# A Reassessment of the James A. FitzPatrick Nuclear Power Plant for Conformance to the Requirements of Appendix R to 10 CFR 50

Power Authority of the State of
New York

Docket No. 50-333

July 13, 1982

TABLE OF CONTENTS

Appendices

## LIST OF FIGURES

LIST OF FIGURES (Cont'd)

## LIST OF TABLES

## 1.0 INTRODUCTION

With respect to fire protection concerns, the Commission required that Licensees reexamine those Configurations of Fire protection that do not meet the requirements as specified in 10CFR50 Appendix R Sections III.G. Based on this reexamination, Licensees must either meet the requirements of Section III.G. of Appendix R or apply for an exemption that justifies alternatives.

The Power Authority has performed an extensive reexamination of the J.A. FitzPatrick Nuclear Power Plant in accordance with 10CFR50 Appendix R. This study builds upon the previous review performed in accordance with Branch Technical Position APCSB 9.5-1 and documented in the Safe Shutdown Analysis dated October 1980 and submitted to the NRC on November 20, 1980. A document entitled "Appendix II to the Safe Shutdown Analysis" was submitted to the NRC on February 26, 1982. This submittal documented the reexamination performed in accordance with Appendix R. On May 10, 1982, the NRC staff indicated that a 60 day grace period was granted such that the Authority would insure completeness of the Appendix R, February 26, submittal.

To identify those areas for which the staff considers the Authority's submittal incomplete and further information or clarification would be needed, a meeting between Power Authority personnel and NRC staff was held on June 29, 1982. Based on the concerns raised by the NRC staff in this meeting, the Authority performed further reviews of the fire protection capability of the J.A. FitzPatrick plant. This report summarizes the results of these reviews. This report supplements the previous findings and superceeds in its entirety the Appendix R submittal of February 26, 1982.

In Section 2 of this report, the results of the reexamination are summarized. This section includes terms and assumptions used for the Appendix R reexamination. For each fire area, the requirement of Appendix R which are met are identified. Section 2 includes the exemption requests to the requirements of Appendix R as applicable to a fire area, action or assumptions identified.

The Power Authority has expended vast amounts of resources over a period of several years to upgrade the fire protection provisions for the J.A. FitzPatrick facility. A detailed historical overview of the fire protection effort has been included in Section 3.

The plant was divided into 68 fire areas. These areas have been described in the Safe Shutdown Analysis previously submitted to the NRC. For the purpose of Appendix R reevaluation, no change has been made to the fire zones previously identified except for those associated with the Turbine Building and the Reactor Building. The 3 fire zones in the Turbine Building were combined into one fire area for this analysis with no change in results from the previous submittal. The Reactor Building zones have been reidentified from 20 to 5 and are described in Section 4. The degree of compliance with Appendix R for all zones, except those for which alternate shutdown is provided, and the method of evaluation is also presented in Section 4. Conformance with the separation requirement of Section III.G.2 as supported by the exemption requests have been demonstrated for all the zones except the main control room, relay room and cable spreading area. For these three zones, since the separation criteria of section III.G.2 is not met, alternate shutdown is provided. The method of analysis and the alternate shutdown method are presented in Section 5. Also in Section 5, the response to Generic Letter 81-12 has been included as clarified by the NRC letter dated May 10, 1982. The information requested by this letter is provided to the extend that requested details are available.

Various appendicies provide additional information in support of the issues discussed throughout the report. Appendices A through E have not changed from those included in the February 26, 1982 submittal.

# 2.0 SUMMARY

## 2.1 Applicability of 10CFR50.48 and Appendix R to the James A. FitzPatrick Nuclear Power Plant.

The Nuclear Regulatory Commission published a final rule regarding fire protection programs for operating nuclear power plants in the November 19, 1980 FEDERAL REGISTER as an amendment to Title 10 of the Code of Federal Regulations, Part 50 (45 FR76602). This final rule, effective February 17, 1981, is applicable to the James A. FitzPatrick Nuclear Power Plant since the plant was licensed to operate prior to January 1, 1979. In essence, Appendix R to 10CFR50 established fire protection features to satisfy Criterion of Appendix A of 10CFR50 (General Design Criteria), while 10CFR50.48 itself describes schedules, reviews and exemption procedures. 10CFR50.48(b) further limits the applicability of Appendix R to three Sections (III.G, III.J and III.O) for plants licensed to operate prior to January 1, 1979.

Therefore only these three Sections of Appendix R to 10CFR50 apply to the FitzPatrick plant: III.G, III.J and III.O. This report limits itself to address only the requirements of these three sections.

1. Section III.G Specific Requirements, Fire Protection of Safe Shutdown Capability; applies in its entirety to the James A. FitzPatrick facility and is addressed in this report.

2. In accordance with Section III.J Specific Requirements, Emergency Lighting; the Authority submitted via letter dated June 22, 1981

(Reference 43) plans and schedules for the implementation of the requirements of this section.

3. Section III.0 Specific Requirements, Oil Collection System for Reactor Coolant Pump; does not apply, since the FitzPatrick plant's primary reactor containment is inerted during normal operation.

## 2.2 ASSUMPTIONS AND DEFINITIONS

### 2.2.1 Assumptions

The following are the assumptions and criteria for the FitzPatrick Plant analyses:

1. The only consequence of fire that is considered unacceptable is the inability to safely shutdown and maintain the plant in a safe shutdown mode.

2. It is assumed that:

   a. The reactor is operating at 100 percent power when a fire occurs.

   b. Only onsite emergency power is available for use in achieving safe shutdown.

   c. The reactor is isolated from the main condenser.

   d. There would be an automatic or manual scram at the direction of the Shift Supervisor to bring the reactor to hot shutdown.

3. It was assumed that there is a 72 hour period in which to achieve cold shutdown. During this 3-day period, credit may be taken for manual system operation, as well as for reasonable repairs, as specified in Appendix R.

4. No single or concurrent failures other than those directly attributable to the fire were considered.

5. It is assumed that for any fire in a given area, that the equipment identified as lost in the "Safe Shutdown Analysis" dated September 1979 and revised October 1980 is also lost in this study. This report addresses equipment which is outside the fire area but still within twenty feet of the area boundary and could be affected by a fire in light of the separation criteria of 10CFR50 Appendix R Section III.G.

6. Loss of a cable does not automatically mean loss of components connected to that cable. Each cable is evaluated to determine whether it is essential to the functioning of the components to which it is connected before it is concluded that the component is lost.

2.2.2 DEFINITIONS

1. Safe shutdown - hot shutdown or cold shutdown.

2. Hot shutdown - the reactor mode switch is in the shutdown position, and the average reactor coolant temperature is greater than 212°F. Note that when the mode switch is in the shutdown position the reactor has scrammed.

3. Cold shutdown - the reactor mode switch is in the shutdown position, and the average reactor coolant temperature is less than or equal to 212°F.

4. Fire Area - is an area which is protected by fire measures defined in Appendix R Section III.G.2(a), in order to prevent the propagation of fire to an area which contain redundant equipment or cable.

5. Fire zone - is considered a Fire Area due to the physical arrangement or fire protection measures which provide adequate assurance that a fire will not propagate across the boundary to adjacent fire zone.

6. Twenty (20) foot separation - as defined in Section III.G of Appendix R to 10CFR50 is the horizontal distance by which cables, equipment and associated non-safety circuits of redundant trains are required to be separated (with no intervening combustible or fire hazard and with fire detectors and an automatic fire suppression system installed in the fire area) if:

   (a) "The cables and equipment and associated non-safety circuits of redundant trains are not separated by a fire barrier having a 3-hour rating"; or

   (b) "The cables and equipment and associated non-safety circuits of one redundant train are not enclosed within a fire barrier having a 1-hour rating [with] fire detectors and an automatic fire suppression system installed in the fire area."

7. Associated circuit - Refer to Section 6.1.1.

## 2.3 SAFE SHUTDOWN MODEL

In order to safely shutdown the FitzPatrick Plant, the capability to perform the following four primary safe shutdown functions must be maintained:

1. Negative reactivity insertion - maintain the reactor in a subcritical condition with at least 1 percent $\Delta$ k/k margin.

2. Reactor vessel water level control - maintains water level at an acceptable level above the fuel.

3. Reactor coolant pressure control - maintains reactor coolant pressure.

4. Core cooling - removes the decay heat at hot and cold shutdown conditions as well as the sensible heat during the cooldown process. This heat is then transferred to the ultimate heat sink via the RHR Service Water System.

The safety-related systems that are capable of contributing to the performance of these functions are given below.

1. Negative Reactivity Insertion

   Systems capable of performing this function are the Reactor Protection or the Standby Liquid Control Systems. Each system is capable of achieving the shutdown margin using diverse methods.

2. Reactor Vessel Level Control

Systems capable of performing this function are the Reactor Core Isolation Cooling (RCIC) and High Pressure Coolant Injection (HPCI) systems or, under certain circumstances, the Low Pressure Coolant Injection (LPCI) or Core Spray (CS) systems in conjunction with the Automatic Depressurization System (ADS).

3. Reactor Coolant Pressure Control

Systems capable of performing this function are the RCIC, HPCI or ADS systems in conjunction with the steam condensing mode of the RHR system.

4. Core Cooling

Initial cooling is provided by the RCIC or HPCI systems, or by either the LPCI or CS system in conjunction with ADS. Extended cooling is accomplished by the shutdown cooling mode of the RHR system, or by the use of the LPCI or CS systems in conjunction with the suppression pool cooling mode of the RHR system.

Table 1.0 lists the components of all systems, both primary and auxiliary, which are essential to or are potentially useful in achieving safe shutdown.

Figures 4-12 and 5-1 show all modes of achieving safe shutdown using the primary systems named above. Any path from the top of the figure, beginning with reactor shutdown through extended cooling shown at the bottom of the figure, is a successful path to cold shutdown. The reactor can be maintained at a safe, stable, hot standby condition while maintenance or operator action allows for continued cooldown to cold shutdown. Support functions which must be performed in association with the above primary function are:

1. Motive power - power to operate safe shutdown equipment

2. Auxiliary cooling - provides an acceptable environment for safe shutdown equipment.

Systems which provide the support functions are listed below:

1. Motive power - steam for steam driven pumps from the Main Steam System and the Electrical Distribution System which comprises the Emergency Diesel Generators, the 4,160V AC buses, the 600V AC buses, the 120V AC buses and the 125V DC buses. Refer to Figure 2-14.

2. Auxiliary cooling - Figures 2-2 through 2-13 show the flow paths for the systems involved. Systems from which only a few components are needed (such as the suction and discharge valves of the Reactor Recirculation System) are not shown. For the Reactor Building Ventilation System, only the crescent area unit coolers are needed and a figure showing these is not included.

## 2.4 COMPLIANCE WITH SECTION III.G.1 REQUIREMENTS

The James A. FitzPatrick plant will meet or exceed the requirements of Section III.G.1 of Appendix R to 10CFR50 (Fire protection of safe shutdown capability) for all plant fire areas and zones upon completion of modifications and approval of exemption requests. Exemption from the requirements of this Section are being requested based upon a limited amount of low-voltage cable cutting, lifting of leads and/or fuse pulling. For the Control Room, Cable Spreading Room and Relay Room, III.G.1 is met by providing an alternate shutdown capability in accordance with III.G.3 and III.L or exemption requests. For all other areas, III.G.1 is met by providing separation in accordance with III.G.2 or exemption requests.

Table 2.0 summarizes, for each designated fire zone or area, what Section(s) of Appendix R are met and whether any exemption(s) has been requested for that fire zone or area.

## 2.5 COMPLIANCE WITH SECTION III.G.2 REQUIREMENTS

The James A. FitzPatrick plant will meet or exceed the requirements of Section III.G.2 of Appendix R to 10CFR50 (Fire protection of safe shutdown capability) for all plant areas/zones outside the Reactor Building. Exceptions to Appendix R requirements have been requested for the fire zones inside the Reactor Building.

Table 2.0 summarizes, for each designated fire zone or area, what section(s) of Appendix R are met and whether any exemption(s) has been requested for that fire zone or area.

## 2.6 COMPLIANCE WITH SECTION III.G.3 AND III.L REQUIREMENTS

The James A. FitzPatrick plant will meet or exceed the requirements of Section III.G.3 and III.L of Appendix R to 10CFR50 for the Control Room, Relay Room and Cable Spreading Room with alternate shutdown capability and exemption requests.

Table 2.0 summarizes, for each designated fire zone or area, what section(s) of Appendix R apply and whether any exemptions(s) have been requested for that fire zone or area.

## 2.7 Requests For Exemption

The Power Authority has reevaluated the fire protection features of the FitzPatrick plant for conformance to the specific requirements of 10CFR50 Appendix R. This section of the report contains the exemptions, from certain specific requirements of the rule, which the Authority is requesting as a result of this reevaluation. These exemptions are being requested in accordance with the provisions of 10 CFR 50.48(c)(6).

This section of the reevaluation report also contains requests for exemption from specific criteria which the NRC staff has established, but which are not included in the regulation. The Power Authority does not consider requests for exemptions from staff criteria, or the granting of them by the NRC staff, to be a legal requirement for compliance with the rule. Exemption requests of this kind are submitted to identify the methodology employed by the Authority in the analyses, to demonstrate that the Authority has considered criteria established by the staff, and to assist the staff in their evaluation of the completeness of the Authority's submittal.

Section 2.7.1 contains exemption requests which concern analytical methodology and therefore apply to the Authority's entire reevaluation.

Section 2.7.2 contains exemption requests which are specific to one or more identified fire areas.

## 2.7.1 Exemptions to the Rule Based on Methodology

### 2.7.1.1 Exemption Requests for 3 Phase AC and DC Power Circuits

The Power Authority requests an exemption from Section III.G.2 of Appendix R to 10 CFR 50, to the extent that this would require further analyses and modifications to provide protection against the extremely unlikely occurrence of a two conductor (DC) or three conductor (three phase AC) power cable being severed by a fire and then reconnecting to cause maloperation of systems or equipment.

This exemption is justified for three-phase power cables, because in order for a piece of equipment to be activated in forward or reverse, it would be necessary for two cables to become severed and then for those two cables to become connected, albeit in any combination. It would also require that one of the cables be connected to a power source and the other to a piece of equipment. This type of failure is considered to be incredible and is not considered in the analysis.

The second type of failure considered is two-wire power circuits (direct current). For the failure of such cables to cause equipment to activate, either of the following would have to occur:

a. The cables would have to be severed and then two wires of one connected to two wires of the other. It would also require that one of the cables be connected to a power source and the other to a piece of equipment.

b. The cable to the equipment in question would have to fail such that one wire goes to ground and the other hot shorts to another DC wire of the same polarity. If a ground exists on the battery of the opposite polarity (the grounded leg of the equipment), then the equipment would be activated.

While these sequences are not as unlikely as in the case of three-phase wires, they still are highly unlikely and are not considered in the analysis.

With repect to two-wire control circuits, it is considered credible that control wires will fail and short together and thereby give spurious control or information signals. These kinds of failures were considered in the analysis.

2.7.1.2 Exemption Request for Fuse Pulling and Lifting Leads etc.

The Power Authority requests an exemption from Section III.G.1.a, III.G.2, III.G.3 and III.L to the extent that repairs are considered to include low voltage fuse pulling, lifting of leads and cable cutting. The Power Authority specifically requests an exemption to allow these actions where identified in the Fire Area/Zone Summary Sheets and wherever the following are met:

a) The action to be taken is identified in the appropriate procedures;

b) The tools required are located at each locations where needed;

c) The fuse to be pulled, lead to be lifted or cable to be cut is clearly and indelible marked; and,

d) The action to be taken can be accomplished before an unrecoverable condition develops.

e) The electrical connections in question are of low voltage.

2.7.1.3 <u>Exemption Request for the Restoration of Offsite Power within 72 Hours</u>

The Power Authority requests an exemption from the requirements of III.L.4 and III.L.5 to the extent that if offsite power is lost, it must be restored within 72 hours. This request is justified by the following:

a) The existing onsite emergency power systems were originally designed to be of sufficient size to power, not only to equipment used for safe shutdown in the event of a fire, but to all existing safe shutdown equipment;

b) Sufficient fuel is on hand at all times to assure operation of the onsite emergency power systems for approximately 1 week; and,

c) Even in the event of a fire, additional fuel for the onsite emergency power systems is readily available from offsite locations.

### 2.7.2 Exemptions Concerning Fire Areas or Zones

#### 2.7.2.1 Exemption Request For Control Room Fire Suppression System

The Power Authority requests an exemption from Section III.G.2 and III.G.3 to the extent that area wide fire detection and a fixed suppression system are required to be installed in the Control Room.

This requirement is unnecessary to assure the capability to safely shutdown the plant, in the event of a fire in the Control Room for the following reasons:

(a) The plant can be safely shutdown, even in the highly unlikely event of the total loss of the Control Room, with the alternate shutdown system;

(b) The Control Room is occupied continuously by licensed operators;

(c) Combustibles such as furniture, paper and books are kept to a minimum;

(d) The suspended ceiling has a flame spread rating of less than 25;

(e) Fire detection is provided in Control Room panels;

(f) A hose station and $CO_2$ fire extinguishers are provided in the Control Room; and,

(g) There is a minimum amount of cable above the hung ceiling.

2.7.2.2 Exemption Request For Areas RB-1E and RB-1W

The Power Authority requests an exemption from the requirements of Sections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternate shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1E and RB-1W in the Crescent Area on Elevations 227'-6" and 242'-6" in the Reactor Building (Figure 4-6). The Authority specifically requests exemption from the requirement that these zones be separated by a 3 hour fire barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1E and RB-1W.

# FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA RB-1

## FIRE ZONE RB-1E

### Reactor Building - Crescent Area (East), Elev. 227'6"

I. Safe Shutdown Systems Disabled

All Division B shutdown systems are assumed disabled including RHR, Core Spray, HPCI, ESW, and manual ADS. RCIC System (Division A) is also assumed disabled.

II. Shutdown Capability

The following shutdown systems are available for safe shutdown:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A)

3. RHR (Division A) - LPCI, Suppression pool cooling and shutdown cooling modes.

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core

Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify and Required Manual Actions

1. Local manual operation of the following RHR System (Division A) valves may be required: 10MOV-25A, 10MOV-27A, 10MOV-39A, and 10MOV-38A.

2. Local manual operation of RHR valves required for the normal shutdown cooling mode of RHR for long term cooling may be required. Manual operation of the ADS (Division A) System and Core Spray will be used initially for achieving hot shutdown. This will provide sufficient time for the operators to manually operate the RHR valves mentioned above. The number of valves above are few and repositioning of the valve if necessary, manually, can be accomplished relatively easy.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

    a) Pump discharge pressure

    b) Loop flow

6. RHR System

    a) Pump discharge pressure

    b) Loop flow

7. RCIC System

    a) Pump discharge pressure

    b) Loop flow

8. RHR Service Water

    a) Flow

Notes:

RCIC System is assumed to be unavailable

V. Methods of Protecting Shutdown Capability

For fire zone RB-1E adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1W, and RB-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Fire Zones adjacent to RB-1E are zones RB-1W to the west and RB-1A above. The boundary with RB-1A is the Elevation 272' building floor which provides greater than a 3 hour rating. Piping and cable penetration sleeves through this floor are protected by 3 hour rated fire stops. A twenty foot area beyond the boundary between RB-1E and extending into RB-1W, was reviewed for potential effects on the safe shutdown path. This review showed that if the fire propagates up to 20 feet beyond the boundary of RB-1E it has no effect on the safe shutdown path. This is true except with the circuits identified in the exemption request presented in section 2.7.2.3.

b. Detection Systems - RB-1E and adjoining RB-1W and RB-1A are equipped with area ionization detectors which alarm in the

Control Room. There is also a heat actuated detector (HAD) system in the HPCI area enclosure for automatic water spray actuation.

c. Suppression Systems

| Type | Actuation | Location |
| --- | --- | --- |
| a. Water Spray | Automatic/Manual | HPCI Enclosure |
| b. Foam System | Manual | HPCI Enclosure |
| c. Hose Stations | Manual | Entire Crescent Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of section III.G.2 of Appendix R for the interface between this zone (RB-1E) and RB-1W to the west. The only intervening combustible is flame retardant cabling in trays which pass from RB-1E to RB-1W. This cabling has been assumed lost for the proposed shutdown path for this fire zone except for 5 cables for which an exemption is requested. Therefore the fire protection concern is only the presence of the intervening combustible.

   To mitigate this concern, the intervening cable trays which are located at, or within 20 foot seperation of redundant/diverse circuits or equipment, will be equipped with a water spray system to further mitigate postulated cable combustion. R
   The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

b. A fire barrier will be provided in the stairway area to mitigate the propagation of fire from zone RB-1E (El. 227) to zone RB-1A, (El. 272) above the stairway. The fire rating of this barrier

will be commensurate with the fire loading in the entire zone and its distance from the stairway area.

Attachment 1

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1W

Reactor Building-Crescent Area West-Elev. 227'6"

I. Safe Shutdown Systems Disabled

The following Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ESW, and RCIC. HPCI System (Division B) is also assumed to be disabled.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A or B) - manual mode.
2. Core Spray (Division B)
3. RHR (Division B) - LPCI, shutdown cooling, and suppression pool cooling modes.
4. ESW (Division B)
5. RHR Service Water (Division B)

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Divsion A or B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined up in the LPCI injection mode. If the Core Spray System, (Division B) is used for reactor coolant makeup and level control, RHR System (Division B) may be lined up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal cooling mode of the RHR System (Division B)

III. Identify And Justify Any Required Manual Actions

Local manual operation of the following RHR System (Division A) valves may be required: 10MOV-25B, 10MOV-27B, and 10MOV-17.

Local manual operation of RHR valves required for the normal shutdown cooling mode of RHR for long term cooling may be required.

Using ADS and core spray for initial shutdown cooling will provide sufficient time to manually operate the above valves.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow (Cable of this instrumentation will be rerouted from the fire to ensure its availability).

7. RHR Service Water

a) Pump flow

V. Methods Of Protecting Shutdown Capability

For fire zone RB-1W, adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1E, and RB-1B in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protecion

a. Fire Zone RB-1W is bounded by zones RB-1E to the east and RB-1B above. The boundary with RB-1B is the elevation 272' building floor which provides greater than a 3 hour rating. Piping and cable penetration sleeves through this floor are protected by 3 hour rated fire stops.

Within RB-1W, the RCIC turbine is completely enclosed within a room having a three-hour fire rating thus protecting all other equipment in this zone from this source of combustible material.

The stairwell from this zone to RB-1B is designed to provide a 3 hour fire rating.

b. <u>Detection Systems</u> - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room. There are also heat activated detector (HAD) systems in the RCIC area enclosure for automatic water spray actuation.

c. <u>Suppression Systems</u>

| | Type | Actuation | Location |
|---|---|---|---|
| 1. | Water Spray | Automatic/Manual | RCIC Enclosure |
| 2. | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operator and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

1. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1W) and (RB-1E) to the east. The only intervening combustible is flame retardant cabling in trays which pass from RB-1W to RB-1E. This cabling has been assumed lost for the proposed shutdown path for this fire zone except for 5 cables for which an exemption was requested. Therefore, the fire protection concern is only the presence of the interveining combustible.

To resolve this concern, the intervening cable trays which are located at, or within 20 foot separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near cable trays and the boundary of the zone.

2.7.2.3 Exemption Request For Separation of Circuits within Zones RB-1E and RB-1W

The Power Authority requests an exemption, from the requirements Sections III.G.2, III.G.3 and III.L of Appendix R to 10CFR50.3, to the extent that the separation criteria of III.G.2 or the alternate shutdown capability of III.G.3 and III.L would have to be met for Fire Zones RB-1E and RB-1W in the Crescent area on Elevations 227'-6" and 242'-6" in the Reactor Building (Figure 4-6). The Authority specifically requests exemption from the requirement to provide 20 foot separation between the following circuits:

Division B

1CSPBBC144 - Control to core spray valve, 10MOV-26B

Division A

1RNVARC255
1RNVCRC261
1RNVERC267 — Power to unit coolers 66UC-22-C, -E, -G, and -J
1RNVGRC273
1RNVJRC279

The area of interest is referred to as the "Crescent Area" containing the boundaries of fire zones RB-1E and RB-1W which join at column line T. The crescent area is shown in Figure 4-6. This area extends from Elevation 227 ft 6 in. to the ceiling beneath the floor at Elevation 272'. Within this area at column line T is a section referred to as the HPCI area which is bounded on the east and west by fire suppression system foam barrier walls. These walls extend approximately 8 ft vertically and are designed to maintain the foam associated with the HPCI area foam fire suppression system within the area of the HPCI turbine-pump unit. In addition to the manually-activated foam fire suppression system, there is an automatically-actuated water-spray fire suppression system.

The HPCI area is approximately 35 ft in length and approximately 20 ft in width. In the center of the HPCI area is a 29 ft by approximately 5-1/2 ft wide concrete pedestal upon which the HPCI turbine and pump are fixed. To either side of the HPCI pedestal there is an approximately 4 ft wide grating area for access over and around the HPCI turbine-pump unit. There is an additional 3 ft to 5 ft of access space between the grating and the surrounding walls.

In the southeast sector of the HPCI area is a unit cooler 66UC-22K, a Division B unit cooler. The bottom of the unit cooler is 19 ft above the floor and the top is 24 ft above the floor elevation. A second, redundant Division A unit cooler, 66UC-22A, also serving the HPCI area at the same elevation, exists in the northwest corner. Approximately 12 ft to the west of the western edge of unit cooler 66UC-22K is a Division A cable tray, 1TC593R.

Since the HPCI system and the unit coolers UC66-22K and A are not part of the alternate shutdown system for postulated fires in fire zones RB-1E and RB-1W, their system functions may be lost. The Appendix R separation review is between circuits that could be of the alternate shutdown system(s). In this instance it would not be between power cables to unit coolers 66UC-22A and K because their function of space cooling in the HPCI area is not required in the aftermath of an HPCI area fire.

Concern for separation in or near the HPCI area is proper between the circuits identified above. Cable 1CSPBBC144 is routed outside the HPCI area 2-1/2 ft east of the east foam barrier wall and 30 ft above the floor elevation. It exits into a tray 26 ft above the floor and runs east away from the HPCI area. The Division A cables noted above run in cable tray 1TC593R from an elevation 25 ft off the floor to an elevation 39 ft off the floor. This cable tray is located 25-1/2 ft west of 1CSPBBC144, approximately 23 ft west of the east foam barrier wall, above the HPCI pump, and 13-1/4 ft away from the nearest hot surface that could potentially be an ignition source for the HPCI system lubricating oil. The circuits listed above for components of opposite divisions are considered here as "redundant" to each other merely to indicate that the closest circuits potentially of the alternate shutdown system(s) are separated by more than 25 ft, i.e., greater than the specific separation distance of the Appendix R, Section III.G.2.

The effects of intervening combustibles between the two locations are mitigated due to the following:

a) The cables in tray 1TC591B are flame retardant;

b) The cables in tray 1TC591B are between 25 ft and 29 ft off the floor along the south wall of the HPCI compartment and are routed above large insulated pipes with diameters in excess of the tray width and are thus baffled from the effects of flame impingement from a postulated fire more than 25 feet below.

c) The lubricating oil in the HPCI system is normally contained within the lubricating oil system, and can only be ignited if its temperature rises above its flash point, i.e., above approximately 450°F. This could only happen if the oil is sprayed upon hot surfaces in the area. The lubricating oil system is not pressurized except during system operation and test. Thus, the lube oil system has the potential to spray lube oil from a postulated system break less than approximately 1 percent of the time (assuming three days of continuous HPCI operation and 24 hr of test per year, each a conservative assumption). Other hot surfaces exist only at two points within the HPCI, on the turbine shell and at the turbine control valve, which are generally away from the circuits of concern. When the HPCI turbine is shut down, the lubricating oil systems are not pressurized. A failure of the lube oil system piping under these cirumstances would result in a small amount of oil being drained to the floor area. Since there are no high temperature surfaces in the floor area, ignition of the lube oil would be unlikely.

Previously, in the August 3, 1978 response to an NRC request of April 5, 1978 for additional information, the Power Authority, in response to Question 24, discussed the potential for an HPCI lubricating oil fire. That response stated in part:

A failure of the HPCI turbine lube oil piping for an operating tubine would cause a loss of lubricating oil to the associated turbine bearing causing the unit to become inoperable. There are two circumstances which could cause a fire if this failure did occur:

1. This failure could cause the spraying of lubricating oil in the immediate area of the turbine. A fire could be initiated if the oil comes into contact with a surface at a temperature higher than its flash point (approximately 450°F). The steam supply piping to the turbine has the only surface which could be at a temperature higher than 450°F. Ignition of the lubricating oil by this piping is prevented by the metallic insulated covering which protects this piping.

2. Failure of the lubricating oil supply would cause overheating of the turbine bearings which could ignite lubricating oil in the turbine itself. Control Room annunciation of "HPCI TURBINE BEARING OIL LOW PRESSURE," "RCIC TURBINE OIL LOW PRESSURE," or "RCIC TURBINE COUPLING END BEARING HIGH TEMPERATURE" will inform the Control Room operator of a lube oil system failure. Prompt investigation and tripping of the turbine by operating personnel will prevent a fire from igniting.

d) Transient combustibles are unlikely to be present due to the nature of the area, i.e., a contaminated security area requiring proper authorization and preparation for access.

A "back calculation" was performed to examine the ability of the existing configuration to provide passive protection against a postulated fire involving the smallest quantity of fuel in the worst possible geometry and location. As was previously done, no credit was taken in the analysis for any other protection such as detection, automatic or manual suppression.

This analysis focused entirely on the smallest, worst-case fire necessary to exceed the damage criteria, i.e., electrical failure of cross-linked, polyethylene-insulated multiconductor cable with a neoprene jacket, for a single division. This approach was intentionally taken and understood to provide more limiting results than that anticipated for the case of failure of redundant divisions.

The postulated fire was assumed to involve a rupture in the HPCI lubricating oil system and the subsequent spontaneous ignition. Steady-state heat release rates were assumed to be achieved instantaneously and computer optimum techniques were employed to identify the smallest fuel volume and fire diameter necessary to exceed the failure criteria as a result of radiative and convective heat transfer.

Upon completion of this analysis it was determined that 35 gallons of lubricating oil would be necessary to exceed the damage criteria of a critical heat flux of $19 kW/m^2$ and a critical energy of $5560 kJ/m^2$. Such a fire would have to spread over an area of 98 $ft^2$ in and around the HPCI area in order to achieve this damage threshold. These results further imply that for the extremely limiting assumptions utilized in this model, it is not possible for lesser quantities of lubricating oil to exceed the cable damage criteria for this single division. Moreover, the physical limitations associated with the crescent area and the equipment layout within the area would preclude the simultaneous failure of both divisions solely as a result of an exposure fire involving lubricating oil.

In reality, one would expect the existing configuration to provide sufficient passive protection against even greater quantities of lubricating oil should one fully consider the mitigating effects of equipment and piping layouts, contact cooling and ventilation. These results suggest that a significant quantity of lubricating oil must be consumed by fire prior to loss of function of a single division. Loss of function for redundant divisions as a result of a lubricating oil fire is essentially precluded by room geometry.

Because of the realization of a potential for NRC staff concern with regard to the routing of the Division A circuits within the HPCI area, a supplementary quantitative fire hazards analysis was performed assuming a fire in the vicinity of the HPCI steam supply piping. The fire assumes a lube oil line rupture which sprays oil onto the steam supply line which is assumed to be unlagged and ignites the oil.

The location of this fire is approximately 8.5 ft horizontally from tray 1TC593R. At this point 1TC593R is approxmiately at its highest elevation of 39 ft off the floor. When 1TC593R is at its lowest elevation, 25 ft off the floor, the horizontal separation is approximately 14 ft. In reality, the lube oil fire would be expected to be confined to an area in the vicinity of the postulated unlagged steam supply piping which is on the north side of the HPCI pedestal. Tray 1TC593R is at its lowest point at the south wall, on the other side of the pedestal.

The following conclusions can be reached regarding the potential for fire within the HPCI area and the ability of the plant to withstand a fire in the HPCI area:

a) The quantity of transient and fixed combustibles within the area is generally low, resulting in low fire hazard.

b) Fire detection and suppression within the area, both automatic and remote manual, is more than adequate.

c) The plant's ability to withstand the effects of a fire within the area is excellent. More systems are available in the aftermath of a fire which is confined to HPCI area than in most other areas of the plant. For an HPCI area fire, the only system that would be likely to be directly disabled is the HPCI system itself.

d) Refer to exemption request in Section 2.7.2.2 for additional planned fire measures within the area of the Reactor Building.

Other analyses of fires in either fire zone RB-1E or RB-1W included essentially all the divisional equipment within that zone, plus the HPCI system. In the instance of a fire which is confined to the HPCI area, essentially all division equipment other than the HPCI system itself is available for postfire shutdown. The only reason that the HPCI area has been studied and evaluated in the depth and detail presented in this report, is because of the existence of a single Division A cable tray above the HPCI system near the boundary line of the two fire zones and the imposition of the additional separation requirements contained within Section III.G.2 of Appendix R. After the detailed reexamination as requested by Appendix R, the conclusion reached is that, for a fire in this particular area, the plant can safely achieve both hot standby and cold shutdown with a minimum of disruption of existing plant equipment.

The assumption of any damage beyond the HPCI system itself assumes a massive fire and thereby presumes some failure in both the detection system and the redundant and diverse suppression systems. Given the low probability of the existence of a transient combustible or a lubricating oil system failure, which would be required to initiate any form of major fire in the area, and then the additional low probability of redundant and diverse fire suppression systems failing; it is unlikely that any major fire could occur within the HPCI area which could have any significant adverse effect on either Division A or Division B safe shutdown systems. Additional fire suppression sprays with fusible heads will be installed along the boundary of the two zones. Water spray density will be sufficient to mitigate propagation of the fire across the boundary. On that basis, it is concluded that in fact substantially greater safe shutdown capability exists in the aftermath of an HPCI system fire than one would have concluded simply through the review of the previous Safe Shutdown Analysis.

Table 2.7.2.3 item B.2 indicates the safe shutdown systems available after a HPCI fire. That table indicates certain limitations on the availability of equipment and indicates local manual valve operation. In fact, it is believed that no local manual valve operation, with the exception of a Division B core spray valve, would be required.

The summary information presented in that table regarding safe shutdown systems is an abbreviated composite taken from the previous Safe Shutdown Analysis. In fact, most if not all divisional equipment, both A and B other than the HPCI system itself, should be available in the aftermath of an HPCI area fire.

For additional supporting information refer to Appendices A-F, and H.

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST

REACTOR BUILDING ELEV. 227'-6" HPCI AREA

EVALUATION PARAMETERS SUMMARY TABLE

A. Area Description

1. Construction

   a. North walls - 36 in. concrete - equal to or greater than 3 hr rating

   b. South walls - 42 in. concrete backed by grade

   c. East walls - Foam barrier wall - 8 in. concrete block, part height 8 ft

   d. West walls - Foam barrier wall - 8 in. concrete block, part height 8 ft

2. Ceiling height - 44 ft, 6 in.

3. Room volume - approx 35 ft x 44.5 ft x 20 ft = 31,150 $ft^3$

4. Ventilation - area unit coolers

5. Congestion - typically 3 ft to 5 ft of access around HPCI turbine-pump unit; manual large scale fire suppression would be from elevated platforms outside, but proximate to the area. General access for manual suppression is considered good.

B. Safe Shutdown Equipment

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST
REACTOR BUILDING ELEV. 227'-6" HPCI AREA
EVALUATION PARAMETERS SUMMARY TABLE - (Cont)

1. Redundant systems in area

   a. Division A electrical power cables to unit cooler UC-22-A, -C, -E, -G and -J; power cables are routed high above floor, i.e., 25 ft to 39 ft and are horizontally separated from assumed fire source by 13-1/4 ft to 8-1/2 f. (at 39 ft elevation off floor); power cables are not assumed lost due to effects of fire given vertical and horizontal separation from fire source.

   b. Division B - HPCI system (assumed lost due to fire)

2. Equipment in the HPCI area is not required for hot shutdown. The fire can be expected to be contained within the HPCI area north and south walls and the foam barrier walls. The following equipment outside the HPCI area, as a minimum, remains functional.

   a. ADS (Division A and B)

   b. Core Spray (Division A - local manual valve operations required; (Division B))

   c. RHR (Division A - suppression pool cooling; Division B - suppression pool cooling with local manual valve operation required)

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST
REACTOR BUILDING ELEV. 227'-6" HPCI AREA
EVALUATION PARAMETERS SUMMARY TABLE - (Cont)

d. RHR (Division A - shutdown cooling with local valve operation required; Division B - shutdown cooling)

e. ESW (Division A and B)

3. Type of equipment involved - HPCI system and associated unit coolers

C. Fire Hazards Analysis

1. Type of combustibles in area

a. HPCI system lubricating oil

b. Electrical cable which is flame retardant

2. Quantity of combustibles - the area generally contains very low quantities of combustibles material

a. 155 gal of oil in lubricating oil systems

b. Four trays, low cable density separated vertically and horizontally

3. Ease of ignition and propagation

a. Oil flash point (requires raising oil bulk volume temperature above 450 F)

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST
REACTOR BUILDING ELEV. 227'-6" HPCI AREA
EVALUATION PARAMETERS SUMMARY TABLE - (Cont)

b. Cable is neoprene-jacketed with cross-linked polyethylene insulation; cable is flame retardant.

4. Heat release potential

a. Lubricating oil

| | Heat Release Rate $kW/m^2$ |
|---|---|
| convective | 728 |
| radiative | 816 |
| actual | 1544 |

b. XLPE/Neoprene Cable

| | Heat Release Rate $KW/m^2$ |
|---|---|
| convective | 144 |
| radiative | 158 |
| actual | 302 |

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST
REACTOR BUILDING ELEV. 227'-6" HPCI AREA
EVALUATION PARAMETERS SUMMARY TABLE - (Cont)

5. Transient combustibles - essentially none; only limited quantities (16 to 32 fl oz) of solvents/degreasers used in HPCI maintenance. HPCI area, given its out-of-the-way location, is not a materials flow path or storage area. The probability of significant transient combustibles is very low.

6. Suppression damage to equipment - HPCI is assumed lost due to area fire. Additional suppression damage to HPCI system is not relevant. Foam barrier walls with contained fire suppression foam and/or water spary within area. Water spray damage potential to the equipment due to manual suppression is negligible to the confined area, completely separated from other safety-related equipment.

D. Fire Protection-Existing

1. Fire detection systems - smoke detection systems over and around HPCI turbine-pump pedestal

2. Fire Extinguishing Systems

   a. Automatically actuated water spray system

   b. Manually actuated foam fire suppression system

3. Hose Station Extinguisher

   a. Distance to hose station - 60 ft max

   b. Distance to fire extinguisher - immediate vicinity

TABLE 2.7.2.3-1 FIRE ZONES: RB-1 EAST AND RB-1 WEST
REACTOR BUILDING ELEV. 227'-6" HPCI AREA
EVALUATION PARAMETERS SUMMARY TABLE - (Cont)

4. Radiant Heat Shields

   a. The HPCI steam supply piping is lagged, thus minimizing the potential that sprayed lube oil could be raised to its flash point and become a source of combustible material.

   b. The cable trays in the area which are routed along the south wall are above large insulated pipes (approx 36 in. in diameter), steel plates and/or the steel casing of unit cooler UC-22K, all of which will act as flame impingement baffles and minimize the potential for any piloted ignition of these cables.

5. Sprays with fusible heads will be provided for cable trays which are located at, or within 20 foot seperation of redundant/diverse circuits or equipment. R

2.7.2.4 Exemption Request for Interface Between RB-1A and RB-1E Through Stairway

The Power Authority requests an exemption from the requirements of Section III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1E and RB-1A on Elevation 227'-6" and 272'-0" respectively in the Reactor Building. The Authority specifically requests exemption from the requirement that the two areas be separated by enclosing the stairway between them with a 3 hour fire barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1A and RB-1E.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. <u>Identify and Justify Required Manual Actions</u>

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

# FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA RB-1

## FIRE ZONE RB-1E

Reactor Building - Crescent Area (East), Elev. 227'6"

I. Safe Shutdown Systems Disabled

All Division B shutdown systems are assumed disabled including RHR, Core Spray, HPCI, ESW, and manual ADS. RCIC System (Division A) is also assumed disabled.

II. Shutdown Capability

The following shutdown systems are available for safe shutdown:

1. ADS (Division A) - manual mode.
2. Core Spray (Division A)
3. RHR (Division A) - LPCI, Suppression pool cooling and shutdown cooling modes.
4. ESW (Division A).
5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core

Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify and Required Manual Actions

1. Local manual operation of the following RHR System (Division A) valves may be required: 10MOV-25A, 10MOV-27A, 10MOV-39A, and 10MOV-38A.

2. Local manual operation of RHR valves required for the normal shutdown cooling mode of RHR for long term cooling may be required. Manual operation of the ADS (Division A) System and Core Spray will be used initially for achieving hot shutdown. This will provide sufficient time for the operators to manually operate the RHR valves mentioned above. The number of valves above are few and repositioning of the valve if necessary, manually, can be accomplished relatively easy.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Loop flow

6. RHR System

   a) Pump discharge pressure

   b) Loop flow

7. RCIC System

   a) Pump discharge pressure

   b) Loop flow

8. RHR Service Water

   a) Flow

Notes:

RCIC System is assumed to be unavailable

V. Methods of Protecting Shutdown Capability

For fire zone RB-1E adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1W, and RB-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Fire Zones adjacent to RB-1E are zones RB-1W to the west and RB-1A above. The boundary with RB-1A is the Elevation 272' building floor which provides greater than a 3 hour rating. Piping and cable penetration sleeves through this floor are protected by 3 hour rated fire stops. A twenty foot area beyond the boundary between RB-1E and extending into RB-1W, was reviewed for potential effects on the safe shutdown path. This review showed that if the fire propagates up to 20 feet beyond the boundary of RB-1E it has no effect on the safe shutdown path. This is true except with the circuits identified in the exemption request presented in section 2.7.2.3.

b. Detection Systems - RB-1E and adjoining RB-1W and RB-1A are equipped with area ionization detectors which alarm in the

Control Room. There is also a heat actuated detector (HAD) system in the HPCI area enclosure for automatic water spray actuation.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| a. Water Spray | Automatic/Manual | HPCI Enclosure |
| b. Foam System | Manual | HPCI Enclosure |
| c. Hose Stations | Manual | Entire Crescent Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of section III.G.2 of Appendix R for the interface between this zone (RB-1E) and RB-1W to the west. The only intervening combustible is flame retardant cabling in trays which pass from RB-1E to RB-1W. This cabling has been assumed lost for the proposed shutdown path for this fire zone except for 5 cables for which an exemption is requested. Therefore the fire protection concern is only the presence of the intervening combustible.

To mitigate this concern, the intervening cable trays which are located at, or within 20 foot seperation of redundant/diverse circuits or equipment, the zone boundary will be equipped with a water spray system to further mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

b. A fire barrier will be provided in the stairway area to mitigate the propagation of fire from zone RB-1E (El. 227) to zone RB-1A, (El. 272) above the stairway. The fire rating of this barrier

will be commensurate with the fire loading in the entire zone and its distance from the stairway area.

2.7.2.5 Exemption Request for Interface of Fire Zones RB-1A and RB-1B in El. 272'-0"

The Power Authority requests an exemption from the requirements ofSections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1A and RB-1B on Elevation 272'-0" in the Reactor Building. The Authority specifically requests exemption from the requirement that these zones be separated by a 3 hour fire barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1A and RB-1B.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify Required Manual Actions

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propa⁻⁻ ..g to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

FIRE AREA/ZONE SUMMARY

FIRE AREA RB-1

FIRE ZONE RB-1B

REACTOR BUILDING - ELEV. 272' (WEST SIDE) ELEV. 300' (SOUTHWEST QUADRANT)

I. Safe Shutdown Systems Disabled

1. Most Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ADS, and RCIC.

2. HPCI System (Division B) is also assumed to be disabled due to the postulated loss of control and power cables for HPCI steam supply valve 23MOV-16 which is located in adjacent fire zone RB-1A but less that 20 feet from the boundary.

3. Motor Control Center (MCC) 161 (Division B) is also postulated to be disabled due to proximity to this zone. Though this is a Division B electrical power supply, the loads that is supplies are not required to be electrically operable for a fire postulated for the fire zone.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division B) - manual modes

2. Core Spray (Division B).

3. RHR System (Division B) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW System (Division B).

5. RHR Service Water System (Division B)

6. HPCI Systems (Division B) - with certain manual valve actuations

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined-up in the LPCI injection mode. If Core Spray System (Division B) is used for reactor coolant makeup and level control, RHR Systems (Division B) may be lined-up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division B).

III. IDENTIFY AND JUSTIFY ANY REQUIRED MANUAL ACTION

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division B) and manual ADS (Division B) are utilized.

2. If the assumed loss of MCC 161 (Division B) occurs during the fire, manual actions must be taken to deenergize MCC 161 by opening its remote feeder breaker at substation L16 to preclude spurious actuation. In this case and RHR System operation is required, the

following valves must be operated manually: 10MOV-31B, 10MOV-12B, -89B, -166B, -167B, -148B, -149B, -70B, and -26B.

3. Manual operation of HPCI steam supply valve 23MOV-16, if it should be affected by the fire, will restore HPCI system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division B) in the shutdown cooling mode, which is the normal cold shutdown method.

## IV. NECESSARY INSTRUMENTATION AVAILABLE IN CONTROL ROOM

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core spray system
   a) Pump discharge Pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow
7. HPCI System
   a) Pump discharge pressure
   b) Injection flow
8. RHR Service Water
   a) Pump flow*

Notes:

* Cables for this instrumentation will be rerouted from the fire area to insure its availability.

V. METHODS FOR PROTECTING SHUTDOWN CAPABILITY

For fire zone RB-1B adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1A, RB-1C, and RB-1W in which the redundant / diverse shutdown systems and / cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour fire rated barrier satisfying the requirements of 10CFR50 Section III.G.2.a is provided at all zone boundaries with two exceptions which will be addressed as part of an exemption request supported by additional modifications. Piping and electrical penetration sleeves through these barriers are protected by 3 hour rated fire stops.

   b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main control room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev 272' at South West Boundary of RB-1B |
| Hose Station | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is assumed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones.

a. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested to from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A at the 272' elevation (south end). A three hour fire rated wall does not exist at this zone boundary although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the only fire protection concern is only the presence of an intervening combustible.

To resolve this concern, the interviewing cable trays which are located at, or within 20 feet separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable and the zone boundary.

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation

(south side). A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is relatively low. Therefore, the fire protection concern is only the presence of the intervening cable.

To resolve this concern, the intervening cable trays which are located at or within twenty feet separation of redundant/diverse equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the zone boundary.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A in the area of the stairway connecting between Elevations 300' and 326' (southwest corner). A three hour fire rated enclosure does not presently isolate this stairway.

The only requirement for fire protection at this zone boundary is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. Flame retardant cable is the nearest combustible to this stairway (approximately 30 feet away on Elevation 326 and approximately 40 feet away on Elevation 300). Therefore, additional protection is not considered necessary. Approval of this exemption is requested without additional modifications.

d. In order to prevent a fire in Zone RB-1B (elev. 272') from propagating to Zone RB-1C (Elev. 300') through the open hatch located in the northwest corner, a 3 hour rated plug is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2 since a fire barrier with a 3-hour rating is being provided.

2.7.2.6 Exemption Request for Interface Between Fire Zones RB-1B and RB-1C in Elevation 300'-0"

The Power Authority requests an exemption from the requirements of Sections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1B and RB-1C on Elevation 300'-0" in the Reactor Building. The Authority specifically requests exemption from the requirement that these areas be separated by a 3 hour fire barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1B and RB-1C.

FIRE AREA/ZONE SUMMARY

FIRE AREA RB-1

FIRE ZONE RB-1B

REACTOR BUILDING - ELEV. 272' (WEST SIDE) ELEV. 300' (SOUTHWEST QUADRANT)

I. Safe Shutdown Systems Disabled

1. Most Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ADS, and RCIC.

2. HPCI System (Division B) is also assumed to be disabled due to the postulated loss of control and power cables for HPCI steam supply valve 23M[illegible]-16 which is located in adjacent fire zone RB-1A but less that 20 feet from the boundary.

3. Motor Control Center (MCC) 161 (Division B) is also postulated to be disabled due to proximity to this zone. Though this is a Division B electrical power supply, the loads that is supplies are not required to be electrically operable for a fire postulated for the fire zone.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division B) - manual modes

2. Core Spray (Division B).

3. RHR System (Division B) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW System (Division B).

5. RHR Service Water System (Division B)

6. HPCI Systems (Division B) - with certain manual valve actuations

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined-up in the LPCI injection mode. If Core Spray System (Division B) is used for reactor coolant makeup and level control, RHR Systems (Division B) may be lined-up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division B).

III. IDENTIFY AND JUSTIFY ANY REQUIRED MANUAL ACTION

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division B) and manual ADS (Division B) are utilized.

2. If the assumed loss of MCC 161 (Division B) occurs during the fire, manual actions must be taken to deenergize MCC 161 by opening its remote feeder breaker at substation L16 to preclude spurious actuation. In this case and RHR System operation is required, the

following valves must be operated manually: 10MOV-31B, 10MOV-12B, -89B, -166B, -167B, -1 8B, -149B, -70B, and -26B.

3. Manual operation of HPCI steam supply valve 23MOV-16, if it should be affected by the fire, will restore HPCI system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division B) in the shutdown cooling mode, which is the normal cold shutdown method.

IV. NECESSARY INSTRUMENTATION AVAILABLE IN CONTROL ROOM

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core spray system
    a) Pump discharge Pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow
7. HPCI System
    a) Pump discharge pressure
    b) Injection flow
8. RHR Service Water
    a) Pump flow*

Notes:

* Cables for this instrumentation will be rerouted from the fire area to insure its availability.

V. METHODS FOR PROTECTING SHUTDOWN CAPABILITY

For fire zone RB-1B adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1A, RB-1C, and RB-1W in which the redundant / diverse shutdown systems and / cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour fire rated barrier satisfying the requirements of 10CFR50 Section III.G.2.a is provided at all zone boundaries with two exceptions which will be addressed as part of an exemption request supported by additional modifications. Piping and electrical penetration sleeves through these barriers are protected by 3 hour rated fire stops.

   b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main control room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev 272' at South West Boundary of RB-1B |
| Hose Station | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is assumed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones.

a. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested to from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A at the 272' elevation (south enc. A three hour fire rated wall does not exist at this zone boundary although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the only fire protection concern is only the presence of an intervening combustible.

To resolve this concern, the interviewing cable trays which are located at, or within 20 feet separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable and the zone boundary.

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation

(south side). A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is relatively low. Therefore, the fire protection concern is only the presence of the intervening cable.

To resolve this concern, the intervening cable trays which are located at or within twenty feet separation of redundant/diverse equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the zone boundary.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A in the area of the stairway connecting between Elevations 300' and 326' (southwest corner). A three hour fire rated enclosure does not presently isolate this stairway.

The only requirement for fire protection at this zone boundary is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. Flame retardant cable is the nearest combustible to this stairway (approximately 30 feet away on Elevation 326 and approximately 40 feet away on Elevation 300). Therefore, additional protection is not considered necessary. Approval of this exemption is requested without additional modifications.

d. In order to prevent a fire in Zone RB-1B (elev. 272') from propagating to Zone RB-1C (Elev. 300') through the open hatch located in the northwest corner, a 3 hour rated plug is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2 since a fire barrier with a 3-hour rating is being provided.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1C

Reactor Building-Elev. 300' (Northeast and Northwest Quadrants)

I. Safe Shutdown Systems Disabled

1. Most Division B Shutdown Systems are assumed to be disabled including RHR, Core Spray, ADS and RCIC.

2. Core Spray Division A is also disabled due to loss of injection valves 14-MOV-11A and B and 14-MOV-12A and B.

II. Shutdown Capability

The following Shutdown Systems are available:

1. ADS (Division A) Manual Mode from the Control Room

2. RHR System (Division A) Suppression Pool Cooling, shutdown cooling (with Manual operation of 10-MOV-18), LPCI (after injection valves have been powered from MCC153)

3. RCIC System - Manual Mode from the Control Room

4. ESW System (Division A)

5. RHR Service Water System (Division A)

Hot shutdown can be accomplished by manual Reactor depressurization using ADS Division A from the Control Room. High pressure makeup and level control can be provided by RCIC operation from the Control Room. Low

pressure Reactor coolant makeup and Level Control will be provided by RHR (Division A) LPCI Mode after injection valves have been powered from MCC153. Extended cooling can be provided by LPCI Heat Exchanger, Long term cooling can also be provided later by manual line-up of the RHR Shutdown Cooling mode after manual opening of 10-MOV-18.

III. Identify and Justify Any Required Manual Action

1. No manual operations are initially required in order to achieve the hot shutdown condition if ADS Division A and RCIC Division A are used. R

2. If the assumed loss of inverter 3A actually occurs LPCI operation can be restored by manually closing breaker OG2 in MCC163. R

3. Long term cooling in addition to LPCI Heat Exchanger may be provided by manually opening 10-MOV-18 if its control cables are actually affected. This will make RHR Shutdown Cooling available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Injection flow
   b) Pump discharge pressure
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1C adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B,-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle employed for reactor plant safety.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2 is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on additional modifications

assembled below. Piping and electrical penetration sleeves through these barriers are protected by 3 hours rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main Control Room.

c. Suppression Systems

| | Type | Actuation | Location |
|---|---|---|---|
| a | Water Spray | Manual | Above Cable Trays, Elev. 272' at south west boundary of RB-1B |
| b | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early indentification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V above.

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A. This request is the same as requested for RB-1A. A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary in this zone for this concern. R

Deleted

R

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A in the area of the connecting stairway between elevations 300' and 326' (northeast corner). This is the same request as for Zone RB-1A. A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are <u>not</u> required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and, an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1B on the 300' elevation. A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located within twenty feet of the zone boundary is relatively low. To resolve this concern, the intervening cable trays, which are located at or within twenty feet separation of redundant/diverse circuit or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the

intervening flame retardant cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

d. In order to prevent a fire in zone RB-1C Elev 300' from propagating to zone RB-1B Elev 272' through the open hatch located in the northwest corner, a plug with a 3 hour rating is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2.

2.7.2.7 Exemption Request for the Interface Between Fire Zones RB-1A and RB-1C in Elevation 300'-0"

The Power Authority requests an exemption from the requirements of Sections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1A and RB-1C on Elevation 300'-0" in the Reactor Building. The Authority specifically requests exemption from the requirement that these areas be separated by a 3 hour fire barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1A and RB-1C.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify Required Manual Actions

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C in the area of the connecting stairway between Elevations 300' and 326' (northeast corner). This is the same request for zone RB-1C. A three hour fire rated enclosure does not presently isolate the stairway. The only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation flcor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if .equired), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1C

Reactor Building-Elev. 300' (Northeast and Northwest Quadrants)

I. Safe Shutdown Systems Disabled

1. Most Division B Shutdown Systems are assumed to be disabled including RHR, Core Spray, ADS and RCIC.

2. Core Spray Division A is also disabled due to loss of injection valves 14-MOV-11A and B and 14-MOV-12A and B.

II. Shutdown Capability

The following Shutdown Systems are available:

1. ADS (Division A) Manual Mode from the Control Room

2. RHR System (Division A) Suppression Pool Cooling, shutdown cooling (with Manual operation of 10-MOV-18), LPCI (after injection valves have been powered from MCC153)

3. RCIC System - Manual Mode from the Control Room

4. ESW System (Division A)

5. RHR Service Water System (Division A)

Hot shutdown can be accomplished by manual Reactor depressurization using ADS Division A from the Control Room. High pressure makeup and level control can be provided by RCIC operation from the Control Room. Low

pressure Reactor coolant makeup and Level Control will be provided by RHR (Division A) LPCI Mode after injection valves have been powered from MCC153. Extended cooling can be provided by LPCI Heat Exchanger, Long term cooling can also be provided later by manual line-up of the RHR Shutdown Cooling mode after manual opening of 10-MOV-18.

III. Identify and Justify Any Required Manual Action

1. No manual operations are initially required in order to achieve the hot shutdown if ADS Division A and RCIC Division A are used.

2. If the assumed loss of inverter 3A actually occurs LPCI operation can be restored by manually closing breaker 062 in MCC163.

3. Long term cooling in addition to LPCI Heat Exchanger may be provided by manually opening 10-MOV-18 if its control cables are actually affected. This will make RHR Shutdown Cooling available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Injection flow
   b) Pump discharge pressure
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1C adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B,-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle employed for reactor plant safety.

1. Existing Fire Protection

a. Zone Boundaries - a three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2 is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on additional modifications

assembled below. Piping and electrical penetration sleeves through these barriers are protected by 3 hours rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main Control Room.

c. Suppression Systems

| | Type | Actuation | Location |
|---|---|---|---|
| a | Water Spray | Manual | Above Cable Trays, Elev. 272' at south west boundary of RB-1B |
| b | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early indentification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V above.

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A. This request is the same as requested for RB-1A. A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary in this zone for this concern. R

Deleted

R

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A in the area of the connecting stairway between elevations 300' and 326' (northeast corner). This is the same request as for Zone RB-1A. A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and, an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation . A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located within twenty feet of the zone boundary is relatively low. To resolve this concern, the intervening cable trays, which are located at or within twenty feet separation of redundant/diverse circuit or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the

intervening flame retardant cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

d. In order to prevent a fire in zone RB-1C Elev 300' from propagating to zone RB-1B Elev 272' through the open hatch located in the northwest corner, a plug with a 3 hour rating is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2.

2.7.2.8 Exemption Request for Interface Between Fire Zones RB-1A and RB-1C through Stairway

The Power Authority requests an exemption from the requirements of Sections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1A and RB-1C on Elevations 272'-0" and 300'-0" respectively in the Reactor Building through stairway. The Authority specifically requests exemption from the requirement that these areas be separated by enclosing the stairway between them with a 3 hour barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1A and RB-1C.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify Required Manual Actions

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

    a) Pump discharge pressure

    b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1C

Reactor Building-Elev. 300' (Northeast and Northwest Quadrants)

I. Safe Shutdown Systems Disabled

1. Most Division B Shutdown Systems are assumed to be disabled including RHR, Core Spray, ADS and RCIC.

2. Core Spray Division A is also disabled due to loss of injection valves 14-MOV-11A and B and 14-MOV-12A and B.

II. Shutdown Capability

The following Shutdown Systems are available:

1. ADS (Division A) Manual Mode from the Control Room

2. RHR System (Division A) Suppression Pool Cooling, shutdown cooling (with Manual operation of 10-MOV-18), LPCI (after injection valves have been powered from MCC153)

3. RCIC System - Manual Mode from the Control Room

4. ESW System (Division A)

5. RHR Service Water System (Division A)

Hot shutdown can be accomplished by manual Reactor depressurization using ADS Division A from the Control Room. High pressure makeup and level control can be provided by RCIC operation from the Control Room. Low

pressure Reactor coolant makeup and Level Control will be provided by RHR (Division A) LPCI Mode after injection valves have been powered from MCC153. Extended cooling can be provided by LPCI Heat Exchanger, Long term cooling can also be provided later by manual line-up of the RHR Shutdown Cooling mode after manual opening of 10-MOV-18.

III. Identify and Justify Any Required Manual Action

1. No manual operations are initially required in order to achieve the hot shutdown if ADS Division A and RCIC Division A are used.

2. If the assumed loss of inverter 3A actually occurs LPCI operation can be restored by manually closing breaker 062 in MCC163.

3. Long term cooling in addition to LPCI Heat Exchanger may be provided by manually opening 10-MOV-18 if its control cables are actually affected. This will make RHR Shutdown Cooling available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Injection flow
   b) Pump discharge pressure
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1C adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B,-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle employed for reactor plant safety.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2 is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on additional modifications

assembled below. Piping and electrical penetration sleeves through these barriers are protected by 3 hours rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main Control Room.

c. Suppression Systems

| | Type | Actuation | Location |
|---|---|---|---|
| a | Water Spray | Manual | Above Cable Trays, Elev. 272' at south west boundary of RB-1B |
| b | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early indentification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V above.

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A. This request is the same as requested for RB-1A. A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are <u>no</u> cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary in this zone for this concern. R

Deleted

R

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A in the area of the connecting stairway between elevations 300' and 326' (northeast corner). This is the same request as for Zone RB-1A. A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and, an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation . A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located within twenty feet of the zone boundary is relatively low. To resolve this concern, the intervening cable trays, which are located at or within twenty feet separation of redundant/diverse circuit or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the

intervening flame retardant cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

d. In order to prevent a fire in zone RB-1C Elev 300' from propagating to zone RB-1B Elev 272' through the open hatch located in the northwest corner, a plug with a 3 hour rating is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2.

2.7.2.9 Exemption Request for the Interface Between Fire Zones RB-1C and RB-1A through Stairway

The Power Authority requests an exemption from the requirements of Sections III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1C and RB-1A on Elevations 300'-0" and 272'-0" respectively in the Reactor Building. The Authority specifically requests exemption from the requirement that the zones be separated by enclosing the stairway between them with a 3 hour barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1C and RB-1A.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify Required Manual Actions

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

   a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

   Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1C

Reactor Building-Elev. 300' (Northeast and Northwest Quadrants)

I. Safe Shutdown Systems Disabled

1. Most Division B Shutdown Systems are assumed to be disabled including RHR, Core Spray, ADS and RCIC.

2. Core Spray Division A is also disabled due to loss of injection valves 14-MOV-11A and B and 14-MOV-12A and B.

II. Shutdown Capability

The following Shutdown Systems are available:

1. ADS (Division A) Manual Mode from the Control Room

2. RHR System (Division A) Suppression Pool Cooling, shutdown cooling (with Manual operation of 10-MOV-18), LPCI (after injection valves have been powered from MCC153)

3. RCIC System - Manual Mode from the Control Room

4. ESW System (Division A)

5. RHR Service Water System (Division A)

Hot shutdown can be accomplished by manual Reactor depressurization using ADS Division A from the Control Room. High pressure makeup and level control can be provided by RCIC operation from the Control Room. Low

pressure Reactor coolant makeup and Level Control will be provided by RHR (Division A) LPCI Mode after injection valves have been powered from MCC153. Extended cooling can be provided by LPCI Heat Exchanger, Long term cooling can also be provided later by manual line-up of the RHR Shutdown Cooling mode after manual opening of 10-MOV-18.

III. Identify and Justify Any Required Manual Action

1. No manual operations are initially required in order to achieve the hot shutdown if ADS Division A and RCIC Division A are used.

2. If the assumed loss of inverter 3A actually occurs LPCI operation can be restored by manually closing breaker 062 in MCC163.

3. Long term cooling in addition to LPCI Heat Exchanger may be provided by manually opening 10-MOV-18 if it~ control cables are actually affected. This will make RHR Sh ıown Cooling available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Injection flow
   b) Pump discharge pressure
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1C adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B,-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle employed for reactor plant safety.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2 is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on additional modifications

assembled below. Piping and electrical penetration sleeves through these barriers are protected by 3 hours rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main Control Room.

c. Suppression Systems

| | Type | Actuation | Location |
|---|---|---|---|
| a | Water Spray | Manual | Above Cable Trays, Elev. 272' at south west boundary of RB-1B |
| b | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early indentification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V above.

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A. This request is the same as requested for RB-1A. A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary in this zone for this concern. R

Deleted

R

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A in the area of the connecting stairway between elevations 300' and 326' (northeast corner). This is the same request as for Zone RB-1A. A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are <u>not</u> required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and, an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation . A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located within twenty feet of the zone boundary is relatively low. To resolve this concern, the intervening cable trays, which are located at or within twenty feet separation of redundant/diverse circuit or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the

intervening flame retardant cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

d. In order to prevent a fire in zone RB-1C Elev 300' from propagating to zone RB-1B Elev 272' through the open hatch located in the northwest corner, a plug with a 3 hour rating is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2.

### 2.7.2.10 Exemption Request for the Torus Room in the Reactor Building

The Power Authority requests and exemption from the requirements of Sections III.G.2, and III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for the Torus Room, Fire Area SU-1, in the Reactor Building.

The existing and proposed alternate protecting, technical basis, and justification for this exemption request are contained in the Fire Area/Zone Summary Sheet for SU-1.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA SU-1

Torus Room

I. Safe Shutdown Systems Disabled

No safe shutdown systems are assumed disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B Valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room. R

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure

b) Injection flow

7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection

Within this fire area there are no exposed sources of combustible materials, therefore the occurrence of a fire is not postulated. Flame retardant cables in this area are all enclosed in rigid conduit. Even though an individual cable may short electrically, it would not cause a fire since their would be essentially no oxygen to support combustion. This area has controlled access. It can be assured that no transient combustibles would be accidently brought in or stored in this area.

Additionally, the only equipment required in this area is the RHR Pump Suction Valves 10MOV151A & B which have had their power cables electrically disabled under a previously approved plant modification, and are in the open position. This ensures this flowpath will be available during a fire in any area.

2. Planned Additional Fire Protection

No additional fire protection is provided. An exemption request to the requirements of Appendix R, Section III.G.2, III.G.3 and III.L is provided based upon the existing installation as outlined above.

3. This area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

# FIRE AREA RB-1

## FIRE ZONE RB-1B

## REACTOR BUILDING - ELEV. 272' (WEST SIDE) ELEV. 300' (SOUTHWEST QUADRANT)

### I. Safe Shutdown Systems Disabled

1. Most Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ADS, and RCIC.

2. HPCI System (Division B) is also assumed to be disabled due to the postulated loss of control and power cables for HPCI steam supply valve 23MOV-16 which is located in adjacent fire zone RB-1A but less that 20 feet from the boundary.

3. Motor Control Center (MCC) 161 (Division B) is also postulated to be disabled due to proximity to this zone. Though this is a Division B electrical power supply, the loads that is supplies are not required to be electrically operable for a fire postulated for the fire zone.

### II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division B) - manual modes

2. Core Spray (Division B).

3. RHR System (Division B) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW System (Division B).

5. RHR Service Water System (Division B)

6. HPCI Systems (Division B) - with certain manual valve actuations

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined-up in the LPCI injection mode. If Core Spray System (Division B) is used for reactor coolant makeup and level control, RHR Systems (Division B) may be lined-up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division B).

III. IDENTIFY AND JUSTIFY ANY REQUIRED MANUAL ACTION

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division B) and manual ADS (Division B) are utilized.

2. If the assumed loss of MCC 161 (Division B) occurs during the fire, manual actions must be taken to deenergize MCC 161 by opening its remote feeder breaker at substation L16 to preclude spurious actuation. In this case and RHR System operation is required, the

following valves must be operated manually: 10MOV-31B, 10MOV-12B, -89B, -166B, -167B, -148B, -149B, -70B, and -26B.

3. Manual operation of HPCI steam supply valve 23MOV-16, if it should be affected by the fire, will restore HPCI system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division B) in the shutdown cooling mode, which is the normal cold shutdown method.

## IV. NECESSARY INSTRUMENTATION AVAILABLE IN CONTROL ROOM

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core spray system
   a) Pump discharge Pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow
7. HPCI System
   a) Pump discharge pressure
   b) Injection flow
8. RHR Service Water
   a) Pump flow*

Notes:

* Cables for this instrumentation will be rerouted from the fire area to insure its availability.

## V. METHODS FOR PROTECTING SHUTDOWN CAPABILITY

For fire zone RB-1B adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1A, RB-1C, and RB-1W in which the redundant / diverse shutdown systems and / cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle.

1. Existing Fire Protection

   a. Zone Boundaries - a three hour fire rated barrier satisfying the requirements of 10CFR50 Section III.G.2.a is provided at all zone boundaries with two exceptions which will be addressed as part of an exemption request supported by additional modifications. Piping and electrical penetration sleeves through these barriers are protected by 3 hour rated fire stops.

   b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main control room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev 272' at South West Boundary of RB-1B |
| Hose Station | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is assumed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones.

a. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested to from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A at the 272' elevation (south end). A three hour fire rated wall does not exist at this zone boundary although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the only fire protection concern is only the presence of an intervening combustible.

To resolve this concern, the interviewing cable trays which are located at, or within 20 feet separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable and the zone boundary.

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation

(south side). A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is relatively low. Therefore, the fire protection concern is only the presence of the intervening cable.

To resolve this concern, the intervening cable trays which are located at or within twenty feet separation of redundant/diverse equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the zone boundary.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A in the area of the stairway connecting between Elevations 300' and 326' (southwest corner). A three hour fire rated enclosure does not presently isolate this stairway.

300). The[illegible] Approval [illegible] necessary. [illegible] additional modifications.

d. In order to prevent a fire in Zone RB-1B ([illegible]) [illegible] propagating to Zone RB-1C (Elev. 300') through the open [illegible] located in the northwest corner, a 3 hour rated plug is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2 since a fire barrier with a 3-hour rating is being provided.

Attachment 9

The only requirement for fire protection at this zone boundary is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. Flame retardant cable is the nearest combustible to this stairway (approximately 30 feet away on Elevation 326 and approximately 40 feet away on Elevation 300). Therefore, additional protection is not considered necessary. Approval of this exemption is requested without additional modifications.

d. In order to prevent a fire in Zone RB-1B (elev. 272') from propagating to Zone RB-1C (Elev. 300') through the open hatch located in the northwest corner, a 3 hour rated plug is provided. This ensures compliance with 10CFR50 Appendix R, Section III.G.2 since a fire barrier with a 3-hour rating is being provided.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify Required Manual Actions

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feeder or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

   a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

   Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18 to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

2.7.2.11 Exemption request for the Interface Between Fire Zones RB-1B and RB-1A through Stairway

The Power Authority requests an exemption from the requirements of Section III.G.2, III.G.3 and III.L of Appendix R to 10 CFR 50, to the extent that the separation criteria of III.G.2 or the alternative shutdown capability criteria of III.G.3 and III.L would have to be met for Fire Zones RB-1B and RB-1A on Elevations 300'-0" and 326'-0" respectively in the Reactor Building through stairway. The Authority specifically requests exemption from the requirement that the zones be separated by enclosing the stairway between them with a 3 hour barrier.

The existing and proposed alternate protection, technical basis and justification for this exemption request are contained in the attached Fire Area/Zone Summary Sheets for RB-1B and RB-1A.

TABLE 2.0
APPENDIX R COMPLIANCE SUMMARY
by FIRE AREA

| No. | Name | Location | *Compliance with Appendix R | Exemption Request |
|---|---|---|---|---|
| 1 | RB-1E | Reactor Bldg. Crescent Area-East | Sect.III.G.2 | YES |
| 2 | RB-1W | Reactor Bldg. Crescent Area-West | Sect.III.G.2 | YES |
| 3 | RB-1A | Reactor Bldg. | Sect.III.G.2 | YES |
| 4 | RB-1B | Reactor Bldg. | Sect.III.G.2 | YES |
| 5 | RB-1C | Reactor Bldg. | Sect.III.G.2 | YES |
| 6 | CR-1 | Control Room | Sect.III.L | NO |
| 7 | RR-1 | Relay Room | Sect.III.L | NO |
| 8 | CS-1 | Cable Spreading Room | Sect.III.L | NO |
| 9 | MG-1 | Motor Generator Room Elev. 300'-0" | Sect.III.G.2.a | NO |
| 10 | AD-1 | Administration Bldg. Elev. 272'-0" | Sect.III.G.2.a | NO |
| 11 | AD-2 | Administration Bldg. Elev. 272'-0" | Sect.III.G.2.a | NO |
| 12 | AD-3 | Administration Bldg. Elev. 272'-0" | Sect.III.G.2.a | NO |
| 13 | AD-4 | Administration Bldg. Elev. 286'-0" | Sect.III.G.2.a | NO |
| 14 | AD-5 | Administration Bldg. Elev. 286'-0" | Sect.III.G.2.a | NO |
| 15 | AD-6 | Administration Bldg. Elev. 300'-0" | Sect.III.G.2.a | NO |
| 16 | CR-2 | Radwaste Control Room | Sect.III.G.2.a | NO |
| 17 | CT-1 | Cable Tunnel West-Elev. 260'0" | Sect.III.G.2.a | NO |
| 18 | CT-2 | Cable Tunnel East-Elev. 260'0" | Sect.III.G.2.a | NO |
| 19 | CT-3 | Cable Tunnel 3, Elev. 286'-0" | Sect.III.G.2.a | NO |
| 20 | CT-4 | Cable Tunnel 4, Elev. 286'-0" | Sect.III.G.2.a | NO |
| 21 | TB-1 | Turbine Bldg. | Sect.III.G.2.a | NO |
| 22 | RW-1 | Radwaste Bldg. and Pipe Tunnel | Sect.III.G.2.a | NO |
| 23 | SH-1 | Screen Well House-Elev. 272'-0" | Sect.III.G.2.a | NO |
| 24 | SW-1 | Switchgear Rm Elev. 272'-0" Turbine Bldg. | Sect.III.G.2.a | NO |
| 25 | SW-2 | Switchgear Rm Elev. 272'-0" Turbine Bldg. | Sect.III.G.2.a | NO |
| 26 | FP-1 | Diesel Fire Pump Room | Sect.III.G.2.a | NO |
| 27 | FP-2 | Foam Room Turbine Bldg.-Elev. 272'-0" | Sect.III.G.2.a | NO |
| 28 | SG-1 | Standby Gas Filter Room | Sect.III.G.2.a | NO |
| 29 | AS-1 | Auxiliary Boiler Room | Sect.III.G.2.a | NO |
| 30 | BR-1 | Battery Room No. 1 | Sect.III.G.2.a | NO |
| 31 | BR-2 | Battery Room No. 2 | Sect.III.G.2.a | NO |
| 32 | BR-3 | Battery Room No. 3 | Sect.III.G.2.a | NO |
| 33 | BR-4 | Battery Room No. 4 | Sect.III.G.2.a | NO |
| 34 | BR-5 | Battery Room Corridor | Sect.III.G.2.a | NO |
| 35 | EG-1 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 36 | EG-2 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 37 | EG-3 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 38 | EG-4 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 39 | EG-5 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 40 | EG-6 | Emergency Diesel Generator Room | Sect.III.G.2.a | NO |
| 41 | SP-1 | Service Water Pump Room (Train B) | Sect.III.G.2.a | NO |
| 42 | SP-2 | Service Water Pump Room (Train A) | Sect.III.G.2.a | NO |
| 43 | OR-1 | Turbine Oil Storage Room | Sect.III.G.2.a | NO |
| 44 | OR-2 | Turbine Oil Storage Room | Sect.III.G.2.a | NO |
| 45 | OR-3 | Misc. Oil Storage Room | Sect.III.G.2.a | NO |

TABLE 2.0
APPENDIX R COMPLIANCE SUMMARY
by FIRE AREA (CONT'D)

| No. | Name | Location | *Compliance with Appendix R | Exemption Request |
|---|---|---|---|---|
| 46 | PC-1 | Primary Containment (Drywell) | Sect.III.G.2.a | NO |
| 47 | SU-1 | Torus Room | Sect.III.G.2 | YES |

* Pending approval of Exemption Request

SECTION 3.0

## Historical Overview of Fire Protection Activities at the James A. FitzPatrick Nuclear Power Plant

### 3.1 1976

In February of 1976, a report was issued by an NRC special review group entitled "Recommendations Related to the Browns Ferry Fire" (NUREG-0050). This report seems to provide the basis for many of the early concerns of the NRC about fire protection.

Three months later, in May of 1976, Standard Review Plan - Section 9.5.1 "Fire Protection" was issued incorporating many of the recommendations of NUREG-0050. Only eight days later, the Authority was asked to "...conduct an examination to compare the exisiting fire protection provisions at your facility with the guidelines in the Standard Review Plan." The guidelines were to be applied to operating plants "to the extent reasonable and practicable" (emphasis added). Although a twenty-day response was requested, the Authority postponed a reply until late June "because of the extensive criteria in these documents relating to plant design, engineering, procedures and training." In the June response, a date of April 1, 1977 was estimated for the completion of the requested evaluation.

Four months into this nine month fire protection evaluation, the Commission issued Appendix A to Branch Technical Position APCSB 9.5-1 entitled "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976." Included with Appendix A was a document entitled "Supplementary Guidance on Information Needed For Fire Protection Program Evaluation." This was provided because, after reviewing the submittals made to date, the NRC felt that "your initial response may not adequately present the results of your fire hazards analysis. We stress that in order to begin a re-evaluation of the fire protection program of your facility, you must perform a fire hazard analysis with the assistance and direction of a qualified fire protection engineer" (emphasis added). This same September 30, 1977 letter requested that the Authority propose Technical Specifications for existing fire protection systems (with the fire protection evaluation due April 1, 1977), and provide a schedule for implementing Section B of Appendix A, "Administrative Procedures, Controls and Fire Brigade."

