondary source consisting of a standby generator serving all locations and 4 hr. batteries for only the main control panel. As indicated by Attachment B, all panels in the SNUPPS system can be powered by 125V batteries.

The O.I. specifies that given the indicated system power configuration, batteries with 4 hour capacity are required "at location A." Location A is a campus building not specifically a panel. The intent of this O.I. is to reiterate the requirement that remotely located control equipment/panels be provided with primary and secondary power supplies as detailed in NFPA 72D, section 2-6 (Article 220 of 1975 edition). Clearly, the system described in the O.I. does not meet the intent of this section since a battery source is provided only to the control panel and is not provided to the local systems. Failure of the standby generator upon loss of normal power will render the local systems out of service due to the lack of a DC battery source.

As previously detailed, all SNUPPS panels are equipped with battery sources incorporated into the secondary power source. This ensures automatic continuing operation of all systems upon loss of primary power.

In summary, the primary and secondary power supplies provided for all panels in the fire detection system exceed the minimum requirements of NFPA 72D. Although the NFPA official interpretation is not applicable to the SNUPPS system, the preceding analysis provides an acceptable basis for taking exception to the NRC application of this interpretation.

Item 5. (Page 9.5-5, Fire and Smoke Detection and Alarm System)

You state that the fire and smoke detection system is powered by the non-class 1E dc system which is backed by a battery charger supplied from the emergency power supply. This arrangement is unacceptable. It is our position, as stated in Section E.1.(a) of Appendix A, that primary and secondary power supplies should be provided for the fire detection system and for electrically operated control valves for automatic suppression systems by:

(a) Using normal offsite power as the primary supply, with a 4-hour battery supply as secondary supply; and

(b) Having capability for manual connection to the Class 1E emergency power bus within 4 hours of loss of offsite power. Such connection should follow the applicable guidelines in Regulatory Guides 1.6, 1.32 and 1.75.

Revise your design accordingly.

Response:

The fire protection system is provided with two diverse power sources. The primary power source is the non-Class 1E instrument ac system, and the backup power source is the non-Class 1E 125 V dc system. An auctioneering circuit at each fire protection panel automatically selects the dc source upon, and only upon, failure of the ac source, and reverts back to the ac source upon ac source restoration.

The non-Class 1E instrument ac system is continuously supplied by the Class 1E ac emergency power system through a qualified isolation device that sheds its load only upon the occurrence of a ground fault. Since the offsite power system is the preferred and normal source of the Class 1E power system, the offsite network is the normal fire protection system power source.

The non-Class 1E 125 V dc system is supplied by batteries and battery chargers. The battery chargers are sized to carry the total connected load indefinitely. Upon failure of a battery charger, each separation group battery can carry

O.I.
NFPA 72D
Reference: **2223C**

Official Interpretation

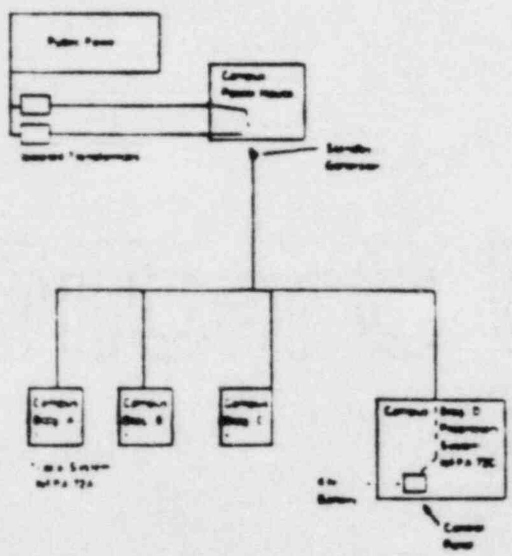
Document: **PROPRIETARY PROTECTIVE SIGNALING SYSTEMS**

Edition: **1975**

Question: Based on Figure A, per paragraph 2223C, NFPA 72D 1975, are batteries with 4 hour capacity required at location A?

Answer: Yes

Figure A



Issue Edition: 1975 **Reference: 2223C** **Date: Aug. 1977**

This Official Interpretation was issued as a result of a question on the above edition. It applies to all previous and subsequent editions in which the text remains substantially unchanged.

5M 5/5 1 78

ATTACHMENT A

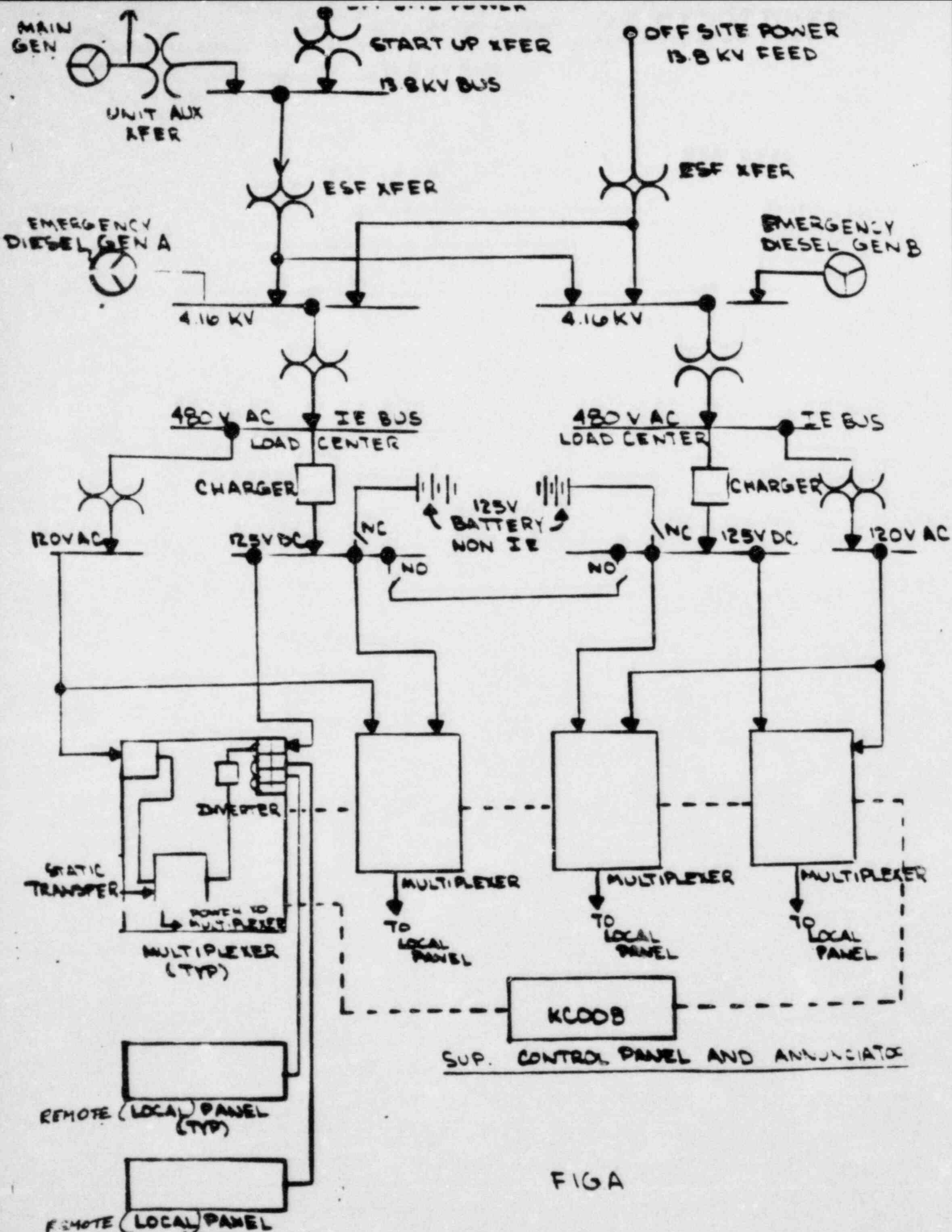


FIG A

DETECTION SYSTEM POWER SUPPLY

ATTACHMENT B

Enclosure

11. FIRE EVALUATION FOR MISSILE RESISTANT DOORS FOR SNUPPS

An evaluation was performed on the SNUPPS plant missile doors located in fire barrier walls to demonstrate the doors meet the test acceptance criteria established in ANSI/ASTM E-152, Standard Methods of Fire Tests of Door Assemblies. The evaluation concludes that the missile doors will satisfactorily meet the ASTM E-152 acceptance criteria.

The SNUPPS plant utilizes 10 missile doors in fire rated walls. Six of the doors are single swing and four are double swing doors. Each leaf of the 10 doors is of similar construction which includes a 2 1/2 inch thick steel plate front and vertical and horizontal reinforcing beams which form a boxed-in area near the perimeter of the door. The multiple point latching mechanisms pass through the reinforcing beams and fix the doors in the opening. The back face of the doors are covered by a thin gauge plate steel.

Two representative doors were modeled and analyzed. One was a single swing door and the other is the largest double swing door. Since the design and construction of each door leaf is very similar from front to back only one leaf was subjected to a thermal analysis to determine temperatures at the various structural members. A set of thermal analyses were preformed to allow the evaluation of thermal growth for use in a comparison with ASTM E-152 acceptance criteria and for use as input to the structural analyses calculations for door seating and structural integrity.

A typical physical model was generated on which conductive, convective and radiative heat transfer coefficients were applied. Door members were analyzed as flat plates and fins. A temperature distribution was established based on steady state conditions at six time periods. The time periods were 20, 30, 45, 60, 90 and 180 minutes; based on ASTM E-152 requirements. An iterative analysis was performed to determine the temperatures and heat transfer through the various door members and spaces and the heat losses (convective and radiative) from the door. Natural convection was considered in the enclosed door cavity. Iterations were performed until the thermal losses from the door matched the heat transfer through the door thereby establishing the temperatures within the door components and spaces.

Temperature distribution through the structural projections off of the unexposed side of the door were evaluated as fins. The temperature at the base of the projections was conservatively assumed to be equal to the furnace temperature. Surface parameters for thermal transference were derived with the aid of the temperature distribution established through the door, as noted above.

Other assumptions included the following:

A. The temperature of the exposed face of the door equalled the furnace temperature.

B. The unexposed door surface was exposed to a temperature which equalled the ambient (68°F) temperature.

C. The internal locking mechanisms do not affect the heat transfer and temperature distributions.

The results of the thermal analysis, growth and temperature distribution, were used in the structural evaluation.

A structural evaluation was performed on both missile doors. Each door was analyzed for failure by comparing the compressive forces acting upon the door, due to restricted thermal expansion, with the forces required to cause failure of the assembly or subparts.

The weakening effects in the structural components due to elevated temperature were taken into account. The yield and tensile strengths were reduced by multiplying the appropriate minimum ASTM values by a factor corresponding to the yield strength and tensile strength ratios. These ratios are based on the strength of the material at an elevated temperature divided by the strength of the material at room temperature.

The failure analysis was based on static conditions for a given time, and temperature. Each door was analyzed as a column in both the vertical and horizontal directions. The doors and subparts were analyzed for elastic failure and rupture due to compression. The doors were analyzed to evaluate the time and temperature at which the door seats against the frame by comparing the thermal expansion with the design gaps around the door. Each door was analyzed to evaluate the time and temperature at which elastic failure would occur by comparing the compressive forces corresponding to a given thermal expansion with the yield strength of the material at the same temperature.

The thin guage cover plate on the unexposed side of the door was assumed not to contribute to or detract from the strength of the door. The edges of the door are considered fixed with respect to the column analysis because of the multiple locking pin arrangement and because the 2 1/2" thick door face expands into the frame at relatively low temperatures.

The missile door evaluation indicates that the door will expand on temp- [illegible] and seat with the frame jamb. After the door becomes seated, the thermal expansion is restricted by the wall, the compressive forces exerted on the door will be absorbed by increased strain in the door. The increased strain is relieved by minor deformation along the door edges through simple compressive failure. The door edges will experience minor deformation unless the concrete wall experiences localized failure by spalling.

During a 3 hour fire, it is expected that the concrete wall may spall around the frame edges on the exposed side of the door. The magnitude of spalling is not easily evaluated because it is affected by various factors including high temperature and compressive forces. Spalling along the

frame edges will not adversely affect the performance of the door with respect to the ASTM E-152 acceptance criteria. The door will remain intact in the frame because the jamb is embedded, completely sandwiches both sides of the wall opening and will remain in place on the unexposed side. Further, the door will remain in position with the door frame and jamb because of the multiple pin latching arrangement which is forced to engage with the frame during thermal expansion. Spalling along the frame edges will serve to relieve the door strain developed by restrained thermal expansion and will allow the frame jamb to expand with the door. This will serve to reduce any potential deflection of the door from the vertical plane.

The gross structural integrity of the door is verified by comparing the maximum possible force that the door could experience with the force required to buckle the door. The maximum possible force was determined by calculating the unrestrained thermal growth of the door and then calculating the force required to completely eliminate that growth. The maximum force does not exceed the force required to buckle either door in the vertical or horizontal directions. Therefore, structural deflection of the door in the vertical plane will not occur due to compressive loads.

As a conservative approach, the door was assumed to deflect and bow; the deflection was calculated to be less than the maximum allowed in ASTM E-152. The deflection incorporated the maximum effects of the thermal gradient through the 2 1/2" thick door plate and the geometrical configuration of the door plate resulting from restrained thermal growth. These effects were compared to the stiffening effects of the structural members on the unexposed side of the door to determine the resulting deflection and forces acting on the multiple point latching mechanisms. It was determined that the door construction and the rapid thermal transference characteristics preclude significant thermal warpage. The door is extremely rigid due to the 2 1/2" thick door plate and the reinforcing beam box assembly. These structures resist the tendency for the door to bow toward the fire.

Insignificant amounts of smoke will be generated as the paint and gasket seals are consumed during heat up of the door. Since the door is so massive and well restrained, the effects of the jet force of the hose stream portion of a test will not adversely affect the door. Similarly, since there is no significant deflection in the door at the end of the test, a rapid cooldown will merely bring the door back to its original condition.

In summary, the missile doors would pass the three (3) hour fire test and meet all acceptance criteria established in ASTM E-152. There will possibly be some localized damage to the door and wall.

The largest door was analyzed and found to pass a postulated test. Because the compressive forces will be the greatest on the largest door and because the smaller doors are of similar design, this analysis indicates that all missile doors required to be fire rated would pass a test.