50-309

February 14, 1997

Mr. Raymond Shadis
Information Coordinator
Friends of the Coast
  Opposing Nuclear Pollution
P. O. Box 98
Edgecomb, ME 04556

Dear Mr. Shadis:

On February 4, 1997, you presented information to the United States Nuclear Regulatory Commission (NRC) at a public Commission meeting related to the Maine Yankee Atomic Power Station (MYAPS). Included in the materials you presented was the first page of handwritten notes of a former NRC inspector relating to fire protection at MYAPS. The notes are dated March 1, 1978.

Following the Commission meeting, I requested the remainder of the notes. You provided approximately 60 pages of notes with the mutual understanding that I would make copies for the NRC staff and return your copy to you. Your copy is enclosed with this letter.

I appreciate your time and effort in both preparing your remarks for the Commission and traveling here to present them.

Sincerely,

/S/

Daniel H. Dorman, Project Manager
Project Directorate I-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure: As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Daniel H. Dorman, Project Manager
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Division of Reactor Projects - I/II
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March 1, 1978

Subj: Maine Yankee Fire Protection Evaluation

In my note to R. Ferguson of February 14, 1978, specific information and guidance was provided concerning problems encountered during the fire protection evaluation. Certain distinct safety problems were identified which may affect the continued operation of this nuclear power plant. Commitments were made by myself to provide more specific requirements after an additional evaluation was conducted of certain specific fire areas.

By this note I enclose my evaluation of some selected plant areas. Some significant highlights of the problems encountered are identified below.

1) In general plant areas, redundant divisions of safe shutdown / safeguards cables are routed in the same open ladder type aluminum cable trays with an aluminum partition separator. This layout is contrary to all Nuclear Regulatory Commission safety requirements, especially those within Regulatory Guide 1.75.
2) Equipment required for safe shutdown is located in the turbine building, a non-safety related area.
3) Redundant divisions of equipment and

cabling are located in the same fire area, making them vulnerable to a design basis fire.

4) The use of highly combustible and explosive chemicals throughout the plant appears to be commonplace. In some cases no evaluation has been provided as to the potentially adverse consequences of these chemicals on plant safety.

It must be concluded that as a result of these findings, no installation of fire protection provisions alone will ~~improve plant safety~~ correct all deficiencies. A seismically qualified dedicated safe shutdown system completely independent of all plant areas outside containment is required. Additional details are revealed in the enclosed evaluation.

Furthermore, as a result of these findings which are not in accordance with staff requirements, the staff does not consider the plant to be safe for continued operation and requires that the plant be shutdown until these deficiencies have been corrected. These deficiences are correctable by satisfactory completion of the modifications and

requirements cited in the enclosed evaluation. An evaluation of the remaining plant areas will follow shortly.

The shutdown condition above is the safe shutdown condition: reactivity $K_{eff} < 1$, average coolant temperature < 200F, and rated thermal power = 0%. To assure that safe shutdown is achieved, the licensee is required to physically remove the reactor pressure vessel head, discharge the hydrogen from the main generator, and physically remove any manual disconnect links or power circuit breakers between the main generator and the switchyards. Provisions should be made to assure the availability from the switchyard of two different electrical access circuits. At least one diesel generator shall be operable at all times.

One qualified regional inspector is required to be on site to enforce the shutdown requirement.

Control Room

Safety Related Equipment

The control room contains safety related panels, A walk-through main control board and safeguards instrument tunnel, and a walk through electrical control board in addition to other safety and non-safety related control panels. A number of cable tray risers enclose safety related power and instrumentation cables along the south wall of the control room. Some of this equipment and cabling is required for safe shutdown. The cables for lights at the ceiling level are non-safety related. The ventilation system consists of ducts, air conditioning units, and fans located outside the control room in the ventilation area of the turbine hall.

Fire Protection Systems

There are no fire detectors located within the control room. Fire protection consists of two 40 pound carbon dioxide extinguishers in the room, a 1½ inch hose station with an adjustable nozzle located within 40 feet of the control room door,

and a 50 pound carbon dioxide extinguisher located adjacent the computer room door. The walls, floors, and ceilings are constructed of reinforced concrete rated as a three hour barrier. The suspended ceiling is of mineboard construction.

Adequacy of Fire Protection

The fire protection system within the control room is judged to be inadequate to prevent functional loss of redundant safe shutdown systems. Without fire detectors within the control room, there is not reasonable assurance that fires will be detected and extinguished early. In addition, the walk-through instrument tunnels and the cable tray risers contain redundant divisions of the same equipment or cables. A fire in these places if not extinguished early may prevent safe shutdown of the reactor. Cabling in close proximity within these tunnels may be damaged by attempts to manually extinguish any fire within these panels. In addition, portable carbon dioxide extinguishers may not be able to extinguish certain electrical or Class A fires. Further, the use of carbon dioxide manually in a normally

manned, enclosed area may adversely affect the health of the fire fighters.

Modifications

The licensee proposes the following improvements in fire protection for the control room:

1) Install a line detection system inside the enclosed cable tray risers.
2) Install smoke detectors and an automatic halon or ~~cat~~ or carbon dioxide extinguishing system in the enclosed cable tray risers.
3) Coat all cables with a flame retardant material.

The staff considers the above proposed modifications to be adequate provided the proposed line detection system, fire detectors and cable coatings are qualified for the environment in which they serve.

In addition, the staff has required and the licensee has agreed to the following additional modifications.

1) An automatically-actuated Halon suppression system will be installed within the main control board instrument tunnel, within the electrical control board instrument tunnel, and in the

cable chase. Ventilation penetrations to the control boards ~~should~~ will be provided with closure devices to seal the enclosures upon Halon system actuation.