A subsequent NRC letter dated December 2, 1976 provided (more than half-way through the scheduled evaluation) sample Technical Specifications for guidance in preparing a portion of the April 1, 1977 submittal. (An errata sheet for Appendix A was similarly provided with this letter).

The NRC issued a letter dated December 14, 1976 including a corrected Specification 4.7.11.2 (Plant Spray and/or Sprinkler Systems - Surveillance Requirements) for incorporation into the proposed Technical Specification changes.

3.2 1977

On January 11, 1977, the Authority transmitted an evaluation of the FitzPatrick Fire Protection Program which compared the guidelines of Standard Review Plan 9.5.1 to existing or planned plant fire protection features. The alternate guidance of Appendix A to APCSB 9.5-1 was used in preparing this report. A more detailed fire hazards analysis using the guidance of the September 30, 1976 "Supplementary Guidance on Information

Needed for Fire Protection Program Evaluatior,' remained scheduled for the originally projected April 1, 1977 date. Technical Specification changes using the recently received sample specifications would also be submitted at that time. Because the Authority was in the process of assuming responsibility for the operation of FitzPatrick, compliance with Section B to Appendix A ("Administrative Procedures, Control and Fire Brigade") would be delayed until full responsibility was assumed or by July 1, 1977, whichever occured first.

Two documents, in preparation for an NRC site visit, were received in mid-January of 1977: (1) a description of site visit programs entitled "Site Visits - Fire Protection Program Evaluations" and, (2) proposed agenda for a FitzPatrick site visit. No specific date was mentioned for this visit.

The NRC was informed via a March 30, 1977 letter that the detailed fire protection evaluation incorporating the guidance of Enclosure 2 to Branch Technical Position APCSB 9.5-1 previously scheduled for March 31, 1977, would be delayed until April 29, 1977.

The detailed Fire Protection Hazards Analysis was transmitted to the NRC on April 29, 1977, three weeks after the date originally projected.

3.3 1978

Approximately eleven months after the submittal of the FitzPatrick detailed Fire Hazards Analysis, the NRC requested via an April 5, 1978 letter, additional information in the form of 41 questions and drawings. The letter further established two NRC staff positions on applicability of the Authority's QA program to fire protection systems/equipment and backup power for automatic carbon dioxide suppression systems. This requested information was supplied to the Commission by letter dated August 3, 1978.

An NRC visit to the FitzPatrick Site was conducted August 15 through 18 by eight NRC staff members/consultants to review the FitzPatrick fire protection program. As a result of this visit, thirty-six fire protection staff positions were sent to the Authority via letter dated September 22, 1978.

For twenty-six of these concerns, the Authority agreed during the August 18th exit meeting to either implement the staff's position or to propose an alternative solution within 30 days. Five items required further consideration by the Authority, while the last five concerns were developed by the NRC subsequent to the exit meeting. An implementation schedule for these ten staff positions, or justifiable alternative, was requested within three weeks of the date of the letter. Less than a week's time was allotted for providing written commitments and implementation schedules for the twenty-six issues discussed at the exit meeting.

On October 23, of 1978, the Authority responded to the first twenty-six issues by completely adopting twenty-four, and taking limited exceptions to two. Commitments and schedules for the remaining ten questions/positions were rescheduled for submittal in early November.

Two additional letters, dated October 27, 1978 and December 21, 1978 addressed the remaining ten concerns: three resulted in the adoption of the staff position, two required the initiation of an engineering study, and for one issue, the Authority provided further justification for the proposed alternate. Schedules for the completion of the remaining nine concerns would be provided as soon as they were completed.

3.4 1979

In a January 4, 1979 letter, the Authority committed to provide a schedule for these nine issues by mid-February. The schedule was submitted on February 8, along with a detailed description of the scope of work. A third fire hazards analysis, to determine the exact location of electrical cables for systems and auxiliaries required for safe shutdown and cooldown (including definition of safe shutdown functions, redundancy required and available diversity), was scheduled for September 10, 1979 submittal.

To support the issuance of a fire protection SER by the NRC by mid-March, the Authority submitted two tables: (1) 3.1- which listed implementation dates for thirty-one modifications and, (2) 3.2 - which listed completion dates for five fire protection studies. This March 7th letter further responded to twenty draft SER items. A second Authority letter (dated May 7, 1979) provided a table of water spray sprinkler densities in deluge systems for item 3.3.6 and clarification of four specific issues. A detailed description of the cable tray flame propagation tests, as well as information to verify that the electric cable installed at FitzPatrick, would pass tests now incorporated into IEEE-383, was also included with this second May letter. Also implied by this NRC letter was that the Commission was prepared to issue a satisfactory SER on the subject of cable flame retardencey as soon as documentation was provided on the adequacy of these tests. Some of this cable fire test documentation had apparently been inspected by a Region I NRC inspector in 1975.

In a May 23rd letter, the NRC states that only five items needed resolution prior to the issuance of the Safety Evaluation Report. Only two are specified in the letter: 3.2.4 and 3.3.16. The letter goes on to request "the entire fire test documentation for cabling installed in the FitzPatrick plant."

Two Authority July 1979 letters detailed the status and schedules for numerous SER items. With the submittal of these letters, the Authority considered all fire protection SER items resolved.

The Commission issued Facility Operating License (FOL) Amendment No. 47 for the FitzPatrick plant on August 1, 1979. This Amendment added a license condition pertaining to the completion of facility modifications to improve fire protection (Tables 3.1 and 3.2) and an SER. A thirty-day extension to the effective date of FOL Amendment No. 47 was requested by the Authority because it was not received until August 14-15, 1979 apparently due to mail delays. The NRC responded on August 23rd with a twenty-day extension making the new effective date August 29, 1979.

Through two additional letters during 1979, the Authority updated the status on the unfinished work referred to in FOL Amendment No. 47. The first of these two, in September, addressed eight issues including cable flame tests. Several hundred pages, comprising the entire cable fire test documentation, were provided to the NRC project manager. Similiarly, two reports were submitted. The second letter (dated November 14, 1979), provided additional information about six SER areas and revised Tables 3.1 and 3.2.

## 3.5 1980

In early May of 1980, the Authority submitted a revised response to concern PF-23, (Crescent Area Fire Protection), originally submitted nine months earlier in September of 1979. The Authority committed, in this letter, to install a seismic Class I barrier and a new manual foam system to backup the automatic spray system around the HPCI turbine and pump.

During October of 1980, the Commission provided a listing of eighteen SER items and their status. Two were classified as unacceptable with two labeled incomplete. A letter describing the final disposition of these five items was requested within thirty days. A little more than two weeks later, on October 17th, the Authority provided an update on the status of SER modifications or procedural changes. Eighteen items were shown as complete as of October 13th, twelve more to be completed by October 31st and, for eleven items, extensions of time were requested for their completion. The Authority further pointed out that almost four hundred craft personnel were currently on site for Fire Protection System modifications.

Nine days later, in another October letter, the Authority found it necessary to further revise the schedule for five SER items due to numerous material and installation delays.

In November, the Authority replied to the Commission's request for final disposition of five unacceptable or incomplete items. The Authority considered the fire protection issue closed for the FitzPatrick plant with the submittal of this letter.

On the 24th of November, 1980 the Commission sent to all power reactor licenses, a copy of the recently published 10CFR50.48 and Appendix R to 10CFR50. Included in this new rule, was a new schedule for the completion of previously approved fire protection modifications, and a statement that previous extension requests would have to be reapplied for, should they still be justified. Certain provisions of Appendix R were required to be backfit in their entirety, regardless of whether or not alternatives have been previously approved by the NRC staff.

3.6 1981

During 1981, eleven pieces of correspondence were either to sent or recieved from the NRC on the subject of fire protection for the FitzPatrick plant.

The Authority, in February, requested schedule extensions for the completion of ten SER fire protection items, and reported 21 items as complete. This letter went on to detail compensatory measures that would be instituted for each of the incomplete items.

A few days later, the NRC sent a summary listing of eighteen fire protection review items - fifteen were shown as "closed" and three as "under review."

Shortly thereafter, in mid-February 1981, the Authority summarized for the NRC, compensatory measures that were being provided until completion of related fire protection modifications. These six measures were discussed with NRC staff members on the previous day in support of the pending schedule extension request.

By letter dated February 20, 1981 (Generic Letter No. 81-12), the NRC requested the Authority to implement those applicable portions of the recently effective Appendix R to 10CFR50. Included with this letter were two enclosures: (1) "Staff Position Safe Shutdown Capability" and, (2) additional information needed to ensure that associated circuits for alternate safe shutdown equipment was included in this new assessment of fire protection. Section III.G.3 of Appendix R required that plans, schedules and design descriptions for modifications be submitted within thirty-days (March 19, 1981).

On February 24, the Commission approved the schedular relief requested by the Authority earlier in February. A total of eight SER items were rescheduled as a result.

In mid-March, the Authority petitioned the Commission for an exemption to the schedular provisions of 10CFR Part 50.48(C) governing the implemention of Sections III.G and III.J of Appendix R. (Since FitzPatrick's containment is inerted, the provisions of Section III.O are not applicable.) The March 19, 1981 date was requested to be extended until December 28, 1981 to allow the Authority sufficient time to adequately investigate Appendix R requirements to determine optimal compliance methods.

A fee of $1200 was requested for the review of the Authority's February schedule extension request. A check for the full amount was transmitted in mid-June.

On June 22, 1981, the Authority submitted: (1) plans and schedules for the implementation of Appendix R Section III.J, "Emergency Lighting;" and, (2) action plan to meet the requirements of Appendix R Section III.G, "Fire Protection Safe Shutdown Capability." Plans and schedules, or exemption request, for Section III.G would be provided by December 11, 1981.

The NRC was informed in late October that a small but vital portion of the fire protection modifications would not be completed by the previously committed November 1 deadline. The FitzPatrick plant would, however, be shutdown November 1 for its annual refueling outage. Therefore, this delay in the completion of this fire protection modification would not prevent safe operation of the facility. The NRC concurred in this course of action in an October 30, 1981 letter.

3.7 1982

The Authority requested exemption from requirements from provisions of Section III.G of Appendix R on the basis that existing plant configurations provide equivalent protection. Included with this February 26, 1982 letter was "Appendix II to Safe Shutdown Analysis Response to 10CFR50 Appendix R Fire Protection of Safe Shutdown Capability." This report re-examined the physical separation of safety-related and associated circuits. (This submittal of this analysis was rescheduled via January 19, 1982 letter to the NRC).

3.8 Summary of Completed Plant Fire Protection Modification

This section summarizes those hardware modifications which have been completed to date to enhance the ability of the FitzPatrick plant to withstand the effects of fire. The modifications are listed by fire zone.

3.8.1 Reactor Building Cresent Area, East (Zone RB-1E)

Two cables were rerouted out of this area to assure the availability of three core spray system valves.

3.8.2 Reactor Building Crescent Area, West (Zone RB-1W)

Sixteen cables were rerouted out of this area to assure the availability of Division B RHR and core spray system.

3.8.3 Reactor Building - El. 272'-0" NE & SE Quadrants, El. 300'-0" SE Quadrant, El. 326'-0", El. 344'-0" and El. 369'-0" (Zone RB-1A)

A total of fourteen cables were rerouted out of this fire zone to assure that seven RCIC valves are available in the event of a fire in this fire zone.

Two additional cables were rerouted out of this fire zone to assure availability of the RCIC system.

3.8.4 Reactor Building - El. 272'0" SW & NW Quadrants, El. 300'-0" SW Quadrant (Zone RB-1B)

Division B (blue) power and redundant Division B solenoid actuating valves were installed on main steam SRVs. Three cables were rerouted out of this fire zone to assure the availibility of the HPCI system.

Trays and exposed cables in the vicinity of two motor control centers in this fire zone were protected by a manually operated water spray system over the cable trays. In addition, a fire barrier was installed between these two motor control centers.

Three cables were rerouted out of this fire zone to ensure the availability of Division B emergency service water. A three hour barrier was constructed to ensure fire separation between Division A and B emergency service water valves.

3.8.5 Reactor Building - El. 300'-0", NW & NE Quadrants (Zone RB-1C)

A cable was rerouted out of this fire zone to prevent the loss of 600V switchgear and breaker. An open hatch adjacent to a piece of switchgear will be closed to prevent a fire on El. 272'-0" from affecting switchgear on El. 300'-0".

3.8.6 Reactor Building Fan Rooms - (Zone RB-17E)

There were no modifications made within this fire zone.

3.8.7 Torus Room - (Zone SU1)

There were no modifications made within this fire zone.

3.8.8 Standby Gas Filter Room - (Zone SG1)

There were no modifications made within this fire zone.

3.8.9 Relay Room - (Zone RR1)

Control power (120VDC) cables, running from the battery room to the emergency diesel generator room building distribution cabinet were rerouted so as not to pass through either the relay or cable spreading rooms. Division B control power (120VDC) was run to a control station, remote from the control room, relay room or cable spreading room, for manual ADS operation of Division B actuating solenoid valves.

3.8.10 Cable Spreading Room - (Zone CS1)

Control power (120VDC) cables, running from the battery room to the emergency diesel generator room building distribution cabinet, were rerouted so as not to pass through either the relay or cable spreading rooms. Division B control power (120VDC) was run to a control station, remote from the control room, relay room or cable spreading room, for manual ADS operation of Division actuating solenoid valves.

The 600VAC supply cable to a battery charger was rerouted to avoid both the cable spreading area and the relay room.

3.8.11 Cable Tunnel West - (Zone CT1)

Two power cables, serving an RHR pump and core spray pump, were rerouted out of this fire zone. Seven HPCI power supply or isolation logic cables were similiarly rerouted out of this zone. Two cables associated with availability switchgear, were also rerouted out of this fire zone.

3.8.12 Cable Tunnel East - (Zone CT2)

Thirteen Division A cables were rerouted out of this fire zone to assure the availability of the emergency service water and residual heat removal systems.

3.8.13 Cable tunnel 3 - (Zone CT3)

There were no modifications made within this fire zone.

3.8.14 Cable Tunnel 4 - (Zone CT4)

The existing ADS solenoid actuator assemblies, on each of the eleven main steam SRVs, were replaced with dual solenoid assemblies. One solenoid on each assembly is connected to the existing Division A cables and controlled via the logic panel in the relay room. The second solenoid is controlled from a new, independent, manual Division B ADS control panel installed at a location away from the relay room, control room or cable spreading room.

3.8.15 Switchgear Rooms - (Zones SW1 and SW2)

There were no modifications made within these fire zones.

3.8.16 Emergency Diesel Generator Room - (Zones EG-1, EG-2, EG-3, EG-4, EG-5 and EG-6)

There were no modifications made within these fire zones.

3.8.17 Turbine Building (Basement, Mezzanine and Operating Floor) - (Zones TB11, TB12 and TB13)

There were no modifications made within these fire zones.

3.8.18 Screenwell House - (Zone SH13)

There were no modifications made within this fire zone.

3.8.19 Service Water Pump Rooms (Trains A and B) - (Zones SP1 and SP2)

There were no modifications made within these fire zones.

3.8.20 Administration Building - El. 272 - (Zone AD3)

There were no modifications made within this fire zone.

3.8.21 Control Room Ventilation Area (Zone AD6)

There were no modifications made within this fire zone.

3.8.22 Battery Room - (Zones BR1, BR2, BR3 and BR4)

There were no modifications made within these fire zones. Portable fans will be used to ventilate this fire zone when required.

3.8.23 Battery Room Corridor - (Zone BR5)

A single cable was rerouted to assure the availability of a bus for cold shutdown. Portable fans will be used to ventilate this fire zone when required.

## SECTION 4.0

## 10 CFR50 Appendix R Separation Analysis

### 4.1 Criteria

#### 4.1.1 Description of Separation Criteria

In accordance with 10CFR50 Appendix R Section III.G.2 the criteria by which cables or equipment of redundant trains or diverse counterpart systems are considered to be "separated" are as follows:

- Separation of cables or equipment by a fire barrier having a 3-hour rating.
- Separation of cables or equipment by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the area.
- Enclosure of cables or equipment in a fire barrier having a 1 hour rating with fire detectors and an automatic fire suppression system installed in the area.

#### 4.1.2 Method of Choosing Fire Areas or Zones

All areas, except the areas in the Reactor Building, the Control Room, Cable Spreading Area and Relay Room which were originally presented in the Fire Hazards Analysis for FitzPatrick, were reviewed only for the impact to the safe shutdown systems as a result of a fire within the area. This review also considered associated cables. However, since each of these areas is enclosed by a 3 hour rated fire barrier which meets the requirement of Appendix R, and all the equipment within the area is assumed lost, separation with the redundant system shown to be available for a shutdown path, was not reviewed further. See Figures 4-1 thru 4-5.

The Reactor Building was divided into 5 zones depending on the systems and components required for safe shutdown located within the zones. Since each zone contained equipment associated with a shutdown path, separation analysis considered the effects of a fire extending 20 ft at either side of the boundary. This additional area considers the separation of 20 feet between cables, equipment and associated non-safety circuits of redundant trains and/or diverse counterparts.

The Reactor Building zones were redefined from those previously described in the Safe Shutdown Analysis dated October 1980. The Crescent Area was divided into east and west zones, and the remainder of the Reactor Building was divided into three zones. This division is justified by the defense in depth features utilized for fire protection. These new Fire Zones are shown on Figures 4-6 thru 4-11.

The control room, relay room and cable spreading room were reviewed relative to Section III.G.3 and III. L and the analysis is addressed in section 5.0 of this report. R

## 4.2 Analytical Method

The Power Authority's analysis of a fire area begins with the extremely conservative assumption that all equipment and cables within the area are destroyed. Then the analysis was conducted to identify at least one safe shutdown method which is unaffected by the fire, not necessarily all the unaffected equipment.

The summary sheets include a safe shutdown method but do not detail all the equipment which survives the postulated fires. However, the existing procedures systematically address all safe shutdown paths, warning the operator in each step which components may not be available as a result of a fire. In this way, the site procedures reflect all unaffected shutdown equipment and emphasize minimal manual action outside the control room. Therefore, existing plant procedures may not be directly comparable to the safe shutdown capability as identified in this report.

The Separation Analysis consisted of three distinct tasks. These tasks were performed as follows:

### 4.2.1 Task One

Task One to identified the locations of all cables used for safe shutdown. This was performed through the use of electrical tray, sleeve and conduit location drawings on a zone by zone basis. As in the original Safe Shutdown Analysis, it was assumed that all components located in a fire area or zone, or that are serviced by cables located therein, are impacted by a fire in that area or zone. New zones were developed by adding an adjacent 20-foot

## 4.2 Analytical Method

The Power Authority's analysis of a fire area begins with the extremely conservative assumption that all equipment and cables within the area are destroyed. Then the analysis was conducted to identify at least one safe shutdown method which is unaffected by the fire, not necessarily all the unaffected equipment.

The summary sheets include a safe shutdown method but do not detail all the equipment which survives the postulated fires. However, the existing procedures systematically address all safe shutdown paths, warning the operator in each step which components may not be available as a result of a fire. In this way, the site procedures reflect all unaffected shutdown equipment and emphasize minimal manual action outside the control room. Therefore, existing plant procedures may not be directly comparable to the safe shutdown capability as identified in this report.

The Separation Analysis consisted of three distinct tasks. These tasks were performed as follows:

### 4.2.1 Task One

Task One to identified the locations of all cables used for safe shutdown. This was performed through the use of electr' al tray, sleeve and conduit location drawings on a zone by zone basis. As in the original Safe Shutdown Analysis, it was assumed that all components located in a fire area or zone, or that are serviced by cables located therein, are impacted by a fire in that area or zone. New zones were developed by adding an adjacent 20-foot wide area onto the original fire zone in the Safe Shutdown Analysis. In this way, all cables within 20-ft of their redundant or counterparts in another zone were identifed.

### 4.2.2 Task Two

Task Two evaluated the impact on system operation. An affected component list developed in Task One was used with a flow diagram for each system to determine if a fire could reduce the system availability to a level below that required to assure safe shutdown capability. In areas where the potential loss of a shutdown function was identified, a detailed review was performed.

Rather than performing a fault tree analysis to determine the actual effect produced by the loss of a cable, it was conservatively assumed that the loss of any safety-related cable associated with a component could result in the loss of that component whether the component was in that fire area or not. If a loss of function appeared to result from the loss of such cables, the failure mode of the associated component was reexamined to see if there would be an actual loss of safe shutdown function. For example, if a valve is normally open and designed to fail open upon the loss of power, a fire affecting the power cable alone would not cause the valve to close even though the analysis would indicate a component failure. In addition, even if the valve were to reposition as a result of a fire, actual loss of the safe shutdown function would not result provided the valve is accessible and can be locally operated within the time required. The analysis thus identified the s/ .e shutdown function available in the event of a fire.

Spurious valve actuation, credible shorts and simultaneous failure of loads were also considered. The detailed description and procedure used for each was identical to that found in the original Safe Shutdown Analysis Report dated October, 1980.

4.2.3 Task Three

Task Three addressed the event of a total loss of function resulting from the fire. This situation occurs if both sets of redundant trains or diverse counterparts of equipment are located within the 20-foot expanded fire zone or if the equipment malfunctions and results in an unrecoverable condition. In this case, the physical location of the safety cables routed through the additional 20-foot zone and the physical location of its redundant train or diverse counterparts in the original fire zone was examined and plotted. If the separation between the trains or counterparts was determined to be at least 20 feet with no intervening combustibles, then it was concluded that the separation criteria between redundant trains or diverse counterparts was satisfied and the redundant train or diverse counterparts in the additional 20-foot zone was assumed to be available.

If the seperation between the redundant trains or diverse counterparts was determined to be less than 20 feet, then it was con-concluded that both counterparts were lost due to the fire and appropriate fix was recommended to ensure that at least one safety related train or diverse counterpart required for safe shutdown is available. R

## 4.3 Method of Presentation

### 4.3.1 Description of Analysis Summary Sheets

In order to ensure that the criteria described above were applied to each fire zone/area, analysis summary sheets were prepared for all fire areas or zones in the plant as indicated in Table 4.1. Each summary sheet indicated in detail the results of a fire in the zone identified. The format of these summary sheets is as follows:

I. Safe Shutdown Systems Disabled - A listing of safety system functions required for safe shutdown affected by the fire. Where a fire causes extensive equipment damage in one train (Division A or B), a statement such as "All Division A functions assumed lost" is made, and the remaining statements generally refer to disabled functions in Division B.

II. Shutdown Capability - Identifies whether diverse means of providing necessary safe shutdown functions are available and generally describes an available procedure for safe shutdown. Such a procedure is graphically depicted as a success path "reactor shutdown" through "extended cooling" on Figure 4-12.

III. Identify and Justify any Required Manual Action - Identifies all potential manual actions required by the operator and the reasons for which the action is required.

IV. Necessary Instrumentation Available in Control Room - The minimum acceptable level of process instrumentation required to monitor safe shutdown equipment was identified. If rerouting of cables are required to ensure availability of the instrumentation, it is so described.

V. Methods of Protecting Shutdown Capability - The methods of protecting the shutdown capability is identified as either satisfying the requirements of 10CFR50 Appendix R Section III.G.2 or by showing that adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zones in which the redundant/diverse shutdown systems and/or cables are located. Planned additional modifications identified in this analysis to mitigate the presence of fire retardant cable within the 20 ft separation of redundant/diverse circuits or equipment were also described.

4.3.2 Tables and Diagrams

Table 1-0 in the Appendix lists the components of all systems, both primary and auxiliary, which are essential to, or are potentially useful in, achieving safe shutdown.

Figure 4-12 shows all modes of achieving safe shutdown using the primary systems named above. Any path from the top of the figure, beginning with reactor shutdown through extended cooling, shown at the bottom of the figure, is a successful path to cold shutdown. The reactor can be maintained in a safe, stable, hot standby condition while maintenance or operator action allows for continued cooldown to cold shutdown.

Support functions which must be provided in association with the above primary functions are:

1. Motive power - power to operate safe shutdown equipment

2. Auxiliary cooling - provides an acceptable environment for safe shutdown equipment

Systems which provide the support functions are listed below:

1. Motive power - steam for steam driven pumps from the main steam system and the electrical distribution system which comprises the Emergency Diesel Generators, the 4,160V AC buses, the 600V AC buses, the 120V AC buses and the 125V DC buses. Refer to Figure 2-14 in the Appendix

2. Auxiliary cooling - Figures 2-2 through 2-13 in the Appendix show the flow paths for the systems involved. Systems from which only a few components are needed (such as the suction and discharge valves of the reactor recirculation system) are not shown. For the reactor building ventilation system, only the crescent area unit coolers are needed and a figure showing these is not included.

4.3.3 System Numbers

Listed below are the system numbers used in the tables in this report:

02 Nuclear Boiler System

03 Control Rod Drive Hydraulic System

10 Residual Heat Removal System

11 Standby Liquid Control System

12 Reactor Water Cleanup System

13 Reactor Core Isolation Cooling System

14 Core Spray System

15 Reactor Building Component Cooling Water System

20 Radwaste System

23 High Pressure Coolant Injection System

29 Main Steam System

46 Emergency Service Water System

66 Reactor Building Ventilation System

67 Emergency Generator Switchgear Room Ventilation System

70 Relay Room Ventilation System

71 Class 1E Electrical Distribution System

72 Battery Room Ventilation System

73 Screen House Ventilation System

92 Diesel Generator Room Ventilation System

93 Diesel Fuel Transfer System

4.4 Fire Area/Zone Summary Sheet

A summary sheet for each of the Fire Areas and Zones listed below is included in this Section.

FIRE AREAS/ZONES

| Number | Name | Location |
|---|---|---|
| 1 | RB-1E | Crescent Area East Elev. 227'-6" |
| 2 | RB-1W | Crescent Area West Elev. 227'-6" |
| 3 | RB-1A | Reactor Building Elev. 272'-0" East, Elev. 300'-0"(SE), Entire Elev. 326'-0", thru Elev. 369'-0" |
| 4 | RB-1B | Reactor Building Elev. 272'-0" West, Elev. 300'-0" (SW) |
| 5 | RB-1C | Reactor Building Elev. 300'-0", (NE & NW) |
| 6 | CR-1 | Main Control Room |
| 7 | RR-1 | Relay Room |
| 8 | CS-1 | Cable Spreading Room |
| 9 | MG-1 | Motor Generator Room Elev. 300'-0" |
| 10 | AD-1 | Administration Bldg. Elev. 272'-0" |
| 11 | AD-2 | Administration Bldg. Elev. 272'-0" |
| 12 | AD-3 | Administration Bldg. Elev. 272'-0" |
| 13 | AD-4 | Administration Bldg. Elev. 286"-0" |
| 14 | AD-5 | Administration Bldg. Elev. 286"-0" |
| 15 | AD-6 | Administration Bldg. Elev. 300"-0" |
| 16 | CR-2 | Radwaste Control Room, Elev. 284'-0" |
| 17 | CT-1 | Cable Tunnel West-Elev. 260'0" |
| 18 | CT-2 | Cable Tunnel East-Elev. 260'0" |

FIRE AREAS/ZONES (Cont'd)

| Number | Name | Location |
|---|---|---|
| 19 | CT-3 | Cable Tunnel 3 Elev. 286'-0" |
| 20 | CT-4 | Cable Tunnel 4 Elev. 286'-0" |
| 21 | TB-1 | Turbine Bldg. (Basement) Elev. 252'-0", (Mezzanine) Elev. 272'-0" and (Operating Floor) Elev. 300'-0" |
| 22 | RW-1 | Radwaste Bldg. and Pipe Tunnel |
| 23 | SH-13 | Screen Well House Elev. 272'-0" |
| 24 | SW-1 | Turbine Bldg. Switchgear Room Elev. 272'-0" |
| 25 | SW-2 | Turbine Bldg. Switchgear Room Elev. 272'-0" |
| 26 | FP-1 | Diesel Fire Pump Room |
| 27 | FP-2 | Foam Room Turbine Bldg. Elev. 272' 0" |
| 28 | SG-1 | Standby Gas Filter Room |
| 29 | AS-1 | Auxiliary Boiler Room |
| 30 | BR-1 | Battery Room No. 1 |
| 31 | BR-2 | Battery Room No. 2 |
| 32 | BR-3 | Battery Room No. 3 |
| 33 | BR-4 | Battery Room No. 4 |
| 34 | BR-5 | Battery Room Corridor |
| 35 | EG-1 | Emergency Diesel Generator Room |
| 36 | EG-2 | Emergency Diesel Generator Room |
| 37 | EG-3 | Emergency Diesel Generator Room |
| 38 | EG-4 | Emergency Diesel Generator Room |
| 39 | EG-5 | Emergency Diesel Generator Switchgear |
| 40 | EG-6 | Emergency Diesel Generator Switchgear |
| 41 | SP-1 | Service Water Pump Room (Train B) |

R

R

## FIRE AREAS/ZONES (Cont'd)

| Number | Name | Location |
|---|---|---|
| 42 | SP-2 | Service Water Pump Room (Train A) |
| 43 | OR-1 | Turbine Oil Storage Room |
| 44 | OR-2 | Turbine Oil Storage Room |
| 45 | OR-3 | Misc. Oil Storage Room |
| 46 | PC-1 | Primary Containment (Drywell) |
| 47 | SU-1 | Torus Room |

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1E

Reactor Building - Crescent Area (East), Elev. 227'6"

I. Safe Shutdown Systems Disabled

All Division B shutdown systems are assumed disabled including RHR, Core Spray, HPCI, ESW, and manual ADS. RCIC System (Division A) is also assumed disabled.

II. Shutdown Capability

The following shutdown systems are available for safe shutdown:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A)

3. RHR (Division A) - LPCI, Suppression pool cooling and shutdown cooling modes.

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core

Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. Identify and Justify any Required Manual Actions | R

1. Local manual operation of the following RHR System (Division A) valves may be required: 10MOV-25A, 10MOV-27A, 10MOV-39A, and 10MOV-38A.

2. Local manual operation of RHR valves required for the normal shutdown cooling mode of RHR for long term cooling may be required. Manual operation of the ADS (Division A) System and Core Spray will be used initially for achieving hot shutdown. This will provide sufficient time for the operators to manually operate the RHR valves mentioned above. The number of valves above are few and repositioning of the valve if necessary, manually, can be accomplished relatively easy.

## IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

    a) Pump discharge pressure

    b) Loop flow

6. RHR System

    a) Pump discharge pressure

    b) Loop flow

7. RCIC System

    a) Pump discharge pressure

    b) Loop flow

8. RHR Service Water

    a) Flow

Notes:

RCIC System is assumed to be unavailable

## V. Methods of Protecting Shutdown Capability

For fire zone RB-1E adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1W, and RB-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

   a. Fire Zones adjacent to RB-1E are zones RB-1W to the west and RB-1A above. The boundary with RB-1A is the Elevation 272' building floor which provides greater than a 3 hour rating. Piping and cable penetration sleeves through this floor are protected by 3 hour rated fire stops. A twenty foot area beyond the boundary between RB-1E and extending into RB-1W, was reviewed for potential effects on the safe shutdown path. This review showed that if the fire propagates up to 20 feet beyond the boundary of RB-1E it has no effect on the safe shutdown path. This is true except with the circuits identified in the exemption request presented in section 2.7.2.3.

   b. Detection Systems - RB-1E and adjoining RB-1W and RB-1A are equipped with area ionization detectors which alarm in the

Control Room. There is also a heat actuated detector (HAD) system in the HPCI area enclosure for automatic water spray actuation.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| a. Water Spray | Automatic/Manual | HPCI Enclosure |
| b. Foam System | Manual | HPCI Enclosure |
| c. Hose Stations | Manual | Entire Crescent Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of section III.G.2 of Appendix R for the interface between this zone (RB-1E) and RB-1W to the west. The only intervening combustible is flame retardant cabling in trays which pass from RB-1E to RB-1W. This cabling has been assumed lost for the proposed shutdown path for this fire zone except for 5 cables for which an exemption is requested. Therefore the fire protection concern is only the presence of the intervening combustible.

To mitigate this concern, the intervening cable trays which are located at, or within 20 foot seperation of redundant/diverse circuits or equipment, will be equipped with a water spray system to further mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone. |R

b. A fire barrier will be provided in the stairway area to mitigate the propagation of fire from zone RB-1E (El. 227) to zone RB-1A, (El. 272) above the stairway. The fire rating of this barrier

will be commensurate with the fire loading in the entire zone and its distance from the stairway area.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1W

Reactor Building-Crescent Area West-Elev. 227'6"

I. Safe Shutdown Systems Disabled

The following Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ESW, and RCIC. HPCI System (Division B) is also assumed to be disabled.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A or B) - manual mode.
2. Core Spray (Division B)
3. RHR (Division B) - LPCI, shutdown cooling, and suppression pool cooling modes.
4. ESW (Division B)
5. RHR Service Water (Division B)

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Divsion A or B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined up in the LPCI injection mode. If the Core Spray System, (Division B) is used for reactor coolant makeup and level control, RHR System (Division B) may be lined up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal cooling mode of the RHR System (Division B)

III. <u>Identify And Justify Any Required Manual Actions</u>

Local manual operation of the following RHR System (Division A) valves may be required: 10MOV-25B, 10MOV-27B, and 10MOV-17.

Local manual operation of RHR valves required for the normal shutdown cooling mode of RHR for long term cooling may be required.

Using ADS and core spray for initial shutdown cooling will provide sufficient time to manually operate the above valves.

IV. <u>Necessary Instrumentation Available in Control Room</u>

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow (Cable of this instrumentation will be rerouted from the fire zone to ensure its availability). | R

7. RHR Service Water

a) Pump flow

V. Methods Of Protecting Shutdown Capability

For fire zone RB-1W, adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1E, and RB-1B in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protecion

a. Fire Zone RB-1W is bounded by zones RB-1E to the east and RB-1B above. The boundary with RB-1B is the elevation 272' building floor which provides greater than a 3 hour rating. Piping and cable penetration sleeves through this floor are protected by 3 hour rated fire stops.

Within RB-1W, the RCIC turbine is completely enclosed within a room having a three-hour fire rating thus protecting all other equipment in this zone from this source of combustible material.

The stairwell from this zone to RB-1B is designed to provide a 3 hour fire rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room. There are also heat activated detector (HAD) systems in the RCIC area enclosure for automatic water spray actuation.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| 1. Water Spray | Automatic/Manual | RCIC Enclosure |
| 2. Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operator and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

1. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1W) and (RB-1E) to the east. The only intervening combustible is flame retardant cabling in trays which pass from RB-1W to RB-1E. This cabling has been assumed lost for the proposed shutdown path for this fire zone except for 5 cables for which an exemption was requested. Therefore, the fire protection concern is only the presence of the interveining combustible.

To resolve this concern, the intervening cable trays which are located at, or within 20 foot separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near cable trays and the boundary of the zone.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1A

Reactor Building - Elev. 272' (East Side), Elev. 300' (Southeast Quadrant) and Entire Elevations 326', 344', and 369'

I. Safe Shutdown Systems Disabled

1. Most Division B shutdown systems are assumed disabled including RHR, Core Spray, ADS, HPCI, and ESW.

2. RCIC System (Division A) is also assumed disabled due to the postulated lost of control and power cables for RCIC steam supply valve 13MOV-16.

3. Motor Control Center (MCC) 151 (Division A) is also postulated to be disabled due to its proximity to zone RB-1A. Though this is a Division A electrical power supply, the loads that it supplies, if required, can be operated manually to effect shutdown.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division A) - manual mode.

2. Core Spray (Division A).

3. RHR (Division A) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW (Division A).

5. RHR Service Water (Division A).

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division A). Low pressure reactor coolant makeup and level control will be provided by either Core Spray System (Division A) or RHR System (Division A) lined up in the LPCI injection mode. If Core Spray System (Division A) is used for reactor coolant makeup and level control, RHR System (Division A) may be lined up on the suppression pool cooling mode. If RHR System (Division A) is used for injection and level control with vessel discharge occuring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division A).

III. <u>Identify and Justify Required Manual Actions</u>

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division A) and ADS (Division A) are utilized.

2. If the assumed loss of MCC 151 (Division A) actually occurs due to the fire, manual actions must be taken to deenergize MCC 151 by opening the breaker for its supply feecer or the supply feeder located in another fire zone and manually verifing valve positions for the

following RHR System valves: 10MOV-13A, -12A, -89A, -166A, -167A, -148A, -149A, -70A, and -26A.

3. Manual operation of steam supply valve 13MOV-16, if it should be affected by the fire, will restore RCIC system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division A) shutdown cooling mode, which is the normal cold shutdown method.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1A adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B, RB-1E and RB-1C in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense-in-depth principle.

1. Existing Fire Protection

a. Zone Boundaries - A three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2.a is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on the additional modifications described below. Piping and electrical penentration sleeves through these barriers will be protected by 3 hour rated fire stops.

Within RB-1A on Elevation 344, the combustibles are lead acid storage battery systems which are contained in enclosures with a one (1) hour rating.

b. Detection Systems - The entire fire zone is equipped with area ionization detectors which alarm in the Control Room.

c. Suppression Systems

| Type | Actuation | Location |
| --- | --- | --- |
| Water Spray | Manual | Above Cable Trays, Elev. 272' at Southwest boundary of RB-1A |
| Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operators and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major volume combustibles in this fire zone are the flame retardant cables located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assummed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones indicated in Section V above.

   a. The 20 foot separation is provided between redundant cable with the exception of one Division A control cable for RHR shutdown cooling isolation valve 10MOV-18. This seperation deficiency is described below:

   Fire zones RB-1A and RB-1B contain a corridor which passes MCC-151 and -161 adjacent to the drywell equipment hatch shieldwall at Elevation 272 feet (Figure 2-18). Within this zone, the safe shutdown analysis identified the coexistence of the following redundant cables within 20 feet of horizontal separation with the intervening combustible material consisting only of flame retardant cabling.

| Division A | Division B | Closest Horizontal Separation with no Intervening Combustible Material |
|---|---|---|
| Conduit 1CC655RP containing control cable 1PCIARC014 | Junction Box JBPCI3 containing control cable 1PCIBBC016 | 13ft |

to 10MOV-18          to 10MOV-17

Based on this finding the cabling and power supply for 10MOV-18 will be rerouted to a different fire zone.

b. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1B at the 272' elevation (south end). A three hour fire rated wall does not exist at the boundary of these zones although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the fire protection concern is limited only to the presence of an intervening combustible.

To resolve this concern, the existing cable tray spray system for the intervening cable trays which are located at or within 20 foot separation of redundant/diverse cables or equipment will be modified to mitigate the postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system equipped with fusable link spray heads. The pre-action valve will be

automatically opened by heat detectors near the cable trays and the boundary of the zone.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1A) EL 300' and zone RB-1B on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are <u>no</u> cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

d. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C which consists of a connecting stairway between Elevations 300' and 326' (northeast corner). A three hour fire rated enclosure does not presently enclose the stairway. The

only combustibles located in the vicinity of the stairway are flame retardant cabling which pass through sleeves at the 326' Elevation floor boundary which is adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1A.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1A to RB-1C at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area and the distance of combustibles from the zone boundary to be isolated.

e. See also fire zone RB-1E exemption request for stairwell barrier between this zone and RB-1E.

f. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it it conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V. above. R

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2

of Appendix R for the interface between this zone RB-1A and zone RB-1C on Elev. 300'. A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary for this concern.

g. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirement of Section III.G.2 of Appendix R for the interface between this zone (RB-1A) and zone RB-1C in the area of the connecting stairway between elevations 300'-0" and 326'-0" and elevations 300'-0" and 272'-0" (northeast corner). A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are not required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from elevation 300' to elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors with dampers (if required) will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

h. In order to prevent a fire in zone RB-1A elevation 326'-0" from propagating to zone RB-1C elevation 300' through the open hatch located in the northeast corner, a plug with a 3 hour rating will be provided. This ensures compliance with 10CFR50, Appendix R, Section III.G.2.

FIRE AREA/ZONE SUMMARY

FIRE AREA RB-1

F..E ZONE RB-1B

REACTOR BUILDING - ELEV. 272' (WEST SIDE) ELEV. 300' (SOUTHWEST QUADRANT)

I. Safe Shutdown Systems Disabled

1. Most Division A shutdown systems are assumed to be disabled including RHR, Core Spray, ADS, and RCIC.

2. HPCI System (Division B) is also assumed to be disabled due to the postulated loss of control and power cables for HPCI steam supply valve 23MOV-16 which is located in adjacent fire zone RB-1A but less that 20 feet from the boundary.

3. Motor Control Center (MCC) 161 (Division B) is also postulated to be disabled due to proximity to this zone. Though this is a Division B electrical power supply, the loads that is supplies are not required to be electrically operable for a fire postulated for the fire zone.

II. Shutdown Capability

The following shutdown systems are available:

1. ADS (Division B) - manual modes

2. Core Spray (Division B).

3. RHR System (Division B) - LPCI, suppression pool cooling, and shutdown cooling modes. (manual and electrical operation).

4. ESW System (Division B).

5. RHR Service Water System (Division B)

6. HPCI Systems (Division B) - with certain manual valve actuations

Hot shutdown can be accomplished by manual reactor depressurization using manual operation of ADS (Division B). Low pressure reactor coolant makeup and level control will be provided by either Core Spray (Division B) or RHR System (Division B) lined-up in the LPCI injection mode. If Core Spray System (Division B) is used for reactor coolant makeup and level control, RHR Systems (Division B) may be lined-up in the suppression pool cooling mode. If RHR System (Division B) is used for injection and level control with vessel discharge occurring through the open safety relief valve lines, suppression pool cooling will also be provided.

Long term cooling can later be provided by manual line-up of the normal shutdown cooling mode of the RHR System (Division B).

III. IDENTIFY AND JUSTIFY ANY REQUIRED MANUAL ACTION

1. No manual operations are initially required in order to achieve the hot shutdown condition if the Core Spray System (Division B) and manual ADS (Division B) are utilized.

2. If the assumed loss of MCC 161 (Division B) occurs during the fire, manual actions must be taken to deenergize MCC 161 by opening its remote feeder breaker at substation L16 to preclude spurious actuation. In this case and RHR System operation is required, the

following valves must be operated manually: 10MOV-31B, 10MOV-12B, -89B, -166B, -167B, -148B, -149B, -70B, and -26B.

3. Manual operation of HPCI steam supply valve 23MOV-16, if it should be affected by the fire, will restore HPCI system operation.

4. An additional method of long term core cooling may be provided by manually lining up the RHR System (Division B) in the shutdown cooling mode, which is the normal cold shutdown method.

## IV. NECESSARY INSTRUMENTATION AVAILABLE IN CONTROL ROOM

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core spray system
    a) Pump discharge Pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow
7. HPCI System
    a) Pump discharge pressure
    b) Injection flow
8. RHR Service Water
    a) Pump flow*

Notes:

* Cables for this instrumentation will be rerouted from the fire area to insure its availability.

## V. METHODS FOR PROTECTING SHUTDOWN CAPABILITY

For fire zone RB-1B adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1A, RB-1C, and RB-1W in which the redundant / diverse shutdown systems and / cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurrence of any unrecoverable situation due to a postulated fire and provide protection based on the defense in depth principle.

### 1. Existing Fire Protection

a. Zone Boundaries - a three hour fire rated barrier satisfying the requirements of 10CFR50 Section III.G.2.a is provided at all zone boundaries with two exceptions which will be addressed as part of an exemption request supported by additional modifications. Piping and electrical penetration sleeves through these barriers are protected by 3 hour rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main control room.

c. Suppression Systems

| Type | Actuation | Location |
|---|---|---|
| Water Spray | Manual | Above Cable Trays, Elev 272' at South West Boundary of RB-1B |
| Hose Station | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early identification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection - The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is assumed that all cable and equipment in this zone becomes disabled. The basis for protection is to contain the fire in this zone and not allow its propagation to other fire zones.

a. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested to from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A at the 272' elevation (south end). A three hour fire rated wall does not exist at this zone boundary although a partial height three hour rated wall is presently installed. The only intervening combustible between these two fire zones is flame retardant electrical cabling in cable trays which pass from zone RB-1A to RB-1B. All of this cabling is assumed disabled for the proposed shutdown path for this fire zone. Therefore, the only fire protection concern is only the presence of an intervening combustible.

   To resolve this concern, the interviewing cable trays which are located at, or within 20 feet separation of redundant/diverse circuits or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the cable tray spray system will be commensurate with the fire loading calculated for the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable and the zone boundary.

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation

(south side). A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is relatively low. Therefore, the fire protection concern is only the presence of the intervening cable.

To resolve this concern, the intervening cable trays which are located at or within twenty feet separation of redundant/diverse equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the intervening cabling. The spray system will be a pre-action system with fusable link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the zone boundary.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1A in the area of the stairway connecting between Elevations 300' and 326' (southwest corner). A three hour fire rated enclosure does not presently isolate this stairway.

The only requirement for fire protection at this zone boundary is to prevent the propagation of flame from Elevation 300' to Elevation 326 via the stairway. Flame retardant cable is the nearest combustible to this stairway (approximately 30 feet away on Elevation 326 and approximately 40 feet away on Elevation 300). Therefore, additional protection is not considered necessary. Approval of this exemption is requested without additional modifications.

d. In order to prevent a fire in Zone RB-1B (Elev. 272') from propagating to Zone RB-1C (Elev. 300') through the open hatch located in the northwest corner, a 3 hour rated concrete plug was provided previously. This ensures compliance with 10CFR50 Appendix R, Section III.G.2 since a fire barrier with a 3 hour rating is provided.

e. To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from Section III.G.2 of Appendix R for the interface between this zone RB-1B elevation 300' and zone RB-1A on the 300' elevation. A three hour fire rated barrier does not exist on this zone boundary. The only combustibles located in the vicinity of the fire zone boundary is flame retardant electrical cabling. These cables are not directly intervening because there is an open 4' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path R for a fire in this zone. In addition, the fire loading resulting from cabling located twenty feet to either side of the zone boundary is very low (about 6 cables). Therefore, the fire retardant cables are of very low density to cause the propagation of fire from one zone to the other. No modifications are considered necessary in this zone for this concern.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RB-1

FIRE ZONE RB-1C

Reactor Building-Elev. 300' (Northeast and Northwest Quadrants)

I. Safe Shutdown Systems Disabled

1. Most Division B Shutdown Systems are assumed to be disabled including RHR, Core Spray, ADS and RCIC.

2. Core Spray Division A is also disabled due to loss of injection valves 14-MOV-11A and B and 14-MOV-12A and B.

II. Shutdown Capability

The following Shutdown Systems are available:

1. ADS (Division A) Manual Mode from the Control Room

2. RHR System (Division A) Suppression Pool Cooling, shutdown cooling (with Manual operation of 10-MOV-18), LPCI (after injection valves have been powered from MCC153)

3. RCIC System - Manual Mode from the Control Room

4. ESW System (Division A)

5. RHR Service Water System (Division A)

Hot shutdown can be accomplished by manual Reactor depressurization using ADS Division A from the Control Room. High pressure makeup and level control can be provided by RCIC operation from the Control Room. Low

pressure Reactor coolant makeup and level control will be provided by RHR (Division A) LPCI Mode after injection valves have been powered from MCC153. Extended cooling can be provided by LPCI Heat Exchanger, long term cooling can also be provided later by manual line-up of the RHR Shutdown Cooling mode after manual opening of 10-MOV-18.

III. Identify and Justify Any Required Manual Action

1. No manual operations are initially required in order to achieve the hot shutdown condition if ADS Division A and RCIC Division A are used. | R

2. If the assumed loss of inverter 3A actually occurs LPCI operation can be restored by manually closing breaker OG2 in MCC163. | R

3. Long term cooling in addition to LPCI Heat Exchanger may be provided by manually opening 10-MOV-18 if its control cables are actually affected. This will make RHR Shutdown Cooling available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Injection flow
    b) Pump discharge pressure
6. RHR System
    a) Pump discharge pressure
    b) Injection flow

7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

For fire zone RB-1C adequate protection is provided to prevent a fire in this fire zone from propagating to adjoining fire zone(s) RB-1B,-1A in which the redundant/diverse shutdown systems and/or cables are located. This is accomplished by the existing and proposed measures described below. These measures are considered commensurate with the level of protection required to ensure that adequate time is available for plant personnel to bring the unit to, and to maintain it in, the safe shutdown mode. These measures also prevent the occurence of any unrecoverable situation due to a postulated fire and provide protection based c defense in depth principle employed for reactor plant safety.

1. Existing Fire Protection

a. Zone Boundaries - a three hour rated fire barrier satisfying the requirements of 10CFR50, Section III.G.2 is provided at all zone boundaries with three exceptions which will be addressed as part of an exemption request based on additional modifications

assembled below. Piping and electrical penetration sleeves through these barriers are protected by 3 hours rated fire stops.

b. Detection Systems - The entire zone is equipped with area ionization detectors which alarm in the main Control Room.

c. Suppression Systems

| | Type | Actuation | Location |
|---|---|---|---|
| a | Water Sprav | Manual | Above Cable Trays, Elev. 272' at south west boundary of RB-1B |
| b | Hose Stations | Manual | Entire Area |

d. A trained fire brigade is continuously available with off-site backup.

e. The only intervening combustible between this zone and other zones is electrical cabling. All electrical cabling is classified as flame retardant based on recognized industry standards.

f. Roving operations and security patrols will contribute to an early indentification and action for plant fires.

g. Good housekeeping and the control of combustible materials is employed in this fire zone.

2. Planned Additional Fire Protection

a. The major combustibles in this fire zone are the flame retardant cables located in the cable tray system which is located throughout the fire zone. In providing the safe shutdown capability for this zone, it is conservatively assumed that all cable and equipment in this zone becomes disabled. The bases for protection is to contain the fire in this zone and not allow its propogation to other fire zones identified in Section V above.

To provide protection considered adequate for this zone the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A on elevation 300'-0". A three hour fire rated wall does not exist at this zone boundary. The only combustibles located in the vicinity of the fire zone boundary are flame retardant electrical cabling. These cables are not directly intervening because there is an open 6' horizontal air-gap between cabling in the two zones. There are no cables on either side of the zone boundary for 20 feet required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located at twenty feet to either side of the zone boundary is low (less than 25 cables total). Therefore, no additional modifications are considered necessary for this concern. R

*Deleted*

R

b. To provide protection considered adequate for this zone, the fire protection features described below are proposed, and an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1C) and zone RB-1A in the area of the connecting stairway between elevations 300' and 326' (northeast corner). This is the same request as for Zone RB-1A. A three hour fire rated enclosure does not presently isolate this stairway. The only combustibles located in the vicinity of the stairway is flame retardant cabling which pass through sleeves at the 326' elevation floor boundary which are adjacent to the stairway. These cables are all Division B cables which are <u>not</u> required for the safe shutdown capability required for a fire in zone RB-1C.

The only requirement for fire protection is to prevent the propagation of flame from Elevation 300' to Elevation 326' via the stairway. To resolve this concern, a fire barrier with fire-rated doors and dampers (if required), will be constructed around the stairway to mitigate the propagation of fire from zone RB-1C to RB-1A at this location. The fire rating of this barrier will be commensurate with the fire loading in the entire zones and the immediate area, and the distance of combustibles from the zone boundary to be isolated.

c. To provide protection considered adequate for this zone the fire protection features described below are proposed and, an exemption is requested from the requirements of Section III.G.2 of Appendix R for the interface between this zone (RB-1B) and zone RB-1C on the 300' elevation . A three hour fire-rated wall does not exist at this zone boundary. The only combustible located in the vicinity of the fire zone boundary is flame retardant electrical cabling. There are no cables on either side of the zone boundary for 20 feet which are required for the proposed shutdown path for a fire in this zone. In addition, the fire loading resulting from cabling located within twenty feet of the zone boundary is relatively low. To resolve this concern, the intervening cable trays, which are located at or within twenty feet separation of redundant/diverse circuit or equipment will be equipped with a water spray system to mitigate postulated cable combustion. The density and distribution of the spray will be commensurate with the fire loading resulting from the

intervening flame retardant cabling. The spray system will be a pre-action system equipped with fusible link spray heads. The pre-action valve will be automatically opened by heat detectors near the cable trays and the boundary of the zone.

d. In order to prevent a fire in zone RB-1C Elev 300' from propagating to zone RB-1A Elev 326' through the open hatch located in the northwest corner, a new concrete plug with a 3 hour rating will be provided. This ensures compliance with 10CFR50 Appendix R. Section III.G.2. R

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA CR-1

## Main Control Room-El. 300'-0"

I. Safe Shutdown Systems Disabled

All Division A and Division B Systems are assumed disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown will be accomplished using alternate shutdown capability. (See Section 5.0)

III. Identify And Justify Any Required Manual Operation

Not Applicable

IV. Necessary Instrumentation Available in Control Room

Not Applicable

V. Methods of Protecting Shutdown Capability

Not Applicable

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RR-1

Relay Room-El. 284'-8"

I. Safe Shutdown Systems Disabled

All Division A and Division B Systems are assumed disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown will be accomplished using alternate shutdown capability. (See Section 5.0)

III. Identify And Justify Any Required Manual Operation

Not Applicable

IV. Necessary Instrumentation Available in Control Room

Not Applicable

V. Methods of Protecting Shutdown Capability

Not Applicable

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA CS-1

### Cable Spreading Room-El. 272' 0"

I. Safe Shutdown Systems Disabled

All Division A and Division B Systems are assumed disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown will be accomplished using alternate shutdown capability. (See Section 5.0)

III. Identify And Justify Any Required Manual Operation

Not Applicable

IV. Necessary Instrumentation Available in Control Room

Not Applicable

V. Methods of Protecting Shutdown Capability

Not Applicable

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA MG-1

Motor Generator Room-Reactor Building-El. 300'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIPE AREA/ZONE SUMMARY SHEET

FIRE AREA AD-1

Administration Building-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. HPCI System

    a) Pump discharge pressure

    b) Injection flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA AD-2

Administration Building-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA AD-3

Administration Building-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA AD-4

### Administration Building-El. 286'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. HPCI System

    a) Injection flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA AD-5

Administration Building-El. 286'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

AREA FIRE AD-6

Administration Building-El. 286'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

1. ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

2. De-energize all non-essential circuits in Control Room and Relay Room since Control Room, Relay and Battery Room ventilation systems are affected.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA CR-2

Radwaste Building Control Room-El. 284'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System

a) Pump discharge pressure

b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA CT-1

Cable Tunnel West-El. 260'-0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems. SADS (Division B) can be operated from local control panel 02ADS-071. All other Division B systems can be operated from the Control Room.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071 since ADS Division A is not available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray Systems
    a) Pump discharge pressure
    b) Injection flow
6. RHR System

a) Pump discharge pressure

b) Injection flow

7. HPCI System

a) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA CT-2

Cable Tunnel East/El. 260'-0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled. Core Spray of Division A is also disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems except Core Spray. RHR valve 10MOV-16A must be manually closed. Except for this manual operation, all other systems can be operated from the Control Room.

III. Identify and Justify Any Required Manual Action

1. ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

2. Local manual operation of 10MOV-16A is required. The control cable of this valve is assumed to have been affected and spurious activation could occur.

IV. Necessary Instrumentation Available in Control Room For a Fire in this Area:

1. Reactor Pressure

2. Reactor Water Level

3. Suppression Pool Temperature*

4. Suppression Pool Level

5. Core Spray System

   a) Pump discharge pressure

   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. RCIC System

   a) Pump discharge pressure*

   b) Injection flow*

8. RHR Service Water

   a) Pump flow

* Cables for this instrumentation will be rerouted from the fire area to ensure its availability.

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA CT-3

Cable Tunnel-El. 286'-0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled. RCIC Division A is partially disabled. (See Section III).

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Prior to initiation of RCIC, Division B RCIC logic control power fuse in panel 09-33 in the Relay Room must be removed and RCIC isolation valve 13MOV-15 must be manually operated.

III. Identify and Justify Any Required Manual Action

1. Remove RCIC logic control power fuse in Panel 09-33 in Relay Room. The RCIC "B" logic control cables are assumed to have been affected, therefore to ensure the preclusion of spurious signals the fuse must be removed.

2. Local operation of 13MOV-15 is required. The control cable is assumed to have been affected, which may cause the normally open isolation valve to close. Therefore to ensure operation of RCIC System, manual action may be required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow
7. RCIC System
   a) Pump discharge pressure
   b) Injection flow
8. RHR Service Water
   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).
2. Planned additional fire protection features: NONE.
3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA CT-4

Cable Tunnel-El. 286'-0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled. HPCI Division B is partially disabled. (See Section III.)

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems. Prior to initiation of HPCI, the Division A HPCI logic control power fuse in Panel 09-32 in the Relay Room must be removed and HPCI isolation valve 23MOV-15 must be manually operated. ADS is operated at the local control panel 02ADS-071.

Except for those local operations, the above systems can be operated from the Control Room.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Since ADS Division A is not available.

Remove HPCI logic control power fuse in panel 09-33 in Relay Room. The HPCI "A" logic control cables are assumed to have been affected, therefore to ensure the preclusion of spurious signals, the fuse must be removed.

Operation of 23MOV-15 is required. The control cable is assumed to have been affected, which may cause spurious activation of the valve.

Therefore, to ensure that the steam supply valve is open, manual action may be required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow
7. HPCI System
   a) Pump discharge pressure
   b) Injection flow
8. RHR Service Water
   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).
2. Planned additional fire protection features: NONE.
3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA TB-1 (ZONES TB-11,12,13)

Turbine Building-El. 252'-0", El. 292'-0" and

El. 300'0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems from the Control Room with local operation of ADS from panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5 Core Spray System
   a) Pump discharge pressure

b) Injection flow

6. RHR System

a) Pump discharge pressure

b) Injection flow

7. HPCI System

a) Pump discharge pressure

b) Flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. <u>Methods of Protecting Shutdown Capability</u>

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA RW-1

Radwaste Building-Pipe Tunnel-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. HPCI System

    a) Pump discharge pressure

    b) Flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA SH-13

### Screenwell House-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. <u>Methods of Protecting Shutdown Capability</u>

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA SW-1

### Turbine Building-Switchgear Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA SW-2

### Turbine Building Switchgear Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify and Justify Any Required Manual Action

No manual action required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature*
4. Suppression Pool Level
5. Core Spray System
    - a) Pump discharge pressure
    - b) Injection flow
6. RHR System
    - a) Pump discharge pressure
    - b) Injection flow
7. RCIC System

a) Pump discharge pressure*

b) Flow*

8. RHR Service Water

a) Pump flow

* Cables for this instrumentation will be rerouted from the fire area to insure its availability.

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA FP-1

### Diesel Fire Pump Room

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA FP-2

### Foam Room-Turbine Building-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. HPCI System

    a) Pump discharge

    b) Injection flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA SG-1

Standby Gas Filter Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequently cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA AS-1

### Auxiliary Boiler Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA BR-1

Battery Room

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Since ADS Division A is not available.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure

b) Injection flow

7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

# FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA BR-2

### Battery Room

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems, operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071, Since ADS Division A is not available. R

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RHR Service Water

   a) Pump flow

V. <u>Methods of Protecting Shutdown Capability</u>

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA BR-3

### Battery Room-Reactor Building-El. 272'-0"

I. Safe Shutdown Systems Disabled

Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify And Justify Any Required Manual Action

No Manual action required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow
7. HPCI System

a) Pump discharge pressure

b) Flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA BR-4

### Battery Room

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify and Justify Any Required Manual Action. | R

No Manual action required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    - a) Pump discharge pressure
    - b) Injection flow
6. RHR System
    - a) Pump discharge pressure
    - b) Injection flow
7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA BR-5

Battery Room - Corridor Reactor Building-El. 272'0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot shutdown can be accomplished using ADS (Division A) to depressurize with Core Spray (Division A) or LPCI for cooling. Cold shutdown can be accomplished using RHR Shutdown Cooling or Suppression Pool Cooling.

III. Identify and Justify any Manual Action. | R

No manual action required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA EG-1

### Emergency Diesel Generator Room-El. 272'0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems operated from the Control Room with ADS operation from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray Systems
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA EG-2

### Emergency Diesel Generator Room-El. 272'0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division B systems operated from the Control Room with ADS operation from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray Systems
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow

7. HPCI System

    a) Pump discharge pressure

    b) Injection flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA EG-3

### Emergency Diesel Generator Room-El. 272'0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify and Justify Any Required Manual Action

No manual action is required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA EG-4

### Emergency Diesel Generator Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify and Justify Any Required Manual Action

No manual operation is required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow
6. RHR System
   a) Pump discharge pressure
   b) Injection flow
7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA EG-5

Emergency Diesel Generator Switchgear Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division B systems.

Except for local operations described below, Division B systems can be operated from the Control Room.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071.

Operation of 10MOV-16B may be required since control cables in the RHR system are assumed to be affected.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure

b) Injection flow

6. RHR System

    a) Pump discharge pressure

    b) Injection flow

7. HPCI System

    a) Pump discharge pressure

    b) Injection flow

8. RCIC System

    a) Pump discharge pressure

    b) Injection flow

9. RHR Service Water

    a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA EG-6

Emergency Diesel Generator Switchgear Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems.

Except for local operations described below, Division A systems can be operated from the Control Room.

III. Identify and Justify Any Required Manual Action

Operation of 10MOV-16A may be required since control cables in the RHR system are assumed to be affected.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System

a) Pump discharge pressure

b) Injection flow

7. HPCI System

   a) Pump discharge pressure

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA SP-1

Service Water Pump Room

I. Safe Shutdown Systems Disabled

All Division B systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division A systems operated from the Control Room.

III. Identify and Justify Any Required Manual Action

No manual operation is required.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow
7. HPCI System

a) Pump discharge pressure

b) Injection flow

8. RCIC System

a) Pump discharge pressure

b) Injection flow

9. RHR Service Water

a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA SP-2

Service Water Pump Room

I. Safe Shutdown Systems Disabled

All Division A systems are assumed to be disabled.

II. Shutdown Capability

Hot and cold shutdown can be accomplished using Division B systems operated from the Control Room with ADS operation from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure
    b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA OR-1

Turbine Building - Turbine Oil Storage Room

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA OR-2

Turbine Building - Turbine Oil Storage Room

I. Safe Shutdown Systems Disabled

No safe shutdown systems a. isabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA OR-3

### Turbine Building

### Misc. Oil Storage Room-El. 272'-0"

I. Safe Shutdown Systems Disabled

No safe shutdown systems are disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B valves can be operated from Panel 02 ADS-071. Note, however, that ADS Division A is available and can be operated from the Control Room.

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
   a) Pump discharge pressure
   b) Injection flow

6. RHR System

   a) Pump discharge pressure

   b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection as noted in this report (See Table 2.0).

2. Planned additional fire protection features: NONE.

3. The area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

## FIRE AREA/ZONE SUMMARY SHEET

## FIRE AREA SU-1

### Torus Room

I. Safe Shutdown Systems Disabled

No safe shutdown systems are assumed disabled.

II. Shutdown Capability

Hot and subsequent cold shutdown can be accomplished using Division A systems operated from the Control Room. Shutdown can also be accomplished using Division B systems operated from the Control Room with local operation of ADS from local control panel 02ADS-071.

III. Identify and Justify Any Required Manual Action

ADS Division B Valves can be operated from Panel 02A DS-071. Note, however, that ADS Division A is available and and can be operated from the control room

R

IV. Necessary Instrumentation Available in Control Room

1. Reactor Pressure
2. Reactor Water Level
3. Suppression Pool Temperature
4. Suppression Pool Level
5. Core Spray System
    a) Pump discharge pressure
    b) Injection flow
6. RHR System
    a) Pump discharge pressure

b) Injection flow

7. HPCI System

   a) Pump discharge pressure

   b) Injection flow

8. RCIC System

   a) Pump discharge pressure

   b) Injection flow

9. RHR Service Water

   a) Pump flow

V. Methods of Protecting Shutdown Capability

1. Existing protection

Within this fire area there are no exposed sources of combustible materials, therefore the occurrence of a fire is not postulated. Flame retardant cables in this area are all enclosed in rigid conduit. Even though an individual cable may short electrically, it would not cause a fire since their would be essentially no oxygen to support combustion. This area has controlled access. It can be assured that no transient combustibles would be accidently brought in or stored in this area.

Additionally, the only equipment required in this area is the RHR Pump Suction Valves 10MOV151A & B which have had their power cables electrically disabled under a previously approved plant modification, and are in the open position. This ensures this flowpath will be available during a fire in any area.

2. Planned Additional Fire Protection

No additional fire protection is provided. An exemption request to the requirements of Appendix R, Section III.G.2, III.G.3 and III.L is provided based upon the existing installation as outlined above.

3. This area meets the requirements of Appendix R Section III.G.2.a. It is bounded by a three (3) hour fire barrier. Therefore, no additional protection is required.

FIRE AREA/ZONE SUMMARY SHEET

FIRE AREA PC-1

Primary Containment (Drywell)

I. Safe Shutdown Systems Disabled

Not Applicable.

II. Shutdown Capability

Primary containment is inerted with nitrogen to less than 4 percent oxygen during operation and therefore no fires are postulated in this fire zone.

III. Identify and Justify Any Required Manual Action

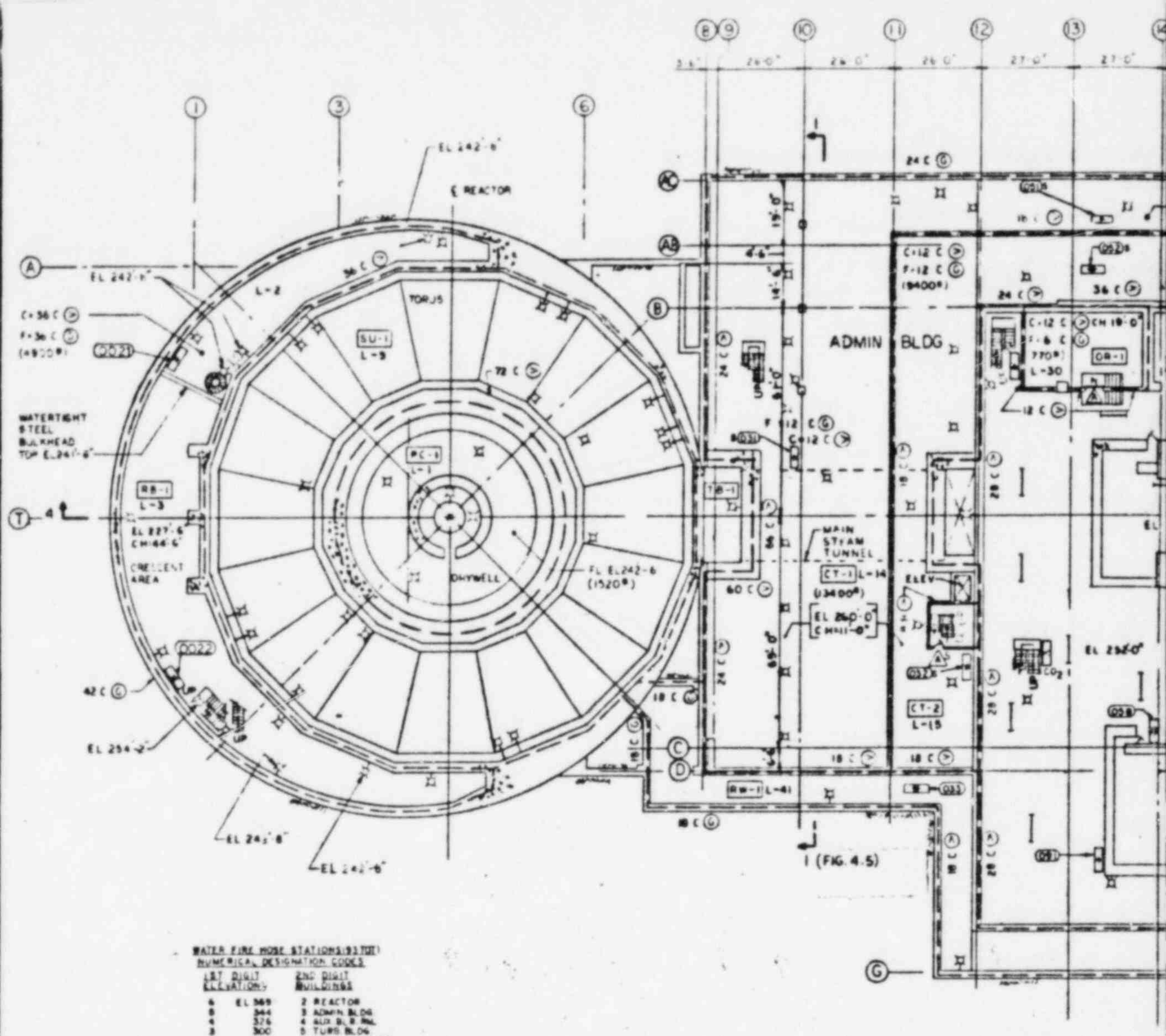
Not Applicable.

IV. Necessary Instrumentation Available in Control Room

Not Applicable.

V. Methods of Protecting Shutdown Capability

No Applicable.




