Docket No. 50-289

December 30, 1986

DCR 016

Mr. Henry D. Hukill, Vice President
and Director - TMI-1
GPU Nuclear Corporation
P. O. Box 480
Middletown, Pennsylvania 17057

Dear Mr. Hukill:

SUBJECT: FIRE PROTECTION FOR TMI-1

By Exemption dated June 4, 1984, we granted several exemptions from the fire protection technical requirements of Appendix R to 10 CFR 50. However, our Safety Evaluation (SE) related to this June 4, 1984 Exemption contained several open items concerning your compliance with fire protection requirements. In subsequent correspondence (letters dated October 30, 1984, February 11, 1985, November 7, 1985, May 17, 1986, July 22, 1986, August 19, 1986, October 22, 1986, November 19, 1986 (2 letters), and November 20, 1986), you either requested additional exemptions from the technical requirements of Sections III.G and III.J of Appendix R to 10 CFR 50 or provided additional descriptions of your program.

Based upon our evaluation of your submittals, as listed above, we conclude for some of the exemptions requested, that the TMI-1 alternate fire protection configuration provides an equivalent level of safety to that achieved by conformance with Appendix R. Therefore, certain exemption requests as described in the enclosed Exemption (Enclosure 1) are granted. However, exemptions in two areas are denied as described in our SE of your fire protection program (Enclosure 2).

In your November 7, 1985 Revision 7 to the Fire Hazards Analysis Report (FHAR) and in the July 22, 1986 letter to the NRC, you provided a revised description of the fire protection for the safe shutdown and alternate shutdown capability from that which we evaluated in our June 4, 1984 SE. Enclosure 2 includes a revised Safety Evaluation which reflects the information you have submitted to date. Your staff has indicated that new information will be submitted in Revision 8 to the FHAR and in a revised response to NRC Generic Letter 81-12. This will include a description of the alternate shutdown capability for the Engineered Safeguards Actuation System (ESAS) room which has not yet been provided for our review. We consider the adequacy of the fire protection for the safe and alternate shutdown capabilities to be an open item pending receipt and evaluation of the new information and the results of the Appendix R compliance inspection.

Compliance with Appendix R is to be achieved during your current shutdown per 10 CFR 50.48. Schedular extensions beyond the refueling outage will require an approved Exemption. You are requested to inform the Commission in writing when the actions described in our SE are completed.

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A copy of the Exemption (Enclosure 1) is being filed with the Office of the Federal Register for publication.

Sincerely,
/S/

John F. Stolz, Director
PWR Project Directorate #6
Division of PWR Licensing-B

Enclosures:
1. Exemption
2. Safety Evaluation

cc w/enclosures:
See next page

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Atomic Safety & Licensing Appeal
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UNITED STATES NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
GENERAL PUBLIC UTILITIES NUCLEAR CORPORATION, ET AL.	)	Docket No. 50-289
	)	
(Three Mile Island Nuclear Station, Unit No. 1)	)	

EXEMPTION

I.

General Public Utilities Nuclear (GPUN) Corporation (the licensee) and three co-owners hold Facility Operating License No. DPR-50, which authorizes operation of the Three Mile Island Nuclear Station, Unit No. 1 (TMI-1) (the facility) at power levels not in excess of 2535 megawatts thermal. This license provides, among other things, that the facility is subject to all rules, regulations, and Orders of the Nuclear Regulatory Commission (the Commission or the staff) now or hereafter in effect.

The facility is a pressurized water reactor located at the licensee's site in Dauphin County, Pennsylvania.

II.

10 CFR 50.48, "Fire Protection," and Appendix R to 10 CFR Part 50, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979" set forth certain fire protection features required to satisfy the General Design Criterion related to fire protection (Criterion 3, Appendix A to 10 CFR 50).

Section III.G of Appendix R requires fire protection for equipment important to safe shutdown. Such fire protection is achieved by various combinations of fire barriers, fire suppression systems, fire detectors, and

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separation of safety trains (III.G.2) or alternate safe shutdown equipment free of the fire area (III.G.3). The objective of this protection is to assure that one train of equipment needed for hot shutdown would be undamaged by fire, and that systems needed for cold shutdown could be repaired within 72 hours (III.G.1).

Section III.J of Appendix R requires emergency lighting units with at least an eight-hour battery power supply be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto.

III.

By letters dated October 30, 1984, February 11, 1985, November 7, 1985, May 17, 1986, July 22, 1986, August 19, 1986, October 22, 1986, and November 20, 1986, the licensee provided details of their fire protection program and requested approval of a number of exemptions from the technical requirements of Sections III.G and III.J of Appendix R to 10 CFR 50. In subsequent correspondence dated July 22, 1986, and November 19, 1986, the licensee withdrew several of the previously requested exemptions. The Commission is denying some of the requested exemptions as set forth in its concurrently issued Safety Evaluation. A description of the remaining exemption requests and a summary of the Commission's evaluation follow.

1. III.G.2; exemption requested from installing automatic fire detection in area FH-FZ-2 (Fuel Handling Building at elevation 305 feet): The staff's principal concern with the level of protection in this area was that a fire might propagate undetected and damage redundant, shutdown-related systems. However, the locations within the area which contain most of the combustible material and in which transient combustibles would most likely be found are

protected by an automatic fire suppression system. If a fire of significant magnitude were to occur, the staff expects the suppression system to actuate. This would cause an alarm to be visually and audibly annunciated in the control room. The fire brigade would be subsequently dispatched and would complete fire extinguishment using manual fire fighting equipment. Pending actuation of the suppression system and the arrival of the brigade, a fire barrier would provide adequate passive protection to one division of shutdown-related cables. For those cables which have not been physically separated or protected, the licensee has stated that sufficient time is available to manually operate valves to reestablish flow paths (see Exemption 2). These manual actions would be taken in areas that are isolated from the effects of a fire either by physical barriers or by automatic fire suppression systems. On this basis, the staff concludes that the licensee's alternate fire protection configuration represents an equivalent level of fire safety to that achieved by compliance with Section III.G.2.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The regulations require the installation of an automatic fire detection system to warn operators of a fire so that appropriate corrective action can be taken. The area of concern contains an automatic fire suppression system. A fire of sufficient magnitude would cause the fire suppression system to actuate which would in turn sound an alarm. Thus, the underlying purpose of the rule would be satisfied without installing an automatic fire detection system.

2. III.G.2; exemption requested to allow manual operation of certain valves and pumps in lieu of providing fire protection: The licensee identified a number of areas in which redundant cables and components associated with letdown valves, makeup valves, steam dump valves, steam supply valves, emergency feedwater valves, and the intermediate cooling water and nuclear service cooling water pumps are not protected per the fire protection options identified in Section III.G.2. The licensee states that if a fire damages these cables, sufficient time exists to manually align the valves and to manually control the pumps so as to achieve and maintain safe shutdown conditions. The time periods within which the licensee must accomplish these actions vary from 20 minutes for certain emergency feedwater system valves to 240 minutes for certain valves in the makeup system. The minimum time frame to establish local control of the intermediate cooling water pumps and the nuclear service cooling water pumps is 30 minutes.

The technical requirements of Appendix R are not met in the subject areas because cables and components for certain shutdown-related valves and pumps are not provided with fire protection in accordance with the options identified in Section III.G.

The staff has several concerns regarding the reliance on manual actions in lieu of physical protection of shutdown systems. The first is that plant operators may have to enter the fire area before it is reasonable to expect that habitable conditions may be restored after the fire. The licensee, in the July 22, 1986 submittal, identified a number of locations where safe shutdown can only be achieved by reentering the fire area to assure proper valve alignment. However, in no instance is it necessary to enter these

areas before two hours after fire damage occurs. Although it is not possible to predict the nature and duration of a fire in any location, the staff expects that within one hour a fire would have been detected and controlled and near ambient conditions restored. This conclusion is based on the description of plant hazards and available protection as provided by the licensee in Revision 7 of the Fire Hazards Analysis Report (FHAR). The licensee's analyses indicated that an additional hour exists beyond the staff's assumptions. This results in a sufficient margin of safety to provide reasonable assurance that manual actions within the fire area can be achieved.

The staff was also concerned that fire damage to valve operators would prevent manual valve alignment. However, the licensee responded to this concern by stating, in the July 22, 1986 letter, that fire damage to valve operators will not prevent the valve operators from being manually turned.

A further staff concern is that because not all fire areas are physically separated from adjoining locations by continuous fire-rated construction, fire propagation through non-rated boundaries might prevent operators from performing manual operations. However, where fire area boundaries are not completely fire-rated, the licensee indicates that 1) the areas on one or both sides of the boundary are protected by an automatic fire suppression system, or 2) the boundary wall or floor/ceiling forms a continuous non-combustible barrier to the propogation of fire, or 3) the adjoining area into which fire may spread is not relied upon for safe shutdown.

An additional concern is that the post-fire shutdown procedures and available personnel are adequate for the tasks to be performed. The licensee responded that procedures will be prepared in conformance with staff fire

protection guidance as provided in Generic Letters 81-12 and 86-10. The staff considers this response acceptable. However, the adequacy of these procedures will be confirmed during the Appendix R inspection.

The staff's remaining concern is that the manual actions required in locations outside the fire area could actually be accomplished within the maximum available time period stipulated by the licensee while a plant fire was underway. As previously stated, these time limits range from 20 minutes to 240 minutes. It is not possible to predict the nature of a fire event or the actions of plant operators during an emergency. However, the staff expects that a degree of uncertainty and confusion will exist and that time delays will occur in the implementation of manual actions. It is the staff's judgment that where manual actions, including valve alignment and pump control, are required less than 30 minutes after initial fire damage, an insufficient margin of safety exists to provide reasonable assurance that safe shutdown can be achieved and maintained. For those actions which must be taken beyond 30 minutes, the staff concludes that manual actions can be expected to be completed before an unrecoverable plant condition occurs. For those valves where manual action can be taken beyond 30 minutes, the staff concludes that the licensee's proposal represents an equivalent level of safety to that achieved by compliance with III.G.2.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the rule is to accomplish safe shutdown in the event of a single fire and maintain the plant in a safe condition. The rule requires fire protection for circuits and components associated with shutdown-related valves and pumps. However, certain

valves and pump controllers can withstand the effect of a fire and still be manually operated. Sufficient time exists to allow this manual operation and maintain the plant in a safe shutdown condition. Thus, the underlying purpose of the rule is satisfied allowing manual operation of these components. Additionally, the licensee argues that providing additional protection features, as required by the regulations, would not result in a significant increase in the level of protection provided and would result in undue hardship and costs significantly in excess of those incurred by others similarly situated. These costs consist of additional engineering, procurement of materials, fabrication, and installation costs.

3. III.G.2; exemption requested to allow use of fire-rated cable in lieu of a fire barrier around certain shutdown-related circuits in the following areas: AB-FZ-4 (Penetration Area), ISPH-FZ-1 (Intake Screen Pumphouse), ISPH-FZ-2 (Intake Screen Pumphouse), and FH-FZ-1 (Fuel Handling Building Area): The technical requirements of Section III.G are not met in Areas AB-FZ-4, ISPH-FZ-1, ISPH-FZ-2, and FH-FZ-1 because certain shutdown-related cables delineated in the licensee's Revision 7 of the FHAR and May 17, 1986 letter are not protected by a one-hour fire-rated barrier and would not be free of damage after being subjected to a fire.

The staff's concerns with the use of the fire-rated cable outside of containment are as follows:

(a) Functional Capability

The staff was concerned that the cable would not perform its intended function when exposed to the effects of a fire. In response, by letter dated June 9, 1984, the licensee submitted the results of a fire test conducted by

Underwriter's Laboratories, Incorporated. Representative samples of the cable were subjected to a one-hour fire endurance and hose stream test in accordance with the method in ASTM E-119. During the fire test and for a period of 93 hours beyond, electrical measurements were taken to confirm the cable's electrical performance. The results confirm that the acceptance criteria of ASTM E-119 were met or exceeded. The staff, therefore, has reasonable assurance that the cables will function as designed until the fire is extinguished.

(b) Mechanical Damage

The staff was concerned that the heat produced in a fire would cause structural features such as cable trays to collapse. The falling debris might impact the cable and cause its failure. In response, the licensee indicated that the four areas of concern are protected by a complete fire detection system that alarms in the control room. If a fire should occur, it would be detected in its formative stages before significant temperature rise occurs. The fire brigade would then extinguish the fire using manual fire fighting equipment. Additionally, if rapid fire propagation occurred, the available automatic sprinkler systems would actuate to suppress the fire and reduce room temperatures and thereby protect the shutdown-related cable and prevent debris formation. The staff, therefore, has reasonable assurance that the "fire-rated" cable will not be mechanically damaged by falling debris during a fire.

(c) Higher Temperatures in Cable Trays

In the proposed application, the "fire-rated" cable would be routed, in part, through cable trays containing conventional cable. The staff was concerned that a fire involving such cable would be more severe than the ASTM E-119 time-

temperature curve. The fire test previously discussed included a configuration containing conventional cable, and since satisfactory results were obtained, this concern is resolved.

(d) Applicable Cable Voltages

In the early fire tests, the conductors of the "fire-rated" cable were energized at 110 Vac. The staff was concerned that the cable would be used at higher voltages (e.g. 600V). Subsequent fire tests were performed with the conductors energized at 480 Vac and 960 Vac and satisfactory results achieved. Therefore, this concern has been resolved.

(e) Changes in Electrical Characteristics

The staff was concerned that the "fire-rated" cable would not provide the electrical performance characteristics that are necessary for successful operation in the various applications. For example, the "fire-rated" cable is proposed for power, control and instrumentation circuits. The electrical characteristics of the cable (i.e. conductor and insulation) will change with temperature increase. Thus, the insulation must be designed and the cable must be sized so that these changes do not affect the performance of the required function. The electrical performance criteria for each application (i.e. power, control or instrumentation) must be specified. The "fire-rated" cable must then be shown to meet these criteria to assure that changes in the electrical characteristics of the "fire-rated" cable during a fire will not affect circuit operation. In response, electrical performance criteria were provided in Section 3.0 of the FHAR. The staff concludes this response is acceptable.

(f) Post-Fire Operability

Because the fire-rated cable could be damaged by a fire, the staff was originally concerned that this damage would effect long-term performance of shutdown functions following a fire. However, because the licensee will install the cables outside of containment in areas completely protected by automatic fire detection and suppression systems, the staff concludes that any damage would be negligible and should not affect performance.

(g) Immersion Resistance

The staff was concerned that "wet short" conditions were not simulated in the "fire-rated" cable tests but cables in cable trays may be immersed in water for a significant time. The exemption request included only stainless steel sheathed cables and unsheathed cables in conduit. The staff concludes that such cables would not be subject to failure by "wet shorts," and this concern is considered resolved.

(h) Thermal Expansion Forces

The staff was concerned that thermal expansion forces and post-fire mechanical forces due to firefighting and recovery operations were not simulated. The licensee indicated, however, that for the distributed fire load in this area, a real fire would not result in temperatures approaching the ASTM E-119 time-temperature curve over a large portion of the fire area even if the automatic suppression system did not operate. Prompt action by the fire brigade and automatic suppression would further reduce the time-temperature curve. The staff, therefore, concludes that satisfactory results from the hose stream tests with repeated application of hose stream forces have resolved this concern.

(i) Post-Test Assessment of Operability

The staff was concerned that no post-test assessment of the operability of the "fire-rated" cables had been made. Subsequent tests have shown that the "fire-rated" cable can remain functional during the fire and for at least 94 hours thereafter. Therefore, this concern is resolved.

(j) Mechanical Damage Due to Delay in Automatic Suppression

The staff was concerned that if the automatic suppression system did not operate as designed for a rapidly developing fire, the "fire-rated" cable could be damaged by debris. In the staff's opinion, the probability of a severe, rapidly developing fire is low with the in-situ final configuration, and the cable would not be damaged even if automatic suppression was delayed. Therefore, this concern is resolved.

(k) Continuous Cable in Each Fire Area

The "fire-rated" cable should be continuous through the fire area (i.e., splices between "fire-rated" and non "fire-rated" cable should be made outside of the fire area boundaries). In the November 7, 1985 revision to the FHAR, the licensee stated that the "Rockbestos" cable will generally be continuous. Where joining within the fire area is required, the splices will be enclosed in terminal boxes protected by a one-hour fire barrier. On this basis, this concern is considered resolved.

(l) Long-Term Surveillance

The staff was concerned that for the life of the plant there would be no surveillance of the fire-rated cable comparable to that provided for fire-rated barriers. However, by letter dated July 22, 1986, the licensee committed to visually inspect the cable to verify its integrity whenever work is conducted

in the vicinity of the cable. The plant maintenance procedures which will be modified to incorporate this requirement were listed in the letter. On this basis, the staff considers this concern resolved.

Based on the above evaluation, the staff concludes that the use of "fire-rated" cable in a fire area with a distributed in-situ fire loading and protected by automatic suppression systems provides an equivalent level of safety to that achieved by installing a one-hour fire barrier per Section III.G.2.C of Appendix R.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The rule requires that redundant shutdown related systems be separated by a one hour fire-rated barrier and be free of fire damage. The underlying purpose of the rule is to accomplish safe shutdown in the event of a single fire and maintain the plant in a safe condition. This is accomplished by assuring that sufficient undamaged equipment is available to support safe shutdown assuming a fire within the area of concern. The use of fire-rated cable in a fire area with a distributed in-situ fire loading and protected by automatic suppression systems assures that the equipment involved will be available to accomplish its safe shutdown function in the event of a fire. Thus, the underlying purpose of the rule is achieved.

4. III.G.2; exemption requested to allow less than 20 feet of separation which is free of intervening combustibles between redundant shutdown systems in area AB-FZ-4 (Penetration Area): The specific concern for a fire in this area is failure of the reactor coolant pump seals due to loss

of both seal injection and thermal barrier cooling. Protection of either is sufficient to assure safe shutdown. In the June 4, 1984 Safety Evaluation, the staff granted an exemption in this area from the requirement to protect the required shutdown systems on the basis that sufficient time existed to perform manual actions to compensate for fire damage and provide adequate seal injection. However, by letter dated May 17, 1986, the licensee identified a shutdown scenario in which the time available for manual operation of valve MU-V14A (for seal injection) is "unacceptably short." Therefore, in order to assure reactor coolant pump seal integrity, the licensee reevaluated the availability of either seal injection through MU-V14A or thermal barrier cooling through IC-V3 for a fire in the area. The licensee concludes that one of these paths will be free of fire damage in order to ensure safe shutdown.

Protection of the cables for the above referenced valve operators in this fire area will be achieved using "Rockbestos" fire-rated cable. Despite these modifications, the valve operators for MU-V14A and its redundant counterpart, IC-V3, will not have a fire barrier between them. These valves are separated by a line-of-sight distance in excess of 33 feet.

The technical requirements of Section III.G.2 have not been met for the above referenced valves because even though the valve operators are separated by more than 33 feet, the intervening space contains combustible materials in the form of cables in trays.

The staff was concerned that in the event of a fire both valve operators would be damaged. However, the fire hazard between these valves consists of cable insulation. A fire involving cable insulation would

initially burn slowly with much smoke but with low heat release. The staff expects the existing fire detection system to actuate during the formative stages of the fire before serious damage would result. The fire brigade would be dispatched and would put out the fire using manual fire fighting equipment.

If the fire spread rapidly and a significant temperature rise occurred, the automatic sprinkler system would actuate to control the fire and to protect the valve actuators. Pending actuation of the system and/or arrival of the brigade, the horizontal distance between the valves provides reasonable assurance that no more than one valve would be damaged in the fire. Therefore, the presence of combustible materials in the intervening space between the valves is not significant.

Based on the plant conditions as described above, the staff concludes that the licensee's alternate fire protection configuration represents an equivalent level of safety to that achieved by compliance with Section III.G.2.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The rule requires that redundant shutdown related systems be separated by more than 20 feet free of intervening combustibles or fire hazards. The purpose of the rule is to assure that sufficient undamaged equipment is available to support safe shutdown assuming a fire within the area of concern. The twenty feet of separation free of intervening combustibles between redundant shutdown systems provides adequate time for the fire brigade to respond to a fire and protect at least one train. The 33 feet separating these redundant valves contains intervening combustibles in the form of cable insulation. Cable insulation initially

burns slowly with much smoke and low heat release. Existing fire detection systems would actuate during the formative stages of a fire allowing the fire brigade ample time to respond to the fire before both trains were lost. Thus, the underlying purpose of the rule is achieved.

5. III.G.2; exemption requested to allow manual operation in lieu of providing fire protection for certain cables associated with emergency feedwater system valves in area IB-FZ-8: The technical requirements of Appendix R are not met in this area because circuits for redundant emergency feedwater system valves are not protected per the options identified in Section III.G. As summarized in our evaluation in Exemption 2, on the basis that a fire which occurs in IB-FZ-8 will not spread such as to effect the manual operators for valves EF-V30A thru D, and on the basis that plant procedures and personnel are adequate to perform the necessary tasks within the time frame stipulated by the licensee, the absence of physical protection for these circuits is not significant.

The staff concludes that the licensee's alternate fire protection configuration provides an equivalent level of safety to that achieved by compliance with Section III.G. of Appendix R.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the rule is to accomplish safe shutdown in the event of a single fire and maintain the plant in a safe condition. The rule requires fire protection for circuits and components associated with shutdown-related valves and pumps. However, certain valves can withstand the effect of a fire and still be manually

operated. Sufficient time exists to allow this manual operation and maintain the plant in a safe shutdown condition. Thus, the underlying purpose of the rule is satisfied allowing manual operation of these components. Additionally, the licensee argues that providing additional protection features, as required by the regulations, would not result in a significant increase in the level of protection provided and would result in undue hardship and costs significantly in excess of those incurred by others similarly situated. These costs consist of additional engineering, procurement of materials, fabrication, and installation costs.

6. III.G.3; exemption requested from installing a fixed fire suppression system in the control room: The staff was concerned that if a fire of significant magnitude occurred, it would damage redundant shutdown systems and prevent the plant from achieving and maintaining safe shutdown conditions. However, the area is equipped with a smoke detection system as described in the FHAR. If a fire were to occur, it would be detected in its formative stages by this system or by the plant operators who are always present. The fire would be able to be suppressed before significant damage occurred by the use of portable fire fighting equipment.

If a significant fire resulted which would force control room evacuation, the licensee states that the plant can be safely shut down using the alternate shutdown capability which is independent of this fire area. Pending eventual fire extinguishment, the continuous fire-rated boundary construction of the control room would be able to confine the effects of the fire to the area of origin. Therefore, a fixed fire suppression system is not necessary to assure safe plant operation.

Based on the above evaluation, the staff concludes that the licensee's alternate fire protection configuration for the control room provides an equivalent level of safety to that achieved by compliance with Section III.G.3.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The rule requires the installation of a fixed fire suppression system in an area which has been provided with an alternate shutdown capability. The underlying purpose of the rule is to accomplish safe shutdown in the event of a single fire and maintain the plant in a safe condition. This is accomplished by assuring that sufficient undamaged equipment is available to support safe shutdown assuming a fire within the area of concern. The control room is continuously manned and has an installed smoke detection system. Thus, fires would be detected and extinguished in their formative stage. But in any event, the licensee has installed alternate shutdown capability which is independent of the control room. Thus, the underlying purpose of the rule is satisfied

7. III.J; exemption requested from installing eight-hour battery powered emergency lighting in certain locations of the reactor building and control room: The staff's concern in the reactor building containment was that a reliable means of illumination be provided, that the path of travel be unobstructed and easily traversed, that the valves requiring manipulation be accessible and that portable lighting would be adequate for the task.

During a visit to the plant on November 13, 1986, the staff walked down the route of travel to the valves and observed the valve locations in relation to the floor and possible obstructions. It is the staff's judgment

that because 1) the route of travel is open and unobstructed and does not require travel via ladders, 2) the valves are within reach when standing on the floor, and 3) two operators will be performing the tasks together, each carrying a portable light, the use of portable lighting is an acceptable alternative in this instance.

The staff's concern in the control room was that a fire outside the area, concurrent with a loss of offsite power would result in the loss of all emergency lighting in the room. However, because the licensee will protect cables and components of one of the three emergency power sources to the control room lighting in accordance with Section III.G.2, the staff has reasonable assurance that adequate emergency lighting will be available in the control room for a fire in any other area/zone.

Based on the licensee's commitments and plant conditions as described above, the staff concludes that the proposed alternate lighting will provide an equivalent level of illumination to that achieved by the installation of individual, fixed, eight-hour lighting units.

The special circumstances of 10 CFR 50.12 apply in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The regulations require individual eight-hour battery powered lighting units in areas required for safe shutdown and in access routes to such routes. The rule was designed to provide adequate, dependable lighting for operators under emergency conditions. For the control room, the protected lighting will be supplied power from the station batteries or the diesel generators. Both of these power supplies are dependable and

would supply power for more than eight hours. Thus, the underlying purpose of the rule is achieved. For the containment building, portable lighting vice fixed lighting will satisfy the underlying purpose of the rule because (1) a very minimum number of valves are involved, (2) there is easy access to and from the valves and the valve operators, and (3) a minimum of two operators each with a portable light would be sent to operate the valves. Additionally, the licensee argues that compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted. Specifically, providing additional permanently mounted emergency lighting units would not result in a significant increase in the level of plant safety and would result in undue costs for engineering, procurement of materials, fabrication, and installation.

For further details with respect to this action, see the licensee's letters requesting the exemptions and the NRC's evaluation dated December 30, 1986 , of the licensee's fire protection program, which are available for public inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C., and at the Government Publications Section, State Library of Pennsylvania, Education Building, Commonwealth and Walnut Streets, Harrisburg, Pennsylvania 17126.

IV.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, this exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. The Commission further determines that special circumstances, as

provided in 10 CFR 50.12(a)(2)(ii), are present justifying the exemption, namely that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. Specifics are discussed in each exemption request but in general the underlying purpose of the rule is to accomplish safe shutdown in the event of a single fire and maintain the plant in a safe condition. This is accomplished by assuring that sufficient undamaged equipment is available to support safe shutdown assuming a fire within the area of concern. In the areas for which an exemption is being requested, passive as well as active fire protection features assure that any single fire will not result in the loss of safe shutdown capability. These features include separation distance, fire barriers, sealed penetrations, water spray to preclude propagation, and manual actions. The fire protection features, in conjunction with low combustible loadings, provide a high degree of assurance that a single fire will not result in loss of safe shutdown capability. In addition, the special circumstances of 10 CFR 50.12(a)(2)(iii) apply on that compliance would result in costs that are significantly in excess of those contemplated when the regulation was adopted. Providing additional protection features, as would be required to meet the regulations, would not result in a significant increase in the level of protection provided and would result in undue costs for additional engineering, procurement of materials, fabrication, and installation. Accordingly, the Commission hereby grants the exemptions listed in Section III above from the requirements of 10 CFR 50, Appendix R.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this Exemption will have no significant impact on the environment (51 FR 45406).

This Exemption is effective upon issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Frank Schroeder, Acting Director
Division of PWR Licensing-B

Dated at Bethesda, Maryland
this 30th day of December, 1986.

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

ENCLOSURE 2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
FIRE PROTECTION EXEMPTIONS AND REVISED SAFETY EVALUATION OF THE
SAFE AND ALTERNATE SHUTDOWN CAPABILITY
METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER AND LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY
GPU NUCLEAR CORPORATION

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

1.0 INTRODUCTION

In the Nuclear Regulatory Commision's (the Commission or the staff) fire protection Safety Evaluation (SE) of June 4, 1984, two issues were considered as being open: 1) adequacy of fire area/zone boundary construction, and 2) adequacy of "partial" fire detection and suppression systems. In addition, a previously requested exemption from the requirement for automatic fire detection in area FH-FZ-2 was not evaluated. By letters dated October 30, 1984; February 11, and November 7, 1985; May 17, July 22, August 19, October 22, November 19 (two letters) and 20, 1986, GPU Nuclear Corporation (GPUN or the licensee) provided additional information on the Three Mile Island Nuclear Station, Unit No. 1 (TMI-1) fire protection program in general and the degree of conformance with Sections III.G, III.J, III.L, and III.O of Appendix R, in particular. Included in this information were requests for approval of a number of exemptions from the technical requirements of Sections III.G and III.J of Appendix R. Also included was a revised description of the safe shutdown and alternate shutdown capabilities as well as answers to several staff requests for additional information.

The staff's evaluation of this information is contained in this report as follows: Sections 2.0 through 9.0 consist of the evaluation of specific exemption requests; Sections 10.0 and 11.0 are the evaluation of the licensee's response to the June 30, 1984 SE open items; Section 12.0 is the evaluation of the licensee's response to certain concerns raised by the staff during their review of the Novmeber 7, 1985, Revision 7 of the Fire Hazards Analysis Report (FHAR) and Safe Shutdown Evaluation; and, Section 13.0 constitutes a revision of the staff Safety Evaluation of the safe shutdown and alternate shutdown capabilities.

Section III.G.2 of Appendix R requires that one train of cables and equipment necessary to achieve and maintain safe shutdown be maintained free of fire damage by one of the following means:

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a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier;

b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet containing no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; and

c. Enclosure of cables and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

If these conditions are not met, Section III.G.3 requires an alternative shutdown capability independent of the fire area of concern. It also requires that a fixed fire suppression system be installed in the fire area of concern if it contains a large concentration of cables or other combustibles. These alternative requirements are not deemed to be equivalent; however, they provide equivalent protection for those configurations in which they are accepted.

Because it is not possible to predict the specific conditions under which fires may occur and propagate, the design basis protective features are specified in the rule rather than a design basis fire. Plant specific features may require protection different from the measures specified in Section III.G. In such a case, the licensee must demonstrate, by fire hazards analysis, that existing protection in conjunction with proposed modifications will provide a level of safety equivalent to the technical requirements of Section III.G of Appendix R.

In summary, Section III.G is related to fire protection features for ensuring that systems and associated circuits used to achieve and maintain safe shutdown are free of fire damage. Fire protection configurations must either meet the specific requirements of Section III.G or an alternative fire protection configuration must be justified by a fire hazard analysis.

Our general criteria for accepting an alternative fire protection configuration are the following:

- The alternative assures that one train of equipment necessary to achieve hot shutdown from either the control room or emergency control stations is free of fire damage.

- The alternative assures that fire damage to at least one train of equipment necessary to achieve cold shutdown will be limited such that it can be repaired within a reasonable time (minor repairs with components stored onsite).

- Modifications required to meet Section III.G would not enhance fire protection safety above that provided by either existing or proposed alternatives.

- Modifications required to meet Section III.G would be detrimental to overall facility safety.

2.0 AREA FH-FZ-2 (FUEL HANDLING BUILDING AT EL. 305 FEET)

2.1 Exemption Requested

The licensee requested approval of an exemption in this area from the technical requirements of Section III.G.2 to the extent that it requires the installation of an automatic fire detection system.

2.2 Discussion

This area is bounded by reinforced concrete walls, floor and ceiling as described in Section 4.7 of the FHAR. Penetrations of these boundaries are located and protected as described in Attachment 1.1 of the FHAR. Safe shutdown cables and equipment in this area are listed in Attachment 3-6 of the FHAR.

Combustible materials consist of cable insulation and transient materials with an average fire loading of about 21,000 BTU's/sq. ft.

Existing fire protection includes an automatic wet pipe sprinkler system, portable fire extinguishers and manual hose stations.

In Revision 7 to the FHAR, the licensee committed to enclose certain power and control cables in this area in a 1-hour fire-rated barrier. In addition, to prevent a fire in this area from initiating spurious signals to certain valves, the licensee also committed to replace existing control switches.

The licensee justified the exemption on the basis of the initial fire hazards, the existing fire protection and the proposed modifications.

2.3 Evaluation

The technical requirements of Section III.G.2 are not met in this area because of the lack of a fire detection system. In addition, certain cables associated with shutdown-related systems are not adequately separated or protected by a fire barrier. The latter condition is evaluated in Section 3.0 concerning manual valve realignment.

The staff's principal concern with the level of protection in this area was that a fire might propagate undetected and damage redundant, shutdown-related systems. However, the locations within the area which contain most of the combustible material and in which transient combustibles would most likely be found are protected by an automatic fire suppression system. If a fire of significant magnitude were to occur, the staff expects the suppression system to actuate. This

would cause an alarm to be visually and audibly annunciated in the control room. The fire brigade would be subsequently dispatched and would complete fire extinguishment using manual fire fighting equipment. Pending actuation of the suppression system and the arrival of the brigade, the above referenced fire barrier would provide adequate passive protection to one division of shutdown-related cables. For those cables which have not been physically separated or protected, the licensee has stated that sufficient time is available to manually operate valves to reestablish flow paths. These manual actions would be taken in areas that are isolated from the effects of a fire either by physical barriers or by automatic fire suppression systems. On this basis, the staff concludes that an acceptable level of protection has been provided for this area.

2.4 Conclusion

Based on the plant conditions and evaluation as summarized above, the staff concludes that the licensee's alternate fire protection configuration represents an equivalent level of fire safety to that achieved by compliance with Section III.G.2. Therefore, the licensee's request for exemption from the requirement for an automatic fire detection system in area FH-FZ-2 should be granted.

3.0 MANUAL ACTIONS - ALIGNMENT AND PUMP CONTROL

3.1 Exemption Requested

The licensee requested approval for an exemption from the requirements of Section III.G.2 of Appendix R in a number of plant areas (listed in the licensee's July 22, 1986 letter to the staff) to the extent that it requires fire protection for circuits and components associated with shutdown-related valves and pumps.

3.2 Discussion

The licensee identified a number of areas in which redundant cables and components associated with letdown valves, makeup valves, steam dump valves, steam supply valves, emergency feedwater valves, and the intermediate cooling water and nuclear service cooling water pumps are not protected per the fire protection options identified in Section III.G.2. The licensee states that if a fire damages these cables, sufficient time exists to manually align the valves and to manually control the pumps so as to achieve and maintain safe shutdown conditions. The time periods within which the licensee must accomplish these actions vary from 20 minutes for certain emergency feedwater system valves to 240 minutes for certain valves in the makeup system. The minimum time frame to establish local control of the intermediate cooling water pumps and the nuclear service cooling water pumps is 30 minutes.

3.3 Evaluation

The technical requirements of Appendix R are not met in the subject areas because cables and components for certain shutdown-related valves and pumps are not provided with fire protection in accordance with the options identified in Section III.G.

The staff has several concerns regarding the reliance on manual actions in lieu of physical protection of shutdown systems. The first is that plant operators may have to enter the fire area before it is reasonable to expect that habitable conditions may be restored after the fire. The licensee, in the July 22, 1986 submittal, identified a number of locations where safe shutdown can only be achieved by reentering the fire area to assure proper valve alignment. However, in no instance is it necessary to enter these areas before two hours after fire damage occurs. Although it is not possible to predict the nature and duration of a fire in any location, the staff expects that within one hour a fire would have been detected and controlled and near ambient conditions restored. This conclusion is based on the description of plant hazards and available protection as provided by the licensee in Revision 7 of the FHAR. These conditions will be confirmed during the Appendix R inspection. Nevertheless, the licensee's analyses indicate that an additional hour exists beyond the staff's assumptions. This results in a sufficient margin of safety to provide reasonable assurance that manual actions within the fire area can be achieved and, thus, this issue is considered resolved.

The staff was also concerned that fire damage to valve operators would prevent manual valve alignment. However, the licensee responded to this concern by stating, in the July 22, 1986 letter, that fire damage to valve operators will not prevent the valve operators from being manually turned. On that basis the staff considers this issue closed.

A further staff concern is that because not all fire areas are physically separated from adjoining locations by continuous fire-rated construction, fire propagation through non-rated boundaries might prevent operators from performing manual operations. However, as discussed in Section 10.0, where fire area boundaries are not completely fire-rated, the licensee indicates that 1) the areas on one or both sides of the boundary are protected by an automatic fire suppression system, or 2) the boundary wall or floor/ceiling forms a continuous non-combustible barrier to the propogation of fire, or 3) the adjoining area into which fire may spread is not relied upon for safe shutdown. On this basis, the staff considers this issue closed.

An additional concern is that the post-fire shutdown procedures and available personnel are adequate for the tasks to be performed. The licensee responded that procedures will be prepared in conformance with staff fire protection guidance as provided in Generic Letters 81-12 and 86-10. The staff considers this response acceptable. However, the adequacy of these procedures will be confirmed during the Appendix R inspection.

The staff's remaining concern is that the manual actions required in locations outside the fire area could actually be accomplished within the maximum available time period stipulated by the licensee while a

plant fire was underway. As previously stated, these time limits range from 20 minutes to 240 minutes. It is not possible to predict the nature of a fire event or the actions of plant operators during an emergency. However, the staff expects that a degree of uncertainty and confusion will exist and that time delays will occur in the implementation of manual actions. It is the staff's judgment that where manual actions, including valve alignment and pump control, are required less than 30 minutes after initial fire damage, an insufficient margin of safety exists to provide reasonable assurance that safe shutdown can be achieved and maintained. The staff concludes that in these cases, the vulnerable shutdown-related circuits and components should be provided with additional passive and/or active fire protection, or an alternate shutdown capability should be provided which is physically and electrically independent from the fire area. For those actions which must be taken beyond 30 minutes, the staff concludes that manual actions can be expected to be completed before an unrecoverable plant condition occurs. Therefore, the staff finds that credit cannot be granted for post-fire safe shutdown manual actions to be performed in less than 30 minutes.

3.4 Conclusion

Based on the above evaluation, the staff concludes that the protection provided for cables and components associated with the emergency feedwater valves EF-V-30A, through 30D; nuclear service river water valves NR-V-15A, 15B, 18, 19, and 32; and the intermediate cooling water and nuclear service cooling water pumps, does not ensure an equivalent level of protection to that achieved by compliance with Section III.G of Appendix R. Therefore, the licensee's request for exemption from the need to protect these components should be denied.

Based on the above evaluation, the licensee's alternate fire protection configuration for the remaining circuits identified in Section 3.0 of Revision 7 to the FHAR provides an equivalent level of safety to that achieved by compliance with Section III.G of Appendix R. Therefore, the licensee's request for exemption for these systems should be approved.

4.0 MANUAL ACTIONS - EF PUMP ROOM, DIESEL GENERATOR BUILDING AND CONTROL BUILDING VENTILATION

4.1 Exemption Requested

The licensee requested approval for an exemption from the requirements of Section III.G.2 of Appendix R to the extent that it requires fire protection for circuits associated with the emergency feedwater pump room, diesel generator building and control building ventilation systems.

4.2 Discussion

In Revision 7 to the FHAR and in a letter to the staff dated July 22, 1986, the licensee identified a number of locations where redundant circuits for the above referenced systems are not protected per the fire protection options identified in Section III.G. The licensee states that if the EF pump room ventilation was lost, portable ventilation would be established within two hours, and that, based on previous analyses, this is sufficient to reduce room temperatures to a level which would permit the pumps to operate indefinitely.

If the diesel generator building ventilation was lost, the licensee would induce air flow into the building by opening doors and relying upon the air flow created by the diesel radiator fan. These actions would have to be taken within one hour.

If the control building ventilation system was damaged by fire, the licensee proposes to rely upon manual actions utilizing portable fans to reestablish an adequate level of ventilation.

4.3 Evaluation

The technical requirements of Appendix R are not met in the above referenced areas because redundant circuits associated with the EF pump room, diesel generator building and control building ventilation systems which are required for post-fire safe shutdown are not protected per the fire protection options of Section III.G of the rule.

The staff has three principal concerns with the licensee's compensatory measures following fire damage to the ventilation systems' circuits. The first is that the time-temperature profiles accurately reflect post-fire conditions in the affected areas. The second is that the manual actions which the licensee will rely upon will actually result in restoration and/or maintenance of proper room temperatures. Based on the information provided to date, the staff was unable to confirm the validity of the licensee's analysis and the effectiveness of the compensatory actions.

The staff's remaining concern is that the post-fire shutdown procedures reflect all of the required actions that operators must take to compensate for the loss of these systems, and that sufficient manpower is available to accomplish these actions within the time limits identified by the licensee. As of this date, the licensee has not provided the staff with either the draft procedures or a summary which would confirm the acceptability of the proposed procedures.

4.4 Conclusion

Based on the lack of sufficient information to support the licensee's exemption request, the staff is unable to conclude that the alternate fire protection configuration represents an equivalent level of safety to that achieved by compliance with Appendix R. Therefore,

the licensee's request for exemption from the need to protect certain ventilation system circuits should be denied at this time. The licensee has indicated, however, that supplemental information will be provided in the future. The staff will review this information at that time.

5.0 FIRE-RATED ("ROCKBESTOS") CABLE

5.1 Exemption Requested

The licensee requested approval of an exemption from the requirements of Section III.G of Appendix R to 10 CFR 50 in four plant areas to the extent that it requires that redundant shutdown-related systems be separated by a 1-hour fire-rated barrier and be free of fire damage.

5.2 Discussion

By letter dated February 14, 1984, the licensee proposed to use Rockbestos fire-rated cable in lieu of installing 1-hour fire-rated barriers to protect certain shutdown-related circuits. At the staff's request, the licensee identified several locations in the plant where the use of the subject cable would represent a "worst-case" condition. A "sample" exemption request with supporting information was submitted by letter dated February 11, 1985. In a Safety Evaluation of this request dated July 22, 1985, the staff concluded that with adequate supporting information, the use of fire-rated cable could be shown to provide equivalent level of safety to that achieved by installing a 1-hour fire barrier per Section III.G.2 of Appendix R.

Subsequently, in Revision 7 of the FHAR, the licensee identified six areas where the use of Rockbestos cables was proposed. By letter dated November 19, 1986, the licensee withdrew area AB-FZ-5 from consideration. The remaining areas are:

a. Penetration area, AB-FZ-4;
b. Intake screen pumphouse, ISPH-FZ-1;
c. Intake screen pumphouse, ISPH-FZ-2;
d. Fuel handling building area, FH-FZ-1; and
e. Reactor building (containment).

These areas are bounded by reinforced concrete walls, floors and ceilings as described in Section 4.7 of the FHAR. Penetrations of the boundaries of these areas are located and protected as described in Attachment 1.1 of the FHAR. Safe shutdown cables and equipment in these areas are listed in Attachment 3-6 of the FHAR.

Combustible materials consist of cable insulation and various quantities and types of ordinary combustibles such as paper, plastic and wood. The combustible materials are dispersed throughout the areas so as not to produce a concentrated fire exposure hazard. The fire loading for the four areas where exemptions were requested are as follows:

AB-FZ-4, 52,822 BTU's/sq. ft.
ISPH-FZ-1, 15,854 BTU's/sq. ft.
ISPH-FZ-2, 16,020 BTU's/sq. ft.
FH-FZ-1, 29,697 BTU's/sq. ft.

The above locations are protected by area-wide fire detection systems and automatic fire suppression systems. Additional protection includes portable fire extinguishers and manual hose stations. The licensee proposed to implement the following modifications in addition to replacing conventional cable with the fire-rated cable:

- The manually actuated fire suppression system in AB-FZ-4 will be converted to an automatic pre-action-type system.
- Control scheme modifications as discussed in the FHAR will be made to prevent spurious operation of certain valves.
- Terminations of the protected cables in AB-FZ-4 will be protected by 1-hour fire-rated barriers.
- The 4160-volt power cable for the 1T switchgear will be protected in ISPH-FZ-1 with a 1-hour fire barrier.
- The 4160-volt power cable for the 1R switchgear will be protected in ISPH-FZ-2 with a 1-hour fire barrier.
- 4160-volt power cables for pump MU-P-1C, and 1T 480-volt switchgear, 480-volt cables for pump IC-P-1B, 1B ES screen house control center, dc control power cables for 1T switchgear and RC-RV-2, control cable for valve MU-V-16C and instrumentation cables will be wrapped with a 1-hour fire barrier in FH-FZ-1.

The licensee justified the exemption on the basis of the existing fire protection systems in the areas, the performance of the "Rockbestos" cable under fire tests and the response to specific staff concerns in the staff's July 22, 1985 Safety Evaluation.

5.3 Evaluation

The technical requirements of Section III.G are not met in Areas AB-FZ-4, ISPH-FZ-1, ISPH-FZ-2, and FH-FZ-1 because certain shutdown-related cables delineated in the licensee's Revision 7 of the FHAR and May 17, 1986 letter are not protected by a 1-hour fire-rated barrier and would not be free of damage after being subjected to a fire. The installation of fire-rated cable in the reactor building (containment) meets the requirements of Section III.G.2.f which requires that shutdown related cables be separated by a radiant energy shield.

The staff's concerns with the use of the fire-rated cable outside of containment are as follows:

5.3.1 Functional Capability

The staff was concerned that the cable would not perform its intended function when exposed to the effects of a fire. In response, by letter dated June 9, 1984, the licensee submitted the results of a fire test conducted by Underwriter's Laboratories, Incorporated. Representative samples of the cable were subjected to a 1-hour fire endurance and hose stream test in accordance with the method in ASTM E-119. During the fire test and for a period of 93 hours beyond, electrical measurements were taken to confirm the cable's electrical performance. The results confirm that the acceptance criteria of ASTM E-119 were met or exceeded. The staff, therefore, has reasonable assurance that the cables will function as designed until the fire is extinguished.

5.3.2 Mechanical Damage

The staff was concerned that the heat produced in a fire would cause structural features such as cable trays to collapse. The falling debris might impact the cable and cause its failure. In response, the licensee indicated that the four areas identified above outside containment are protected by a complete fire detection system that alarms in the control room. If a fire should occur, it would be detected in its formative stages before significant temperature rise occurs. The fire brigade would then extinguish the fire using manual fire fighting equipment. Additionally, if rapid fire propagation occurred, the available automatic sprinkler systems would actuate to suppress the fire and reduce room temperatures and thereby protect the shutdown-related cable and prevent debris formation. The staff, therefore, has reasonable assurance that the "fire-rated" cable will not be mechanically damaged by falling debris during a fire.

5.3.3 Higher Temperatures in Cable Trays

In the proposed application, the "fire-rated" cable would be routed, in part, through cable trays containing conventional cable. The staff was concerned that a fire involving such cable would be more severe than the E-119 time-temperature curve. The fire test previously discussed included a configuration containing conventional cable, and since satisfactory results were obtained, this concern is resolved.

5.3.4 Applicable Cable Voltages

In the early fire tests, the conductors of the "fire-rated" cable were energized at 110 Vac. The staff was concerned

that the cable would be used at higher voltages (e.g. 600V). Subsequent fire tests were performed with the conductors energized at 480 Vac and 960 Vac and satisfactory results achieved. Therefore, this concern has been resolved.

5.3.5 Changes in Electrical Characteristics

The staff was concerned that the "fire-rated" cable would not provide the electrical performance characteristics that are necessary for successful operation in the various applications. For example, the "fire-rated" cable is proposed for power, control and instrumentation circuits. The electrical characteristics of the cable (i.e. conductor and insulation) will change with temperature increase. Thus, the insulation must be designed and the cable must be sized so that these changes do not affect the performance of the required function. The electrical performance criteria for each application (i.e. power, control or instrumentation) must be specified. The "fire-rated" cable must then be shown to meet these criteria to assure that changes in the electrical characteristics of the "fire-rated" cable during a fire will not affect circuit operation. In response, electrical performance criteria were provided in Section 3.0 of the FHAR. They will be confirmed during the Appendix R inspection. On the basis of the above described design of the cabling, this concern is considered resolved.

5.3.6 Post-Fire Operability

Because the fire-rated cable could be damaged by a fire, the staff was originally concerned that this damage would effect long-term performance of shutdown functions following a fire. However, because the licensee will install the cables outside of containment in areas completely protected by automatic fire detection and suppression systems, the staff concludes that any damage would be negligible and should not affect performance. This issue is, therefore, considered resolved.

5.3.7 Immersion Resistance

The staff was concerned that "wet short" conditions were not simulated in the "fire-rated" cable tests but cables in cable trays may be immersed in water for a significant time. The exemption request included only stainless steel sheathed cables and unsheathed cables in conduit. The staff concludes that such cables would not be subject to failure by "wet shorts," and this concern is considered resolved.

5.3.8 Thermal Expansion Forces

The staff was concerned that thermal expansion forces and post-fire mechanical forces due to firefighting and recovery operations were not simulated. The licensee indicated, however, that for the distributed fire load in this area, a real fire would not result in temperatures approaching the E-119 time-temperature curve over a large portion of the fire area even if the automatic suppression system did not operate. Prompt action by the fire brigade and automatic suppression would further reduce the time-temperature curve. The staff, therefore, concludes that satisfactory results from the hose stream tests with repeated application of hose stream forces have resolved this concern.

5.3.9 Post-Test Assessment of Operability

The staff was concerned that no post-test assessment of the operability of the "fire-rated" cables had been made. Subsequent tests have shown that the "fire-rated" cable can remain functional during the fire and for at least 94 hours thereafter. Therefore, this concern is resolved.

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5.3.10 Mechanical Damage Due to Delay in Automatic Suppression

The staff was concerned that if the automatic suppression system did not operate as designed for a rapidly developing fire, the "fire-rated" cable could be damaged by debris. In the staff's opinion, the probability of a severe, rapidly developing fire is low with the in-situ final configuration, and the cable would not be damaged even if automatic suppression was delayed. Therefore, this concern is resolved.

5.3.11 Improved Separation

The staff suggested that it would be prudent to provide improved separation (i.e., better than required by Regulatory Guide 1.75) between the "fire-rated" cable and its redundant counterpart. However, based on the above evaluation, the staff concludes that lack of improved separation would not be safety significant. This issue is resolved.

5.3.12 Continuous Cable in Each Fire Area

The "fire-rated" cable should be continuous through the fire area (i.e., splices between "fire-rated" and non "fire-rated" cable should be made outside of the fire area boundaries). In the November 7, 1985 revision to the FHAR, the licensee stated that the "Rockbestos" cable will generally be continuous. Where joining within the fire area is required, the splices will be enclosed in terminal boxes protected by a 1-hour fire barrier. On this basis, this concern is considered resolved.

5.3.13 Long-Term Surveillance

The staff was concerned that for the life of the plant there would be no surveillance of the fire-rated cable comparable to that provided for fire-rated barriers. However, by letter dated July 22, 1986, the licensee committed to visually inspect the cable to verify its integrity whenever work is conducted in the vicinity of the cable. The plant maintenance procedures which will be modified to incorporate this requirement were listed in the letter. On this basis, the staff considers this concern resolved.

5.4 Conclusion

Based on the above evaluation, the staff concludes that the use of "fire-rated" cable in a fire area with a distributed in-situ fire loading and protected by automatic suppression systems provides an equivalent level of safety to that achieved by installing a 1-hour fire barrier per Section III.G.2.C of Appendix R. Therefore, the licensee's request for exemption in the four areas outside of the reactor building where the "Rockbestos" cable will be installed should be granted.

6.0 CONTROL ROOM

6.1 Exemption Requested

The licensee requested approval of an exemption from the technical requirements of Section III.G.3 of Appendix R to 10 CFR 50 for the control room to the extent that it requires the installation of a fixed fire suppression system in an area which has been provided with an alternate shutdown capability.

6.2 Discussion

This area is bounded by walls, floor and ceiling of reinforced concrete. Entrance to the control room is through 3-hour fire-rated, Class A doors. All penetrations through the area boundaries are sealed with 3-hour fire-rated seals. The HVAC ducts which penetrate the boundaries are provided with 3-hour rated fire dampers. The window in the shift superintendent's office is protected by a 3-hour sliding fire door. Redundant safe shutdown cables and components located in the control room are identified in Attachment 3-6 of the FHAR. Because these redundant systems cannot be protected per the fire protection options of Section III.G.2, the licensee states that an alternate shutdown capability which is physically and electrically independent of this area and which conforms with Section III.L of Appendix R has been provided to compensate for loss of shutdown systems.

Combustible materials consist of cable insulation and transient materials. The fire load for the control room is about 55,000 BTUs/sq. ft.

Existing fire protection includes an automatic halon fire suppression system for the computer subfloor area and cable trench which is actuated by smoke detectors in the subfloor area, smoke detectors located inside safety-related control consoles and panels, portable fire extinguishers, and manual hose stations.

The licensee justifies the exemption on the basis of the existing fire protection capability and the constant attendance by control room operators.

6.3 Evaluation

The technical requirements of Section III.G.3 are not met in this area because of the lack of a fixed fire suppression system. The staff was concerned that if a fire of significant magnitude occurred, it would damage redundant shutdown systems and prevent the plant from achieving and maintaining safe shutdown conditions. However, the area is equipped with a smoke detection system as described in the FHAR. If a fire were to occur, it would be detected in its formative stages by this system or by the plant operators who are always present. The fire would be able to be suppressed before significant damage occurred by the use of portable fire fighting equipment.

If a significant fire resulted which would force control room evacuation, the licensee states that the plant can be safely shut down using the alternate shutdown capability which is independent of this fire area. Pending eventual fire extinguishment, the continuous fire-rated boundary construction of the control room would be able to confine the effects of the fire to the area of origin. Therefore, a fixed fire suppression system is not necessary to assure safe plant operation.

6.4 Conclusion

Based on the above evaluation, the staff concludes that the licensee's alternate fire protection configuration for the control room provides an equivalent level of safety to that achieved by compliance with Section III.G.3. Therefore, the licensee's request for exemption from the requirement for a fixed fire suppression system should be granted.

7.0 PENETRATION AREA AB-FZ-4

7.1 Exemption Requested

The licensee requested approval of an exemption request from the technical requirements of Section III.G.2 of Appendix R to 10 CFR 50 for penetration area AB-FZ-4 to the extent that it requires that redundant shutdown systems be separated by more than 20 feet free of intervening combustibles or fire hazards.

7.2 Discussion

The specific concern for a fire in this area is failure of the reactor coolant pump seals due to loss of both seal injection and thermal barrier cooling. Protection of either is sufficient to assure safe shutdown. In the June 4, 1984 Safety Evaluation, the staff granted an exemption in this area from the requirement to protect the required shutdown systems on the basis that sufficient time existed to perform manual actions to compensate for fire damage and provide adequate seal injection. However, by letter dated May 17, 1986, the licensee identified a shutdown scenario in which the time available for manual operation of valve MU-V14A (for seal injection) is "unacceptably short." Therefore, in order to assure reactor coolant pump seal integrity, the licensee reevaluated the availability of either seal injection through MU-V14A or thermal barrier cooling through IC-V3 for a fire in the area. The licensee concludes that one of these paths will be free of fire damage in order to ensure safe shutdown.

Protection of the cables for the above referenced valve operators in this fire area will be achieved using "Rockbestos" fire-rated cable as evaluated in Section 5.0 of this Safety Evaluation. Despite these modifications, the valve operators for MU-V14A and its redundant counterpart, IC-V3, will not have a fire barrier between them. These valves are separated by a line-of-sight distance in excess of 33 feet.

The physical description of this area, including combustible materials and available fire protection, is provided in Section 5.0 of this Safety Evaluation.

The licensee justifies the exemption on the basis of the low fire loading, existing fire protection and proposed modifications.

7.3 Evaluation

The technical requirements of Section III.G.2 have not been met for the above referenced valves because even though the valve operators are separated by more than 33 feet, the intervening space contains combustible materials in the form of cables in trays.

The staff was concerned that in the event of a fire both valve operators would be damaged. However, the fire hazard between these valves consists of cable insulation. A fire involving cable insulation would initially burn slowly with much smoke but with low heat release. The staff expects the existing fire detection system to actuate during the formative stages of the fire before serious damage would result. The fire brigade would be dispatched and would put out the fire using manual fire fighting equipment.

If the fire spread rapidly and a significant temperature rise occurred, the automatic sprinkler system would actuate to control the fire and to protect the valve actuators. Pending actuation of the system and/or arrival of the brigade, the horizontal distance between the valves provides reasonable assurance that no more than one valve would be damaged in the fire. Therefore, the presence of combustible materials in the intervening space between the valves is not significant.

7.4 Conclusion

Based on the plant conditions as described above, the staff concludes that the licensee's alternate fire protection configuration represents an equivalent level of safety to that achieved by compliance with Section III.G.2. Therefore, the licensee's request for exemption from the requirement for more than 20 feet of separation, free of intervening combustibles or fire hazards, between valves MU-14A and IC-V3 should be granted.

8.0 INTERMEDIATE BUILDING AREA IB-FZ-8

8.1 Exemption Requested

The licensee requested approval of an exemption from Section III.G of Appendix R to 10 CFR 50 for intermediate building area IB-FZ-8 to the extent that it requires that redundant shutdown circuits be provided with fire protection per the options listed in Section III.G.2.

8.2 Discussion

In the November 7, 1985 Revision 7 to the FHAR, the licensee identified a number of locations where redundant circuits were not protected per Appendix R criteria and where manual actions will be taken to compensate for fire damage. These conditions were evaluated in Section 3.0 of this SE. By letter dated May 17, 1986, the licensee summarized a new approach to Appendix R in several areas. This approach results in an additional area of nonconformance. Area IB-FZ-8 contains cables for redundant emergency feedwater valves EF-V30A through EF-V30D. The circuits are not separated by more than 20 feet free of fire hazards or by a fire-rated barrier. The area is also not protected by an automatic fire suppression system. The licensee justifies the exemption on the basis of being able to manually align the valves, which are located in a separate fire area, within two hours after damage occurs.

8.3 Evaluation

The technical requirements of Appendix R are not met in this area because circuits for redundant emergency feedwater system valves are not protected per the options identified in Section III.G. As summarized in our evaluation in Section 3.0 of this SE, on the basis that a fire which occurs in IB-FZ-8 will not spread such as to effect the manual operators for valves EF-V30A thru D, and on the basis that plant procedures and personnel are adequate to perform the necessary tasks within the time frame stipulated by the licensee, the absence of physical protection for these circuits is not significant.

8.4 Conclusion

The staff concludes that the licensee's alternate fire protection configuration provides an equivalent level of safety to that achieved by compliance with Section III.G. of Appendix R. Therefore, the licensee's request for exemption from the requirement to protect the redundant emergency feedwater system valve circuits in this area should be approved.

9.0 EMERGENCY LIGHTING - REACTOR BUILDING AND CONTROL ROOM

9.1 Exemption Requested

The licensee requested approval of an exemption from the technical requirements of Section III.J of Appendix R to 10 CFR 50 to the extent it requires individual 8-hour battery powered lighting units in areas required for safe shutdown and in access routes to such areas.

9.2.1 Discussion (Reactor Building)

Access to the reactor building within eight hours is only required for a fire which causes spurious operation of one of three normally open valves, located in reactor building zone RB-FZ-1c, associated with the reactor coolant letdown cooler. Such a fire could potentially prevent alignment of the redundant valves to the letdown cooler. The licensee states that manual realignment is required within four hours to reestablish reactor coolant letdown. Portable lights dedicated for this purpose will be administratively controlled and maintained at the entrance to containment. Containment entry will be a planned activity by at least two operators to perform the above task.

The licensee justified the exemption on the limited circumstances which would compel containment entry, the difficulty of maintaining fixed lighting units in containment, the unobstructed path of travel to the valves, the accessibility of the valves and the reliance on two operators to perform the tasks required.

9.2.2 Discussion (Control Room)

Power for the control room lighting is presently supplied from three sources in the event of loss of off-site power. These are the Train A and Train B emergency diesel generators and the station batteries. Any of these sources would be able to provide power for at least eight hours. In any zone/area which contains cables or components for all three of these sources, the licensee proposes to protect one of the three system's cables or components by one of the fire protection options delineated in Section III.G.2.

The licensee justifies the exemption on the basis that the availability of an assured power source provides an equivalent level of emergency lighting to that required by Section III.J for the control room.

9.3 Evaluation

The technical requirements of Section III.J. of Appendix R are not met in the reactor building containment and the control room because fixed, individual 8-hour battery powered lighting units are not provided for safe shutdown.

The staff's concern in the reactor building containment was that a reliable means of illumination be provided, that the path of travel be unobstructed and easily traversed, that the valves requiring manipulation be accessible and that portable lighting would be adequate for the task. Because the portable lighting will be controlled and two operators each carrying a flashlight will enter containment, the licensee's alternate lighting is considered to be sufficiently reliable.

During a visit to the plant on November 13, 1986, the staff walked down the route of travel to the valves and observed the valve locations in relation to the floor and possible obstructions. It is the staff's judgment that because 1) the route of travel is open and unobstructed and does not require travel via ladders, 2) the valves are within reach when standing on the floor, and 3) two operators will be performing the tasks together, the use of portable lighting is an acceptable alternative in this instance.

The staff's concern in the control room was that a fire outside the area, concurrent with a loss of offsite power would result in the loss of all emergency lighting in the room. However, because the licensee will protect cables and components of one of the three emergency power sources to the control room lighting in accordance with Section III.G.2, the staff has reasonable assurance that adequate emergency lighting will be available in the control room for a fire in any other area/zone.

9.4 Conclusion

Based on the licensee's commitments and plant conditions as described above, the staff concludes that the proposed alternate lighting will provide an equivalent level of illumination to that achieved by the installation of individual, fixed, 8-hour lighting units. Therefore, the licensee's request for exemption from the requirements of Section III.J of Appendix R in the reactor building containment and control room should be granted.

10.0 AREA-ZONE BOUNDARIES

In the June 4, 1984 Safety Evaluation, the staff expressed concern regarding the adequacy of the walls, floors and ceilings which constitute the boundaries of fire areas and zones at TMI-1. The staff stated that "boundaries defined by non-substantive, non-physical, logical divisions or equipment groupings cannot be expected to restrict fire and smoke spread." The licensee was requested to identify and justify every instance where a fire area/zone boundary was not fire-rated. The justification was to be based on criteria which were discussed in meetings with the licensee on June 2, and August 14, 1984, and May 1 and 2, 1986.

By letter dated October 30, 1984, in the November 7, 1985 Revision 7 to the FHAR, and by letter dated July 22, 1986, the licensee supplied additional information on this issue.
The licensee has divided the plant into fire areas and fire zones. However, the staff considers each zone to be an individual fire area for the purpose of determining Appendix R conformance. With this in mind, the licensee justified the adequacy of area/zone boundaries in the plant in accordance with the following criteria.

a. Boundaries which consist of fire-rated walls, floors or roofs with any opening or penetration protected by fire-rated doors, or dampers or penetration seals having a fire resistance equivalent to that of the rating of the barrier.

The staff concludes that where these boundaries exist and where the unmitigated fire loading, as represented by the ASTM E-119 time-temperature curve is less than the rating of the boundary with conservative margin, these boundaries conform with the guidelines of Appendix A to BTP APCSB 9.5-1, and Generic Letters 83-33 and 86-10, and are acceptable.

b. Boundaries which are not adjacent to other zones/areas, such as an outside wall. (Identified as A.1 boundaries).

The staff concludes that as long as these boundaries do not separate one division of shutdown systems from another or are not relied upon to separate inside plant areas from an external fire exposure hazard, these boundaries conform with the above-referenced guidelines and are acceptable.

c. Boundaries which are protected on one or both sides by an automatic fire suppression system (Identified as A.2 and A.3 boundaries respectively).

The staff concludes that an automatic fire suppression system which is designed in accordance with the applicable National Fire Protection Association standards and is inspected per the surveillance requirements of the Technical Specifications will provide reasonable assurance that fire propagation through the boundaries will not occur. Such boundaries conform with the guidance issued in Generic Letter 86-10.

d. Boundaries which consist of non-rated walls or floor/ceiling assemblies with penetrations sealed with non-combustible material (Identified as B.1 boundaries).

The staff concludes that where the fire loading on either side of the boundary is low and where the wall, floor and ceiling provide a continuous barrier to the passage of products of combustion, these boundaries will provide reasonable assurance that the effects of a fire will be confined to the area of origin. Such boundaries conform with the guidance issued in Generic Letter 86-10.

e. Boundaries not relied upon to separate or protect redundant trains of safe shutdown cables and equipment. (Identified as B.2 boundaries.)

The staff concludes that where: 1) a boundary wall or floor/ceiling does not separate shutdown systems in one area/zone from the redundant counterpart in an adjoining area/zone; 2) such boundaries do not separate shutdown systems from an area/zone containing components or cables from the alternate shutdown capability; and 3) such boundaries are not relied upon to prevent fire spread into adjoining areas/zones which must be entered to effect manual actions necessary for achieving and maintaining safe shutdown, then such walls and floor/ceiling assemblies are not significant from a fire safety standpoint and need not be continuous and/or fire-rated.

f. Partial non-rated barriers where adequate horizontal separation distance is provided between redundant shutdown systems and where vertical fire spread will not result in damage to redundant shutdown systems. (Identified as B.3 boundaries.)

The staff concludes that where: 1) at least 50 feet of horizontal distance exists between the non-rated barrier (boundary) and the cable or component of redundant or alternate shutdown systems; 2) the fire loading on either side of the barrier is low; and 3) the barrier is not relied upon to prevent fire spread into adjoining areas/zones which must be entered to effect manual actions necessary for achieving and maintaining safe shutdown, then such barriers are not significant from a fire safety standpoint and need not be continuous and/or fire-rated.

During the staff's review of the licensee's submittals concerning this issue, a number of questions/concerns were raised. The licensee responded to these concerns by letter dated July 22, 1986.

The staff was concerned that proposed modifications, such as re-routing cables, will be consistent with the assumptions regarding fire spread through "B-2" and "B-3" boundaries. The licensee responded to this concern by affirming that cables will not be re-routed into adjoining areas/zones if the boundary between these locations contains unprotected openings unless the re-routed cable comes no closer than 50 feet to its redundant counterpart. The staff finds this response acceptable.

The staff was concerned that in fire-rated barriers, all openings are protected by fire doors, fire dampers or penetration seals which have a fire resistance rating consistent with the rating of the barrier. The licensee responded that except for those features identified in Revision 7 of the FHAR as exceptions, all openings in fire-rated barriers are protected by equivalently rated doors, dampers, or penetration seals. These exceptions consist of reach rod penetrations, pipe penetrations, HVAC duct penetrations, steel hatch covers, a sheet metal wall, and bus duct penetrations. The staff considers these exceptions acceptable based on the criteria identified above for non-rated barriers. On this basis, this issue is considered closed.

The staff expressed concern that fire dampers may not close under design operating conditions (Ref. 10 CFR Part 21 notification concerning "Rusken" fire dampers). However, the licensee confirmed that all fire dampers are functionally tested every 18 months. If during testing a damper fails to close, the fire barrier is considered degraded per the plant Technical Specifications, and appropriate remedial action is taken. On this basis, the staff considers this issue closed.

The staff expressed concern that all barriers relied upon to prevent fire propagation may not be surveilled under the plant Technical Specifications. The licensee responded that all fire-rated as well as "B.1" barriers identified in the FHAR will be covered by the plant Technical Specifications. All other barriers will be under surveillance to assure that fire protection-related modifications are not degraded. On this basis, the staff considers this issue closed.

The staff expressed concern that new penetration seals may not be fire-rated. The licensee responded that where the FHAR calls for penetrations to be sealed with "non-combustible" material, the sealant will be qualified for a rating of at least one hour. The staff finds this response to be acceptable.

The staff requested confirmation that the new doors referenced in the FHAR will be 1-1/2-hour fire-rated, class B doors. In the July 22, 1986 letter, the licensee provided the required confirmation.

The staff will confirm during the Appendix R inspection that the area/zone boundary acceptance criteria, as described above, have been properly implemented by the licensee.

11.0 AREA-WIDE FIRE DETECTION AND SUPPRESSION

In the June 4, 1984 Safety Evaluation, the staff expressed concern that where fire detection and suppression systems were installed, they may not be installed throughout an area/zone. The licensee responded to this concern by letter dated July 22, 1986 stating that except where specifically identified in Revision 7 of the FHAR, detection and suppression systems are installed throughout individual areas/zones. The information presented in the FHAR indicates that there are no significant unmitigated fire hazards which would necessitate additional fire detectors or automatic fire suppression systems. This will be confirmed during the Appendix R inspection. On this basis, this issue is considered closed.

12.0 REACTOR BUILDING (CONTAINMENT)

The staff requested clarification as to the nature of the radiant energy shields which will be installed to protect vulnerable shutdown systems inside containment. The licensee responded in the July 22, 1986 letter that such shields will consist of either 1-hour fire-rated "Rockbestos" cable or 1/2-hour fire-rated TSI board. Openings in the TSI board will be located away from potential sources of radiant energy. The installation of radiant shielding will be implemented assuming that the reactor building is a single fire area. That is, the shielding will not terminate at the boundary of any of the six reactor building zones. The staff considers this response acceptable.

The staff expressed concern that the oil collection reservoirs for the reactor coolant pump (RCP) oil collection system are not sized to hold the oil from all of the RCPs. However, the licensee responded that the RCP lube oil system was seismically qualified and, as such, is capable of withstanding the safe shutdown earthquake. Generic Letter 86-10 states that only "random oil leaks" should be assumed to occur when the RCP lube oil system is seismically qualified. Therefore, the existing oil storage capacity is adequate and acceptable. This issue is considered closed.

13.0 SAFE SHUTDOWN AND ALTERNATE SHUTDOWN CAPABILITIES

13.1 Introduction

In the Safety Evaluation of June 4, 1984, the staff evaluated the adequacy and fire protection provisions for the normal safe shutdown capability and the alternate shutdown capability for the control room and relay room.

In the November 7, 1985 Revision 7 of the FHAR and in subsequent submittals dated July 22, October 22, and November 20, 1986, the licensee revised the approach toward assuring a safe shutdown capability following a fire in certain plant areas. Changes included reliance upon additional manual actions to compensate for fire-damaged cables and components, new modifications associated with the alternate shutdown capability, and new post-fire emergency shutdown procedures. The licensee indicated, in addition, that new information concerning their Appendix R compliance effort will be provided by February 1, 1987 following the NRC Region I Appendix R inspection. The following revisions to the staff's previous Safety Evaluation are based on information supplied by the licensee to date.

13.2 Systems Required for Safe Shutdown

Shutdown of the reactor and reactivity control would, initially, be performed by rod insertion from the control room. Reactor coolant inventory and long term reactivity control would be maintained by the makeup system. Primary system pressure control would be maintained by the pressurizer heaters or, if they were unavailable because of fire damage, by letdown flow and the makeup system. The pressurizer spray would be available for primary depressurization during cold shutdown. For a fire in every area except IB-FZ-3 and IB-FZ-8, decay heat removal during hot shutdown would be accomplished by the emergency feedwater system, main steam safety valves and atmospheric dump valves. For a fire in IB-FZ-3, which contains the motor driven emergency feedwater pumps, and IB-FZ-8, which is located below IB-FZ-3 and contains cables for emergency feedwater valves, decay heat removal would be accomplished for an interim period through high pressure injection cooling under the "feed and bleed" mode until the emergency feedwater system could be restored. In Revision 7 of the FHAR, the licensee stated that one reactor coolant pump (RCP) would be needed in this operating mode. However, because offsite power is assumed to be unavailable after a fire in accordance with Appendix R criteria, credit for use of an RCP cannot be granted. Instead, natural circulation of the primary coolant must be relied upon in hot shutdown. Decay heat removal during cold shutdown would be accomplished by the decay heat removal system, decay heat closed cooling water system, and decay heat river water system.

13.3 Area Where Alternate Safe Shutdown Is Required

In the June 4, 1984 SE, the staff indicated that an alternate shutdown capability would be provided for the control room and relay

room (cable spreading room). In Revision 7 of the FHAR, the licensee indicated that in addition to these areas, the requirements of Section III.G.2 could not be met in the ESAS room, area CB-FA-3c. For a fire in this area, the ESAS system may spuriously initiate the operation of shutdown components. The licensee states that the alternate shutdown capability will be utilized to compensate for damage in this area. The licensee has not identified ESAS cables and components by fire area, as was done for other systems. The licensee has also not provided the information requested in Generic Letter 81-12 to enable the staff to conclude that the alternate shutdown capability will provide an adequate shutdown means to compensate for fire damage in this area. Pending receipt and evaluation of this information, the adequacy of fire protection in the ESAS room is considered open.

13.4 Alternate Safe Shutdown System

The licensee's original alternate shutdown capability was based on the utilization of "A" train shutdown equipment using "A" channel electrical power. In Revision 7 of the FHAR, the licensee changed this design philosophy to reliance upon the "B" train systems. The alternate safe shutdown capability utilizes existing plant systems and equipment as identified in Section 13.2, remote shutdown stations and post-fire shutdown procedures. Remote shutdown stations consist of the following:

A. Remote Shutdown Transfer Switch Panels (RSTSP)

The "B" channel RSTSP is located on elevation 322 feet of the control building in area CB-FA-2B. The redundant "A" channel RSTSP is installed on elevation 338 feet 6 inches of the control building in area CB-FA-3C. For a fire in the control room, relay room, and ESAS room, the operators will close transfer switches on both of these panels to isolate control circuits and to transfer control of shutdown equipment to the Remote Shutdown Panel (RSP). Transfer from the "A" RSTSP is provided for convenience only since the "A" diesel generator is not electrically isolable.

B. Remote Shutdown Panel (RSP)

This panel provides the capability to monitor key process variables and to control the atmospheric dump valves and emergency feedwater pump. It is comprised of a red (Channel A) and a green (Channel B) panel. Separate panels containing signal conditioning and circuit isolation transfer switches are also provided for the functions at the RSP. The licensee committed to modify these panels to accommodate the additional controls, instruments, and indicators as described in their document "Division I, System Design Description for TMI-1 Remote Shutdown System."

C. Auxiliary Remote Shutdown Panel (Auxiliary RSP)

This panel contains control and indication for the secondary plant systems.

D. Diesel Generator B Remote Shutdown Panel

This panel is installed near the 1E-4160V ES switchgear to house the equipment relocated from the control room for diesel generator 1B.

E. Remote Shutdown Stations

These are areas in the plant, physically isolated from areas for which alternate shutdown is required where the operators will remotely operate a safe shutdown component via the use of a circuit isolation transfer switch because of postulated fire damage to the normal control capability.

During its review of the alternate shutdown capability, the staff expressed concern regarding a potential deficiency in the design of electric isolation as described in I&E Information Notice 85-09. The licensee responded to this concern by letter dated July 22, 1986. The licensee stated that the alternate shutdown system circuits for hot shutdown components at TMI-1 are designed to include redundant fuses. The transfer scheme is such that upon selecting the "alternate" mode via the transfer switch, the existing fuses are automatically bypassed and the redundant fuses are switched into the circuit through the transfer switch contacts. Therefore, the post-fire hot shutdown capability at TMI-1 does not rely upon any troubleshooting or repair procedures. Thus, the concern identified in the notice is not applicable to TMI-1.

As of this date, the licensee has not developed post fire safe shutdown procedures. The "guidelines for shutdown" in Revision 7 of the FHAR are not sufficient to permit the staff to conclude that safe shutdown conditions can be achieved and maintained with the manpower available and in the time limits stipulated by the licensee. In addition, these guidelines do not encompass a fire in IB-FZ-3 and make no distinction for a fire in the ESAS room.

The licensee also stated that a revised response to Generic Letter 81-12 will be submitted by February 1, 1987. Because this response will pertain to the alternate shutdown capability, the staff is unable to complete its review. For the above reasons, therefore, the staff considers the adequacy of the alternate shutdown capability to be open.

13.5 Section III.G.2 of Appendix R

The licensee stated that all other areas of the plant not required to have an alternate shutdown capability will comply with the requirements of Section III.G.2 of Appendix R, unless an exemption has been approved by the staff. The staff's evaluation of the

licensee's exemption requests is contained in the June 4, 1984 SE and in Sections 2.0 through 9.0 of this SE. For the remaining areas of the plant, where no exemptions have been requested, the licensee demonstrated in Attachments 3.5 and 3.5 of Revision 7 of the FHAR that the requirements of Section III.G.2 were met. However, the licensee has indicated that the information in these attachments is no longer current. Pending receipt and evaluation of the finalized version of these attachments, the staff's evaluation of this issue will remain open.

13.6 Associated Circuits And Isolation - Common Enclosures

Previously, the licensee stated that all associated circuits that share a common enclosure with shutdown circuits are provided with isolation devices. On this basis, the staff concluded that this issue was resolved. However, in Revision 7 of the FHAR and by letter dated July 22, 1986, the licensee indicated that the provision of electrical protection was confirmed by a statistical sampling of these circuits. A total of 59 circuits from a sample size of over 8,000 circuits were analyzed. The staff expressed a number of concerns with this methodology. These concerns related to the homogeneity of the statistical population, the randomness of the sample, and the impact of fire damage on inadequately protected circuits that might be overlooked by the analysis. The licensee has not responded to these concerns. Therefore, this issue is unresolved.

13.7 Conclusion

Based on the above, the staff considers the adequacy of the post-fire safe and alternate shutdown capabilities per Sections III.G and III.L of Appendix R to be open. The staff will report resolution of this issue in a supplement to this evaluation.

14.0 SUMMARY

In the June 4, 1984 Safety Evaluation, the staff granted exemptions from the requirements of Section III.G. of Appendix R in the following areas:

(1) Reactor Building Outside Secondary Shield, North (Zone RB-FZ-1a);
(2) Valve Gallery (Zone AB-FZ-3);
(3) Engineered Safeguards Motor Center B (Zone AB-FZ-6a);
(4) Control Building Health Physics and Lab Area (Zone CB-FA-1);
(5) Penetration Area (Zone AB-FZ-4);
(6) IR Switchgear Area (Zone ISPH-FZ-1);
(7) IT Switchgear Area (Zone ISPH-FZ-2);
(8) Demineralizers and MCC A (Zone AB-FZ-6);
(9) Valve Gallery and Penetration Room (Zone 1B-FZ-1);
(10) Motor Driven Emergency Feedwater Pump Area (Zone 1B-FZ-3);
(11) Decay Heat Removal and Nuclear Service Closed Cycle Cooling Pump Area (Zone AB-FZ-7);
(12) Heat Exchanger Vault (Zone AB-FZ-1); and
(13) General Area - Elevation 281 feet (Zone AB-FZ-5).

The adequacy of fire area/zone boundaries and the issue of area wide fire detection and suppression systems were left unresolved. In the November 7, 1985 Revision 7 to the FHAR, the licensee stated that the exemptions for RB-FZ-1a and AB-FZ-1 were no longer required. The remaining exemptions remain valid.

Based on its evaluation of the information submitted by the licensee since the issuance of the June 4, 1984 SE, the staff recommends that the following additional exemptions be granted:

1. Lack of automatic fire detection in area FH-FZ-2.

2. Certain manual valve alignments in lieu of protection of shutdown systems as described in Section 3.0 of this SE.

3. The use of a fire-rated cable in lieu of a fire barrier around certain shutdown-related circuits in the following areas:

   a. AB-FZ-4;
   b. ISPH-FZ-1;
   c. ISPH-FZ-2; and
   d. FH-FZ-1

4. Lack of a fixed fire suppression system in the control room.

5. Lack of 20 feet of separation free of intervening combustibles between redundant shutdown systems in area AB-FZ-4.

6. Lack of protection for cables associated with emergency feedwater system valves in area IB-FZ-8.

7. Lack of individual, 8-hour, battery powered emergency lighting in certain locations of the reactor building and in the control room.

The staff also concludes that, subject to confirmation of plant conditions during the Appendix R audit, the licensee's response to the open items from the June 4, 1984 SE are acceptable.

Based on its evaluation of the remaining exemption requests, the staff concludes that the licensee's alternate fire protection configuration does not provide an equivalent level of safety to that achieved by compliance with Appendix R. Therefore, the licensee's request for approval of the following exemption requests should be denied:

1. Certain manual valve alignments as described in Section 3.0 of this SE.

2. Manual control of the intermediate cooling water and nuclear service cooling water pumps.

3. Manual actions in conjunction with loss of ventilation systems.

The staff also concludes that the adequacy of the alternate shutdown capability and the review of the licensee's safe shutdown evaluation are open.