2. Cable, cable tray, and ventilation duct penetrations will be sealed to provide three hour fire rated protection.

3. Smoke detectors will be provided within the reactor protection system cabinet and in the control room kitchen area.

4. The wooden kitchen cabinets and coffee supply cabinet will be replaced with non-combustible cabinets.

5) A four inch curb at the entrance to the control room from the turbine building will be provided.

4) A 2½ gallon pressurized portable water extinguisher will be provided inside the computer room near the door from the control room and inside the control room near the door from the turbine building.

In addition the staff requires the following additional changes:

1) A dedicated safe shutdown system, the controls, instrumentation, and power of which are independent of the control room must be provided as discussed in Section ____.

2) The qualification criteria must meet the requirements of IEEE Std 323-1974.

3) The licensee is required to provide a seismically qualified automatically actuated fixed water suppression system for the Control Room Recirculation Filters.

4) The licensee is required to remove the control room air conditioning units and fans from the turbine hall and relocate them in a protected area of the service building.

5) ~~The fire protection system will be seismically qualified.~~

6)

Containment Spray Pump Area

Safety Related Equipment

This area contains all equipment for low pressure safeguard system operation except for the sump pumps and lighting. The equipment consists of low pressure safety injection pumps, containment spray pumps, recirculation heat exchangers motor operated valves, and ancillary piping. The area also houses switchgear, cables, and cable trays ~~which provide power and control current~~ for valve motors and pumps. The area itself is a missile protected structure. ~~that~~

Combustibles

The combustibles in the area consist mainly of cable insulation and motor lubricating oil. Spaced throughout the area are wood, some polyethylene, and plastic portions of switchgear.

Consequences with No Fire Suppression

A design basis fire in this room would eliminate the safe plant shutdown capability. Without the low pressure safety injection pumps which also serve as the residual heat removal pumps,

the plant is unable to achieve cold shutdown.

Fire Protection Systems

Ventilation is provided by a heating and ventilation unit located outside the area which supplies 13,000 cubic feet per minute of outside air. Ventilation exhaust is provided by fans outside the area which exhaust air ~~from~~ ~~the~~ at 13,500 cubic feet per minute. There is no ~~auto~~ fixed fire suppression system installed in this area. A 20 pound dry chemical extinguisher is located on the 30 foot elevation. A 30 pound dry chemical extinguisher is located on the 21 foot elevation. A yard hose house is located within 40 feet of the entrance to the building. The ~~wall~~ exterior walls, floor, and ceiling are rated in excess of three hours. However, the doors are all 1½ hour rated. There are no fire detectors.

(~~In some cases~~ (in the same cable tray in some cases)

Adequacy of Fire Protection

The combustible loading within this area is low. However, switchgear and redundant divisional cabling in close proximity are located at the ~~30 foot~~ upper elevation valve operating room ~~and~~ floor. Redundant divisions of power and control cabling to the fire pumps are also routed in close proximity and are susceptible to ~~a pump [illegible]~~ fire damage. There is no fire ~~suppression~~ detection or fixed fire suppression system in this area. ~~This is unacceptable.~~ In addition, the penetrations into this building are not three hour rated. The staff does not consider current fire suppression systems as adequate to detect and suppress a fire before damage will occur to switchgear and redundant cables. The space is not normally manned.

Modifications

The licensee has proposed to install smoke or heat detectors for early warning of a fire or hot spot.

The staff has required and the licensee has agreed to the following requirements:

1) ~~The~~ The necessary 1 3/4 inch hose station equipment will be installed in the Containment Spray Pump Area.
2) A smoke detector will be specifically located over each pump in the containment spray pump area.
3) Fire detectors will be located in ~~the~~ all safety related cable

trays. ~~to the Low Pressure Safety Injection (Residual Heat Removal) and Containment Spray Pumps.~~

The Staff will require the following additional modifications:

1) An automatically actuated fixed directed water spray ~~sprinkler~~ system will be required for protection of cables ~~and~~ and switchgear at the 30 foot elevation.

2) An automatically actuated sprinkler system is required for protection against a ~~lube~~ oil ~~and~~ fire. Directed spray ~~should~~ is required be ~~provided~~ for the cable trays in the pump cubicles.

3) A three hour rated penetration seal is required for cable tray penetrations in the pump cubicles. ~~and through the~~ Similarly rated penetration seals are required for pipe, duct, cable, and conduit penetrations through the exterior walls, floors, and ceiling.

4) The dedicated safe shutdown system will ~~must~~ be independent of this Area.

5) The equipment qualification requirements must meet those of IEEE Std 323-1974.

6) Fire detectors ~~must~~ will be provided on all floor levels in accordance with NFPA requirements.

7) A 1 1/2 inch hose station is required ~~to~~ be provided ~~on all levels~~ with 80 feet of hose and an adjustable spray nozzle within the containment spray pump

ventilation equipment room.

Battery Rooms

Safety Related Equipment

There are two battery rooms, each room having enough batteries to supply two channels of emergency DC power. Batteries #3 and #4 are housed in the 35 foot elevation battery room, which itself is located within the protected cable tray room. Batteries #1 and #2 are housed in the 45 foot 6 inch elevation battery room, which itself is located within the protected switchgear room. The safety-related equipment contained in these rooms are the batteries, their associated cabling, and some transient cabling.

Combustibles

The combustibles in these rooms consist of the battery cases, inserts, some cable insulation, jacketing, and hydrogen gas.

Consequences with No Fire Suppression

A design basis fire in either battery room would cause the loss of the contents of the entire room. Two battery buses remain in the unaffected battery room to provide the necessary safe shutdown equipment operation. However, A potentially serious hydrogen hazard exists in these battery rooms as the result of pockets of hydrogen forming. The explosive

nature of this hydrogen has not been identified. The safety-related nature of the electrical cable traversing the rooms has not been identified either. A fire in these rooms may spread to the protected cable tray room or to the emergency switchgear room.