WATER FIRE HOSE STATIONS (93 TOT)
NUMERICAL DESIGNATION CODES

| 1ST DIGIT ELEVATIONS | | 2ND DIGIT BUILDINGS | |
|---|---|---|---|
| 6 | EL 369 | 2 | REACTOR |
| 5 | 344 | 3 | ADMIN BLDG |
| 4 | 326 | 4 | AUX B. R. RM. |
| 3 | 300 | 5 | TURB BLDG |
| 2 | 284 | 6 | EMER GEN BLDG |
| 1 | 272 | 7 | SCREENWELL HS |
| 0 | 262 | 8 | RADWASTE BLDG |
| 00 | BELOW 262 | 9 | HEATER BAY |

LEGEND:

① WALL FLOOR & CEILING DESIGNATIONS ARE BASED ON A FOUR DIGIT SYSTEM AS FOLLOWS:

FIRST DIGIT:
W = WALL (NOT REQUIRED ON PLAN VIEW)
F = FLOOR
C = CEILING

SECOND DIGIT:
THICKNESS IN INCHES (BASE MATERIAL)

THIRD DIGIT: MATERIALS
B = CONCRETE BLOCK
C = CONCRETE
M = INSULATED METAL SIDING
S = INSULATED METAL DECK

FOURTH DIGIT: FIRE RATING
Ⓖ = BACKED BY GRADE (NO HAZARD)
Ⓞ = OUTSIDE WALL OR CEILING
Ⓒ = LESS THAN 3 HR FIRE RATING
Ⓓ = EQUAL TO OR GREATER THAN 3 HR FIRE RATING

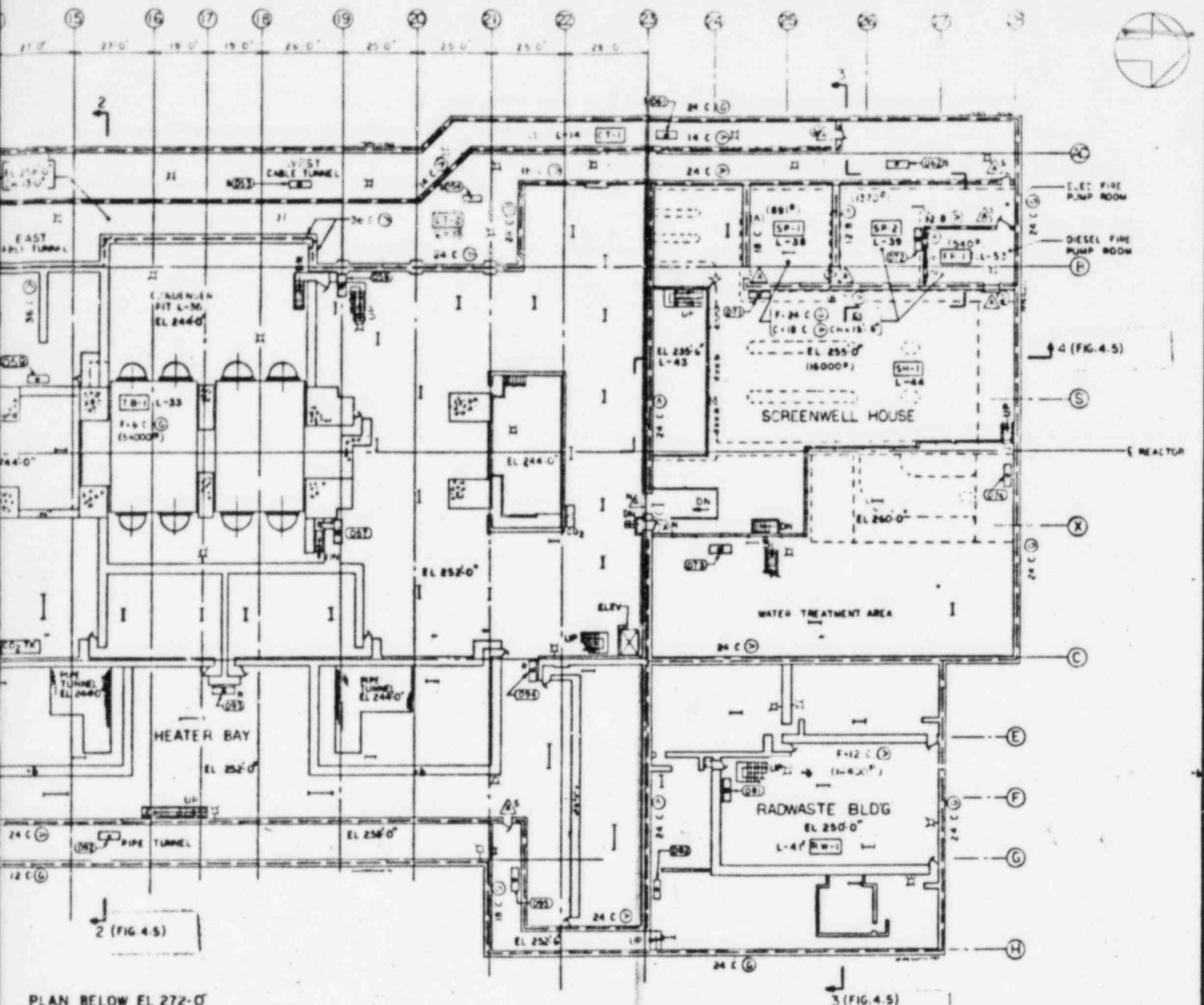
EXAMPLE:
DIGIT 4
3
2
1
C = 12 C Ⓓ
CEILING
12" THICK
CONCRETE
EQUAL TO OR GREATER THAN 3 HR FIRE RATING

② ▭ = DESIGNATES A FIRE AREA
— — — BOUNDARY OF FIRE AREA

FIRE AREA DESIGNATIONS ARE BASED ON THE FOLLOWING:
AD = ADMINISTRATION BUILDING
AS = AUXILIARY STEAM BOILER ROOM
BR = BATTERY ROOM
CR = CONTROL ROOM
CS = CABLE SPREADING ROOM
CT = CABLE TUNNEL
EG = EMERGENCY GENERATOR (DIESEL)
FP = FIRE PROTECTION ROOM
MG = MOTOR GENERATOR ROOM
OR = OIL ROOM
PC = PRIMARY CONTAINMENT
RR = RELAY ROOM
RW = RAD WASTE
SG = STANDBY GAS TREATMENT
SH = SCREENWELL HOUSE
SP = SAFETY RELATED PUMPS
SU = SAFETY RELATED TANKS (SUPPRESSION)
SW = SWITCHGEAR ROOM
TB = TURBINE BUILDING
XR = TRANSFORMER
RB = REACTOR BLDG

EXAMPLE:
AD-5
ADMINISTRATION BUILDING
AREA 5

L-1, L-2, ECT - FIRE HAZARD ANALYSIS WORK SHEET LINE NUMBER




PLAN BELOW EL 272'-0"

20' 40' 60' 80'

1" = 20'-0" FULL SIZE
1" = 50'-0" REDUCED

- = EXISTING 3 HR FIRE RATED DOOR
- = 1½ HR FIRE RATED DOORS
- = $CO_2$ HOSE REEL
- = WATER HOSE REEL
- = WATER HOSE CABINET
- CH = CEILING HEIGHT
- = HAND RAIL
- = EMERGENCY LIGHT (FLUORESCENT)
- = EMERGENCY LIGHT (INCANDESCENT)
- = EMERGENCY LIGHT (INCANDESCENT)(WALL MOUNTED)
- = EMERGENCY LIGHT (MERCURY VAPOR)
- = ARROW INDICATES DIRECTION OF LIGHT
- S = SUPERVISED DOOR (BY SECURITY SYSTEM)
- N = NON-SUPERVISED DOOR
- F = AUTOMATIC FIRE DOOR
- = HOSE STATION NUMBER, S SUFFIX DENOTES SEISMIC SUPPORTS

NOTES:
1. THESE PLANS & SECTIONS HAVE BEEN TRACED FOR FIRE HAZARD ANALYSIS ONLY. WALL THICKNESSES, DOOR SWINGS, ETC. MAY NOT BE EXACT. REFER TO CONSTRUCTION DRAWINGS FOR EXACT DETAILS

FOR INFORMATION ONLY

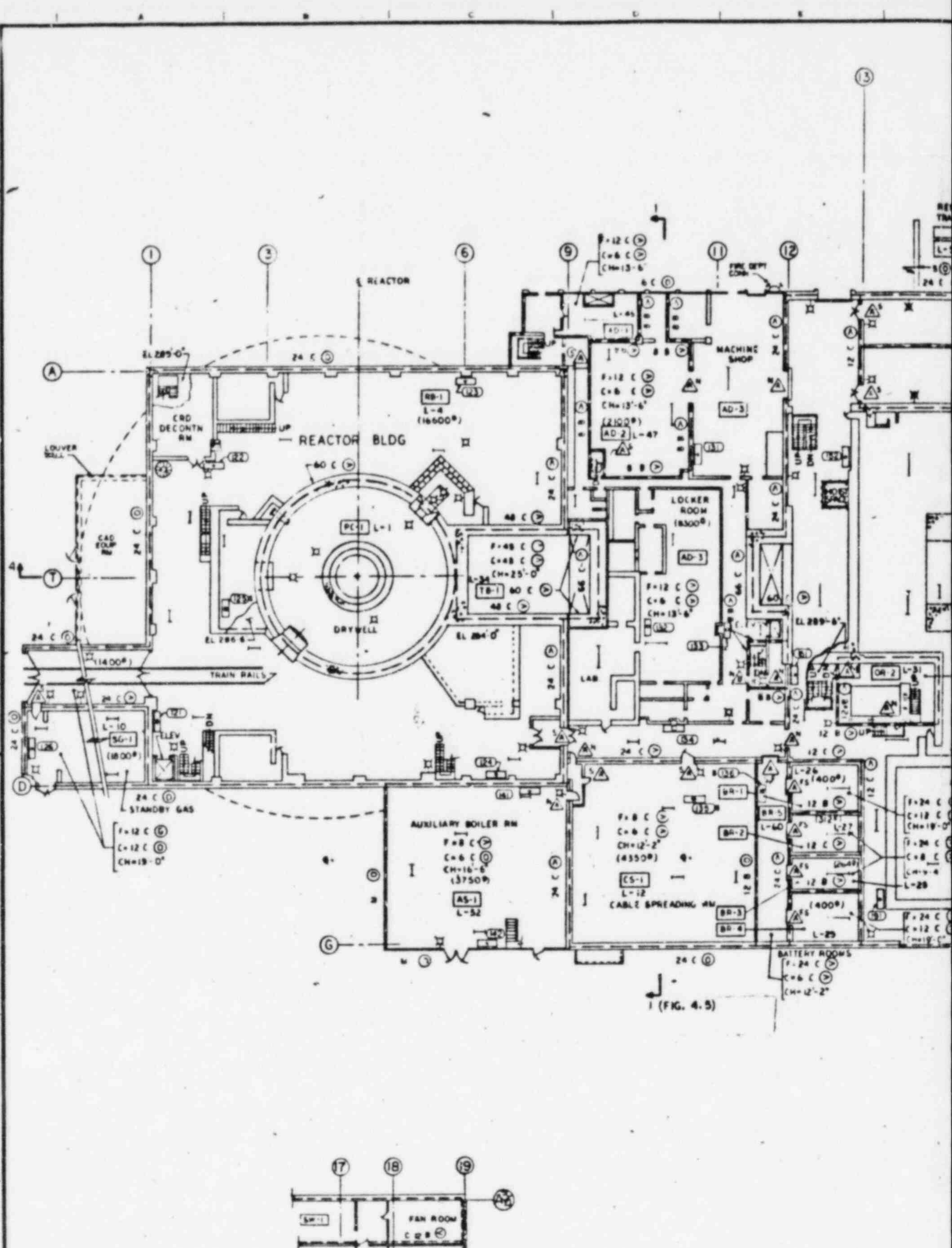
| ISSUE | DESCRIPTION | CHKD | CORR | APPR | DATE |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | ORIGINAL ISSUE | | | | |

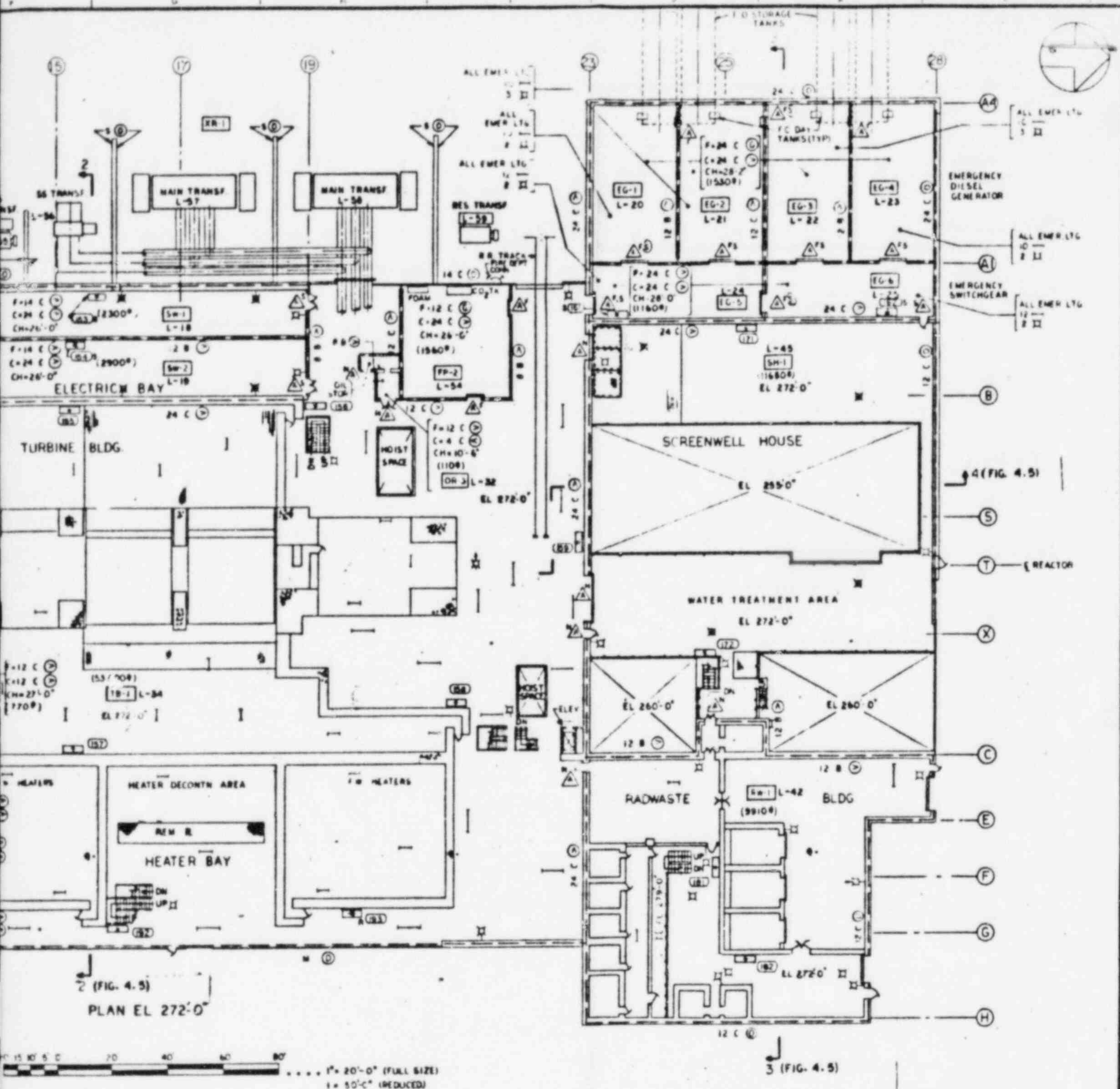
POWER AUTHORITY OF THE STATE OF NEW YORK

**JAMES A. FITZPATRICK**
NUCLEAR POWER PLANT

FIRE HAZARD ANALYSIS
PLAN BELOW EL 272'-0"

FIGURE 4.1


REACTOR BLDG
DRYWELL
℄ REACTOR
CRD DECONTN RM
LOUVER WALL
CAD EQUIP RM
TRAIN RAILS
STANDBY GAS
ELEV
AUXILIARY BOILER RM
CABLE SPREADING RM
LOCKER ROOM
MACHINE SHOP
LAB
BATTERY ROOMS
FAN ROOM
FAN ROOM
FIRE DEPT CONN
EL 289'-0"
EL 286'-6"
EL 284'-0"
EL 289'-6"
RB-1
L-4
(16600#)
PC-1 L-1
TB-1
SG-1
L-10
(1800#)
(1400#)
AS-1
L-52
(3750#)
CS-1
L-12
(4350#)
AD-1
AD-2 L-47
AD-3
(2100#)
(6300#)
BR-1
BR-2
BR-3
BR-4
BR-5
DR-2 L-31
SW-1
SW-2
F=12 C
C=6 C
CH=13'-6"
F=48 C
C=48 C
CH=25'-0"
F=8 C
C=6 C
CH=16'-6"
CH=12'-2"
CH=19'-0"
F=24 C
C=6 C
CH=12'-2"
24 C
60 C
12 B
I (FIG. 4.5)
PLAN EL 286'-0"




FOR INFORMATION ONLY

| ISSUE | DESCRIPTION | CHKD | CORR | APPR | DATE |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | ORIGINAL ISSUE | | | | |

POWER AUTHORITY OF THE STATE OF NEW YORK

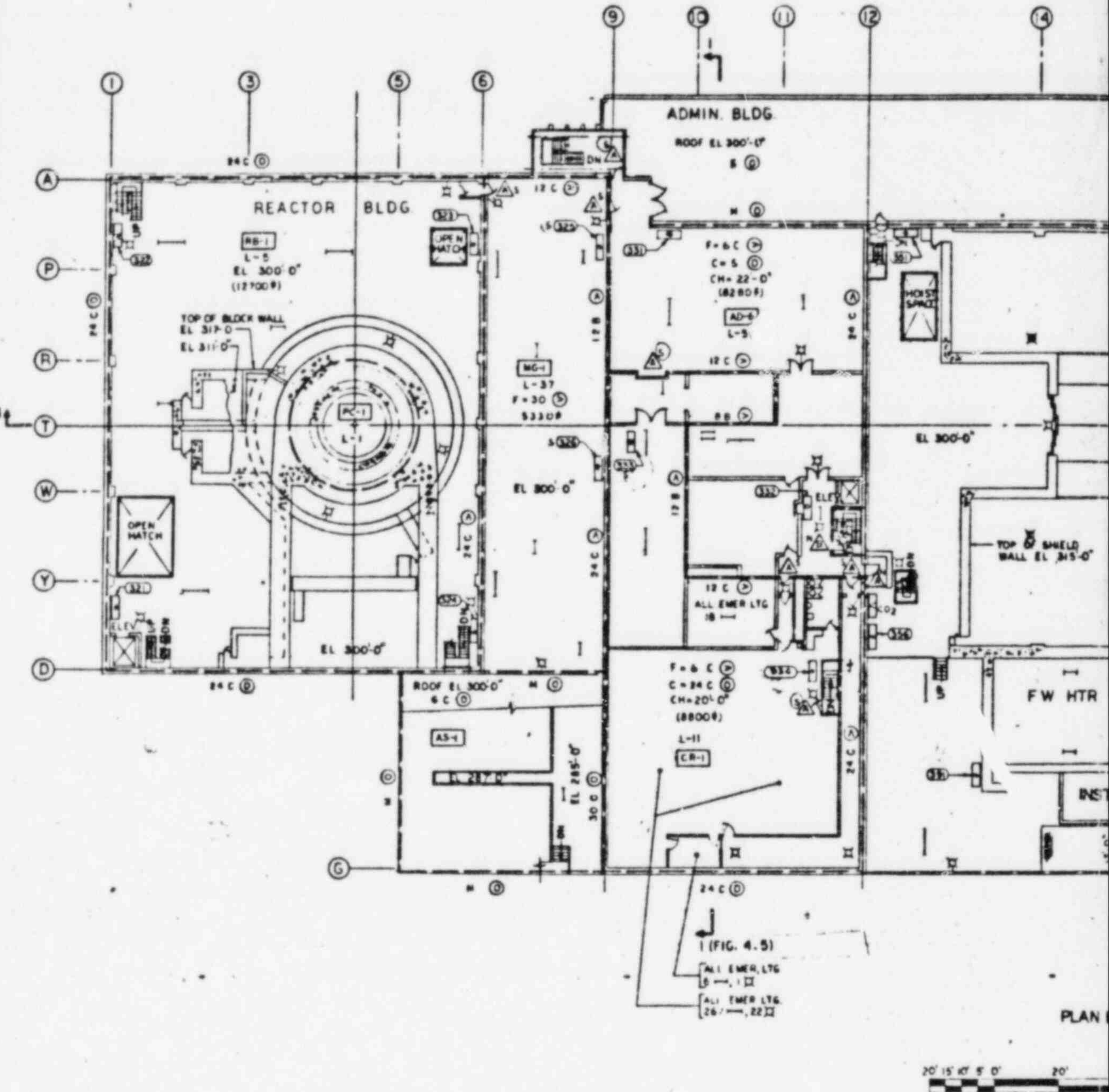
**JAMES A. FITZPATRICK**

NUCLEAR POWER PLANT

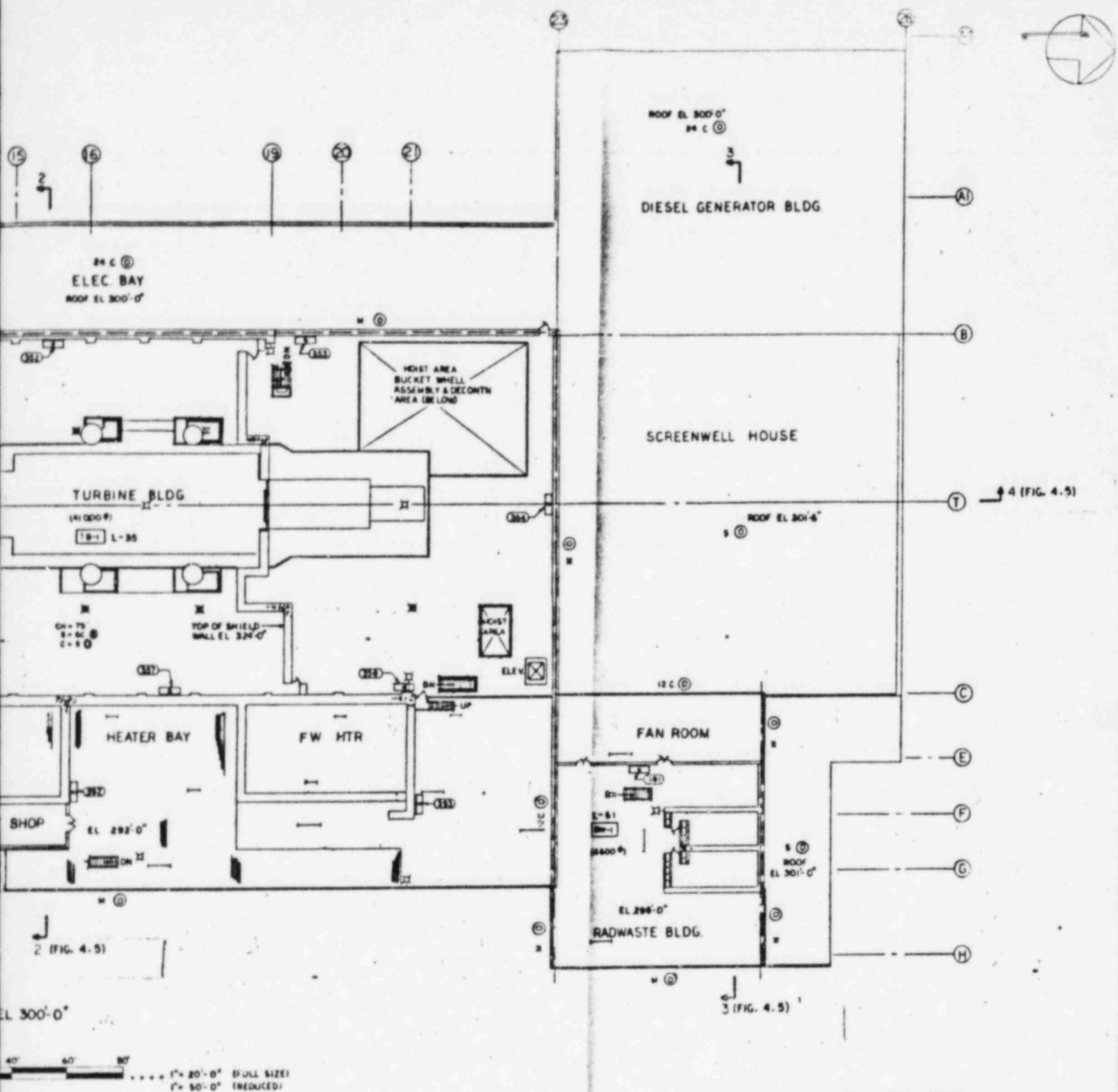
FIRE HAZARD ANALYSIS

PLAN EL 272'-0"

FIGURE 4.2



ADMIN. BLDG
ROOF EL 300'-0"
REACTOR BLDG
RB-1
L-5
EL 300'-0"
OPEN HATCH
TOP OF BLOCK WALL
EL 317'-0"
EL 311'-0"
PC-1
L-1
MG-1
L-37
EL 300'-0"
AD-6
CH= 22'-0"
HOIST SPACE
TOP OF SHIELD WALL EL 315'-0"
ALL EMER LTG
ELEV
ROOF EL 300'-0"
AS-1
EL 285'-0"
CR-1
L-11
CH=20'-0"
FW HTR
INST
1 (FIG. 4.5)
ALL EMER. LTG
PLAN




FOR INFORMATION ONLY

| ISSUE | DESCRIPTION | CHKD | CORR | APPR | DATE |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | ORIGINAL ISSUE | | | | |

POWER AUTHORITY OF THE STATE OF NEW YORK

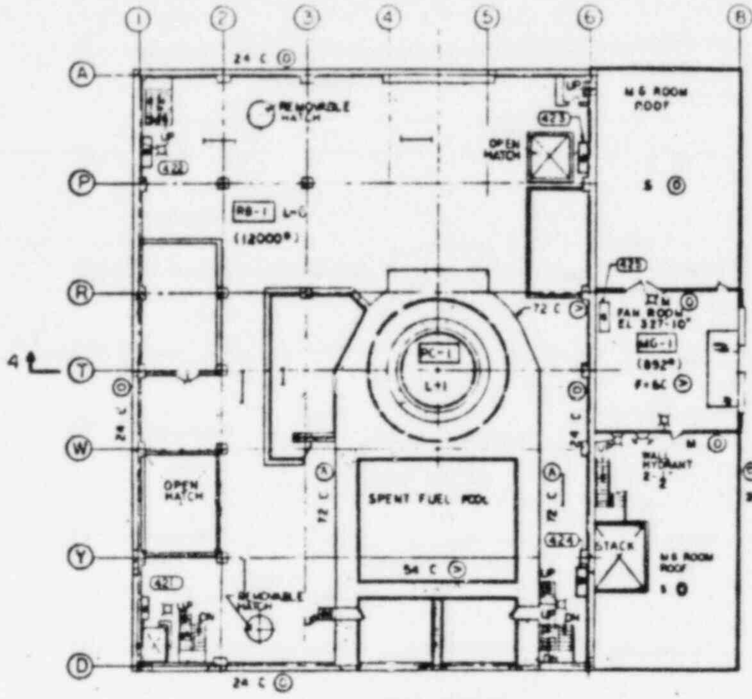
**JAMES A. FITZPATRICK**

NUCLEAR POWER PLANT

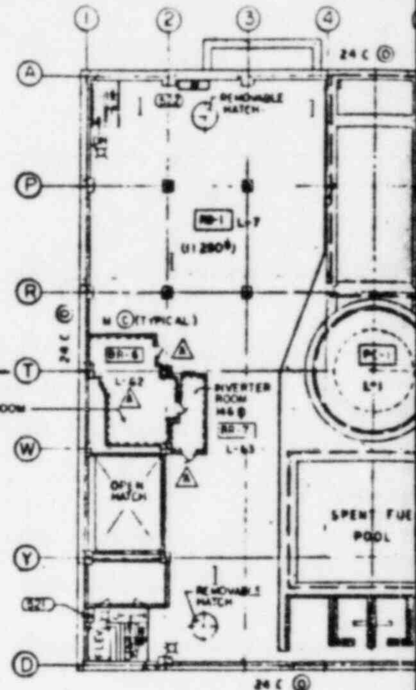
FIRE HAZARD ANALYSIS

PLAN EL 300'-0"

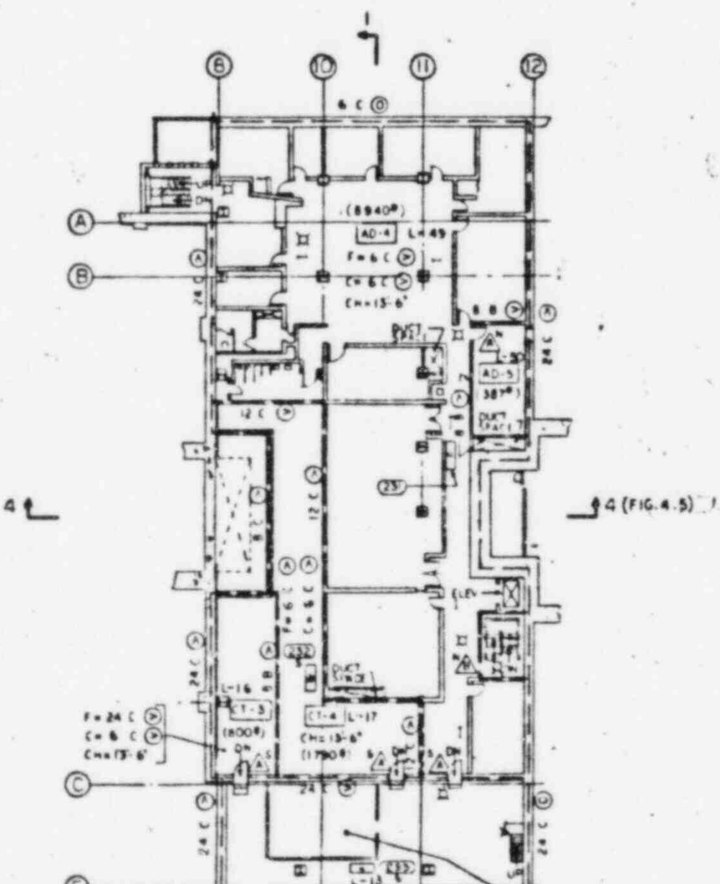
FIGURE 4.3



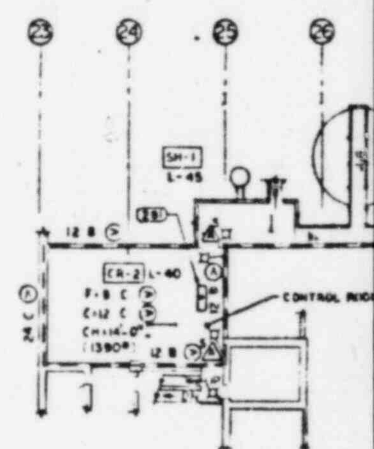

PLAN EL 326'-9"
REACTOR BLDG



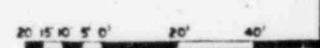

PLAN EL 344'-6"
REACTOR BLDG

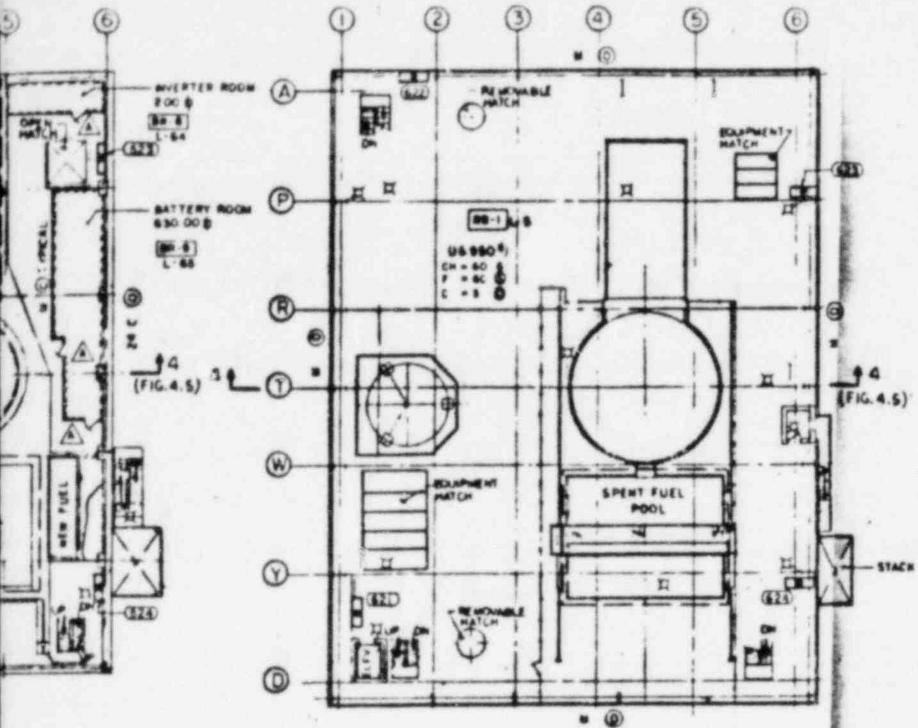



PLAN EL 285'-0"
ADMIN BLD'G

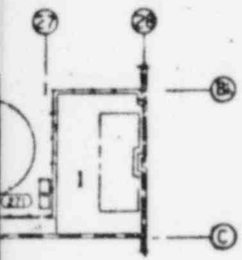



PLAN EL284'-0"
RADWASTE & SCREENWELL HOUS






PLAN EL 369'-6"
REACTOR BLDG



1" = 20'-0" (FULL SIZE)
1" = 50'-0" (REDUCED)

THE INFORMATION ON THIS DRAWING MAY NOT BE COPIED OR USED FOR OTHER THAN THE CONSTRUCTION, MAINTENANCE OR REPAIR OF THE PLANT FACILITY DESCRIBED IN THE TITLE BLOCK

FOR INFORMATION ONLY

| ISSUE | DESCRIPTION | CHKD | CORR | APPR | DATE |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | ORIGINAL ISSUE | | | | |

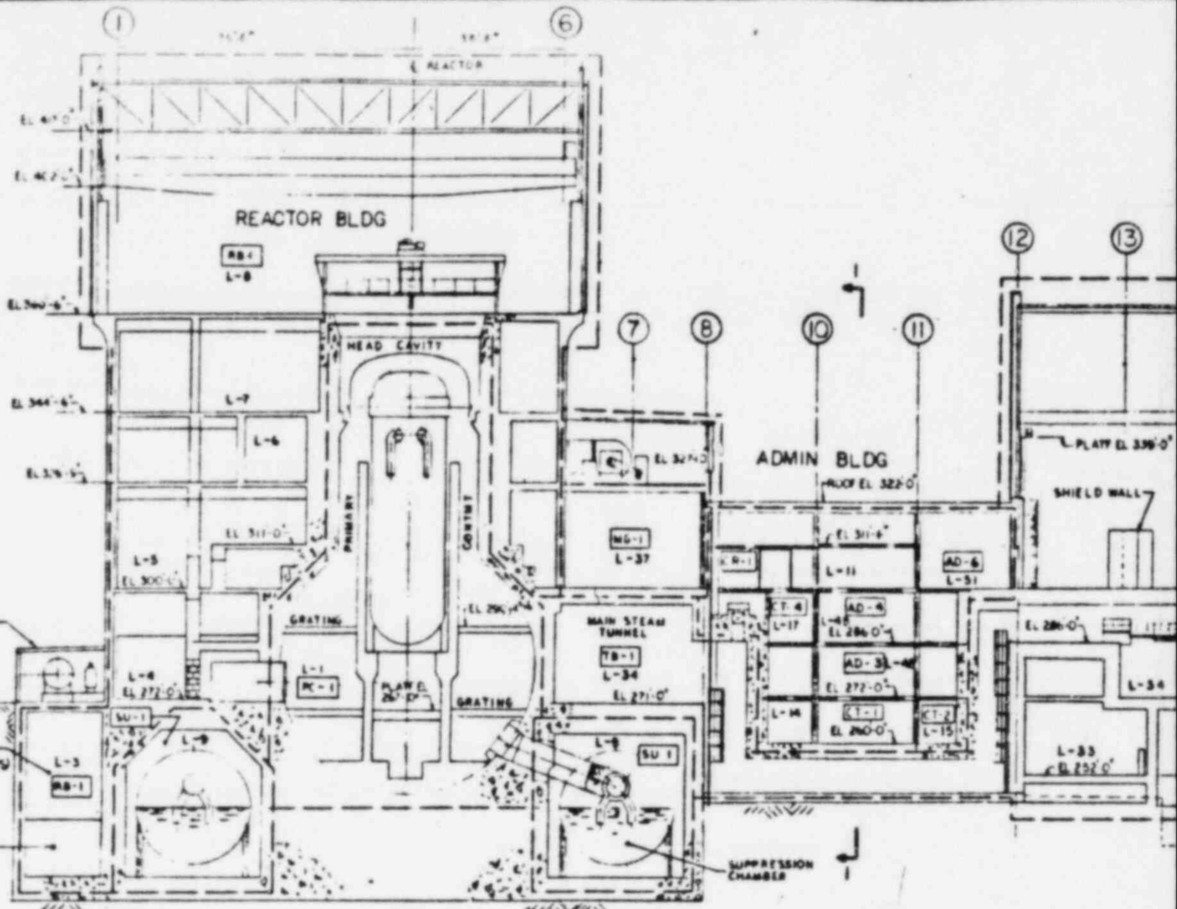
POWER AUTHORITY OF THE STATE OF NEW YORK

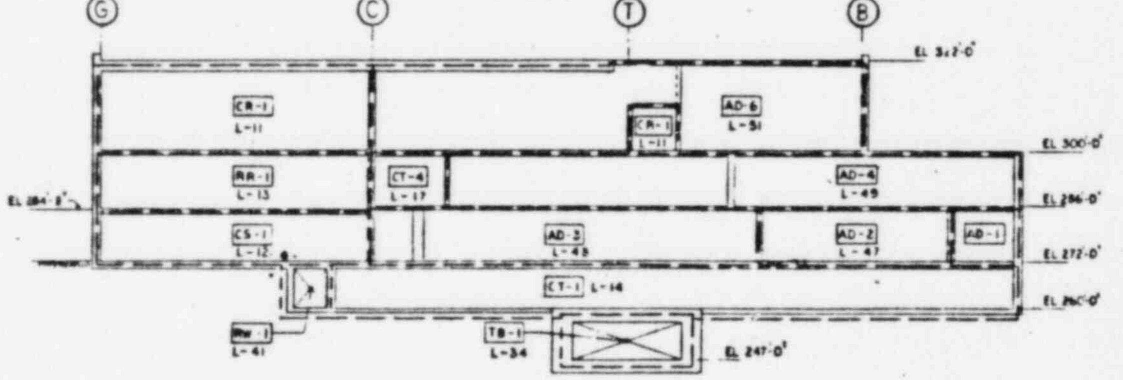
**JAMES A. FITZPATRICK**

NUCLEAR POWER PLANT

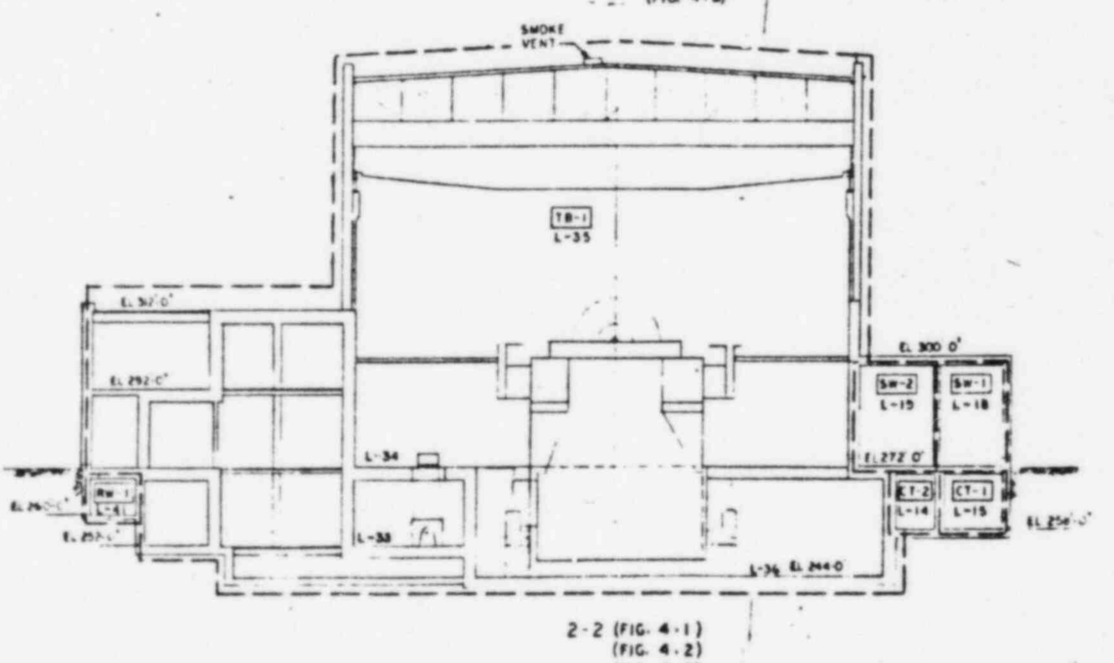
FIRE HAZARD ANALYSIS
PLANS

FIGURE 4.4

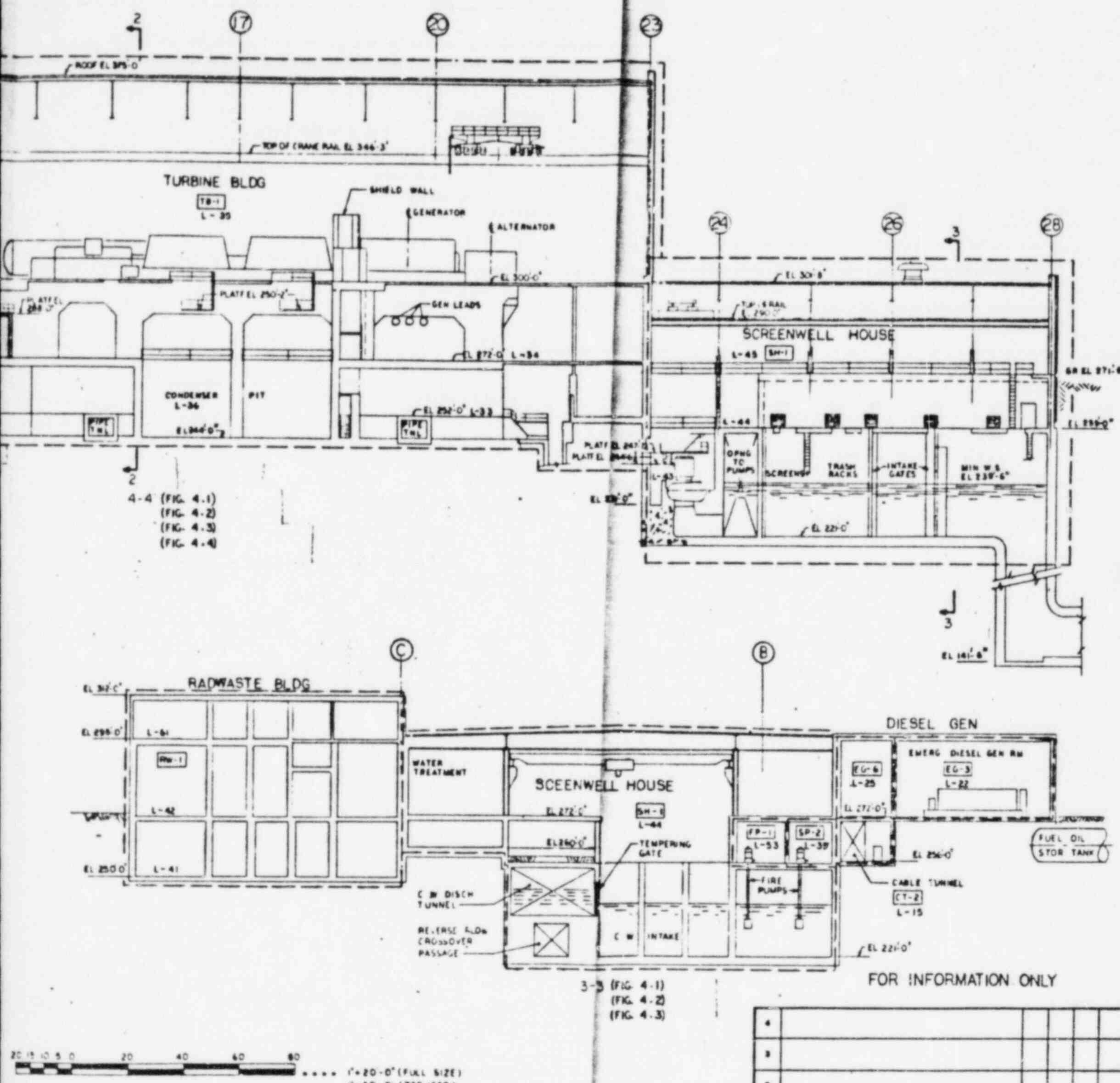



1-1 (FIG. 4-1)
(FIG. 4-2)
(FIG. 4-3)




2-2 (FIG. 4-1)
(FIG. 4-2)
(FIG. 4-3)




FOR INFORMATION ONLY

| | | | | | |
|---|---|---|---|---|---|
| 4 | | | | | |
| 3 | | | | | |
| 2 | | | | | |
| 1 | ORIGINAL ISSUE | | | | |
| ISSUE | DESCRIPTION | CHKD | CORR | APPR | DATE |

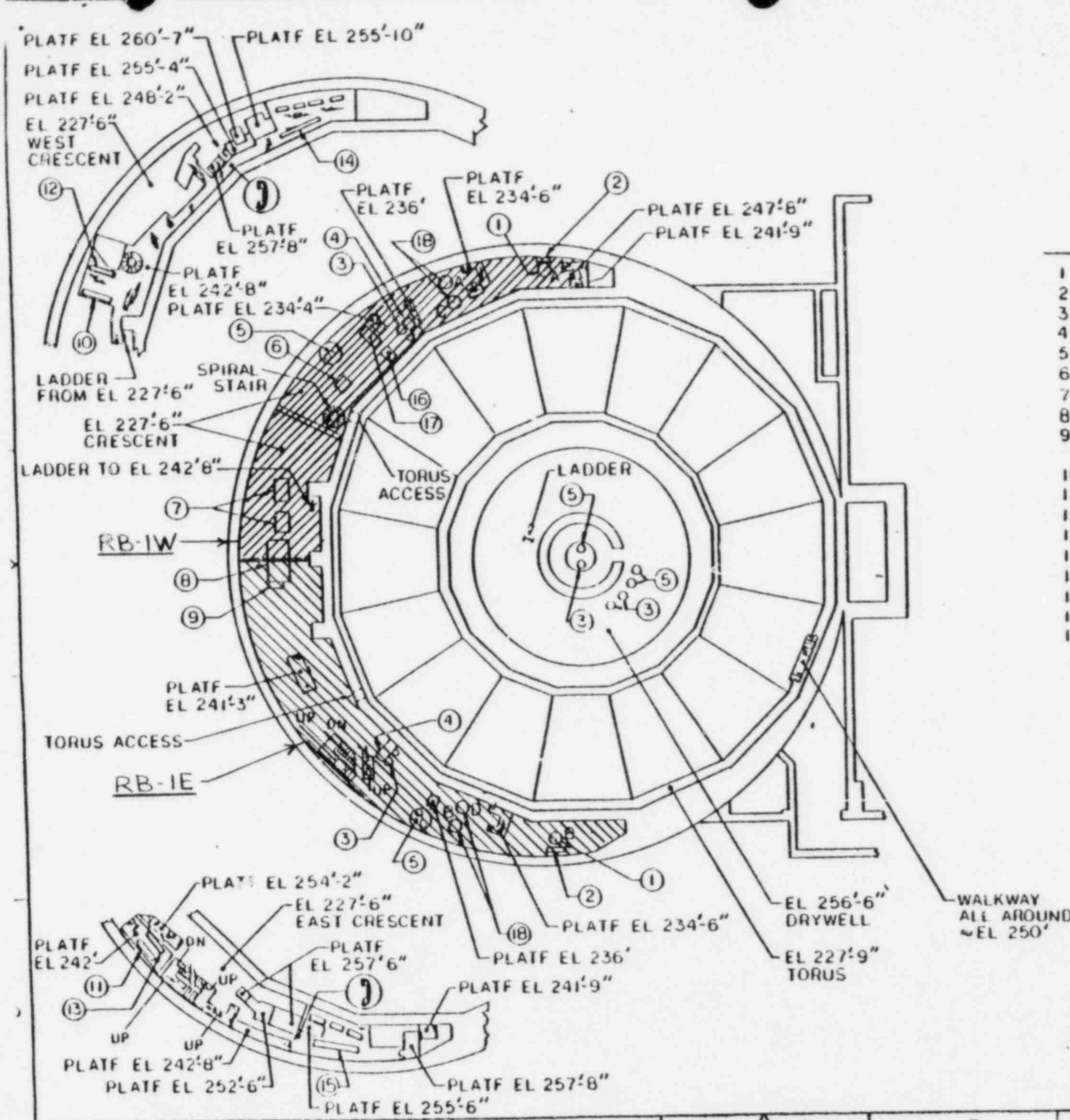
POWER AUTHORITY OF THE STATE OF NEW YORK

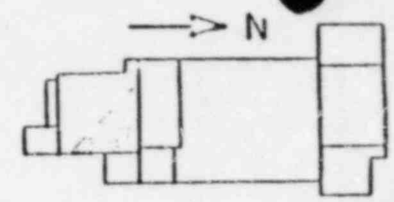
**JAMES A. FITZPATRICK**

NUCLEAR POWER PLANT

FIRE HAZARD ANALYSIS
SECTIONS

FIGURE 4.5



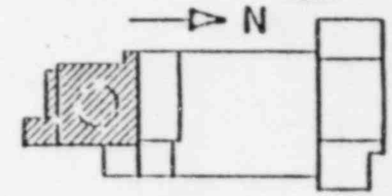

| | EQUIPMENT | ZONE |
|---|---|---|
| 1 | CORE SPRAY PUMP(2) | C2,C4 |
| 2 | CORE SPRAY HOLDING PUMP(2) | C2,C4 |
| 3 | EQUIP. DRAIN SUMP(5) | B2,B4,C3 |
| 4 | EQUIP. DRAIN SUMP COOLER(2) | B2,B4 |
| 5 | FLOOR DRAIN SUMP(5) | B2,B4,C3 |
| 6 | GLAND PUMP CONDENSER | B2 |
| 7 | HPCI PUMP | B3 |
| 8 | HPCI TURBINE | B3 |
| 9 | HPCI TURBINE LUBE OIL COOLER | B3 |
| 10 | PANEL BMCC-1 | A2 |
| 11 | PANEL BMCC-2 | A5 |
| 12 | PANEL BMCC-3 | A2 |
| 13 | PANEL BMCC-4 | A5 |
| 14 | PANEL MCC-71-C153 | B1 |
| 15 | PANEL MCC-71-C163 | B5 |
| 16 | RCIC PUMP | B2 |
| 17 | RCIC TURBINE | B2 |
| 18 | RHR PUMP(4) | C2,C4 |

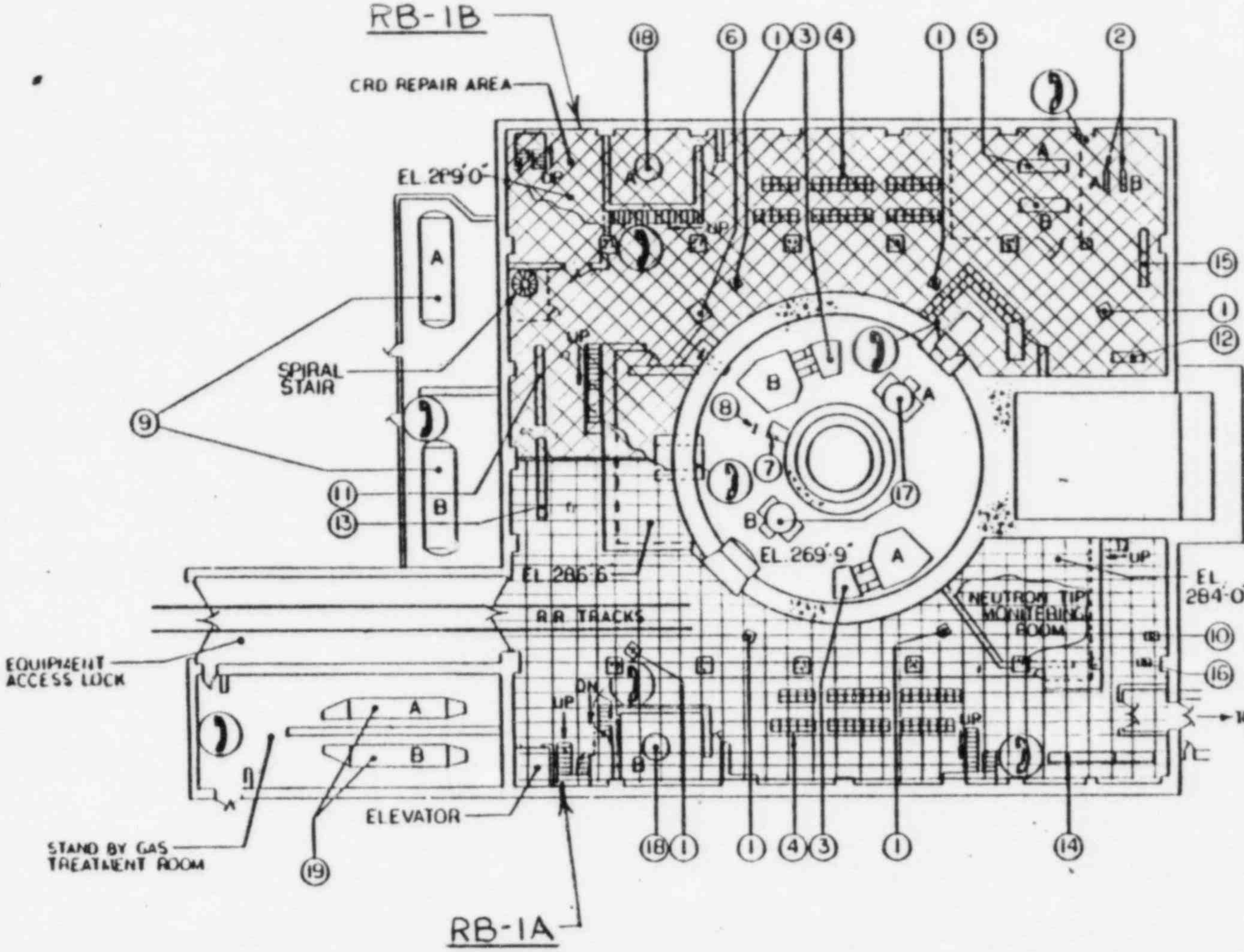
FIGURE 4-6

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

AREA PLAN
REACTOR BLDG
EL 227' & 242'





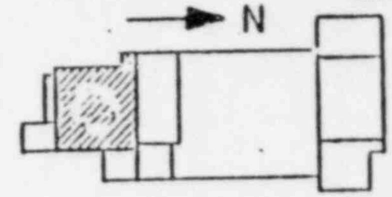

| | EQUIPMENT | ZONE |
|---|---|---|
| 1 | ACCESS HATCH TO TORUS (6) | C2,4,D2,4,E2 |
| 2 | CONDENSATE TRANSFER PUMP (2) | E2 |
| 3 | COOLING COILS & BLOWERS (2) | D3 |
| 4 | CRD HYD. CONTROL UNITS | D2,4 |
| 5 | CRD WATER PUMP (2) | E2 |
| 6 | EQUIPMENT HATCH TO TORUS | C2 |
| 7 | LADDER TO EL. 256'6" | D3 |
| 8 | LADDER TO EL. 292'0" | D3 |
| 9 | LIQUID NITROGEN TANK (2) | B2,3 |
| 10 | PANEL BMCC-6 | E4 |
| 11 | PANEL MCC C132, C151 | C3 |
| 12 | PANEL MCC C133 | E3 |
| 13 | PANEL MCC C142, C161 | C3 |
| 14 | PANEL MCC C143, C162 | E4 |
| 15 | PANEL MCC C152 | E2 |
| 16 | PANEL MCC C164 | E4 |
| 17 | RECIRC. PUMP (2) | D3 |
| 18 | RHR HEAT EXCHANGER (2) | C2,4 |
| 19 | STANDBY GAS TREATMENT FILTER TRAIN (2) | B4 |

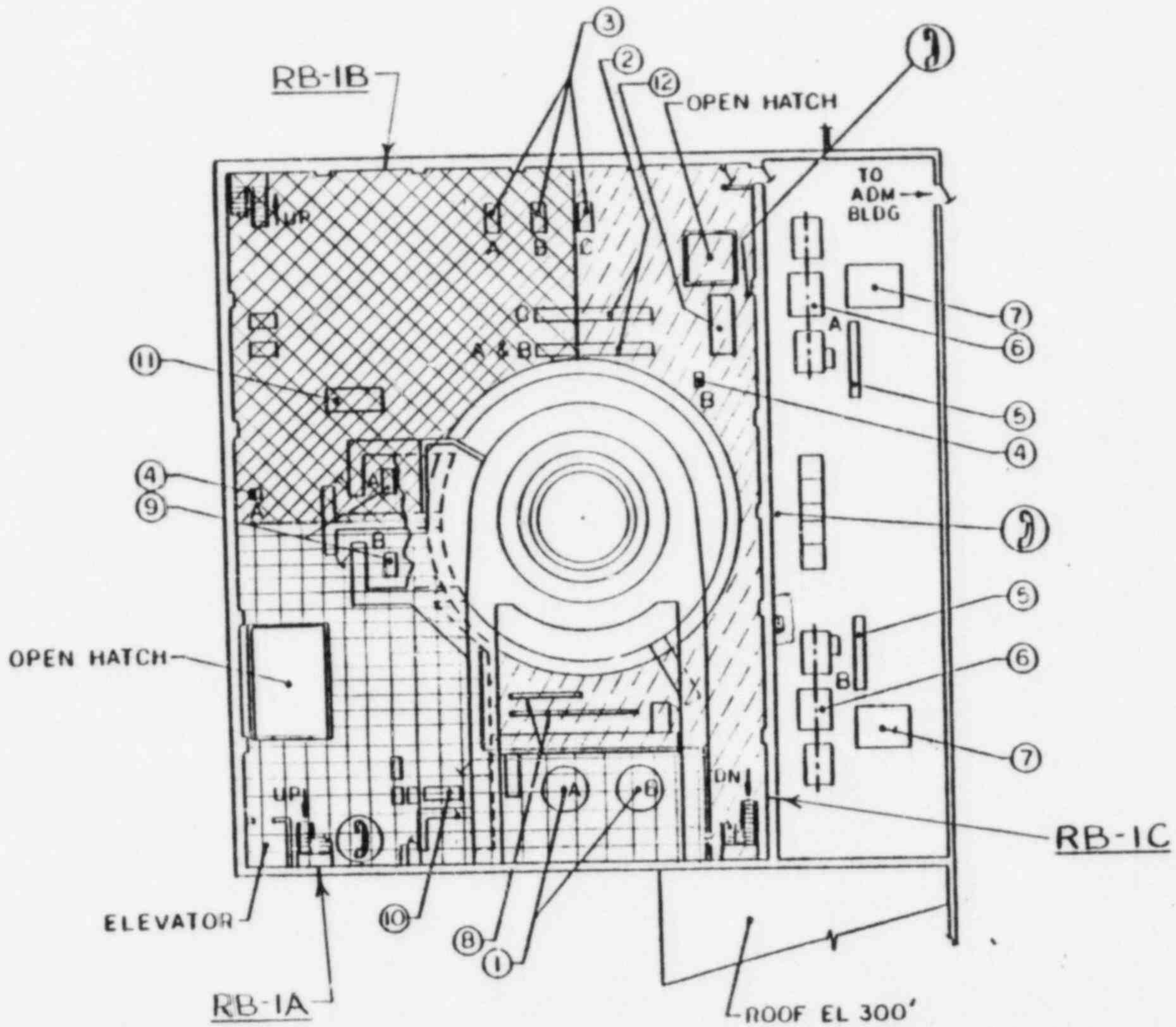
FIGURE 4-7

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

AREA PLAN
REACTOR BLDG.
EL 272'




| EQUIPMENT | ZONE |
|---|---|
| 1 CLEANUP PHASE SEP TANK(2) | C4 |
| 2 CLCW HEAT EXCHANGER(3) | C2 |
| 3 CLCW PUMP(3) | C2 |
| 4 DRYWELL INERTING SAMPLE PUMP (2) | B3,D3 |
| 5 MG FLUID COOLER(2) | D2,D3 |
| 6 MG FLUID DRIVE(2) | D2,D3,D4 |
| 7 MG FLUID DRIVE LUBE OIL PUMP ASSY(2) | D2,D4 |
| 8 RWCU NON-REGENERATIVE HEAT EXCHANGER(2) | C4 |
| 9 RWCU PUMP(2) | C3 |
| 10 SAMPLE STATION NO.1 | C4 |
| 11 SWGR,600V,71-L15 | B3 |
| 12 SWGR,600V,71-L16 | D2 |

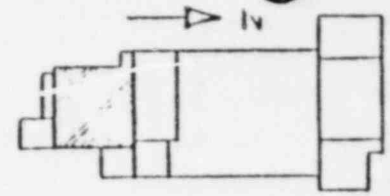
FIGURE 4-8

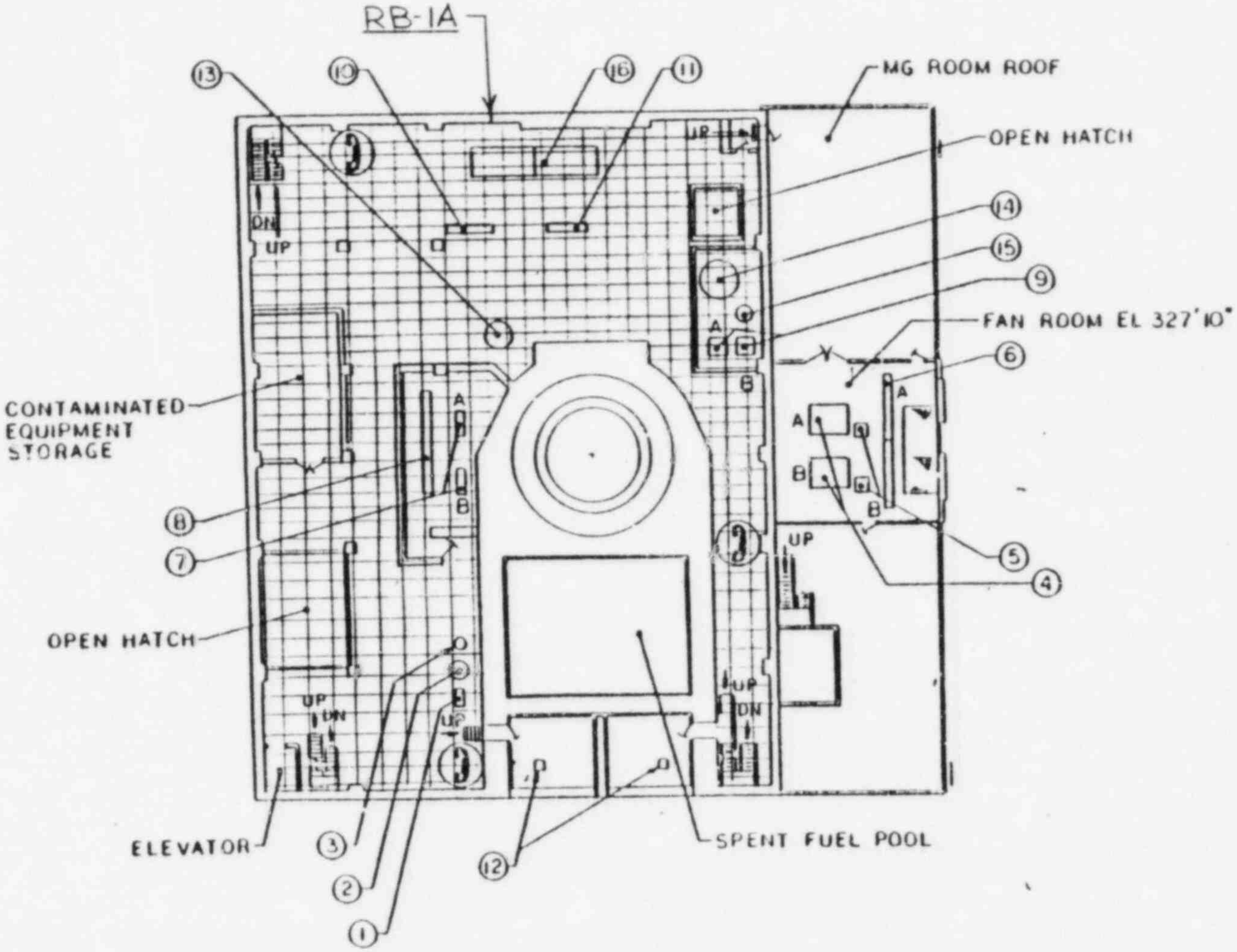
POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

AREA PLAN
REACTOR BLDG

EL 300'






| | EQUIPMENT | ZONE |
|---|---|---|
| 1 | CLEAN-UP PRECOAT PUMP | B4 |
| 2 | CLEAN-UP PRECOAT TANK | B4 |
| 3 | CLEAN-UP RESIN-FEED TANK | B4 |
| 4 | FAN(2) | D3 |
| 5 | FAN MOTOR(2) | D3 |
| 6 | FILTER(2) | D3 |
| 7 | FUEL POOL CLEAN UP RECIRC PUMP(2) | B3 |
| 8 | FUEL POOL HEAT EXCH(2) | B3 |
| 9 | LIQUID POISON PUMP(2) | C3,D3 |
| 10 | PANEL, MCC 71-C131 | C2 |
| 11 | PANEL, MCC C141 | C2 |
| 12 | RWCU HOLDING PUMP(2) | C4 |
| 13 | REACTOR BLDG COOLING WATER MAKEUP TANK | C3 |
| 14 | STANDBY LIQUID CONTROL TK | C2 |
| 15 | STANDBY LIQUID CONTROL TEST TANK | D3 |
| 16 | SWGR, 600V 71 L13/14 | C2 |

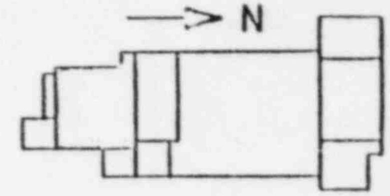
FIGURE 4-9

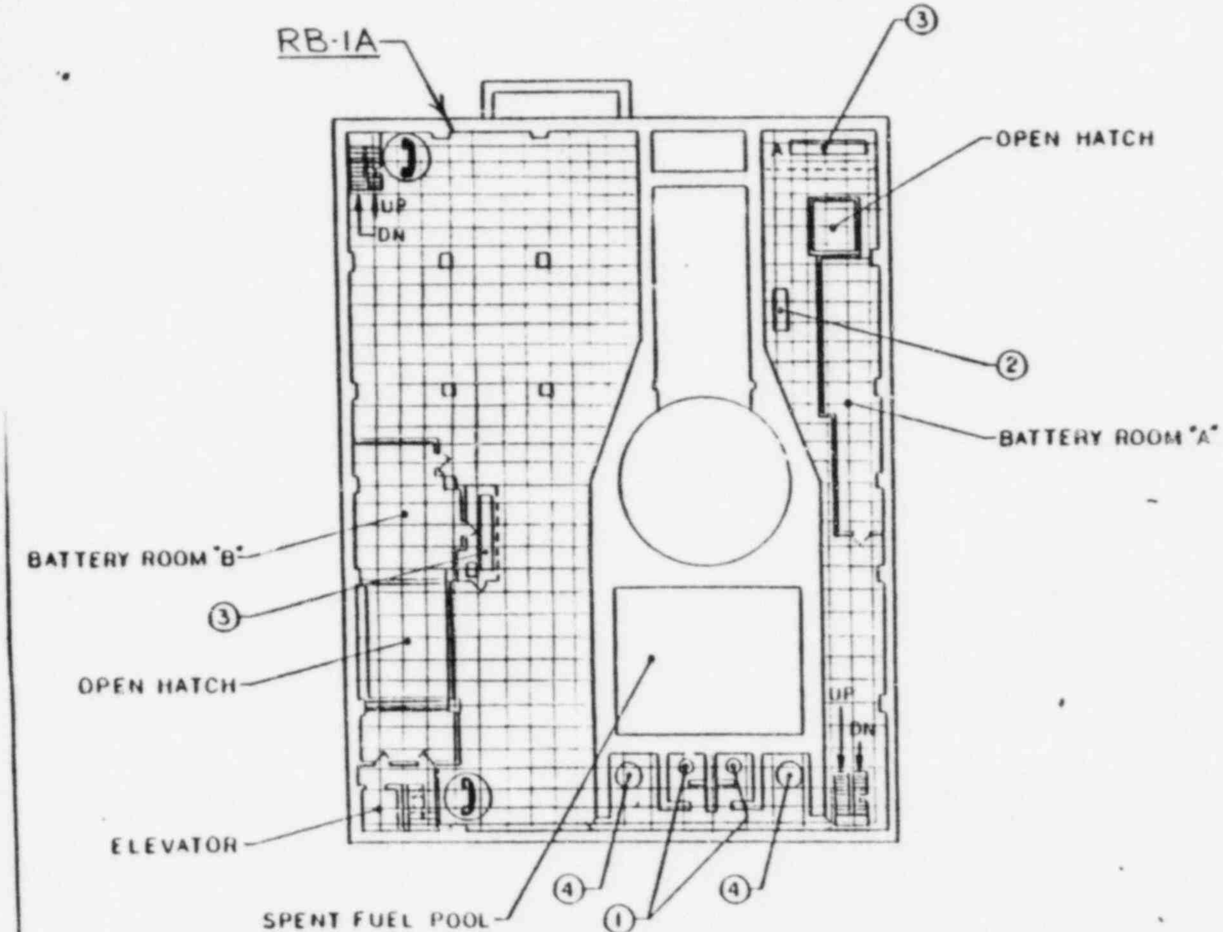
POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

AREA PLAN
REACTOR BLDG

EL 326'




| | EQUIPMENT | ZONE |
|---|---|---|
| 1 | CLEAN UP FILTER DEMIN(2) | C4 |
| 2 | FILTER UNIT | C2 |
| 3 | INVERTER(2) | B3,C2 |
| 4 | SKIMMER SURGE TANK(2) | C4 |

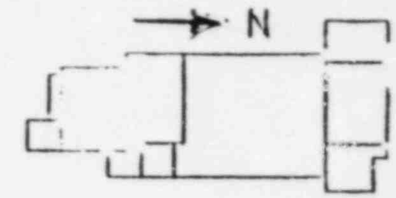
FIGURE 4-10

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

AREA PLAN
REACTOR BLDG

EL 344'




| | EQUIPMENT | ZONE |
|---|---|---|
| 1 | REFUELING PLATFORM | C4 |

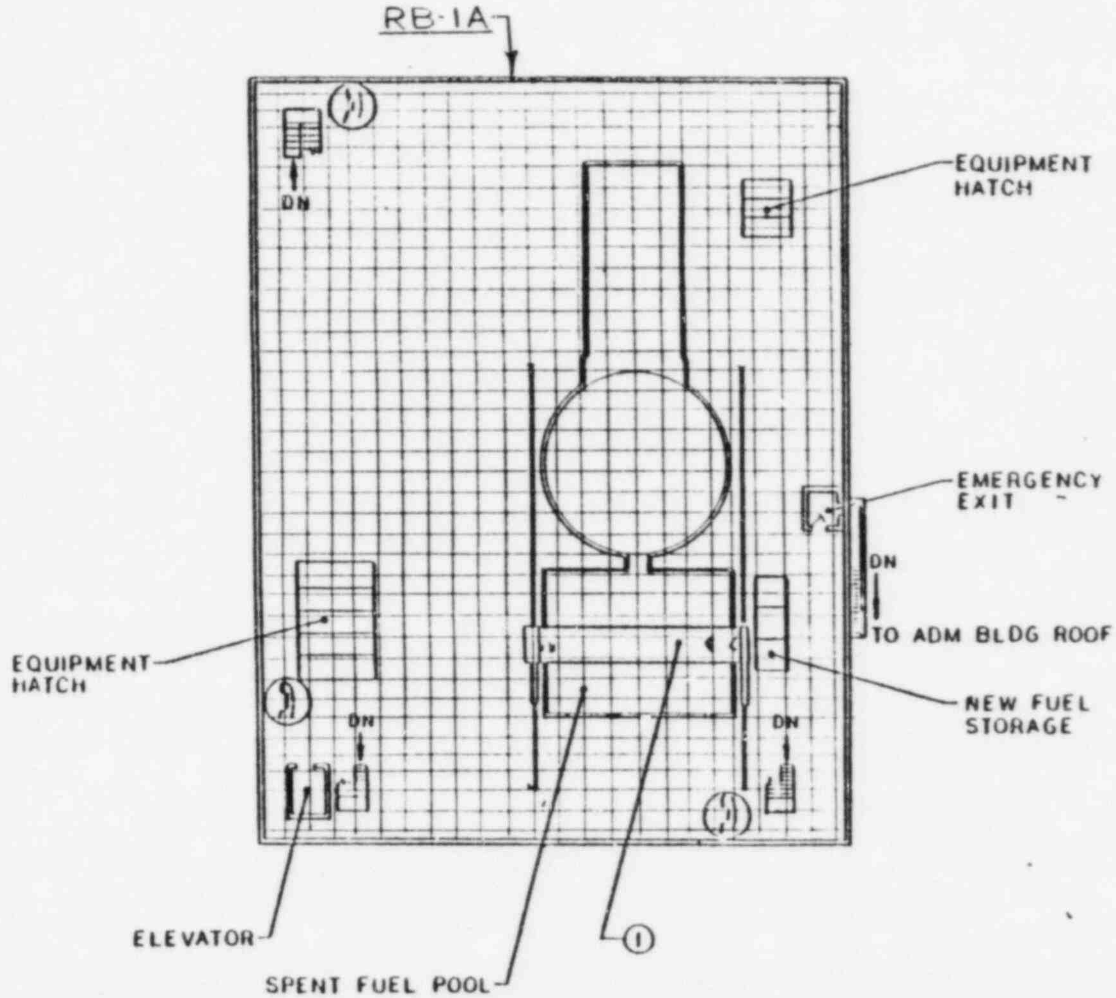
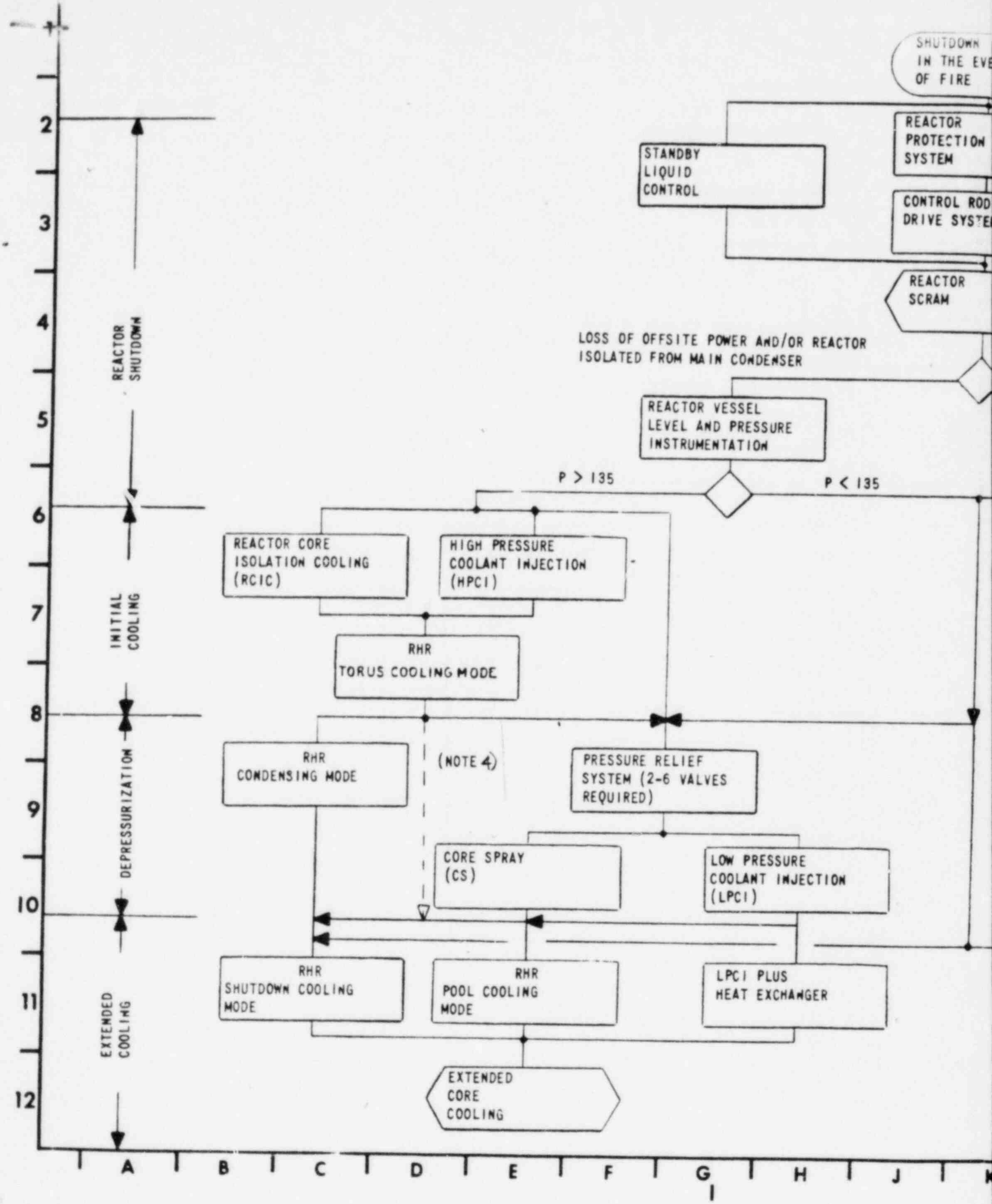


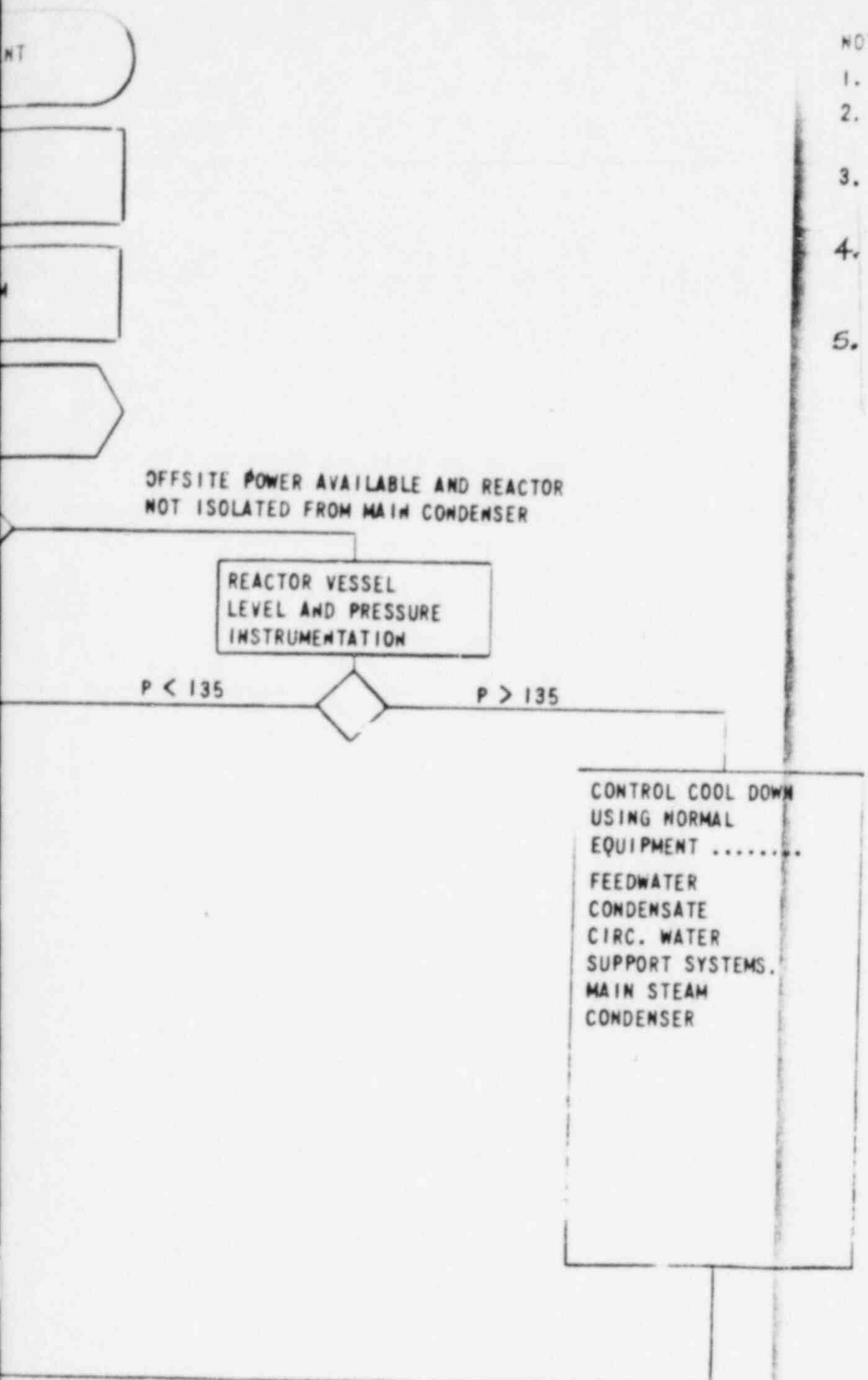

FIGURE 4-11

AREA PLAN
REACTOR BLDG
EL 369'



SHUTDOWN IN THE EVE[NT] OF FIRE
REACTOR PROTECTION SYSTEM
STANDBY LIQUID CONTROL
CONTROL ROD DRIVE SYSTE[M]
REACTOR SCRAM
LOSS OF OFFSITE POWER AND/OR REACTOR ISOLATED FROM MAIN CONDENSER
REACTOR VESSEL LEVEL AND PRESSURE INSTRUMENTATION
P > 135
P < 135
REACTOR CORE ISOLATION COOLING (RCIC)
HIGH PRESSURE COOLANT INJECTION (HPCI)
RHR TORUS COOLING MODE
RHR CONDENSING MODE
(NOTE 4)
PRESSURE RELIEF SYSTEM (2-6 VALVES REQUIRED)
CORE SPRAY (CS)
LOW PRESSURE COOLANT INJECTION (LPCI)
RHR SHUTDOWN COOLING MODE
RHR POOL COOLING MODE
LPCI PLUS HEAT EXCHANGER
EXTENDED CORE COOLING
REACTOR SHUTDOWN
INITIAL COOLING
DEPRESSURIZATION
EXTENDED COOLING
2
3
4
5
6
7
8
9
10
11
12
A B C D E F G H J K


A 9860.8




NOTES:

1. RCIC IS AUTO START . MANUAL RESET.
2. PHR CONDENSING MODE REQUIRES NON-SAFETY INSTRUMENT AIR.
3. INSTRUMENTATION NOT SHOWN.
4. VIA THIS PATH THE PLANT REMAINS SAFE IN HOT SHUTDOWN CONDITION AND WILL EVENTUALLY DEPRESSURIZE.
5. ADDITIONAL FLEXIBILITY EXISTS IN THAT PATHS OF MANY OPERATIONS MAY BE RETRACED.

| DATE | | | | | | |
|---|---|---|---|---|---|---|
| C | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| P | | | | | | | |
| E | | | | | | | |

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

POWER AUTHORITY OF THE STATE OF NEW YORK

FIGURE 4-12
PROTECTION SEQUENCE FOR SHUTDOWN DURING A FIRE

L M N P Q R S T U V

# SECTION 5.0

# 10 CFR 50 APPENDIX R ALTERNATIVE SHUTDOWN ANALYSIS

## 5.1 Criteria

The Main Control Room (CR-1), Relay Room (RR-1) and Cable Spreading Room (CS-1) do not satisfy the requirements of 10CFR50 Appendix R Section III.G.2. Accordingly, for these areas alternate shutdown means have been demonstrated. The criteria used for this evaluation follows the requirement of Appendix R Section III.L as follows:

a. The alternate shutdown path and the supporting systems (i.e. cooling, power etc.) of the plant are independent of the Main Control Room, Relay Room and Cable Spreading Room. Thus, a fire in any of these areas will not affect the safe shutdown of the unit.

b. No spurious actuation as a result of the fire will affect the alternate shutdown means nor cause an unrecoverable plant condition.

c. Process variables necessary to assure that the alternate shutdown means is performing its intended function are available independent of the Main Control Room, Relay Room and Cable Spreading Room.

## 5.2 Method of Analysis

In order to facilitate the analysis, the effort was performed in two concurrent phases as described below:

Phase I

In this phase, an alternate shutdown path was selected; ADS - RHR Division B with appropriate supporting systems (See Figure 5-1). For the systems selected, a detail review of the cable routing and logic, interconnections, etc. was conducted. The effort identified all areas in which spurious action could prevent the alternative shutdown path from performing it's intended function due to interconnection and/or cable routing to the fire areas in question. Where a function was not available and could not be restored with procedures, corrective modifications would be planned. Thus, the result of this analysis will ensure the availability of the alternate shutdown path systems.

Phase II

Phase II was performed concurrently with Phase I. In this Phase, it was assumed that the shutdown path identified in Phase I would be available. Based on this assumption, an operational review of other systems was performed to analyse the effect of spurious actuations. The operational analysis considered both the effect on the alternate shutdown path and actuation of other systems and components.

For interconnections or operational effects which are identified as potentially detrimental, an engineering analysis of the system design was performed. This additional review ensured that the spurious action does not affect plant safe shutdown. If plant shutdown was affected, appropriate modifications were identified.

5.3 Proposed Plant Modifications

In order to meet the requirements of the alternate shutdown means described above and as further detailed in the table in Section 5.4, a new panel, local control and isolation switches, and alternate control power feeders will be added for equipment affected by postulated Control Room (CR), Relay Room (RR) and Cable Spreading Room (CS) fires.

5.4 Response to Attachment No. 1 of NRC Letter of May 10, 1982

Question: 1.0

Identify those areas of plant that will not meet the requirements of Section III.G.2 of Appendix R and, thus alternative shutdown will be provided or an exemption from the requirements of Section III.G.2 of Appendix R will be provided. Additionally, provide a statement that all other areas of the plant are or will be in compliance with Section III.G.2 of Appendix R.

Response:

Fire Areas/Zones Meeting Appendix R Section III.G.2

The following fire zones meet Appendix R, Section III.G.2 separation requirements and no exemptions or alternative shutdown capability will be provided (see Response Section 4.0):

| Fire Area | Area Location |
|---|---|
| MG-1 | Motor Generator Room, elev. 300' |
| AD-1, -2, -3 | Administration Building, elev. 272' |

| Fire Area | Area Location(cont'd) |
| --- | --- |
| AD-4, -5, | Administratation Building, elev. 286'-0" \| R |
| CR-2 | Radwaste Control Room |
| CT-1 | Cable Tunnel West, elev. 260' |
| CT-2 | Cable Tunnel East, elev. 260' |
| CT-3 | Cable Room North, elev. 286' |
| CT-4 | Cable Room South, elev. 286' |
| TB-11 | Turbine Bldg. Basement, elev. 252' |
| TB-12 | Turbine Bldg. Mezzanine, elev. 272' |
| TB-13 | Turbine Bldg. Operating Floor, elev. 300' |
| RW-1 | Radwaste Bldg. and Pipe Tunnel |
| SH-1 | Screenhouse Area, elev. 272' |
| SW-1 | Switchgear Room West, elev. 272' |
| SW-2 | Switchgear Room East, elev. 272' |
| FP-1 | Diesel Fire Pump Room, elev. 260' |
| FP-2 | Turbine Bldg. Foam Room, elev. 272' |
| SG-1 | Standby Gas Filter Room, elev. 272' |
| AS-1 | Auxiliary Boiler Room, elev. 272' |
| BR-1 | Battery Room No. 1, elev. 272' |
| BR-2 | Battery Room No. 2, elev. 272' |
| BR-3 | Battery Room No. 3, elev. 272' |
| BR-4 | Battery Room No. 4, elev. 272' |
| BR-5 | Battery Room Corridor, elev. 272' |
| EG-1, -2, -3, -4 | Emergency Diesel Generator Rooms, elev. 272' |

| Fire Area | Area Location(cont'd) |
|---|---|
| EG-5, -6 | Emergency Diesel Generator Switchgear Rooms, elev. 272' |
| SP-1, -2 | Service Water Pump Rooms, elev. 260' |
| OR-1, -2 | Turbine Oil Storage Rooms |
| OR-3 | Miscellaneous Oil Storage Room, elev. 272' |
| PC-1 | Primary Containment Area. |

R

Fire Areas For Which Alternative Shutdown Capability will be Provided

The following fire zones do not meet Appendix R, Section III.G.2 separation requirements and an alternative shutdown capability will be provided (see Response Section 5.0):

| Fire Area | Area Location |
|---|---|
| CR-1 | Control Room, elev. 300' |
| RR-1 | Relay Room, elev. 286' |
| CS-1 | Cable Spreading Room, elev. 272' |

Fire Areas for Which Appendix R, Section III.G.2 Exemption Requests are Provided

The following fire zones do not fully meet the separation requirements of Appendix R, Section III.G.2 and exemption requests are being provided:

| Fire Area | Area Location |
|---|---|
| RB-1E | Reactor Bldg. East, elev. 227' |
| RB-1W | Reactor Bldg. West, elev. 227' |
| RB-1A | Reactor Bldg. elev. 272' (east), 300' (southeast) and elevations 326', 344', and 369' |
| RB-1B | Reactor Bldg., elev. 272' (west) and 300' (west) |
| RB-1C | Reactor Bldg., elev. 300' (north) |
| SU-1 | Torous Room |

R

Question: 1.0 (Cont)

For each of those fire areas of the plant requiring an alternative shutdown system(s) provide a complete set of responses to the following for each fire area:

a. List the system(s) or portions thereof used to provide the shutdown capability with the loss of offsite power.

Response:

List of Systems and Subsystems Used to Provide Alternative Shutdown Capability

An alternative shutdown capability per Appendix R, Section III.G.3 will be provided for the following fire areas:

1. Control Room (CR-1)

2. Cable Spreading Room (CS-1)

3. Relay Room (RR-1)

For all three of these fire areas, the alternative shutdown method is the same. The list of systems and subsystems required to perform this alternative shutdown capability with the loss of off-site power are as follows:

| System Name | Division | Mode |
|---|---|---|
| Residual Heat Removal (RHR) | B | Manual LPCI Mode |
| Residual Heat Removal (RHR) | B | Manual Shutdown Cooling Mode |
| Automatic Depressurization (ADS) | B | Manual Mode |
| Emergency Electrical Power | B | Manual Mode |
| Emergency Service Water (ESW) | B | Manual Mode |
| RHR Service Water (RHR SW) | B | Manual Mode |

Miscellaneous Independent Instrumentation as follows:

- Reactor Water Level
- Reactor Pressure
- Suppression Pool Temperature
- Suppression Pool Level
- RHR Loop B Injection Flowrate
- RHR Pump 10P-3D Discharge Pressure
- RHR Service Water Loop B Flowrate
- Drywell Temperature (SRV elevation)

Question: 1.0 (Cont)

b. For those systems identified in 1.a for which alternative or dedicated shutdown capability must be provided, list the equipment and components of the normal shutdown system in the fire area and identify the functions of the circuits of the normal shutdown system in the fire area (power to what equipment, control of what components and instrumentation). Describe the system(s) or portions thereof used to provide the alternative shutdown capability for the fire area and provide a table that lists the equipment and components of the alternative shutdown system for the fire area.

For each alternative system identify the function of the new circuits being provided. Identify the location (fire zone) of the alternative shutdown equipment and/or circuits that bypass the fire area and verify that the alternative shutdown equipment and/or circuits are separated from the fire area in accordance with Section III.G.2.

Response:

The only equipment and/or components in the fire areas are control and instrumentation circuit components (i.e. switches, fuses, breakers to control circuits, instruments etc.) and their associated cables.

The systems used to provide the shutdown capability for the fire areas are described under 1.a above. A detailed list of components, functions of new circuits and locations meeting Section III.G.2 are shown in the table below:

# New Circuits

| Component | Function | Location | |
|---|---|---|---|
| RHR Pump 10P-3D | Isolate and Control | New Panel in RB-1C | |
| RHR Service Water Pump 10P-1B | Isolate and Control | New Panel in RB-1C | R |
| Emergency Service Water Pump 46P-2B | Isolate and Control | 600V Swgr L26 in SW-2 | |
| 10-MOV66B | Isolate and Control | New Panel In RB-1C | |
| 10-MOV39B | Isolate and Control | MCC 163 in RB-1E | |
| 10-MOV25B | Isolate and Control | New Panel in RB-1C | |
| 10-MOV27B | Isolate and Control | MCC 165 in RB-1E | R |
| 10-MOV13D | Isolate and Control | MCC 163 in RB-1E | R |
| 10-MOV15D | Isolate and Control | MCC 163 in RB-1E | R |
| 10-MOV148B | Isolate and Control | MCC 161 in RB-1A | |
| 10-MOV12B | Isolate and Control | MCC 161 in RB-1A | |
| 10-MOV65B | Isolate and Control | MCC 163 in RB-1E | |
| | | | R |
| 10-MOV18 | Isolate and Control | MCC 151 in RB-1B | |
| 10-MOV16B | Isolate and Control | MCC 163 in RB-1 E | R |
| 10-MOV70B | Isolate and Control | MCC 161 in RB-1A | |
| 10-MOV166B | Isolate and Control | MCC 161 in RB-1A | |
| 10-MOV21B | Isolate and Control | MCC 163 in RB-1E | R |
| 10-MOV89B | Isolate and Control | New Panel in RB-1C | |
| 10-MOV148A | Isolate and Control | MCC 151 in RB-1B | |
| | | | R |
| 46-MOV102B | Isoalte and Control | MCC 262 in SW-2 | |

New Circuits (cont'd)

| Component | Function | Location |
|---|---|---|
| 46-MOV101B | Isolate and Control | MCC 262 in SW-2 |
| 27-SOV126B | Transfer Switch to Alternate Power Supply | Outside CR1, RR-1, CS-1 Areas |
| 27-SOV129B | Transfer Switch to Alternate Power Supply | Outside CR-1, RR-1, CS-1 Areas |
| 29-AOV86A | Fail Safe Valve Position | Near Valve Area |
| 29-AOV86B | Fail Safe Valve Position | Near Valve Area |
| 29-AOV86C | Fail Safe Valve Position | Near Valve Area |
| 29-AOV86D | Fail Safe Valve Position | Near Valve Area |
| 29-MOV77 | Isolate and Control | BMCC-2 in RB-1E |
| 02-AOV17 | Fail Safe Valve Position | Near Valve Area |
| 23-MOV16 | Isolate and Control | BMCC-6 in RB-1A |
| 23-MOV60 | Isolate and Control | BMCC-2 in RB-1E |
| 23-MOV25 | Isolate and Control | BMCC-4 in RB-1E |
| 12-MOV18 & 80 | Isolate and Control | BMCC-4 in RB-1E R |
| New Instrument | Suppression Pool Temperature | New Panel in RB-1C |
| New Instrument | Suppression Pool Level | New Panel in RB-1C |
| New Instrument | RHR "B" Loop Flow From "B" Loop Injection | New Panel in RB-1C |
| New Instrument | RHR "D" Pump Discharge Pressure | New Panel in RB-1C |
| New Instrument | RHR "B" Loop Service Water Flow | New Panel in RB-1C |

New Circuits (cont'd)

| Component | Function | Location | |
|---|---|---|---|
| New Instrument | Drywell Temperature | New Panel in RB-1C | |
| 4KV Breaker 10604 | Isolate and Control | 4KV SWGR H06 in EG-6 | |
| 4KV Breaker 10602 | Isolate and Control | 4KV SWGR H06 in EG-6 | |
| 4KV Breaker 10612 | Isolate and Control | 4KV SWGR H06 in EG-6 | |
| 4KV Breaker 10614 | Isolate and Control | 4KV SWGR H06 in EG-6 | |
| 4KV Breaker 10660 | Isolate and Control | 4KV SWGR H06 in EG-6 | \|R |
| 600V Breaker 12602 | Isolate and Control | 600V Bus L26 in SW-2 | |
| 600V Breaker 11602 | Isolate and Control | 600V Bus L16 in RB-1C | |R |

Question 1.0 (Con't)

c. Provide drawings of the alternative shutdown system(s) which highlight any connections to the normal shutdown systems (P&IDs for piping and components, elementary wiring diagrams of electrical cabling). Show the electrical location of all breakers for power cables, and isolation devices for control and instrumentation circuits for the alternative shutdown systems for that fire area.

Response:

The alternate shutdown systems and components will be independent of the CR-1, RR-1 and CS-1 areas and drawings will be provided for all components when design drawings/locations are finalized.

Question: 1.0 (Cont)

d. Verify that changes to safety systems will not degrade safety systems; (e.g., new isolation switches and control switches should meet design criteria and standards in the FSAR for electrical equipment in the system that the switch is to be installed; cabinets that the switches

Question: 1.0 (Cont)

are to be mounted in should also meet the same criteria (FSAR) as other safety related cabinets and panels; to avoid inadvertent isolation from the control room, the isolation switches should be keylocked or alarmed in the control room if in the "local" or "isolated" position; periodic checks should be made to verify that the switch is in the proper position for normal operation; a single transfer switch or other new device should not be a source of a failure which causes loss of redundant safety systems).

Response:

All changes to safety systems will meet the requirements described above.

Question: 1.0 (Cont)

e. Verify that licensee procedures have been or will be developed which describe the tasks to be performed to effect the shutdown method. Provide a summary of these procedures outlining operator actions.

Response:

Preliminary plant procedures for the alternative shutdown capability have been prepared and implemented, for J.A. FitzPatrick using presently installed equipment. These procedures will be updated as the new alternative shutdown equipment is installed which has previously been described (i.e. isolation switches, local control switches, and independent instrumentation).

Question: 1.0 (Cont)

The following is a synopsis of the actions to be taken by Operations personnel in order to effect plant shutdown and cooldown using the alternative shutdown capability. The same procedure is used for fires in any of three areas (CR-1, RR-1, and CS-1).

The initial assumption is that a fire occurs in one of the three areas and that the fire causes system control to be lost or the Control Room to become uninhabitable. The alternative shutdown capability is also valid for any situation which develops which threatens the life and function of the Nuclear Control Operator (NCO) in the Control Room.

1) Initial Operator Actions - When the NCO realizes that the Control Room must be evacuated or has determined that a serious fire is underway in the Control Room, Relay Room, or Cable Spreading Room and that damage to normal reactor shutdown equipment is taking.place, the NCO performs the following actions before evacuating:

a. Initiates manual reactor scram.

b. Trips the main turbine.

c. Verfies all control rods are fully inserted.

d. Closes the Main Steam Isolation Valve.

If the NCO is unable to manually scram the reactor for some reason, a

Question: 1.0 (Cont)

contingency procedure is provided for initiating the reactor scram by deenergizing the Reactor Protection buses.

Upon evacuation the NCO will proceed to the Reactor Building and the Senior Nuclear Operator (SNO) proceeds to the Electrical Switchgear Rooms and the Emergency Diesel Generator Area. Both the SNO and NCO will be assisted in lining up and accomplishing the alternative shutdown path by other Operations personnel.

2) Senior Nuclear Operator (SNO) Actions - The SNO proceeds to the Emergency Diesel Generator Switchgear Room (EG-6) via the East Electrical Bay (SW-2). While in the East Electrical Bay the SNO will position isolation switches on 600 VAC emergency substation L26, which isolates electrical breaker control from fire generated spurious actuations. He will also start ESW pump 46P-1B at substation L26 by manually closing its air circuit breaker.

The SNO then proceeds to the Emergency Diesel Generator Room (EG-6) to manually perform emergency power system electrical operations. The SNO observes 4kV 10600 bus status. He locally isolates Emergency Diesel Generators "B" and "D" from cabling routed to the Control Room in order to prevent fire generated spurious signals from affecting EDG operations. The SNO also positions isolation switches for the following 4kV 10600 bus electrically operated breakers:

Question: 1.0 (Cont)

| Breaker No. | Function |
|---|---|
| 10604 | EDG B & D tie breaker |
| 10602 | EDG B output breaker |
| 10612 | EDG D output breaker |
| 10610 | 10P-1B-RHR SW Pump B |
| 10640 | 10P-3D-RHR Pump D |
| 10614 | Bus tie to Normal Bus 10400 |
| 10660 | Substation L16 and L26 feeder |

The SNO then locally starts Emergency Diesel Generators (EDG) B and D and verifies ESW cooling water flow to the EDGs. If the 10600 bus has become deenergized due to the fire, the SNO positions the 10600 bus breakers to isolate the bus and then reenergizes it using EDG B and D as its source. He positions breaker 10660 to reenergize substations L16 and L26.

If the 10600 bus is still energized after the EDGs are started, the SNO will manually synchronize the EDGs to the bus and assume load. He will then isolate emergency bus 10600 from normal bus 10400 by opening breaker 10614.

The SNO will establish communications with the NCO, who is in the Reactor Building in the area of the Manual ADS panel and new shutdown panel on elevation 300'. The SNO will standby in the EDG area monitoring the operation of the EDG's, bus electrical conditions, and

Question: 1.0 (Cont)

await further word from the NCO concerning the starting of the RHR (10P-3D) and RHR Service Water (10P-1B) Pumps.

3) Nuclear Control Operator Actions - After evacuating the Control Room, the NCO proceeds to the Reactor Building to establish the alternative shutdown path at the local shutdown panel. The NOC first stops in the area of the CRD air header on elevation 272'. He isolates the Control Rod Drive Air header air supply to the scram valves to preclude spurious control rod actuations which may be caused by the fire. If all rods were not verified to be fully inserted, prior to Control Room evacuation, the NOC verifies that all scram valves are open.

The NOC then proceeds to the following switchgear and actuates isolation switches to preclude fire-generated spurious actuations of motor operated valves and equipment which may affect the alternative shutdown path.

| Switchgear | Reactor Building Location |
|---|---|
| L16 | Elev. 300' |
| MCC 161 | El. 272' |
| MCC 162 | El. 272' |
| MCC 163 | El. 242' - E. Crecent |
| MCC 165 | El. 242' - E. Crescent |

Question: 1.0 (Cont)

The NOC actuates isolation switches, opens breakers, and verifies valve positions at these MCCs for valves affecting the shutdown path. In parallel with the NOC's efforts, the NCO assesses the plant parameters as indicated on the shutdown panel and local reading instruments in instrument rack 25-06. The NCO then establishes communications with the SNO who is in the Emergency Diesel Generator Switchgear Room.

The NCO then aligns the equipment he has control of as follows:

a. NCO starts RHR Pump 10P-3D and verifies pump discharge pressure at the alternate shutdown panel.

b. NCO starts RHR Service Water Pump 10P-1B and verifies flowrate at the alternate shutdown panel.

c. NCO opens valve 10MOV-89B to admit RHR service water flow to RHR B heat exchanger.

d. NCO depressurizes the reactor by manually opening six (6) safety relief valves from the manual ADS panel. The NCO monitors reactor pressure using instruments on rack 25-06.

e. When reactor pressure decreases to approximately 350 psig, the NCO opens RHR injection valve 10MOV-25B at the shutdown panel. At approximately 250 psig reactor pressure (shutoff head for RHR pump) the NCO verifies injection flow from the RHR System into the reactor vessel.

Question: 1.0 (Cont)

f. The NCO allows the reactor to continue to depressurize and reactor vessel level to rise until water spills out of the safety relief lines which route the discharge to the suppression pool.

This cooling path is maintained and provides both reactor vessel level and inventory control, and suppression pool cooling. The NCO and SNO monitor the alternate shutdown path to ensure correct functioning using available instrumentation.

As conditions normalize and additional operations personnel become available, the normal RHR System shutdown cooling path will be implemented using manual line-up.

Question: 1.0 (Cont)

f. Verify that the manpower required to perform the shutdown functions using the procedures of 1.e as well as to provide fire brigade members to fight the fire is available as required by the fire brigade technical specifications.

Response:

The existing procedures for shutdown outside the Control Room are similar to the proposed procedures described in 1.e. above but require many more manual actions. Once the alternate shutdown panel is installed, this will greatly reduce the time and manpower to implement these procedures.

Question: 1.0 (Cont)

Adequate manpower will be available to perform the alternate shutdown procedure and man the fire brigade when the new shutdown equipment is installed. Until the new alternate shutdown equipment is installed, the time frame for accomplishing the alternate shutdown procedure is extended.

Question: 1.0 (Cont)

g. Provide a commitment to perform adequate acceptance tests of the alternative shutdown capability. These tests should verify that: equipment operates from the local control station when the transfer or isolation switch is placed in the "local" position; that the equipment cannot be operated from the control room; and that equipment operates from the control room but cannot be operated at the local control station when the transfer isolation switch is in the "remote" position.

Response:

Adequate tests of alternative shutdown equipment will be performed consistent with the performance of testing required of all new equipment and plant modifications.

Question: 1.0 (Cont)

h. Provide Technical Specificatons of the surveillance requirements and limiting conditions for operation for that equipment not already covered by existing Technical Specifications. For example, if new

Question: 1.0 (Cont)

isolation and control switches are added to a shutdown system, the existing Technical Specification surveillance requirements should be supplemental to verify system/equipment functions from the alternate shutdown station at testing intervals consistent with the guidelines of Regulatory Guide 1.22 and IEEE 338. Credit may be taken for other existing tests using group overlap test concepts.

Response:

Technical Specifications including surveillance requirements for new alternative shutdown equipment will be prepared, reviewed and submitted upon completion of modifications. Surveillance testing intervals will be consistent with Regulatory Guide 1.22 guidelines as they apply to J.A. FitzPatrick.

Question: 1.0 (Cont)

i. For new equipment comprising the alternative shutdown capability, verify that the systems available are adequate to perform the necessary shutdown function. The functions required should be based on previous analyses, if possible (e.g., in the FSAR), such as a loss of normal ac power or shutdown on Group 1 isolation (BWR). The equipment required for the alternative capability should be the same or equivalent to that relied on in the above analysis.

Question: 1.0 (Cont)

Response:

The alternative shutdown capabilities described in 1.e are adequate to perform the necessary shutdown and cooldown functions. The shutdown and cooldown paths provided are based on existing FSAR analyses and more recent small - break, Loss-of-Coolant Accident (LOCA) analyses performed, as a result of the TMI Action Plan. The alternate shutdown path is identical to that contained in the new BWR Emergency Procedure Guidelines (EPGs) which are presently being implemented at BWRs including J.A. FitzPatrick.

Question: 1.0 (Cont)

j. Verify that repair procedures for cold shutdown systems are developed and material for repairs is maintained on site. Provide a summary of these procedures and a list of the material needed for repairs.

Response:

No repair procedures for cold shutdown systems have been identified to be necessary for the alternative shutdown capability being provided for J.A. FitzPatrick.

5.5 Response to Systems Approach, NRC Letter of May 10, 1982

Question: 1.0

For each area where an alternative or dedicated shutdown method, in accordance with Section III.G.3 of Appendix R is provided, the

Question: 1.0 (Cont)

following information is required to demonstrate that associated circuits will not prevent operation or cause maloperation of the alternative or dedicated shutdown method:

a. Describe the methodology used to assess the potential of associated circuits adversely affecting the alternative or dedicated shutdown. The description of the methodology should include the methods used to identify the circuits which share a common power supply or a common enclosure with the alternative or dedicated shutdown system and the circuits whose spurious operation would affect shutdown. Additionally, the description should include the methods used to identify if these circuits are associated circuits of concern due to their location in the fire area.

Response:

The methodology used to mitigate the consequences of these associated circuits (spurious signals) resulting from a postulated Control Room, Relay Room and Cable Spreading Room Fire is to:

1) Provide local isolation/control switches which isolate spurious control signals from the fire areas and allow local control of the alternate shutdown equipment

or

Question: 1.0 (Cont)

for certain valves, provide local position indication so that the operator can verify and/or manually align the valve in the correct position after de-energizing power to the valve motor.

The circuits whose spurious operation could affect shut-down were identified using the elementary diagrams for the components described in Section 5.4.

2) Provide additional local instrumentation as described in Section 5.4 for operator intelligence.

3) Manually operate breakers at the 600V switchgear in the event of power loss to the switchgear control bus.

Power Supplies were identified using electric one line diagrams and physical location drawings.

Thus the alternate shutdown method will be independent of the Main Control Room, Relay Room and Cable Spreading Room.

Question: 1.0 (Cont)

b. Provide a table that lists all associated circuits of concern located in the fire area.

Response:

The types of circuits described above are associated with the alternative shutdown equipment described in Section 5.4.

Question: 1.0 (Cont)

c. Show that fire-induced failures (hot shorts, open circuits or shorts to ground) of each of the cables listed in "b" will not prevent operation or cause maloperation of the alternative or dedicated shutdown method.

Response:

For the control cables identified as requiring local isolation, the design modification is shown on a typical drawing provided for "d" below.

Question: 1.0 (Cont)

d. For each cable listed in b where new electrical isolation has been provided, provide detailed electrical schematic drawings that show how each cable is isolated from the fire area.

Response:

A typical modification for the control circuit is shown on Fig. 5-2.

Question: 1.0 (Cont)

e. Provide a location at the site or other offices where all the tables and drawings generated by this methodology approach for the associated circuits review may be audited to verify the information provided above.

Response:

Question: 1.0 (Cont)

This information and all associated drawings will be available at the J.A. FitzPatrick Plant when finalized.

Question: 2.0

The residual heat removal system is generally a low pressure system that interfaces with the high pressure, primary coolant system. To preclude a LOCA through this interface, we require compliance with the recommendations of Branch Technical Position RSB 5-1. Thus, the interface most likely consists of two redundant and independent motor operated valves. These two motor operated valves and their associated cables may be subject to a single fire hazard. It is our concern that this single fire could cause the two valves to open resulting in a fire initiated LOCA through the high-low pressure system interface. To assure that this interface and other high-low pressure interfaces are adequately protected from the effects of a single fire, we require the following information:

a. Identify each high-low pressure interface that uses redundant electrically controlled devices (such as two series motor operated valves) to isolate or preclude rupture of any primary coolant boundary.

Response:

Each high-low pressure interface is identified by the valves below:

1) 10-MOV 17 & 18

Question: 2.0 (cont)

2) 12-MOV 15, 18 & 80

3) 23-MOV 15, 16 & 60

4) 02-AOV 17 & 18

5) 29-MOV 74 & 77

6) 03-AOV 32 A/B

7) 03-AOV 33

8) MSIVs

Question: 2.0 (cont)

b. For each set of redundant valves identified in a., verify the redundant cabling (power and control) have adequate physical separation as required by Section 111.G.2 of Appendix R.

RESPONSE:

i) For each set of redundant valves identified in a., the following set of redundant valves have met the physical separation requirements of Appendix R, Section III,G.2, except for the Control Room, relay Room and Cable Spreading Room.

1. 12-MOV 15, & 12-MOV 18 & 80
2. 23-MOV 15, 16 & 60
3. 02-AOV 17 & 18
4. 29-MOV 74 & 77
5. MSIVs

For a fire in the Control Room, Relay Room or Cable Spreading Area isolation and control switches will be installed outside the control room to prevent fire induced spurious actuations. The valves for which isolation & control switches will be provided are listed in page 5 - 9 thru 5 - 11.

ii) For each set of redundant valves identified in a., the following set of redundant valves have not met the physical separation requirements of Appendix R, Section III.G.2:

1. 10-MOV 17 & 18

2. 03-AOV 32A/B

3. 03-AOV 33

Question: 2.0 (cont)

c. For each case where adequate separation is not provided, show that fire induced failures (hot short, open circuits or short to ground) of the cables will not cause maloperation and result in a LOCA.

RESPONSE:

i) 10-MOV 17 & 18

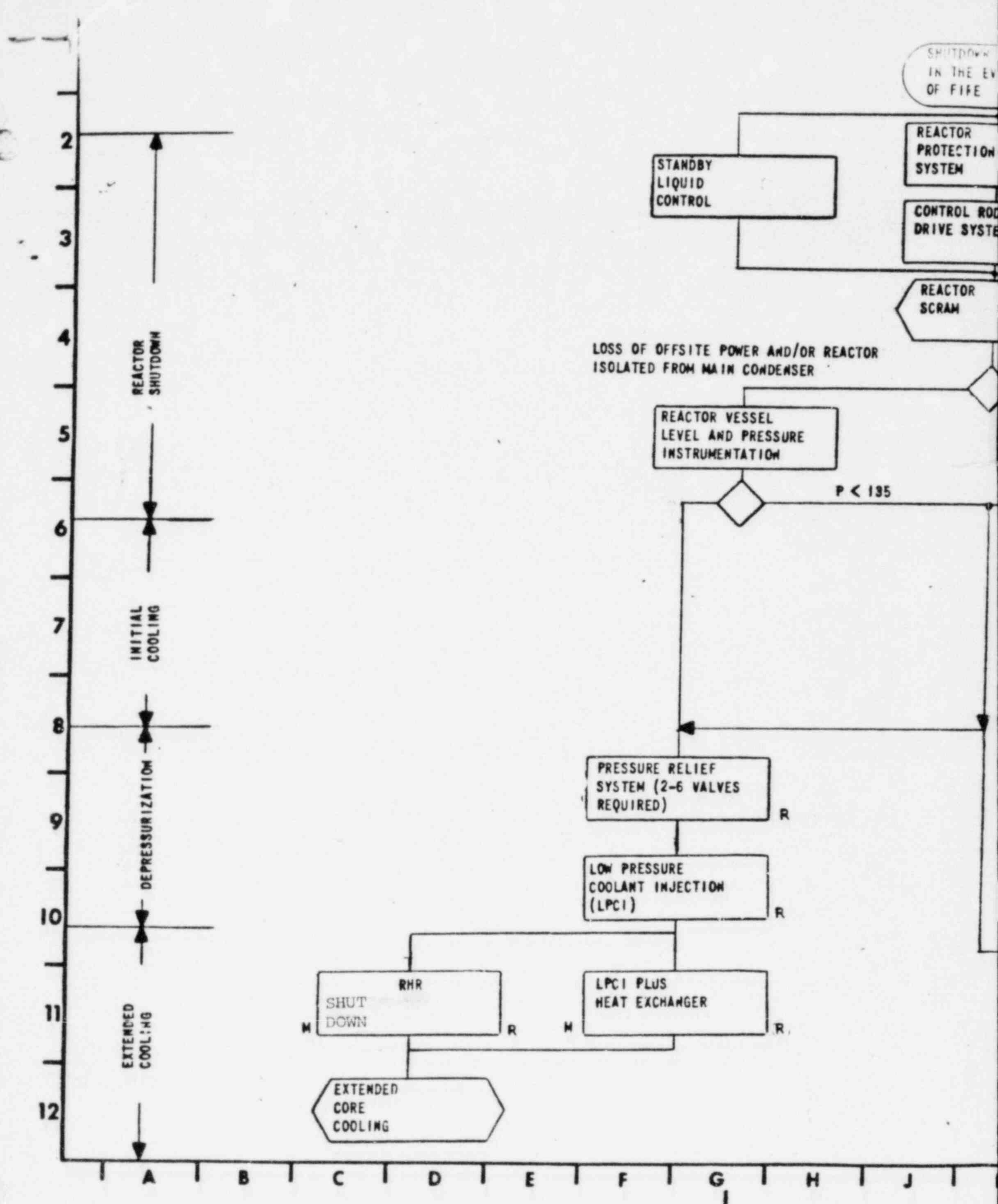
10-MOV 17 & 18 isolate reactor coolant loop from RHR pump suction. These valves are normally closed. The circuit breaker for 10-MOV 18 will be left open to preclude the possibility of opening the valve due to a fire. In addition, the control and power cables for 10-MOV 18 will be re-routed.

ii) 03-AOV 32A/B and 03-AOV33

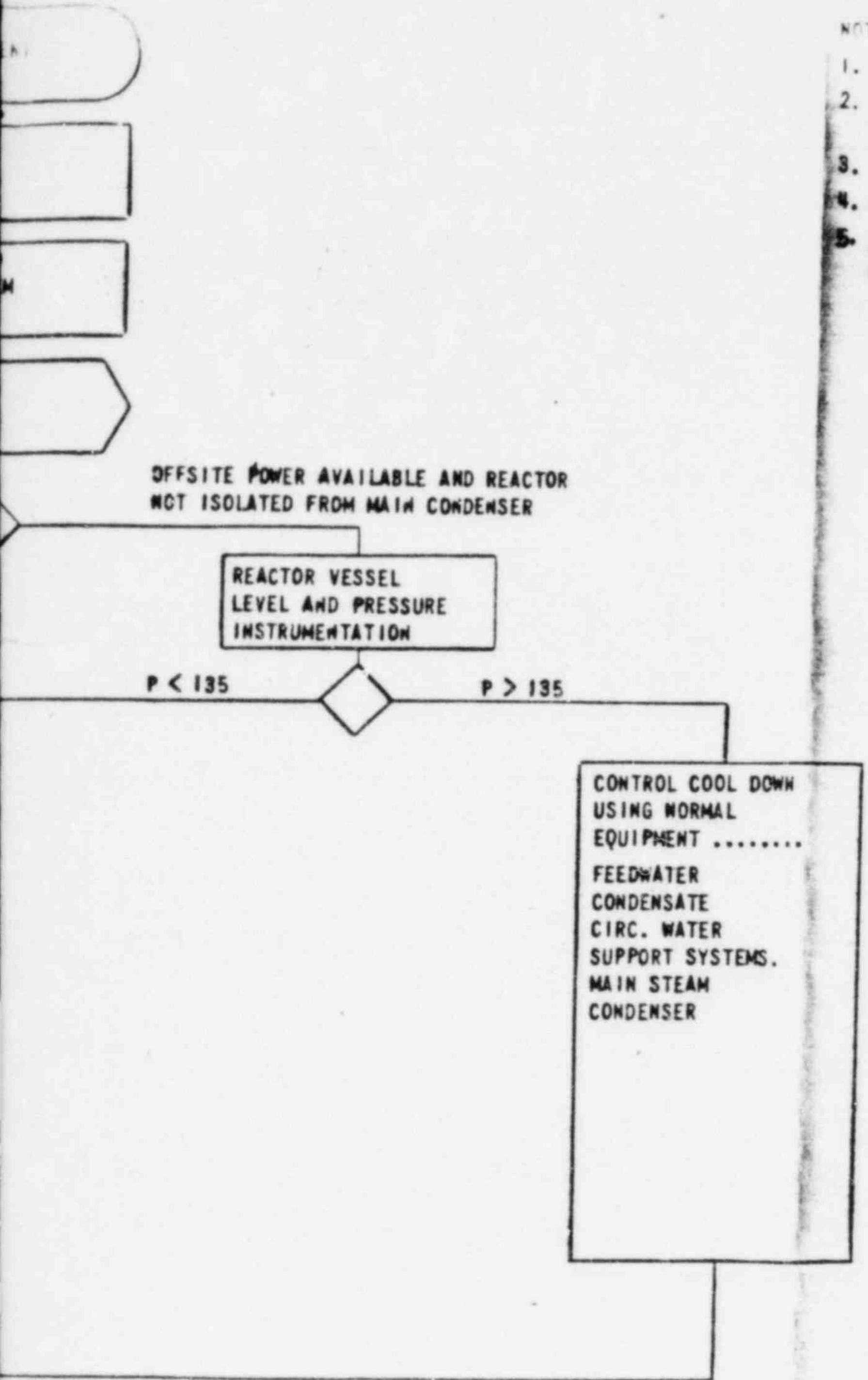
03-AOV 32A and B are the Scram Discharge volume vent valves and 03-AOV-33 is the drain valve. This system is currently being redesigned to meet the NRC Long Term CRD requirements. For this new design, the control circuit for these valves will be located in the Control Room. Thus, a fire outside the Control Room will either short or open the 125V DC supply wires to the valve. This type of damage will not cause the valve to open after closed or will cause the valve to close (safe position) if open. For a fire in the Contol Room, Relay Room and Cable Spreading Room, the operator by procedure is instructed to isolate the control rod air header air supply to the Scram Valves to preclude fire induced

Question 2.0 (cont)

spurious control rod actuations (refer to page 5-16). This operator action also isolates the air supply to the above mentioned valves. Thus Control Room, Relay Room and Cable Spreading Room fire induced spurious actuations will not cause these valves to open.



SHUTDOWN IN THE EV OF FIRE
REACTOR PROTECTION SYSTEM
STANDBY LIQUID CONTROL
CONTROL ROD DRIVE SYSTE
REACTOR SCRAM
LOSS OF OFFSITE POWER AND/OR REACTOR ISOLATED FROM MAIN CONDENSER
REACTOR VESSEL LEVEL AND PRESSURE INSTRUMENTATION
P < 135
PRESSURE RELIEF SYSTEM (2-6 VALVES REQUIRED)
LOW PRESSURE COOLANT INJECTION (LPCI)
RHR SHUT DOWN
LPCI PLUS HEAT EXCHANGER
EXTENDED CORE COOLING
REACTOR SHUTDOWN
INITIAL COOLING
DEPRESSURIZATION
EXTENDED COOLING
M
R
2
3
4
5
6
7
8
9
10
11
12
A
B
C
D
E
F
G
H
J




NOTES:

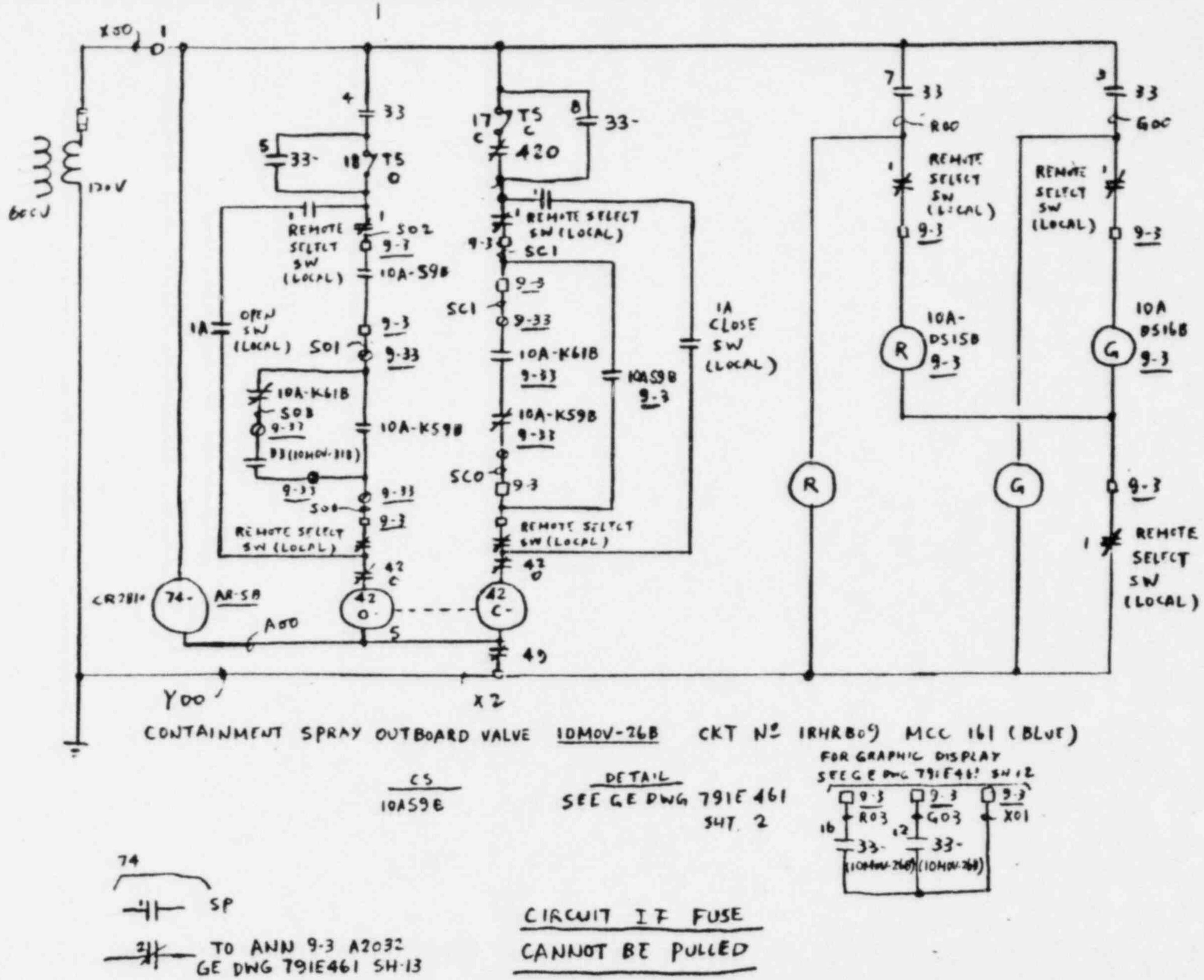
1. RCIC IS AUTO START, MANUAL RESET.
2. RHR CONDENSING MODE REQUIRES NON-SAFETY INSTRUMENT AIR.
3. INSTRUMENTATION NOT SHOWN.
4. M – MANUAL, R – REDUNDANT EQUIPMENT AVAILABLE
5. ADDITIONAL FLEXIBILITY EXISTS IN THAT PATHS OF MANY OPERATIONS MAY BE RETRACED.

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
POWER AUTHORITY OF THE STATE OF NEW YORK

FIGURE 5-1
PROTECTION SEQUENCE FOR SHUTDOWN DURING A FIRE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C P E | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

K L M N P Q R S T U V



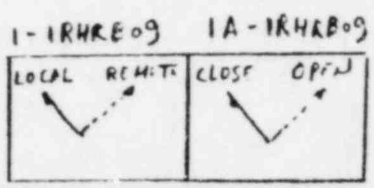



FIGURE 5-2

TYPICAL CONTROL CIRCUIT - CONTROL ROOM
RELAY ROOM CABLE SPREADING AREA
LOCAL VALVE ISOLATION SWITCHES

## SECTION 6.0
## 10 CFR 50 APPENDIX R ASSOCIATED CIRCUIT ANALYSIS

### 6.1 Criteria

#### 6.1.1 Definition of Associated Circuits

In order to assess the impact of associated circuits on safe shutdown capability, it was necessary to identify the criteria by which cables are considered to be "associated".

- A common power source with the alternate shutdown equipment and the power source is not protected electrically from the post fire shutdown circuit of concern by coordinated circuit breakers, fuses or similar devices.

- A connection to control circuits of equipment whose spurious operation will adversely affect the shutdown capability.

- A common enclosure i.e. raceway, panel with alternative shutdown cables which are not electrically protected from the post fire shutdown cables and circuits of concern by circuit breakers, fuses or similar devices.

#### 6.1.2 Method of Choosing Fire Areas or Zones

The fire areas chosen for associated circuits analysis are those presented in the Safe Shutdown Analysis for FitzPatrick of September 1979 (and revised October 1980) and the Fire Hazards Analysis for FitzPatrick of January 1977 (and supplemented in April 1977) and as modified and described in the introduction to this report. These areas are listed in Section 4.4 and shown in Figures 4-6 through 4-11.

## 6.2 Analytical Method

The associated circuits analysis consisted of five tasks. Each task addressed a different aspect of the associated cable criteria. The five tasks are described below:

### 6.2.1 Task One

Task One identified the neutral cables crossing the boundaries of all fire areas (or zones). This was done on an area-by-area basis. To accomplish this; electrical tray, sleeve and conduit location drawings were used to identify all the raceways, both colored and neutral that cross the fire area boundary. The Stone & Webster computerized Electrical Cable Schedule Information System (ECSIS) was then used to identify all the neutral cables of concern leaving a fire area or zone. Cables of low power source, e.g., annunciator cables, were omitted from the list due to their insignificant impact.

### 6.2.2 Task Two

Task Two addressed the first item in the associated circuit criteria; a common power source. All cables connected to power distribution buses and panels were identified. This was done by examining the cable location schedules. The schedule is a computer generated listing of all cables terminating on electrical equipment in the plant. This was a sub-report of The ECSIS.

By using the cable location schedule a list of all nonsafety cables terminating on colored power buses and distribution panels was identified. The cables on this list were first checked to determine if the protective devices were coordinated with the main power breakers. If the protective devices were coordinated, then the cable was dropped from the list. If the protection was not coordinated, then all equipment powered from the bus or distribution panel in question was considered lost for a fire in any area that destroyed the "non-coordinated" associated cable. For the 125V DC system, short circuit calculations were performed on the non-coordinated associated cable, for the fire areas of concern, to determine how the cable's loss affected the bus. If there was no adverse effect the cable was dropped from further consideration.

The results of Task Two indicated that the protective devices were found to be coordinated, and the cables were dropped from the list.

### 6.2.3 Task Three

Task Three identified all associated cables connected to the control circuits of equipment whose spurious operation could adversely affect the shutdown capability (Item 2 of the criteria). This was accomplished by reviewing the control circuitry for the safe shutdown model components. The electrical elementary and wiring diagrams for each component were evaluated to determine if spurious operation could be initiated through the failure of an associated cable.

If it was found that a cable could potentially cause a spurious operation of an essential component it was than checked against the area cable list generated in Task One. The spurious failure would then be added to the other effects of a fire in that given area. The effect on shutdown was considered in Task Five.

### 6.2.4 Task Four

Task Four addressed the third criteria of association; common enclosure. Each cable on the computer generated list of Task One was examined to insure that it was properly protected. This was done by reviewing the electrical one lines, elementary and wiring diagrams for the associated cables. If a cable was found not to be electrically protected, the ECSIS was used to determine the cables's routing, the essential cables in a common enclosure, and the essential equipment affected. Again the effects on shutdown were considered in Task Five.

### 6.2.5 Task Five

In Task Five the cumulative results of Tasks One, Two, Three and Four were added to the results of the original safe shutdown analysis on an area by area basis. It was then determined if the capability still existed to safely shut down the plant after a fire. If adequate shutdown capability did not remain, then the cables in question were reviewed for further analysis.

## 6.3 Proposed Plant Modifications

No plant modifications are required based upon the results of the above analysis.

Modifications for spurious signals resulting from Control Room, Relay Room and Cable Spreading Room postulated fires are addressed in Section 5.0.

## APPENDIX A

### Basis for Heat Release Rates

The heat release rate associated with a fire is related to the fuel's mass loss rate (pyrolysis) and the heat of combustion (Tewarson [1]).

$$\dot{Q}''_T = \dot{m}''_b H_T$$

where

$\dot{Q}''_T$ = Total theoretical heat release rate

$\dot{m}''_b$ = Mass loss rate in burning

$H_T$ = Total theoretical heat of combustion

The mass loss rate is given by:

$$\dot{m}''_b = \frac{\dot{q}''_n}{L}$$

where:

$\dot{q}''_n$ = Net heat flux received by the fuel

$L$ = Heat required to generate a unit mass of fuel vapors

Typically, the net heat flux is given as the difference between the total heat flux received by the fuel and that flux lost through a variety of processes. These relationships may be modified, however, by the relative concentration of oxygen entrained in the combustion zone. The principal effect of this consideration is seen in the heat of combustion which reflects different oxidation reactions as oxygen concentration varies.

The measure of oxygen in the combustion zone relative to fuel is as follows:

$$\phi = \frac{\dot{M}''_{O_2}(\alpha)}{\dot{m}''_b K_{O_2}}$$

where $\phi$ = fraction of stoichiometric oxygen to fuel ratio

$\alpha$ = fraction of oxygen entrained in combustion

$K_{O_2}$ = stoichiometric mass oxygen to fuel ratio

$\dot{M}''_{O_2}$ = mass flow rate of oxygen to fire vicinity

The effect of this parameter on combustion may be illustrated for the case of polymethylmethacrylate for a range of values of the stoichiometric oxygen/fuel fraction:

| $\phi$ | Fuel Condition | Chemical Reactions | Combustion Efficiency | $H_A$ (kJ/g) |
|---|---|---|---|---|
| ≥1.0 | Lean | $C_5H_8O_2 + 6O_2 \rightarrow 5CO_2 + 4H_2O$ | 100 | 24.9 |
| 0.81 | Lean | $C_5H_8O_2 + 4.9O_2 \rightarrow 4CO_2 + 35H_2O$ | 80 | 19.9 |
| 0.63 | Rich | $C_5H_8O_2 + 3.8O_2 \rightarrow 4CO_2 + 3.5H_2O$ $+ 0.25CO_2 + 0.25CH_4 + 0.75C$ | 60 | 14.9 |
| 0.42 | Rich | $C_5H_8O_2 + 2.5O_2 \rightarrow 2CO_2 + 2H_2O$ $+ CO + CH_4 + C$ | 35 | 8.7 |

As may be evident from this table, combustion efficiency has a significant effect on the overall heat release rate. In addition, it should be noted that lower combustion efficiencies produce increasing amounts of carbon which lead to higher smoke rates, lower optical transmission path lengths, and higher soot concentrations.

The stoichiometric oxygen/fuel fraction affects heat release rates through its influence on the value of $\chi_i$ in the standard equation:

$$\dot{Q}_i'' = \chi_i(\phi)\left(\frac{h_T}{L}\right)\dot{q}_n''$$

where $\chi_i$ = fraction of total theoretical heat release rate associated with mode i

The analysis utilizes a constant value of $\chi_i$ associated with large scale fires unless otherwise documented. This assumption has the effect of ensuring that the effects of postulated fires are treated conservatively through the use of maximum heat release rates.

The heat of combustion for a fuel is measured in a bomb calorimeter. For the case of acetone, Weast (2) reports a heat of combustion of 426.8 kG-cal/g-MW or 30.8 kJ/g. This heat of combustion may be related to the heat release rate through the determination of a mass loss rate or fuel vaporization. Such a rate is given by:

$$\dot{m}_b'' = \frac{\dot{q}_n''}{L}$$

This rate has been shown to approach an asymptotic limit at higher rates of $\dot{q}''_n$ (Tewarson et.al. [4]), especially for aromatic, i.e., benzene-like compounds (Tewarson [3]). Tewarson (1) showed that acetone, an aliphatic ketone, exhibits characteristics similar to the aromatic liquids which suggests the validity of the asymptotic limit assumption for acetone's fuel vaporization rate. For most hydrocarbons, this limit is bounded by vaporization rates of $40 g/m^2$-s, a mass flux supported by experimental data in Tewarson (3) and (5), where a value of $30 g/m^2$-s is given, and Blinov and Khudiakov (7).

Tewarson (2) reports a value of $x_A\ H_T/L=36$ for acetone while Tewarson (1) reports $H_T/L = 47.48$ . This suggests that $x_A = 0.76$. On this basis, the following heats of combustion may be calculated:

Actual Heat of Combustion: 23.4 kJ/g

Theoretical Heat of Combustion: 30.8 kJ/g

These calculated values may be compared to experimental data obtained by Tewarson (6) for acetone:

Actual Heat of Combustion: 21.71 kJ/g

Theoretical Heat of Combustion: 28.49 kJ/g

This analysis acknowledges the experimental basis for the Tewarson data but utilizes the higher heats of combustion for purposes of conservatism.

Tewarson (6) also reports the following data for acetone in the experiments performed:

| | | |
|---|---|---|
| Actual Heat Release Rate: | 262 | $kW/m^2$ |
| $X_{actual}$ | = | 0.762 |
| $X_{convective}$ | = | 0.5666 |
| $X_{radiative}$ | | |
| luminous | = | 0.20 |
| highly luminous: | | 0.37 |

It is apparent from a review of this data that a fuel vaporization rate of 12.1 $g/m^2$ was characteristic of the tests reported in Tewarson (6). This vaporization rate may be best described as laminar, and highlights the conservatism in the higher fuel vaporization rate used in this analysis. In larger fires where flow is turbulent, it has been seen (Tewarson et.al. [4]) that radiation begins to dominate convective heat release. Utilizing the higher value of 37% for the radiative component associated with highly luminous flames, the following values are assumed for acetone:

$X_{actual}$ = 0.76

$X_{radiative}$ = 0.37

$X_{convective}$ = 0.39

This yields the following results for acetone:

Heat of Combustion ($kJ/g$)

| | | |
|---|---|---|
| convective | = | 12.0 $kJ/g$ |
| radiative | = | 11.4 |

| | | |
|---|---|---|
| actual | = | 23.4 |
| complete combustion | = | 30.8 |

Vaporization Rate ($g/m^2$-sec.)

| | | |
|---|---|---|
| highly luminous flame | = | 40.0 |

Heat Release Rate ($kW/m^2$)

| | | |
|---|---|---|
| convective | = | 480.0 |
| radiative | = | 456.0 |
| actual | = | 936.0 |

For lubricating oil, Tewarson (4) reports the following data as representative for typical high-temperature hydrocarbons:

| | Laboratory Scale | Large Scale |
|---|---|---|
| Heat of Combustion ($kJ/g$) | | |
| convective | 18.2 | - |
| radiative | 20.4 | 16.3 |
| actual | 38.6 | - |
| complete combustion | 46.3 | - |
| Vaporization Rate ($g/m^2$-s) | | |
| highly luminous flame | 40.0 | 26.8 |

| | Laboratory Scale | Large Scale |
|---|---|---|
| Heat Release Rate ($kW/m^2$) | | |
| convective | 728 | 534 |
| radiative | 816 | 415 |

| | | |
|---|---|---|
| actual | 1544 | 949 |

Tewarson (4) reports the following data for heptane:

| | Laboratory Scale | Large Scale |
|---|---|---|
| Heat of Combustion ($^{kJ}/_{g}$) | | |
| convective | 21.6 | - |
| radiative | 17.4 | 14.4 |
| actual | 39.0 | - |
| complete combustion | 44.6 | - |
| Vaporization Rate ($^{g}/_{m^2\text{-}s}$) | | |
| highly luminous flame | 70 | 70.1 |
| Heat Release Rate ($^{kW}/_{m^2}$) | | |
| convective | 1512 | 1514 (estimated) |
| radiative | 1218 | 1009 (estimated) |
| actual | 2730 | 2523 (estimated) |

This analysis utilizes the laboratory scale values for fuel vaporization rate and heat release rates in calculating the effects of exposure fires on electrical cables and plant equipment. This practice effectively assumes that the most efficient combustion achievable in the laboratory occurs in general plant areas as well.

References:

(1) A. Tewarson, "Heat Release Rate in Fires", Fire and Materials, V4, pp. 185-191 (1980).

(2) R.C. Weast, Editor, "Handbook of Chemistry and Physics", 61st Edition (1980-81), Chemical Rubber Company, Cleveland, OH, 1980.

(3) A. Tewarson, "Physico-Chemical and Combustion/Pyrolysis of Polymeric Materials", Report RC80-T-9, Prepared for U.S. Department of Commerce, National Bureau of Standards, Center for Fire Research by Factory Mutual Research Corporation, Norwood, MA, November, 1980.

(4) A. Tewarson, "Fire Behavior of Transformer Dielectric Insulating Fluids", DOT-TSC-1703, Prepared for U.S. Department of Transportation, Transportation Systems Center by Factory Mutual Research Corporation, Norwood, MA, September, 1979.

(5) A. Tewarson and R.F. Pion, "A Laboratory-Scale Test Method for the Measurement of Flammability Parameters", FMRC 22524, Factory Mutual Research Corporation, Norwood, MA, October, 1977.

(6) A. Tewarson, "Experimental Evaluation of Flammability Parameters of Polymeric Materials", Report FMRC J.1.1A6R1, Prepared for Products Research Committee, National Bureau of Standards by Factory Mutual Research Corporation, February, 1979.

(7) V.I. Blinov and G.N. Khudiakov, "Diffusion Burning of Liquids", Moscow Academy of Sciences (1961).

## APPENDIX B

## Stratification

The stratification model used in this section has its origins in work performed by J.S. Newman and J.P. Hill of Factory Mutual Research Corporation on behalf of the Electric Power Research Institute (1). This EPRI research related the radiative and convective heat flux associated with stratified layers of hot gases developed in an enclosure fire to the room's dimensions, the height above the floor, the fuel's flammability parameters and the ventilation rate. Data was obtained in a series of experiments involving 14 methanol and heptane enclosure fires at elevations ranging from 30%-98% of the ceiling height for up to 12 room air changes per hour. Among the general observations, FMRC scientists noted the following:

(1) Varying the location of the pan fire within the enclosure had no appreciable effect on the measured heat fluxes or gas temperatures at any given position. This suggests the lack of sensitivity of stratified heat flux to horizontal separation.

(2) Differences in gas temperature or heat flux measurements at the same vertical position at different locations were, in general, inconsequential and within the variation expected from the measuring instrument.

(3) In terms of horizontal variation, measurements indicate a tendency for the enclosure corners to be slightly cooler and receive lower total heat fluxes than at other locations within the enclosure.

(4) The ventilation rate does not appear to have a dominant effect on gas temperatures or heat fluxes within the enclosure, with ventilation rates below approximately one and one-half room changes per hour having virtually no effect.

(5) The total heat flux measured at any point in the enclosure is approximately 5-10% radiative and 90-95% convective for all conditions investigated independent of fuel. Since the heat flux data collected was for an exposed sphere, this suggests predicted values which would actually be conservative for cylindrical cable bundles found in cable trays.

(6) Because of the observed stratification, the application of these empirical results would be appropriate for any room shape as long as the floor area of the particular room is greater than or equal to the floor area of a comparable room of the same height with dimensions of 2:1:1.

Newman and Hill reported empirical spatially dependent transient and steady state heat fluxes. Figure B-1 illustrates the course of heat flux over time following ignition. The transient heat flux was shown to be related to a time constant unique to each fuel that was obtained by a power curve fit to the fire diameter. Herkestad (2) provides the basis for such a response in the early stages of a fire.

Correlations of the data were obtained by Newman and Hill (1) and are reproduced below:

(1) $$\frac{\dot{q}''_{ss} H^2}{Q''_T A} \left[\frac{h}{H}\right]^{-\frac{1}{2}} = 0.24 - \frac{4.73 \dot{V}_f}{H^{5/2}}$$ (Steady State)

(2) $$\frac{\dot{q}''_t}{\dot{q}''_{ss}} \left[\frac{h}{H}\right]^{-\frac{1}{2}} = \left[0.52 + \frac{13\dot{V}_f}{H^{5/2}}\right] \left[\frac{t}{\tau}\right]^{0.9}$$ (Transient)

These results were reviewed for accuracy against the original data in the EPRI report presented in Table 3-4 of Newman and Hill (1), which is reproduced as Table B-1. Plotting the reported data onto Newman and Hill's Figure 3-2 (reproduced herein as Figure B-2) suggests that the original EPRI correlation defines a poorly behaved function with respect to the ventilation component such that with higher ventilation rates, a refrigeration effect may be noted. In reality, while higher ventilation rates will in general have a disruptive effect on any enclosure fire to the point where some mitigation is possible, it was felt that use of the EPRI correlations would be non-conservative at some points. It should be noted, however, that for relatively small exposure fires which are not ventilation-limited, the fire severity is reduced as ventilation increases. This point is discussed in some detail by T.Z. Harmathy (2,3).

Nevertheless, to provide assurance that the function remains well behaved in a conservative fashion and that the experimental data provided bounding results, a modified correlation was obtained as follows:

$$(3)\quad \dot{q}''_{ss} = \begin{cases} 0.7854\, \dot{Q}''_T \dfrac{D^2}{H^2} \left[\dfrac{0.05585}{(1.193 - \frac{h}{H})^{\frac{1}{2}}} \cdot \left[0.01161 - \dfrac{0.01031}{(2.13 - \frac{h}{H})^{\frac{1}{2}}}\right]^{-0.153}\right]; \\ \qquad \dot{V}_f \le H^{5/2}\left[0.01161 - 0.01031\left(2.13 - \frac{h}{H}\right)^{-\frac{1}{2}}\right] \\ 0.7854\, \dot{Q}''_T \dfrac{D^2}{H^2} \left[\dfrac{0.05585}{(1.193 - \frac{h}{H})^{\frac{1}{2}}} \cdot \left[\dfrac{\dot{V}_f}{H^{2.5}}\right]^{-0.153}; \right. \\ \qquad \dot{V}_f \ge H^{5/2}\left[0.01161 - 0.01031\left(2.13 - \frac{h}{H}\right)^{-\frac{1}{2}}\right] \end{cases}$$

$$(4) \quad \dot{q}''_t = \dot{q}''_{ss} \left(\frac{t}{\tau}\right)^{0.9} \left[\frac{h}{H}\right]^{\frac{1}{2}} \left[0.52 + \frac{13\dot{V}_f}{H^{5/2}}\right] ; \dot{q}''_t \leq \dot{q}''_{ss}$$

Utilizing these revised correlations, the analysis applies classical optimization techniques for non-linear functions to determine the minimum fuel volumes and associated geometries (i.e., fire area and spill depth) necessary to exceed the damage criteria for the cables of concern at the elevations of interest within an enclosure.

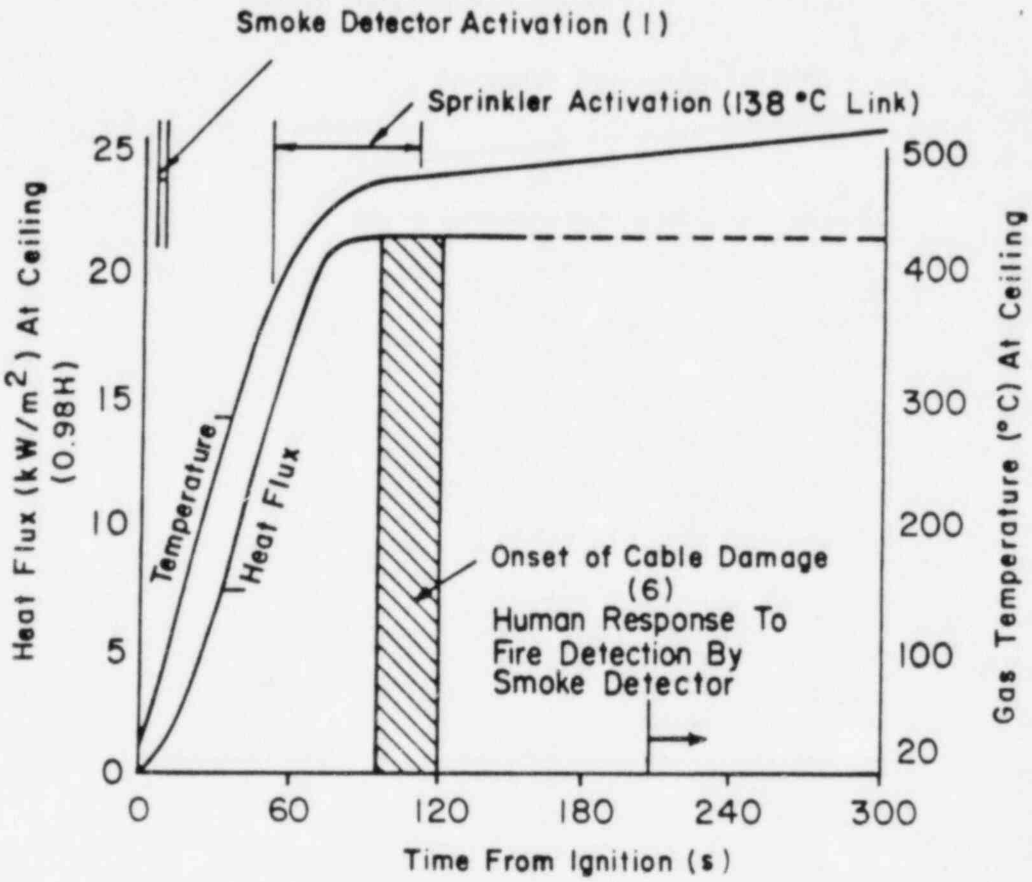
References:

(1) J.S. Newman and J.P. Hill, "Assessment of Exposure Fire Hazards to Cable Trays", EPRI-NP-1675, Electric Power Research Institute, Palo Alto, CA, January, 1981.

(2) G. Heskestad and M.A. Delichatsius, "The Initial Convective Flow in Fire", Report RC79-T-2, Factory Mutual Research Corporation, Norwood, MA, January, 1979.

(3) T.Z. Harmathy, "Some Overlooked Aspects of the Severity of Compartment Fires", Fire Safety Journal, 3(1980/1981), pp. 261-271.

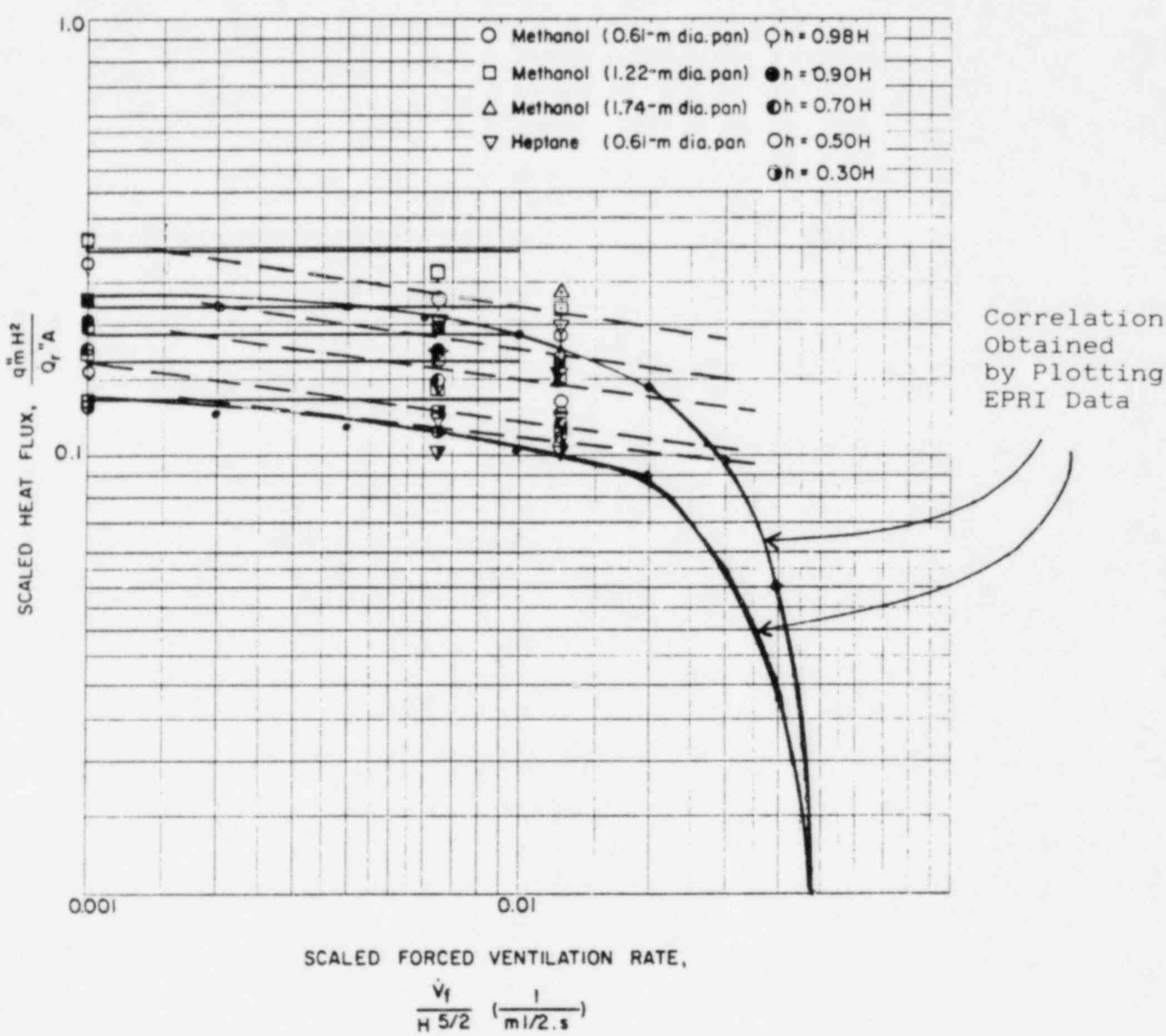
(3) T.Z. Harmathy, "Effect of the Nature of Fuel on the Characteristics of Fully Developed Compartment Fires", Fire and Materials, V3, N3 (1979), pp. 49-60.




Heat flux and gas temperature at ceiling (Station 4) versus time from ignition for Test EP008

Figure B-1

Reproduced from Newman, J.S. and Hill, J.P., "Assessment of Exposure Fire Hazards to Cable Trays", EPRI-NP-1675, Electric Power Research Institute, Palo Alto, CA, January 1981.




Scaled Heat Flux versus Scaled Forced Ventilation Rate

Figure B-2

Reproduced from Newman, J.S. and Hill, J.P., "Assessment of Exposure Fire Hazards to Cable Trays", EPRI-NP-1675, Electric Power Research Institute, Palo Alto, CA, January 1981.

GAS TEMPERATURES, GAS VELOCITIES AND TOTAL HEAT FLUXES
VERSUS POSITION FOR ENCLOSURE FIRE TEST EP008
(70 s AFTER IGNITION)

| Station | Vertical Position | Gas Temperature (°C) | Gas Velocity (m/s) | Total Heat Flux ($kW/m^2$) | Percent Radiative |
|---|---|---|---|---|---|
| 1 | 0.98H | 387 | 5.0 | 20.4 | 7.9 |
| 2 | | 458 | 6.4 | 24.9 | 9.4 |
| 3 | | 429 | 5.1 | 20.5 | 6.5 |
| 4 | | 457 | 5.3 | 23.1 | 7.9 |
| 5 | | 406 | 2.8 | 17.1 | 7.1 |
| 1 | 0.90H | 364 | 1.5 | 12.5 | 6.5 |
| 2 | | 356 | 1.9 | 12.2 | 6.8 |
| 3 | | 328 | 2.1 | 11.8 | 5.2 |
| 4 | | 342 | 1.9 | 12.5 | 6.0 |
| 5 | | 385 | 1.4 | 13.4 | 7.1 |
| 1 | 0.70H | 315 | 1.5 | 11.0 | 7.4 |
| 2 | | 294 | 1.5 | 9.7 | 4.3 |
| 3 | | 299 | 1.5 | 10.0 | 7.3 |
| 4 | | 297 | 1.9 | 11.0 | 7.6 |
| 5 | | 311 | 1.1 | 10.1 | 9.9 |
| 1 | 0.50H | 269 | 2.4 | 10.9 | 8.9 |
| 2 | | 268 | 2.7 | 10.9 | 9.1 |
| 3 | | 267 | 1.7 | 9.1 | 5.6 |
| 4 | | 258 | 1.3 | 7.9 | 3.9 |
| 5 | | 256 | 0.8 | 7.1 | 5.7 |
| 1 | 0.30H | 232 | 1.7 | 8.0 | 5.0 |
| 2 | | 241 | 2.8 | 9.2 | 4.7 |
| 3 | | 218 | 2.2 | 7.7 | 5.8 |
| 4 | | 222 | 1.7 | 6.1 | 7.5 |
| 5 | | 217 | 0.5 | 4.7 | 5.0 |

Table B-1

Reproduced from Newman, J.S. and Hill, J.P., "Assessment of Exposure Fire Hazards to Cable Trays", EPRI-NP-1675, Electric Power Research Institute, Palo Alto, CA, January, 1981

## APPENDIX C

### Diffusion Plumes

A low-level fire in an enclosure develops a turbulent, buoyant, diffusion plume which flows upward towards the ceiling or the first horizontal surface. Driving the upward flow of hot gases are the gravitational forces acting on the difference in density between the plume and its ambient environment, a condition which poses a problem for the analyst to consider. An understanding of the physics of such plumes is esential to the modeling of the effects of such plumes on immersed materials and components. Fortunately, recent developments as discussed in the literature allow for the prediction of the effects of such plumes.

The history of the modeling of turbulent buoyant diffusion plumes is fairly recent. An early description of the flow of buoyant plumes published in 1941 is attributable to Schmidt (1). In a series of experiments involving convective plumes of air above small sources, Schmidt noted the tendency of buoyant plumes to exhibit conical patterns in turbulent vertical flow. Assuming symmetry conditions existed, Schmidt generated velocity and temperature profiles for constant ambient temperatures involving point and line sources and verified their accuracy against experimental data.

Batchelor extended Schmidt's results to both stratified and uniform environments in a manner similar to Rouse et. al. (3). These classical relationships are reproduced below:

$$U = F_a^{1/3} z^{-1/3} f_1\left(\frac{r}{z}\right)$$

$$g' = F_a^{1/3} z^{-5/3} f_2\left(\frac{r}{z}\right)$$

$$d = \lambda z$$

where

$F_a \equiv$ buoyancy/unit time $\Big|_{\text{source}}$

$= 2\pi \int_o^\infty U\, g' r dr$

$g' \equiv$ buoyancy $= g \frac{\Delta\rho}{\rho_a}$.

$z \equiv$ height above source

$r \equiv$ radial distance from plume axis or centerline

$g =$ acceleration of gravity

$\Delta\rho =$ density difference between local and ambient gas

$\rho_a =$ ambient density

$U =$ mean vertical velocity in plume

$d =$ plume radius

$\lambda =$ dimensionless constant

In defining these relationships, the forms of $f_1(r/z)$ and $f_2(r/z)$ were initially undetermined although it may be apparent that boundary conditions require that they be at once continuous and well-behaved. This consideration was confirmed through a series of experiments involving hot air in a large room by Rouse (3) where it was demonstrated that both the mean temperature and the velocity profiles were essentially Gaussian. On this basis, Batchelor's relationships become:

$$U = 4.7F_a^{1/3} z^{-1/3} e^{-(\frac{96r^2}{z^2})}$$

$$g' = 11F_a^{1/3} z^{-5/3} e^{-(\frac{71r^2}{z^2})}$$

At this point, the development of a theory for buoyant diffusion plumes is limited by the mixing length theories which form the basis for the similarity solution approach taken by Batchelor. These assumptions imply a loss of generality of Batchelor's functions for plumes diffusing into non-uniform gas temperatures. However, this difficulty is overcome through the use of an entrainment assumption attributable to Taylor (4) for air blast phenomena associated with nuclear detonations. This very fundamental assumption relates the mean inflow velocity across a plume edge to the local mean vertical velocity primarily through entrainment. Morton et. al. (5) applied this assumption to the study of convection currents.

As reported in Stavrianidis (6), three principal assumptions are made by Morton (5).

(1) The largest local variations of density in the field of motion are small in comparison to some chosen reference density.

(2) The mechanics of entrainment can be represented fully by taking a mean radial inflow velocity across some suitably defined "mean outer boundary" as proportional to the mean vertical velocity on the plume axis at that height. Equivalently,

$V = E_o U_o$ where, $E_o$ = 0.1 from Stavrianidis (6) and Turner (2)

$U_o$ = mean vertical velocity on plume centerline

(3) The mean profiles of longitudinal velocity, temperature and density are similar in shape at all elevations in the plume.

These relationships apply to weakly buoyant plumes. Extension of the theory to strongly buoyant plumes initially leads to a redefinition of the local entrainment function due to Morton (8):

$$E = \left(\frac{\rho}{\rho_a}\right)^{1/2} E_o$$

With this modification for the local entrainment function, solution of the general plume conservation equations for the case of the strongly buoyant plume was shown by Morton to be essentially equivalent to that of the weakly buoyant plume with larger convective heat release rates. Heskestad (9) subsequently confirmed this generality inside the flame envelope in a series of experiments.

With this background, it is apparent that turbulent, buoyant, diffusion plumes could be described mathematically in terms of convective heat release rates and position above the source. Stavrianidis (6) extended this basis in a series of experiments involving large scale hydrocarbon fires which measured the actual heat release rate in the plume. The redefined plume laws correlated to Stavrianidis' data yield, independent of fuel type:

$$\overline{\Delta T} = 0.092 Q_c^{2/3} (z-z_o)^{-5/3} \; e^{-(\frac{71 r^2}{z^2})}$$

$$U = 1.20 Q_c^{1/3} (z-z_o)^{-1/3} \; e^{-(\frac{96 r^2}{z^2})}$$

where

$\overline{\Delta T}$ = normalized excess temperature on plume centerline

= $\frac{T - T_a}{T_a}$

$T$ = mean plume temperature

$T_a$ = ambient temperature

$Q_c$ = actual convective heat release rate

$z$ = height above physical source

$z_o$ = height of virtual source above physical source

Stavrianidis demonstrated the validity of these correlations well into the flame envelope to a point of divergence noted for plume gas temperatures. The data reveals a constant maximum value for temperature of 1235°K for heptane, methanol, and silicone oil fires. The point of divergence is defined as the critical height, a function solely of the convective heat release rate, and given by:

$$z_c = 0.13Q_c^{2/5} + z_o$$

The determination of the height of the vertical source is given by:

$$z_o = 7.54F^{1/5}\left(\frac{\dot{m}^2 S^3}{\alpha_c H_c}\right)^{1/5} - 0.15Q_c^{2/5}$$

where

$$F = \frac{c_p T_a}{\rho_a^2 g}$$

$\dot{m}$ = fuel vaporization rate

$$\alpha_c = \frac{Q_c}{\dot{m}H_T}$$

$H_c$ = convective heat of combustion

$H_T$ = theoretical heat of combustion

S = stoichiometric fuel-oxygen ratio

With these experimentally derived relationships, it is possible to calculate a number of parameters of interest relative to the exposure fire problem, in particular:

(1) Plume temperatures above a pool fire,

(2) Gas velocities above a pool fire,

(3) Heat flux delivered to a point above a pool fire,

(4) Radiative heat flux associated with luminous flames.

Each of these calculations are of value in the quantitative fire hazards analysis contained in this report. This appendix will cover those aspects related to the heat flux associated with diffusion plumes.

The problem of plume impingement is treated in this analysis in three distinct approaches:

(1) Stagnation heat flux associated with direct plume impingement on a horizontal surface.

(2) Cross flow heat flux to a cylinder (cable) associated with immersion in a turbulent buoyant plume.

(3) Parallel flow along a plate associated with immersion in a turbulent buoyant plume.

Axisymmetric fire-induced flow beneath a flat horizontal surface such as a ceiling has been discussed in the literature for some time. Early work includes that of Pickard et. al. (10) and Thomas (11). The theory, however, did not progress to the level of generality until Alpert (12) developed a basis for the accurate prediction of turbulent ceiling jets as a function of the heat release rate and distance to the ceiling. Alpert's analytical work, which was verified through experiments, demonstrated the validity of using small-scale models to predict the behavior of large-scale ceiling jets.

The basis for Alpert's work includes the top-hat source profiles of Morton et. al. (5) and the Gaussian temperature/velocity profiles of Rouse (3). Alpert's model views the ceiling jet as a boundary layer divided into two regions: an outer region where entrainment occurs as a result of turbulent mixing and a viscous essentially laminar sublayer at the horizontal surface. Data taken in Alpert's experiments indicates a decline in entrainment by an order of magnitude 3-4 ceiling heights from the fire axis. A significant decline in ceiling temperature as well as an increase in jet thickness is also noted 3-5 ceiling heights from the fire axis. Finally, the stagnation region is considered to extend radially outward to a distance of approximately 20% of the ceiling height prior to transitioning to a uniform stratified layer. Semi-gaussian profiles are assumed for the transition or turning region.

You and Faeth (13) extend Alpert's work and determine a heat flux within the stagnation region $(r/h<0.2)$ as a function of gas properties and the fire's heat release rate:

$$\frac{\dot{q}''H^2}{\dot{Q}} = 31.2\,Pr^{-3/5}Ra^{-1/6}$$

when Pr = Prandtl number (~0.7)

Ra = Rayleigh number

$$= \frac{g\beta\dot{Q}H^2}{\rho C_p \nu^3} \qquad (10^9<Ra<10^{14})$$

$$\frac{H_f}{H} < 1.5$$

$H$ = ceiling height

$H_f$ = free flame height

$g$ = gravitational constant

$\beta$ = coefficient of volumetric expansion

$\rho$ = density

$\nu$ = ceiling radial velocity for the jet

$\dot{q}''$ = heat flux

$c_p$ = heat capacity

$$\frac{\dot{q}'' H^2}{\dot{Q}} = 0.04\left(\frac{r}{H}\right)^{-1/3}$$

for $10^{10} < Ra < 2 \times 10^{13}$

$Pr \sim 0.7$

$\frac{H_f}{H} < 0.6$

References:

(1) W.Z. Schmidt, "Turbulent Propagation of a Stream of Heated Air", Z. Agnew Math. Mech.; V21, pp. 265-351, (1941).

(2) G.K. Batchelor, "Heat Convection and Buoyancy Effects in Fluids", Quarterly Journal of the Royal Meteorological Society; V80, pp. 339-358, (1954).

(3) M. Rouse, C.S. Yih, and H.W. Humphreys, "Gravitational Convection from a Boundary Source"; Tellus, V4, pp. 201-210, (1952).

(4) G.I. Taylor, "Dynamics of a Mass of Hot Gas Rising in Air", U.S. Atomic Energy Commission, MCCD, 919, LADC, 276, (1945).

(5) B.R. Morton, G.I. Taylor and J.S. Turner, "Turbulent Gravitational Convection for Maintained and Instantaneous Sources", Procedings of the Royal Society, A236, pp. 1-23, (1956).

(6) P. Stavrianidis, "The Behavior of Plumes Above Pool Fires", A Thesis Presented to the Faculty of the Department of Mechanical Engineering of Northeastern University, Boston MA, August 1980.

(7) J.S. Turner, "Buoyancy Effects in Fluids", Cambridge University Press, Cambridge, England, 1973.

(8) B.R. Morton, "Modeling Fire Plumes", Tenth Symposium (International) on Combustion, The Combustion Institute, Pittsburgh, PA, 1965.

(9) G. Heskestad, "Optimization of Sprinkler Fire Protection", FMRC Report 18972, Factory Mutual Research Corporation, Norwood, MA, 1974.

(10) R.W. Pickard, D. Hird, and P. Nash, JFRO Note 247, Fire Research Station, Boreham Wood, Huts, England, 1957.

(11) P.H. Thomas, JFRO Note 141, Fire Research Station, Boreham Wood, Huts, England, (1955).

(12) R.L. Alpert, "Turbulent Ceiling--Jet Induced by Large-Scale Fires"; Combustion Science and Technology, V11, pp. 197-213 (1975).

(13) H.Z. You and G.M. Faeth, "Ceiling Heat Transfer During Fire Plume and Fire Impingement", Fire and Materials, V3 N3, pp. 140-147, (1979).

# APPENDIX D

## Cable Failure Criteria

A concept of an electrical cable damage criterion with a sound technical basis is essential to the modeling of the effects of fire. The approach utilized in this report focuses on the flammability properties of the materials of concern and the effects of incident heat flux on the ability of the cable to function properly.

Electrical cables consist of several individual insulated cables bounded within a jacket designed to protect the cables from external hazards while ensuring adequate cooling under normal conditions. Generally, both the insulation and the jacket are manufactured from polymeric materials. Typical of such macromolecules is polyethylene, a long molecule based on the ethylene monomer $(-CH_2CH_2-)_n$ chain. Polymerization of vinyl monomers with chloride as the pendant group yields polyvinylchloride, a jacket material found in electric cables in older nuclear units.

Thermal decomposition of polymeric materials (pyrolysis) results in the physical degradation of a cable's insulation and produces combustible gases that may ignite in the presence of an ignition source. The process of pyrolysis requires a minimum heat flfux exposure and may be measured in terms of the insulation and jacket mass loss rate. Higher mass loss rates at a particular heat flux exposure suggest that more rapid combustion and higher overall heat release rates are possible with the material.

The detailed study of material flammability properties and an understanding of the pyrolysis/combustion process requires the use of a calorimeter capable of measuring mass loss rates, analyzing gaseous products, and determining heat release rates under varying incident fluxes. Such an apparatus has been in use for several years at Factory Mutual Research Corporation as described by Tewarson and Pion (1). This apparatus presents results for ignition, mass pyrolysis/burning rate, product mass generation rates, heat release rates, optical transmission through the products, and material thermal inertia. Experimental data for common polymeric solids and liquid hydrocarbons is presented in Tewarson (2) and Tewarson (3) et. al.

With the objective of understanding the physical processes underlying electrical cable flammability, the Electric Power Research Institute funded research at Factory Mutual Research Corporation utilizing the Tewarson apparatus. Initial results were reported in Tewarson et. al. (4) for twenty (20) different cable specimens which included a number of IEEE-383 qualified cables (IEEE [5]). Cables evaluated in this program are listed in Table D-1. This program was the most comprehensive study of electrical cable flammability then in existence. With the Tewarson work as a basis, the transition from a fundamental and comprehensive understanding of the electrical cable flammability parameters to a damageability criteria is not especially difficult. Before making that transition, however, it is important to discuss the relationship of the flammability parameters to the IEEE-383 fire test and the meaning of the standard itself.

The criteria given for the IEEE-383 flame test is as follows:

(1) The fire test should demonstrate that the cable does not propagate fire even if its outer covering and insulation have been destroyed in the area of flame impingement.

(2) The fire test should approximate installed conditions and should provide consistent results.

This test is essentially a "go/no-go" test which is generally considered appropriate for all cable arrangement conditions. Tewarson et. al. (4) demonstrated the validity of the intuitive notion, however, that cable flammability is actually dependent on multiple parameters. In that series of tests it was demonstrated that some electrical cables which were not qualified according to IEEE-383 exhibited flammability characteristics more desirable than that of the qualified cables tested. In fact, the only statement that Tewarson could make concerning the IEEE-383 tested cables was that the actual heat release rates were less than about 350 $kW/m^2$ for an external heat flux of 60 $kW/m^2$. This is not to suggest that IEEE-383 cable does not demonstrate good fire resistance qualities but rather to illustrate the complex phenomenon associated with fire and to highlight the fact that some unqualified IEEE-383 cables exhibited equally desirable performance characteristics.

The value of controlled laboratory experiments in categorizing cable flammability has been clearly demonstrated.

As thermal conditions vary with a fire, different electrical cables undergo physical and chemical changes depending upon their chemical composition. In this context the concept of damageability must be related to the thermal conditions which cause impairment to the cable's function.

This concept of damageability was examined by Lee (6) using data presented by Tewarson (4). Four basic phenomena were examined and are presented below in increasing magnitude of damage.

- o Insulation degradation--the onset of jacket mass loss from a cable.
- o Electrical failure under piloted conditions--the onset of short circuit between conductors for a 70 VDC signal under piloted conditions.
- o Piloted ignition--the onset of ignition in the presence of a small pilot flame.
- o Auto-ignition--the onset of self ignition.

For each cable, Lee plotted the external heat flux incident of the specimen against the inverse of the time to failure. These plots yielded the following information for each specimen:

(1) Critical heat flux--that incident heat flux above which the cable damage process is expected to occur.

(2) Critical energy--that amount of energy exposure necessary to cause cable failure to occur given a heat flux at or above the critical value.

The critical heat flux is obtained through the linear extrapolation of a regression curve to the heat flux intercept as the time to failure approaches infinity. The critical energy is defined as the inverse slope of the regression curve on the heat flux-inverse time to failure (x-y) axis. Figures D-1, D-2, and D-3 illustrate the case of cross-linked polyethylene cables with neoprene jackets for the four criteria defined.

It should be emphasized at this point that the data presented for each cable represents fundamental properties of the cable without taking credit for the mitigating effects associated with the use of cable trays. Such effects include and are not necessarily limited to self-shielding and conductive cooling. Thus, these values should be considered to be conservative in the usual sense and offer the unique advantage of understanding relative performance characteristics independent of qualification. This point is especially meaningful when evaluating the relative fire resistance of electrical cables installed in nuclear power plants prior to the implementation of IEEE-383.

The fire hazards analysis utilizes this concept for electric cable failure criteria when modeling the effects of exposure fires on safe shutdown equipment. In general, the more limiting criterion of electrical failure is considered unless otherwise specified. The use of electrical failure as a criterion rather than cable ignition is also useful in that it focuses on the loss of function aspect of the fire protection issue. In cases where cable tray fires are postulated, their ignition is investigated using the piloted ignition criteria for cable flammability defined by parameters developed in Tewarson (4). Thus, issues related to variation in the ignition criteria associated with fully developed fires are moot.

References:

(1) A. Tewarson and R.F. Pion, "A Laboratory Scale Test Method for the Measurement of Flammability Parameters", FMRC 22524, Prepared for Products Research Committee, National Bureau of Standards, U.S. Department of Commerce by Factory Mutual Research Corporation, Norwood, MA, October, 1977.

(2) A. Tewarson, "Experimental Evaluation of Flammability Parameters of Polymeric Materials", FMRC J.I.1A6R1, Prepared for Products Research Committee, National Bureau of Standards, U.S. Department of Commerce by Factory Mutual Research Corporation, Norwood, MA, February, 1979.

(3) A. Tewarson, J.L. Lee, and R.F. Pion, "Fire Behavior of Transformer Dielectric Insulating Fluids", Report DOT-TSC-1703, U.S. Department of Commerce, Transportation Systems Center, Cambridge, MA, September, 1979.

(4) A. Tewarson, J.L. Lee, and R.F. Pion, "Categorization of Cable Flammability Part 1: Laboratory Evaluation of Cable Flammability Parameters", EPRI-NP-1200 Part 1, Electric Power Research Institute, Palo Alto, CA, October, 1979.

(5) IEEE, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations", ANSI/IEEE STD 383-1974 (ANSI N41.10-1975), The Institute of Electrical and Electronic Engineers, Inc., New YorkJber, October, 1978.

(6) J.L. Lee, "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.

## TABLE D-1

### CABLE SAMPLES USED IN THE STUDY

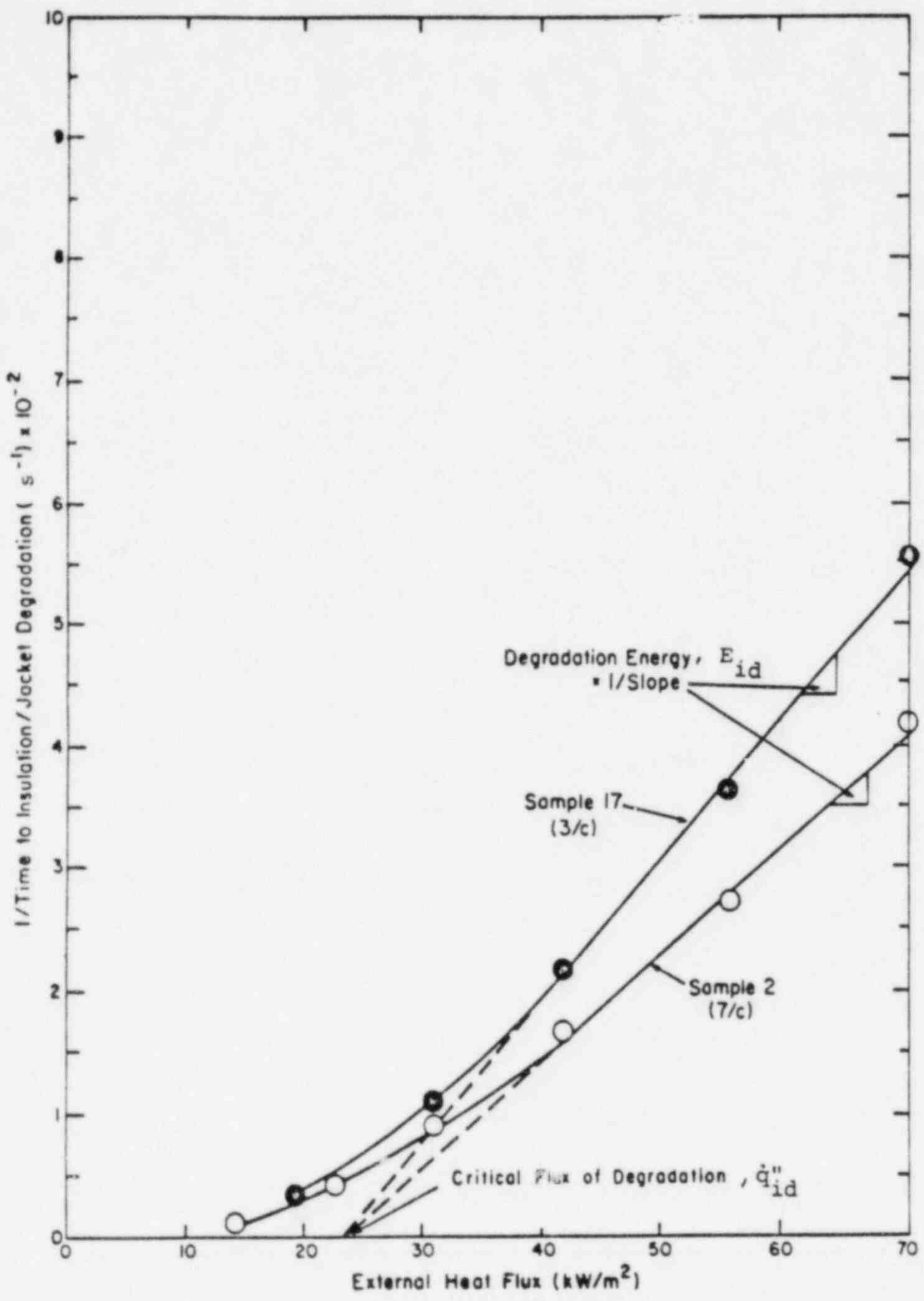
| Number | Insulation/Jacket Materials[a] | Conductor No. | Conductor Size (AWG) | Outer Cable Diameter in. (m) | Insulation/Jacket Materials (% of total cable weight | Insulation Jacket Materials remaining as char (% of initial wt. of insulation/jacket materials) | IEEE-383 Rating |
|---|---|---|---|---|---|---|---|
| | | | | Polyethylene (PE)/No Jacket | | | |
| 1 | Low density PE (ℓdPE), no jacket | 1 | 14 | 0.128(0.003) | 23.9 | 0.10 | - |
| | | | | Polyethylene/Polyvinyl chloride (PE/PVC) | | | |
| 3 | PE/PVC | 1 | - | 0.945(0.024) | 15.6 | 21.9 | |
| 4 | PE/PVC | 1 | 12 | 0.164(0.004) | 26.5 | 0.6 | Fail |
| 5 | PE/PVC | 3 | - | 0.438(0.011) | 49.9 | 20.8 | Fail |
| 6 | PE/PVC | 5 | - | 0.748(0.019) | 51.0 | 25.6 | |
| 7 | PE/PVC | 12 | - | 1.000(0.025) | 57.8 | 24.4 | |
| | | | | Polyethylene, Polypropylene/Chlorosulfonated Polyethylene (PE, PP/Cℓ·S·PE) | | | |
| 8 | PE,PP/Cℓ·S·PE (silicone coating) | 1 | - | 0.445(0.011) | 23.2 | 41.6 | Pass |
| 9 | PE,PP/FRCℓ·S·PE[b] | 1 | 6 | 0.368(0.009) | 40.2 | 46.4 | Pass |
| 10 | PE,PP/Cℓ·S·PE | 1 | 12 | 0.192(0.005) | 42.9 | 45.6 | Pass |
| 11 | PE,PP/Cℓ·S·PE | 5 | 14 | 0.668(0.017) | 77.1 | 48.3 | Pass |
| 12 | PE,PP/Cℓ·S·PE | 2 | 16 | 0.426(0.011) | 77.4 | 40.5 | Pass |
| | | | | Cross-Linked Polyethylene/Cross-Linked Poyethylene (XPE/XPE) | | | |
| 13 | XPE/FRXPE[b] | 3 | 12 | 0.458(0.012) | 61.4 | 44.9 | Pass |
| 14 | XPE/XPE | 2 | 14 | 0.377(0.010) | 73.5 | - | Pass |
| | | | | Cross-Linked Polyethylene/Chlorosulfonated Polyethylene (XPE/Cℓ·S·PE) | | | |
| 15 | FRXPE/Cℓ·S·PE[b] | 4 | 16 | 0.368(0.009) | 56.2 | 29.5 | Pass |
| 16 | XPE/Cℓ·S·PE | 4 | 16 | 0.442(0.011) | 62.1 | 31.0 | Pass |
| | | | | Cross Linked Polyethylene/Neoprene (XPE/Neo) | | | |
| 17 | XPE/Neo | 3 | 16 | 0.369(0.009) | 73.2 | 43.9 | Pass |
| 2 | XPE/Neo | 7 | 12 | 0.630(0.016) | 53.6 | - | |
| | | | | Polyethylene, Nylon/Polyvinyl chloride, Nylon (PE, Ny/PVC, Ny) | | | |
| 18 | PE, Ny/PVC, Ny | 7 | 12 | 0.526(0.013) | 39.9 | - | |
| 19 | PE, Ny/PVC, Ny | 7 | 12 | 0.520(0.013) | 43.5 | - | |
| | | | | Teflon | | | |
| 20 | Teflon | 34 | - | 0.516(0.013) | 48.9 | 3.9 | Pass |
| | | | | Silicone | | | |
| 21 | Silicone, glass braid | 1 | - | 0.363(0.009) | 31.0 | - | |
| 22 | Silicone, glass braid/asbestos | 9 | 14 | 0.875(0.022) | 70.5 | 59.4 | Pass |

[a]Generic class as given by the suppliers. Cable samples belonging to similar generic class may not be similar because of different types and amounts of unknown additives in the cable samples.

[b]FR - with fire retardant chemical

(Reproduced from A. Tewarson, J. L. Lee, and R. F. Pion, "Categorization of Cable Flammability Part 1: Laboratory Evaluation of Cable Flammability Parameters", EPRI-NP-1200, Part 1, Electric Power Research Institute, Palo Alto, CA, October, 1979.)

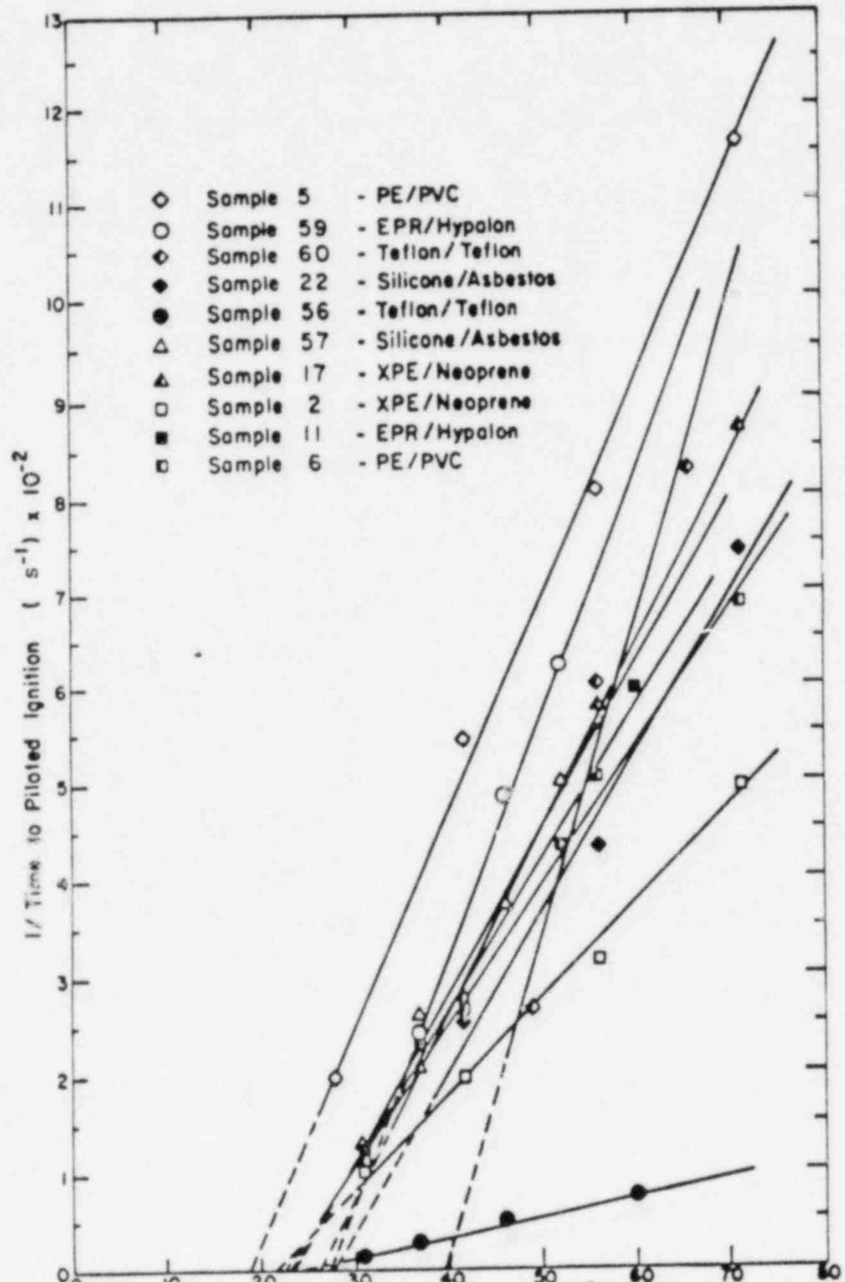
FIGURE D-1




Thermal Degradation of XPE/Neoprene Cables

(Reproduced from J. L. Lee, "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.)

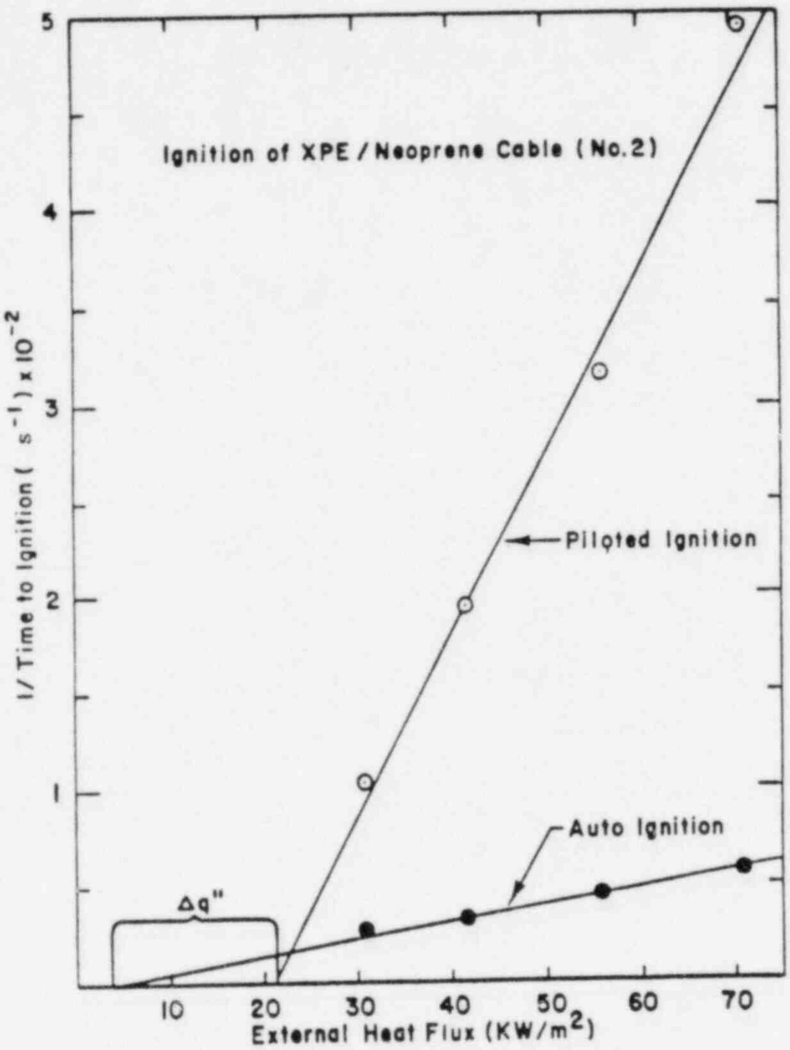
FIGURE D-2




Piloted Ignition of Cables Under Various External Heat Flux

(Reproduced from J. L. Lee, "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.)

FIGURE D-3




Auto and Piloted Ignition of XPE/Neoprene Cable (#2) at Various External Heat Flux. $\Delta\dot{q}''$ is the difference between the critical flux of piloted ignition and that of non-piloted ignition.

(Reproduced from J. L. Lee, "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.)

## APPENDIX E

## Radiation

Radiation can be a significant contributor to the overall heat flux produced as a result of a fire and must be accounted for in properly modeling exposure fires in nuclear power plants. This appendix discusses the approach taken in this report for modeling the effects of radiation from such fires.

The combustion of organic materials such as liquid hydrocarbons is an exothermic reaction. The energy released as a result of such reactions leads to the generation of a high temperature turbulent buoyant diffusion-plume consisting of both gaseous byproducts of combustion and soot particles. The energy contained within this plume is transferred to the environment through two processes: (1) convection associated with momentum of the plume and (2) radiation from the plume.

Molecules in an excited state transfer energy via radiation principally through band emission. For the fundamental products of combustion, i.e., $CO_2$, CO, $H_2O$ and soot, such emission tends to be concentrated in the visible and infrared regions typically less than 15μ (1). The energy transferred by radiation over these wavelengths depends only on a number of parameters including average temperature of the source and its constancy.

Historically, fire models and the discipline of fire protection engineering have addressed radiation in considering the effects of an initial exposure fire. Radiant heating has been found to be a dominant mechanism in the development of largscale conflagrations. This focus is inherently reflected in the use of temperature as a standard of measurement in tests determining fire resistance. Typical of this genre are the standards published by the National Fire Protection Association for qualifying barriers and doors for commercial structures and the E-152 Test issued by the American Society for Testing and Materials (2, 3). These tests are essentially oven tests employing radiant heaters in an attempt to model the dominant heat transfer process in large scale conflagrations involving residential and commercial structures consisting of and containing high densities of combustible material.

The early application of classical radiative heat transfer techniques to the problem of determining safe horizontal separation distances for building fires is documented in reports issued in the post-war period by British and Japanese investigators (4, 5). These and later reports published in the 1950s and 1960s retained the concept of horizontal separation as a principal means of protecting adjacent combustible material (i.e., neighboring buildings) from the intensive effects of major building fires where radiant heat transfer in the open air is the dominant mechanism for damage. During this period, applications of principles for modeling radiant heating, well known in other scientific disciplines, were also made to such distinct problems as the effects of fire-induced flows through windows and doors on adjacent structures, effects of wind on flames, the sensitivity of radiant energy to different flame temperatures and the impact of various wall materials. The conclusions from such studies tended to emphasize the difficulty of developing generalized empirical relationships independent of scientifically based theory and the importance of understanding the effects of material flammability parameters in modeling the radiative effects of fire.

At a more fundamental level, the effects of radiation may be tied to the gaseous dynamics associated with the fire plume itself. With its dominant contributions in both the visible and infrared regions of the electromagnetic spectra, the natural focus for a radiation model therefore becomes one based on the material flammability parameters and, in particular, the height of the visible portion of the turbulent buoyant diffusion plume. In this regard, F.R. Steward's work, (1970), assumes an important rule in providing a comprehensive statement of the dynamics of fire plumes for subsequent researchers (6).

Later work by Dayan and Tien (1974) builds on Steward's research in developing a radiant heat flux model which offers excellent agreement with experimental data (7). This model assumes good mixing associated with combusion conditions in the burning zone so as to provide an essentially uniform gaseous temperature and chemical species concentration in a cylindrical form. The use of cylindrical form does not appear to suffer a loss of generality relative to some other shape such as one which is either conical or hyperbolic and, in fact, may well be a more accurate representative of average fire conditions. Of greater significance than fire shape in the modeling of radiant heating is that of soot and gaseous temperature.

Soot and gaseous temperature directly affect the emissivity associated with the luminous flames of a fire. This effect is seen in the following form of the Stefan-Boltzmann law:

$$\dot{Q} = E\sigma T^4$$

where $\dot{Q}$ = radiant energy transfer rate

$E$ = emissivity (dimension loss)

$\sigma$ = Stafan-Boltzmann constant

$T$ = absolute blackbody temperature

The emissivity of a flame essentially determines the proportion of energy released in the form of radiant energy. The individual components of the total emissivity may be broken up as follows:

$$E = E_g + E_s$$

where $E$ = total emissivity associated with the fire

$E_g$ = emissivity of the hot gas within the burning zone

$E_s$ = emissivity of the luminous soot within the burning zone

Felske and Tien (1973) provide an analytical basis supported by experimental data for understanding the parametric relationships of gaseous and soot emissivity (1). This understanding is a further development on an earlier description provided by Hottel and Sarofim (8). In particular, the relationship of emissivity to spectral wavelength is given for the dominant emission species of water vapor, carbon dioxide and soot. This relationship is strongly affected by the partial pressures of the products of combustion. As in the case of other, well-behaved spectral functions, the use of an effective value for emissivity is supported by the data and may be provided over the range of sensitivity. This range occurs at wavelengths shorter than the 15μ and for infrared band and contains over 96 per cent of the total black body radiation emitted in a fire.

Focusing on gaseous emissivity for the moment, with the assumption of near-optimal fluid mixing and thermal conditions in a fire, combustion may be assumed to involve the following typical reaction:

$$(CH_2)_X + (\frac{3}{2})\ X\ O_2 \rightarrow X\ CO_2 + X\ H_2O$$

Under ideal conditions, the partial pressure of $CO_2$ is 0.131 atm, given a standard environment where the partial pressure of oxygen is 0.21 atm and the partial pressure of nitrogen-argon is 0.79 atm. From Hottel and Sarofim and Hadvig (10), the gaseous emissivity is described by:

$$E_g T_g = 600.0(P_{CO_2}\ L_m)^{0.412}$$

where $L_m$ = mean beam length

$T_g$ = gaseous temperature

$P_{CO_2}$ = partial pressure of $CO_2$

For the case of an essentially infinite cylinder (i.e., an electrical cable):

$$L_m = 0.94D$$

where

D = cylinder diameter

This yields the following for the emissivity of a hot gas:

$$E_g = \frac{[600][(0.131)(0.94D)]}{T_g}$$

The gaseous temperature is assumed to be a uniform 1255°K (1800°F) based on the work of Stavrianidis (1980) using pool fires consisting of heptane and acetone as fuel (9).

As in the case of gaseous emissivity, the contribution of soot to total emissivity may also be characterized by effectively a single value. Here again, Felske and Tien develop a view consistent with earlier work by Hottel and Sarofim. This view suggests that the mainstream of conditions involving the burning of liquid hydrocarbons, i.e., generally lower gaseous temperatures and longer volume of reaction path lengths associated with fairly efficient (energetic) combustion, the emissivity of soot may be bounded for the majority of cases. In these circumstances, a value of 0.1 for the soot emissivity becomes limiting.

With this perspective, a cylindrical fire model is utilized to analyze the effects of radiant heating on the material of interest. The burning zone is described by a more current analytical model for turbulent buoyant diffusion plumes strongly supported by excellent correlations with experimental data obtained under controlled conditions involving fairly large scale acetone and heptane fires (9). This model is described in more detail in the appendix covering diffusion plumes.

The radiant heat flux to an electrical cable from a postulated fire is therefore given by:

$$\dot{q}'' = (5.67 \times 10^{-12} T_g{}^4 + \frac{1.435 \times 10^{-8} D^{0.412}}{T_g} T_g{}^4) F_{21}$$

where

$\dot{q}''$ = radiant heat flux incident on

D = cable diameter

$T_g$ = gaseous temperature = 1200°K (1800°F)

$F_{21}$ = configuration factor describing the fraction of heat flux delivered to a point by a right cylinder radiant right cylinder

This expression is accurate to within 5% for a gasious temperature range of 1000°K-1600°K.

References:


(1) J.D. Felske and C.L. Tien, "Calculation of the Emissivity of Luminous Flames", Combustion Science and Technology, V7, pp. 25-31 (1973).

(2) National Fire Protection Association, "Fire Tests - Building Construction and Materials", NFPA-25-1979.

(3) American Society for Testing and Materials, "Standard Methods of Fire Fests of Door Assemblies", ASTM-E-152-1978.

(4) R.C. Bevan and C.T. Webster, "Investigations on Building Fires, Part IV, Radiation from Building Fires", National Building Studies Technical Paper #5, H.M. Stationery Office, London, 1950.

(5) K. Fujita, "Fire Spread in Japan - Fire Spread Caused by Fire Radiant Heat and Methods of Prevention", Tokohu University, Japan, 1948.

(6) F.R. Steward, "Prediction of the Height of Turbulent Diffusion Buoyant Flames", Combustion Science and Technology, V2, pp. 203-212 (1970).

(7) A. Dayan and C.L. Tien, "Radiant Heating from a Cylindrical Fire Column", Combustion Science and Technology, V9, pp. 41-47 (1974).

(8) H.C. Hottel and A.F. Sarofim, "Radiative Transfer", McGraw Hill Book Company, New York (1967).

(9) P. Stavrianidis, "The Behavior of Plumes Above Pool Fires", A Thesis Presented to the Faculty of Northeastern University, Boston, MA, 1980.

(10) S. Hadvig, "Gas Emissivity and Absorptivity: A Thermodynamic Study", Journal of the Institute of Fuel, April, 1970.

## APPENDIX F

## SUMMARY OF CORRESPONDENCE

### 1976

1. NRC 5/3/76 letter, R.S. Boyd To Power Authority, transmits Standard Review Plan 9.5.1 "Fire Protection" dated 5/1/76.

2. NRC 5/11/76 letter, V. Stello to G.T. Berry, requests that an examination comparing the existing fire protection provisions at JAFNPP with the guidelines of Standard Review Plan 9.5.1, "Fire Protection" dated May 1, 1976 that was attached to NRC 5/3/76 letter.

3. PASNY 5/24/76 letter, G.T. Berry to V. Stello, commits to submit a schedule for the fire protection evaluation by 6/28/76 in response to NRC 5/11/76 request.

4. PASNY 6/28/76 letter, G.T. Berry to V. Stello, commits to provide requested fire protection evaluation by 4/1/77.

5. NRC 9/30/77 letter, K.R. Goller to G.T. Berry, transmits: (1) Appendix A to Branch Technical Position APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976" and, (2) "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation." These expand or clarify previously transmitted guidance documents. Letter further requests that the Authority propose Technical Specification changes for present fire protection systems, and provide a schedule for compliance with Section B of Appendix A to APCSB 9.5-1, "Administrative Procedures, Controls and Fire Brigade."

6. NRC 12/2/76 letter, R.W. Reid to G.T. Berry, transmits: (1) sample technical specifications to describe the scope and type of specifications expected in response to NRC 9/30/77 letter and, (2) errata sheet for Appendix A to Branch Technical Position APCSB 9.5-1.

7. NRC 12/14/76 letter, R.W. Reid to G.T. Berry, transmits corrected section 4.7.11.2 previously sent as part of 12/2/76 Standard Technical Specifications for fire protection.

1977

8. PASNY 1/11/77 letter (LE-10-77) G. T. Berry to V. Stello, submits "JAFNPP Fire Protection Program Comparison with Branch Technical Positions APCSB 9.5-1 and Appendix A" in response to NRC 5/11/76 letter. A more detailed fire hazards analysis (using guidance of NRC 9/30/76 letter) and proposed changes to Technical Specifications is committed to by 3/31/77. Section B of APCSB 9.5-1 Appendix A ("Administrative Procedures, Control and Fire Brigade") will be addressed upon assumption of responsibility for JAFNPP operation or 7/1/77, whichever occurs first.

9. NRC 1/11/77 letter, R.W. Reid to G.T. Berry, transmits: (1) a description of NRC program for site visits," Site Visits - Fire Protection Program Evaluations" and (2) proposed agenda for JAFNPP visit.

10. PASNY 3/30/77 letter, G.T. Berry to R.W. Reid, reschedules submittal of detailed fire hazard analysis from 3/31/77 until 4/29/77.

11. PASNY 4/29/77 letter, L.W. Bennett to R.W. Reid, transmits detailed fire hazard analysis.

12. NRC 4/5/78 letter, G. Lear to G.T. Berry, requests additional information as a result of initial review of fire hazard analysis and establishes two staff positions. Forty-five day response requested.

13. PASNY 8/3/78 letter (JNRC-78-35), P.J. Early to T.A. Ippolito, transmits responses to NRC 4/5/78 request for additional information - includes revisions to JAFNPP Fire Hazards Analysis.

14. NRC 9/22/78 letter, T.A. Ippolito to G.T. Berry, summarizes NRC 8/18/78 staff visit. Enclosure 1 lists exit meeting attendees; Enclosure 2 lists verbal agreements reached at exit meeting - written commitments and schedules by 9/30/78; Enclosure 3 lists staff concerns requiring further consideration; Enclosure 4 includes staff positions developed subsequent to site visit - written commitments and schedules by 10/15/78.

15. PASNY 10/23/78 letter (JNRC-78-53), P.J. Early to T. A. Ippolito, responds to Enclosure 2 of 9/22/78 NRC concerns/positions. Responses to Enclosures 3 and 4 to be provided during the first week of November 1978.

16. PASNY 10/27/78 letter (JNRC-78-55), W.L. Gronberg to T.A. Ippolito, responds to Enclosure 4 of NRC 9/22/78 concerns/positions. Response to Enclosure 3 to be provided during first week of November 1978.

17. PASNY 12/21/78 letter (JNRC-78-63), P.J. Early to T.A. Ippolito, responds to Enclosure 3 of NRC 9/22/78 concerns/positions.

18. PASNY 1/4/79 letter (JPN-79-1), P.J. Early to T.A. Ippolito, restates commitment to provide schedules for phase II work for nine SER items (PF-8, PF-11, PF-20, PF-22, PF-23, PF-27, PF-32, PF-36) by 2/15/79.

19. PASNY 2/8/79 letter (JPN-79-8), P.J. Early to T.A. Ippolito, transmits: (1) schedule for phase II work and, (2) scope of work for nine fire protection questions (PF-8, PF-11, PF-19, PF-20, PF-22, PF-23, PF-27, PF-32, PF-36).

20. PASNY 3/7/79 letter (JPN-79-12), J.R. Schmieder to T.A. Ippolito, transmits: (1) "Implementation Dates for Licensee Proposed Modifications and Staff Requirements" for 31 items, (2) completion dates for five studies and, (3) responses to 20 draft SER items (PF-9, PF-24, PF-12, PF-29, PF-32, PF-19, PF-22, PF-23, PF-27, PF-18).

21. PASNY 5/7/79 letter (JPN-79-25), P.J. Early to T.A. Ippolito, provides additional responses regarding fire protection SER resulting from telephone conversations with NRC Staff members (Items: 3.2.4, 3.3.1, 3.3.6, 3.3.14, 3.3.16).

22. NRC 5/23/79 letter, T.A. Ippolito to G.T. Berry, provides five remaining SER items to be resolved prior to issuance of satisfactory SER. Requests entire fire test documentation for JAF cable (Items: 3.2.4, 3.3.16).

23. PASNY 7/2/79 letter (JPN-79-40), P.J. Early to T.A. Ippolito, responds to NRC 5/23/79 letter and clarifies prior submittals on ten SER items. Commits to provide entire fire test documention for cable by August 1979. Includes revised Table 3.1, "Implementation Dates for Licensee Proposed

Modifications and Staff Requirements," originally provided 3/7/79 (Items: 3.1.1, 3.1.4, 3.1.5, 3.1.16, 3.1.10, 3.1.11, 3.1.14, 3.2.4, 3.3.1, 3.3.16).

24. PASNY 7/27/79 letter (JPN-79-44), P.J. Early to T.A. Ippolito, transmits revised tables: (1) Table 3.1 - "Implementation Dates for Licensee Proposed Modifications and Staff Requirements" and, (2) Table 3.2 - "Completion Dates for Studies" along with justification for rescheduling nine of these items: (3.1.1, 3.1.7, 3.3.2, 3.3.12, 3.3.15, 3.3.16, 3.2.1, 3.2.3, 3.2.5).

25. NRC 8/1/79 letter, T.A. Ippolito to G.T. Berry, issues FOL Amendment No. 47 which adds license conditions regarding completion of fire protection modifications and associated Safety Evaluation. Letter further requests that the Authority propose Technical Specification Changes, as described, within ninety days.

26. PASNY 8/17/79 letter (JPN-79-51), G.T. Berry to T.A. Ippolito requests that effective date of FOL Amendment No. 47 be extended thirty days because it was delayed in the mail.

27. NRC 8/23/79 letter, T.A. Ippolito to G.T. Berry approves twenty day extension for implementation of FOL Amendment No. 47 till 8/29/79.

28. PASNY 9/5/79 letter (JPN-79-55), P.J. Early to T.A. Ippolito provides status update on eight SER items and entire fire test documentation for JAF cable (Items: 3.1.7, 3.1.10, 3.2.4, 3.2.6, 3.2.7, 3.2.8, 3.2.10, 3.2.11).

29. PASNY 11/14/79 letter (JPN-79-72), P.J. Early to T.A. Ippolito addresses seven SER issues (PF-9, PF-20, PF-24, PF-22, PF-33, PF-36, PF-8) and updated Tables 3.1 and 3.2 ("Implementation Dates for Licensee Proposed

Modifications and Staff Requirements," and "Completion Dates for Incomplete Items") (Items: 3.1.1, 3.1.8, 3.1.19, 3.2.2, 3.3.3, 3.2.5).

1980

30. PASNY 5/8/80 letter (JPN-80-27) P.J. Early to T.A. Ippolito, transmits revised response to NRC Concern PF-23, "Crescent Area Fire Protection." Original response provided 9/5/79 (JPN-79-55). Refer to NRC 9/22/78 letter, Enclosure 3.

31. NRC 10/3/80 letter (received 10/20/80), T.A. Ippolito to G.T. Berry, transmits status of eighteen outstanding SER items. Enclosure 2 evaluates these eighteen items and classifies five as incomplete or unacceptable, and refers to the proposed 10CFR50 Appendix R. (Items 3.2.1, 3.2.8, 3.1.9, 3.1.15, 3.1.20). Thirty day response/disposition requested.

32. PASNY 10/17/80 letter (JPN-80-46), G.M. Wilverding to T.A. Ippolito, provides updated status on modifications and procedural changes required by 8/1/79 SER and FOL Amendment No. 47. Attachment No. 3 requests extension for ten items to various dates (Items: 3.1.19, 3.1.15, 3.1.18, 3.2.5, 3.2.6, 3.2.20, 3.2.10, 3.2.2, 3.2.1, 3.2.8).

33. PASNY 10/28/80 letter (JPN-80-48), J.P. Bayne to T.A. Ippolito, updates PASNY 10/17/80 letter (JPN-80-46) and requests further schedular extensions on five SER items; (3.2.1, 3.1.18, 3.2.5, 3.2.6, 3.1.17).

34. PASNY 11/20/80 letter (JPN-80-53), J.P. Bayne to T.A. Ippolito, responds to NRC 10/3/80 letter regarding five incomplete or unacceptable SER items (3.1.20, 3.2.8, 3.2.1, 3.1.9, 3.1.15), and transmits revised "Safe Shutdown

Analysis" dated October 1980. This analysis and resulting modifications use BTP-APCSB 9.5-1, Appendix A as the primary licensing basis.

35. NRC 11/24/80 letter, to All Power Reactor Licensees with plants licensed prior to January 1, 1979 from D.G. Eisenhut, transmits: revised 10CFR50.48, a new Appendix R to 10CFR50 (45 FR 76602) effective 2/19/81, and a summary listing of open items for each plant.

36. NRC 11/25/80 letter to All Power Reactor Licensees with plants licensed prior to 1/1/79 corrects typographical error in effective date of FEDERAL REGISTER notice included with NRC 11/24/80 letter. Correct date is 2/17/81.

<u>1981</u>

37. PASNY 2/11/81 letter (JPN-81-10), J.P. Bayne to T.A. Ippolito, updates the status of fire protection SER Items and requests for extension of completion dates for fire protection modifications previously transmitted 10/17/80 and 10/28/78 (3.1.17, 3.1.18, 3.2.5, 3.2.6, 3.1.19, 3.1.20, 3.2.1, 3.2.2, 3.2.10). Details compensatory measures taken for each item requiring a delayed schedule.

38. NRC 2/13/81 letter, T.A. Ippolito to G.T. Berry, transmits: (1) Enclosure 1 which lists 18 supplementary items to JAF Fire Protection Safety Evaluation (Amendment No. 47) including status, and (2) Enclosure 2 provides evaluation of 2 completed items, 3.1.20 and 3.2.8).

39. PASNY 2/18/81 letter (JPN-81-11), J.P. Bayne to T.A. Ippolito, summarizes seven fire protection compensatory measures which have been implemented

until the completion of modifications (Items: 3.1.17, 3.1.18, 3.2.6, 3.2.5, 3.1.20, 3.2.2, 3.2.10).

40. NRC 1/20/81 letter, D.G. Eisenhut to All Power Reactor Licensees with plants licensed prior to 1/1/79 (Generic Letter 81-12, "Fire Protection Rule - 45 FR 76602, November 19, 1980"), transmits: (1) "Staff Position Safe Shutdown Capability" and, (2) a request for additional information. Design description required by 3/19/81.

41. NRC 2/24/81 letter, H.R. Denton to G.T. Berry, grants extension for eight SER items (3.1.17, 3.1.18, 3.2.5, 3.2.6, 3.1.19, 3.1.20, 3.2.2, 3.2.8) requested in PASNY 2/11/81 and 2/18/81 letters. Enclosure 1 discusses justification for each of these eight items; Enclosure 2 is FEDERAL REGISTER notice.

42. PASNY 3/19/81 letter (JPN-81-21), J.P. Bayne to H.R. Denton, requests exemption from implementation schedule of Appendix R to 10CFR50, Sections III.G and III.J.

43. NRC 5/28/81 letter, W.O. Miller to G.T. Berry, requests payment of $1200 fee for 2/11/81 application for extensions of completion schedules for certain JAFNPP fire protection modifications.

44. PASNY 6/15/81 letter (JPN-81-41), J.P. Bayne to W.O. Miller, transmits payment of $1200 fee for NRC review of 2/11/81 request for 10CFR50 Appendix R schedule extension.

45. PASNY 6/22/81 letter (JPN-81-45), J.P. Bayne to T.A. Ippolito, submits in accordance with PASNY 3/19/81 letter: (1) Item (a) plans and schedules for implementation of Section III.J "Emergency Lighting" of Appendix R and, (2)

Item (b) an action plan to meet Section III.G "Fire Protection Safe Shutdown Capability."

46. PASNY 10/28/81 letter (JPN-81-85A), J.P. Bayne to T.A. Ippolito, informs NRC that fire protection modifications will not be complete by 11/1/81 as required. JAFNPP will start outage 11/1/81. Compensatory measures will provide adequate fire protection until modifications are complete.

47. NRC 10/30/81 letter, T.A. Ippolito to G.T. Berry, concurs in PASNY decision to shutdown JAFNPP until fire protection modifications are complete.

1982

48. PASNY 1/19/82 letter (JPN-82-11), J.P. Bayne to T.A. Ippolito reschedules submittal that will demonstrate compliance with Section III.G. until February 18, 1982. Exemptions requests will be filed for those areas where the requirements of Appendix R cannot be met.

49. PASNY 2/26/82 letter (JPN-82-24), J.P. Bayne to H.R. Denton, transmits "Appendix II to Safe Shutdown Analysis Response to 10CFR50 Appendix R Fire Protection of Safe Shutdown Capability." This report reviews those previously approved configurations of fire protection that do not meet the requirments as specified in Section III.G to Appendix R. One exemption was requested.

| EQUIPMENT | DESCRIPTION | ESK | POWER SOURCE |
|---|---|---|---|
| | AUTOMATIC DEPRESSURIZATION SYSTEM (02) | | |
| 02-SOV71A | ADS VV | ESK-11AZ | 71-PNL-DC-A2/B2 |
| 02-SOV71B | ADS VV | ESK-11AZ | 71-PNL-DC-A2/B2 |
| 02-SOV71C | ADS VV | ESK-11AAA | 71-PNL-DC-A2/B2 |
| 02-SOV71D | ADS VV | ESK-11AAA | 71-PNL-DC-A2/B2 |
| 02-SOV71E | ADS VV | ESK-11AAB | 71-PNL-DC-A2/B2 |
| 02-SOV71F | ADS VV | ESK-11AAB | 71-PNL-DC-A2/B2 |
| 02-SOV71G | ADS VV | ESK-11AAC | 71-PNL-DC-A2/B2 |
| 02-SOV71K | ADS VV | ESK-11AAC | 71-PNL-DC-A2/B2 |
| 02-SOV71H | ADS VV | ESK-11AAD | 71-PNL-DC-A2/B2 |
| 02-SOV71J | ADS VV | ESK-11AAD | 71-PNL-DC-A2/B2 |
| 02-SOV71L | ADS VV | ESK-11AAL | 71-PNL-DC-A2/B2 |
| | HIGH PRESSURE COOLING INJECTION SYSTEM (23) | | |
| 23-MOV021 | HPCI TEST RETURN VV | ESK-11AM | 71-PNL-BMCC-6 |
| 23-MOV016 | HPCI STEAM SUP OUTBRD ISO VV | ESK-11AK | 71-PNL-BMCC-6 |
| 23-MOV015 | HPCI STEAM SUP INBOARD ISO VV | ESK-6MAV | 71-MCC-C153 |
| 23-MOV017 | HPCI PUMP SUCT FM CON ST TK VV | ESK-11AL | 71-PNL-BMCC-2 |
| 23-MOV058 | HPCI PUMP SUCT FM SUP POOL VV | ESK-11AP | 71-PNL-BMCC-4 |
| 23-MOV057 | HPCI PUMP SUCT FM SUP POOL VV | ESK-11AP | 71-PNL-BMCC-4 |
| 23-MOV024 | HPCI TEST BYPASS VV TO CST VV | ESK-11AN | 71-PNL-BMCC-4 |
| 23-MOV020 | HPCI PUMP DISCHARGE VV | ESK-11AM | 71-PNL-BMCC-6 |
| 23-MOV019 | HPCI PUMP DISCHARGE VV | ESK-11AL | 71-PNL-BMCC-6 |
| 23-MOV014 | HPCI STEAM TO SUPPLY VV | ESK-11AK | 71-PNL-BMCC-2 |
| 23-P140 | HPCI COND PUMP W/23TU | ESK-11CB | 71-PNL-BMCC-2 |
| 23-P141 | HPCI GLAND EXHAUST PUMP W/23TU | ESK-11CB | 71-PNL-BMCC-2 |
| 23-MOV060 | HPCI OUTB STLN ISOL VV BYPASS | ESK-11AAG | 71-PNL-BMCC-2 |
| 23-P150 | HPCI AUX OIL PUMP | ESK-11CB | 71-PNL-BMCC-4 |
| 23-FS078 | HPCI PUMP DISCHARGE LO FLOW | FM-25A-13 | |
| 23-LIS072A | REACT WT LEVEL LOW | FM-47A-8 | |
| 23-LIS072C | REACT WT LEVEL LOW | FM-47A-8 | |
| 23-PS01 | HPCI LUB OIL SUCTION SW | FM-25B-8 | |
| 23-PS097A | HPCI TURB EXH | FM-25B-8 | |
| 23-PS097B | HPCI TURB EXH | FM-25B-8 | |
| 23-PS086B | HPCI TURB EXH | FM-25B-8 | |
| 23-PS086D | HPCI TURB EXH | FM-25B-8 | |
| 23-PS086A | HPCI TURB EXH | FM-25B-8 | |
| 23-PS086C | HPCI TURB EXH | FM-25B-8 | |
| 23-PS068A | HPCI STM PRES LOW | FM-25A-13 | |
| 23-PS068B | HPCI STM PRES LOW | FM-25A-13 | |
| 23-PS068C | HPCI STM PRES LOW | FM-25A-13 | |
| 23-PS068D | HPCI STM PRES LOW | FM-25A-13 | |
| 23-PDS076 | HPCI HI STM D/P | FM-25A-13 | |
| 23-PDS077 | HPCI HI STM D/P | FM-25A-13 | |
| 23-TDS094A | HPCI HI AREA TEMP EQUIP RM | FM-25A-13 | |
| 23-TDS094B | HPCI HI AREA TEMP EQUIP RM | FM-25A-13 | |

| | | | |
|---|---|---|---|
| 23-TDS0102A | HPCI HI AREA TEMP TORUS AREA | FM-25A-13 | |
| 23-TDS0102B | HPCI HI AREA TEMP TORUS AREA | FM-25A-13 | |
| 23-TS117A | HPCI HI AREA TEMP EMERG AREA | FM-25A-13 | |
| 23-TS107A | HPCI HI AREA TEMP TORUS AREA | FM-25A-13 | |
| 23-TS107B | HPCI HI AREA TEMP TORUS AREA | FM-25A-13 | |
| 23-LS074 | HPCI LO LEVEL COND STORAGE TK | FM-25A-13 | |
| 23-LS075 | HPCI LO LEVEL COND STORAGE TK | FM-25A-13 | |
| 10-P.101B | HPCI HI DRYWELL PRES | FM-20A-15 | |
| 10-PS101D | HPCI HI DRYWELL PRES | FM-20A-15 | |
| 10-PS101A | HPCI HI DRYWELL PRES | FM-20A-15 | |
| 10-PS101C | HPCI HI DRYWELL PRES | FM-20A-15 | |
| 2-3-LIS072B | REACT WT LEVEL LOW | FM-47A-8 | |
| 2-3-LIS072D | REACT WT LEVEL LOW | FM-47A-8 | |
| 23-LS099 | HPCI COND PP HOTWL HI A042/43 | FM-25B-13 | |

REACTOR RECIRCULATION SYSTEM (02-2)

| | | | |
|---|---|---|---|
| 02-2-MOV053A | RECIRC PUMP DISC VV | ESK-6MB | 71-MCC-C155 |
| 02-2-MOV054A | RECIRC PUMP DISC VV | ESK-6MC | 71-MCC-C155 |
| 02-2-MOV053B | RECIRC PUMP DISC VV | ESK-6MB | 71-MCC-C165 |
| 02-2-MOV054B | RECIRC PUMP DISC VV | ESK-6MC | 71-MCC-C165 |
| 02-MOV043A | RECIRC PUMP SUCT VV | ESK-6MA | 71-MCC-C155 |
| 02-MOV043B | RECIRC PUMP SUCT VV | ESK-6MA | 71-MCC-C165 |

CORE SPRAY SYSTEM (14)

| | | | |
|---|---|---|---|
| 14-P01A | CS PUMP | ESK-5BF | 71-SWGR10530 |
| 14-MOV07A | CS SUCT VV | ESK-6MAN | 71-MCC-C153 |
| 14-MOV011A | CS DISCH VV | ESK-6MAK | 74-MCC-C152 |
| 14-MOV012A | CS DISCH VV | ESK-6MAJ | 74-MCC-C152 |
| 14-MOV05A | CS MIN FLOW VV | ESK-6MAL | 71-MCC-C153 |
| 14-MOV026A | CS RECIRC VV | ESK-6MAM | 71 MCC-C153 |
| 14-P02A | CS HOLD PUMP | ESK-6RK | 71-MCC-C153 |
| 14-PS047A | CS PRES INTLK PP DISCHG | FM-23A-13 | |
| 14-PS068A | CS PRES INTLK | FM-23A-13 | |
| 14-PS068C | CS PRES INTLK | FM-23A-13 | |
| 14-P01B | CS PUMP | ESK-5BP | 71-SWGR10630 |
| 14-MOV07B | CS SUCT VV | ESK-6MAN | 71-MCC-C153 |
| 14-MOV011B | CS DISCH VV | ESK-6MAK | 71-MCC-C162 |
| 14-MOV012B | CS DISCH VV | ESK-6MAJ | 71-MCC-C162 |
| 14-MOV05B | CS MIN FLOW VV | ESK-6MAL | 71-MCC-C163 |
| 14-MOV026B | CS RECIR VV | ESK-6MAM | 71-MCC-C163 |
| 14-P02B | CS HOLD PUMP | ESK-6RK | 71-MCC-C163 |
| 14-PS047B | CS PRES INTLK PP DISCHG | FM-23A-13 | |
| 14-PS068B | CS PRES INTLK | FM-23A-13 | |
| 14-PS068D | CS PRES INTLK | FM-23A-13 | |

REACTOR CORE INJECTION COOLING SYSTEM (13)

| | | | |
|---|---|---|---|
| 13-MOV018 | RCIC PP SUCT COND STG TK VV | ESK-11AR | 71-PNL-BMCC-1 |
| 13-MOV039 | RCIC PP SUCT SUP POOL VV | ESK-11AT | 71-PNL-BMCC-3 |
| 13-MOV020 | RCIC PP DISCHARGE VV | ESK-11AR | 71-PNL-BMCC-1 |
| 13-MOV021 | RCIC PP DISCHARGE VV | ESK-11AS | 71-PNL-BMCC-1 |
| 13-MOV015 | RCIC STEAM SUP INBRD ISO VV | ESK-6MAZ | 71-MCC-C163 |

| | | | |
|---|---|---|---|
| 13-MOV016 | RCIC STM SUP OUTBRD ISO VV | ESK-11AQ | 71-PNL-BMCC-1 |
| 13-MOV131 | RCIC STM SUP TO TURB SUP VV | ESK-11AQ | 71-PNL-BMCC-3 |
| 13-MOV132 | RCIC LUB OIL COOL VV | ESK-11AU | 71-PNL-BMCC-3 |
| 13-PP | RCIC COND CONDENSATE PP | ESK-11CC | 71-PNL-BMCC-1 |
| 13-PP | RCIC COND VACUUM PP | ESK-11CC | 71-PNL-BMCC-1 |
| 13-MOV030 | RCIC TEST BYPASS VV | ESK-11AS | 71-PNL-BMCC-1 |
| 13-MOV041 | RCIC PP SUCT SUP POOL VV | ESK-11AT | 71-PNL-BMCC-3 |
| 13-PS087A | REAC PRS | FM-22A-13 | |
| 13-PS087B | REAC PRS | FM-22A-13; | |
| 13-PS087C | REAC PRS | FM-22A-13 | |
| 13-PS087D | REAC PRS | FM-22A-13 | |
| 13-PDS083 | REAC D/P STM LINE HI | FM-22A-13 | |
| 13-PDS084 | REAC D/P STM LINE HI | FM-22A-13 | |
| 2-3PS072A | REAC LO LEVEL | FM-47A-8 | |
| 2-3PS072C | REAC LO LEVEL | FM-47A-8 | |
| 2-3PS072B | REAC LO LEVEL | FM-47A-8 | |
| 2-3PS072D | REAC LO LEVEL | FM-47A-8 | |
| 13-PS067A | LO PUMP SUCTION | FM-22B-10 | |
| 13-PA067B | LO PUMP SUCTION | FM-22B-10 | |
| 13-LS012 | VACUUM TANK LVL | FM-22B-10 | |
| 13-TDS076A | RCIC AREA HI TEMP EQUIP RM | FM-22A | |
| 13-TDS076B | RCIC AREA HI TEMP EQUIP RM | FM-22A | |
| 13-TS089 | RCIC AREA HI TEMP EME AR COOL | FM-22A | |
| 13-TDS102A | RCIC AREA HI TEMP TORUS | FM-22A | |
| 13-TDS102B | RCIC AREA HI TEMP TORUS | FM-22A | |
| 13-TS107A | RCIC AREA HI TEMP TORUS | FM-22A | |
| 13-TS107B | RCIC AREA HI TEMP TORUS | FM-22A | |
| 13-TDS090A | RCIC PERMIS | FM-22A | |
| 13-TDS103A | RCIC PERMIS | FM-22A | |
| 13-PS078A | RCIC HI TURB EXH | FM-22B-10 | |
| 13-PS078B | RCIC HI TURB EXH | FM-22B-10 | |
| 13-PS078C | RCIC HI TURB EXH | FM-22B-10 | |
| 13-PS078D | RCIC HI TURB EXH | FM-22B-10; | |
| 13-PS058 | RCIC PERMIS RCIC PP DISCH PRES | FM-22B-10 | |

RHR-CONTAINMENT SPRAY SYSTEM (10)

| | | | |
|---|---|---|---|
| 10-MOV038A | RHR CONTAIN INBRD VV | ESK-6MV | 71-MCC-C153 |
| 10-MOV039A | RHR CONTAIN SPRAY VV | ESK-6MW | 71-MCC-C153 |
| 10-MOV026A | RHR CONTAIN OUTBRD VV | ESK-6MQ | 71-MCC-C152 |
| 10-MOV031A | RHR CONTAIN OUTBRD VV | ESK-6MS | 71-MCC-C152 |
| 10-MOV016A | RHR PP MIN FLOW VV | ESK-6ML | 71-MCC-C153 |
| 10-MOV012A | RHR HX DRAIN TO SUPP POOL VV | ESK-6MF | 71-MCC-C151 |
| 10-MOV036A | RHR HX DRAIN TO RCIC VV | ESK-6MU | 71-MCC-C153 |
| 10-MOV070A | RHR HPSI TO RHR STM STOP VV | ESK-6MAE | 71-MCC-C151 |
| 10-MOV067 | RHR HPSI STM SUP TO RADHT VV | ESK-11AH | 71-PNL-BMCC-2 |
| 10-MOV034A | RHR CONTAIN SPRAY VV | ESK-6MT | 71-MCC-C153 |
| 10-MOV038B | RHR CONTAIN INBRD VV | ESK-6MV | 71-MCC-C163 |
| 10-MOV039B | RHR CONTAIN SPRAY VV | ESK-6MW | 71-MCC-C163 |
| 10-MOV026B | RHR CONTAIN OUTBRD VV | ESK-6MQ | 71-MCC-C161 |
| 10-MOV031B | RHR CONTAIN OUTBRD VV | ESK-6MS | 71-MCC-C161 |
| 10-MOV012B | RHR HX DRAIN TO SUPP POOL VV | ESK-6MF | 71-MCC-C161 |
| 10-MOV036B | RHR HX DRAIN TO RCIC VV | ESK-6MU | 71-MCC-C163 |
| 10-MOV070B | RHR HPSI TO RHR STM STOP VV | ESK-6MAE | 71-MCC-C161 |
| 10-MOV057 | RHR HPSI STM SUP TO RADHT VV | ESK-6MAH | 71-MCC-C151 |
| 10-MOV034B | RHR CONTAIN SPRAY VV | ESK-6MT | 71-MCC-C163 |
| 10-MOV069A | RHR PRES REDUCING VV | ESK-7G | 71-EESA1 |
| 10-MOV069B | RHR PRES REDUCING VV | ESK-7G | 71-ESSB1 |

RHR-SUPPRESSION POOL MODE (10)

| | | | |
|---|---|---|---|
| 10-MOV027A | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C155 |
| 10-MOV025A | RHR INBOARD VV | ESK-6MP | 71-MCC-C155 |
| 10-MOV065A | RHR HX SHELL SIDE INLET VV | ESK-6MX | 71-MCC-C153 |
| 10-MOV012A | RHR HX SHELL SIDE OUTLET VV | ESK-6MF | 71-MCC-C151 |
| 10-MOV066A | RHR HX SHELL SIDE BYPASS VV | ESK-6MY | 71-MCC-C155 |
| 10-MOV015A | RHR SHUTDOWN COOL INJECT VV | ESK-6MJ | 71-MCC-C153 |
| 10-MOV015C | RHR SHUTDOWN COOL INJECT VV | ESK-6MJ | 71-MCC-C153 |
| 10-MOV166A | RHR HEAT EXCH A VENT | ESK-6MD | 71-MCC-C151 |
| 10-MOV167A | RHR HEAT EXCH A VENT | ESK-6MAC | 71-MCC-C151 |
| 10-MOV017 | RHR SHUTDOWN CLG INBD ISOL VV | ESK-11AE | 71-PNL-BMCC-4 |
| 10-MOV018 | RHR SHUTDOWN CLG OUTBD ISO VV | ESK-6MAF | 71-MCC-C151 |
| 10-P-03A | RHR PUMP | ESK-5BU | 71-SHGR10550 |
| 10-P-03C | RHR PUMP | ESK-5BH | 71-SHGR10650 |
| 10-MOV027B | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C165 |
| 10-MOV025B | RHR INBOARD VV | ESK-6MP | 71-MCC-C165 |
| 10-MOV151A | RHR SUP POOL STR OUT VV | ESK-6MAB | 71-MCC-C153 |
| 10-MOV066B | RHR HX SHELL SIDE BYPASS VV | ESK-6MY | 71-MCC-C165 |
| 10-MOV065B | RHR HX SHELL SIDE INLET VV | ESK-6MX | 71-MCC-C163 |
| 10-MOV012B | RHR HX SHELL SIDE OUTLET VV | ESK-6MF | 71-MCC-C161 |
| 10-MOV015B | RHR SHUTDOWN COOL INJECT VV | ESK-6MK | 71-MCC-C163 |
| 10-MOV015D | RHR SHUTDOWN COOL INJECT VV | ESK-6MK | 71-MCC-C163 |
| 10-MOV166B | RHR HEAT EXCH B VENT | ESK-6MD | 71-MCC-C161 |
| 10-MOV167B | RHR HEAT EXCH B VENT | ESK-6MAC | 71-MCC-C161 |
| 10-P-03B | RHR PUMP | ESK-5BV | 71-SHGR10540 |
| 10-P-03D | RHR PUMP | ESK-5BX | 71-SHGR10640 |
| 10-MOV151B | RHR SUP POOL STR OUT VV | ESK-6MAB | 71-MCC-C163 |
| 10-MOV020 | RHR CROSS HDR SHUTOFF VV | ESK-6ME | 71-MCC-C132 |
| 10-MOV033 | RHR OUTBRD ISO VV HD SPRAY | ESK-11AG | 71-PNL-BMCC |

RHR-SHUTDOWN COOLING MODE (10)

| | | | |
|---|---|---|---|
| 10-MOV027A | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C155 |
| 10-MOV025A | RHR INBOARD VV | ESK-6MP | 71-MCC-C155 |
| 10-MOV066A | RHR HX SHELL SIDE BYPASS VV | ESK-6MY | 71-MCC-C155 |
| 10-MOV065A | RHR HX SHELL SIDE INLET VV | ESK-6MX | 71-MCC-C153 |
| 10-MOV012A | RHR HX SHELL SIDE OUTLET VV | ESK-6MF | 71-MCC-C151 |
| 10-MOV015A | RHR SHUTDOWN COOL INJECT VV | ESK-6MJ | 71-MCC-C153 |
| 10-MOV015C | RHR SHUTDOWN COOL INJECT VV | ESK-6MJ | 71-MCC-C153 |
| 10-MOV166A | RHR HEAT EXH A VENT | ESK-6MD | 71-MCC-C151 |
| 10-MOV167A | RHR HEAT EXH A VENT | ESK-6MAC | 71-MCC-C151 |
| 10-P-03A | RHR PUMP | ESK-5BU | 71-SHGR10550 |
| 10-P-03C | RHR PUMP | ESK-5BH | 71-SHGR10650 |
| 10-MOV032 | RHR OUTBOARD ISO VV HD SPRAY | ESK-6MAH | 71-PNL-BMCC |
| 10-MOV033 | RHR DNSTR ISO VV HD SPRAY | ESK-11AG | 71-MCC-C151 |
| 10-MOV027B | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C165 |
| 10-MOV025B | RHR INBOARD VV | ESK-6MP | 71-MCC-C165 |
| 10-MOV066B | RHR HX SHELL SIDE BYPASS VV | ESK-6MY | 71-MCC-C165 |
| 10-MOV065B | RHR HX SHELL SIDE INLET VV | ESK-6MX | 71-MCC-C163 |
| 10-MOV012B | RHR HX SHELL SIDE OUTLET VV | ESK-6MF | 71-MCC-C161 |
| 10-MOV015B | RHR SHUTDOWN COOL INJECT VV | ESK-6MK | 71-MCC-C163 |
| 10-MOV015D | RHR SHUTDOWN COOL INJECT | ESK-6MK | 71-MCC-C163 |
| 10-MOV166B | RHR HEAT EXH B VENT | ESK-6MD | 71-MCC-C161 |
| 10-MV0167B | RHR HEAT EXH B VENT | ESK-6MAC | 71-MCC-C161 |

| | | | |
|---|---|---|---|
| 10-P-03B | RHR PUMP | ESK-5BV | 71-SHGR10540 |
| 10-P-03D | RHR PUMP | ESK-5BX | 71-SHGR10640 |
| 10-MOV017 | RHR SHUTDOWN CLG INBD ISOL VV | ESK-11AE | 71-PNL-BMCC-4 |
| 10-MOV018 | RHR SHUTDOWN CLG OUTBD ISO VV | ESK-6MAF | 71-MCC-C151 |
| 10-SOV68B | RHR TESTABLE CHECK VV | ESK-7H | 71PNL-ESSB1 |
| 10-SOV068 | RHR TESTABLE CHECK VV | ESK-7H | 71-PNL-ESSB1 |

RHR-LOW PRESSURE COOLING INJECTION MODE (10)

| | | | |
|---|---|---|---|
| 10-P-03A | RHR PUMP | ESK-5BU | 71-SHGR10550 |
| 10-P-03C | RHR PUMP | ESK-5BW | 71-SHGR10650 |
| 10-MOV013A | RHR PUMP SUCTION VV | ESK-6MG | 71-MCC-C153 |
| 10-MOV013C | RHR PUMP SUCTION VV | ESK-6MG | 71-MCC-C153 |
| 10-MOV027A | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C155 |
| 10-MOV025A | RHR INBOARD VV | ESK-6MP | 71-MCC-C155 |
| 10-MOV066A | RHR HX SHELL BYPASS VV | ESK-6MY | 71-MCC-C155 |
| 10-MOV151A | RHR SUP POOL STR OUT VV | ESK-6MAB | 71-MCC-C153 |
| 10-MOV166A | RHR HEAT EXCH A VENT | ESK-6MD | 71-MCC-C151 |
| 10-MOV167A | RHR HEAT EXCH A VENT | ESK-6MAC | 71-MCC-C151 |
| 10-P-03B | RHR PUMP | ESK-5BV | 71-SHGR10540 |
| 10-P-03D | RHR PUMP | ESK-5BX | 71-SHGR10640 |
| 10-MOV013B | RHR PUMP SUCTION VV | ESK-6MH | 71-MCC-C163 |
| 10-MOV013D | RHR PUMP SUCTION VV | ESK-6MH | 71-MCC-C163 |
| 10-MOV027B | RHR OUTBOARD VV | ESK-6MR | 71-MCC-C165 |
| 10-MOV025B | RHR INBOARD VV | ESK-6MP | 71-MCC-C165 |
| 10-MOV066B | RHR HX SHELL BYPASS VV | ESK-6MY | 71-MCC-C165 |
| 10-MOV020 | RHR CROSS HDR SHUTOFF VV | ESK-6ME | 71-MCC-C132 |
| 10-MOV151B | RHR SUP POOL STR OUT VV | ESK-6MAB | 71-MCC-C163 |
| 10-MOV021A | RHR HX TO SUP POOL VV | ESK-6MN | 71-MCC-C153 |
| 10-MOV021B | RHR HX TO SUP POOL VV | ESK-6MN | 71-MCC-C163 |
| 10-MOV166B | RHR HEAT EXCH B VENT | ESK-6MD | 71-MCC-C161 |
| 10-MOV167B | RHR HEAT EXCH B VENT | ESK-6MAC | 71-MCC-C161 |
| 2-3LIS-072A | RHR REACT VESSEL WT LV LOW PP | FM-47A-8 | |
| 2-3LIS-072C | RHR REACT VESSEL WT LV LOW PP | FM-47A-8 | |
| 2-3LIS-072B | RHR REACT VESSEL WT LV LOW PP | FM-47A-8 | |
| 2-3LIS-072D | RHR REACT VESSEL WT LV LOW PP | FM-47A-8 | |
| 2-DPIS-129A | RHR OUTBRD VV MOV27 | FM-47A-8 | |
| 2-DPIS-129C | RHR OUTBRD VV MOV27 | FM-47A-8 | |
| 2-DPIS-129B | RHR OUTBRD VV MOV27 | FM-47A-8 | |
| 2-DPIS-129D | RHR OUTBRD VV MOV27 | FM-47A-8 | |
| 2-PS-052A | RHR OUTBRD VV MOV27 PERMIS | FM-47A-8 | |
| 2-PS-052B | RHR OUTBRD VV MOV27 PERMIS | FM-47A-8 | |
| 2-PS-128A | RHR INBRD VV MOV25 PERMIS | FM-47A-8 | |
| 2-PS-128B | RHR INBRD VV MOV25 PERMIS | FM-47A-8 | |

RHR-CONDENSING MODE (10)

| | | | |
|---|---|---|---|
| 23-MOV016 | HPSI STEAM SUP OUTBRD ISOL VV | ESK-11AK | 71-BMCC-6 |
| 10-SOV069A | RHR STEAM REDUCING VV | ESK-7G | |
| 10-SOV069B | RHR STEAM REDUCING VV | ESK-7G | |

FIRE PROTCTION SYSTEM (76)

| | | | |
|---|---|---|---|
| 76-CKT | FIRE PROT SYS HPCI/RSS T2/T3 | ESK-11DB | 71-PNL-DC-A3 |

| | | | |
|---|---|---|---|
| 76-CKT | FIRE PROT SYS GEN H2/RFPT | ESK-11DC | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS COND HOLD PIT | ESK-11DD | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS RCIC/HPCI/SGT | ESK-11DE | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS CABLE/SHGR/RELAY | ESK-11DF | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS CO2 HOSES/LINES | ESK-11DG | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS EDG SHG RM N/S | ESK-11DH | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS PP/CHPR/REELS | ESK-11DJ | 71-PNL-DC-A3 |
| 76-CKT | FIRE PROT SYS DIESEL PP RM/BR | ESK-11DK | 71-PNL-DCA3 |
| 76-CKT | FIRE PROT SYS TURB OIL BR BOX | ESK-11DL | 71-PNL-DCA3 |
| 76-CKT | FIRE PROT SYS RECIR PP RM AUX | ESK-11DM | 71-PNL-DCA3 |

EMERGENCY SERVICE WATER SYSTEM (46)

| | | | |
|---|---|---|---|
| 46-P-2A | ESW PP | ESK-6AF | 71-SWGR-12510 |
| 46-MOV102A | ESW ISOL VV | ESK-6HS | 71-MCC-C252 |
| 46-MOV101A | ESW DISCH VV | ESK-6HQ | 71-MCC-C252 |
| 15-MOV103 | ESW DRYWELL COOL ISOL VV | ESK-6HAL | 71-MCC-C162 |
| 15-MOV101 | ESW CROSS-OVER VV RBCW | ESK-6HP | 71-MCC-C152 |
| 15-MOV175A | ESW RBC RETURN VV RBCW | ESK-6HR | 71-MCC-C152 |
| 46-CKT | ESW LOCKOUT MATRIX A/B | ESK-11AC | 71-PNL-DC-A3/B3 |
| 46-P-2B | ESW PP | ESK-6AF | 71-SWGR-12600 |
| 46-MOV102B | ESW ISOL VV | ESK-6HS | 71-MCC-C262 |
| 46-MOV101B | ESW DISCH VV | ESK-6HQ | 71-MCC-C262 |
| 15-MOV102 | ESW DRYWELL COOL ISOL VV | ESK-6HAL | 71-MCC-C152 |
| 15-MOV175B | ESW RBC RETURN VV | ESK-6HR | 71-MCC-C162 |

RHR-SERVICE WATER SYSTEM (10)

| | | | |
|---|---|---|---|
| 10-P-01A | RHR SERV WT PP | ESK-5BG | 71-SWGR10520 |
| 10-P 01C | RHR SERV WT PP | ESK-5BQ | 71-SWGR10510 |
| 10-MOV089A | RHR HX DISCH VV | ESK-6HZ | 71-MCC-C151 |
| 10-MOV148A | RHR ISOL VV SW CROSS TIE | ESK-6HH | 71-MCC-C151 |
| 10-MOV149A | RHR ISOL VV SW CROSS TIE | ESK-6HAA | 71-MCC-C151 |
| 10-P-01B | RHR SERV WT PP | ESK-5BH | 71-SWGR-10620 |
| 10-P-01D | RHR SERV WT PP | ESK-5BR | 71-SWGR-10620 |
| 10-MOV089B | RHR HX DISCH VV | ESK-6HZ | 71-MCC-C161 |
| 10-MOV148B | RHR ISOL VV SW CROSS TIE | ESK-6HH | 71-MCC-C161 |
| 10-MOV149B | RHR ISOL VV SW CROSS TIE | ESK-6HAA | 71-MCC-C161 |

REACTOR BUILDING COMPONENT COOLING WATER SYSTEM (15)

| | | | |
|---|---|---|---|
| 15-P02A | RBCW PP | ESK-6AC | 71-SWGR-11316 |
| 15-P02C | RBCW PP | ESK-6AE | 71-SWGR-11330 |
| 15-P02B | RBCW PP | ESK-6AD | 71-SWGR-11416 |

CONTROL ROOM CHILLED WATER (70)

| | | | |
|---|---|---|---|
| 70-P09A | CRC CHILLER PP | ESK-6FR | 71-MCC-C253 |
| 70-RWC02A | CRC CHILLER | ESK-6FAG | 71-MCC-C253 |
| 70-P09B | CRC CHILLER PP | ESK-6FR | 71-MCC-C263 |
| 70-RWC02B | CRC CHILLER | ESK-6FAJ | 71-MCC-C263 |
| 70-TS-106A | CRC TEMP SW | ESK-6FR | 71-MCC-C253 |

| | | | |
|---|---|---|---|
| 70-TS-106B | CRC TEMP SH | ESK-6FR | 71-MCC-C263 |

REACTOR BUILDING VENTILATION SYSTEM (66)

| | | | |
|---|---|---|---|
| 66-UC22C | RBV UNIT COOL | ESK-6EG | 71-MCC-C153 |
| 66-UC22D | RBV UNIT COOL | ESK-6EG | 71-MCC-C163 |
| 66-UC22E | RBV UNIT COOL | ESK-6EG | 71-MCC-C153 |
| 66-UC22F | RBV UNIT COOL | ESK-6EG | 71-MCC-C163 |
| 66-UC22G | RBV UNIT COOL | ESK-6EG | 71-MCC-C153 |
| 66-UC22H | RBV UNIT COOL | ESK-6EG | 71-MCC-C163 |
| 66-UC22J | RBV UNIT COOL | ESK-6EG | 71-MCC-C153 |
| 66-UC22K | RBV UNIT COOL | ESK-6EG | 71-MCC-C163 |

CONTROL ROOM VENTILATION SYSTEM (70)

| | | | |
|---|---|---|---|
| 70-MOV108 | CRA INTAKE ISOL VV | ESK-6FAF | 71-MCC-C263 |
| 70-MOD105 | CRA INTAKE DMP | ESK-6FS | 71-PNL-AC9 |
| 70-AHU03A | CRA COOL UNIT | ESK-6FP | 71-MCC-C253 |
| 70-MOD106A | CRA LOAD SIDE DMP | ESK-6FAA | 71-PNL-ACA2 |
| 70-E007 | CRA HTR REHEAT COIL | ESK-6FAP | 71-MCC-C253 |
| 70-E008 | CRA HTR REHEAT COIL | ESK-6AZ | 71 SWGR-12620 |
| 70-MOD113 | CRA EMG VENT OUTSIDE AIR | FB-45A | 71-PNL-RRACB-8 |
| 70-MOD114 | CRA RETURN FILT ISOS DMP | FBK45A | 71-PNL-RRACB-8 |
| 70-MOD110A | CRA RETRN AIR DMP | ESK-6FAA | 71-PNL-ACA2 |
| 70-FN04A | CRA RETRN EXHAUST FAN | ESK-6FN | 71-MCC-C253 |
| 70-MOD108A | CRA RETRN EXHAUST DMP | ESK-6FN | 71-MCC-C253 |
| 70-MOD109 | CRA EXHAUST DMP | ESK-6FS | 71-PNL-AC9 |
| 70-MOV107 | CRA EXHAUST ISOL VV | ESK-6FAF | 71-MCC-C263 |
| 70-FN06A | CRA BOASTER FAN | ESK-6FM | 71-MCC-C253 |
| 70-MOD112A | CRA BOASTER FAN DMP | ESK-6FM | 71-MCC-C253 |
| 70-AHU03B | CRA COOL UNIT | ESK-6FP | 71-MCC-C263 |
| 70-MOD106B | CRA LOAD SIDE DMP | ESK-6FAB | 71-PNL-ACB2 |
| 70-MOD110B | CRA RETRN AIR DMP | ESK-6FAB | 71-PNL-ACB2 |
| 70-FN04B | CRA RETRN EXHAUST FAN | ESK-6FN | 71-MCC-C263 |
| 70-FN06B | CRA BOASTER FAN | ESK-6FM | 71-MCC-C263 |
| 70-MOD112B | CRA BOASTER FAN DMP | ESK-6FM | 71-MCC-C263 |
| 70-MOD108B | CRA RETRN EXHAUST DMP | ESK-6FN | 71-MCC-C263 |
| 70-PNL-HV-5A | CRA HVAC TAYLOR INST. | FE-1AF | 71-PNL-RRACA8 |
| 70-PNL-HV-5B | CRA HVAC TAYLOR INST/ | FE-1AF | 71-PNL-RRACB8 |

RELAY ROOM VENTILATION (70)

| | | | |
|---|---|---|---|
| 70-MOV106 | RRM INTAKE ISOL VV | ESK-6FQ | 71-MCC-C263 |
| 70-MOD100 | RRM INTAKE DMP | ESK-6FS | 71-PNL-AC9 |
| 70-AHU012A | RRM COOL UNIT | ESK-6FK | 71-MCC-C253 |
| 70-MOD101A | RRM LOAD SIDE DMP | ESK-6FT | 71-PNL-ACA2 |
| 70-E016 | RRM HTR UNIT | ESK-6FAQ | 71-MCC-C253 |
| 70-FN013A | RRM RETURN FAN | ESK-6FL | 71-MCC-C253 |
| 70-MOD102A | RRM RETURN DMP | ESK-6FT | 71-PNL-ACA2 |
| 70-MOD103 | RRM EXHAUST DMP | ESK-6FS | 71-PNL-71AC9 |
| 70-MOV105 | RRM EXHAUST ISOL VV | ESK-6FQ | 71-MCC-C253 |
| 70-AHU012B | RRM COOL UNIT | ESK-6FK | 71-MCC-C263 |
| 70-MOD101B | RRM LOAD SIDE DMP | ESK-6FU | 71-PNL-ACB2 |
| 70-FN013B | RRM RETURN FAN | ESK-6FL | 71-MCC-C253 |

| | | | |
|---|---|---|---|
| 70-MOD102B | RRM RETURN DMP | ESK-6FU | 71-PNL-ACB2 |
| 70-MOD104A | RRM CROSS-TIE DMP | FB-6FT | 71-PNL-ACA2 |
| 70-MOD104B | RRM CROSS-TIE DMP | FB-6FU | 71-PNL-ACB2 |

SCREEN HOUSE VENTILATION SYSTEM (73)

| | | | |
|---|---|---|---|
| 73-FN03A | SRHS EMERG SHR PP FAN | ESK-6FZ | 71-MCC-C252 |
| 73-FN03B | SRHS EMERG SHR PP FAN | ESK-6FZ | 71-MCC-C262 |

BATTLRY ROOM VENTILATION SYSTEM (72)

| | | | |
|---|---|---|---|
| 72-MOD100A | BTRM SUPPLY DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-AHU030A | BTRM COOL UNIT DC EQUIP RM | ESK-6JF | 71-MCC-C253 |
| 72-FN031A | BTRM RECIR FAN | ESK-6JD | 71-MCC-C253 |
| 72-MOD102A | BTRM RECIR FAN ISOL DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-MOD101A | BTRM COOL UNIT ISOL DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-MOD104A | BTRM RECIR DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-FN046A | BTRM BTRY RM A FAN | ESK-6JE | 71-MCC-C253 |
| 72-MOD103A | BTRM BTRY RM A DISCH DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-MOD100B | BTRM SUPPLY DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-AHU30B | BTRM COOL UNIT DC EQUIP RM | ESK-6JF | 71-MCC-C263 |
| 72-FN031B | BTRM RECIRC FAN | ESK-6JD | 71-MCC-C263 |
| 72-MOD102B | BTRM RECIRC FAN ISOL DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-MOD101B | BTRM COOL UNIT ISOL DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-FN046B | BTRM BTRY RM D FAN | ESK-6JG | 71-MCC-C263 |
| 72-MOD103B | BTRM BTRY RM D DISCH DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-MOD104B | BTRM RECIRC DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-FN046C | BTRM BTRY RM A FAN | ESK-6JE | 71-MCC-C253 |
| 72-MOD103C | BTRM BTRY RM A DISC DMP | ESK-6FAL | 71-PNL-ACA2 |
| 72-FN046D | BTRM BTRY RM D FAN | ESK-6JG | 71-MCC-C263 |
| 72-MOD103D | BTRM BTRY RM D DISC DMP | ESK-6FAM | 71-PNL-ACB2 |
| 72-PNL-HV-7A | BTRM BTRY RM TAYLOR INSTR | FE-1HF | 71-PNL-RRACA8 |
| 72-PNL-HV-7A | BTRM BTRY RM TAYLOR INSTR | FE-1HF | 71-PNL-RRACB8 |

DIESEL GENERATOR ROOM VENTILATION (92)

| | | | |
|---|---|---|---|
| 92-MOD150A | DGRM EDG RM A SUPPLY DMP | ESK-6JX | 71-MCC-C254 |
| 92-MOD149A | DGRM EDG RM A ISOL DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-MOD148A | DGRM EDG RM A RECIR DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-FN01A | DGRM EDG RM A SUPPLY FAN | ESK-6JX | 71-MCC-C254 |
| 92-FN02A | DGRM EDG RM A EXHAUST FAN | ESK-6JX | 71-MCC-C254 |
| 92-MOD144A | DGRM EDG RM A EXHAUST FAN DMP | ESK-6JX | 71-MCC-C254 |
| 92-MOD143A | DGRM EDG RM A VENT DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-MOD150B | DGRM EDG RM B SUPPLY DMP | ESK-6JY | 71-MCC-C264 |
| 92-MOD149B | DGRM EDG RM B ISOL DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-MOD148B | DGRM EDG RM B RECIR DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-FN01B | DGRM EDG RM B SUPPLY FAN | ESK-6JY | 71-MCC-C264 |
| 92-FN02B | DGRM EDG RM B EXHAUST FAN | ESK-6JY | 71-MCC-C264 |
| 92-MOD144B | DGRM EDG RM B EXHAUST FAN DMP | ESK-6JY | 71-MCC-C264 |
| 92-MOD143B | DGRM EDG RM B VENT DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-MOD150C | DGRM EDG RM C SUPPLY DMP | ESK-6JX | 71-MCC-C254 |
| 92-MOD149C | DGRM EDG RM C ISOL DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-MOD148C | DGRM EDG RM C RECIR DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-FN01C | DGRM EDG RM C SUPPLY FAN | ESK-6JX | 71-MCC-C254 |

| | | | |
|---|---|---|---|
| 92-FN02C | DGRM EDG RM C EXHAUST FAN | ESK-6JX | 71-MCC-C254 |
| 92-MOD144C | DGRM EDG RM C EXHAUST FAN DMP | ESK-6JX | 71-MCC-C254 |
| 92-MOD143C | DGRM EDG RM C VENT DMP | ESK-6JX | 71-PNL-ACA-4 |
| 92-MOD150D | DGRM EDG RM D SUPPLY DMP | ESK-4JY | 71-MCC-C264 |
| 92-MOD149D | DGRM EDG RM D ISOL DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-MOD148D | DGRM EDG RM D RECIR DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-FN01D | DGRM EDG RM D SUPPLY FAN | ESK-6JY | 71-MCC-C264 |
| 92-FN02D | DGRM EDG RM D EXHAUST FAN | ESK-6JY | 71-MCC-C264 |
| 92-MOD144D | DGRM EDG RM D EXHAUST FAN DMP | ESK-6JY | 71-MCC-C264 |
| 92-MOD143D | DGRM EDG RM D VENT DMP | ESK-6JX | 71-PNL-ACB-4 |
| 92-HV-9A | DGRM EDG TAYLOR INSTR | 1.79.95 | |
| 92-HV-9B | DGRM EDG TAYLOR INSTR | 1.79.95 | |

EMERGENCY GENERATOR SWGR ROOM VENT SYSTEM (67)

| | | | |
|---|---|---|---|
| 67-MOD141 | EMER GEN SWGR DMP W PIPE TUN | ESK-6ES | 71-PNL-ACA4 |
| 67-FN012A | EMER GEN SWGR SUPPLY FAN TRBLG | ESK-6ER | 71-MCC-C251 |
| 67-MOD142A | EMER GEN SWGR SUPPLY FAN DMP | ESK-6ER | 71-MCC-C251 |
| 67-MOD141B | EMER GEN SWGR DMP W PIPE TUN | ESK-6ES | 71-PNL-ACA4 |
| 67-FN012B | EMER GEN SWGR SUPPLY FAN TRBLG | ESK-6ER | 71-MCC-C261 |
| 67-MOD142B | EMER GEN SWGR SUPPLY FAN DMP | ESK-6ER | 71-MCC-C261 |
| 67-FN012C | EMER GEN SWGR SUPPLY FAN TRBLG | ESK-6ER | 71-MCC-C251 |
| 67-MOD142C | EMER GEN SWGR SUPPLY FAN DMP | ESK-6ER | 71-MCC-C251 |
| 67-FN012D | EMER GEN SWGR SUPPLY FAN TRBLG | ESK-6ER | 71-MCC-C261 |
| 67-MOD142D | EMER GEN SWGR SUPPLY FAN DMP | ESK-6ER | 71-MCC-C261 |
| 67-UC016A1 | EMER GEN UNIT COOLER | ESK-6EQ | 71-MCC-C251 |
| 67-UC016A2 | EMER GEN UNIT COOLER | ESK-6EQ | 71-MCC-C251 |
| 67-UC016B1 | EMER GEN UNIT COOLER | ESK-6EQ | 71-MCC-C261 |
| 67-UC016B2 | EMER GEN UNIT COOLER | ESK-6EQ | 71-MCC-C261 |
| 67-MOD147 | EMER GEN DAMPER | ESK-6ES | 71-ACB4 |

DIESEL FUEL TRANSFER SYSTEM (93)

| | | | |
|---|---|---|---|
| 93-P01A1 | EDGA TRANSFER PUMP | ESK-6VA | 71-MCC-C254 |
| 93-P01A2 | EDGA TRANSFER PUMP | ESK-6VA | 71-MCC-C254 |
| 93-P10C1 | EDGC TRANSFER PUMP | ESK-6VA | 71-MCC-C254 |
| 93-P10C2 | EDGC TRANSFER PUMP | ESK-6VA | 71-MCC-C254 |
| 93-P10B1 | EDGB TRANSFER PUMP | ESK-6VA | 71-MCC-C264 |
| 93-P10B2 | EDGB TRANSFER PUMP | ESK-6VA | 71-MCC-C264 |
| 93-P10D1 | EDGD TRANSFER PUMP | ESK-6VA | 71-MCC-C264 |
| 93-P10D2 | EDGD TRANSFER PUMP | ESK-6VA | 71-MCC-C264 |

CONTROL ROD DRIVE SYSTEM (03)

| | | | |
|---|---|---|---|
| 03-P016A | DRIVE WATER PUMP | ESK-6AK | 71-SWGR-11516 |
| 03-P016A | DRIVE WATER PUMP | ESK-6AK | 71-SWGR-11616 |

EMERGENCY DIESEL GENERATOR SYSTEM (93)

| | | | |
|---|---|---|---|
| 93-SWGR-10502 | EDG A OUTPUT ACB | ESK-5BB | H05 |
| 93-SWGR-10512 | EDG C OUTPUT ACB | ESK-5BC | H05 |
| 93-SWGR-10504 | EDG A-C TIE ACB | ESK-5BD | H05 |

| | | | |
|---|---|---|---|
| 93-SWGR-10602 | EDG B OUTPUT ACB | ESK-5BK | H06 |
| 93-SWGR-10612 | EDG D OUTPUT ACB | ESK-5BL | H06 |
| 93-SWGR-10604 | EDG B-D TIE ACB | ESK-5BM | H06 |
| 93-EDGA | EDG A CURRENT PROTECTION | ESK-8HA | EDGA |
| 93-EDGB | EDG B CURRENT PROTECTION | ESK-8HB | EDGB |
| 93-EDGC | EDG C CURRENT PROTECTION | ESK-8HC | EDGC |
| 93-EDGD | EDG D CURRENT PROTECTION | ESK-8HD | EDGD |
| 93-EDG | EDG A/B/C EXCITATION CONTROL | ESK-8HE | EDGA/B/C |
| 93-EDG | EDG A/B/C GOVENOR CONTROL | ESK-8HF | EDGA/B/C |
| 93-EDGA | EDG A CONTROL | ESK-11BA | 71-PNL-DC-A4 |
| 93-EDGA | EDG A CONTROL | ESK-11BB | 71-PNL-DC-A4 |
| 93-EDGA | EDG A CONTROL | ESK-11BC | 71-PNL-DC-A4 |
| 93-EDGA | EDG A CONTROL | ESK-11BD | 71-PNL-DC-A4 |
| 93-PNL-FPAC | EDG A/C CONTROL FORCE PARALLEL | ESK-11BE | 71-PNL-DC-A4 |
| 93-EDGC | EDG C CONTROL | ESK-11BF | 71-PNL-DC-A4 |
| 93-EDGC | EDG C CONTROL | ESK-11BG | 71-PNL-DC-A4 |
| 93-EDGC | EDG C CONTROL | ESK-11BH | 71-PNL-DC-A4 |
| 93-EDGC | EDG C CONTROL | ESK-11BJ | 71-PNL-DC-A4 |
| 93-EDGB | EDG B CONTROL | ESK-11BK | 71-PNL-DC-B4 |
| 93-EDGB | EDG B CONTROL | ESK-11BL | 71-PNL-DC-B4 |
| 93-EDGB | EDG B CONTROL | ESK-11BM | 71-PNL-DC-B4 |
| 93-EDGB | EDG B CONTROL | ESK-11BN | 71-PNL-DC-B4 |
| 93-EDGD | EDG B/D CONTROL | ESK-11BP | 71-PNL-DC-B4 |
| 93-BDGD | EDG D CONTROL | ESK-11BQ | 71-PNL-DC-B4 |
| 93-BDGD | EDG D CONTROL | ESK-11BR | 71-PNL-DC-B4 |
| 93-BDGD | EDG D CONTROL | ESK-11BS | 71-PNL-DC-B4 |
| 93-BDGD | EDG D CONTROL | ESK-11BT | 71-PNL-DC-B4 |
| 93-P002A | EDG LUB OIL PP | ESK-6VB | 71-MCC-C254 |
| 93-P002B | EDG LUB OIL PP | ESK-6VB | 71-MCC-C264 |
| 93-P002C | EDG LUB OIL PP | ESK-6VB | 71-MCC-C254 |
| 93-P002D | EDG LUB OIL PP | ESK-6VB | 71-MCC-C264 |
| 93-PNL-FPBD | EDGB/D CONTROL FORCE PARALLEL | ESK-11BP | 71-PNL-DC-B4 |
| 93-CK | EMER BS 10500 UV PROT | ESK-5BS | |
| 93-CKT | EMER BS 10600 UV PROT | ESK-5BT | |

4160VAC BUS

| | | | |
|---|---|---|---|
| 71-CKT | 4160 SYNCH CKT | ESK-8GA | |
| 71-CKT | 4160 SYNCH CKT | ESK-8GC | |
| 71-CKT | 4160 SYNCH CKT | ESK-8GB | |
| 71-CKT | STA SERV BUS MET/RELAY 10500 | ESK-8J | 71-10502/512/514 |
| 71-CKT | STA SERV BUS MET/RELAY 10600 | ESK-8J | 71-10602/612/614 |
| 71-CKT | STA SERV BUS MET/RELAY 10300 | ESK-8H | 71-10302/312/314 |
| 71-CKT | STA SERV BUS MET/RELAY 10400 | ESK-8H | 71-10402/412/404 |
| 71-CKT | NORMAL SERV T4 MET/RELAY | ESK-8C | 71-SWGR-10001 |
| 71-CKT | MAIN TRANS T1A/B MET/RELAY | ESK-8B | 71-SWGR-10001 |
| 71-CKT | RESER TRANS T2 MET/RELAY | ESK-8D | 115 KV SWYD |
| 71-CKT | MAIN GEN MET/RELAY | ESK-8A | 71-SWGR-10003/005 |
| 71-CKT | RESER TRANS T3 MET/RELAY | ESK-8E | 15 KV SWYD |
| 71-SWGR-10402 | NORMAL SUPPLY ACB | ESK-5AJ | H04 |
| 71-SWGR-10412 | RESERVE SUPPLY ACB | ESK-5AK | H04 |
| 71-CKT | FAST TRANSF ACB 10412 | ESK-5J | 71-DC-A5 |
| 71-SWGR-10302 | NORMAL SUPPLY ACB | ESK-5AA | H03 |
| 71-SWGR-10312 | RESERVE SUPPLY ACB | ESK-5AB | H03 |
| 71-SWGR-10304 | 600V FEEDER ACB | ESK-5AH | H03 |
| 71-SWGR-10440 | 600V FEEDER ACB | ESK-5AR | H04 |
| 71-SWGR-10304 | BUS 10300/10500 TIE | ESK-5AX | H03 |
| 71-SWGR-10404 | BUS 10400/10600 TIE | ESK-5AY | H04 |

| | | | |
|---|---|---|---|
| 71-SWGR-10514 | BUS 10500/10300 T[illegible] | ESK-5BA | H05 |
| 71-SWGR-10560 | 600V EMER SWGR TO T13/T15 | ESK-5BE | H05 |
| 71-SWGR-10614 | BUS 10600/10400 TIE | ESK-5BJ | H06 |
| 71-SWGR-10660 | 600V EMERG SWGR TO T14/T16 | ESK-5BN | H06 |
| 71-SWGR-11402 | 600V SUPPLY ACB | ESK-6A | 71-SWGR-10440 |
| 71-SWGR-11302 | 600V SUPPLY ACB | ESK-6A | 71-SWGR-10340 |
| 71-SWGR-12402 | 600V SUPPLY ACB | ESK-6B | 71-SWGR-10440 |
| 71-SWGR-12302 | 600V SUPPLY ACB | ESK-6B | 71-SWGR-10340 |
| 71-SWGR-13302 | 600V SUPPLY ACB | ESK-6C | 71-SWGR-10340 |
| 71-SWGR-13402 | 600V SUPPLY ACB | ESK-6C | 71-SWGR-10440 |
| 71-SWGR-14402 | 600V SUPPLY ACB | ESK-6D | 71-SWGR-10440 |
| 71-SWGR-14302 | 600V SUPPLY ACB | ESK-6D | 71-SWGR-10340 |
| 71-SWGR-11304 | 600V SUPPLY ACB | ESK-6E | 71-SWGR-10340 |
| 71-SWGR-11502 | 600V SUPPLY ACB | ESK-6G | 71-SWGR-10560 |
| 71-SWGR-12502 | 600V SUPPLY ACB | ESK-6G | 71-SWGR-10560 |
| 71-SWGR-11602 | 600V SUPPLY ACB | ESK-6H | 71-SWGR-10660 |
| 71-SWGR-12602 | 600V SUPPLY ACB | ESK-6H | 71-SWGR-11502 |

600 VAC BUS

| | | | |
|---|---|---|---|
| 71-MCC-C153 | MAINT FD A LPCI MOVS MCCC155 | ESK-6J | 71-SWGR-11502 |
| 71-MCC-C163 | MAINT FD B LPCI MOVS MCCC165 | ESK-6J | 71-SWGR-11502 |
| 71-T14 | TRANSFORMER TO SWGR 10660 | FE-1B-5 | 71-SWGR-10660 |
| 71-SW-11661 | DISC SWITCH | FE-1B-5 | 71-SWGR-10660 |
| 71-T16 | TRANSFORMER TO SWGR 10660 | FE-1B-5 | 71-SWGR-10660 |
| 71-SW-12661 | DISC SWITCH | FE-1B-5 | 71-SWGR-10660 |
| 71-T06 | TRANSFORMER TO SWGR 10440 | FE-1B-5 | 71-SWGR-10440 |
| 71-SW-11441 | DISC SWITCH | FE-1B-5 | 71-SWGR-10440 |
| 71-MCC-C152 | AC INPUT TO LPSI MOV IND PWS A | ESK-6K | 71-SWGR-11602 |
| 71-MCC-C162 | AC INPUT TO LPSI MOV IND PWS B | ESK-6K | 71-SWGR-11602 |
| 71-T05 | TRANSFORMER TO SWGR L13 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-11341 | DISC SWITCH TO SWGR L13 | FE-1B-5 | 71-SWGR-10340 |
| 71-T08 | TRANSFORMER TO SWGR L24 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-12441 | DISC SWITCH TO SWGR L24 | FE-1B-5 | 71-SWGR-10340 |
| 71-T07 | TRANSFORMER TO SWGR L23 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-12341 | DISC SWITCH TO SWGR L23 | FE-1B-5 | 71-SWGR-10340 |
| 71-T10 | TRANSFORMER TO SWGR L34 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-13441 | DISC SWITCH TO SWGR L34 | FE-1B-5 | 71-SWGR-10340 |
| 71-T09 | TRANSFORMER TO SWGR L33 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-13341 | DISC SWITCH TO SWGR L33 | FE-1B-5 | 71-SWGR-10340 |
| 71-T12 | TRANSFORMER TO SWGR L44 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-14441 | DISC SWITCH TO SWGR L44 | FE-1B-5 | 71-SWGR-10340 |
| 71-T11 | TRANSFORMER TO SWGR L43 | FE-1B-5 | 71-SWGR-10340 |
| 71-SW-14341 | DISC SWITCH TO SWGR L43 | FE-1B-5 | 71-SWGR-10340 |
| 71-T15 | TRANSFORMER TO SWGR L25 | FE-1B-5 | 71-SWGR-10560 |
| 71-SW-12561 | DISC SWITCH TO SWGR L25 | FE-1B-5 | 71-SWGR-10560 |
| 71-T13 | TRANSFORMER TO SWGR L15 | FE-1B-5 | 71-SWGR-10560 |
| 71-SW-11561 | DISC SWITCH TO SWGR L15 | FE-1B-5 | 71-SWGR-10560 |
| 71-MCC-C261 | 600V BUS 126100 ELECT BAY | FE-1N | 71-SWGR-12646 |
| 71-MCC-C263 | 600V BUS 126300 ADMIN BLDG | FE-1Z | 71-SWGR-12606 |
| 71-MCC-C262 | 600V BUS 126200 ELECT BAY | FE-1R | 71-SWGR-12608 |
| 71-MCC-C264 | 600V BUS 126440 DIESEL GEN RM | FE-1Z | 71-SWGR-12608 |
| 71-MCC-C252 | 600V BUS 125200 ELECT BAY | FE-1R | 71-SWGR-12506 |
| 71-MCC-C254 | 600V BUS 125400 DIESEL GEN RM | FE-1Z | 71-SWGR-12506 |
| 71-MCC-C251 | 600V BUS 125100 ELECT BAY | FE-1N | 71-SWGR-12508 |
| 71-MCC-C253 | 600V BUS 125300 ADMIN BLDG | FE-1Z | 71-SWGR-12508 |
| 71-TBTS-01 | MAN THRVR SW C251 TO C261 | FE-1N | 71-SWGR-12502 |
| 71-RMTS-01 | AUTO THRVR SW C253 TO C254 | FE-1Z | 71-SWGR-12502 |

| | | | |
|---|---|---|---|
| 71-PT-71ACA2 | TRANS EMER CONT/INST PNL71ACA2 | FE-1Z | 71-MCC-C253 |
| 71-RRTS-01 | MAN THRVR SW C263 TO C253 | FE-1Z | 71-SWGR-12502 |
| 71-PT-71ACB4 | TRANS EMER CONT/INST PNL71ACA4 | FE-1Z | 71-MCC-C264 |
| 71-PT-71ACA4 | TRANS EMER CONT/INST PNL71ACA4 | FE-1Z | 71-MCC-C254 |
| 71-PT-ACB2 | TRANS EMER CONT/INST PNL71ACB2 | FE-1Z | 71-MCC-C263 |
| 71-PT-05-06A | TRANS RPS | FE-1R | 71-MCC-C252 |
| 71-PT-71ACUPS | TRANS UNINTR BUS TRANS SW MG | FE-1R | 71-MCC-C252 |
| 71-PT-71ESSA1 | TRANS SAFEGUARD INST BUS A | FE-1R | 71-MCC-C252 |
| 71-PNL-UPP | UNINTR BUS MG | FE-1R | 71-MCC-C262 |
| 71-MCC-C163 | 600V BUS 116300 RB | FE-1L-8 | 71-SWGR-11610 |
| 71-MCC-C161 | 600V BUS 116100 RB | FE-1S-8 | 71-SWGR-11646 |
| 71-MCC-C162 | 600V BUS 116200 RB | FE-1S-8 | 71-SWGR-11608 |
| 71-INV-03B | C162 AC IN LPSI MOV IND PWS B | FE-1S-8 | 71-SWGR-11608 |
| 71-RBTS-01 | MAIN THRVR SW C162/C152 | FE-1S-8 | 71-SWGR-11608 |
| 71-MCC-C164 | 600V BUS RB | FE-1AA-6 | 71-SWGR-11608 |
| 71-MCC-C153 | 600V BUS 115300 RB | FE-1L-8 | 71-SWGR-11508 |
| 71-MCC-C152 | 600V BUS 115200 RB | FE-1S-8 | 71-SWGR-11506 |
| 71-PNL-ACA3 | EMER CONT/INS DIST PNL | FE-1S-8 | 71-SWGR-11506 |
| 71-PNL-ACA5 | EMER CONT/INS DIST PNL | FE-1S-8 | 71-SWGR-11506 |
| 71-PT-71ACA5 | TRANS CONT/INS PNL 71ACA3 | FE-1S-8 | 71-SWGR-11506 |
| 71-MCC-C141 | 600V BUS 114100 RB | FE-1R-9 | 71-SWGR-11402 |
| 71-PNL-RB-AC-7 | REACT BLDG DIST PNL | FE-1R-9 | 71-SWGR-11408 |
| 71-MCC-C142 | 600V BUS 114200 RB | FE-1K-9 | 71-SWGR-11408 |
| 71-PNL-RBACD5 | RB DIST PNL | FE-1K-9 | 71-SWGR-11408 |
| 71-PNL-RBACB5 | B DIST PNL | FE-1K-9 | 71-SWGR-11408 |
| 71-PT-RBACD5 | TRANS FOR PNL RBACD5 | FE-1K-? | 71-SWGR-11408 |
| 71-MCC-C132 | 600V BUS 113200 RB | FE-1K-9 | 71-SWGR-11306 |
| 71-PNL-RBACE5 | RB DIST PNL | FE-1K-9 | 71-SWGR-11306 |
| 71-PT-RBACE5 | TRANS FOR PNL RBACE5 | FE-1K-9 | 71-SWGR-11306 |
| 71-PNL-RBACA5 | RB DIST PNL | FE-1K-9 | 71-SWGR-11306 |
| 71-PT-RBACA5 | TRANS FOR RBACA5 | FE-1K-9 | 71-SWGR-11306 |
| 71-MCC-C131 | 600V BUS 113100 RB | FE-1R-9 | 71-SWGR-11310 |
| 71-INV-3A | C152 AC IN LPSI MOV IND PWS A | FE-1M-7 | 71-SWGR-11506 |
| 71-MCC-C151 | 600V BUS 115100 RB | FE-1S-8 | 71-SWGR-11510 |
| 71-PT-71ACNMSA | TRANS FOR PNL 71ACNMS-4 RB | FE-1S-8 | 71-SWGR-11510 |
| 71-PNL-ACNMS-A | PNL 71ACNMS-A RB | FE-1S-8 | 71-SWGR-11606 |
| 71-PT-71ACB3 | TRANS FOR PNL 71ACB3 RB | FE-1S-8 | 71-SWGR-11606 |
| 71-PT-71ACB5 | TRANS FOR PNL 71ACB5 RB | FE-1S-8 | 71-SWGR-11608 |
| 71-PNL-ACB5 | RB DIST PNL | FE-1S-8 | 71-SWGR-11608 |
| 71-MCC-C155 | 600V BUS 115500 MAINT FD C153 | FE-1Y-6 | 71-SWGR-11508 |
| 71-MCC-C165 | 600V BUS 116500 MAINT FD C163 | FE-1Y-6 | 71-SWGR-11610 |
| 71-PT-05-6B | TRANS FOR 120V-2W-S/N RPS | FE-1R-9 | 71-SWGR-12608 |
| 71-PT-71ESSB1 | TRANS FOR SG INST BUS B | FE-1R-9 | 71-SWGR-12608 |
| 71-MCC-C342 | ADMIN BLDG BUS 134200 | FE-1Y | 71-SWGR-13400 |
| 71-PT-AC9 | TRANS FOR PNL 71AC9 | FE-1Y | |
| 71-SW-TS-5 | AUTO THROWOVER SWITCH 332/342 | FE-1Y | |
| 71-PT-RRACA8 | NORMAL INST BUS A PNL RRACA8 | FE-1Y | |
| 71-PT-AC10 | TRANS FOR PNL 71AC10 | FE-1Y | |
| 71-SW-TS-6 | AUTO THROWOVER SWITCH 342/332 | FE-1Y | |
| 71-PT-RRACB8 | NORMAL INST BUS B PNL RRACB8 | FE-1Y | |
| 71-PT-ABAC1 | TRANS FOR RB PNL ACBA1 | FE-1Y | |
| 71-MCC-C332 | ADMIN BLDG BUS 133200 | FE-1Y | 71-SWGR-13300 |

SWGR INTERLOCKS/TRIPS

| | | | |
|---|---|---|---|
| 71-CKT | 4KV BUS 10300/10400 VOLT/SYNM | ESK-5H | 71-DC-B3 |
| 71-CKT | EXCITOR PROTECT CKT | ESK-8DD | 71-DC-B1 |
| 71-CKT | NORM ST SERV TRANS T4 GND OC | ESK-8CG | 71-DC-A3 |

| | | | |
|---|---|---|---|
| 71-CKT | GEN&TRANS PRIM RELAY PROT | ESK-8CC | 71-DC-B1 |
| 71-CKT | UNIT/NORM STA TRANS BU PROT | ESK-8CA | 71-DC-A1 |
| 71-CKT | SYS BACK-UP PROT | ESK-8CD | 71-DC-B1 |
| 71-CKT | RES STA SERV TRANS T-2 PROT | ESK-8CE | 71-DC-A1 |
| 71-CKT | RES STA SERV TRANS T-3 PROT | ESK-8CF | 71-DC-A1 |
| 71-CKT | 115 KV BUS DIF/BKR BACKUP PROT | ESK-8FM | 71-DC-B1 |
| 71-CKT | 115 KV BUS DIF/BKR BACKUP PROT | ESK-8FM | 71-DC-B1 |
| 71-CKT | 115 KV BUS DIF/BKR BACKUP PROT | ESK-8FM | 71-DC-B1 |
| 71-CKT | UNIT/NORM STA TRANS BU PROT | ESK-8CB | 71-DC-A1 |

120 VAC DISTRIBUTION

| | | | |
|---|---|---|---|
| 71-PNL-ESSA1 | RLY RM 120V SG CONT/INT BUS A1 | FE-1AC-7 | 71-MCC-C252 |
| 71-PNL-ESSB1 | RLY RM 120V SG CONT/INT BUS B1 | FE-1AC-7 | 71-MCC-C262 |
| 71-PNL-ACUPS-1 | RLY RM 120V UNITER BUS | FE-1AC-7 | 71-MCC-C252 |
| 71-PNL-ACA3 | RB 120V EMER/INST BUS A3 | FE-1AD-5 | 71-MCC-C152 |
| 71-PNL-ACB3 | RB 120V EMER/INST BUS B3 | FE-1AD-5 | 71-MCC-C162 |
| 71-PNL-ACA4 | EDG RM 120V EMER CON/IN BUS A4 | FE-1AD-5 | 71-MCC-C254 |
| 71-PNL-ACB4 | EDG RM 120V EMER CON/IN BUS B4 | FE-1AD-5 | 71-MCC-C264 |
| 71-PNL-RBACA5 | RB 120V NORM/INST BUS A5 | FE-1AE-5 | 71-MCC-C132 |
| 71-PNL-RBACB5 | RB 120V NORM/INST BUS B5 | FE-1AE-5 | 71-MCC-C142 |
| 71-PNL-TBACA6 | TB 120V NORM/INST BUS A6 | FE-1AE-5 | 71-MCC-C434 |
| 71-PNL-RRACA8 | RLY RM 120V NORM/INST BUS A8 | FE-1AF-4 | 71-MCC-C332 |
| 71-PNL-AC9 | RLY RM 120V COMM CONT/INST 9 | FE-1AG-6 | 71-MCC-C332/342 |
| 71-PNL-ACUPS | RLY RM 120V | FE-1AB-3 | 71-MCC-C262 |
| 71-PNL-05-6A | RLY RM 120V RPS A | FE-1AB-3 | 71-MCC-C251/252 |
| 71-PNL-05-6B | RLY RM 120V RPS B | FE-1AB-3 | 71-MCC-C261/262 |
| 71-PNL-ACA2 | RLY RM 120V EMER CONT/INST A2 | FE-1AS | 71-MCC-C253 |
| 71-PNL-ACB2 | RLY RM 1:0V EMER CONT/INST B2 | FE-1AS | 71-MCC-C263 |
| 71-PNL-AC10 | RLY RM 120V COMM CONT/INST 10 | FE-1AT-4 | 71-MCC-C332/342 |
| 71-PNL-SHACC7 | SCH BLDG NORMAL SUPPLY C7 120V | FE-1AV-3 | 71-MCC-C333 |
| 71-PNL-ACA5 | RB 120V EMER CONT/INS A5 | FE-1AH-4 | 71-MCC-C152 |
| 71-PNL-ACB5 | RB 120V EMER CONT/INS A5 | FE-1AH-4 | 71-MCC-C152 |
| 71-INV-3A | LPCI MOV INDEP PHS A | FE-1AH-4 | 71-PNL-ACA-5 |
| 71-INV-3B | LPCI MOV INDEP PHS B | FE-1AH-4 | 71-PNL-ACA-5 |
| 71-BAT-3A | LPCI MOV INDEP PHS A | FE-1AH-4 | 71-PNL-ACA-5 |
| 71-BAT-3B | LPCI MOV INDEP PHS B | FE-1AH-4 | 71-PNL-ACA-5 |
| 71-PNL-HV-3M | TAYLOR INSTRUMENT LOOP | FE-1AQ-3 | 71-PNL-RBACE-5 |
| 71-PNL-HV-3A | TAYLOR INSTRUMENT LOOP | FE-1AQ 3 | 71-PNL-RBACE-5 |
| 71-PNL-HV-3B | TAYLOR INSTRUMENT LOOP | FE-1AQ-3 | 71-PNL-RBACD-5 |
| 71-PNL-HV-5A | TAYLOR INSTRUMENT LOOP | FE-1AF-4 | 71-PNL-RRACA-8 |
| 71-PNL-HV-5B | TAYLOR INSTRUMENT LOOP | FE-1AR-4 | 71-PNL-RRACB-8 |
| 71-PNL-HV-7A | TAYLOR INSTRUMENT LOOP | FE-1AF-4 | 71-PNL-RRACA-8 |

125 VDC DIST BRD

| | | | |
|---|---|---|---|
| 71-BC-1A | BT//CHARGER 1A | FE-1AH-5 | 71-MCC-C252 |
| 71-BCB-2A | BTY RM 125VDC CONT BRD 2A | FE-1AH-5 | 71-BA-A/BC-1A |
| 71-BA-A | BATTERY A 125VDC | FE-1AH-5 | 71-BCB-2A |
| 71-DC-A4 | EDG 125VDC DIST CAB A4 | FE-1AH-5 | 71-BCB-2A |
| 71-ECPC | EDGC 125VDC PNL | FE-1AH-5 | 71-BCB-2A |
| 71-EPCA | EDGA 125 VDC PNL | FE-1AH-5 | 71-BCB-2A |
| 71-PNL-UPP | RLY RM 125VDC UNINTER | FE-1AB-3 | 71-BCB-2A |
| 71-BC-1B | BTY CHARGER 1B | FE-1AH-5 | 71-MCC-C262 |
| 71-BCB-2B | BTY RM 125VDC CONT BRD 2B | FE-1AH-5 | 71-BA-B/BC-1B |
| 71-BA-B | BATTERY B 125VDC | FE-1AH-5 | 71-BCB-2B |

| | | | |
|---|---|---|---|
| 71-DC-B4 | EDG 125VDC DIST CAB B4 | FE-1AH-5 | 71-BCB-2B |
| 71-ECPD | EDGD 125VDC PNL | FE-1AH-5 | 71-BCB-2B |
| 71-ECPB | EDGB 125VDC PNL | FE-1AH-5 | 71-BCB-2B |
| 93-FPAC | PARALL CONTROL EDG A/C | FE-1AH-5 | 71-DC-A4 |
| 93-FPBD | PARALL CONTROL EDG B/D | FE-1AH-5 | 71-DC-B4 |
| 71-BMCC-1 | 125VDC RB BUS | FE-1AJ | 71-BCB-2A |
| 71-BMCC-3 | 125VDC RB BUS | FE-1AJ | 71-BCB-2A |
| 71-BMCC-2 | 125VDC RB BUS | FE-1AJ | 71-BCB-2B |
| 71-BMCC-4 | 125VDC RB BUS | FE-1AJ | 71-BCB-2B |
| 71-BMCC-6 | 125VDC RB BUS | FE-1AJ | 71-BCB-2B |
| 71-DC-A1 | 125VDC RLY RM DIST CAB | FE-1AK | 71-BCB-2A |
| 71-DC-B1 | 125VDC RLY RM DIST CAB | FE-1AK | 71-BCB-2B |
| 71-DC-B2 | 125VDC RLY RM DIST CAB | FE-1AL | 71-BCB-2A |
| 71-DC-A2 | 125VDC RLY RM DIST CAB | FE-1AL | 71-BCB-2A |
| 71-DC-A3 | 125VDC RLY RM | FE-1AN | 71-BCB-2B |
| 71-DC-B3 | 125VDC RLY RM | FE-1AN | 71-BCB-2B |
| 71-DC-B5 | 125VDC RLY RM | FE-1AX | 71-BCB-2B |
| 71-DC-A5 | 125VDC RLY RM | FE-1AX | 71-BCB-2B |

LOGIC CIRCUITS (125VDC)

| | | | |
|---|---|---|---|
| CKT | RCIC RELAY LOGIC | 791E464 | 71-PNL-DC-A2 |
| CKT | RCIC RELAY LOCIC | 79E464 | 71-PNL-DC-B |
| CKT | RHR CH LOGIC | 791E461 | 71-PNL-DC-A2 |
| CKT | CORE SPRAY CH LOGIC A | 791E465 | 71-PNL-DC-A2 |
| CKT | CORE SPRAY CH LOGIC B | 791E465 | 71-PNL-DC-B2 |
| CKT | STEAM LEAK DET LOGIC | 791E472 | 71-PNL-DC-A2 |
| CKT | STEAM LEAK DET LOGIC | 791E472 | 71-PNL-DC-B2 |
| CKT | HPCI CONTROL SYSTEM LOCIC | 791E464 | 71-PNL-DC-B2 |

TABLE 2.0

FIRE HAZARDS SHUTDOWN ANALYSIS SUMMARY SHEET
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
POWER AUTHORITY OF THE STATE OF NEW YORK

| Fig. No. | Area or Zone Code | El. | Plant Area Identification | Type of Fire Suppression: Primary | Actuation | Backup | Detection | Notes* |
|---|---|---|---|---|---|---|---|---|
| 4.1 | RB-1E | 227 | Crescent Area - East | Water spray | FD/Manual & Foam | Water Hose station | Local Elec. HAD, Area Ionization | 2 |
| 4.1 | RB-1W | 227 | Crescent Area - West | Water spray & foam | Automatic/ Manual | Water Hose station | Local Elec. HAD, Area Ionization | 2 |
| 4.2 | RB-13** | 272 | Reactor Building | Water Hose | Manual | Portable | Area Ionization | 3 |
| 4.3 | RB-14** | 300 | Reactor Building | Water spray & water hose station | Manual | Portable $CO_2$ | Area Ionization | |
| 4.4 | RB-15 | 326 | Reactor Building | Water hose station | Manual | Portable $CO_2$ | Area Ionization | |
| 4.4 | RB-16 | 344 | Reactor Building | Water hose station | Manual | Portable $CO_2$ | Area Ionization | |
| 4.4 | RB-17 | 369 | Reactor Building | Water hose station | Manual | Portable CO | Area Ionization | |
| 4.3 | MG-1 | 300 | Motor Gen. Room | Preact. sprinkler | Elec.HAD/ fusible link | Water hose station | Sprinkler alarm | |
| 4.2 | AD-1 | 272 | Admin. Bldg. Telephone Gear | Portable CO | --- | --- | None | |
| 4.1 | AD-2 | 272 | Shop Stores | Wet Pipe Sprinkler | Fusible link | Water hose station | Sprinkler alarm | |
| 4.2 | AD-3 | 272 | Mach. Shop. Locker | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | |
| 4.2 | AD-4 | 286 | Offices, records etc. | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | |
| 4.2 | AD-5 | 286 | Print room | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | |

*See Notes on Separate Sheet.
**Indicates fire area or zone was further divided for analysis.

FIRE HAZARDS SHUTDOWN ANALYSIS SUMMARY SHEET (CONT'D)

| Fig. No. | Area or Zone Code | El. | Plant Area Identification | Type of Fire Suppression | | | Detection | Notes* | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Primary | Actuation | Backup | | | |
| 4.3 | AD-6 | 300 | Offices, Equip. | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 2.23 2.24 |
| 4.3 | CR-1 | 300 | Main Control Room | Water hose station | Manual | $CO_2$cart | None | | 2.26 2.27 |
| 4.4 | CR-2 | 284 | Radwaste Control Room | Water hose station | Manual | Portable $CO_2$ | None | 6 | 2.29 2.30 |
| 4.1 | CT-1 | 260 | Cable Tunnel West | Water spray | Elec.HAD/ Manual | Portable $CO_2$ | Area Ionization | | 2.32 2.33 |
| 4.1 | CT-2 | 260 | Cable Tunnel East | Water spray | Elec.HAD/ Manual | Portable $CO_2$ | Area Ionization | | 2.35 2.36 |
| 4.4 | CT-3 | 286 | Cable Tunnel South | Total flood $CO_2$ | Elec.HAD/ Manual | Portable $CO_2$ | Area Ionization | | 2.38 2.39 |
| 4.4 | CT-4 | 286 | Cable Tunnel North | Total flood $CO_2$ | Elec.HAD/ Manual | Portable $CO_2$ | Area Ionization | | 2.41 2.42 |
| 4.4 | RR-1 | 286 | Relay Room | Total flood $CO_2$ | Manual | Portable $CO_2$ | Area Ionization & HAD | | 2.44 2.45 |
| 4.2 | CS-1 | 272 | Cable Spreading Room | Total flood $CO_2$ | Elec.HAD/ Manual | Water hose station | Area Ionization | | 2.47 2.48 |
| 4.1 | TB-11 | 252 | Turbine Building Basement | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 2.50 2.51 |
| 4.2 | TB-12 | 272 | Turbine Building Mezzanine | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 2.53 2.54 |
| 4.3 | TB-13 | 300 | Turbine Building Op. Floor | Water spray | Manual | Water hose station | Elec.HAD | | 2.56 2.57 |
| 4.2 4.3 | RW-1 | | Radwaste Building (Baler Room) | Water hose station | Manual | Portable $CO_2$ | None | | 2.59 3.1 |
| 4.1 | SH-13 | 255 | Screenwell House | Water hose station | Manual | Portable $CO_2$ | None | | 3.3 3.4 |
| 4.2 | SW-1 | 272 | Main Switchgear Rm West | Total flood $CO_2$ | Elec.HAD/ Manual | Water hose station | Area Ionization | | 3.6 3.7 |
| 4.2 | SW-2 | 272 | Main Switchgear Rm East | Total flood $CO_2$ | Elec.HAD/ Manual | Water hose station | Area Ionization | | 3.9 3.10 |

| Fig. No. | Area or Zone Code | El. | Plant Area Identification | Type of Fire Suppression | | | Detection | Notes* | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Primary | Actuation | Backup | | | |
| | FP-1 | 255 | Diesel Fire Pump Room | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 3.13<br>3.14 |
| 4.2 | FP-2 | 272 | Foam Room | Water hose station | Manual | Portable $CO_2$ | None | | 3.17<br>3.18 |
| 4.2 | SG-1 | 272 | Standby Gas Filter Room | Water Spray | Manual | Water hose station | Elec.HAD | 5 | 3.20<br>3.21 |
| 4.2 | AS-1 | 272 | Auxiliary Boiler Room | Wet Pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 3.23<br>3.24 |
| 4.2 | BR-1 | 272 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.26<br>3.27 |
| 4.2 | BR-2 | 272 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.29<br>3.30 |
| 4.2 | BR-3 | 272 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.32<br>3.33 |
| 4.2 | BR-4 | 272 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.35<br>3.36 |
| 4.2 | BR-5 | 272 | Battery Room Corridor | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.38<br>3.39 |
| 4.4 | BR-6 | 344 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.41<br>3.42 |
| 4.4 | BR-7 | 344 | Inverter Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.44<br>3.45 |
| 4.4 | BR-8 | 244 | Inverter Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.47<br>3.48 |
| 4.4 | BR-9 | 344 | Battery Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 3.50<br>3.51 |
| 4.2 | EG-1 | 272 | Emerg. Diesel Gen. Room | Preact. sprinkler | Elec.HAD/ fus. link | Portable $CO_2$ | Sprinkler alarm | | 3.53<br>3.54 |
| 4.2 | EG-2 | 272 | Emerg. Diesel Gen. Room | Preact. sprinkler | Elec.HAD/ fus. link | Portable $CO_2$ | Sprinkler alarm | | 3.56<br>3.57 |
| 4.2 | EG-3 | 272 | Emer. Diesel Gen. Room | Preact. sprinkler | Elec.HAD/ fus. link | Portable $CO_2$ | Sprinkler alarm | | 3.59<br>4.1 |
| 4.2 | EG-4 | 272 | Emer. Diesel Gen. Room | Preact. | Elec.HAD/ | Portable | Sprinkler | | 4.3 |

FIRE HAZARDS SHUTDOWN ANALYSIS SUMMARY SHEET (CONT'D)

| Fig. No. | Area or Zone Code | El. | Plant Area Identification | Type of Fire Suppression Primary | Actuation | Backup | Detection | Notes* | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | sprinkler | fus. link | $CO_2$ | alarm | | 4.4 |
| 4.2 | EG-5 | 272 | Emer. Gen. Switchgear Room | Total flood $CO_2$ | Elec.HAD/ manual | Water hose station | Area Ionization | | 4.6 4.7 |
| 4.2 | EG-6 | 272 | Emer. Gen. Switchgear Room | Total flood $CO_2$ | Elec.HAD/ manual | Water hose station | Area Ionization | | 4.9 4.10 |
| 4.1 | SP-1 | 255 | Service Water Pump Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 4.12 4.13 |
| 4.1 | SP-2 | 255 | Service Water Pump Room | Water hose station | Manual | Portable $CO_2$ | Area Ionization | | 4.15 4.16 |
| 4.1 | OR-1 | | Turbine Oil Room | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 4.18 4.19 |
| 4.2 | OR-2 | | Turbine Oil Room | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 4.21 4.22 |
| 4.2 | OR-3 | | Misc. Oil Storage Room | Wet pipe sprinkler | Fusible link | Water hose station | Sprinkler alarm | | 4.24 4.25 |
| 4.1 | SU-1 | 227 | Torus (Suppression Tank) | None | --- | None | | 4 | 4.27 4.28 |
| 4.1 | PC-1 | 242 | Primary Containment | Inert atmos. | None | Water hose station | None | 1 | 4.30 4.31 |

TABLE 2.0 (CONT.) 1.10

NOTES 1.12

GENERAL 1.15

A. All automatic water suppression systems annunciate locally and in the main 1.19
control room when activated.

B. Use of any water hose station will start main fire pump which is 1.20
annunciated in control room. 1.21

C. $CO_2$ can be released locally outside protected area, at control valve or 1.23
from control room. Any release is annunciated in coltrom room. Evacuation 1.25
warning alarm in protected area precedes release.

NOTES: 1.27

1. Primary containment is inerted with nitrogen to less than 4 percent oxygen 1.31
during operation.

2. The RCIC equipment is enclosed by a three (3) hour fire rated enclosure 1.33
with an automatic suppression system to prevent the spread of fire. 1.34

   The HPCI equipment is enclosed by a fire barrier with an automatic 1.36
   suppression system and a backup manual foam system. 1.37

3. A water suppression system is installed over the cable trays and MCC's 132, 1.40
142, 151, 161 located at the south end of the Reactor Building on elevation 1.41
272'-0".

4. Torus is inerted with nitrogen to less than 4 percent oxygen during 1.42
operation in the same manner as the drywell. 1.43

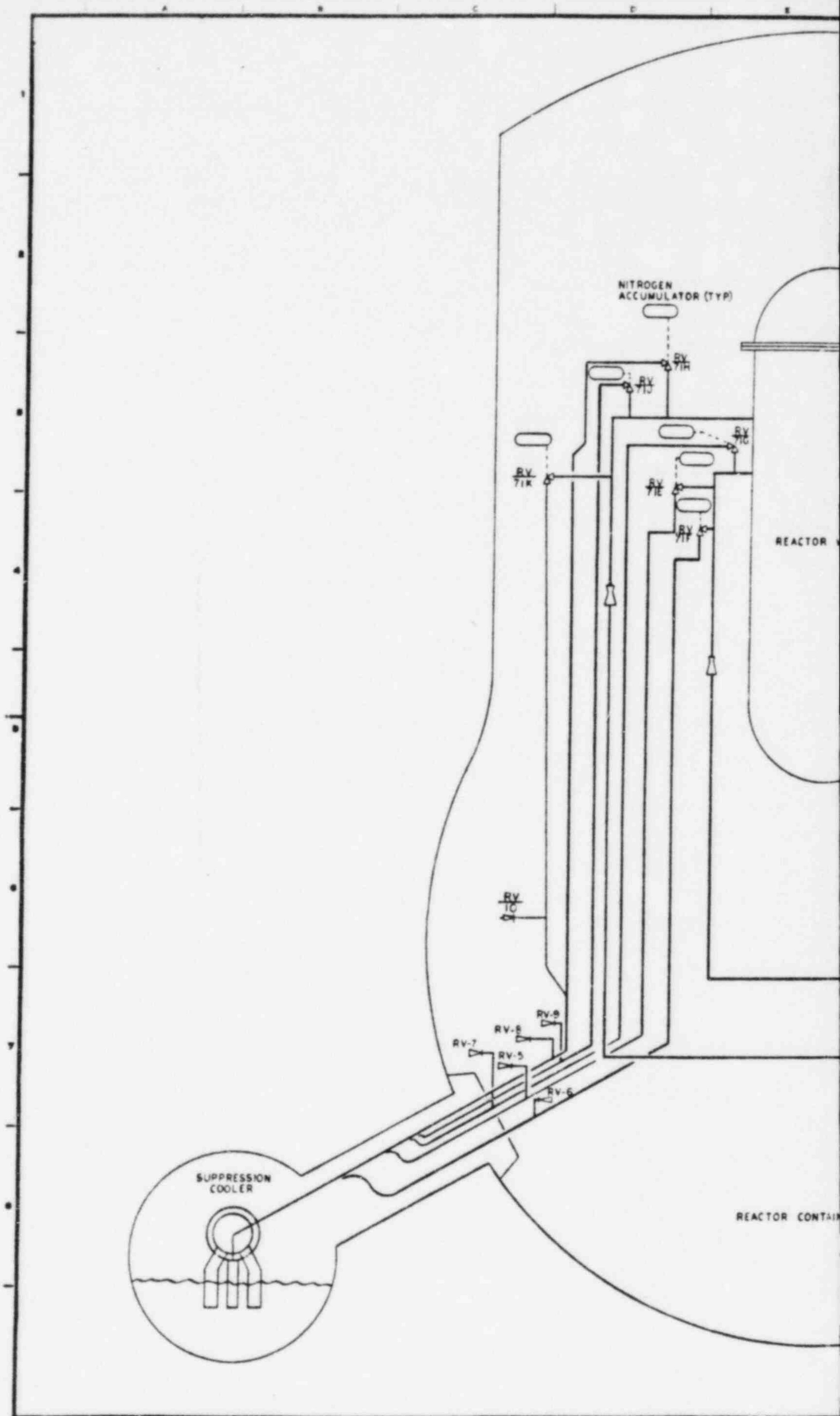
5. Water spray system is inside filter train having for suppression of 1.44
charcoal fire only. 1.45

6. Special window-type directional spray nozzles are located at each control 1.47
cable tray level (tier) and on 20-ft. centers along the cable trays with 1.48
spray direction along the longitudinal axis of the tray.

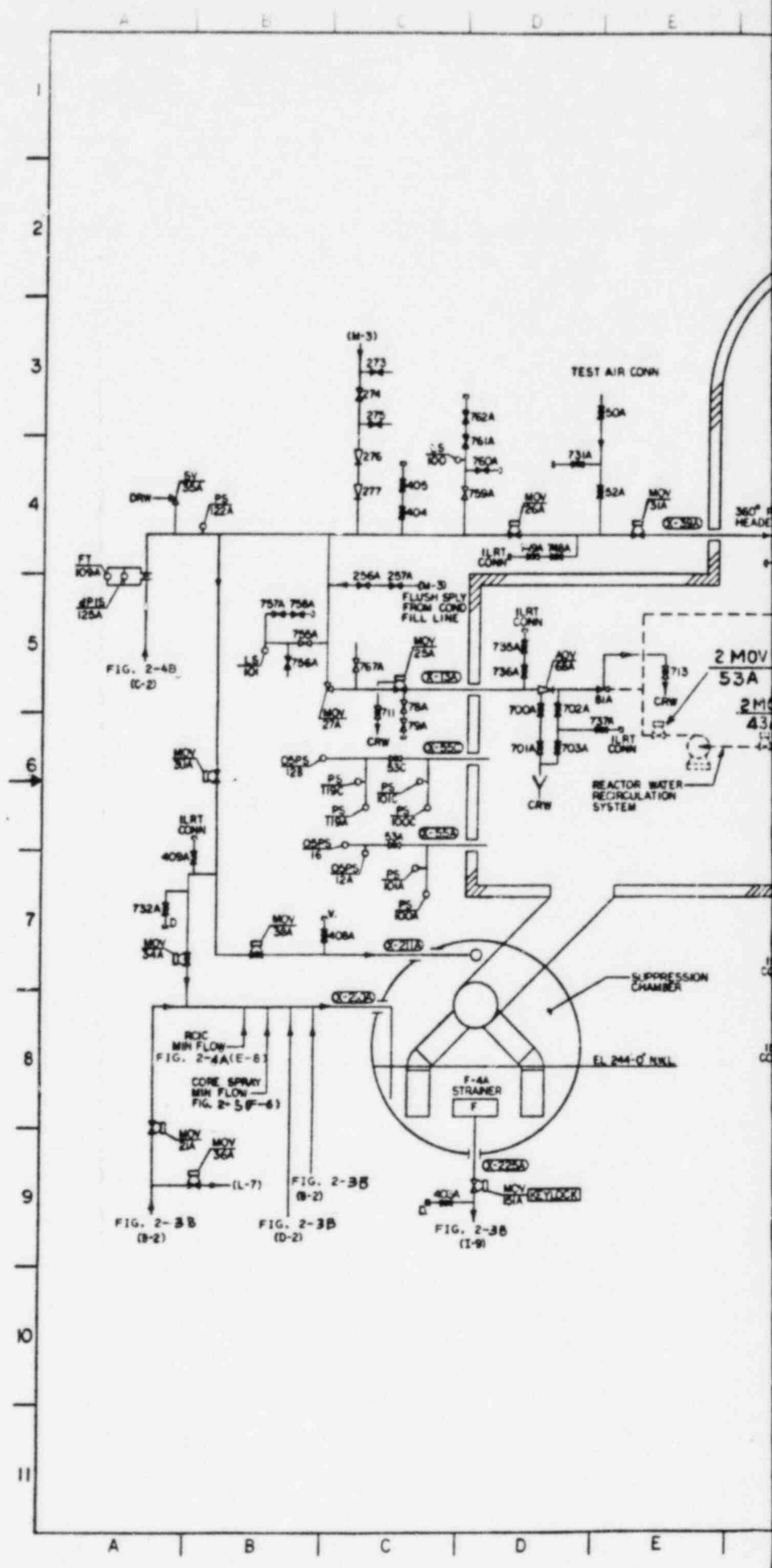
Table 2.0
Sheet 5 of 5
Appendix G

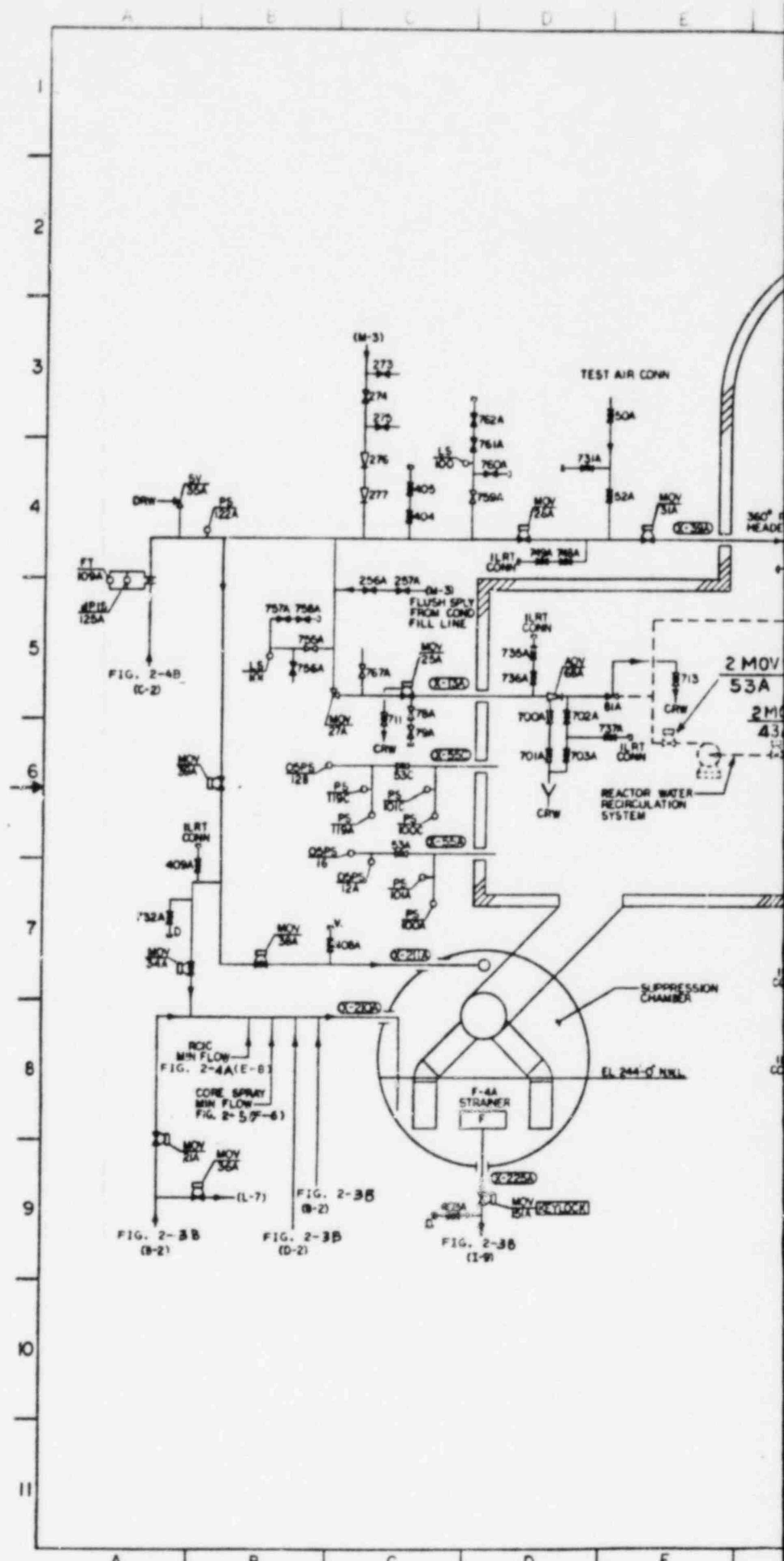
FIGURE 2 - 1

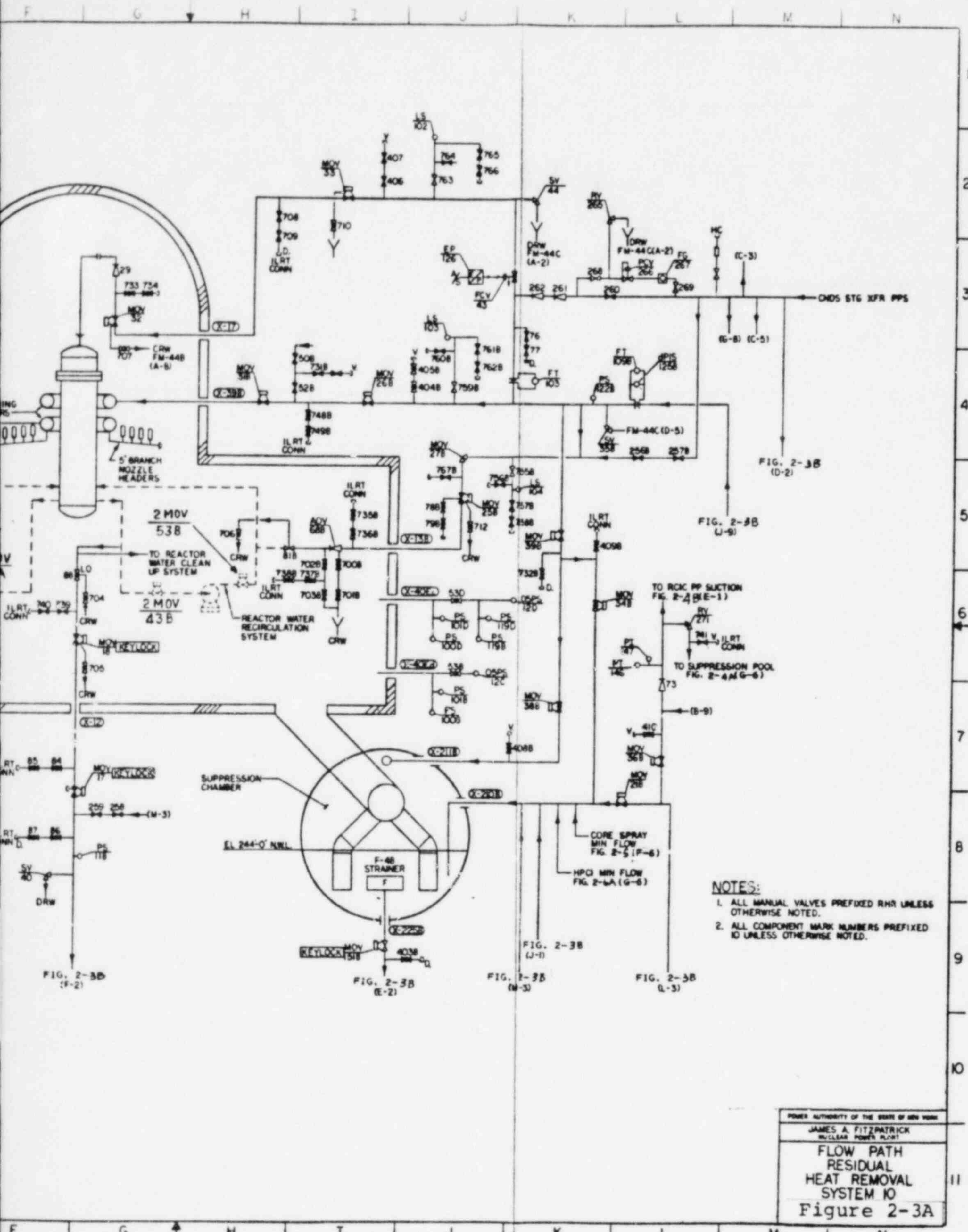
THIS PAGE INTENTIONALLY LEFT BLANK



NITROGEN ACCUMULATOR (TYP)
RV 71H
RV 71J
RV 71G
RV 71K
RV 71E
RV 71F
REACTOR
RV 1C
RV-9
RV-8
RV-7
RV-5
RV-6
SUPPRESSION COOLER
REACTOR CONTAI


TEST AIR CONN
(M-3)
FIG. 2-4B
(C-2)
FLUSH SPLY
FROM COND
FILL LINE
ILRT
CONN
2 MOV
53A
CRW
DRW
REACTOR WATER
RECIRCULATION
SYSTEM
SUPPRESSION
CHAMBER
RCIC
MIN FLOW
FIG. 2-4A(E-8)
CORE SPRAY
MIN FLOW
FIG. 2-5(F-6)
F-4A
STRAINER
KEYLOCK
FIG. 2-3B
(B-2)
FIG. 2-3B
(D-2)
FIG. 2-3B
(I-9)
(L-7)


TEST AIR CONN
360° HEADER
FLUSH SPLY FROM COND FILL LINE
ILRT CONN
2 MOV 53A
REACTOR WATER RECIRCULATION SYSTEM
SUPPRESSION CHAMBER
EL 244-0" NWL
F-4A STRAINER
RCIC MIN FLOW FIG. 2-4A (E-8)
CORE SPRAY MIN FLOW FIG. 2-5 (F-6)
FIG. 2-4B (C-2)
FIG. 2-3B (B-2)
FIG. 2-3B (D-2)
FIG. 2-3B (B-2)
FIG. 2-3B (I-9)
KEYLOCK
(L-7)
(M-3)
CRW
DRW



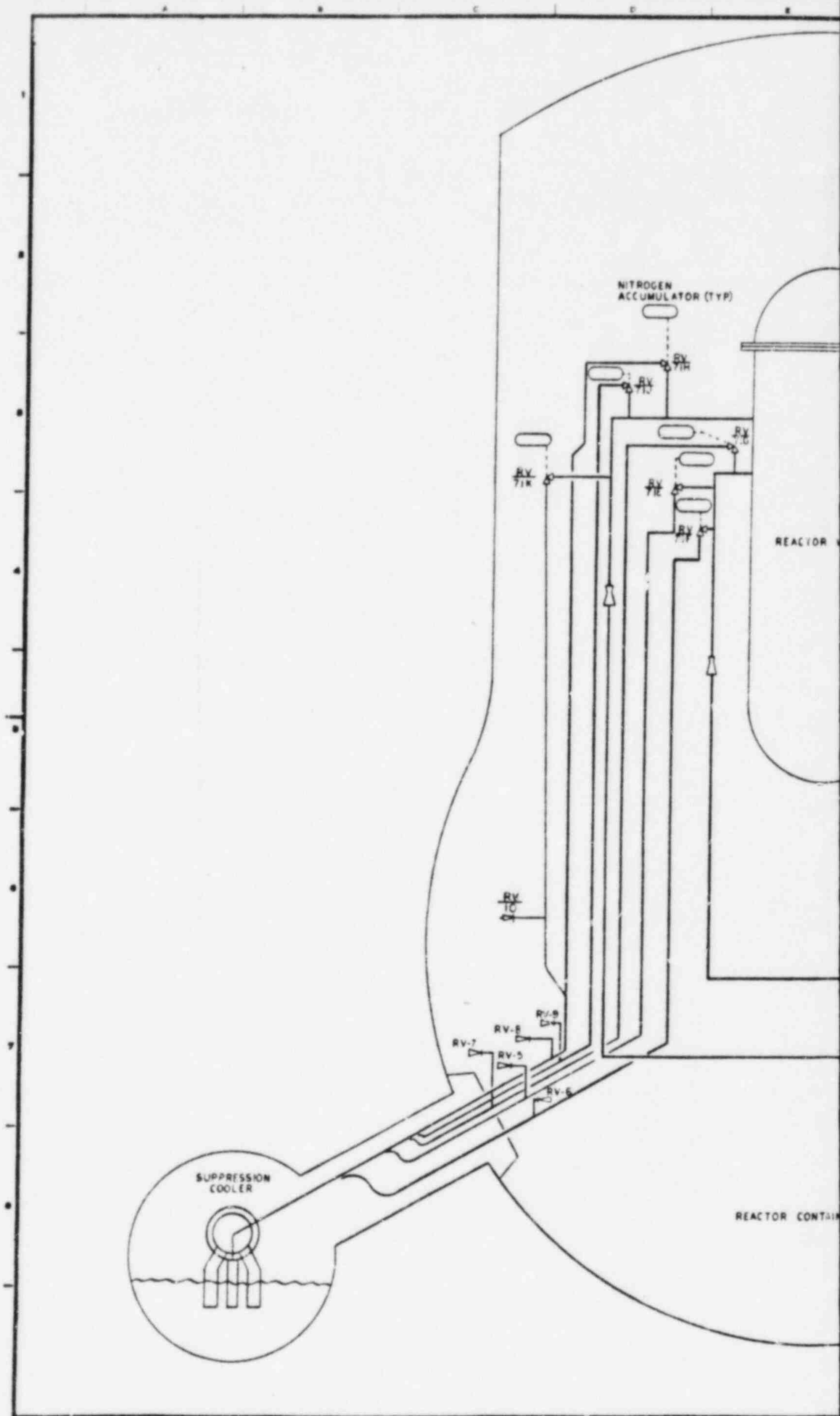

NOTES:

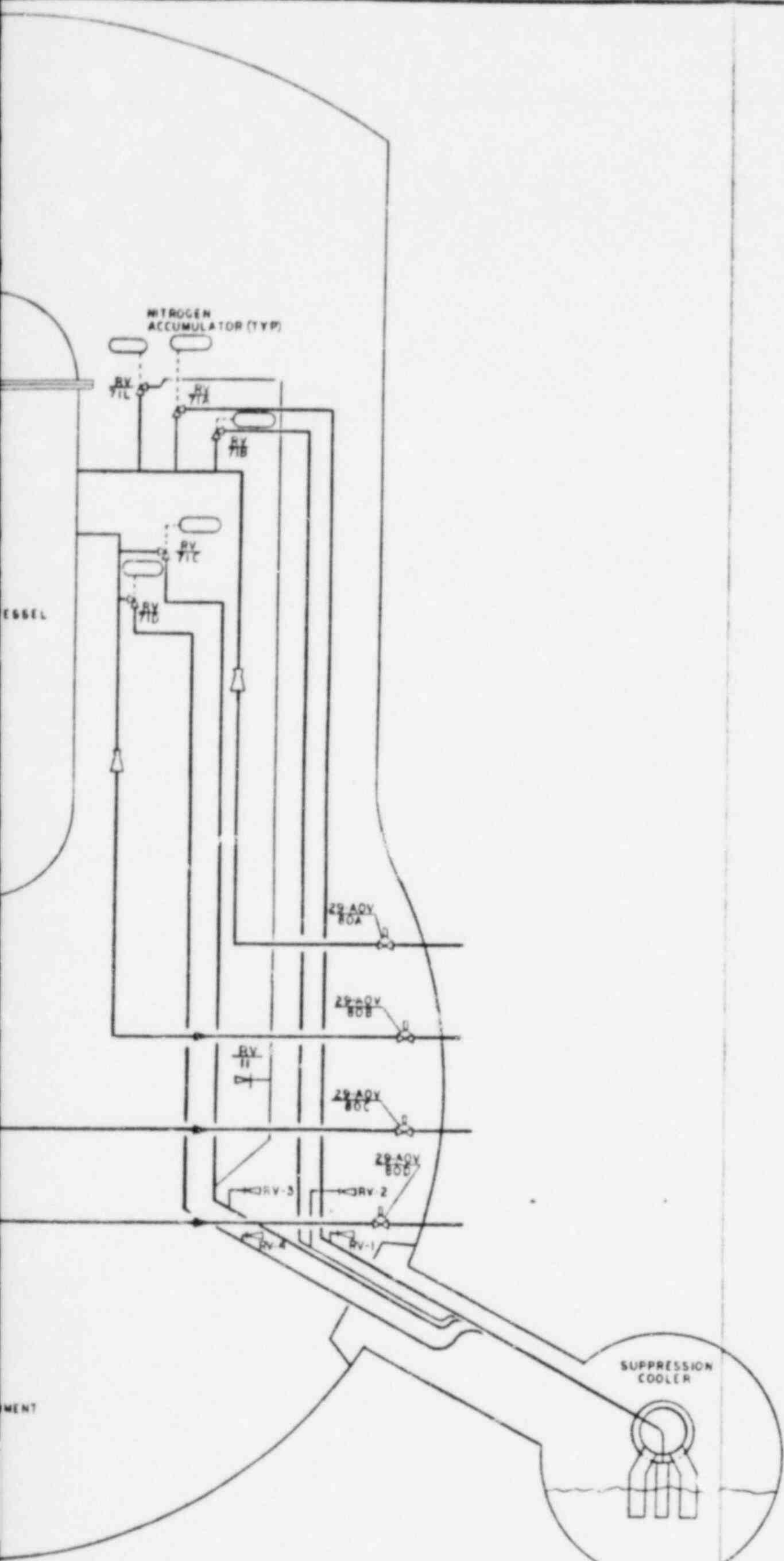
1. ALL MANUAL VALVES PREFIXED RHR UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 10 UNLESS OTHERWISE NOTED.

POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

FLOW PATH RESIDUAL HEAT REMOVAL SYSTEM 10

Figure 2-3A


NITROGEN ACCUMULATOR (TYP)
REACTOR
SUPPRESSION COOLER
REACTOR CONTAI
RV-7
RV-8
RV-9
RV-5
RV-6




POWER AUTHORITY OF THE STATE OF NEW YORK

**JAMES A. FITZPATRICK**

NUCLEAR POWER PLANT

AUTOMATIC DEPRESSURIZATION SYSTEM

Figure 2-2

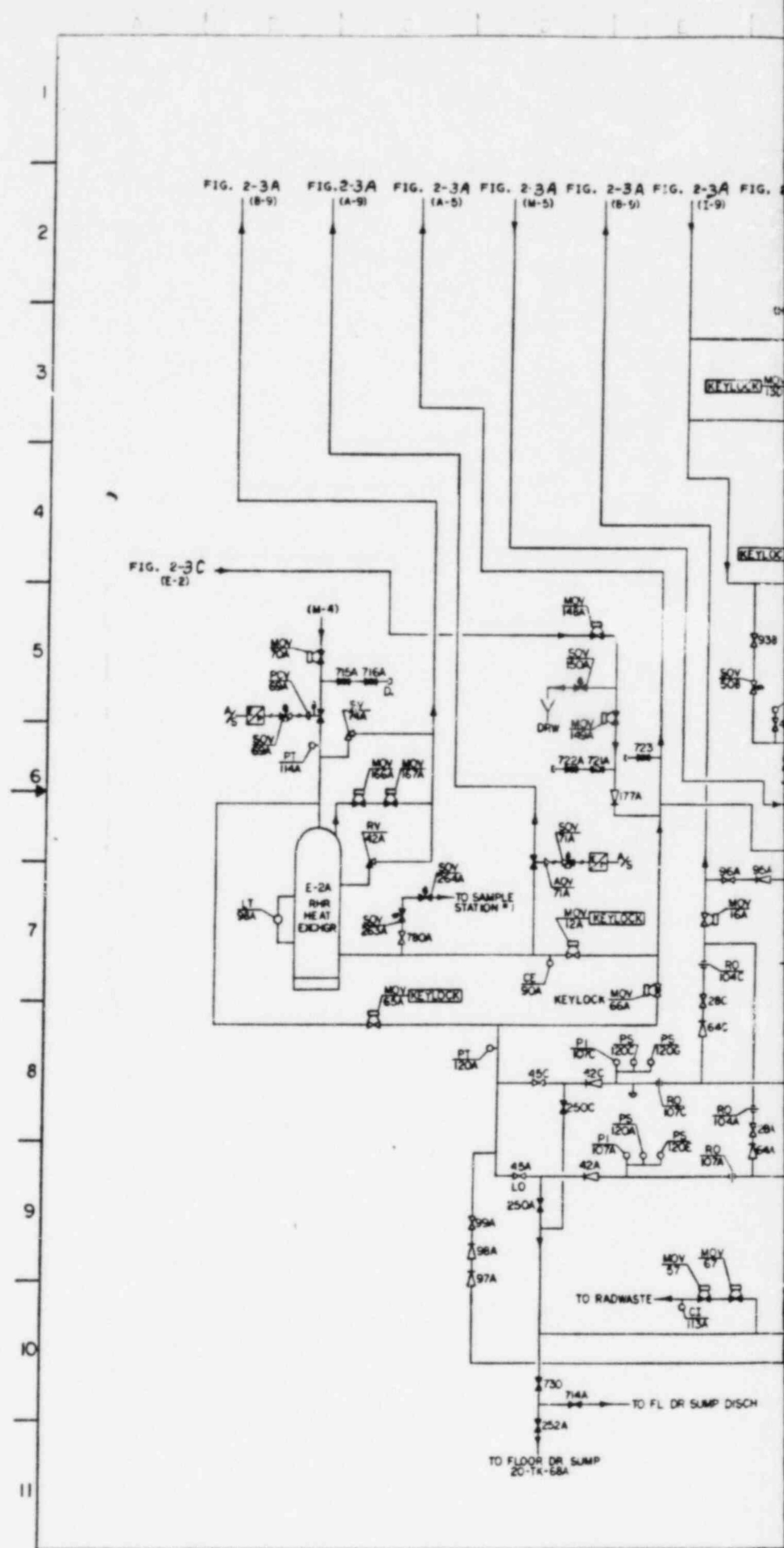
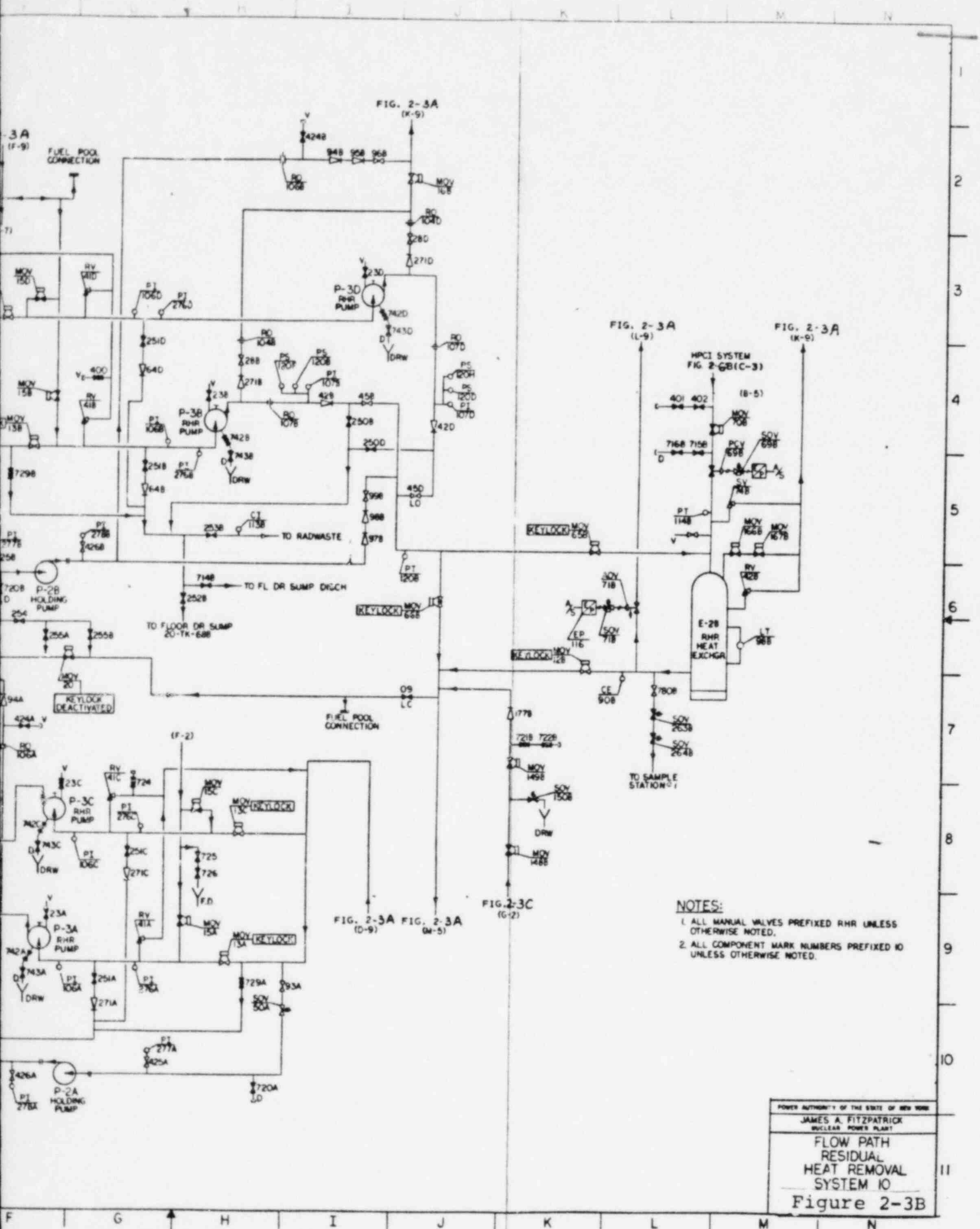


FIG. 2-3A (B-9)
FIG. 2-3A (A-9)
FIG. 2-3A (A-5)
FIG. 2-3A (M-5)
FIG. 2-3A (B-5)
FIG. 2-3A (I-9)
FIG. 2-3C (E-2)
(M-4)
KEYLOCK
E-2A RHR HEAT EXCHGR
TO SAMPLE STATION #1
DRW
TO RADWASTE
TO FL. DR SUMP DISCH
TO FLOOR DR. SUMP 20-TK-68A
A
B
C
D
E
1
2
3
4
5
6
7
8
9
10
11




NOTES:

1. ALL MANUAL VALVES PREFIXED RHR UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 10 UNLESS OTHERWISE NOTED.

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

FLOW PATH RESIDUAL HEAT REMOVAL SYSTEM 10

Figure 2-3B

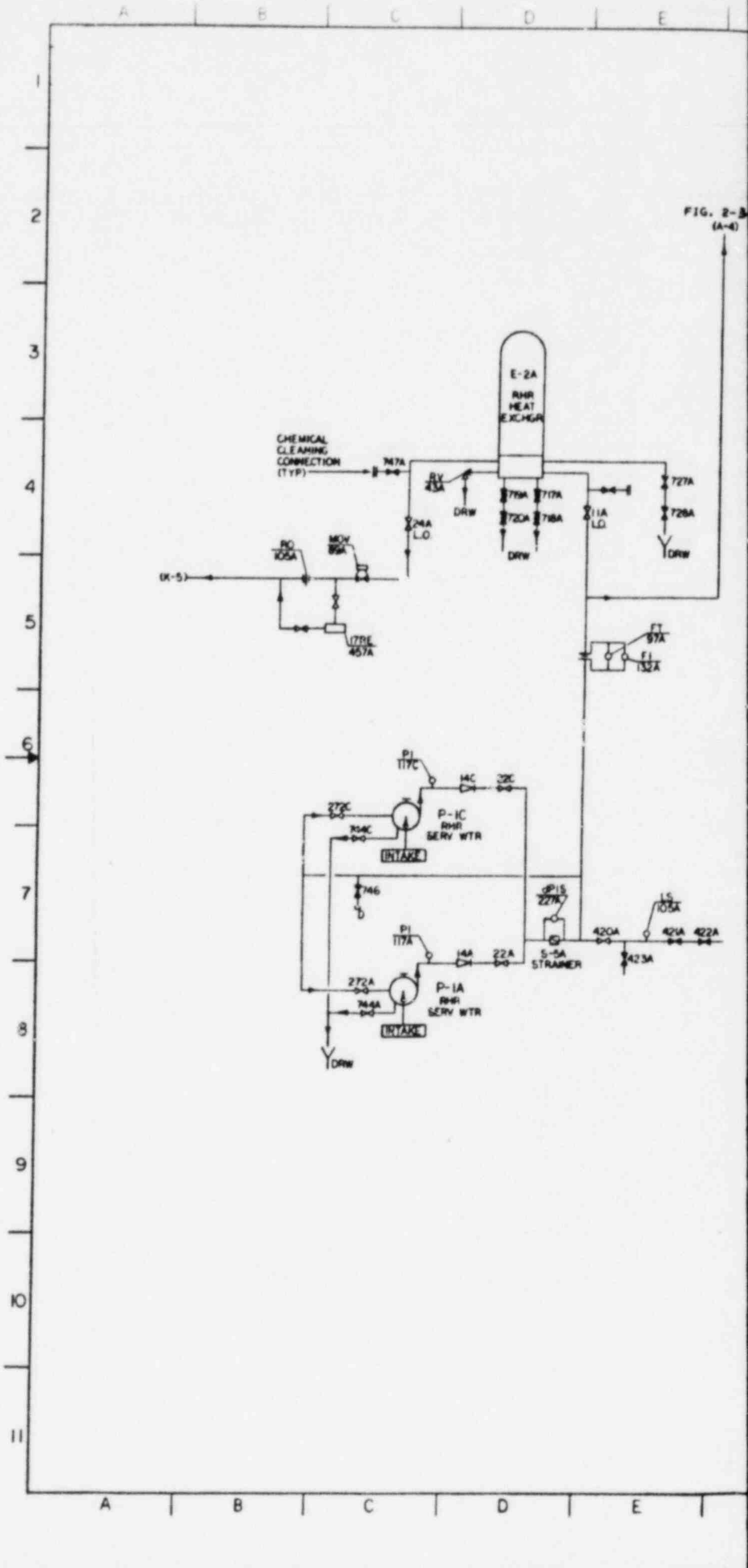
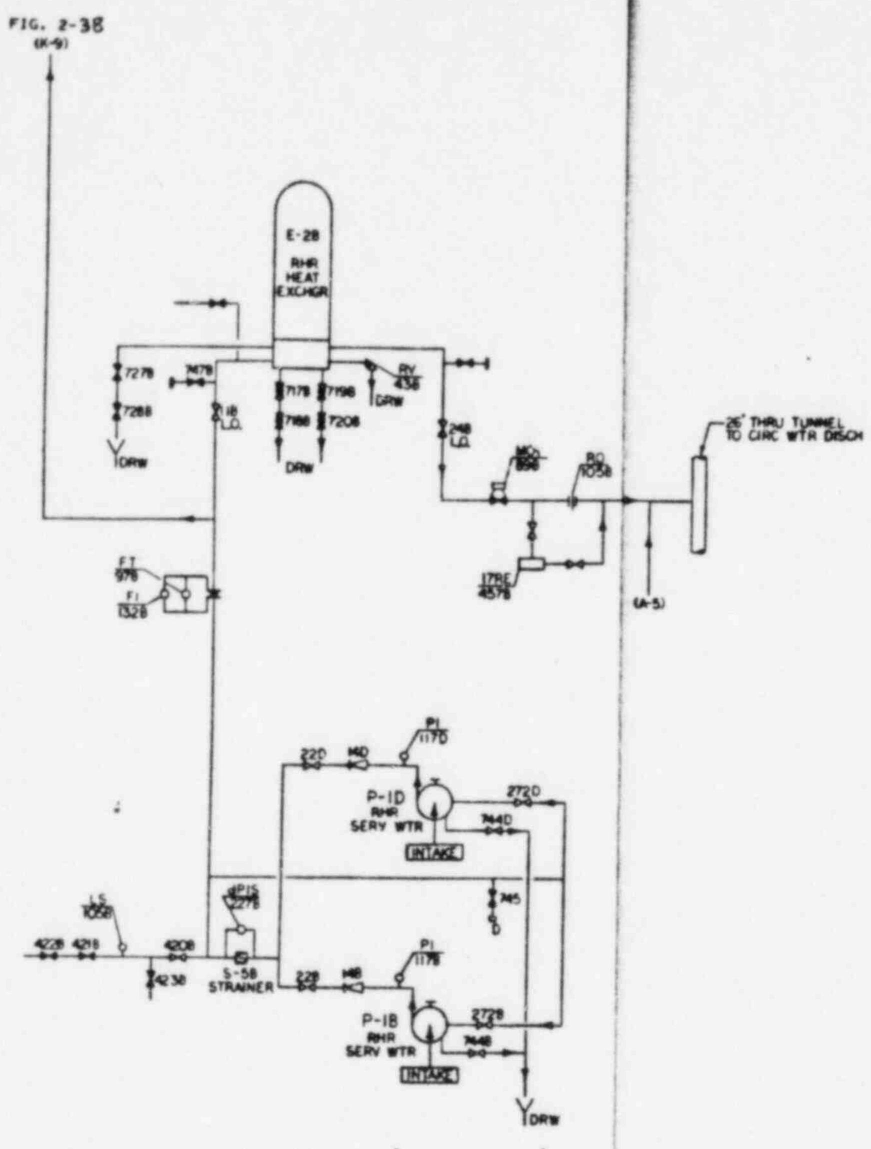


FIG. 2-3
(A-4)
E-2A
RHR
HEAT
EXCHGR
CHEMICAL
CLEANING
CONNECTION
(TYP)
747A
RV
43A
DRW
24A
L.O.
11A
L.O.
727A
728A
DRW
RO
105A
MOV
89A
(K-5)
ITRE
457A
FT
97A
FI
132A
PI
117C
14C
32C
272C
744C
P-1C
RHR
SERV WTR
INTAKE
746
D
dPIS
227A
PI
117A
14A
22A
S-5A
STRAINER
420A
LS
103A
421A
422A
423A
272A
744A
P-1A
RHR
SERV WTR
INTAKE
DRW
A
B
C
D
E
1
2
3
4
5
6
7
8
9
10
11




NOTES:

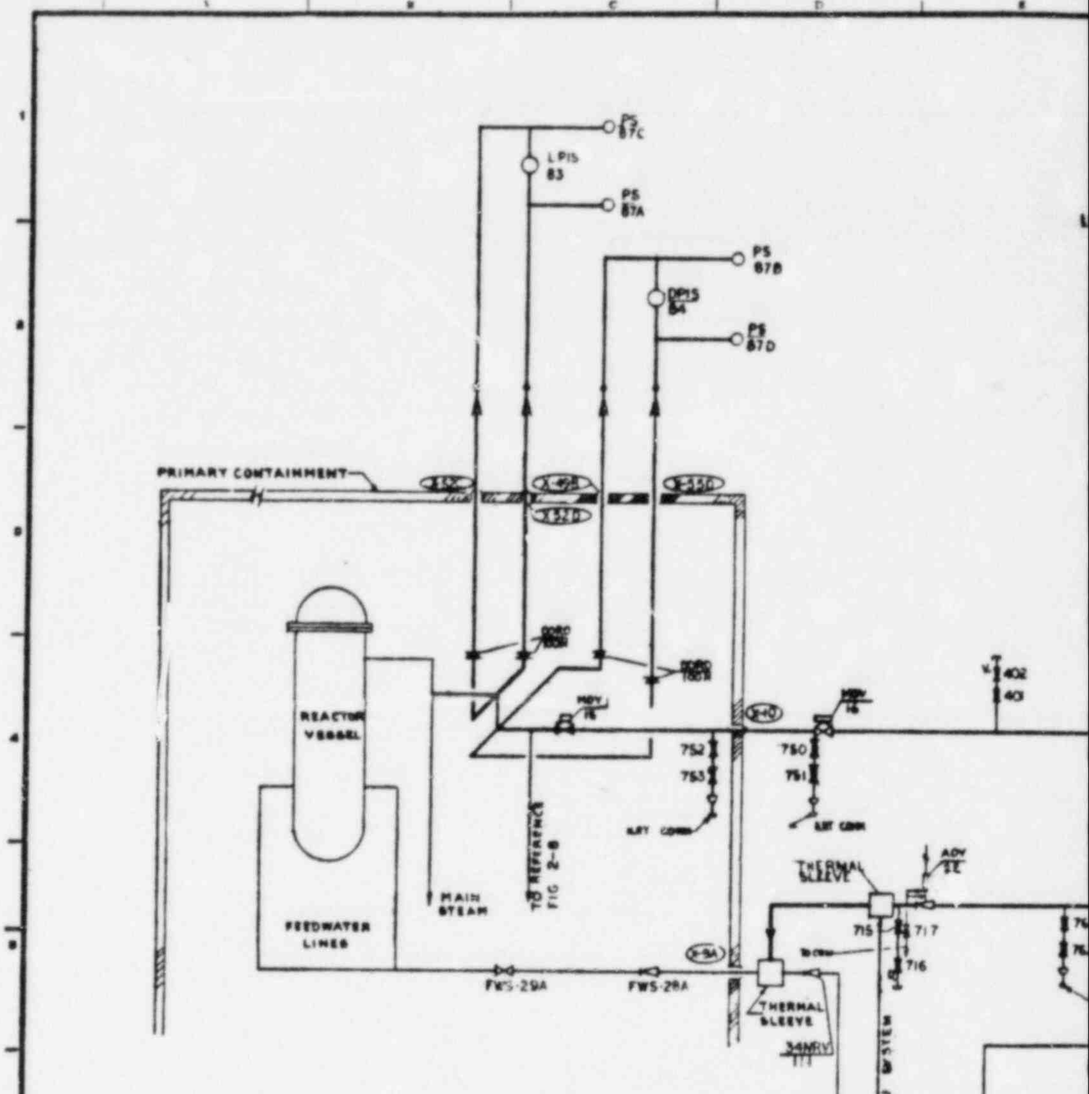
1. ALL MANUAL VALVES PREFIXED RHR UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 10 UNLESS OTHERWISE NOTED.

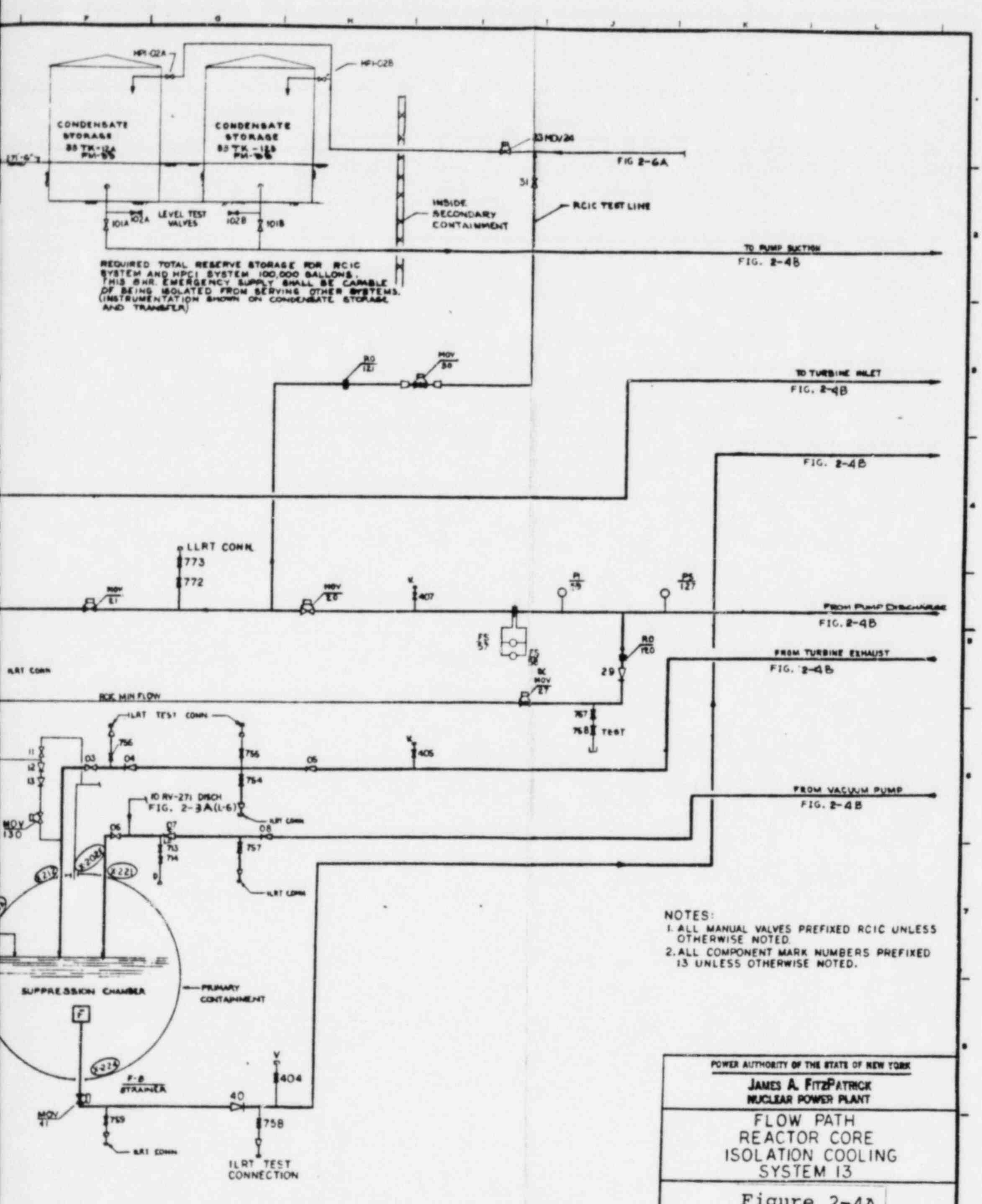
POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

FLOW PATH
RESIDUAL HEAT REMOVAL
SERVICE WATER
SYSTEM 10

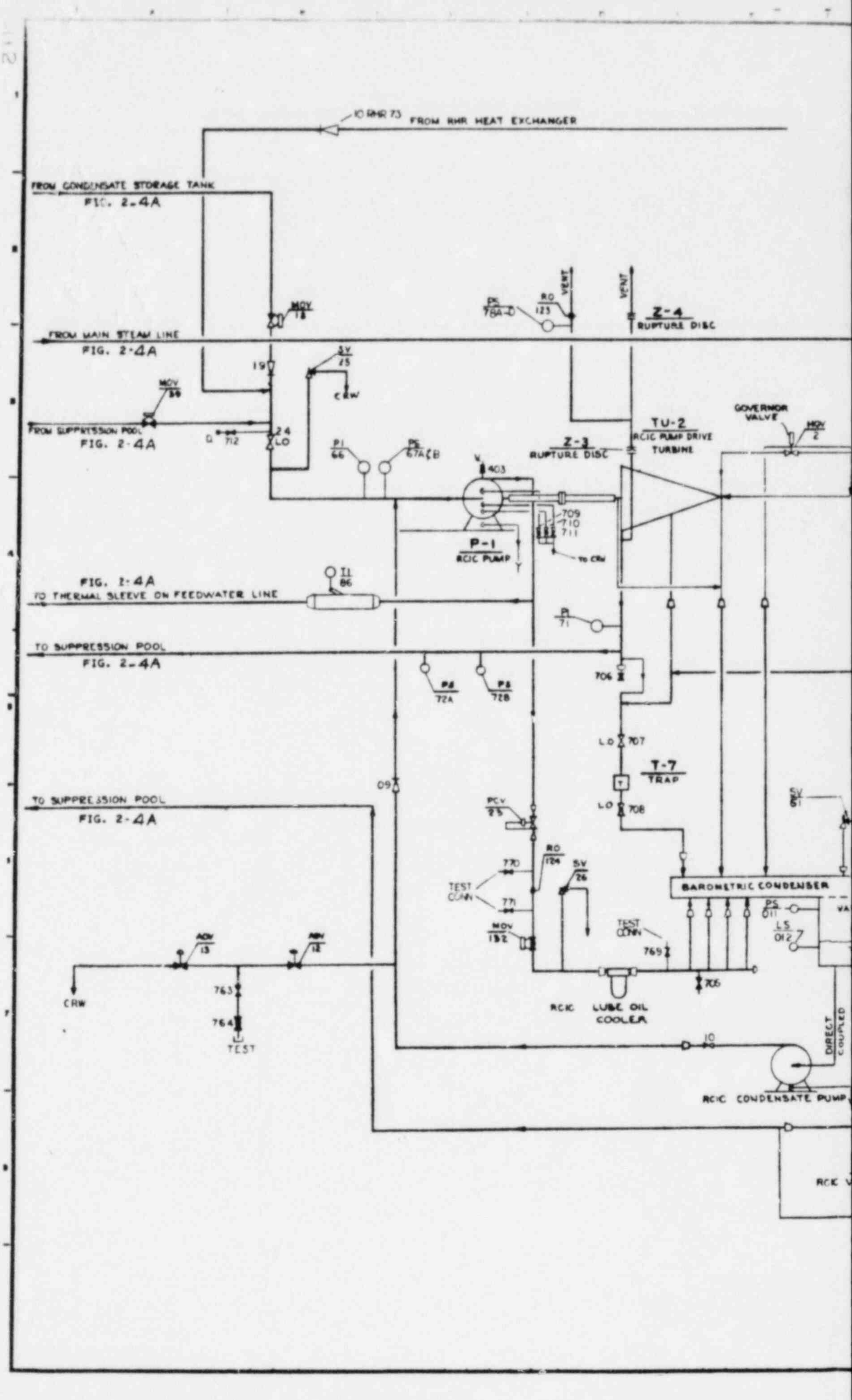
Figure 2-3C


PS 87C
LPIS 83
PS 87A
PS 87B
DPIS 84
PS 87D
PRIMARY CONTAINMENT
REACTOR VESSEL
FEEDWATER LINES
MAIN STEAM
TO REFERENCE FIG 2-8
402
401
752
753
750
751
THERMAL SLEEVE
715
717
716
FWS-29A
FWS-28A
THERMAL SLEEVE
FROM RWCU SYSTEM
760
ILRT
TEST CONN
EL. 244'-0"
RHR TEST LINE
FIG. 2-3A (B-8)

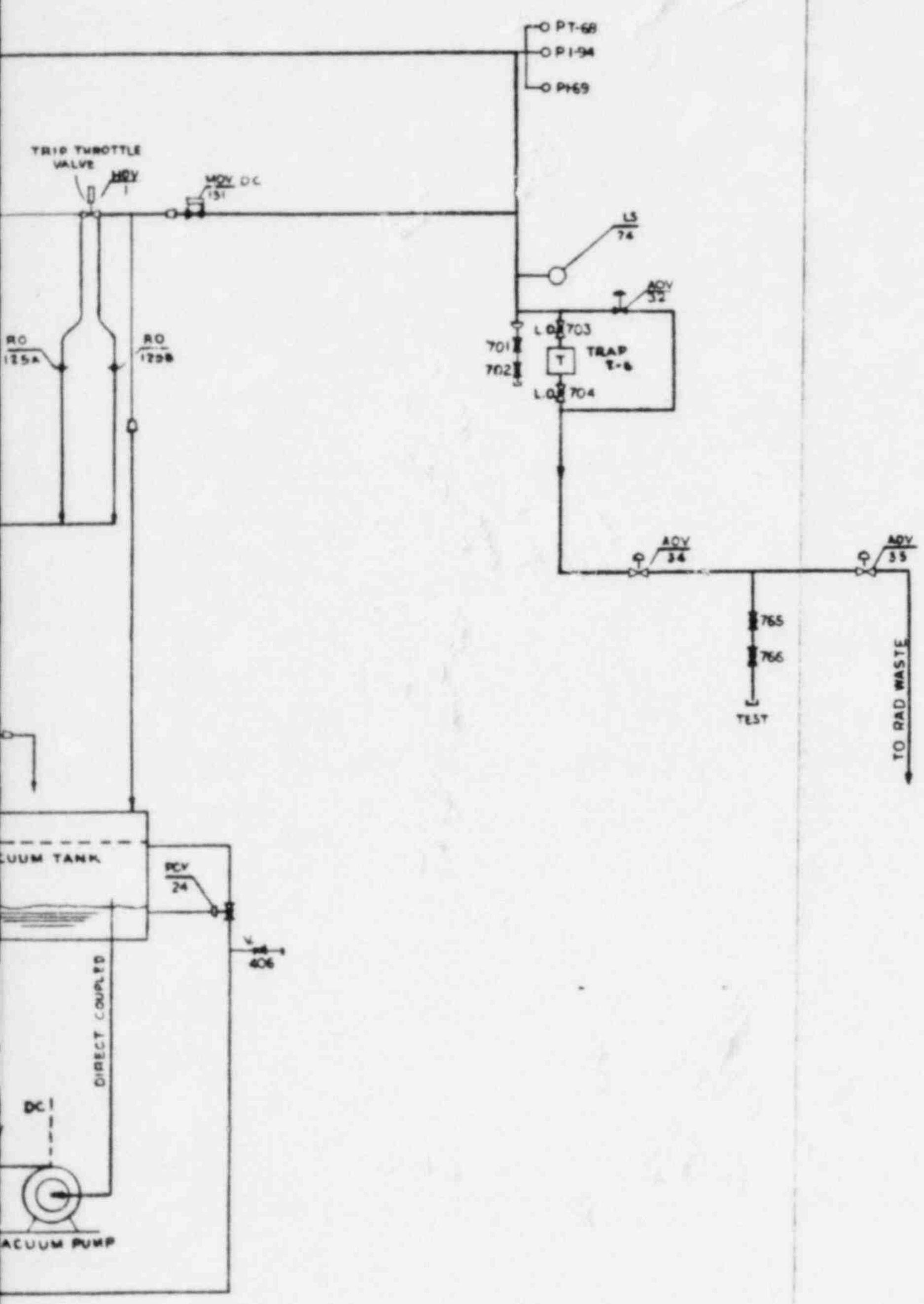



FLOW PATH
REACTOR CORE
ISOLATION COOLING
SYSTEM 13

Figure 2-4A



FROM RHR HEAT EXCHANGER
FROM CONDENSATE STORAGE TANK
FIG. 2-4A
FROM MAIN STEAM LINE
FIG. 2-4A
FROM SUPPRESSION POOL
FIG. 2-4A
Z-4
RUPTURE DISC
Z-3
RUPTURE DISC
TU-2
RCIC PUMP DRIVE TURBINE
GOVERNOR VALVE
P-1
RCIC PUMP
FIG. 2-4A
TO THERMAL SLEEVE ON FEEDWATER LINE
TO SUPPRESSION POOL
FIG. 2-4A
T-7
TRAP
TO SUPPRESSION POOL
FIG. 2-4A
BAROMETRIC CONDENSER
TEST CONN
RCIC LUBE OIL COOLER
CRW
TEST
RCIC CONDENSATE PUMP
DIRECT COUPLED



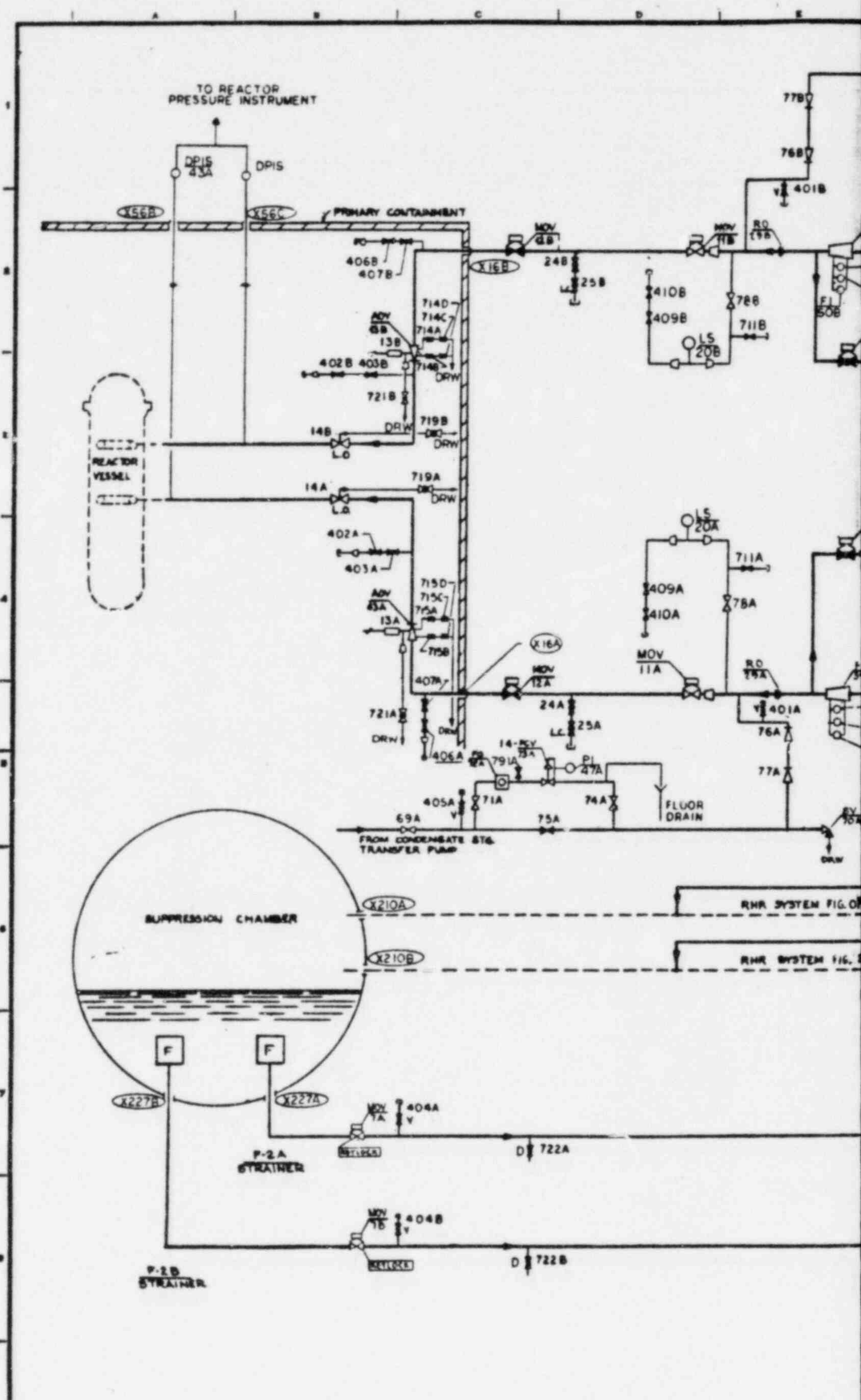

NOTE
ALL VALVE NUMBERS PREFIXED RCIC EXCEPT AS NOTED

POWER AUTHORITY OF THE STATE OF NEW YORK

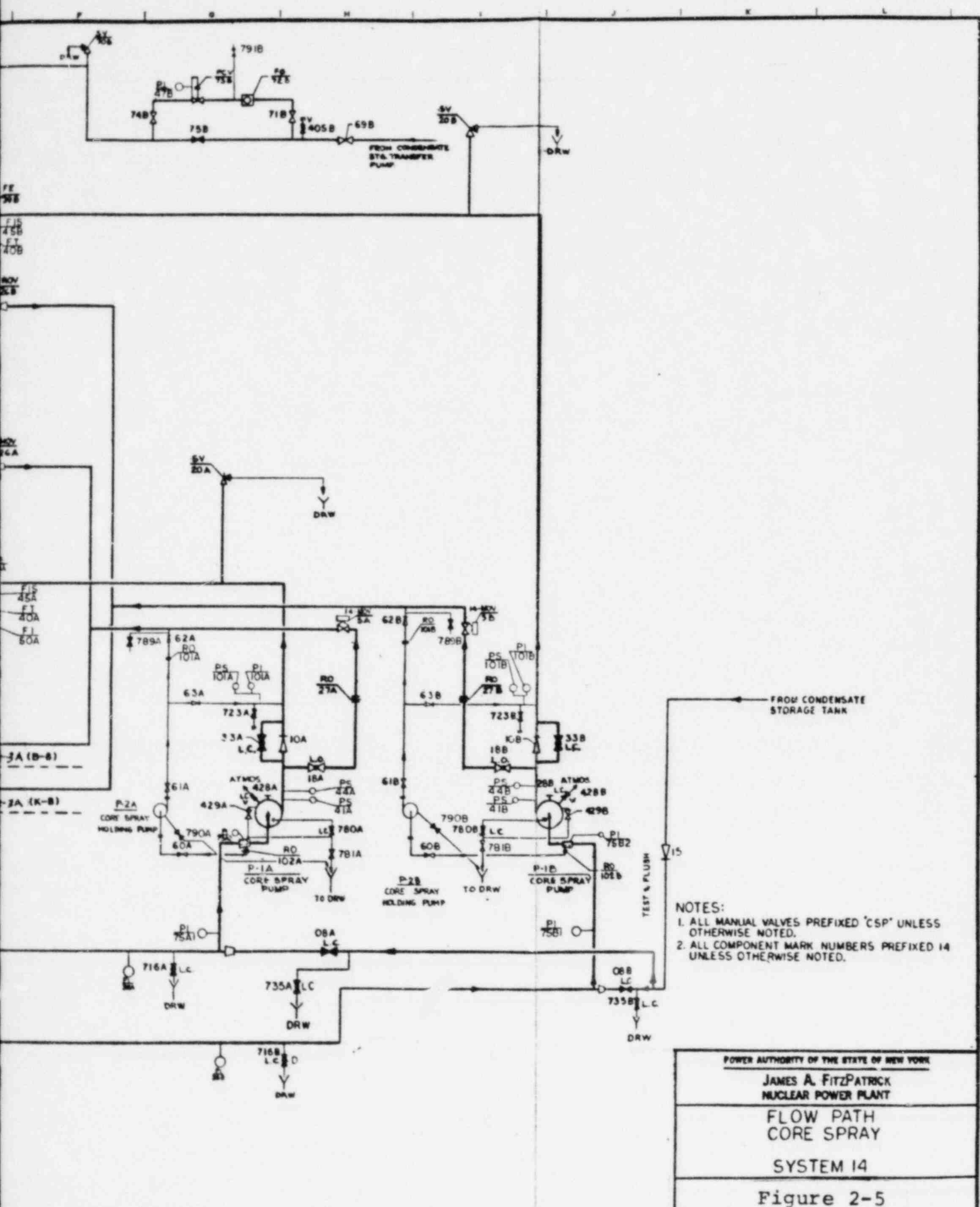
JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

FLOW PATH — REACTOR CORE ISOLATION COOLING SYSTEM NO 13 SHEET 2

Figure 2-4B

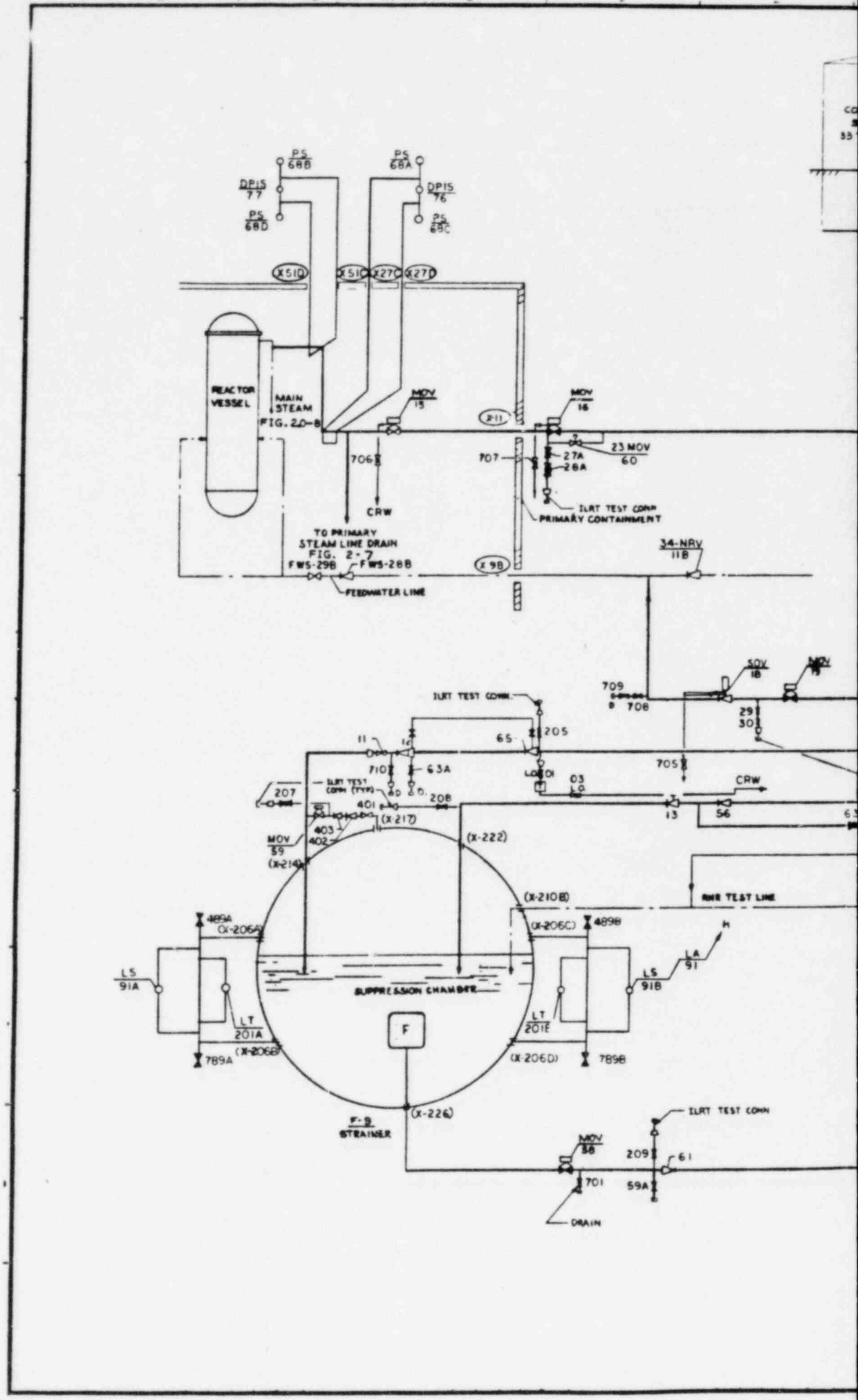


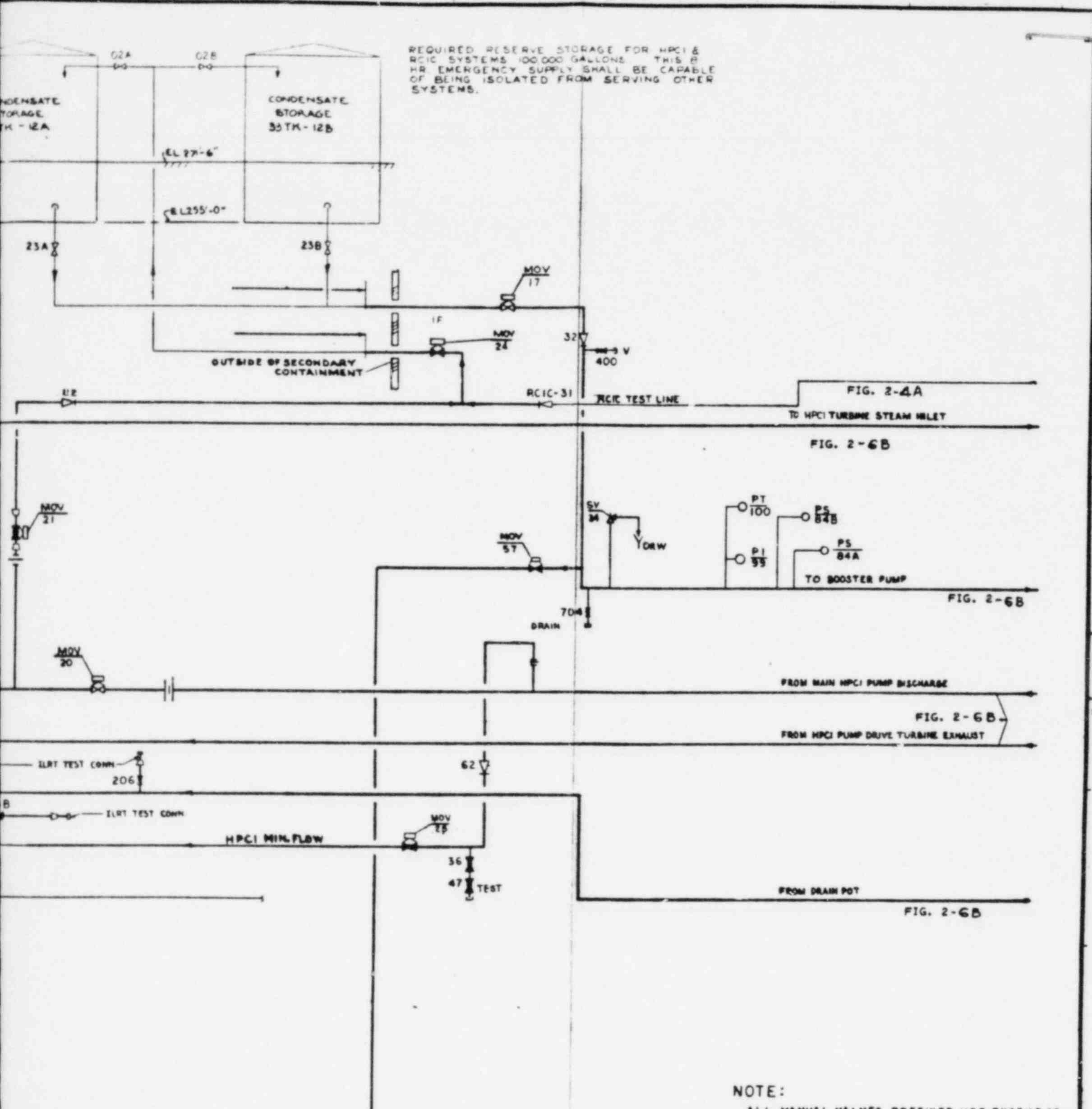
TO REACTOR PRESSURE INSTRUMENT
DPIS 43A
DPIS
X56B
X56C
PRIMARY CONTAINMENT
406B
407B
X16B
MOV 12B
MOV 11B
RO 19B
24B
25B
410B
409B
78B
711B
LS 20B
FI 50B
77B
76B
401B
AOV 13B
714D
714C
714A
714B
402B
403B
721B
DRW
14B
L.O.
719B
REACTOR VESSEL
14A
719A
402A
403A
AOV 13A
715D
715C
715A
715B
407A
X16A
MOV 12A
MOV 11A
RO 19A
LS 20A
711A
409A
410A
78A
24A
25A
401A
76A
77A
721A
406A
14-PSV 791A
PI 47A
71A
74A
FLOOR DRAIN
405A
69A
75A
FROM CONDENSATE STG. TRANSFER PUMP
SUPPRESSION CHAMBER
X210A
X210B
RHR SYSTEM FIG.
F
X227B
X227A
MOV 7A
404A
722A
P-2A STRAINER
MOV 7B
404B
722B
P-2B STRAINER



FROM CONDENSATE STG. TRANSFER PUMP
DRW
FROM CONDENSATE STORAGE TANK
P-2A CORE SPRAY HOLDING PUMP
P-1A CORE SPRAY PUMP
P-2B CORE SPRAY HOLDING PUMP
P-1B CORE SPRAY PUMP
TO DRW
TEST & FLUSH
ATMOS
NOTES:
1. ALL MANUAL VALVES PREFIXED 'CSP' UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 14 UNLESS OTHERWISE NOTED.
POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
FLOW PATH CORE SPRAY
SYSTEM 14


Figure 2-5


PS 68B
PS 68A
DPIS 77
DPIS 76
PS 68D
PS 68C
X51D
X51C
X27C
X27D
REACTOR VESSEL
MAIN STEAM
FIG. 2.0-8
MOV 15
MOV 16
X-11
23 MOV 60
27A
28A
706
707
CRW
ILRT TEST CONN
PRIMARY CONTAINMENT
TO PRIMARY STEAM LINE DRAIN FIG. 2-7
FWS-29B
FWS-28B
FEEDWATER LINE
X 9B
34-NRV 11B
SOV 18
709
708
29
30
ILRT TEST CONN
11
205
65
710
63A
705
LO
01
03
CRW
207
ILRT TEST CONN (TYP)
208
401
403
402
(X-217)
13
56
MOV 39
(X-214)
(X-222)
(X-210B)
RHR TEST LINE
489A
(X-206A)
(X-206C)
489B
LS 91A
LS 91B
LA 91
SUPPRESSION CHAMBER
LT 201A
LT 201E
(X-206B)
(X-206D)
789A
789B
F
F-9 STRAINER
(X-226)
ILRT TEST CONN
MOV 38
209
61
701
59A
DRAIN

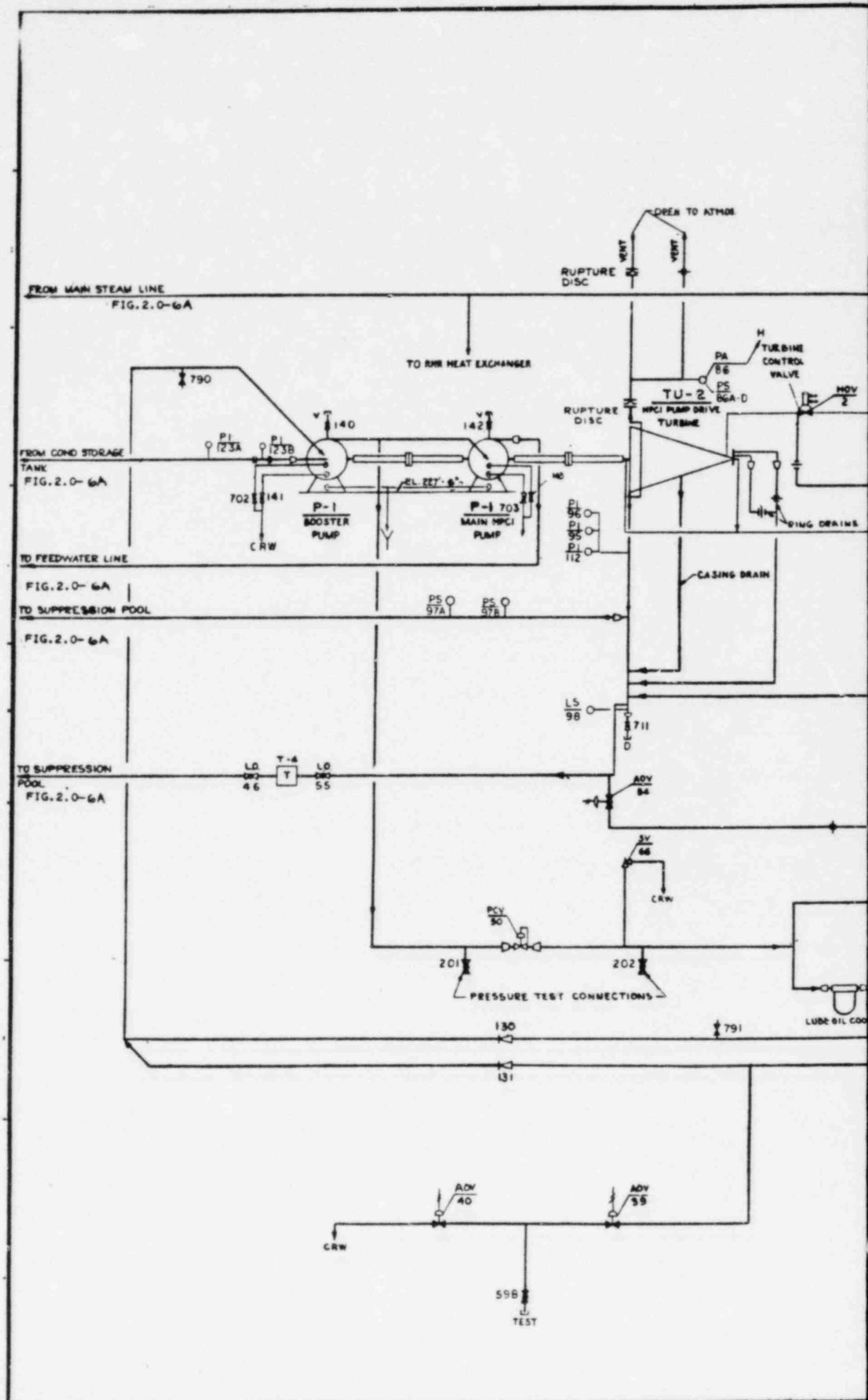



POWER AUTHORITY OF THE STATE OF NEW YORK

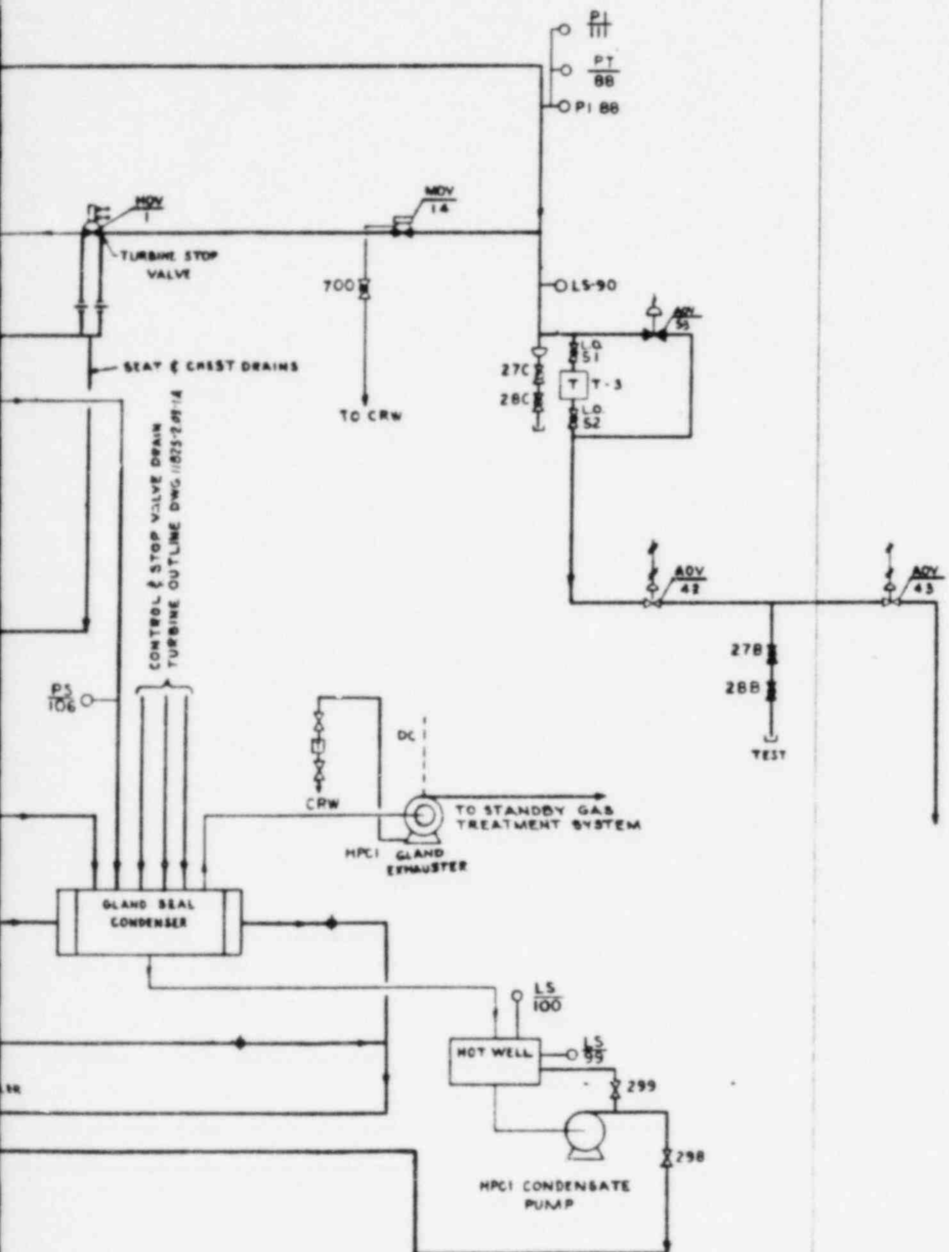
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

FLOW PATH - H.P. COOLANT INJECTION - SYS. NO. 23 - SH. 1

Figure 2-6A



OPEN TO ATMOS
VENT
VENT
RUPTURE DISC
FROM MAIN STEAM LINE
FIG. 2.0-6A
TO RHR HEAT EXCHANGER
790
PA 86
PS 86A-D
TURBINE CONTROL VALVE
MOV 2
TU-2
HPCI PUMP DRIVE TURBINE
RUPTURE DISC
140
142
FROM COND STORAGE TANK
FIG. 2.0-6A
PI 123A
PI 123B
702
141
EL. 227' 6"
703
P-1
BOOSTER PUMP
P-1
MAIN HPCI PUMP
CRW
PI 96
PI 95
PI 112
RING DRAINS
TO FEEDWATER LINE
FIG. 2.0-6A
CASING DRAIN
TO SUPPRESSION POOL
FIG. 2.0-6A
PS 97A
PS 97B
LS 98
711
D
TO SUPPRESSION POOL
FIG. 2.0-6A
LO 46
T-4
T
LO 55
AOV 54
SV 66
CRW
PCV 50
201
202
PRESSURE TEST CONNECTIONS
LUBE OIL COO
130
791
131
AOV 40
AOV 55
CRW
598
TEST



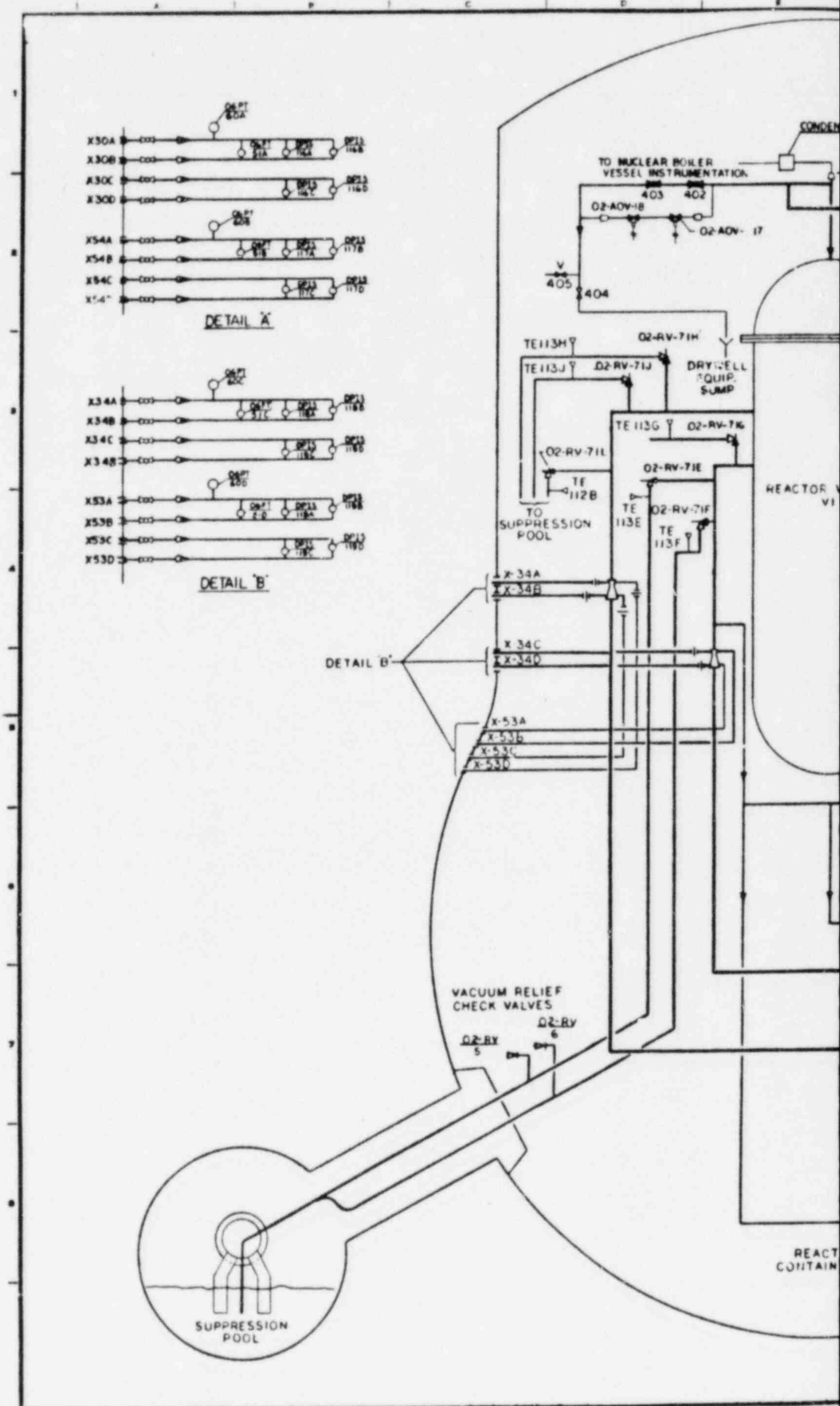

NOTE:
ALL MANUAL VALVES PREFIXED HPI EXCEPT AS NOTED.

POWER AUTHORITY OF THE STATE OF NEW YORK

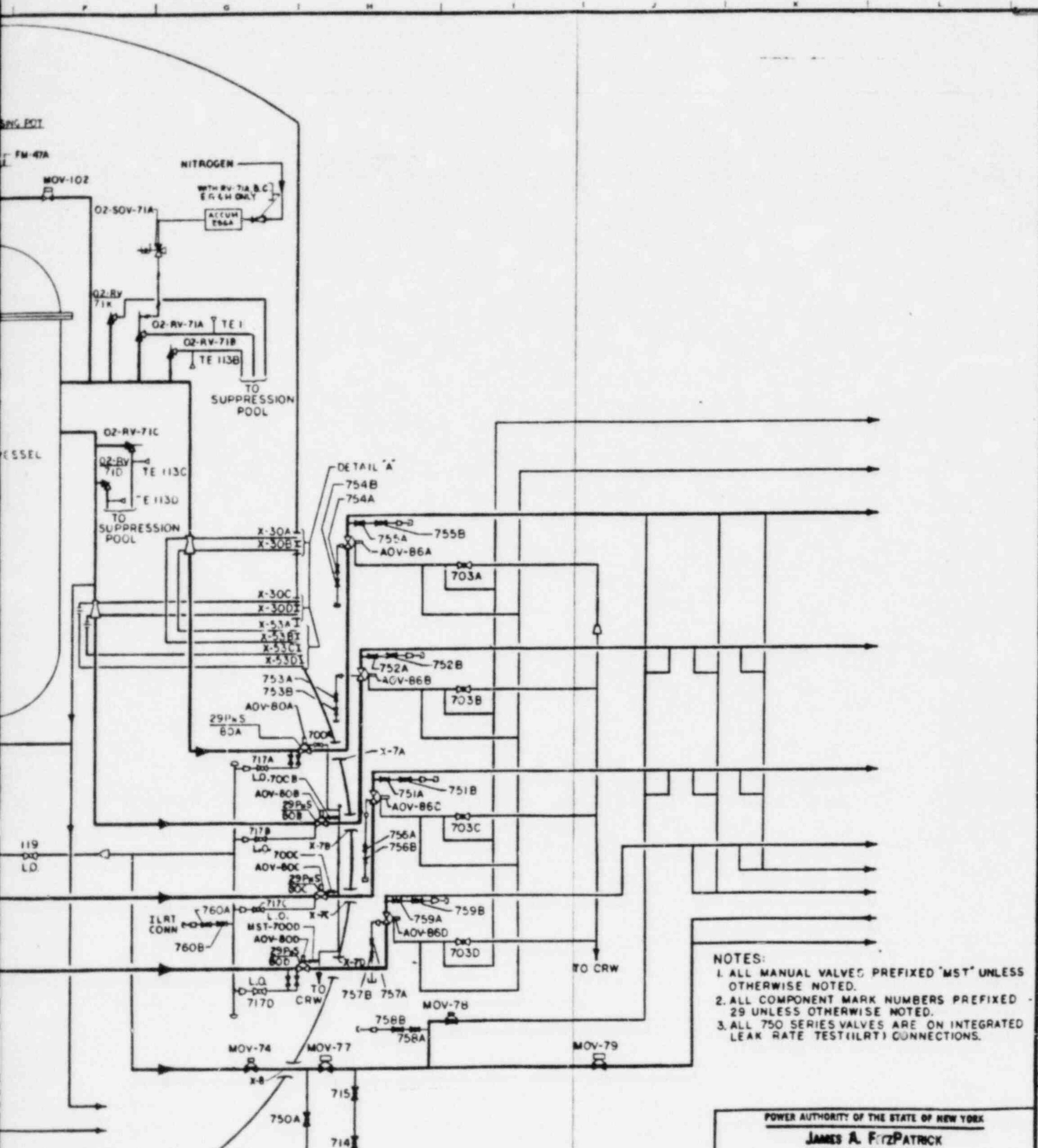
JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

FLOW DIAG - H.P. COOLANT
INJECTION - SYS. NO. 23 - SH. 2

Figure 2-6B



DETAIL 'A'
DETAIL 'B'
X30A
X30B
X30C
X30D
X54A
X54B
X54C
X34A
X34B
X34C
X53A
X53B
X53C
X53D
CONDEN
TO NUCLEAR BOILER VESSEL INSTRUMENTATION
403
402
02-AOV-18
02-AOV-17
405
404
TE113H
TE113J
02-RV-71H
02-RV-71J
DRYWELL EQUIP. SUMP
TE 113G
02-RV-71G
02-RV-71L
TE 112B
02-RV-71E
TE 113E
02-RV-71F
TE 113F
TO SUPPRESSION POOL
REACTOR V
X-34A
X-34B
X-34C
X-34D
DETAIL 'B'
X-53A
X-53B
X-53C
X-53D
VACUUM RELIEF CHECK VALVES
02-RV 5
02-RV 6
SUPPRESSION POOL
REACT CONTAIN




NOTES:

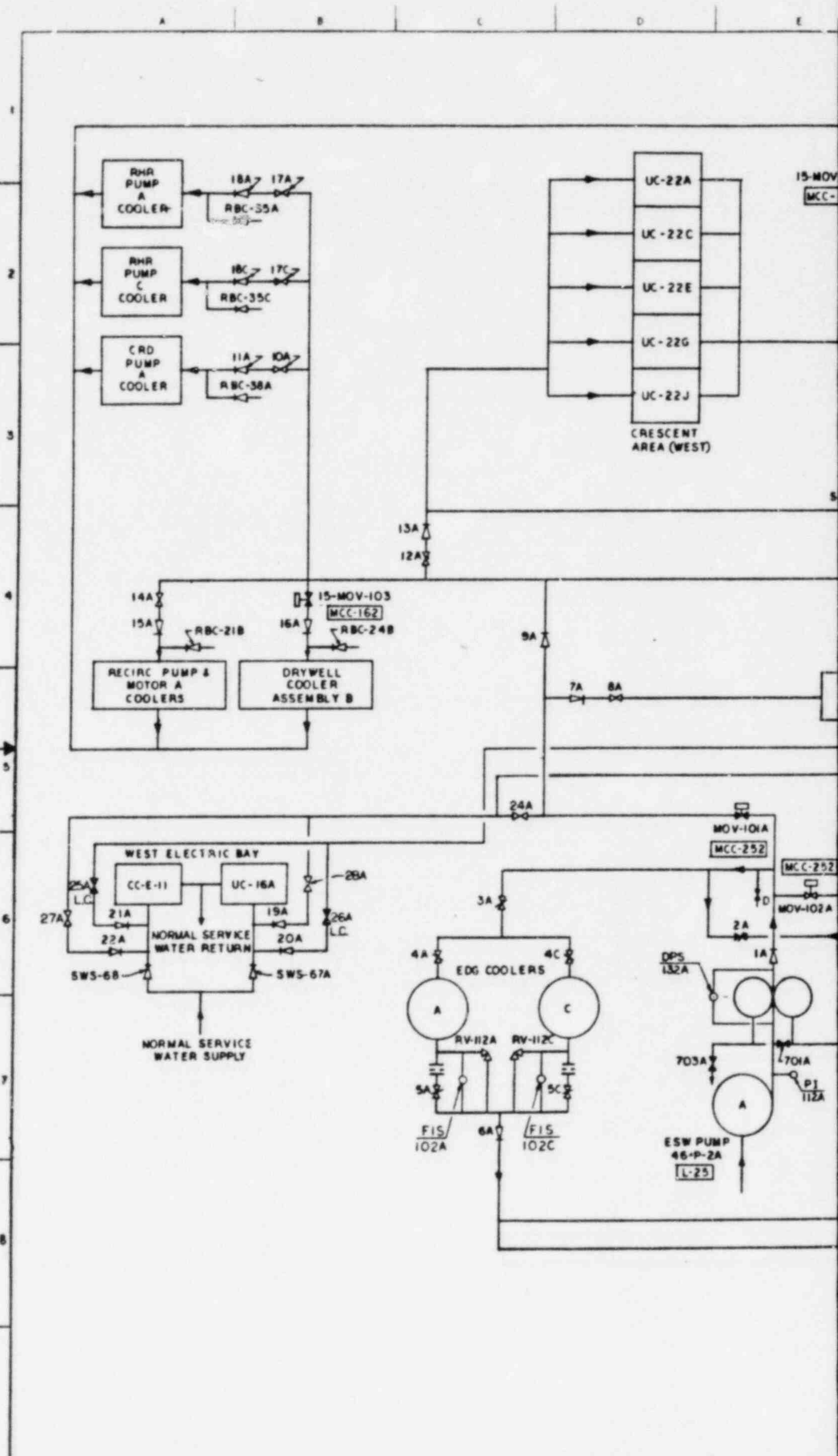
1. ALL MANUAL VALVES PREFIXED "MST" UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 29 UNLESS OTHERWISE NOTED.
3. ALL 750 SERIES VALVES ARE ON INTEGRATED LEAK RATE TEST (ILRT) CONNECTIONS.

POWER AUTHORITY OF THE STATE OF NEW YORK

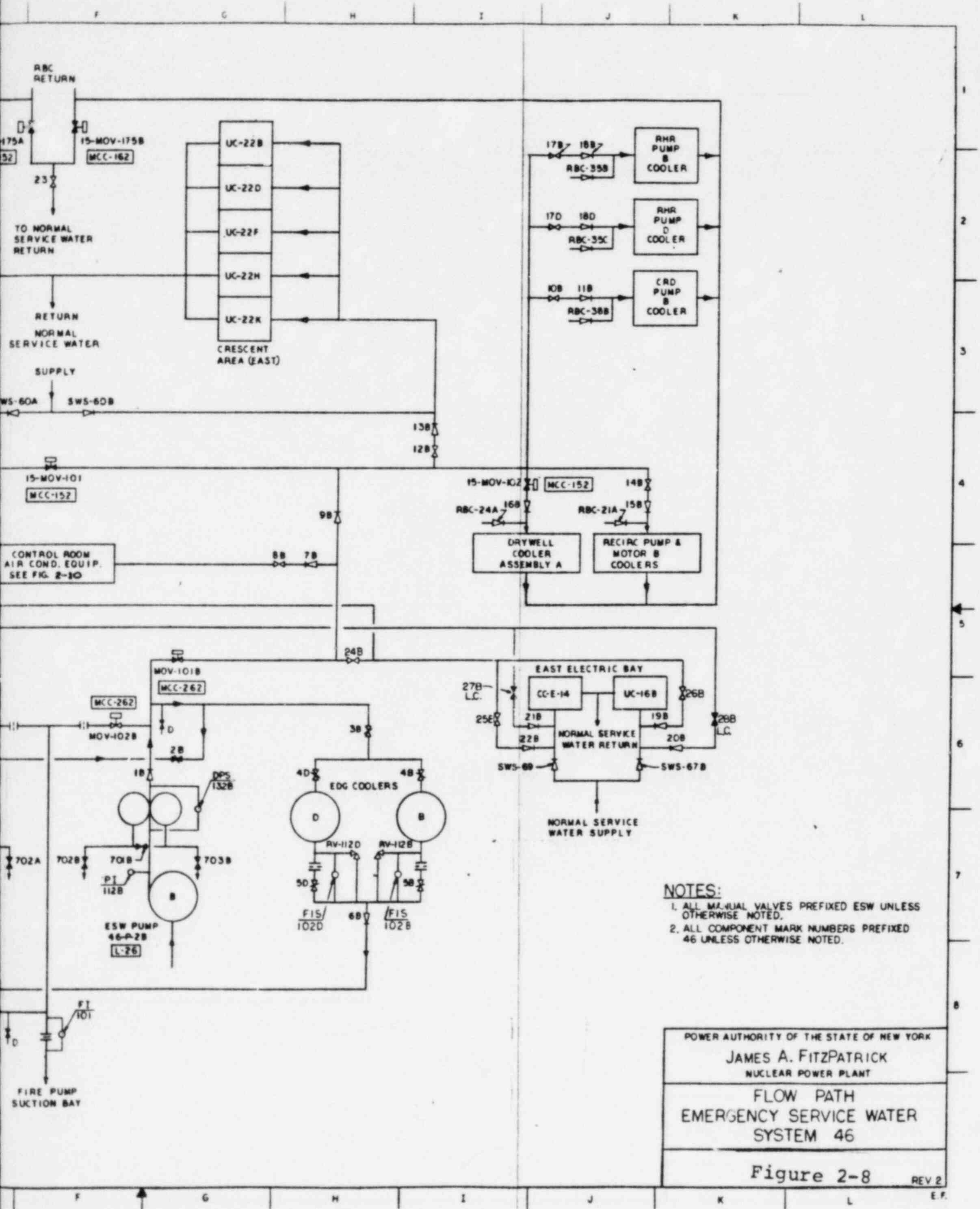
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

FLOW PATH
MAIN STEAM
SYSTEM 29

Figure 2-7



RHR PUMP A COOLER
18A
17A
RBC-35A
RHR PUMP C COOLER
18C
17C
RBC-35C
CRD PUMP A COOLER
11A
10A
RBC-38A
UC-22A
UC-22C
UC-22E
UC-22G
UC-22J
CRESCENT AREA (WEST)
13A
12A
14A
15A
15-MOV-103
MCC-162
16A
RBC-21B
RBC-24B
9A
RECIRC PUMP & MOTOR A COOLERS
DRYWELL COOLER ASSEMBLY B
7A
8A
24A
MOV-101A
MCC-252
WEST ELECTRIC BAY
CC-E-11
UC-16A
28A
25A L.C.
27A
21A
19A
26A L.C.
22A
20A
NORMAL SERVICE WATER RETURN
SWS-68
SWS-67A
NORMAL SERVICE WATER SUPPLY
3A
4A
4C
EDG COOLERS
RV-112A
RV-112C
5A
5C
6A
FIS 102A
FIS 102C
MCC-252
MOV-102A
2A
1A
DPS 132A
703A
701A
PI 112A
ESW PUMP 46-P-2A
L-25




NOTES:

1. ALL MANUAL VALVES PREFIXED ESW UNLESS OTHERWISE NOTED.
2. ALL COMPONENT MARK NUMBERS PREFIXED 46 UNLESS OTHERWISE NOTED.

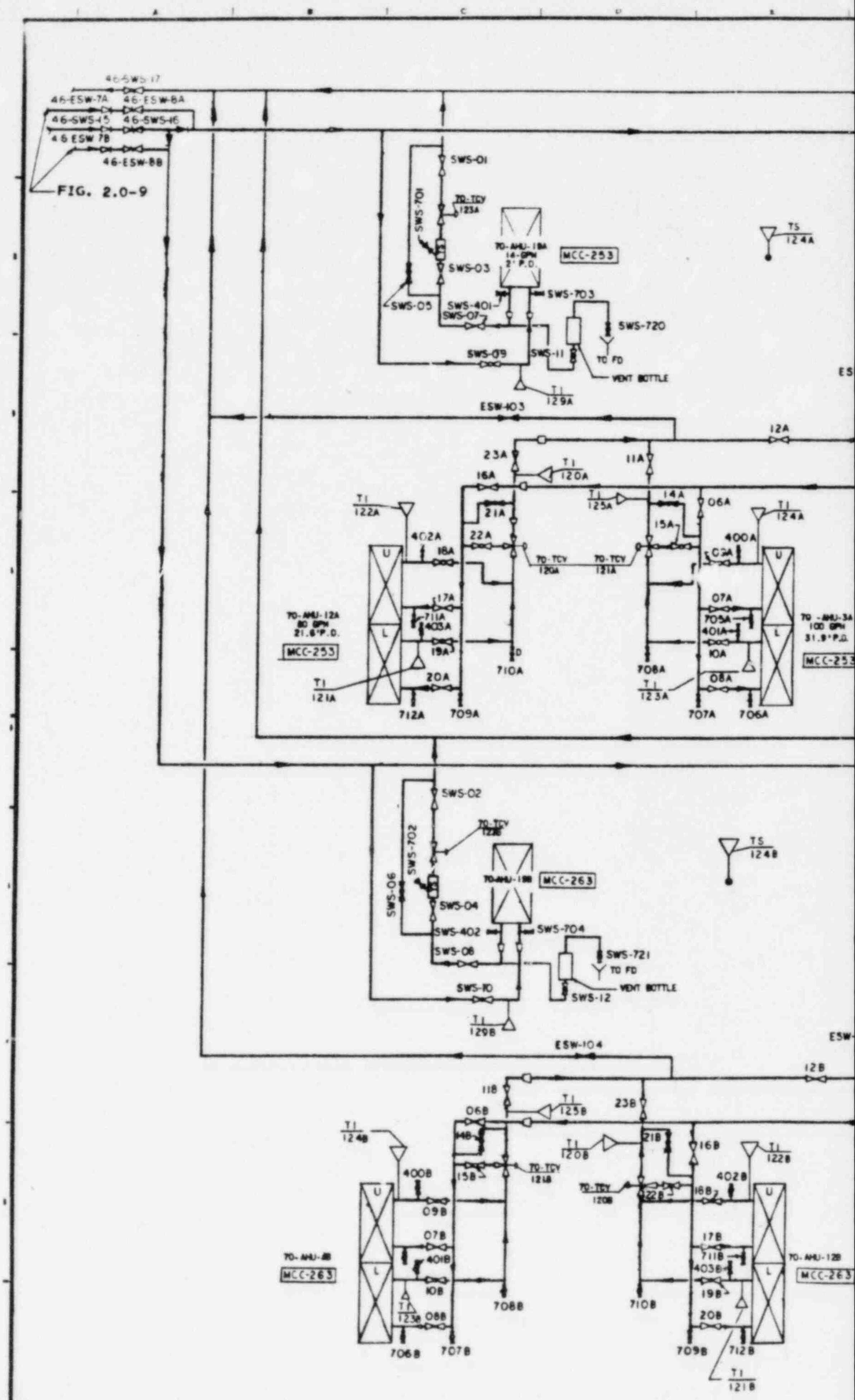
POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

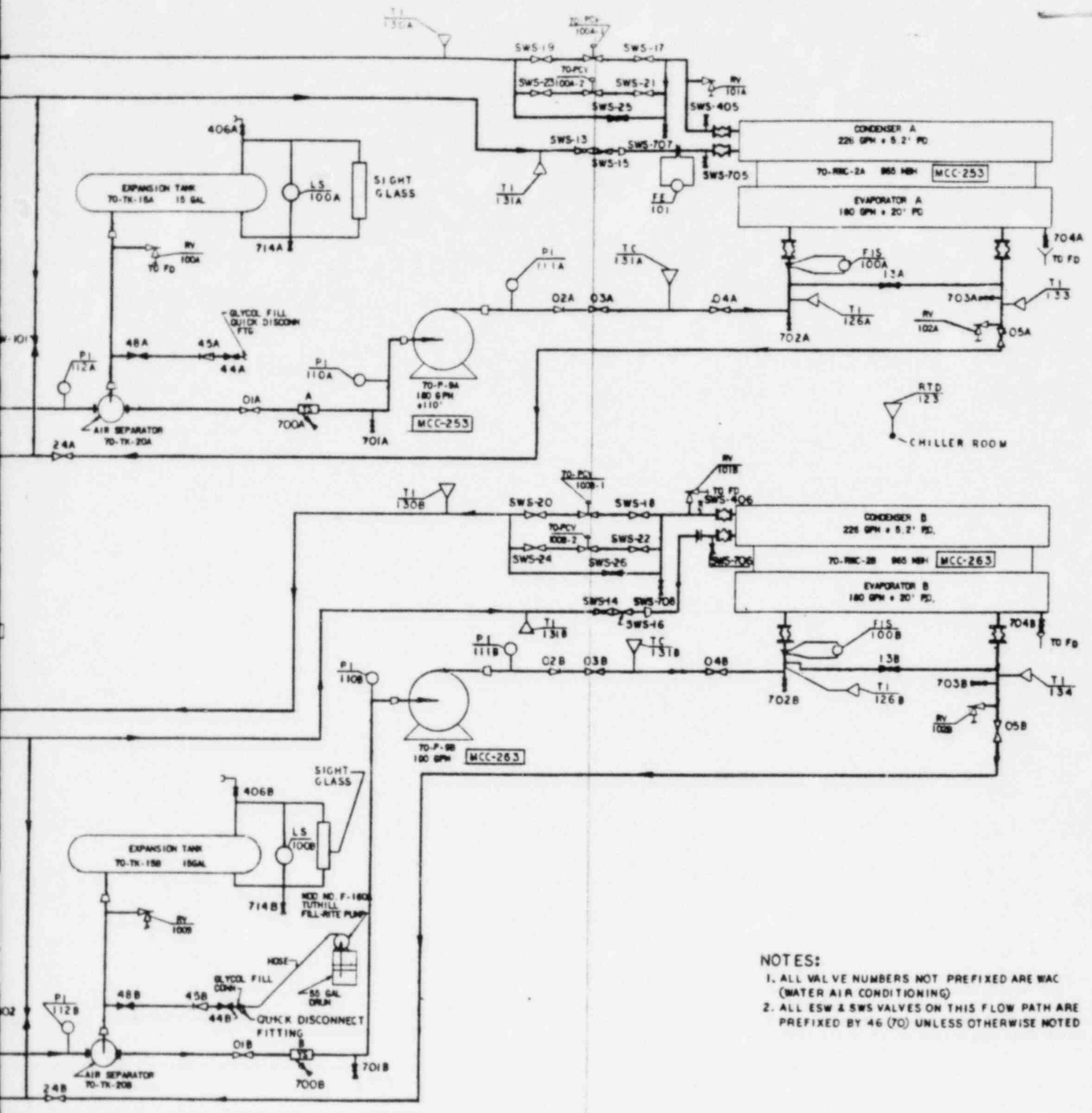
FLOW PATH EMERGENCY SERVICE WATER SYSTEM 46

Figure 2-8

REV 2



46-SWS-17
46-ESW-7A
46-ESW-8A
46-SWS-45
46-SWS-16
46 ESW 7B
46-ESW-8B
FIG. 2.0-9
SWS-01
SWS-701
SWS-03
SWS-05
SWS-401
SWS-07
SWS-703
SWS-720
SWS-09
SWS-11
TO FD
VENT BOTTLE
MCC-253
TS 124A
TI 129A
ESW-103
12A
23A
11A
16A
TI 120A
TI 122A
402A
18A
21A
22A
TI 125A
14A
06A
15A
400A
TI 124A
17A
711A
403A
19A
20A
TI 121A
712A
709A
710A
708A
TI 123A
07A
705A
401A
10A
08A
707A
706A
MCC-253
SWS-02
SWS-702
SWS-06
SWS-04
SWS-402
SWS-08
SWS-704
SWS-721
TO FD
VENT BOTTLE
SWS-10
SWS-12
TI 129B
MCC-263
TS 124B
ESW-104
12B
11B
23B
06B
TI 125B
TI 124B
14B
15B
TI 120B
21B
16B
TI 122B
400B
09B
07B
401B
10B
08B
TI 123B
706B
707B
708B
710B
22B
402B
18B
17B
711B
403B
19B
20B
709B
712B
TI 121B
MCC-263
MCC-263




NOTES:

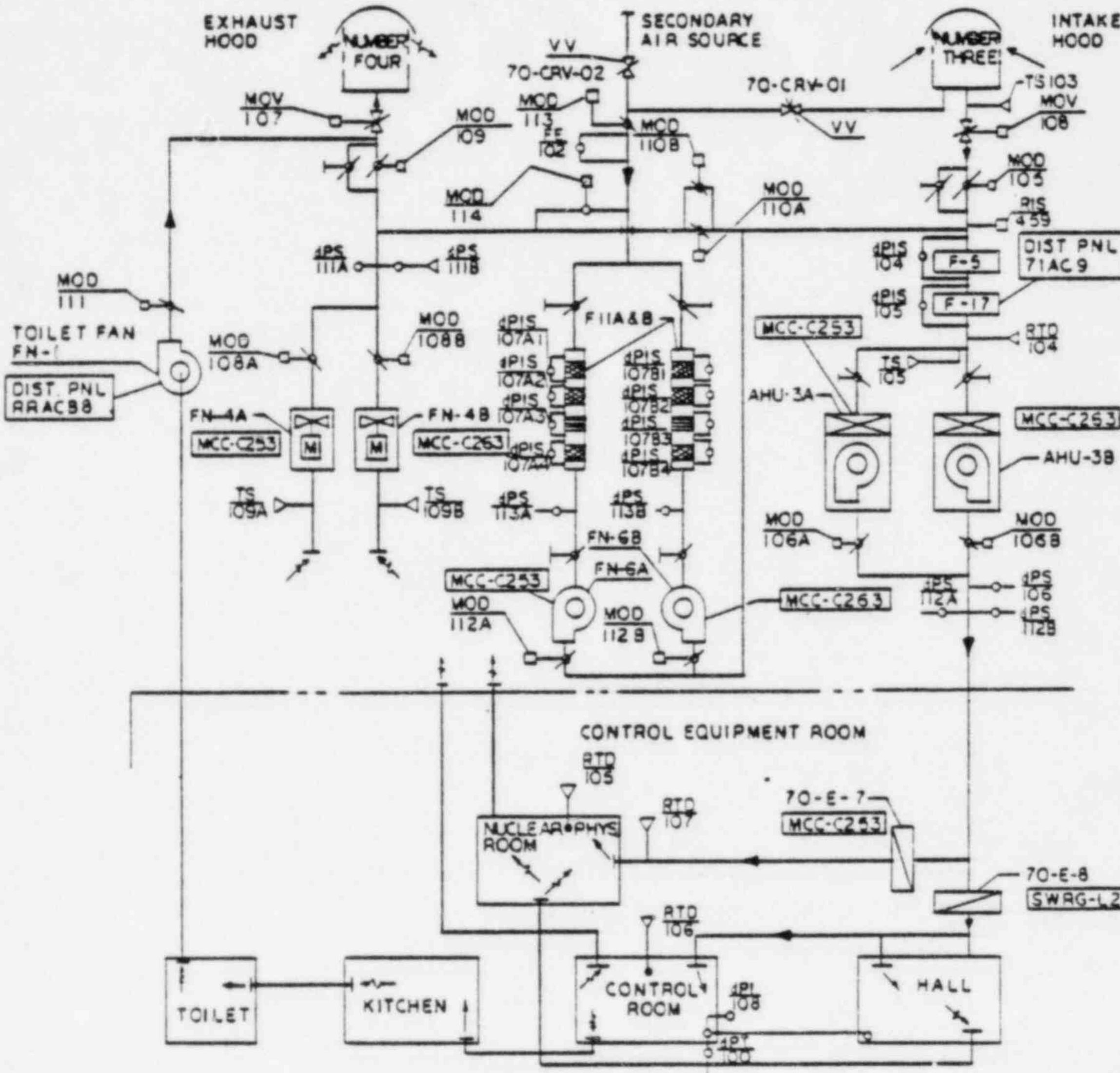
1. ALL VALVE NUMBERS NOT PREFIXED ARE WAC (WATER AIR CONDITIONING)
2. ALL ESW & SWS VALVES ON THIS FLOW PATH ARE PREFIXED BY 46 (70) UNLESS OTHERWISE NOTED

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

FLOW PATH — CONTROL RM AREA
SERVICE & CHILLED WATER
SYSTEM NO.70

Figure 2-9

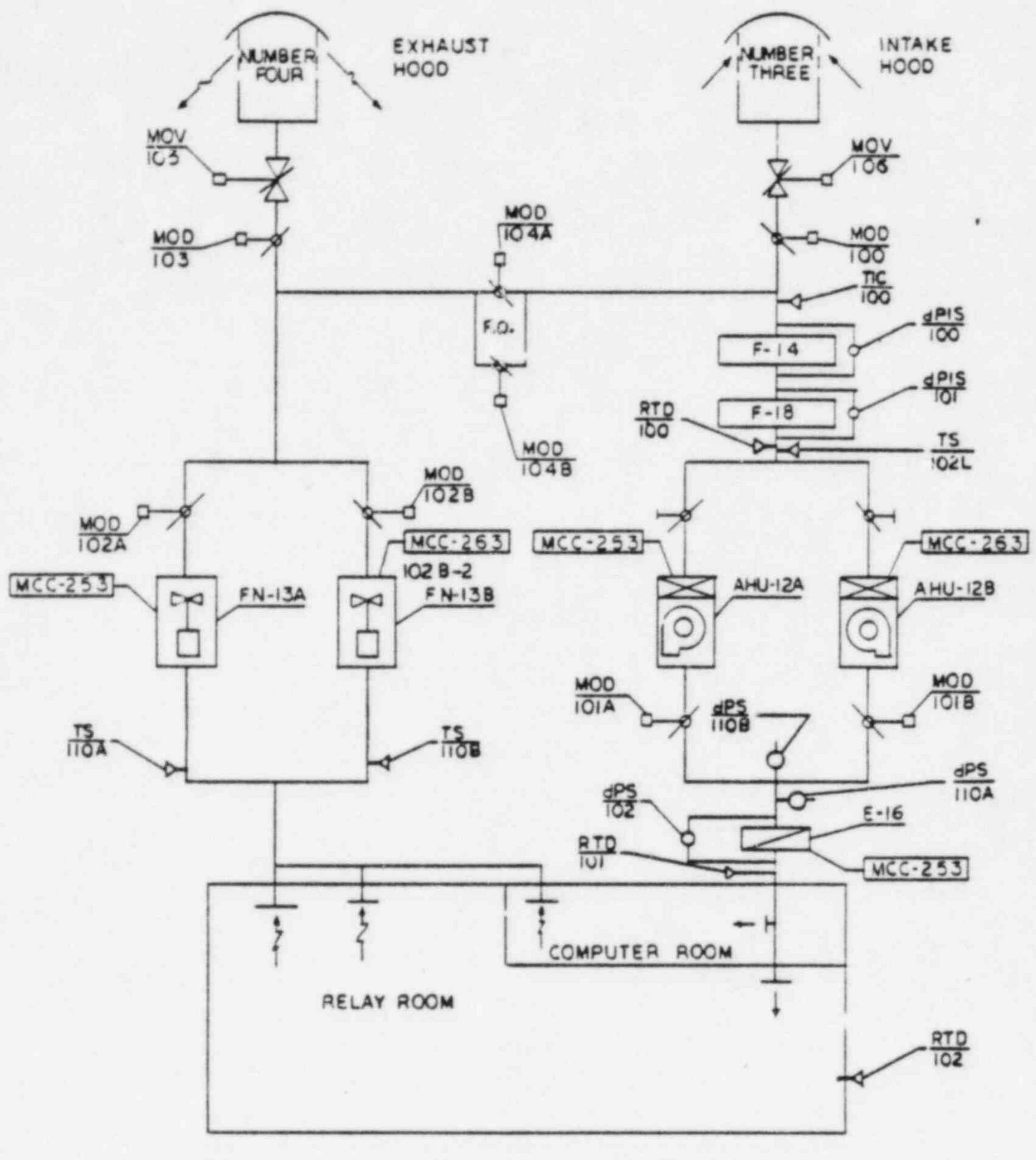



POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

CONTROL ROOM VENTILATION
SYSTEM 70

Figure 2-10




RELAY ROOM VENTILATION SYSTEM (SYSTEM 70)

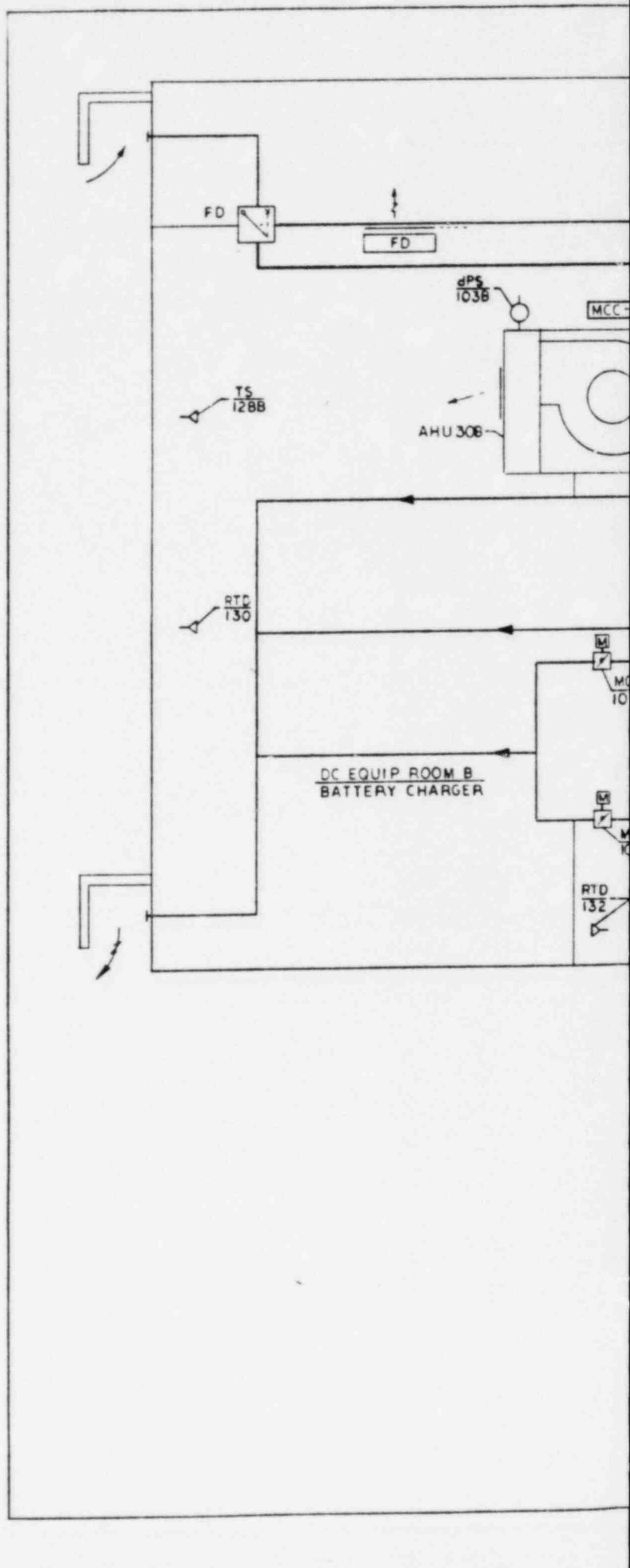
NOTE

ALL NUMBERS PREFIXED 70-CFG EXCEPT AS NOTED

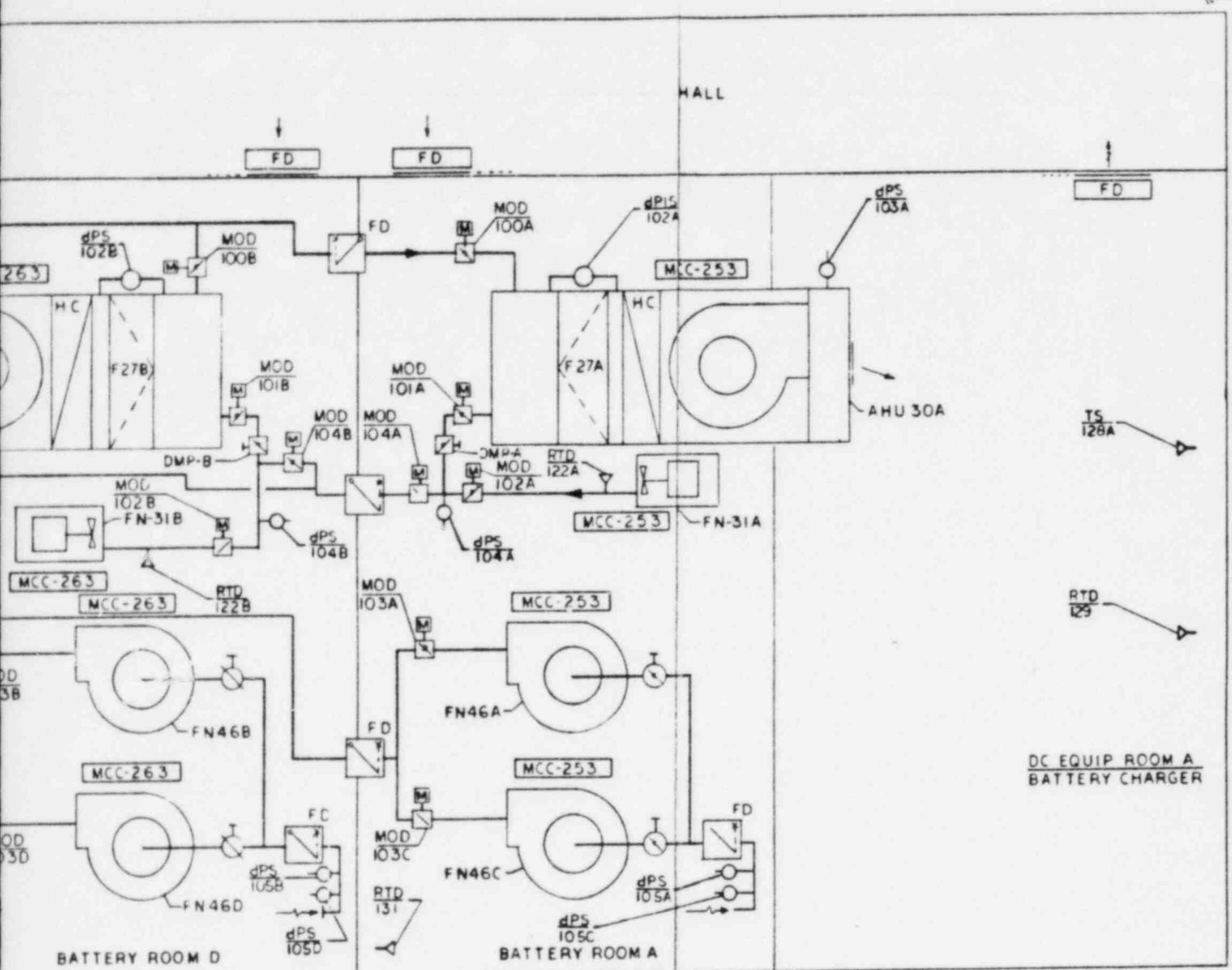
POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK
NUCLEAR POWER PLANT

FLOW PATH
RELAY ROOM VENTILATION
SYSTEM 70

Figure 2-11



FD
FD
dPS 103B
MCC-
TS 128B
AHU 30B
RTD 130
DC EQUIP ROOM B
BATTERY CHARGER
RTD 132



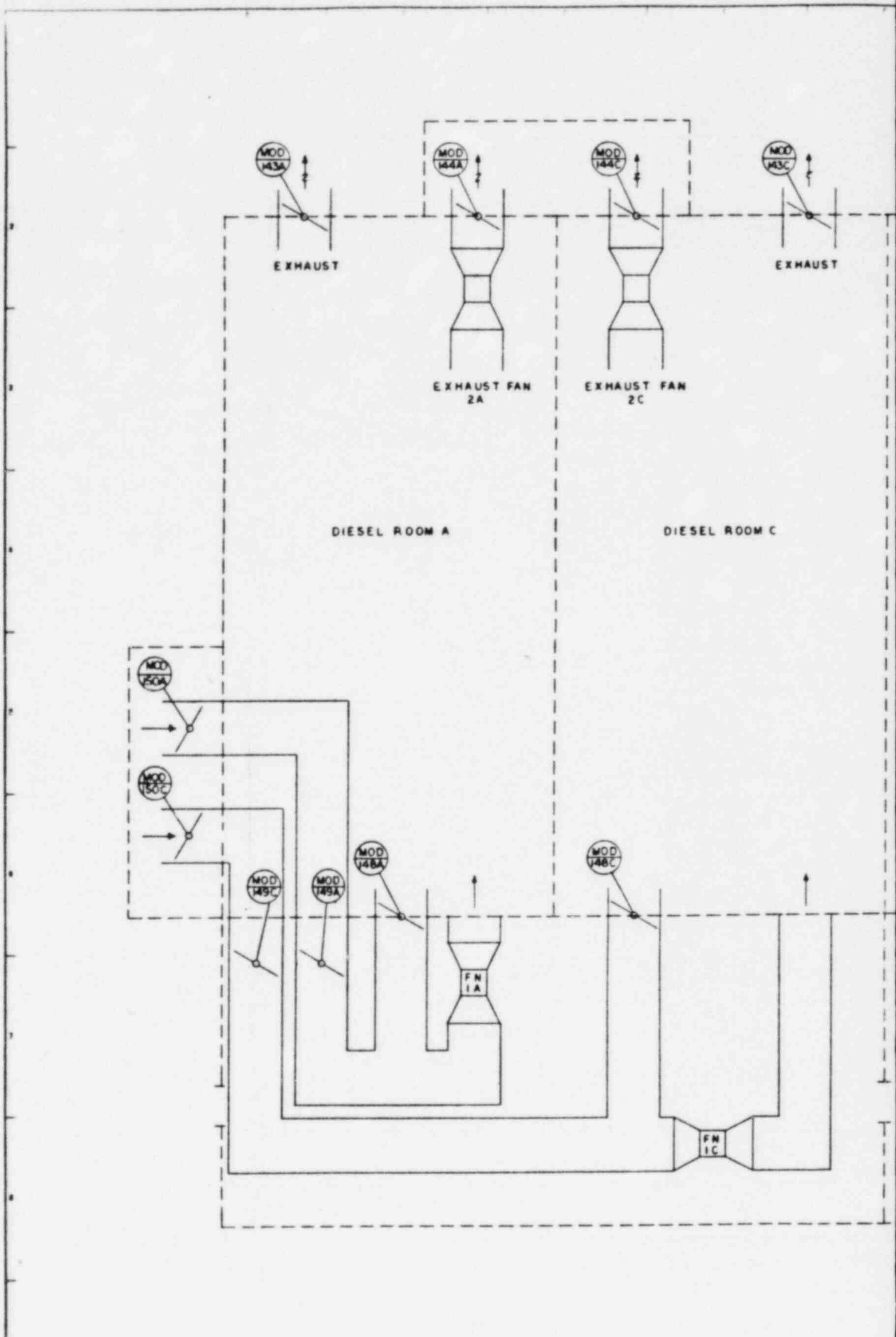

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK

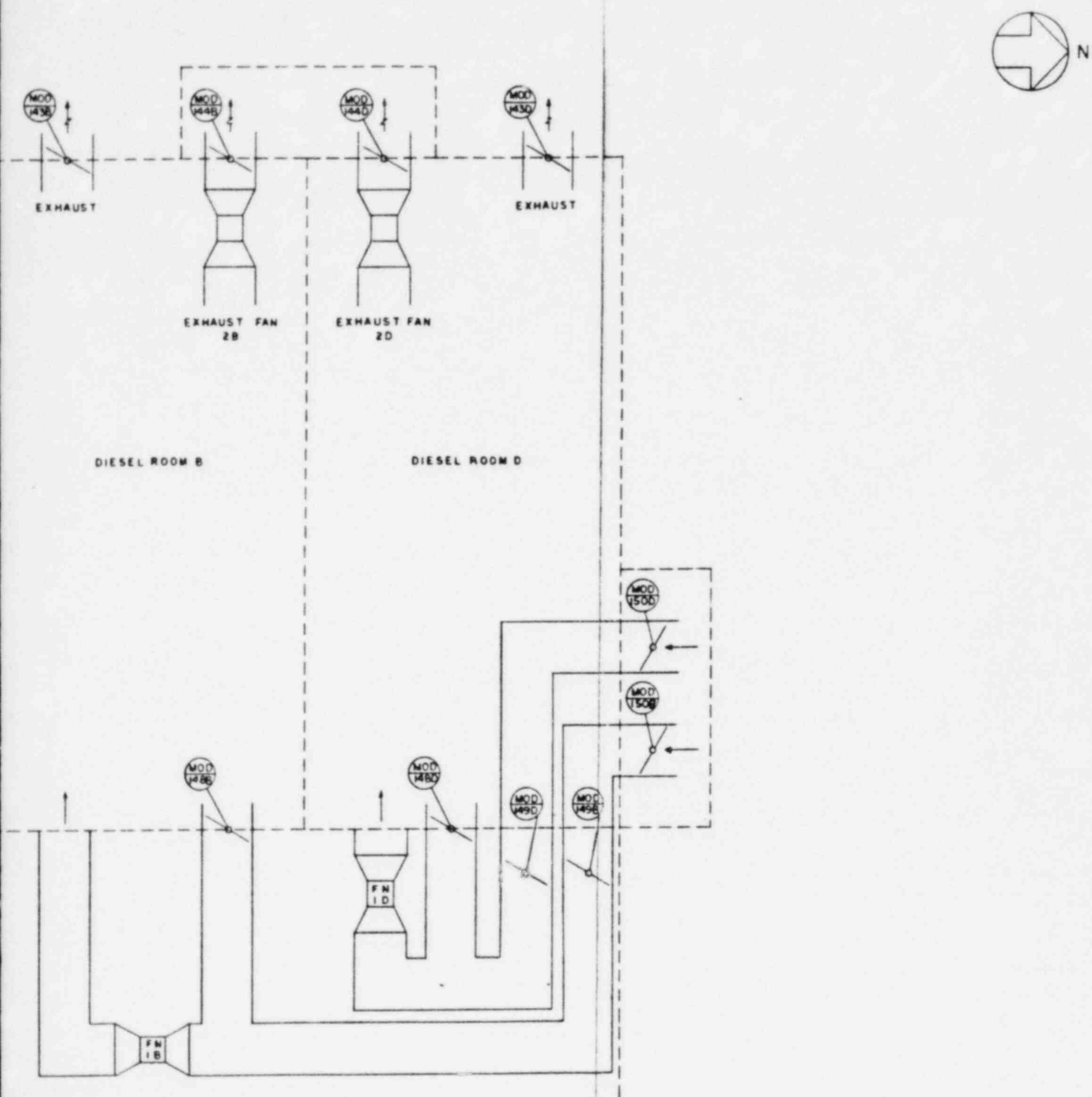
NUCLEAR POWER PLANT

BATTERY ROOM VENTILATION SYSTEM

Figure 2-12



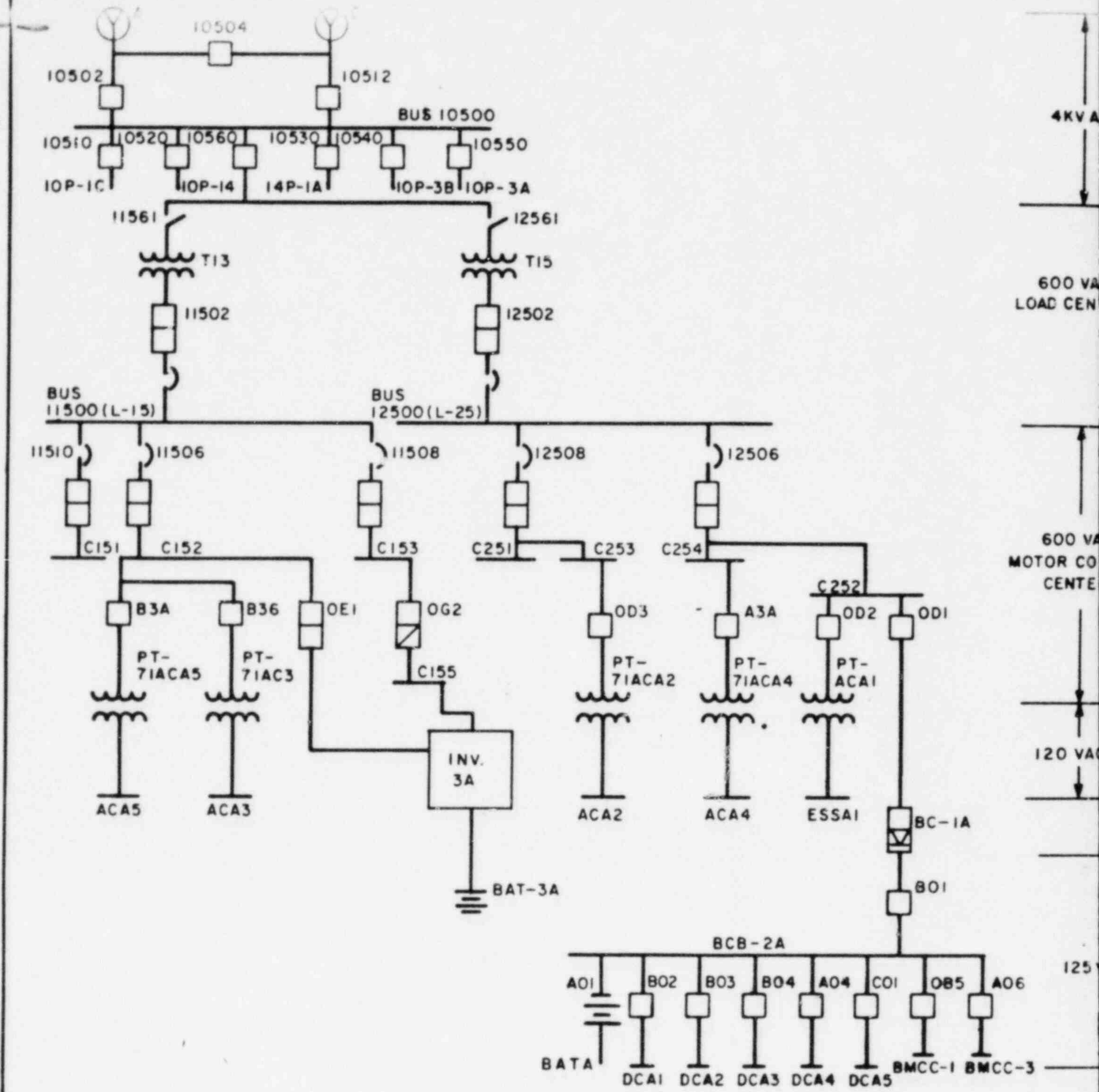
MOD 143A
MOD 144A
MOD 144C
MOD 143C
EXHAUST
EXHAUST
EXHAUST FAN 2A
EXHAUST FAN 2C
DIESEL ROOM A
DIESEL ROOM C
MOD 150A
MOD 150C
MOD 149C
MOD 149A
MOD 148A
MOD 148C
FN 1A
FN 1C




NOTE:
ALL EQUIPMENT PREFIXED 92 WHICH IS SYSTEM 92

POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A FITZPATRICK
NUCLEAR POWER PLANT
FLOW PATH
DIESEL GENERATOR ROOM
VENTILATION SYSTEM 92

Figure 2-13




NOTE:
1 SYSTEM PREFIX-71 HAS BEEN DELETED

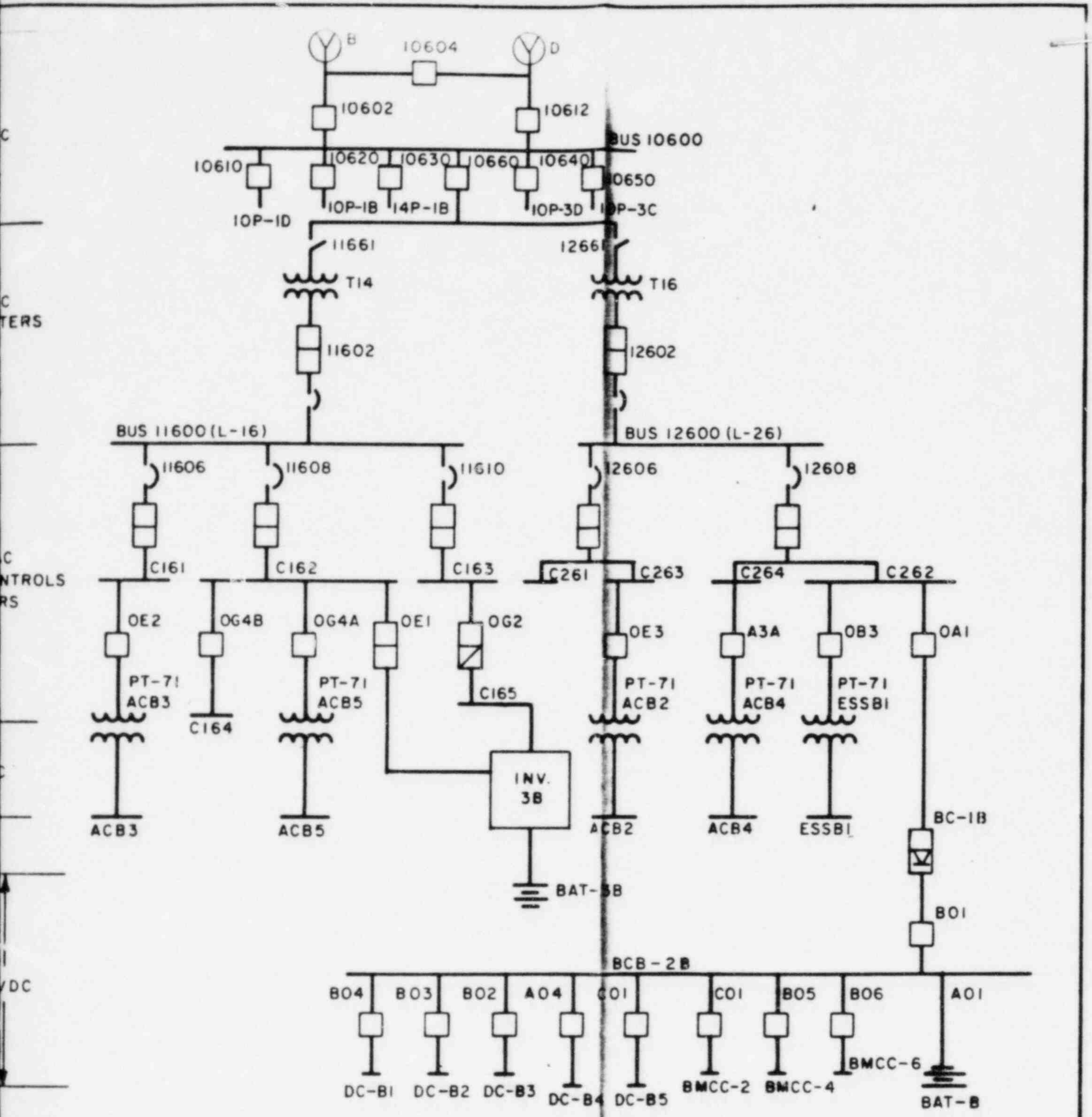



Figure 2-14

**FLOW PATH IE ELECTRICAL DISTRIBUTION SYSTEM**
**JAMES A. FITZPATRICK NUCLEAR POWER PLANT**
**POWER AUTHORITY OF THE STATE OF NEW YORK**

## ANALYTICAL METHODS IN SUPPORT OF EXEMPTION REQUESTS IN SECTION 2.7.2.3

### 3.1 Background

The James A. FitzPatrick NPP, an 821-MWe boiling water reactor owned and operated by the Power Authority of the State of New York, was licensed to operate in October, 1974 with fire protection features designed in accordance with Commission requirements during that period. Since the fire at Browns Ferry, however, and following the publication of the NRC Special Task Force Report (NUREG-0050) in February, 1976, James A. FitzPatrick has undergone a review and upgrade of its fire protection program. This review was documented in a report submitted to the Nuclear Regulatory Commission on April 7, 1977. Since that time the Commission promulgated 10CFR Part 48 and Appendix R to 10CFR Part 50 outlining the requirements necessary for fire protection of nuclear power plants and the process for an exemption on the basis of equivalent protection.

This section discusses the methodology utilized by the Power Authority of the Stae of New York to demonstrate equivalent protection of the public health and safety for those areas identified in Section 2.7.2.3 of this report which do comply with the requirements of Section III.G.2 of 10CFR 50 Appendix R.

### 3.2 Perspective

Since the first fire at Browns Ferry in March, 1975, the nuclear industry has undergone a major upgrade in its approach to fire protection. Most notable in effecting that upgrade was the publication of the findings of the NRC's Special Review Group in "Recommendations Related to Browns Ferry Fire" (NUREG-0050) in February, 1976. That publication called for a comprehensive review and improvement in the fire protection programs at operating nuclear power plants and most clearly articulated the need for a balanced approach in achieving that upgrade to ensure the integrity of the plant's design basis. The balanced approach relied upon multiple layers of active and passive protective measures such as detection, suppression, flame retardant coatings, fire barriers and baffles. The implementation of these modifications was defined as a result of plant-specific analysis performed in accordance with Branch Technical Position 9.5-1 Appendix A. The concept embodied in that document may be best described by the following perspective.

"General Design Criteria for Nuclear Power Plants," to 10CFR Part 50, "Licensing of Production and Utilization Facilities," requires that structures, systems, and components important to safety requirements, the probability and effect of fires and explosions. For new plants, additional Nuclear Regulatory Commission guidelines concerning the implementation of a comprehensive fire protection program is contained in Regulatory Guide 1.120 (For Comment), Revision 1, "Fire Protection Guidelines for Nuclear Power Plants," November, 1977, and in Branch Technical Position ASB 9.5-1. Both of these documents approach fire protection in nuclear power plants from the concept of defense-in-depth aimed at achieving the proper balance in:

a) Preventing fires from starting
b) Detecting fires quickly, suppressing those fires that occur, putting them out quickly, and limiting their damage
c) Designing plant safety systems so that a fire that starts in spite of the fire prevention program and burns for a considerable time in spite of fire protection activities will not prevent essential plant safety functions from being performed.

No one of these echelons can be perfect or complete by itself. Strengthening any one can, however, compensate in some measure for weaknesses, known or unknown, in the others.

3.3 Appendix R and the Exemption Process

In most cases, the modifications which were proposed as a result of plant-specific analyses submitted in 1977 were deemed acceptable by the NRC Staff and documented in a safety evaluation report on each docket. In some cases, technical disagreements between the licensees and the Staff ensued. With the issuance of 10CFR Part 50.48 and Appendix R in November, 1980, the NRC attempted to resolve these disagreements through a rulemaking proceeding which codified the requirements for nuclear power plant fire protection. However, the Commissions's view concerning the acceptability of alternative approaches was also clearly presented. That guidance discussed in the supplementary information section was published in the Federal Register as follows:

> ...the Commission believes that the licensees should reexamine those previously approved configurations of fire protection that do not meet the requirements as specified in Section III.G to Appendix R. Based on this reexamination the licensee must either meet the requirements of Section III.G to Appendix R or apply for an exemption that justifies alternatives by a fire hazard analysis.

This analysis is provided to justify alternatives based on a combination of quantitative analysis of the value of passive protection and the experienced judgment of NRC Staff reviewers as documented in the previously submitted fire hazards analysis.

3.4 Active and Passive Protection Measures

In reviewing the fire protection provided by the existing configuration at James A. FitzPatrick Nuclear Power Plant only passive protection was considered. The objective of this view was to demonstrate the value of inherent protection assuming the nonoperability of active fire protection systems. Thus, neither the actuation of automatic fire detection and operator-initiated suppression nor prompt fire brigade response was assumed in the analysis. In effect, this analysis focused solely on the value of separation of combustible materials from the components of interest.

Separation of combustible material from important structures and systems in nuclear power plants as well as between each other has typically involved the use of such measures as barriers, baffles, coatings and actual physical distance in accordance with Commission guidance and requirements (1, 2, 3, 4, 5). These passive measures should be viewed as an element of fire protection and complementary to such active measures as administrative controls, detection, and suppression (automatic or manual), all of which are oriented towards inhibiting the initiation of a fire and minimizing the effects once it's started. Yet, in focusing on the value of such passive protection, one should not lose sight of the existence and benefits of the other layers of protection which make up the entire comprehensive fire protection program at James A. FitzPatrick Nuclear Power Plant.

### 3.5 Passive Protection Analysis

As was previously stated, this analysis concentrates on evaluating only the third aspect of the defense-in-depth approach to fire protection. The goal of plant designs in this context is described in Regulatory Guide 1.120 Revision 1 (For Comment) as:

> Designing plant safety systems so that a fire that starts in spite of the fire protection programs and burns for a considerable time in spite of fire protection activities will not prevent essential plant safety functions from being performed.

In order to demonstrate this protection, this analysis makes the following assumption:

1) A breakdown of adminstrative controls in the uncontrolled introduction of hazardous material in unacceptable quantities
2) A breach of plant security in the uncontrolled introduction of substantial quantities of hazardous substances
3) No credit for health physics controls in inhibiting access to safe shutdown areas and the introduction of extraneous material
4) Spill occurs at the worst location in a fire zone and assumes a geometry which abets the damage of essential systems
5) Failure of detection systems to determine the presence of the fire and to initiate suppression
6) Failure of operator-initiated suppression to properly function
7) Failure of onsite fire brigade to intervene and suppress the fire
8) Continued plant operation through the course of the fire and reliance on the availability of safe shutdown equipment
9) Optimal ventilation to fuel the fire at the worst stoichiometric fuel/air ratio combined with sufficient ventilation to maintain the compartment smoke-free (for optimized radiation) without mitigating the damaging effects of the hot buoyant diffusion plume.

In modeling fires involving such assumptions as was done in this analysis, one must essentially take an event whereby an infrequent slippage in administrative controls cascades through increasingly less likely circumstances and scenarios to fire initiation and continued burning in the worst possible manner without interference. Moreover, conflicting and even unrealistic requirements must be simultaneously met so as to ensure that the most damaging effects are modeled through optimum heat transfer from the fire to safe shutdown equipment.

The details of the modeling process will be discussed later in the report as well as in the appendices. Nonetheless, it should be emphasized that worst case combinations and values were utilized wherever appropriate so as to ensure that the calculated effects were conservative in the licensing sense.

### 3.5.1 Heat Transfer

Important to the modeling of the fire scenario is the simulation of the associated heat transfer processes. These processes are affected by room geometry, material properties, and the locations of interest and reflect the temporal and spatial dependence of radiative, convective and conductive heat transfer. All of these processes lead to the accumulation of absorbed energy which may also be characterized by a single value of temperature at the point of influence. The absorbed energy, in turn, affects the cable's structural (physical) properties and chemical constituency. Whether viewed in terms of temperature or heat flux, the principal focus is on the availability of the equipment to perform its safe shutdown function.

The cable damage process which results from the heat transfer associated with a fire is related to the pyrolysis and subsequent ignition of the insulation material and short circuiting of the conductor. This vaporization yields a net mass flux of combustible gases and water vapor of some density above the material's surface. If this vaporization or mass loss rate is sufficiently high near the material's surface to maintain an air/fuel mixture of sufficient density and energy to support combustion, then a fire would initiate. The critical values for the mass-loss rate and heat flux necessary for ignition are different for each material but tend to be somewhat similar for comparable organic materials. The ignition of a material such as cable insulation can, therefore, be defined in terms of the minimum incident heat flux and absorbed energy necessary to initiate sufficient mass loss rate to support combustion.

3.5.2 Heat Flux

This analysis focuses on heat flux as a mechanism for modeling the damage process. This approach reflects a developing trend in the combustion literature (7-12), i.e., the use of fire models to conservatively predict heat flux conditions as a result of a fire and the relationship of that heat flux to a material's damage process. Research funded by the Electric Power Research Institute at Factory Mutual Research Corporation, for example, adopted this approach at its inception in 1977 in the aftermath of the Browns Ferry fire (13-17). Similar work involving electric cable fires is currently in progress for the Department of Transportation and has been completed for the Bureau of Mines. The products of these efforts lay the foundation for a proceduralized evaluation of the effects of exposure fires in power plants based upon rigorous analysis and a physically-based cable damage criterion, an approach which has been developed further in this analysis.

3.5.3 Fire Modeling

The modeling of most physical processes, in general, is complicated by the effects of multiple variables. This problem is not new to the licensing process as evidenced in the analysis of design basis accidents. Assumptions concerning such factors as system failures, line break locations, the uncertain cause and flow of natural phenomenon, operator actions under stressful conditions, and the subtle effects of the timing of the sequence of events may all contribute to the perceived difficulty in adequately predicting the course of important plant parameters. Yet, this problem has been and is currently treated satisfactorily through the judicious and careful use of worst case assumptions, the proper application of bounding calculations, and the appropriate selection of extreme values leading to analyses which are conservative and limiting relative to "best estimate" scenarios. As a practical example in nuclear reactor licensing, one need only look to the classical worst case analysis of containment parameters through the course of a loss of coolant accident, a problem at least as complex if not more so than that of modeling small transient combustible exposure fires. This practice involving bounding analysis is fundamental to all engineering disciplines and reflects the structured process associated with the scientific method. Such calculations also form the basis for the critical judgment of experienced analysts.

The methodology used in this analysis of the effects of fire on safe shutdown systems in nuclear power plants embraces the philosophy and discipline commonly utilized in the licensing process. Wherever appropriate, worst case assumptions were made in the course of analysis to assure the conservative nature of the results. But, unlike the fireloading method developed for the protection of high fuel density residential and commercial structures with their unique problems and concerns, the approach taken herein relies upon fundamental principles and relationships developed both under controlled laboratory conditions and in the disciplines of the physical sciences. In effect, the quantitative fire modeling approach taken in this analysis attempts to bring nuclear power plant fire modeling back in line with the high standards for rigor, conservatism, and respect for the scientific method employed in the licensing process. In the following paragraphs, a general discussion will be presented for the treatment of the postulated exposure fire.

### 3.5.4 Radiation

In modeling fires within a nuclear power plant, it should be noted that several processes must be considered (Figure 3-1). The first is the thermal radiation field associated with the band emission

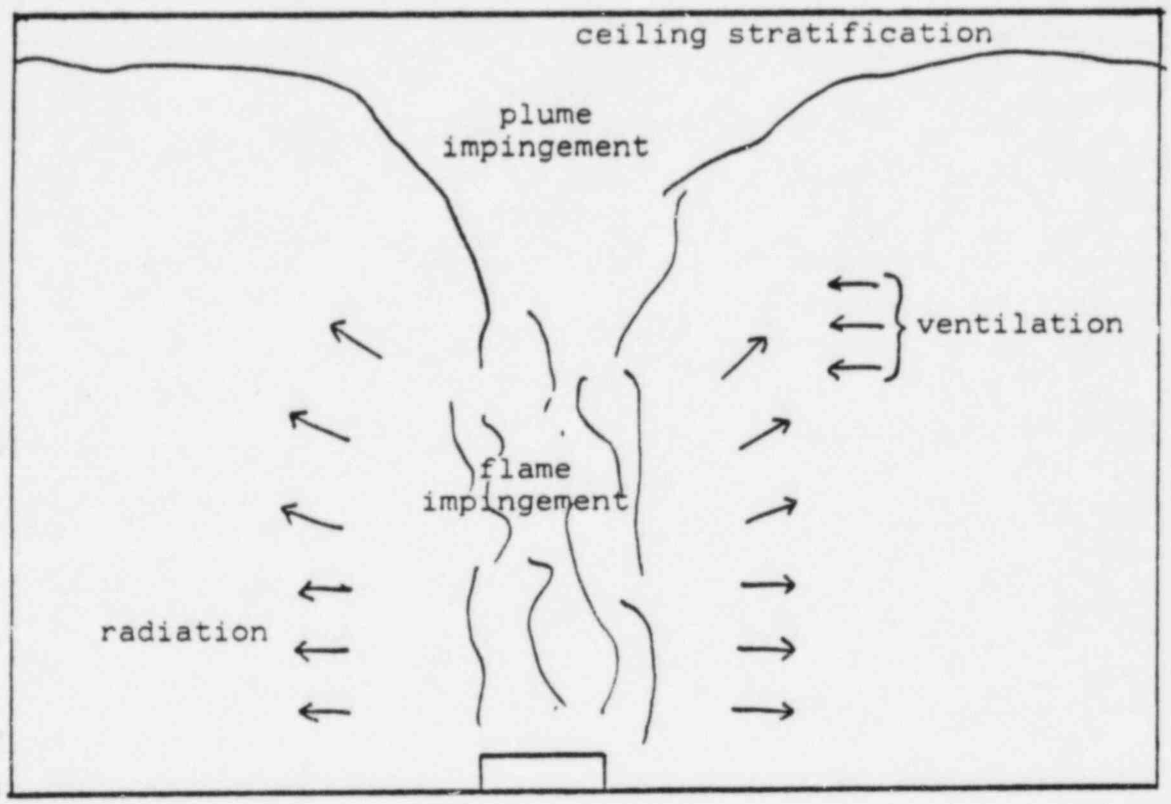



Figure 3-1. Fire Diagrams

of a luminous flame. The dominant emitting species are water vapor, carbon dioxide and soot particles (typically less than 0.1 microns size) with most of the radiant energy being emitted at wavelengths under 15 microns. Total emissivity is directly related to the radiant gas temperature, the gas partial pressures, the soot volume-fraction path length, and the radiant gas geometry. Radiant energy transfer is governed by the Stefan-Boltzman relationship, the flame's emissivity, the absorptivity of the material of interest, and the configuration factor, i.e., the amount of the flame seen at any point. The region of influence for radiation is generally in the immediate vicinity of a fire and the extent of that influence is governed principally by horizontal separation.

3.5.5. Turbulent Buoyant Plumes and the Horizontal Jet

Flame and buoyant plume impingement is predominantly a turbulent convection problem whereby hot gases are driven vertically as a result of density differences with ambient gases. As they rise, diffusion occurs in the plane normal to the vertical momentum vector which, when combined with some entrainment of cooler gases, results in a decline in the energy of the gaseous plume at higher elevations. These effects are also dependent on the fuel's heat of combustion and the convective heat release rate ratio which itself may be affected by the fire area, time of measurement (transient or steady-state conditions), stoichiometric fuel-air ratio and fuel mass loss rate. The transfer of heat from the plume to any object immersed in it will be affected by the creation of flow stagnation points, the presence of baffles and the location of interest. These processes may be effectively modeled based on experimentally derived correlations and the classical methods of mathematical physics.

Finally with the impact of the buoyant plume on the ceiling of an enclosure, the vertical momentum vector is converted into a horizontal jet which leads to the development of a stratified layer of hot gases extending outward in all directions unless otherwise deflected. The effects of ceiling stratification of the buoyant diffusion plume tends to obscure the beneficial effects of horizontal separation at higher elevations within an enclosure. The coupling of the ceiling stratification phenomenon with the buoyant plume occurs in the turning region where the classical Gaussian diffusion assumptions are modified to ensure continuity of the boundary conditions. Ceiling heat transfer effects are appropriately treated as required by experimentally derived correlations.

### 3.5.6 The Combustion Process

Assumptions concerning the fire itself are equally important to the heat transfer and damage processes. In order to reflect the bounding nature of the analysis, it is important that conditions are always assumed to be worst case wherever justification for a lesser case cannot be adequately documented. Besides treating the fuel mass loss rate in such a conservative manner, it is also important to consider the effects of ventilation relative to enclosure fires. Classical analysis of building fires, especially those in residential and office buildings, have attempted to realistically treat ventilation and the effects of drafts on fires. Our purposes are different. With a fundamental objective of bounding the conditions resulting from a fire, realistic or "best estimate" scenarios are of merely academic interest and tend to invite criticisms concerning the nonreproducibility of the problem. .Thus, questions of draft-limited fires are generally ignored. Rather, a two-fold and perhaps even physically contradictory assumption with regard to ventilation is generally considered.

1) Sufficent ventilation to support an optimum stoichiometric fuel/air ratio is always assumed to be present without regard to origin.

2) Sufficient ventilation to maintain the compartment desmoked is always present to maximize radiation effects without affecting the stability of any ceiling stratified layers of taking credit for any cooling effects.

In particular situations where wind effects on the flames themselves result in flame distortions which need to be considered, specific analysis is provided. Thus, ventilation is treated in a fashion which, although not realistic, is extremely conservative and bounding in severity of damage potential.

### 3.5.7 Damage Criteria

In addition to considering the temporal and spatial distribution of heat flux, it is essential that a damage criterion be established. Ideally, such a criterion would be heat flux based. The advantage of this approach is that short, hot fires may be related to long, cool fires on similar terms, i.e., the total energy absorbed by the material of interest necessary for a failure process to occur. In so doing, much of the uncertainty often discussed on the subject of cable resistance to combustion may be reduced.

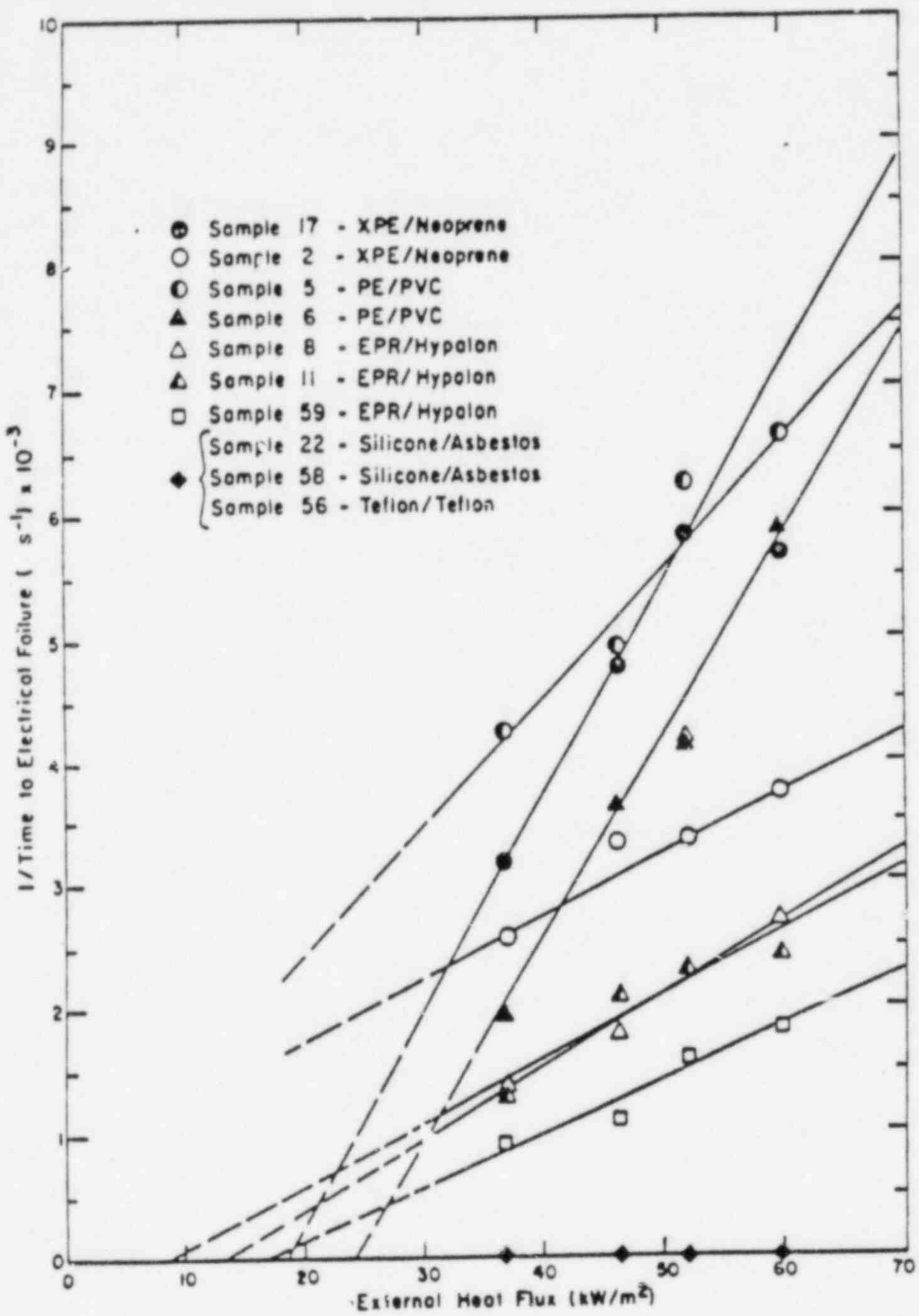
A damage criterion may also be based on temperature. The difficulty of such an approach, however, is that the association between surface temperature and the damage process is indirect, resulting in a range of temperatures over which failures may occur depending upon the duration of exposure. Such a criterion lacks precision and is, hence, unsatisfactory.

The failure concept utilized in this analysis is based on work performed at Factory Mutual Research Corporation (FMRC) (10, 12, 13, 17, 18) and discussed in a report to the NRC Staff by Dr. John Boccio of Brookhaven National Laboratory (19). This approach relates damage in terms of a material's flammability parameters and, in particular, the following two parameters:

1) Critical Heat-Flux - the minimum heat flux below which the damage process essentially will not occur.
2) Critical Energy - the energy required to effectively initiate and complete the damage process.

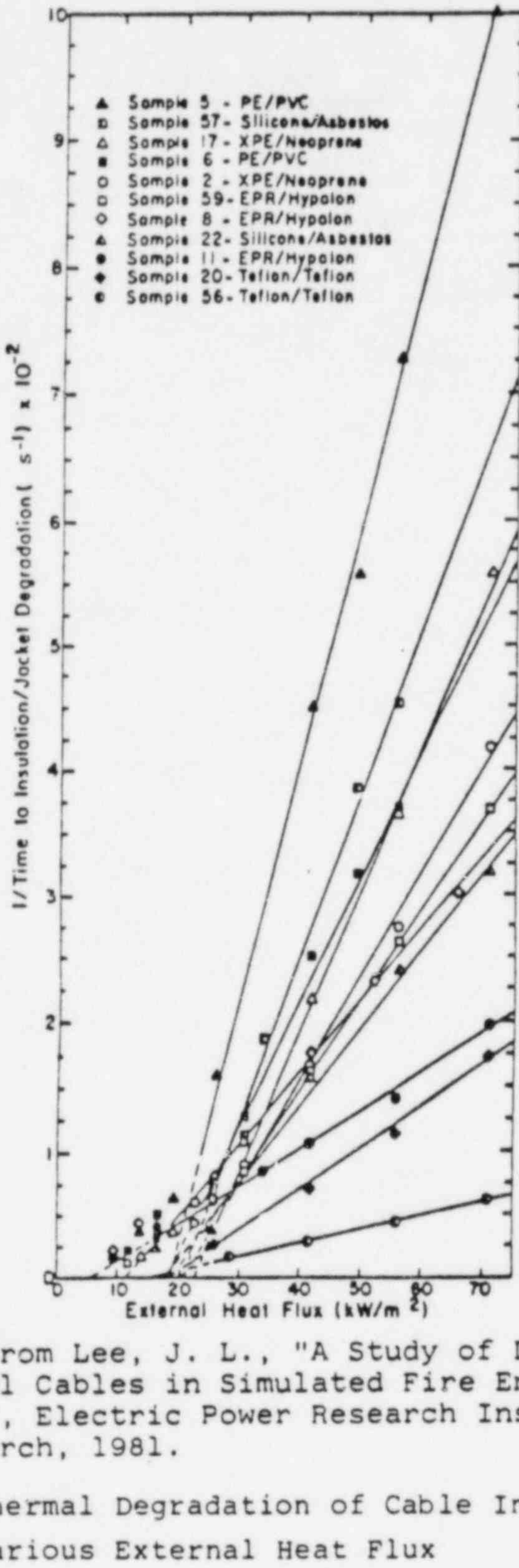
Each material in its particular configuration, e.g., electrical cables, undergoes a series of fire stages when exposed to varying thermal conditions. Those stages include the onset of jacket degradation through offgassing, electrical failure, ignition, maximum burning, and fire decay. The incident heat flux and energy necessary for a cable to achieve each stage may be determined under controlled laboratory conditions. One such method involves the use of the Factory Mutual Research Corporation combustibility apparatus which since 1976 has been utilized in the study of material flammability properties for the National Bureau of Standards, the Bureau of Mines and the Department of Transportation.

The FMRC combustibility apparatus allows for the precise measurement of a material's flammability properties when exposed to an incident heat flux of 0-70 $kW/m^2$. Measured properties under a given heat flux include: 1) time to failure, 2) mass loss rate, 3) heat release rate, 4) generation rates for gaseous combustion products and 5) optical transmission. With this data, it is possible to describe a material's fire hazard independent of configuration or the nature of the source of the incident heat flux (Figures 3-2, 3-3, and 3-4).



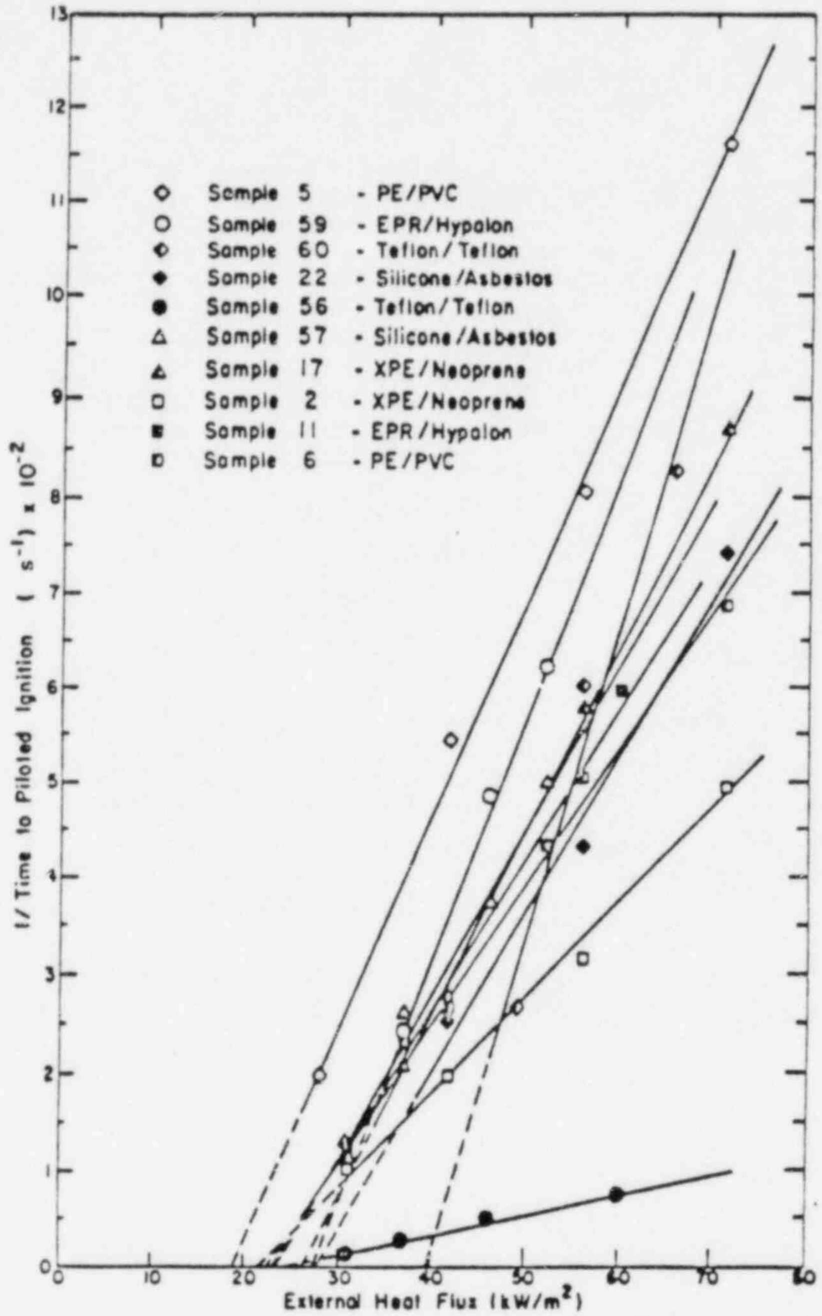

Reproduced from Lee, J. L., "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.

Figure 3-2. Electrical Failure of Cables Under Various External Heat Flux




Reproduced from Lee, J. L., "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.

Figure 3-3. Thermal Degradation of Cable Insulations Under Various External Heat Flux




Reproduced from Lee, J. L., "A Study of Damageability of Electrical Cables in Simulated Fire Environments", EPRI-NP-1767, Electric Power Research Institute, Palo Alto, CA, March, 1981.

Figure 3-4. Piloted Ignition of Cables Under Various External Heat Flux

## 3.6 Summary of the Fire Modeling Process

The general approach taken in this analysis was to identify the minimum quantity and geometry of liquid hydrocarbon spill which would exceed the damage criteria for electrical cable of interest. This was accomplished in the following manner:

1) Identify the electrical cables of interest, their specifications, geometry, and the dimensions of the plant area.
2) Identify the fixed and transient liquid hydrocarbon material of concern.
3) Calculate the minimum quantity of the fuels of interest and the associated fire geometry (location, area, and depth) necessary to exceed the damageability criteria for the identified electrical cable through the following mechanisms:

    a) Stratification
    b) Radiation alone
    c) Buoyant diffusion plume impingement

    For the purposes of analysis, ignore the mitigating effects of actual room geometry, floor slope, and equipment layout and assume the presence of a perfectly horizontal floor free of fire inhibiting equipment. Also ignore the mitigating effects of pipes and ventilation systems in diverting the flow of hot gases, absorbing incident heat flux or blocking the free passage of radiation to the cables of interest.

4) When possible, calculate the minimum quantity and geometry of fuel necessary to exceed the same damage criteria for the same cables in the same plant area with protection provided under Section III.G.2 of Appendix R under the same assumptions as (3).

5) Compare the fuel quantities and geometry necessary to exceed the cables' damage criteria when protected by the Appendix R configuration to the passive protection afforded by the plant configuration analyzed.

The objective of this process is to demonstrate the equivalent protection of plant passive fire protection measures alone to that protection afforded by Appendix R. Thus, wherever possible, the process so described ignores arguments concerning the definition "credible" quantities of transient combustibles or the value of administrative controls and attempts to present fire protection in terms of quantities of different fluids.

The details of the different processes modeled are presented in the appendices while the Analysis Section (Section 4) discusses the specific areas evaluated, the assumptions and techniques considered, and the final results.

References

1) Special Review Group. "Recommendations Related to Browns Ferry Fire," NUREG-0050, U.S. Nuclear Regulatory Commission, Washington, DC, February 1976.

2) NRC, "Guidelines for Fire Protection for Nuclear Power Plants," Auxiliary Systems Branch Technical Position 9.5-1, Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, November 1977.

3) NRC, "Fire Protection Guidelines for Nuclear Power Plants," (For Comment,, Regulatory Guide 1.120, Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, November 1977.

4) NRC, "Physical Independence of Electric Systems," Regulatory Guide 1.75, Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, January 1975.

5) NRC, "Fire Protection Program for Operating Nuclear Power Plants," 10CFR Part 50, U.S. Nuclear Regulatory Commission, 45FR76611, November 19, 1980, corrected 45FR79409, December 1, 1980, U.S. Nuclear Regulatory Commission, Washington, DC.

6) NFPA, "Fire Protection for Nuclear Power Plants," NFPA-803-1978, National Fire Protection Association, Boston, MA, June 6, 1978.

7) Harmathy T.Z., "Relationship Between Fire Resistance and Fire Tolerance," Fire and Materials, V2, N4 (1978).

8) Harmathy, T.Z. and Lie, T.T., "Fire Test Standard in the Light of Fire Research," