FIRE PROTECTION

SAFETY EVALUATION REPORT

BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

U.S. NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF

METROPOLITAN EDISON COMPANY,

JERSEY CENTRAL POWER AND LIGHT COMPANY,

AND PENNSYLVANIA ELECTRIC COMPANY

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

1.0 INTRODUCTION

Following a fire at the Brown's Ferry Nuclear Station in March 1975, the Nuclear Regulatory Commission initiated an evaluation of the need for improving the fire protection programs at all licensed nuclear power plants. As part of this continuing evaluation, the NRC, in February 1976, published the report by a special review group entitled, "Recommendations Related to Browns Ferry Fire," NUREG-0050. This report recommended that improvements in the areas of fire prevention and fire control be made in most existing facilities and that consideration be given to design features that would increase the ability of nuclear facilities to withstand fires without the loss of important functions. To implement the report's recommendations, the NRC initiated a program for reevaluation of the fire protection programs at all licensed nuclear power stations and for a comprehensive review of all new licensee applications.

The NRC issued new guidelines for fire protection programs in nuclear power plants which reflect the recommendations in NUREG-0050. These guidelines are contained in the following documents:

- "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," NUREG-75/087, Section 9.5.1, "Fire Protection," May 1976, which includes "Guidelines for Fire Protection for Nuclear Power Plants" (BTP APCSB 9.5-1), May 1, 1976.

- "Guidelines for Fire Protection for Nuclear Power Plants" (Appendix A to BTP APCSB 9.5-1), August 23, 1976.

- "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation," September 30, 1976.

- "Sample Technical Specifications," May 12, 1977.

- "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," June 14, 1977.

All licensees were requested to: (1) compare their fire protection programs with the new guidelines; and (2) analyze the consequences of a postulated fire in each plant area.

We have reviewed the licensee's* analyses and have visited the plant to examine the relationship of safety-related components, systems and

*As used here and in subsequent portions of this evaluation, the term "licensee" refers specifically to Metropolitan Edison Company which acts as operating and management agent for the group of licensees consisting of Metropolitan Edison Company, Jersey Central Power and Light Company and the Pennsylvania Electric Company.

structures with both combustibles and the associated fire detection and suppression systems. Our review has been limited to the aspects of fire protection within the NRC's jurisdiction, i.e., those aspects related to the protection of the public health and safety. We have not considered aspects of the fire protection associated with life safety of onsite personnel and with property protection, unless they impact the health and safety of the public due to the release of radioactive material.

This report summarizes the result of our evaluation of the fire protection program at Metropolitan Edison Company's Three Mile Island Nuclear Station, Unit 1. The chronology of our evaluation is summarized in Appendix A of this report.

2.0 FIRE PROTECTION GUIDELINES

2.1 General Design Criterion 3 - "Fire Protection"

The Commission's basic criterion for fire protection is set forth in General Design Criterion 3, Appendix A to 10 CFR Part 50, which states:

> "Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions.
>
> "Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and the control room.
>
> "Fire detection and protection systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety.
>
> "Fire fighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components."

2.2 Supplementary Guidance

Guidance on the implementation of General Design Criterion 3 for existing nuclear power plants has been provided by the NRC staff in "Appendix A" of Branch Technical Position 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (BTP 9.5-1).

Appendix A to BTP 9.5-1 provides for a comprehensive program assuring a substantial level of fire protection, deemed to satisfy General Design Criterion 3.

The overall objectives of the fire protection program embodied in BTP 9.5-1, Appendix A are to:

(1) Reduce the likelihood of occurrence of fires;

(2) Promptly detect and extinguish fires if they occur;

(3) Maintain the capability to safely shut down the plant if fires occur; and

(4) Prevent the release of a significant amount of radioactive material if fires occur.

We have used the guidance of Appendix A, as appropriate in our review. We have evaluated alternatives proposed by the licensee to various specific aspects of Appendix A using the overall objectives outlined above to assure that these objectives are met for the actual relationship of combustibles, safety-related equipment and fire protection features of the facility.

3.0 SUMMARY OF MODIFICATIONS AND INCOMPLETE ITEMS

3.1 Modifications

The licensee plans to make certain plant modifications to improve the fire protection program as a result of both his and the staff's evaluations. Such proposed modifications are summarized below. The implementation schedule for these modifications is in Table 3.1. The licensee has agreed to this schedule. The sections of this report which discuss the modifications are noted in parentheses.

Certain items listed below are marked with an asterisk to indicate that the NRC staff will require additional information in the form of design details, test results, or acceptance criteria to assure that the design is acceptable. The balance of other modifications has been described in an acceptable level of detail.

3.1.1 Fire Detectors* (4.2)

Fire detectors will be installed on all levels of the reactor building, in several areas of the auxiliary building, in several areas of the intermediate building, in certain areas in the fuel handling building, and in safety-related control cabinets in the control room.

3.1.2 Manual Hose Stations (4.3.1.4)

Manual hose stations will be installed in the heat exchanger vault of the auxiliary building and on all levels of the zone in the fuel handling building between the fuel pool and the control building. In addition, a hose stretch test will be performed and additional modification proposed as necessary to ensure that all points in safety-related areas, and other areas which contain major fire hazards, can be reached by at least one effective hose stream.

3.1.3 Automatic Water Spray System*(4.3.1.5)

An automatic water spray system will be installed in the pipe penetration area of the auxiliary building.

3.1.4 Automatic Sprinkler Systems or Coating of Electrical Cables* (4.3.1.5)

Automatic sprinkler systems or application of a flame retardant coating will be provided for protection of electrical cables constituting a significant fire hazard on elevation 281 feet of the fuel handling building.

3.1.5 Halon Extinguishing System in Computer Room (4.3.2)

An automatic Halon 1301 extinguishing system will be installed in the subfloor of the computer room on elevation 355 feet of the control building, adjacent to the control room.

3.1.6 Curbs in Reactor Building (5.1)

Curbs will be installed inside the secondary shield at elevation 281 feet of the reactor building to reduce the possible spread of oil from the reactor coolant pump motor lubrication systems.

3.1.7 Fire Dampers (4.9.2)

Fire dampers will be installed in heating, ventilating and air conditioning ducts penetrating fire barriers in several areas throughout the plant.

3.1.8 Fire Doors (4.9.1)

Class A labelled fire doors will be installed, and existing unlabeled doors in various areas of the plant will be verified to have the correct rating or will be replaced with labeled doors.

3.1.9 Fire Barrier Penetrations* (4.9.3, 4.9.4)

Various types of fire barrier penetrations, including cable and pipe penetrations and building construction joints, will be sealed in various areas of the plant to provide appropriate fire resistance.

3.1.10 Thermal Insulation on Valves* (5.1)

Thermal insulation will be installed on decay heat valves in the reactor building.

3.1.11 Fire Barriers at Reactor Building Emergency Cooling Valves*(5.5)

Additional fire barriers will be installed to reduce the possibility of loss of function of the reactor building emergency cooling valves in the event of a fire in the valve gallery and penetration room in the intermediate building.

3.1.12 Fire Water Valve Seals (4.3.1.3)

The existing plastic seals on the fire water valves will be replaced with tamper-proof seals.

3.1.13 Reactor Coolant Pump Lube Oil Collection System* (5.1)

The existing lube oil splash guard on the reactor coolant pump will be modified to enclose the pump motor and to drain the collected oil in a drain tank located inside the secondary shield.

3.1.14 Separation of Control Room (5.12)

Penetrations through fire barriers enclosing the control room will be protected to provide an adequate separation for the control room from the remainder of the plant. All paper, tapes and other combustible materials in the computer office area will be removed.

3.1.15 Electrical Cable Penetration Seals (4.9)

Existing electrical cable penetration seals will be upgraded to conform with a design having a demonstrated three-hour fire resistance rating. In certain areas, additional seals will be provided which conform to this same design.

3.1.16 Battery Room Ventilation Air Flow Monitor (5.9)

A ventilation air flow monitor will be installed in each battery room to alarm and annunciate in the control room the loss of air flow to either battery room.

3.1.17 Fire Fighting Plans (6.5)

Fire fighting plans identifying strategies for fighting fire in all safety-related areas will be developed and implemented.

3.1.18 Smoking (6.4)

Administrative controls to prohibit smoking in safety-related areas and in other plant areas containing major fire hazards will be implemented.

3.1.19 Control of Combustibles (6.3)

Unnecessary combustibles in six plant areas will be removed. Administrative measures will be implemented to control introduction and storage of transient combustibles in various plant areas.

3.1.20 Backup Manual Hose Coverage (4.3.1.3)

Necessary modifications will be provided to secure a backup manual hose coverage for those locations where the isolation of a single section of fire water piping could impair the availability of both automatic water suppression and the manual hose station(s) protecting the same area containing or exposing safety-related equipment.

3.1.21 Alternate Shutdown Capability* (5.11)

An alternate shutdown capability independent of cables and equipment in the cable spreading room (relay room) will be provided.

3.1.22 Brigade Training (6.2)

The licensee will modify the fire brigade training program to provide classroom instruction quarterly and to repeat the entire program within each two-year period. The scope of the classroom training instruction will be expanded to include a detailed review of the plant's fire fighting procedures, prefire strategies, procedure changes, and plant modification relating to manual fire fighting.

3.1.23 Communication Cable Penetrations (4.7)

An asbestos board barrier will be installed to protect redundant communication cables at the containment penetration from fire hazards in the nonsafety-related cable tray below.

3.2 Incomplete Items

The licensee has committed to take action on incomplete items as noted below. The staff's review of the licensee's response to these items and any further proposed changes to the fire protection program will be addressed in a supplement to this report. The schedule for the completion of the licensee action on these incomplete items is given in Table 3.2. The sections of this report which discuss these items are noted in parentheses.

3.2.1 Protection of Emergency Feedwater Pumps (5.5)

The licensee will analyze the fire hazards in the emergency feedwater pump area and propose additional modification as necessary to preserve the safe shutdown capability.

3.2.2 Cable Separation (4.10)

The licensee will perform a study and/or testing to verify the effectiveness of the asbestos board barrier design in preventing (1) the spread of a tray fire to a nearby tray(s) with or without the presence of the interposing nonsafety-related cables, and (2) the damage to redundant cables from a possible exposure fire. Where the study indicates that the present design is inadequate, corrective modification will be proposed.

3.2.3 Effects of Water Spray (4.3.1.6)

The licensee will analyze the effect of water spray to ensure that both divisions of safety-related equipment will not be incapacitated by rupture or inadvertent operation of the fire water system, or the application of fire hoses. Additional modification(s) will be provided as necessary.

3.2.4 Adequacy of the Detector System Design (4.2)

The licensee will perform a study and/or testing to verify the adequacy of the existing and the proposed detector placement and distribution.

3.2.5 Fire Protection Inside the Reactor Building (5.1.6)

The licensee will submit for our review, a study of the feasibility of providing manual hose stations inside the reactor building and proposed modifications.

3.2.6 Unlabeled Fire Doors (4.9.1)

The licensee is studying the feasibility of establishing the adequacy of the fire resistance of unlabeled fire door and frame assemblies. If the adequacy of the fire resistance of such assemblies cannot be established, they will be replaced by properly rated fire door assemblies.

3.2.7 Alarm Circuit Supervision (4.2)

The licensee will perform a study to ensure that the signal initiating and alarm circuits for all fire detection and suppression systems are supervised to detect circuit breaks, ground faults, and power supply failure, and to annunciate in the control room. Additional modification(s) will be proposed if the study determines the need for such.

3.2.8 Remote Shutdown Stations (4.1)

The licensee will perform an analysis to determine whether a single fire at any location could cause loss of both local control and control from the control room of any safe shutdown systems. If the analysis indicates such loss could occur, appropriate corrective modifications will be provided.

3.2.9 Transient Combustibles Study (4.10)

The licensee will conduct a study to determine the effects of transporting transient combustibles through zones that were not analyzed for their presence. Corrective modifications will be provided as needed.

3.2.10 Control Building HVAC Loss (5.13)

The licensee will provide a study of the possible effects of a fire on the operability of the normal and emergency heating, ventilating and air conditioning system used in the Control Building and the effects of such loss of operability on the capability to safely shutdown the reactor. If it is determined that a fire could adversely affect the capability for safe shutdown, the licensee will propose corrective measures.

3.2.11 Interior Hose Station Standpipes Less Than Four Inch Diameter

The licensee has committed to demonstrate by July 1, 1979, using tests or calculations, that all interior hose stations served by standpipes that are less than four inches in diameter (nominal pipe size) are capable of delivering a minimum water flow of 100 gpm at a residual pressure of at least 65 psig at the outlet of the hose station.

3.2.12 Emergency Lighting

The licensee has committed to evaluate the safety-related areas of the facility to assure that adequate emergency lighting has been provided to safely shutdown the plant and to fight fires in safety-related areas, and to submit the results of the evaluation for staff review.

3.2.13 Protection of Relay Room (Cable Spreading Room) (5.1)

The licensee will identify for the staff those areas in the Relay Room where he proposes to provide a manually operated fixed water suppression system or will coat the electrical cables with an appropriate flame retardant coating. We will address the acceptability of the licensee's proposal upon completion of our review of his submittal.

3.2.14 Fire Door Supervision (4.9.1)

The licensee will provide to the staff his proposal with regard to (1) fire doors which are electrically locked and alarmed, (2) fire doors which are mechanically locked closed when not in use, and (3) fire doors which are neither locked nor alarmed but which are kept closed when not in use. We will address the acceptability of the licensee's proposal upon completion of our review of his submittal.

3.2.15 Engineered Safeguards Cabinets (5.10)

The licensee will perform an evaluation to determine if safe shutdown of the reactor can be accomplished assuming loss of both Engineered Safeguards Actuation cabinets in Fire Zone CB-3C. If the evaluation indicates that the capability for safe shutdown could be adversely affected, the licensee will propose additional fire protection measures.

TABLE 3.1

IMPLEMENTATION DATE FOR MODIFICATIONS

	ITEMS	DATE
3.1.1	Fire Detectors	EOR-80*
3.1.2	Manual Hose Stations	EOR-80
3.1.3	Automatic Water Spray System	EOR-80
3.1.4	Automatic Sprinkler Systems or Coating of Electrical Cables	Open**
3.1.5	Halon Extinguishing System in Computer Room	EOR-80
3.1.6	Curbs in Reactor Building	EOR-80
3.1.7	Fire Dampers	EOR-80
3.1.8	Fire Doors	Open**
3.1.9	Fire Barrier Penetrations	EOR-79*
3.1.10	Thermal Insulation on Valves	EOR-80
3.1.11	Fire Barriers at Reactor Building Emergency Cooling Valves	Open**
3.1.12	Fire Water Valve Seals	EOR-79
3.1.13	Reactor Coolant Pump Lube Oil Collection System	EOR-79
3.1.14	Separation of Computer Room from Control Room	EOR-79
3.1.15	Electrical Cable Penetration Seals	EOR-79
3.1.16	Battery Room Ventilation Air Flow Monitor	5-31-79
3.1.17	Fire Fighting Plans	7-01-79
3.1.18	Smoking	10-30-78
3.1.19	Control of Combustibles	9-30-78
3.1.20	Backup Manual Hose Coverage	EOR-80
3.1.21	Alternate Shutdown Capability	Open**
3.1.22	Brigade Training	7-01-79
3.1.23	Communication Cable Penetrations	EOR-80

* EOR-80: By end of refueling outage in 1980
EOR-79: By end of refueling outage in 1979

** The licensee has committed to provide the implementation date for this modification by September 29, 1978. We will review the acceptability of the date upon receipt from the licensee and specify an acceptable date in a supplement to this report.

TABLE 3.2

COMPLETION DATE FOR INCOMPLETE ITEMS

	ITEMS	DATE
3.2.1	Protection of Emergency Feedwater Pumps	12-31-78
3.2.2	Cable Separation	7-15-79
3.2.3	Effects of Water Spray	12-31-78
3.2.4	Adequacy of the Detector System Design	7-15-79
3.2.5	Fire Protection Inside the Reactor Building	12-31-78
3.2.6	Unlabeled Fire Doors	9-15-78
3.2.7	Alarm Circuit Supervision	12-31-78
3.2.8	Remote Shutdown Stations	12-31-78
3.2.9	Transient Combustible Study	10-31-78
3.2.10	Control Building HVAC Loss	12-31-78
3.2.11	Interior Hose Station Standpipes Less Than Four Inch Diameter	7-01-79
3.2.12	Emergency Lighting	12-31-78
3.2.13	Protection of Relay Room (Cable Spreading Room)	10-31-78
3.2.14	Fire Door Supervision	10-31-78
3.2.15	Engineered Safeguards Cabinets	9-30-78

4.0 EVALUATION OF PLANT FEATURES

4.1 Safe Shutdown Systems

There are several arrangements of safety-related systems which can be used to shutdown the reactor and cool the core during and subsequent to a fire. The exact arrangement available in a fire situation will depend upon the effects of the fire on such systems, their power supplies, and control stations. The general functional requirements for safe shutdown and the system auxiliaries and major components required to fulfill these requirements are as follows:

(1) Reactor Coolant System Inventory Control

Following a reactor shutdown or trip, reactor coolant system water inventory is maintained by operation of makeup and purification pumps. Primary coolant letdown is isolated and the makeup pumps are cycled to maintain pressurizer level which otherwise would decrease due to coolant contraction during cooldown.

(2) Decay Heat Removal

Following a normal plant shutdown, a steam bypass control system bypasses steam to the condenser to provide cooldown. If the steam bypass control system is not available, remotely controlled relief valves on a main steam line will provide cooldown by relieving main steam to the atmosphere. This relief valve is backed up by the code safety valves on each steam generator which can be manually operated. The steam relief facility has adequate redundancy. For decay heat removal immediately following the reactor trip, it is necessary only to maintain the control on one steam generator.

For the continued use of the steam generators for decay heat removal, it is necessary to provide a source of water, a means of delivering that water and instrumentation for pressure and level indication. Feedwater may be supplied by a motor-driven or a steam turbine-driven auxiliary feedwater pump.

For a cooldown of the reactor coolant below 250^{0}F, the decay heat removal system is used. The system utilizes the decay heat removal pumps to circulate the reactor coolant through the decay heat removal coolers where the decay heat is transferred to the decay heat closed cycle cooling water system and eventually rejected to Susquehanna River via the decay heat river water system.

(3) Reactivity Control

The rod control system is of fail-safe design. Faulting in the system circuits trip the reactor. Following the reactor trip, soluble poison may be added to the primary system to assure subcriticality. This is accomplished by using makeup and purification pumps to inject borated water from the borated water storage tank into the reactor coolant system.

(4) Monitor Reactor Neutron Level

Source range neutron detectors are required to monitor core reactivity during the shutdown condition.

(5) Auxiliaries

Auxiliaries required for safe shutdown include the nuclear services closed cycle cooling water system, the nuclear services river water system, the reactor building emergency cooling system, and appropriate instrumentation and power supply. Multiple outside sources of power are available to the plant for both normal operation and shutdown functions. Normal operations may utilize either outside or unit-generated power. The power supplies to redundant safety-related equipment are electrically separated. Emergency diesel generators will supply power for shutdown operation when offsite power or unit-generated power is not available.

A substantial degree of capability for safe shutdown from outside the control room now exists. However, it has not been demonstrated that the capability of achieving safe shutdown exists in the event of fire in critical areas such as the relay room. The licensee is continuing to analyze the fire hazard in such areas. The licensee has agreed to provide necessary modifications so that safe shutdown capability can be assured.

We have determined that, subject to completion of the above analysis and implementation of the necessary modifications, a sufficient number of systems and components will be available to perform the shutdown function following a fire.

4.2 Fire Detection and Signaling Systems

The plant has a protective signaling system which transmits various fire alarm and supervisory signals to the control room. In addition to fire alarm and supervisory signals from heat or smoke detectors located in selected areas or ventilation systems in the plant, the system also transmits signals concerning fire pump operation or impairment, carbon dioxide system actuation or trouble, Halon system actuation or trouble, altitude tank level and temperature, operation of fire dampers in the air intake tunnel, operation of or waterflow in automatic sprinkler systems, and closing of selected valves in the fire protection water system.

The signaling system is provided with backup power in event of a loss of offsite power by a connection to the emergency power supply system. Alarm and trouble signals are annunciated in the control room with visual and audible signals. Some detectors in ventilation system ducts in various parts of the plant will also deenergize fans or close dampers upon actuation.

The licensee has committed to provide an analysis to determine if the signal initiating and alarm signal sounding circuits for all fire detection and suppression systems are supervised to detect and annunciate circuit breaks, ground faults, and power supply failures. Based on our review of this analysis, we will present our conclusions as to the acceptability of the circuit supervision in a supplement to this safety evaluation.

Smoke or heat detectors have been provided in selected areas of the plant, generally in ventilation system ducts. Additional detectors are proposed in many unprotected areas. However, there are still a number of safety-related areas without means to detect a fire after the proposed modification. These have been discussed with the licensee and he has agreed to provide detectors for some of these additional areas. These plant areas are identified and discussed in Section 5 of this report. We have reviewed the safety-related areas where fire detectors are not provided and conclude that this condition is acceptable because the occurrence of a significant fire in these areas is not credible.

To ensure that proper consideration has been given to such factors as ceiling height and configuration, ventilation air flow pattern, location and arrangement of plant equipment and combustibles, etc. in determining the type, number and location of fire detectors, the licensee will perform a study and/or testing to verify the adequacy of the existing and proposed detector system design. We will review the licensee's submittal and address the acceptability of the detector design in a supplement to this safety evaluation.

We find that, except for the incomplete item noted above and subject to implementation of the above described modifications, the fire detection and signaling system satisfies the objectives identified in Section 2.2 of this report and are, therefore, acceptable.

4.3 Fire Control Systems

4.3.1 Water Systems

4.3.1.1 Water Supply

The fire protection water supply for the plant is provided by the Susquehanna River. The circulating water flume located between the TMI-1 cooling towers serves as an additional source of fire protection water for the natural draft cooling towers, and can be made available as another source of water for the other areas of the plant by manually opening a bypass valve in the connection to the fire protection water piping system. A 100,000-gallon altitude tank can be made available by opening a normally closed gate valve at the base of the tank.

We find that the water supply conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.3.1.2 Fire Pumps

The water supply is delivered by a combination of three centrifugal fire pumps, each with a rated output of 2500 gpm at 125 psig. One pump, located in the intake screen and pump house, is an electric motor-driven vertical shaft centrifugal pump, taking suction from one of the intake bays beneath the intake screen and pump house. Each of the other pumps is diesel engine driven. One of these, a vertical shaft pump taking suction from a separate bay beneath the intake screen and pump house, is located in a fire pump house adjoining the intake screen and pump house, but separated from it by a 3-hour fire barrier. The other pump, a horizontal shaft centrifugal pump, is located in the circulating water pump house between the natural draft cooling towers, and takes suction from the circulating water flume.

An additional 2500 gpm at 125 psig diesel engine driven centrifugal fire pump taking suction from the Susquehanna River is located at the TMI-2 intake screen and pump house, and is available at all times without additional valve alignment operations.

A 25 gpm automatic electric driven centrifugal jockey pump located at elevation 305 feet on the east side of the turbine building takes suction from the altitude tank to maintain about 120 psig in the fire water system yard loop.

One or more of the fire pumps, depending on the size of the pressure drop, will start automatically if system pressure drops due to a water demand which the jockey pump is unable to satisfy.

A UL listed automatic controller is located with each fire pump. Each pump can be manually started from the control room or at the individual controller, but can be manually stopped only at the controller. Pump running, driver availability and various trouble condition signals are annunciated in the control room as well as at the individual pump controller. Supervision of low fuel tank level is provided for the diesel engine driven pumps, and the main discharge valve from each pump is electrically supervised and annunciated in the control room.

Each of the pumps has sufficient capacity to supply the maximum sprinkler system demand plus 1000 gpm for manual hose streams in any safety-related area.

We conclude that the fire pumps conform to the guidance presented in Appendix A to BTP 9.5-1. Accordingly, we find the fire pumps acceptable.

4.3.1.3 Fire Water Piping System

A separate 12-inch discharge line from each fire pump supplies the 12-inch underground loop main which encircles the plant. Sectional valves permit isolation of this loop from a similar loop around Unit 2. All yard fire

hydrants, automatic and manual water suppression systems, and interior hose stations are supplied by this loop main. Post indicator valves subdivide the loop into a number of sections so that a single section could be isolated without impairing the entire system. However, there are locations where the isolation of a single section between two valves could impair the availability of both automatic sprinklers and the manual hose stations in areas containing or exposing safety-related equipment. The licensee has committed to provide necessary modification(s) to secure a backup manual hose coverage for these locations in the event of such isolation.

Existing seals on post indicator valves in the loop main will be replaced by tamper proof seals. Electrical supervision is provided for other sectional valves in the system, for valves controlling water flow to stand-pipe headers, and for some of the valves controlling water flow into sprinkler or deluge systems, as noted in Section 4.2. The position of all valves is checked monthly.

Yard fire hydrants have been provided at approximately 250-foot intervals around the exterior of the plant. The lateral to each hydrant is controlled by a key operated (curb) valve. Each fire hydrant is provided with a hose house containing 250 feet of 2½-inch hose, combination fog nozzle, and auxiliary equipment. Threads on hydrant outlets and hose couplings are compatible with those of two of three fire departments which serve the plant. Adapters to fit the hoses of the third fire department are kept at the north and south gates to the plant. This fire department is gradually changing over to American National Fire Hose Connection Screw Thread, which is used by the plant and the other two fire departments.

We find that, subject to implementation of the above described modifications, the fire water system conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.3.1.4 Interior Hose Stations

A total of 42 interior hose stations, 37 of which are equipped with 75 feet of 1½-inch diameter synthetic braided rayon cord pile hose, and five of which are equipped with 150 feet of similar hose, are provided in all areas of the plant except containment, control building, diesel generator building, intake screen and pump house, and circulating water pump house.

The licensee has proposed to provide additional hose stations in all areas of the control building, except the 306-foot elevation. The licensee has further committed to perform a hose stretch test, and provide additional modification as necessary, to assure that all points in safety-related areas, and other plant areas which contain major fire hazards, can be reached effectively by at least one hose stream. The licensee will also provide a backup manual hose coverage for those areas containing or exposing safety-related equipment where isolation of a single section of fire water piping could impair the availability of both automatic water suppression and the manual hose station(s) protecting the same area. The licensee has

also committed to perform a study to determine the possibility of installing hose stations inside containment.

The diameter of standpipes supplying interior hose stations does not comply with the requirements of Section E.3(d) of Appendix A to BTP 9.5-1 in that all individual standpipes are not at least four inches in diameter for multiple hose connections. The licensee has agreed to perform calculations or flow tests to verify that a minimum supply of 100 gallons per minute at a residual pressure of 65 psig at the outlet is available at every hose station with standpipe diameter of less than four inches.

We find that, subject to implementation of the above described modifications and verification of interior hose station delivery capability as noted above, the interior fire hose stations satisfy the objectives identified in Section 2.2 of this report and are, therefore, acceptable.

4.3.1.5 Automatic Water Suppression Systems

Automatic wet pipe sprinkler and deluge systems have been provided in the turbine buiding to protect the lube oil systems, the hydrogen seal oil system, the basement and mezzanine areas, and feedwater pump turbine bearings. Automatic sprinkler systems are also provided on the 306-foot elevation of the control building and part of the adjacent fuel handling building, in each of the two diesel generator rooms, the diesel fire pump house, the intake screen and pump house, the circulating water pump house, the machine shop, and the service building. Automatic water spray systems protect the oil filled transformers located outside the turbine building. Manual deluge systems protect many of the charcoal filters in the plant. Automatic deluge systems protect the air intake tunnel, and the combustion and cooling air intakes for the diesel generators. The licensee has proposed to install an automatic deluge system in the penetration area at the 281-foot elevation of the auxiliary building. These suppression systems are designed and maintained in compliance with the provisions of NFPA 13 and NFPA 15.

We find that, subject to implementation of the above described modification, the automatic and manual sprinkler systems conform to the guidance presented in Appendix A to BTP 9.5-1 and are, therefore, acceptable.

4.3.1.6 Effects of Water Spray

The licensee will analyze the effect of water spray to ensure that both divisions of safety-related equipment will not be incapacitated by rupture or inadvertent operation of the fire water system, or the application of fire hoses. Additional modification(s) will be provided as necessary.

We will address the adequacy of protection against the fire water spray damage in a supplement to this report.

4.3.2 Gas Fire Suppression Systems

A total flooding low pressure storage automatic carbon dioxide extinguishing system, actuated by rate anticipation type heat detectors, protect the relay room (cable spreading room). Upon actuation, the system is designed to discharge 4200 pounds of carbon dioxide in 177 seconds, achieving and maintaining a nominal 50% concentration for about 18 minutes. A reserve supply of carbon dioxide is available from the five ton storage unit. Dampers in the ventilation ducts to the relay room close automatically on discharge of the system. Doors to the relay room are maintained closed.

A total flooding Halon 1301 extinguishing system, actuated by pressure and ultraviolet detectors, protect the air intake tunnel. Upon actuation, the system is designed to achieve a 9.9% concentration in the tunnel. Fire door dampers at the discharge end of the tunnel close automatically upon system discharge.

A total flooding automatic Halon 1301 extinguishing system, actuated by an ionization type smoke detector, protects the chemical supervisors office at the 322-foot elevation of the control building.

The acceptability of the designs of the various gas suppression systems is addressed in the discussion of the areas where such systems are utilized (see Section 5).

4.3.3 Portable Fire Extinguishers

Pressurized water, dry chemical and Halon 1211 portable fire extinguishers have been distributed throughout the plant in accordance with the provisions of NFPA 10.

We find that the type and distribution of portable fire extinguishers conform to the guidance presented in Appendix A to BTP 9.5-1 and are, therefore, acceptable.

4.4 Ventilation Systems and Breathing Equipment

4.4.1 Smoke Removal

Ventilation systems are provided for all indoor plant areas. The plant does not have exhaust systems designed specifically for smoke removal, but the installed air handling systems are capable of exhausting limited volumes of smoke direct to the outside.

Ventilation system discharge from controlled areas is monitored for radioactive contamination. In case high radiation levels are detected in these areas, system air intake and exhaust are terminated, and the contaminated air is recirculated through filters. Smoke exhaust operations, if in progress, will be terminated.

Portable smoke removal equipment, consisting of two smoke exhaust fan units with a combined capacity of 15,000 cfm, have been ordered and will be available for smoke removal in case of fire. Two more units are available as backup from Unit 2 of the plant.

We find that, subject to implementation of the above described modifications, the smoke removal capability is adequate and, therefore, satisfies the objectives identified in Section 2.2 of this report and is acceptable.

4.4.2 Filters

HEPA filters used throughout the plant are of noncombustible construction. Charcoal filters are installed in containment as well as in the auxiliary and control buildings. All charcoal filters are, however, normally bypassed. No ignition sources are located near these filters nor can the buildup of radioactive products generate sufficient heat to cause ignition. The amount of combustibles in the area of these filters, other than the filters themselves, is also low. All charcoal filters are protected by deluge systems. The water supply for the kidney filter in containment is provided by a water storage tank and two redundant fire pumps also located in containment.

We find that the fire protection for the charcoal filters satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.4.3 Breathing Equipment

At least ten self-contained breathing units, dedicated to emergency use, will be provided. In addition, the plant has the capability to supply breathing air to 10 men for 6 hours at the rate of three (½ hour) bottles per man per hour. A compressor and cascade system are provided onsite to supply this breathing air.

We find that breathing equipment conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.4.4 Battery Room Ventilation

Maintenance of ventilation air to station battery rooms is vital in prevention of hydrogen buildup in these rooms. Currently, fans in the ventilation systems are provided with air flow monitors. However, these monitors are not sufficiently sensitive to detect the loss of air flow in a single battery room. The licensee will install ventilation air flow monitors to alarm on loss of air flow to either battery room.

We find that, subject to implementation of the above described modification, protection against hyrogen accumulation in battery rooms satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.5 Floor Drains

Floor drains have been provided in areas protected by automatic water suppression systems and in areas where manual hoses are likely to be used, with the exception of the control room, the relay room, the switchgear rooms, the battery rooms, and the diesel generator rooms. In these areas equipment are mounted on pedestals and fire water will be drained out through door openings.

Curbs and drains in various plant areas were reviewed and it was concluded that safety-related equipment in each area will not be flooded with standing water.

There are three safety-related areas inside the plant which contain a large quantity of stored combustible liquids. These are the diesel generator rooms, the makeup and purification pump rooms, and the reactor coolant pump areas inside containment. Floor drain systems in the diesel rooms are physically closed, and drain systems in all three makeup and purification pump rooms are equipped with backflow valves to prevent the spread of liquid fires via the drain system. The existing oil splash guards on the reactor coolant pumps will be modified to enclose the pump motor so that possible oil leakage can be contained. Leaked oil will be drained and stored in lube oil drain tanks inside the secondary shield wall.

We find that, subject to implementation of the above described modification, the drain systems conform to the provisions of Appendix A to BTP 9.5-1 and are, therefore, acceptable.

4.6 Lighting System

The general plant lighting is provided by a system fed by normal AC buses and another system fed from emergency AC buses. The emergency AC units are made up of fluorescent fixtures and are marked with red stripes for more frequent lamp maintenance. In addition DC emergency lights, powered by the station batteries, are also provided throughout the control room. These lights come on during loss of AC power. Battery operated hand lights are also provided.

The licensee has committed to conduct a survey to determine if adequate emergency lighting is provided for shutdown operation and fire fighting in safety-related areas, and to submit the results of the survey for our review.

The acceptability of the emergency lighting provisions, therefore, will be addressed in a supplement to this report.

4.7 Communications

There are three hard wired communication systems located throughout the plant. The standard party/page system contains three party intercoms and covers the general plant area including the containment. A similar system with separate wiring covers safe-shutdown areas but not the containment.

A third system is used for maintenance; this system has three channels with jacks located in the control room, relay room, the containment and most other safe shutdown areas. Portable radio communication is also available.

Separation between the two communication systems which serve the containment is about 4-½ feet at the containment penetration; however, there is a nonsafety-related cable tray located below which could provide a path for fire propagation between these two systems. The terminal boxes at these penetrations are left open.

The licensee will close off the open terminal boxes and provide a fire barrier to separate these communication cables from the fire hazards in the nonsafety-related cable tray below.

We find that, subject to the implementation of the above described modifications, adequate redundancy of communications can be maintained during and following the fire emergency.

4.8 Electrical Cables

Power cables in the plant are insulated by hypalon. Instrumentation and control cables are insulated by either hypalon, cross-linked polyethylene, or Teflon.

IEEE Standard 383-1974 for flame testing electrical cables was not in existence at the time Three Mile Island, Unit 1 cables were purchased and installed. The licensee has performed flame tests in accordance with procedures and criteria similar to the provisions of IEEE Standard 383-1974 on cables representative of a major portion of cables used in the plant. Other cables are also tested but in accordance with different procedures and criteria. Flame retardancy for the latter cables is difficult to determine.

The licensee is contemplating applying a flame retardant coating to cables in certain areas where cable separation may not be adequate. The exact number of areas and locations where additional protection will be needed will be determined by the licensee's pending study on cable separation (see Section 4.10). We will address the acceptability of the cable insulation flame resistance in a supplement to this report.

4.9 Fire Barrier Penetrations

4.9.1 Doorways

Fire barriers are penetrated by doorways, ventilation ducts, electrical raceways, piping and conduit. Many doorway penetrations are not provided with 3-hour rated fire doors and/or labeled frames. The licensee will establish fire resistance ratings of the door assemblies through testing certain representative configurations, or by the study and certification of an independent registered fire protection engineer. Additional modification will be provided to remedy those door assemblies that are found to have inadequate fire resistance.

With respect to supervision of fire doors, the licensee has committed to submit his proposal with regard to: (1) fire doors which will be electrically locked and alarmed, (2) fire doors which are mechanically locked when not in use, and (3) fire doors which are neither locked nor alarmed but which are kept closed when not in use.

We find that, subject to implementation of the above described modifications, protection for door penetrations of fire barriers satisfies the objectives identified in Section 2.2 of this report and are, therefore, acceptable.

We will address the acceptability of fire door supervision measures in a supplement to this report.

4.9.2 Ventilation Duct Penetrations

Fire dampers are installed at the discharge end of the air intake tunnel and in selected ventilation duct penetrations of the fire barriers in various parts of the plant. The licensee has proposed to install rated fire dampers in numerous other ventilation duct penetrations of fire barriers.

We find that, subject to implementation of the above described modifications, protection of ventilation duct penetrations satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.9.3 Electrical Cable Penetrations

Many of the cable penetrations in the plant have previously been sealed using a mineral wool-asbestos board seal with an undefined fire resistance rating. In the course of our review, the licensee presented test data on an alternative seal design using silicone foam. Based on our review of the licensee's submittal, we conclude that the seal design employing silicone foam as described by the licensee provides adequate fire resistance for cable penetration seals. In addition, the licensee has committed to replace the mineral wool seals with silicone foam seals of the approved design, and to use the silicone foam seal in all additional cable penetrations they have committed to seal as a part of this fire protection review.

We find that, subject to completion of installation of the silicone foam seal of approved design, as noted above, the cable penetration seals conform to the guidance presented in Appendix A to BTP 9.5-1 and are, therefore, acceptable.

4.9.4 Piping Penetrations

The licensee has proposed to replace the existing piping penetration seals with a 3-hour rated silicone RTV foam penetration seal.

We find that, subject to implementation of the above described modification, protection of piping penetrations of fire barriers conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.10 Separation Criteria

All reactor protection system cables are routed either in conduits or in completely enclosed trays. Other safety-related cables are routed in conduits or open trays. The separation criteria of the plant between redundant conduits is 6 inches minimum. The minimum conduit to tray separation is 6 inches if the conduit is below a tray and 3 feet otherwise. The separation between redundant trays is 3 feet both horizontally and vertically. Six-inch spacing is maintained where possible for redundant wiring within cabinets.

Where the minimum separation between trays and conduits cannot be maintained fire barriers have been provided. The horizontal barriers consist of two 3/8-inch asbestos cement boards placed together back to back which extend one tray width to either side of the tray. In all vertical barriers inspected, two 3/8-inch asbestos cement boards were extended from about a foot below the trays to the ceiling. Where 6-inch spacing cannot be maintained between redundant wiring within cabinets, double fire retardant tapings were applied.

The design and construction of fire barriers in Three Mile Island, Unit 1 facility has many unique positive features. However, there has been no analysis/test performed to verify the effectiveness of such barriers in preventing the spread of fire. In particular, possible damage from exposure fires involving transient combustibles and nonsafety-related cables providing a possible path of combustion were not taken into account in the original design of the barrier. The licensee will conduct a study to determine the effect of transporting transient combustibles through zones which were not analyzed for their presence. The licensee will also perform an analysis/test to verify the effectiveness of the barrier design in preventing (1) the spread of a tray fire to a nearby redundant tray with or without the interposing nonsafety-related cables, and (2) damage to redundant cables from a possible exposure fire. Where the results of such study indicate that the present design is inadequate corrective modification or additional protection will be provided.

We will address the adequacy of cable separation in a supplement to this report.

4.11 Fire Barriers

Fire areas, with few exceptions, are enclosed by floors, walls and ceilings which have adequate fire resistance ratings for the contained combustibles. Where exceptions have been identified (primarily the absence of fire doors or the use of unlabeled doors), the licensee has agreed to make the necessary modifications.

We find that, subject to implementation of the above modifications, the design of fire barriers satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.12 Access and Egress

All safety-related areas are reasonably accessible for manual fire fighting except the containment. During a normal operation, containment is sealed; access is provided through an interlocked double-door air-lock. Special procedures must be followed to gain access, increasing the response time of the fire brigade.

The diesel generators are accessible by way of a common control center corridor, and also from outside by way of large overhead doors.

The five levels of the control building are accessible either from a common stairway that runs from elevation 306 feet to elevation 380 feet or from the fuel handling building.

We find that reasonable access and egress are available to each fire area in the plant.

4.13 Toxic and Corrosive Combustion Products

The products of combustion of many polymers are toxic to humans and corrosive to metals. Prompt fire detection and extinguishment are relied upon to reduce the quantity of such products produced during a fire. Means of smoke removal, as discussed in Section 4.4.1, are provided as an aid in fire fighting. Members of the fire brigade will be provided with, and trained in the use of, emergency breathing apparatus for fighting fires involving such materials.

We find that, subject to implementation of the modifications described elsewhere in this report, the precautions taken to reduce the effects of toxic and corrosive products satisfy the objectives identified in Section 2.2 of this report and are, therefore, acceptable.

4.14 Nonsafety-Related Areas

We have evaluated the separation by distance or by fire barriers of nonsafety-related areas and have determined that fires in such areas will not adversely affect the ability to safely shut down the plant.

4.15 Instrument Air

Systems in the plant which have pneumatic instruments and controls may be required for safe shutdown depending on the location of a postulated fire. It was verified that air operated valves will fail in safe positions so that a fire induced loss of the instrument air system would not prevent safe shutdown.

5.0 EVALUATION OF SPECIFIC PLANT AREAS

The licensee has performed a fire hazard analysis of the facility to determine the combustibles present in various plant areas, to identify the consequences of fires in safety-related areas and to evaluate the adequacy of fire protection systems.

The results of this analysis, other docketed information, and site visit observations were used in the staff's evaluation of specific plant areas which is discussed in the following sections.

5.1 Reactor Building

5.1.1 Safety-Related Equipment

Outside the secondary shield:

Safety-related equipment in this area includes reactor building emergency cooling units, the steam generator level and the pressurizer level instrumentation, and the decay heat removal valve at elevation 281 feet; steam generator pressure instrumentation at elevation 308 feet; and primary coolant pressure instrumentation at elevation 346 feet.

Inside the secondary shield:

Safety-related equipment includes the reactor and associated auxiliaries, reactor coolant pumps, steam generators, and coolant temperature instrumentation.

The electrical cabling is concentrated in the containment penetration area. Safety-related cables inside the containment are all routed in conduits.

5.1.2 Combustibles

The combustibles in this area consist of approximately 138 gallons of lube oil in each of two reactor coolant pumps, charcoal in the kidney filter plenum and electrical cable insulation. Transient combustibles are minimal due to strict access control into the building.

5.1.3 Consequences if No Fire Suppression

An unmitigated fire involving reactor coolant pump lube oil could damage the affected pump and associated electrical cables. The reactor and associated instrumentation are shielded by a massive concrete wall. Should the containment temperature and pressure increase significantly as a result

of the fire containment spray will be actuated. Charcoal fire in the kidney filters is likely to be contained within the filter casing.

Cables at the containment penetration area are well separated. All safety-related cables are routed in metal conduits and located at least 30 feet above the floor. However, there are some nonsafety-related cable trays forming paths of combustibles between separated conduits/penetrations. The licensee has not analyzed if redundant cables could be damaged by a fire in such trays.

The power-operated decay heat removal valves are accessible for manual operation in the event the power operators were disabled by a fire.

5.1.4 Fire Protection Systems

Each reactor coolant pump is equipped with an oil splash guard to direct leaked oil away from hot metal surfaces. An automatic self-contained deluge system protects charcoal in the kidney filter plenum. Portable water, dry chemical, and Halon 1211 fire extinguishers are distributed throughout the building and are also located outside the reactor building at the personnel air lock.

5.1.5 Adequacy of Fire Protection

Existing fire protection in this area is inadequate. No fire detector has been provided to detect a fire in the area. Portable extinguishers provided are not adequate to suppress a large fire such as the lube oil fire in the reactor coolant pump areas. Portable extinguishers may not be able to reach some cable fires because many cable trays are located high above the floor. Effectiveness of the existing oil splash guards in preventing the reactor coolant pump lube oil fire from starting is not proven.

The self contained deluge system should be adequate to protect against a charcoal fire in the kidney filters.

5.1.6 Modifications

The licensee will provide the following modifications:

(1) Early warning fire detection systems will be installed throughout the reactor building.

(2) Thermal protection will be provided for the decay heat removal valves.

(3) Oil splash guards on the reactor coolant pumps will be modified so that any possible oil leak can be contained and drained to a tank located away from safety-related cables/equipment.

(4) Curbs will be installed inside the secondary shield at elevation 281 feet to reduce the possible spread of lube oil from the reactor coolant pumps. The licensee will also analyze the adequacy of the cable separation against the hazards in the area and provide additional protection as necessary to protect redundant cables from being damaged by a single fire.

In addition, the licensee will perform a study to determine the feasibility of installing manual hose stations within the building and will install such stations if feasible.

We will address the acceptability of the fire protection measures inside the reactor building in a supplement to this report.

5.2 Decay Heat Removal Pits - Auxiliary Building, Elevation 261 Feet

5.2.1 Safety-Related Systems

Each pit contains one division of decay heat removal pump, decay heat cooler, and associated valves and cabling. The pit area has reinforced concrete walls and floor and is covered with a reinforced concrete slab fitted with concrete equipment access hatch covers. The ceiling is penetrated by air handling supply and return ducts, cable trays, piping and steel personnel access hatches.

5.2.2 Combustibles

The combustibles in this area consist of two quarts of lube oil in the pumps and cable insulation.

5.2.3 Consequences if No Fire Suppression

A fire in either pit may disable the division of the decay heat removal system associated with the pit. Because of unsealed or inadequately sealed penetrations, the barrier around each pit may not be adequate to contain a fire within one pit.

5.2.4 Fire Protection Systems

Fire protection for this area consists of dry chemical fire extinguishers and manual hose stations on the basement floor of the auxiliary building.

5.2.5 Adequacy of Fire Protection

Manual suppression would be adequate to control a fire in this area. However, a fire in this area is likely to burn itself out undetected because of the lack of automatic fire detection in the area. Undetected damage, even if limited to one division, could deprive the plant of required redundancy for this vital shutdown system in a subsequent shutdown operation.

5.2.6 Modifications

The licensee will install a fire damper in HVAC supply and return ducts and seal the piping and electrical cable penetrations to provide adequate fire resistance for the penetrations. The licensee has also committed to provide a fire detector in each of the pits to provide an early fire warning.

We find that, subject to implementation of the above described modifications, fire protection for the area conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.3 Fuel and Auxiliary Building Basement - Elevations 271 Feet and 281 Feet

5.3.1 Safety-Related Equipment

Safety-related equipment in the area includes makeup and purification pumps and associated valves; nuclear service cooling water heat exchangers; decay heat removal heat exchangers; and miscellaneous waste storage and treatment facilities.