Fire Protection Systems

The 35 foot elevation battery room is part of zone 2 of the total flooding carbon dioxide system. The pull station is located to the right of the double doors entering the protected cable tray room. Actuation can also be accomplished from the control room. A hose station with a 1½ inch hose is located in the turbine hall approximately 35 feet from the entrance to the protected cable tray room. Another hose station is located on the 45 foot elevation adjacent the switchgear rooms.

The 45 foot 6 inch elevation battery room does not have an installed fixed fire suppression system. A 500 pound wheeled cart is located on the landing at elevation 45 feet. A 20 pound dry chemical extinguisher is located 10 feet

from the switchgear room door. A hose station with 1½ inch hose is located on the landing at elevation 45 feet.

Both battery rooms are sized 10 feet x 40 feet. They are separated from the other areas by three hour rated walls of concrete block or reinforced concrete. Each battery room has a single 1½ hour UL rated door. Ventilation is provided through fixed door louvers in each room with an exhaust at 1200 cubic feet per minute through ducting. The power source for the ventilation system for both rooms comes from a motor control center located in the switchgear room. There are no fire detectors in either room.

Adequacy of Fire Protection Systems

The fire protection system for these rooms is not considered adequate. There is no provision for monitoring hydrogen gas concentrations. One of the battery rooms does not have a fixed fire suppression system. A manually-actuated carbon dioxide fire suppression system is preferred in these rooms in the present configuration

because water spray may cause battery lead arcing, which in turn provides a source of ignition for hydrogen. In addition, the carbon dioxide can help dissipate the hydrog buildup.

Modifications

The licensee has proposed the following improvements in the fire protection system:

1) Install fire detectors in the battery room or its ventilation exhaust.
2) The battery rooms will be periodically "sniffed" with a portable hydrogen detector and the results will be logged in the control room. As an alternate, a hydrogen detector with an alarm will be installed.

In addition, the staff has required and the licensee has agreed to the following modifications:

1) An indication of ventilation loss of flow will be provided in the control room.
2) Smoke detectors will be provided in the battery rooms.
3) All penetrations into the walls of both battery rooms will be upgraded to provide

three hour fire resistance.

The staff considers the above proposal and commitments acceptable. However, the staff is concerned that the potential accumulation of hydrogen in these rooms may be hazardous to the adjacent switchgear or protected cable tray rooms. Therefore, the licensee is required to upgrade the battery room structure to withstand the worst case explosive mixture buildup of hydrogen. This upgrading must include doors, walls, penetrations, and other component parts of the structure. As an alternate, the licensee can provide a less hazardous alternative battery or relocate the battery rooms to other locations.

The licensee is required to install an automatically actuated fixed carbon dioxide suppression system in the battery room at elevation 45 feet 4 inches, if the alternatives are not chosen. The system must be seismically & environmentally qualified in accordance with IEEE Std 323-1974.

The staff requires that the dedicated safe shutdown system be independent of the battery rooms.

Fire Barrier Penetrations

Fire barriers are penetrated by doorways, ventilation ducts, electrical cables, piping and conduit.

Electrical Cable and Conduit Penetration

Penetration seals are provided where electrical cable trays penetrate walls, ceilings or floors. However, the licensee has not provided any information regarding the construction of the penetration seals nor any results of test data confirming that the penetration seals meet appropriate technical standards. The licensee has committed to seal all penetrations with a flame retardant material. The staff is concerned that this material may not be properly qualified. As a result the staff requires that the licensee provide a penetration seal which meets the following requirements:

STAFF POSITIONS

MAINE YANKEE NUCLEAR POWER STATION

1. Cable Penetration Fire Barrier Test

Cable and cable tray penetration fire barriers should be tested to demonstrate a three-hour rating, as is required for the fire barriers. The tests should be performed or witnessed by a representative of a qualified independent testing laboratory, and should include the following:

The tests should be performed in accordance with ASTM E-119, with the following exceptions:

a. The cables used in the test should include the cable insulation materials used in the facility.

b. The test sample should be representative of the worst case configuration of cable loading, cable tray arrangement, anchoring and penetration fire stop size and design. The test sample should also be representative of the cable sizes in the facility. Testing of the penetration fire stop in the floor configuration will qualify the fire stop for use in the wall configuration also.

c. Cable penetrating the fire stop should extend three-feet on the unexposed side and one foot on the exposed side.

d. The fire stop should be tested in both directions unless the fire is symmetrical.

e. The fire stop should be tested with a pressure differential across it that is equivalent to the maximum pressure differential a fire stop in the plant is expected to experience.

f. Temperature levels of the cable insulation, cable conductor, cable tray or conduit, and fire stop material should be recorded for the unexposed side of the fire stop.

g. Acceptance Criteria - the test is successful if:*

1. The cable penetration fire stop has withstood the fire endurance test without passage of flame or ignition of cables on the unexposed side for a period equal to the required fire rating, and

2. The temperature levels recorded for the unexposed side are analyzed and demonstrate that the maximum temperatures are sufficiently below the cable insulation ignition temperature, and

3. The fire stop remains intact and does not allow projection of water beyond the unexposed surface during the hose stream test.

The staff evaluation of the test data results will be addressed in a supplement to this safety evaluation report. Protection details for each fire area are addressed in Section ____ of this report.

Fire Doors

The licensee has doors rated as listed by Underwriter's Laboratory's labels. The door ratings do not exceed a three hour fir rating. The doors to secure fire areas are normally closed and a magnetic card is required for entry. Leaving the door open would cause a control room alarm. The staff is concerned that doors which are secured and not protected by either an automatically actuated or manually actuated filed fire protection system (manual actuation outside the protected room) may hinder manual fire fighting efforts. The licensee is, therefore, required to provide all plant fire fighters with magnetic cards and tools to gain access to all plant fire areas. The licensee is also required to review the design of the magnetic lock mechanism and determine the capability of the doors to be opened considering circuit foilure or power loss. Provide the staff with the results of your analysis showing the capability of gaining access to the area without damaging the fire door.

Ventilation Duct and Pipe Penetrations

The licensee has stated that ventilation duct and pipe penetrations throughout the plant have not been properly sealed. The licensee has, therefore, committed to properly sealing these penetrations to provide a barrier equal to that required for the walls. The installation will be designed to meet the requirements considering the combustible loading and types of fires. However, the staff is concerned that the test used to qualify these penetrations may not be adequate. The licensee is, therefore, required to propose a test for pipe and ventilation duct penetrations commensurate with that identified in Section _____ for electrical cable penetrations.

Note:
[Alternate - We should draft the test requirements.]

Lighting Systems

The station lighting system provides normal and emergency lighting. Electrical power for both lighting systems is supplied from a normal A-C source or a standby A-C system, ~~and the station battery system~~. Fixed emergency lighting is provided at all essential control positions and access ways by incandescent units and can be automatically transferred to the 125 volt D-C station battery supply upon the loss of A-C power.

Fixed emergency lighting for remote areas is provided by local self-contained battery powered emergency lighting units rated for an eight hour duty.

In addition, the licensee proposes to provide suitable sealed-beam, battery-powered portable hand lights for emergency use. Enough portable lights will be provided for emergency use by the fire brigade, damage control, and control room personnel with a margin of 50%. These lights will be designated for emergency purposes only and their use and maintenance will be controlled through administrative procedures. The lights will be located in the office building adjacent the turbine hall. There are three

levels to this building with two masonry towers for access on each end of the building. The internal office space is arranged with a passageway traversing the length of the building on all three levels with offices on either side of the passageway. The fixed individual battery-powered sealed beam emergency lights are located at each end of the passageways on all three levels. The staff will find these portable lights acceptable provided they are qualified for the environment in which they are used.

The staff is concerned that accessibility to a fire area may be unduly restricted if a design basis fire in a given fire area destroys the lighting to the areas adjacent to the affected fire area. In addition, the staff is concerned that emergency lighting in the area of the dedicated safe shutdown system control panel may be insufficient. Therefore, the licensee is required to provide emergency lighting to all safety related areas such that a design basis fire in one fire area does not affect the emergency lighting to adjacent fire areas.

Safe Shutdown Systems

The licensee has identified the safe shutdown condition as that condition which can be maintained for an indefinite period during which time the main coolant system temperature will not increase and cause fuel damage nor decrease by an amount such that sufficient reactivity is added to bring the reactor critical. However, the safe shutdown condition is in fact the cold shutdown condition, [redacted] where the reactivity is ≤ 0.99 at 0% rated thermal power and the average coolant temperature ≤ 200°F. In addition, this cold shutdown condition must be achieved from a single control location either from the control room or from some dedicated remote shutdown panel. No credit will be permitted manual operation of components outside these locations. No credit will be permitted the use of offsite power.

There are several arrangements of safe shutdown systems which are capable of achieving cold shutdown. These systems perform the following four functions:

1) Negative Reactivity Insertion

2) Primary System Pressure Control
3) Primary Plant Water Inventory
4) Decay Heat Removal

The licensee has identified the primary equipment required in order to achieve this cold shutdown condition. However, he has not identified all the mechanical and electrical equipment and cabling that would be required in order to achieve this cold shutdown condition. Nevertheless, the staff has determined from a review of the Fire Hazards Analysis and from a visit to the site that a design basis fire in certain fire areas will leave no methods available to safely shutdown the reactor. As a result, the staff requires that the licensee:

1) Identify all mechanical and electrical equipment required for safe shutdown.
2) Identify all fire areas whose total destruction leaves no safe shutdown system available, considering a loss of offsite power.
3) Install a dedicated safe shutdown system capable of achieving safe shutdown after a design basis fire leaves no safe shutdown methods available. No credit will be permitted manual operation of components outside these locations. No credit will be permitted

for item 4) see below

the use of offsite power.

5) The dedicated safe shutdown system should be independent of the fire areas identified in item 3 above.

Additional details for each fire area are addressed in Section ___ of this report. The staff will review and address the design details of the dedicated safe shutdown system in a supplement to this report. The staff requires that these details be provided no later than four months from this date.

4) The dedicated safe shutdown system must meet the safety criteria applicable at this time, including the seismic design criteria.

Communications Systems

The normal communications system at Maine Yankee consists of sound powered headset stations provided throughout the plant on each elevation in every building except for the office building and warehouse. One headset each is located adjacent to the emergency shutdown stations. The licensee does not use fixed repeaters for portable communication units. Instead he uses portable communication units stored at eight different locations. The staff is concerned that portable communications cannot be provided for all critical plant areas. The licensee is therefore required to evaluate the capability of communicating with personnel at all critical locations throughout the plant using portable radio communication units qualified for the adverse environment produced by a fire.

Electrical Cables

The licensee has stated that the following cable construction is used at Maine Yankee for power, control, and instrumentation cable.

1. EPR / Polyvinylchloride / Armor / Polyvinyl-chloride
2. Cross linked polyethylene / flame resistant neoprene
3. Polyethylene / Polyvinylchloride

The licensee states that all high energy medium voltage cables are of interlocked armor construction. 600 volt power cables are jacketed with flame resistant neoprene. The licensee has indicated that electrical cables are routed in aluminum conduit and in open ladder type cable trays outside containment, and in steel conduit and cable trays inside containment.

The plastic insulation and jacketing materials used in the cable construction are flammable and may not be capable of passing the IEEE Std 383-1974 flame test. Therefore, for fire protection purposes, credit is not allowed fire retardant cable jacketing or insulation in mitigating the consequences of a design basis fire.

Separation Criteria

The separation criteria for electrical cables used ~~at~~ MY during the construction of Maine Yankee does not comply with the requirements of Regulatory Guide 1.75. The licensee has not provided the criteria used for cable separation. However at the site the staff noted that electrical cables to redundant safety related equipment are routed in the same aluminum open ladder type cable tray with a vertical aluminum barrier between the redundant cables. In some cases an aluminum cable tray cover (was installed) with approximately one inch (air) spacing between the sides of the tray and the tray cover. This type design was applicable at all locations except inside containment.

Reactor

1 Containment

Safety Related Equipment

The reactor containment houses the following safety-related equipment: reactor coolant system accumulators, containment fan coolers, valves, instrumentation, pressurizer, and associated cabling. The containment is divided into two fire areas. The cable penetration rooms compose one fire area, while the remainder of the containment composes the other fire area.

Combustibles

The significant combustibles inside containment include: electrical cable insulation and jacketing, lube oil from two reactor coolant pumps, ~~and charcoal filters in the ventilation system.~~ There are ~~two~~ three reactor coolant pumps, each of which contains 115 gallons of lube oil. Transient combustibles such as polyethylene, wooden blocks, ~~etc. also~~ rubber hose, canvas, etc. are located inside containment.

Consequences with No Suppression

The staff was unable to visually observe all ~~fire~~ areas of the containment during the site visit because of radiological contamination. The licensee has not provided the staff with the results of a design basis fire inside containment. The licensee has stated that the pressurizer heater cables ~~and control cables~~ are required for safe shutdown / safeguards actuation. The loss of these would then leave no methods available

for safe shutdown. A design basis fire in the cable penetration rooms would also leave no safe shutdown methods available. Certain instrumentation ~~in the primary system~~ would ~~also~~ be required ~~for~~ in order to monitor the status of the ~~primary~~ reactor coolant system for safe shutdown purposes. The licensee has not identified this instrumentation.

Fire Protection Systems

The containment cable penetration rooms are provided with ~~a~~ fixed ~~fire~~ carbon dioxide fire suppression system. Each of the two rooms has two smoke sensing elements which alarm in the control room. ~~A 400 pound dry~~ A 400 pound dry chemical extinguisher is located within 40 feet of the cable entrance room.

& There are three ~~loops~~ reactor coolant system loops ~~that are similar in equipment and volume~~ located within the containment building annulus. Each loop contains a steam generator, a reactor coolant pump, two loop isolation valves, piping and instrumentation taps. A 20 pound dry chemical extinguisher is located outside each loop area at elevation -2 Ft.

& The containment annulus ~~area contains~~

~~circles~~ is A zone that circles the outer portion of the interior of containment. There are three elevations ~~a~~: 2 feet, 21 feet, and 46 feet. The licensee states that there are no ~~safe~~ shutdown/safeguards equipment in these zones. ~~However, the staff disagrees with the licensees Elevation 2 feet Each elevation has~~ Elevation 2 feet has four 20 pound dry chemical extinguishers and one 600 pound dry chemical extinguisher. Elevation 21 feet has one 20 pound dry chemical extinguisher. Elevation 46 feet has four 20 pound and one 600 pound dry chemical extinguisher. There Are no fire detectors in the Annulus. # The ~~the~~ containment loop areas each have ~~three~~ two smoke sensors which alarm in the control room. A 20 pound dry chemical extinguisher is located outside each loop area at elevation -2 feet.

The containment pressurizer zone houses the pressurizer and contains the pressurizer heater cables, one of the seven banks of which are required for safe shutdown. Portable extinguishers are available from the annulus.

The Charging Floor And Cavity Area is A concrete floor and is the access area to the reactor vessel head, refueling machine, and polar crane. It is located At the 46 foot elevation

One 600 pound and
three 20 pound dry chemical ~~and one 600 pound dry chemical~~ extinguishers are installed on the level.

Adequacy of Fire Protection

The staff is concerned that the licensee has not ~~of~~ provided the results of a design basis fire ~~review to the staff~~ within containment. The effects of the heat developed under accident conditions on both the reactor coolant system and on the containment have not been analyzed. The licensee has not provided for curbs on the reactor coolant pumps to limit the spread of oil. Without the pressurizer heaters the staff is also concerned about overpressurization. ~~The effects of the heat developed on the metal~~

Modifications

The licensee has ~~recommended~~ proposed the following modifications:

1) Provide a penetration seal for the reactor coolant pump power supply cables where they penetrate the crane wall.
2) A portable pressurized water extinguisher will be provided for backup protection.

In addition, ~~the staff has required and the licensee has agreed to the following:~~

~~a)~~ the staff requires that the following items be implemented:

1) An automatically actuated water suppression system should be provided to protect all cables in the containment cable penetration rooms. The system shall be seismically (at least) qualified.
2) Dry pipe hose stations with 180 feet of 1 3/4 inch hose and adjustable spray nozzle should be provided to protect all levels within containment.
3) The results of a design basis fire analysis within containment should be provided. The assumptions, models, and methodology should also be provided.
4) An automatically actuated fixed directed spray water suppression system should be provided to protect the pressurizer heater controls and power cables. ~~The same~~ An identical system ~~should~~ is

should be used to protect vital instrumentation cables. An alternative approach is to route the cables ~~so~~ and protect the instrumentation such that they are not adversely affected by a design basis fire.

5) The plywood cover at the outer end of the equipment hatch ~~should be removed.~~ ~~This must be~~ be removed.

6) The licensee is required to specifically identify all safe shutdown equipment, their location, and cable routing, including instrumentation, control and power cabling.

7) All installations must meet seismic criteria and IEEE Std 323-1974 requirements.

Protected Cable Vault

Safety Related Equipment

~~Protected Cable Vault~~

The protected cable vault is essentially another cable spreading room located below the wall which divides the control room from the instrument room. ~~It houses~~ It contains ~~cable~~ aluminum cable trays & conduit, and redundant divisions of safe shutdown / safeguards ~~equipment~~ electrical cables.

Combustibles

The combustibles in this room consist entirely of electrical cable insulation and jacketing.

Consequences With No Fire Suppression

A design basis fire in this room will damage cables to redundant safety related systems, thereby adversely affecting safe shutdown. ~~From the site visit~~ it appeared that electrical cables are routed from the ~~containment~~ reactor containment motor control center area underground to the vault in conduit. Additional underground conduits ~~are~~ lead to other areas including the control room. ~~The~~ Entrance is through a 3 foot x 3 foot hatch through the floor.

Fire Protection Systems

There are two smoke detector sensing elements located in the vault which alarm in the control room. The vault is zone 1 of the total flooding ~~or~~ carbon dioxide system. The pull station is located on the wall adjacent the cable vault entrance. A twenty pound dry chemical extinguisher is located six feet from the hatch. There are two hose stations with 1½ inch hose located within 40 feet of the hatch opening. The cable vault is constructed of concrete floor, ceiling and walls which are rated in excess of a three hour fire barrier. The hatch cover has an open 1 foot 9 inch by 1 foot 9 inch grating. ~~All cable~~ The cable penetrations are not sealed at the entrance to the vault. It appeared to the staff that there had been standing water at one time in the ~~hatch~~ vault. Ventilation is provided at 1000 cubic feet per minute entering via ductwork and exhausting out the grating. The supply fan is secured upon carbon dioxide initiation. The control switch for the fan is located in the unprotected switchgear room.

Adequacy of Fire Protection

Since a design basis fire in this room could ~~not~~ prevent safe plant shutdown, a gaseous suppression system alone is not acceptable. In addition, the penetrations and hatch in the room are unsealed. Toxic gases and smoke could spread outside this room. The 3 foot by 3 foot hatch presents a difficult access path for manual fire fighting efforts. In addition, water will be required to assure that any fire that ~~is~~ develops will be suppressed.

Modifications

The licensee has proposed the following modifications:

1) Fire detectors will be installed in all cable trays.
2) ~~Provide~~ A control scheme will be provided for the ventilation fan to prevent hot gases from being introduced to another fire area.
3) ~~Seal~~ All inadequately sealed penetrations into and out of the vault must be sealed with a flame retardant material.
4) A manually-controlled fixed dry pipe sprinkler system will be installed in the vault.

The staff finds the above discribed modifications acceptable provided the licensee

~~is required to~~ ~~upgrade~~ the penetration seals to ~~provided~~ a three hour ~~rated penetration seal~~ rating.

• In addition, the detectors must be seismically and environmentally qualified in accordance with the requirements of IEEE Std 323-1974. The ~~sprinkler~~ system must be seismically qualified. The ventilation fan must be secured automatically upon carbon dioxide initiation. Finally, an exhaust duct must be installed in the vault. A three hour rated fire damper will be installed in each of the supply and exhaust ductworks. ~~The damper~~ The grill in the hatch will be sealed with a three hour rated barrier or the hatch must be upgraded to a three hour rated barrier. The necessary provisions for exhausting the ~~carbon dioxide~~ air in the vault during carbon dioxide initiation must be provided. Adequate Curbs and drains must be provided.

The dedicated safe shutdown system must be independent of this area.

Q59 & 60

Cable Entrance ~~Area~~ and Motor Control Center Ar. 1
For Containment
~~Safety~~ Related Equipment

The cable entrance area is a missile protected area adjacent the containment structure that acts as an area for cables to enter the containment and as a switchgear area for equipment located inside containment. There are four rooms on three levels. ~~that have been~~ The safe shutdown / safeguards cables here are the power supply cables for the loop fill valves, power and control cable for the pressurizer heaters, and control and instrumentation cable.

Combustibles

The combustibles in the area consist of electrical cable insulation and jacketing, and plastic parts of switchgear.

Consequences with No Fire Suppression

The licensee has stated that the pressurizer heater cables are required for safe shutdown. Therefore, a design basis fire in this area would prevent safe shutdown.

Fire Protection Systems

There is one smoke sensing element located in each room for a total of four. The four rooms are zone 4 of the total flooding carbon dioxide system. The pull station is located outside on the concrete wall of the structure. Total flooding carbon dioxide actuation can also be accomplished manually from the control room. A 40 pound portable carbon dioxide extinguisher is located on the first floor and a 20 pound dry chemical extinguisher is located on the third floor. The three levels are considered one fire area because of an interconnecting spiral staircase. Concrete walls are considered to have a three hour rating. Doors at each end of the first floor are rated as three hour fire barriers. Ventilation consists of a 1500 cubic foot per minute heating and ventilation unit located in the room on the first floor. The third floor has a 1500 cubic foot per minute exhaust fan. The ventilation system secures automatically upon carbon dioxide initiation.

Adequacy of Fire Protection

The motor control center area is not normally manned. In addition, since the cable penetration area is on the third ~~floor~~ uppermost level, the heavier than air carbon dioxide is likely to settle and not be as effective against a fire. However, the cable penetrations are separated by a non-rated barriers into what appears to be redundant divisions. Nevertheless, the staff does not consider the gaseous suppression system adequate for an electrical fire.

Modifications

The licensee has not proposed any modifications. The staff requires that a seismically qualified ~~fire~~ Electrical cable tray suppression system be provided to suppress a fire in any electrical cable tray. The necessary fire detectors & spacing should be provided to adequately cover the entire area. Qualification requirements must meet those of IEEE Std 323-1974. Curbs and spray shields should be added as required.

The dedicated safe shutdown system is required to be independent of the cable entrance and motor control center areas.

Protected Cable Tray Room

Safety Related Equipment

The protected cable tray room is a cable spreading room located at elevation 35 feet between the protected switchgear area above and the control room below. The room contains redundant divisions of control and power cable for safe shutdown/safeguards equipment as well as other plant normal operating equipment.

Combustibles

The combustibles in this area consist almost exclusively of cable insulation and jacketing composed of plastics (polyethelene, XL polyetalyene, and polyvinyl chloride) and rubber (neoprene, EPR). Aluminum cable trays hold the cable.

Consequences With No Suppression

A design basis fire in this room could become large enough to damage redundant divisions of electric cable and collapse the aluminum cable trays. This fire will damage cabling essential to safely shutdown the reactor.

Fire Protection Systems

The protected cable tray room is part of the total flooding manually actuated fixed carbon dioxide extinguishing system. Carbon dioxide flooding into the cable tray room can be accomplished at the smoke detection panel by a pull station located outside of the control room or by a combination pull station and lever station located outside of the cable tray room. A warning horn sounds in the room to alert personnel prior to and during the carbon dioxide flooding process. Backup protection is afforded by a hose station located in the turbine hall 35 feet from the entrance to the protected cable tray room. A second hose station is located on the 45 foot elevation within approximately 20 feet of the entrance to the cable tray room.

Adequacy of Fire Protection ~~System~~

This area contains redundant divisions of electrical cable. The ~~cat~~ carbon dioxide fire extinguishing system is not considered adequate to suppress a deep seated fire before electrical cable and aluminum cable trays are damaged. The walls are reinforced concrete rated in excess of

three hours. The penetrations through the walls, floor, and ceiling are not rated. The licensee has not provided information concerning the separation criteria used during the plant design. However the site visit revealed that redundant divisions of the same system were sometimes routed in the same cable tray. The staff does not consider that these cables could ~~withstand~~ maintain their integrity during a rapidly developing fire. Therefore, the current fire protection system is inadequate. Although a fixed sprinkler system could ~~withstand~~ suppress the fire, there is no assurance that the fire will be suppressed before damage to redundant safe shutdown divisions is done.

Modifications

The licensee proposes the following improvements in fire protection for the protected cable tray room:

1) Seal all penetrations into the room with an approved fire retardant material. This includes ducting, piping, and two cable tray penetrations from the turbine building.
2) Install fire dampers in all ductwork

at barrier penetrations.

3) Install line detectors in all cable trays to further insure early fire detection.

The staff considers the above proposed ~~fire detection~~ modifications to be acceptable. However, the staff has required and the licensee has agreed to the following additional modifications.

1) Floor penetrations will be sealed to provide protection against water seepage to the control room below. The penetration seals themselves will be three hour rated.

2) A 1½ inch hose station, with adjustable nozzle, will be provided at the entrance to the cable tray room, outside the room.

3) The proposed duct, piping, cable penetration seals and ventilation fire dampers in the walls, floor and ceiling ~~should~~ will be provided with three hour fire resistance as discussed in Section ____, except for those wall penetrations adjacent the battery room.

In addition, the staff requires the following ~~additional~~ modifications:

1. The licensee is required to provide a seismically qualified, manually-actuated, directed fixed water spray system throughout the room capable of suppressing a fire in any cable tray.
2. The necessary curbs and drains for fire suppression water should be installed.
3. The dedicated safe shutdown system is required to be independent of a fire in this room.
4. The equipment qualification criteria must meet IEEE Std 323-1974.

Protected Switchgear Room

Safety Related Equipment

The switchgear room is located on elevation 45 feet 6 inches in the service building directly above the protected cable tray room. It houses redundant divisions of 4160 volt emergency switchgear, 480 volt emergency switchgear, ~~and~~ emergency motor control centers, battery chargers, inverters, D-C distribution panels, and associated cabling.

Combustibles

The combustibles in this room consist almost exclusively of cable insulation and jacketing. The cables are housed in specially designed aluminum cable trays.

Consequences with No Fire Suppression

A design basis fire in this room will damage significant amounts of safety related cable and equipment ~~for both Units 1 and 2~~ of redundant divisions. This fire would prevent safe shutdown of the reactor. There are two sets of double doors for access to the room. ~~The floor walls~~ The fire may spread to adjacent areas unless the electrical cable penetrations are properly sealed.

Fire Protection Systems

There is no fixed fire suppression system in the protected switchgear room. Fire protection consists of a hose station (1½ inch) outside the entrance to the switchgear room and a 500 pound carbon dioxide extinguisher on a cart and a 20 pound dry chemical extinguisher located 10 feet from the door. There are four smoke detectors for fire detection.

Adequacy of Fire Protection Systems

The use of a hose stream for manual fire fighting in this room is not acceptable with the current electrical configuration. ~~The fire hose station should~~ There is no fixed fire suppression system in this room. ~~A design~~ the portable extinguishers are not considered adequate to suppress a cable tray fire in this room. The penetrations through this room are not considered adequate because they are not properly fire rated. The number of detectors is inadequate. The fire door between the protected and unprotected switchgear rooms ~~is inadequate~~ does not have a positive latching means. Ventilation ducts do not have properly rated fire dampers.

Modifications

The licensee has proposed the following modifications:

1) The barrier penetration through the walls will be sealed.
2) Fire dampers in ducts penetrating the walls will be installed.

In addition, the staff has required and the licensee has agreed to the following modifications:

1) The ventilation duct, piping, ~~and~~ cable tray penetration seals, and ventilation fire dampers through the walls, floors and ceilings ~~will should be provided with~~ a three hour fire resistance rating.
2) Three additional smoke detectors will be provided.
3) The doors between the protected and unprotected switchgear room will be provided with positive latching and closing means.
4) A porbable carbon dioide extinguisher and a 2½ gallon pressurized water extinguisher ~~must be provided~~ with a deflector nozzle will be provided inside the protected switchgear room.

The staff has reviewed the overall requirements of the fire protection system design and determined that the proposed design is inadiquate.

1. The licensee is required to provide a seismically qualified, manually-actuated, directional fixed water spray system throughout the room capable of suppressing a fire in any cable tray.
2. The necessary curbs and drains for fire suppression water should be installed.
3. The dedicated safe shutdown system is required to be independent of a fire in this room.
4. All ~~new~~ equipment must be qualified to the requirements of IEEE Std 323-1974.

Turbine Building

Safety Related Equipment

There are three levels to the turbine building: the ground floor (elevation 21 feet), mezzanine level (elevations 35 and 39 feet), and the turbine hall (elevation 41 feet). The turbine building houses the primary and secondary component cooling water pumps and their associated heat exchangers. The power and control cables to the pumps run along the north wall in trays. Power and control cables to the service water pumps located in the circulating water pumphouse run along the north wall before entering conduits on the east side of the turbine building. During the site visit the staff also noted that some color coded cables were routed on the mezzanine level - an indication of safety related cables. It was also noted that breathing air tanks, fans, and filters for control room air are located on the mezzanine level.

Combustibles

Most of the combustibles are located on the ground floor. Some of these combustibles are lube oil, drums of cotton clothing and rubber wear, wood, oxygen-acetylene units, cabling, wax, wax stripper, sealant, cleaner, waste oil and hydrogen gas.

13, 14, 15, 43, 44, 45, 80, 56, 57, 84

Consequences with No Suppression

The turbine building contains a high heat load with a potential for collapsing the ~~whole~~ building. The to complete loss of the component cooling water pumps and service water pump cabling would leave no way of achieving safe shutdown. In addition, the potentially adverse effects of a design basis fire ~~in this building~~ on the ~~turbine~~ service building have not been addressed. The potential for a hydrogen explosion within this building has also not been addressed. ~~The potentially adverse consequences of~~ No safety related equipment should be permitted ~~to operate~~ in the turbine building. The isophase bus duct penetrations through the turbine building are not rated and may be susceptible to a transformer explosion.

~~Fire Protection Systems~~

Fire Protection Systems

Fire protection on the ground floor consists of an automatic wet-pipe sprinkler system. There are four 1½ inch hose stations, two 150 pound dry chemical carts and five 20 pound dry chemical portable extinguishers. The turbine oil reservoir and hydrogen seal oil unit are equipped with a deluge system. Indication in the control room is provided for actuation of any of the automatic sprinklers or deluge systems.

Fire protection on the mezzanine consists of an automatic wet-pipe sprinkler system. It does not cover the heating and ventilation area. There are also five 1½ inch hose stations and four 20 pound dry chemical portable extinguishers.

The is no fixed fire detection system installed on the turbine hall floor. Fire protection consists of five 1½ inch hose stations and five 20 pound dry chemical portable extinguishers.

Adequacy of Fire Protection

The staff does not consider that the fire protection systems are adequate to handle the fire load in the turbine building and adequately protect safety related systems.

Modifications

The licensee proposed to implement the following modifications:

1) Combustible gas bottles will not be stored near the turbine lube oil tank.
2) Each portable gas welder will be equipped with an ABC type fire extinguisher.
3) The storage of combustibles in the turbine building will be reduced to a necessary minimum. ~~Staff to~~
4) a) The retaining berm around the seal oil unit will be increased to contain the potential leakage plus a 10% space for quench water.
   b) A retaining wall around the turbine lube oil tank sized to contain the tank's entire contents will be constructed.
   c) The deluge system over the seal oil tank and lube oil storage tank will be modified to use aqueous film forming foam, which covers and quenches oil fires with minimum liquid volume.
5) The hydrogen lines should be painted yellow to mark the

In addition, the staff has required and the licensee has agreed to implement the following changes:

1) The isophase bus duct penetrations will be upgraded and ~~a~~ the turbine hall door will be strengthened to withstand an explosive impact, or the door will be eliminated entirely.

2) A fixed suppression system for the extinguishment of a main turbine bearing fire will be provided.

3) An automatic sprinkler system will be installed above the component cooling water pumps. ~~Direct application of water~~

4) ~~Hose station 79 will be equipped with 75 feet of hose~~

4) ~~Sufficient hose stations~~ 1 3/4 inch hose stations in the turbine building will be added so that all areas of the building can be reached from at least one hose station. Each station ~~should~~ will have at least ~~maximum of~~ 80 feet of hose and an appropriate ~~3/~~ nozzle for the equipment present.

Furthermore, the staff requires the following additional changes:

1) The dedicated safe shutdown system must be independent of the turbine building and the equipment and cabling in it. ~~The system~~
2) Both divisions of service water pump cabling and both divisions of each of the primary and secondary component cooling water pump cabling must be routed independent of the turbine building. The component cooling water system must be relocated.
3) The licensee is required to determine the impact of the hydrogen hazard and other flammables on the integrity of the turbine and nearby buildings.
4) The drain system must be adequate to handle the expected water and oil flow.
5) The retaining wall around the turbine lube oil tank must be sized to also handle suppression water.
4) The licensee is required to replace all potentially flammable or explosive material ~~with~~ (lube oil, hydrogen, etc) with non-flammable or non-explosive material or relocate the equipment where its destruction will not harm safety related systems.

The results of the implementation of the staff's requirements and the licensee's proposals will be addressed in a supplement to this report

7) All ~~new~~ equipment must be qualified in accordance with IEEE Std 323-1974.