The electrical cables are mostly concentrated in the fuel handling building area to the east of the makeup and purification pumps, and near the penetration area.

5.3.2 Combustibles

The combustibles in this area consist of 20 gallons of lube oil and hydraulic fluid in each of 3 makeup and purification pumps, a small amount of lube oil in other pumps, and electrical cable insulation. Radioactive spent resin is stored in a steel tank in the form of a watery sludge and, therefore, is excluded from the combustibles.

5.3.3 Consequences if No Fire Suppression

Floor drains in the makeup pump cubicles are equipped with back flow protection valves so that an oil fire in these cubicles will not spread via the drain system. However, barriers enclosing each pump, although capable of three hour fire resistance, are penetrated by an unsealed duct, piping, and cable penetrations. A large oil fire may involve all three makeup and purification pumps. At least one of these pumps is needed for shutdown.

Cable trays routed in the fuel handling building to the east of the makeup pump area are provided with asbestos cement board barriers to protect redundant cables from being damaged by a single fire. The design of the barriers has not taken into consideration possible effects of exposure fires and/or interposing nonsafety-related cable trays capable of providing paths for fire propagation. Redundant cables, therefore, could be damaged in a single fire.

An unmitigated fire in the pipe penetration area could disable certain instrumentation, and both divisions of the decay heat removal valves and the makeup and purification valves.

A fire in the remainder of the area is not likely to affect safe plant shutdown because very few combustibles are located in this area during the normal operation and because most of the equipment which could be involved consists of tanks, piping, and heat exchangers all containing water.

5.3.4 Fire Protection Systems

Portable extinguishers and manual hose stations are provided for fire suppression in this area. Fire stops consisting of two 3/8 inch asbesto cement boards, placed back to back, are provided to prevent the spread of fire between cable trays.

5.3.5 Adequacy of Fire Protection

Existing fire protection in this area is inadequate. Because no fire detector has been provided in the area, fire could develop to an advanced stage before being discovered. In the pipe penetration area, a fire could involve both divisions of valves controlling the decay heat removal system and the makeup and purification system. A cable or exposure fire in the fuel handling building could damage both divisions of cables.

The barriers enclosing the makeup and purification pump cubicles may not be able to contain a large fire because the HVAC duct, the piping, and the cable penetrations of the barriers are not protected. Manual hoses may not be able to reach all points in the area effectively and the effectiveness of asbestos board fire stops in preventing redundant cables from being damaged by an exposure fire, or a fire in interposing cable tray(s), has not been demonstrated.

5.3.6 Modifications

The licensee will provide the following modifications:

(1) A deluge system actuated by ionization type smoke detectors will be installed in the pipe penetration area.

(2) A fire damper will be installed in each HVAC duct penetrating the barriers enclosing the "A" makeup and purification pump cubicle. All the piping and cable penetrations of these barriers will be sealed to provide a fire resistance rating commensurate with the fire hazard in the area.

(3) Conduct a hose stretch test, and provide additional hose stations as necessary, to ensure that all points in the area can be reached effectively by at least one hose stream.

The licensee will also perform an analysis or a test to demonstrate the effectiveness of the fire stops in preventing fire damage to redundant cables, considering the effect of exposure fires due to transient combustibles and the effect of interposing nonsafety-related cable trays. Additional protection will be proposed to prevent redundant cables from being damaged by a single fire.

In addition, the licensee has agreed to provide fire detectors in each of the makeup and purification pump cubicles, the valve gallery and the area east of the pump cubicles.

We find that, subject to implementation of the above described modifications, fire protection in this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.4 Fuel and Auxiliary Building, Ground Floor - Elevation 305 Feet

5.4.1 Safety-Related Equipment

Safety-related equipment in this area includes makeup and purification demineralizers, engineered safeguard motor control centers (MCC), decay heat removal cooling pumps, nuclear service cooling pumps, air handling units for the pump area, waste gas decay tanks and exhaust filters for the auxiliary building. The electrical cabling in this area is mainly of one division except in the closed cooling water pump area where there are both divisions of cabling.

5.4.2 Combustibles

The combustibles in this area consist of approximately 1 gallon of lube oil in each of the decay heat removal and the nuclear service water pumps, charcoal in filters and electrical cable insulation. There is also a plastic tank and polyvinyl chloride piping in an area away from safety-related cables/equipment required for shutdown. Ion exchange resin in the demineralizers is excluded from the combustibles because it is always maintained in water.

5.4.3 Consequences if No Fire Suppression

Considering only fixed combustibles, there is not a credible fire hazard in this area which could disable both divisions of safety-related systems except possibly a fire in nonsafety-related cable trays interposing redundant cables. A fire involving lube oil of the cooling water pump will be prevented from affecting the redundant pump(s) by the concrete walls interposing the pump cubicles. A fire in either of the engineered safeguard MCCs is not likely to involve sufficient combustibles to damage the redundant MCC. A charcoal fire in the filters most likely will be contained within the steel casing of the filter.

However, the area is largely open and the possibility for an exposure fire from transient combustibles cannot be ruled out. A pool fire caused by a combustible liquid spillage at certain critical locations in the area could damage redundant components of the engineered safeguard MCCs, the decay heat removal cooling water system, or the nuclear service closed cooling water system.

5.4.4 Fire Protection Systems

An automatic deluge water suppression system is provided to protect against charcoal fires in the exhaust filters. Dry chemical and carbon dioxide extinguishers, and manual hoses are available for manual fire suppression in this area. The area between the east wall of the fuel pool and the control building is protected by a sprinkler system.

5.4.5 Adequacy of Fire Protection

The fire protection in this area is inadequate. There is no detector to provide early warning for a fire in this area. Adequacy of the cable separation, with the asbestos board fire stops, in preventing damage to redundant cables is not established. The fire hazards analysis for this area did not consider the possibility of exposure fires.

5.4.6 Modifications

As stated in Section 4.10, the licensee will provide the results of an analysis or tests to demonstrate the adequacy of the cable separation and effectiveness of the asbestos board fire stops, taking into account the effect of interposing cable trays between redundant cables and the effect of exposure fires. The licensee will also provide the results of a study to identify the type and the maximum quantity of transient combustibles likely to be brought into or through each area for routine operational or maintenance activities and will evaluate the fire hazards from such combustibles to ensure redundant equipment required for shutdown will not be damaged. Corrective modifications or additional protection will be proposed if the results of these studies show that the present protection is inadequate.

In addition, the licensee has agreed to provide automatic fire detection in the decay heat removal and the nuclear service closed cooling water pump area; and the engineered safeguard MCC area.

We will address the adequacy of fire protection for this area in a supplement to this report.

5.5 Intermediate Building, Basement Floor - Elevation 295 Feet

5.5.1 Safety-Related Equipment

Safety-related equipment in this area includes the steam turbine driven emergency feedwater pump, two electric motor driven emergency feedwater pumps, reactor building emergency cooling valves, and electrical containment penetrations.

5.5.2 Combustibles

The combustibles in this area consist of 5 gallons of lube oil in the turbine driven emergency feedwater pump, 2 gallons in the motor driven emergency feedwater pumps, 6 gallons in air compressors, and electrical cable insulation.

5.5.3 Consequences if No Fire Suppression

An unmitigated fire involving the lube oil from either the turbine driven pump or air compressors could disable all emergency feedwater pumps and damage all reactor building emergency cooling valves.

5.5.4 Fire Protection Systems

Water and carbon dioxide extinguishers and manual hoses are available for manual fire suppression.

5.5.5 Adequacy of Fire Protection

The steam driven and the motor driven emergency feedwater pumps are separated from each other and other equipment in the area by concrete walls. However, the walls are penetrated by a door opening and piping penetrations and are inadequate to contain a fire. Since the turbine driven pump and air compressors contain a significant amount of lube oil, the possibility of an oil fire involving several gallons of lube oil must be considered. The licensee, however, has not demonstrated that redundant cabling or equipment required for safe shutdown will not be disabled by such fire in the area

5.5.6 Modifications

An automatic fire detection system will be installed in the area to provide an early fire warning. The licensee will analyze the effects of a lube oil fire or other possible exposure fires in the area. Additional protection will be proposed if the results of the analysis cannot demonstrate that the function of safe shutdown systems in the area will be preserved under such fire.

We will address the adequacy of fire protection for this area in a supplement to this report.

5.6 Remainder of Intermediate Building - Elevations 305 Feet, 322 Feet, and 355 Feet

5.6.1 Safety-Related Equipment

The only safety-related equipment in the area are main steam safety valves, main steam isolation stop check valves and atmospheric dump valves located at elevation 322 feet, and associated electrical cables.

5.6.2 Combustibles

The combustibles in this area consist of a small amount of electrical cable insulation.

5.6.3 Consequences if No Fire Suppression

It is not credible that main steam piping and valves, which are of heavy steel construction, could be damaged by a fire in this area. Damage to cables controlling atmospheric dump valves will not affect the safe shutdown because backup is available by manually operating spring loaded safety valves.

5.6.4 Fire Protection Systems

Water and carbon dioxide portable extinguishers are provided for manual suppression in this area. Manual hoses are available at elevation 305 feet.

5.6.5 Adequacy of Fire Protection

Manual suppression is adequate for the fire hazard in this area.

5.6.6 Modifications

The licensee will install a class A door in the door opening at elevation 305 feet to provide a three hour barrier between the intermediate building and the turbine building.

We find that fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is acceptable.

5.7 Control Building Basement - Elevation 306 Feet

5.7.1 Safety-Related Equipment

The area contains both divisions of safety-related cables. There is no other safety-releated equipment in this area.

5.7.2 Combustibles

Combustibles in this area consist of electrical cable insulation and miscellaneous combustibles consisting of protective clothing, boots, gloves, etc.

5.7.3 Consequences if No Fire Suppression

An unmitigated fire could damage both divisions of cables routed in the area which are required for safe shutdown.

5.7.4 Fire Protection Systems

An automatic sprinkler system is installed to protect the area. Water and dry chemical fire extinguishers are also available. This area is separated from other parts of the plant by concrete walls and ceiling capable of 3-hour fire resistance. However, the door opening and piping and cable penetrations of the barrier separating this area from the fuel handling building are not protected. Asbestos board fire stops are provided to prevent a fire in a cable tray from spreading to redundant trays.

5.7.5 Adequacy of Fire Protection

Fire stops and the automatic sprinkler system should be able to prevent redundant cables from being damaged by a single fire. The barrier is inadequate to prevent the cables in this area from being exposed to the fire hazard in the neighboring areas.

5.7.6 Modifications

The door opening to the fuel handling building will be protected by a class A fire door. Cable and piping penetrations will be sealed to provide an adequate fire resistance. Manual hose(s) will be made available to protect the area.

In addition, the licensee has agreed to limit the miscellaneous combustibles kept in the area to the minimum needed for normal operations.

We find that, subject to implementation of the above described modifications, fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.8 480 Volt Switchgear Room - Control Building, Elevation 322 Feet

5.8.1 Safety-Related Equipment

The safety-related equipment in this area consists of engineered safeguards 480 volt switchgear 1P and 1S, motor control center 1A and 1B, switchgear, area booster fans A and B, AC transfer switch 1C, and DC transfer switch 1M.

5.8.2 Combustibles

The combustibles in this area consist of electrical cable insulation, electrical components, and miscellaneous combustibles kept in the chemical supervisor's office.

5.8.3 Consequences if No Fire Suppression

Redundant switchgear and MCCs are located in separate rooms separated by 3-hour barriers. However, piping, duct, cable penetrations, and door openings of the barriers either are not protected or have unrated barriers, so that redundant equipment required for safe shutdown could be exposed to a single fire. Damage to AC and/or DC transfer switches wll not affect safe shutdown.

5.8.4 Fire Protection Systems

The fire protection for this area consists of smoke detectors in HVAC ducts which alarm and annunciate in the control room, and dry chemical and carbon dioxide fire extinguishers.

5.8.5 Adequacy of Fire Protection

The existing fire protection is not adequate to assure safe shutdown. Separation between the redundant equipment is inadequate and the effectiveness of fire stops is not established.

5.8.6 Modifications

The licensee will provide a damper in each HVAC duct penetration and seal the piping and the cable penetrations to provide adequate fire resistance.

Adequacy of fire resistance will be established for the existing unlabelled door assemblies, or the existing doors and frames will be replaced with those with appropriate ratings. The licensee will also conduct a study to ensure the adequacy of cable separation, including the design of fire stops. Additional protection will be provided, if necessary, to preserve one division of cables/equipment to assure safe shutdown. Manual hoses will be made available to cover the area effectively. The licensee will limit the miscellaneous combustibles kept in this area to the minimum required for normal operations.

We find that, subject to implementation of the above described modifications, fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.9 Station Batteries and Accessories - Control Building, Elevation 322 Feet

5.9.1 Safety-Related Equipment

The safety-related equipment in this area consists of station batteries, battery chargers, inverters, and AC and DC distribution panels.

5.9.2 Combustibles

The combustibles in this area are cable insulation and battery cases.

5.9.3 Consequences if No Fire Suppression

Redundant divisions of station batteries are located in rooms separated from each other and from other parts of the plant by concrete walls, floor and ceiling capable of 3-hour fire resistance. Except for unprotected ducts, piping, and cable penetrations, a fire in either of these rooms is not likely to affect the redundant equipment.

Redundant battery chargers, inverters, and AC and DC distribution panel are also separated from each other and from other parts of the plant by barriers capable of 3-hour fire resistance except for the unsealed penetrations. The rooms also contain both divisions of cables separated by more than 10 feet of space but interposed by a nonsafety-related cable tray. A fire in either room could expose both divisions of cables/equipment to damage.

5.9.4 Fire Protection Systems

The fire protection systems for this area consist of smoke detectors installed in HVAC ducts, serving the area, which alarm and annunciate in the control room, and dry chemical and carbon dioxide portable extinguishers.

5.9.5 Adequacy of Fire Protection

The fire protection in this area is inadequate due to the lack of manual hoses, of proper seals for the barrier penetrations, and of a means for positive surveillance of the ventilation air flow in the battery rooms. Adequacy of cable separation with respect to the fire hazards from the interposing cables and from the transient combustibles is not established.

5.9.6 Modifications

The licensee will install a fire damper in each HVAC duct penetration and seal piping and cable penetrations to provide an adequate fire resistance. Manual hose stations will be installed in adjacent areas to provide coverage for this area. The licensee will review the adequacy of cable separation against fire hazards from the interposing cables and from the transient combustibles. Additional protection will be provided if the study reveals deficiency. A ventilation air flow monitor will be installed for each battery room to alarm and annunciate the loss of the ventilation air flow to either of the battery rooms.

We find that, subject to implementation of the above described modifications, fire protection for this area conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.10 4160 Volt Switchgear - Control Building, Elevation 338 Feet, 6 Inches

5.10.1 Safety-Related Equipment

The safety-related equipment in this area includes 4160 volt engineered safeguard switchgear, and engineered safeguard actuation cabinets and relay cabinets.

5.10.2 Combustibles

The combustibles in this area are electrical cable insulation and electrical components inside cabinets.

5.10.3 Consequences if No Fire Suppression

Redundant switchgear is located in separate rooms; all the actuation and relay cabinets are located together in the third room. Barriers enclosing each room, however, have unprotected ventilation ducts, and cable penetrations. The effects of a fire would not be limited to one division of safety-related cables/equipment.

5.10.4 Fire Protection Systems

The fire protection in this area consists of smoke detectors in the HVAC ducts, and dry chemical and carbon dioxide portable extinguishers.

5.10.5 Adequacy of Fire Protection

Existing fire protection in this area is inadequate. Unlabeled doors and unsealed penetrations could permit the spread of heat and smoke from one room to another. Redundant cabinets in the same room could both be involved in a fire.

5.10.6 Modifications

The licensee will provide manual hose stations to serve the area; will upgrade cable penetration seals and install fire dampers in the HVAC duct penetrations to provide appropriate fire resistance. Adequacy of fire resistance of unlabelled fire door and frame assemblies will be demonstrated by a test/analysis, or the door assemblies replaced if the result of the study fails to establish the adequacy of such assemblies.

In addition, the licensee will perform an evaluation to determine whether safe shutdown can be accomplished assuming the loss of both divisions of engineered safeguards relay and actuation cabinets. If the evaluation indicates that the capability to achieve safe shutdown is adversely affected, the licensee has committed to provide additional protection.

The acceptability of the fire protection measures in this area will be addressed in a supplement to this report.

5.11 Cable Spreading Room - Control Building, Elevation 338 Feet, 6 Inches

5.11.1 Safety-Related Equipment

The safety-related equipment in this area includes redundant relay cabinets in addition to both divisions of cables.

5.11.2 Combustibles

The combustibles in this area consist of electrical cable insulation and electrical components in relay cabinets.

5.11.3 Consequences if No Fire Suppression

An unmitigated fire in this area could disable the safe shutdown capability of the plant.

5.11.4 Fire Protection Systems

Fire protection for this area consists of an automatic, total flooding, low pressure carbon dioxide system actuated by heat detectors; portable dry chemical, Halon 1211, and carbon dioxide extinguishers located outside of the cable spreading room. Asbestos board fire stops are provided to prevent a cable fire from spreading to redundant tray(s).

5.11.5 Adequacy of Fire Protection

Existing fire protection is inadequate. The cable separation is inadequate to prevent fire damage to both divisions of cables. The effectiveness of the total flooding, automatic gas system has against a deep-seated cable fires is questionable. Heat detectors, actuating the automatic gas system,

will not detect a cable fire as quickly as smoke detectors so that a cable fire in the room is more likely to become deep-seated before the gas system is actuated.

5.11.6 Modifications

The licensee will replace unlabeled doors and upgrade barrier penetration seals to provide a 3-hour barrier enclosing the room. Manual hose(s) will be provided to reach all points in the area effectively. The licensee will also provide a shutdown capability independent of cabling and equipment in this area. Additional smoke detectors will be installed in this room.

In addition, the licensee will identify the areas in this room where he proposes to provide a manually operated fixed water suppression system or apply an appropriate flame retardant coating to the electrical cables.

We will address the acceptability of the fire protection measures in this area in a supplement to this report.

5.12 Control Room - Control Building, Elevation 355 Feet

5.12.1 Safety-Related Equipment

The safety-related equipment in the control room consists of instrumentation and control panels and consoles. There is no safety-related equipment or cables in the neighboring rooms.

5.12.2 Combustibles

The combustibles in the control room consist of electrical cable insulation, electrical components in panels and consoles and some class A combustibles such as log books, drawings, operating manuals, and computer printouts.

5.12.3 Consequences if No Fire Suppression

Considering the small quantity of combustibles in the area, and the fact that the area is constantly manned, an unsuppressed fire involving the whole control room is incredible. However, a fire in a cabinet or a console could cause considerable damage before being extinguished. A fire in a neighboring room, such as the computer room, could also expose equipment in the control room. The plant, however, can be shutdown independent of this room.

5.12.4 Fire Protection Systems

Fire protection for this area consists of smoke detectors in HVAC ducts and in the control room, and portable dry chemical and carbon dioxide extinguishers.

5.12.5 Adequacy of Fire Protection

The existing fire protection is inadequate. Many doorway openings either do not have a door or are provided with unlabeled doors. Duct, cable and piping penetrations of the barriers are unprotected. Detection and suppression capabilities are inadequate.

5.12.6 Modifications

The licensee will provide Class A fire doors for the open doorways in the fire barriers enclosing the control room. Unlabeled doors will be replaced or the adequacy of fire resistance established. Fire dampers will be installed in the HVAC duct penetrations, and piping and cable penetrations will be sealed to provide an adequate fire resistance. A manual hose will be provided in the adjacent stairway area. An ionization type smoke detector will be installed in each safety-related cabinet and console in the control room. The licensee will also relocate all unnecessary combustibles from the computer office to nonsafety-related areas.

We find that, subject to implementation of the above described modifications, fire protection for this area conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.13 Control Building HVAC Equipment Area - Control Building, Elevation 380 Feet

5.13.1 Safety-Related Equipment

The safety-related equipment in this area includes the normal and emergency control building supply air charcoal filters, exhaust fans, and associated ducts, dampers, and cables.

5.13.2 Combustibles

The combustibles in this area consist of cable insulation and charcoal in the filters.

5.13.3 Consequences if No Fire Suppression

Redundant components of the normal and the emergency control building ventilation systems are located in separate rooms, except for the exhaust fans. Both exhaust fans are located in "A" room. Barriers enclosing each room, however, have unprotected door openings, ducts, piping, and cable penetrations. The effect of a fire will not be contained within one division. At least one division of either the normal or the emergency control building ventilation system may be needed to maintain control room habitability.

5.13.4 Fire Protection Systems

Fire protection for this area consists of smoke detectors in the HVAC ducts, and portable water and dry chemical extinguishers for manual suppression. Charcoal filters are protected by heat sensors and a deluge water system.

5.13.5 Adequacy of Fire Protection

The existing fire barriers, with unprotected openings and penetrations, are inadequate to prevent a fire in the area from involving both divisions of the ventilation system. Manual suppression capability is inadequate without manual hose coverage. The licensee has not analyzed the safe shutdown consequences of losing control building ventilation.

5.13.6 Modifications

The existing door openings will be modified and Class A doors installed to provide 3-hour fire resistance. Fire dampers will be installed in the HVAC duct penetrations, and cable and piping penetrations sealed to provide an adequate fire resistance rating. A manual hose station will be provided in the adjacent stairway.

The licensee has committed to analyze the safe shutdown consequences of losing control building ventilation and to propose corrective measures if needed.

We will address the adequacy of fire protection in this area in a supplement to this report.

5.14 Intake Screen and Pumphouse

5.14.1 Safety-Related Equipment

Safety-related equipment in this area consists of screen house air handling units A and B, screen house 480 volt switchgear and motor control centers, decay heat river water pumps A and B, nuclear service river water pumps A, B and C, reactor building emergency cooling pumps A and B, and associated valves.

5.14.2 Combustibles

The combustibles in this area consist of a total of about six gallons of lubricating oil, electrical cable insulation, and transient materials. The adjacent diesel fire pump room contains 350 gallons of diesel fuel oil in the fire pump day tank.

5.14.3 Consequences if No Fire Suppression

Postulated fires would be limited to the area of origin. A fire in the diesel fire pump room would not affect safety-related equipment in the adjacent intake screen and pump house because these areas are separated by a 3-hour rated fire barrier. The east section of the intake screen and pumphouse, where nearly all of the safety-related equipment is located, is divided into two rooms by a concrete wall. Redundant items of equipment are located in these separate rooms. Although there is an open doorway in this wall, the location and arrangement of safety-related equipment and combustible materials makes it unlikely that redundant counterparts would be affected by a single fire.

5.14.4 Fire Protection Systems

An automatic sprinkler system equipped with a flow alarm has been installed in this building, including the diesel fire pump room. Portable dry chemical and water type fire extinguishers are also provided. Fire hoses are available from the yard fire hydrants.

5.14.5 Adequacy of Fire Protection

The fire protection measures for this area are adequate.

5.14.6 Modifications

We find the fire protection for this area conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.15 Diesel Generator Rooms

5.15.1 Safety-Related Equipment

The safety-related equipment in each of the two diesel generator rooms includes an emergency diesel generator, diesel fuel day tank, fuel transfer pumps, diesel generator starting air compressors and receivers, the control panel, and the room air handling unit.

5.15.2 Combustibles

The combustibles in each room consist of lubricating oil in the engine, fuel oil in the day tank, fuel oil and lubricating oil in the diesel-driven air compressors, and possible transient materials.

5.15.3 Consequences if No Fire Suppression

Except for a door in the "lobby" area which is unlabeled, the two diesel generator rooms and their control centers are separated by a three-hour rated fire barrier. An unmitigated fire in one diesel generator room could cause the loss of the diesel generator in that room.

5.15.4 Fire Protection Systems

Automatic sprinkler systems are installed in each diesel generator room and lobby. An automatic deluge system is installed in the air intake area for each diesel generator. Portable dry chemical fire extinguishers are provided. Manual hose backup is available from yard fire hydrants.

5.15.5 Adequacy of Fire Protection

The automatic sprinkler and deluge systems will be adequate to control and suppress fires in this area of the plant.

5.15.6 Modifications

The licensee proposes to replace the non-rated door between the diesel generator building and the service building with a Class A labeled fire door and to upgrade or verify the rating of the unlabeled lobby door.

We find that. subject to implementation of the above described modifications, the fire protection for this area conforms to the guidance presented in Appendix A to BTP 9.5-1 and is, therefore acceptable.

5.16 Fuel Storage Areas - Fuel Handling Building, Elevations 329 Feet, 331 Feet, and 348 Feet

5.16.1 Safety-Related Equipment

The safety-related equipment in this area includes the spent fuel pool and the nuclear service closed cooling water surge tank at elevation 348 feet and the decay heat closed surge tanks at elevation 329 feet.

5.16.2 Combustibles

The combustibles in this area consist of lube oil in the fuel handling bridge and crane, and electrical cable insulation. During refueling, significant quantities of transient combustibles could be present.

5.16.3 Consequences if No Fire Suppression

Spent fuel is stored under water and the safety-related cooling water surge tanks are of heavy steel construction and filled with water. Even an unmitigated fire is not likely to cause damage to these components and equipment.

5.16.4 Fire Protection Systems

Manual hoses and portable dry chemical, water, and carbon dioxide extinguishers are available for fire suppression.

5.16.5 Adequacy of Fire Protection

Manual suppression is adequate to control a fire in this area.

5.16.6 Modifications

The licensee will seal joints where the fuel handling building walls abut the reactor building and replace unlabeled doors with Class A doors.

We find that, subject to implementation of the above described modifications, fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.17 Zone Between Fuel Pool and Control Building, Elevations 322 Feet and 380 Feet

5.17.1 Safety-Related Equipment

Some safety-related cables are in the area. There is no other safety related equipment in this area.

5.17.2 Combustibles

Combustibles in this area consist of cable insulation and possible transient combustibles.

5.17.3 Consequences if No Fire Suppression

The licensee's Fire Hazard Analysis did not identify which system(s) is served by the cables routed through this area. The licensee has agreed to submit a list of the systems served by these cables and an analysis of the effect of a fire in this area on the ability to safely shutdown the reactor.

5.17.4 Fire Protection Systems

Dry chemical and carbon dioxide fire extinguishers are available for manual fire suppression.

5.17.5 Adequacy of Fire Protection

We will address the adequacy of fire protection for this area in a supplement to this report.

5.17.6 Modifications

We will identify any needed modifications in a supplement to this report.

5.18 Turbine Building

5.18.1 Safety-Related Equipment

Safety-related equipment in the turbine building consists of one channel of safety-related cables which traverse the area.

5.18.2 Combustibles

The combustibles in the turbine building consist of large quantities of oil, hydrogen and electrical cable insulation.

5.18.3 Consequences if No Fire Suppression

The walls between the turbine building and the control building and intermediate building have a fire resistance rating of at least 3 hours, but they contain unrated cable and pipe penetrations and unlabeled doors.

A detailed evaluation of unmitigated fires in the turbine building has not been completed, but a fire could spread to other parts of the plant through the penetrations mentioned above. The severity of a fire here may exceed the fire resistance of the walls themselves. The turbine building is a separate structure from adjacent buildings, however, and collapse of the turbine building should not affect them.

5.18.4 Fire Protection Systems

Automatic sprinkler systems protect the ground floor and mezzanine level. Specific oil hazards on elevation 305 feet, including the hydrogen seal oil unit and the turbine lubricating oil reservoir, are protected by automatic deluge systems. The turbine bearings are protected by a pre-action system. Manual hose stations and portable extinguishers are also provided.

5.18.5 Adequacy of Fire Protection

The licensee did not provide a detailed analysis of the safe shutdown consequences of possible damage due to a fire in this area in his original submittal, but has agreed to provide such an analysis. We will address the adequacy of fire protection in this area in a supplement to this report.

5.18.6 Modifications

The licensee proposed to make the following improvements in the turbine building:

(1) Unlabeled doors in walls between the turbine building and other buildings will be replaced with Class A labeled fire doors.

(2) Cable and piping penetrations in the turbine building walls and structural joints between the reactor building buttresses and the turbine wall will be sealed.

The staff's evaluation of the adequacy of proposed modifications, and any additional requirements, will be contained in a supplement to this report.

5.19 Air Intake Tunnel

5.19.1 Safety-Related Equipment

There is no safety-related equipment located in this area except some electric cables routed in the conduits.

5.19.2 Combustibles

There are no combustibles located in the tunnel during normal operation.

5.19.3 Consequences if No Fire Suppression

The tunnel is designed to maintain the selected plant areas safe for occupancy following a hypothetical aircraft crash on site. Even without suppression, a fire in this area will be isolated automatically by redundant fire dampers. Safe shutdown of the plant will not be affected.

5.19.4 Fire Protection Systems

In addition to redundant fire dampers described above, the tunnel is provided with smoke detectors and flame detectors to actuate a deluge system and a total flooding Halon 1301 system. Curbs and a sump are also provided to prevent the spread of a fire involving spilled aircraft fuel.

5.19.5 Adequacy of Fire Protection

The existing fire protection is adequate to contain and control a fire in this area.

5.19.6 Modifications

No modifications are needed in this area.

We find that fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.20 Yard Area

5.20.1 Safety-Related Equipment

The safety-related equipment in the yard area includes two condensate storage tanks and a borated water storage tank.

5.20.2 Combustibles

The combustibles in this area consist of fuel oil in an oil storage tank and transformer oil in the transformers.

5.20.3 Consequences if No Fire Suppression

An unsuppressed fire involving one transformer would result in the probable loss of that transformer. Fire barriers between transformers and drainage facilities would restrict the damage to one unit.

A fire in the fuel oil storage tank might affect condensate storage tank "A"; however, the redundant condensate storage tank "B" and the borated water storage tank are located on the other side of the plant and would not be affected.

5.20.4 Fire Protection Systems

Automatic water spray systems, actuated by heat detectors, are installed to protect each transformer in this area. Hose lines from nearby hydrants are available for manual fire suppression.

5.20.5 Adequacy of Fire Protection

The existing fire protection is adequate to control and suppress a fire in this area.

5.20.6 Modifications

No modifications are needed in this area.

We find that the fire protection for this area satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

5.21 Air Conditioning Equipment Room - Fuel Handling Building, Elevation 285 Feet

5.21.1 Safety-Related Equipment

Safety-related equipment in this area includes both divisions of air cooling units serving the control building.

5.21.2 Combustibles

Combustibles in this area consist of small quantities of lube oil and cable insulation.

5.21.3 Consequences if No Fire Suppression

The licensee did not evaluate in his initial submittal the effects of loss of control building air cooling on the habitability and instrumentation in the control building. He has, however, agreed to provide such an analysis.

5.21.4 Fire Protection Systems

A dry chemical portable extinguisher is available for manual suppression.

5.21.5 Adequacy of Fire Protection

We will address the adequacy of fire protection for this area in a supplement to this report.

5.21.6 Modifications

We will identify any modifications necessary in this area in a supplement to this report.

6.0 ADMINISTRATIVE CONTROLS

The administrative controls for fire protection consist of the fire protection organization, fire brigade training, the controls over combustibles and ignition sources, the prefire plans and procedures for fighting fires, and the quality assurance provisions for fire protection. The licensee has provided a description of the elements of his administrative controls for fire protection, as detailed in the following sections.

6.1 Organization

The licensee's fire protection organization defines the organizational responsibilities and lines of communication between the various positions involved in the fire protection program, the qualification requirements of key positions in the fire protection program, and the composition of the fire brigade. The fire protection organization encompasses positions extending from the Vice President-Generation to the Station Shift Supervisor. These management and staff positions are responsible for formulation, implementation, and assessment of the fire protection program. The licensee has described the organizational responsibilities for inspection, training, review of design changes, review of proposed work activities and the station documents that define these and other responsibilities as related to plant fire protection.

The licensee has described the qualification requirements that have been established for the positions responsible for formulating and implementing the fire protection program, training instructions, and for service in the fire brigade. In addition to the training requirements, the licensee will establish minimum physical qualification requirements for service in the fire brigade, and provide an annual physical examination for each fire brigade member.

The licensee has proposed a fire brigade of at least five members to be maintained on site at all times. The fire brigade will not include the operating shift crew shown in Section 6.2.2 of the Technical Specifications or any other personnel required for other essential functions during a fire emergency.

Based on the above, we find that the fire protection organization conforms to the staff document "Nuclear Plant Fire Protection Functional Respnsibilities, Administrative Controls and Quality Assurance" ("Administrative Controls") transmitted to the licensee by letter dated August 4, 1977, and is, therefore, acceptable.

6.2 Fire Brigade Training

The fire brigade training program consists of classroom instruction, practice in fire fighting and fire brigade drills. The classroom instruction is provided annually and includes instruction in the types of fires that could occur in the plant and their particular hazards; reporting

fires; maintenance and use of the plant's fire fighting equipment; fire chemistry; and fire fighting strategies and techniques. Annually brigade members participate in training sessions in actual fire extinguishment. Quarterly brigade members participate in preplanned fire brigade drills.

The licensee has proposed to modify the format of the brigade training program such that classroom instruction will be provided quarterly and the entire program repeated within each two year period. In addition, the scope of the classroom training instruction will be expanded to include: a detailed review of the plant's fire fighting procedures, prefire strategies, procedure changes, and plant modifications relating to manual fire fighting.

We find that, subject to implementation of the above described programmatic changes, the fire brigade training program conforms to the guidance presented in the staff document "Administrative Controls" and is, therefore, acceptable.

6.3 Control of Combustibles

Administrative controls have been established to limit the amount of combustibles that a safety-related area may be exposed to. These controls include: housekeeping procedures; periodic inspections to determine the effectiveness of housekeeping practices; procedures and guidelines for use and storage of flammable, and/or volatile materials; and a review of maintenance requests and modifications for special fire protection requirements. Station procedures have been established for the use of combustible materials in the controlled areas of the plant, and to ensure that non-fire retardant treated wood is not used inside buildings containing safety-related systems. The licensee has proposed to revise the existing administrative control procedures to further limit the amount of transient combustibles that can be brought into safety-related areas of the plant.

We find that, subject to implementation of the above described changes, the program established to control combustible materials in the plant conforms to the guidance presented in the staff document "Administrative Controls" and is, therefore, acceptable.

6.4 Control of Ignition Sources

Administrative controls have been established to protect safety-related equipment from fire damage or loss resulting from work involving ignition sources. These controls include station procedures which require a work permit to perform welding or flame cutting operations. Issuing a hot work permit requires review and signed approval by a responsible supervisor, an inspection of the work area and the posting of a fire watch. Plant procedures prohibit the use of open flames or combustion generated smoke for leak testing. Administrative controls to prohibit smoking in safety-related areas and in other plant areas containing major fire hazards will be implemented.

We find that the procedures established to control ignition sources in the plant conform to the guidance presented in the staff document "Administrative Controls" and are, therefore, acceptable.

6.5 Fire Fighting Procedures

The licensee has described the fire fighting procedures that have been established to prescribe the actions to be taken by the individual discovering the fire, the control room operators and the members of the fire brigade.

New plans covering fire fighting strategies for safety-related fire areas will be developed and documented. Such plans will include a discussion of the combustibles, appropriate extinguishing agents, location of nearby fire fighting equipment, likely approach routes, location and protection of safety-related and vital equipment, fire fighting hazards, location and handling of radiological and toxic hazards, and methods to ventilate the fire area.

Written agreements with local fire companies are maintained to assure adequate support for any fire emergency. Officers and members of these fire companies have been given training and orientation at the station.

We find that, subject to implementation of the above described changes, the fire fighting plans and procedures conform to the guidance presented in the staff document "Administrative Controls" and are, therefore, acceptable.

6.6 Quality Assurance

The design, procurement, installation, testing and administrative control activities for fire protection will be controlled in accordance with the approved Operational Quality Assurance plan, implementing the quality assurance program criteria of Appendix A to BTP 9.5-1. Necessary changes will be made to the procedures implementing the OQA plan to prescribe the controls for fire protection.

We find that, subject to implementation of the above described changes, the quality assurance provisions for fire protection conform to the guidance presented in the staff document "Administrative Controls and are, therefore, acceptable.

7.0 TECHNICAL SPECIFICATIONS

The Technical Specifications were modified by Amendment No. 32, dated November 30, 1977, as corrected December 12, 1977, to include limiting conditions for operation and surveillance requirements for existing fire protection systems and administrative controls. Following the implementation of the modifications of fire protection systems and administrative controls resulting from this review, the Technical Specifications will be similarly modified to incorporate the limiting conditions for operation and surveillance requirements for these modifications.

8.0 CONCLUSIONS

The licensee has performed a fire hazards analysis and has proposed certain modifications to improve the fire protection program. Additional modifications have been proposed by the licensee during the course of our review which are based upon the fire hazards analysis and our onsite evaluation of the fire protection program. These proposed modifications are summarized in Section 3.1. Significant steps are being taken to provide additional assurance that safe shutdown can be accomplished and the plant can be maintained in a safe condition during and following potential fire situations. Additional evaluation of incomplete items, summarized in Section 3.2, will be necessary before we can conclude that the overall fire protection at Three Mile Island, Unit No. 1 will satisfy the provisions of BTP 9.5-1 and Appendix A thereto, which the staff has established for satisfactory long-term fire protection.

We find that the licensee's proposed modifications described herein are acceptable both with respect to the improvements in the fire protection program that they provide and with respect to continued safe operation of the facility, while the remaining items are completed.

In the report of the Special Review Group of the Browns Ferry Fire (NUREG-0050) dated February 1976, consideration of the safety of operation of all operating nuclear power plants pending completion of our detailed fire protection evaluation was presented. The following quotations from the report summarize the basis for our conclusion that the operation of the facility, pending resolution of the incomplete items and the implementation of all facility modifications, does not present an undue risk to the health and safety of the public.

> "A probability assessment of public safety or risk in quantitative terms is given in the Reactor Safety Study (WASH-1400). As the result of the calculation based on the Browns Ferry fire, the study concludes that the potential for a significant release of radioactivity from such a fire is about 20 percent of that calculated from all other causes analyzed. This indicates that predicted potential accident risks from all causes were not greatly affected by consideration of the Browns Ferry fire. This is one of the reasons that urgent action in regard to reducing risks due to potential fires is not required. The study (WASH-1400) also points out that 'rather straightforward measures, such as may already exist at other nuclear plants, can significantly reduce the likelihood of a potential core melt accident that might result from a large fire.'"
>
> "Fires occur rather frequently; however, fires involving equipment unavailability comparable to the Browns Ferry fire are quite infrequent (see Section 3.3 of NUREG-0050). The Review Group believes that steps already taken since March 1975 (see Section 3.3.2) have reduced this frequency significantly."

"Based on its review of the events transpiring before, during and after the Browns Ferry fire, the Review Group concludes that the probability of disruptive fires of the magnitude of the Browns Ferry event is small, and that there is no need to restrict operation of nuclear power plants for public safety. However, it is clear that much can and should be done to reduce even further the likelihood of disabling fires and to improve assurance of rapid extinguishment of fires that occur. Consideration should be given also to features that would increase further the ability of nuclear facilities to withstand large fires without loss of important functions should such fires occur."

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date:

9.0 CONSULTANTS' REPORT

Under contract to Nuclear Regulatory Commission, Brookhaven National Laboratory has provided the services of fire protection consultants who participated in the evaluation of the licensee's fire protection program and in the preparation of this report. Their report, "Fire Protection in Operating Nuclear Power Stations - Three Mile Island, Unit 1," dated September 1, 1978, and supplemented September 11, 1978, discusses several matters which have been addressed in this report. These elements of the consultants' recommendations which we have not adopted are identified in Appendix "B" along with our bases therefor.

APPENDIX A

CHRONOLOGY

In February 1976, the report by the NRC Special Review Group was issued as NUREG-0500, "Recommendations Related to the Browns Ferry Fire."

On May 1, 1976, Standard Review Plan 9.5.1, "Fire Protection," was issued, incorporating the various recommendations contained in NUREG-0500.

By letter dated May 11, 1976, Metropolitan Edison Company was requested to compare the existing fire protection provisions at their facilities with new NRC guidelines as set forth in Standard Review Plan 9.5.1, "Fire Protection," dated May 1, 1976, and to describe (1) the implementation of the guidelines met, (2) the modifications or changes underway to meet the guidelines that will be met in the near future, and (3) the guidelines that will not be met and the basis therefor.

By letter dated September 30, 1976, Metropolitan Edison Company was requested to provide the results of a fire hazards analysis and propose Technical Specifications pertaining to fire protection. Metropolitan Edison Company was also provided a copy of Appendix A which includes acceptable alternatives to the guidelines of SRP 9.5-1.

By letter of December 2, 1976, we provided model Technical Specifications and requested submittal of fire protection Technical Specifications.

On February 10, 1977, Metropolitan Edison Company submitted proposed Technical Specifications for fire protection in response to our request of December 2, 1976.

On May 16, 1977, Metropolitan Edison Company provided a fire hazards analysis submittal responding to our requests of May 11 and September 30, 1976.

On August 12, 1977, Metropolitan Edison Company submitted a revised Fire Protection Technical Specification change, requesting amendment to the operating license.

By letter of April 17, 1978, Metropolitan Edison Company was provided with our requests for additional information and staff positions pertaining to fire protection at the Three Mile Island, Unit 1 facility.

On May 22-26, 1978, the DOR fire protection review team visited the Three Mile Island, Unit 1 facility.

On May 26, 1978, during the meeting at the plant, the review team identified additional staff positions and requested Metropolitan Edison Company to indicate their commitment to these positions.

On June 12, 1978, Metropolitan Edison Company provided a submittal responding to our requests of April 17 and May 26, 1978.

By letter of June 28, 1978, Metropolitan Edison Company was requested to provide additional information and commitment to meet staff positions, pertaining to fire protection at the Three Mile Island, Unit 1 facility.

On July 14, 1978, Metropolitan Edison Company provided additional response to our request of April 17, 1978.

On July 20, 1978, Metropolitan Edison Company provided a submittal responding to our request of June 28, 1978.

On July 28, 1978, Metropolitan Edison Company provided information on the schedule for completion of their study of methods of fire door qualification.

By letter of August 4, 1978, Metropolitan Edison Company was requested to provide additional information and commitments to meet staff positions.

On August 15, 1978, Metropolitan Edison Company provided information on the fire hazards analysis that was performed for the Turbine Building.

By letter of August 17, 1978, Metropolitan Edison Company was requested to provide additional information and commitments to meet staff positions.

On August 28, 1978, Metropolitan Edison Company responded to our requests of August 4 and 17, 1978.

By letter of August 31, 1978, Metropolitan Edison Company was requested to provide commitments to staff positions.

On September 8, 1978, Metropolitan Edison Company responded to our request of August 31, 1978.

On September 18, 1978, Metropolitan Edison Company committed to provide completion dates for certain modifications by September 29, 1978.

APPENDIX B

DISCUSSION OF CONSULTANTS' REPORT

Under contract to the Nuclear Regulatory Commission, Brookhaven National Laboratory has provided the services of fire protection consultants who participated in the evaluation of the licensee's fire protection program and the preparation of the Safety Evaluation Report (SER). Their report, "Fire Protection in Operating Nuclear Power Stations - Three Mile Island Unit 1 (TMI-1) Safety Evaluation Report Review," and the supplement thereto present certain recommendations and comments. The consultant's recommendations and comments and our resolution of these matters is given below.

Fire Water System Control Valve Supervision

It is recommended that electrical supervision be required on all control valves in the fire protection systems protecting areas containing or exposing safety-related equipment.

Staff Response:

The NRC guidelines on valve supervision are given in Appendix A to Branch Technical Position (BTP) 9.5-1 of the Standard Review Plan. These guidelines permit, as an alternative to electrical supervision, an administrative program to assure that valves are maintained in the proper position. Such a program includes locking valves with strict key control or sealing valves with tamper proof seals. Periodic inspections are to be performed to verify that the method of securing the valve is intact.

These measures are consistent with the requirements imposed for supervising valves in safety-related systems, and provide adequate assurance that valves are maintained in the appropriate position. The licensee's program for valve supervision is consistent with NRC guidelines. In addition, the plant Technical Specifications require a monthly check of all valves in the flow path to fire suppression systems, to ensure that each valve is in the correct position.

Hydrotest of Fire Hoses

Establish a program to hydro-test all fire hoses at 220 psi and to maintain records of such tests. The outside hoses to be tested annually and the inside hoses every three years.

Staff Response:

The facility technical specifications already contain a requirement that the hose at each hose station be hydrostatically tested at least once per three years at a pressure at least 50 psi greater than the maximum pressure available at that hose station. Since the pump shutoff head is approximately 170 psig, this would make the maximum test pressure approximately 220 psig, which is in accordance with the consultant's recommendation.

The existing specification of a three year test period for outside hoses instead of one year as recommended, is based on the fact that hoses used at exterior stations are kept inside hose houses where they are provided some protection from the deteriorating effects of sunlight and weather. We agree with the consultant, however, that this protection is less than that received by hoses stored within the facility. Accordingly, we shall request the licensee to increase the frequency of hydrostatic testing of hoses installed at outdoor stations to once a year.

Use of Municipal Fire Pumper

Create a site where a municipal fire pumper can take suction from the cooling tower basin and pump into the yard loop to supply a line for inside fire protection.

Staff Response:

This is not required by Appendix A to BTP 9.5-1 nor is it necessary for adequate fire protection. The number of fixed fire pumps (4) available to the TMI-1 fire water supply system exceeds the number and capacity requirements of Appendix A to BTP 9.5-1. Further, only one of the four pumps is needed to supply the required fire fighting capability. In addition, one of the fixed diesel driven pumps is located in the circulating water pump house when it draws water from the circulating water flume which is the same water source referred to by the consultant. Therefore, since the capability recommended by the consultant already exists as a permanent installation, we do not agree that there is a need for an additional requirement.

Freeze Protection of Outdoor Hydrants

Inspect all outdoor fire hydrants for drainage of their dry-barrels immediately prior to freezing winter weather, and for proper functioning immediately after the winter season.

Staff Response:

The licensee has made a commitment to perform such inspections.

Use of Outdoor Hydrants for Fire Fighting Inside Buildings

Provide a 1-1/2" hose capability in the outside hydrant hose houses as follows: One 2-1/2" x 1-1/2" gated wye with 150' of 1-1/2" hose and 2 adjustable 1-1/2" nozzles should be provided in each hose house where it may be necessary to extend yard hydrant service into the structure to back up other systems.

Staff Response:

The licensee has made a commitment to provide the above capability.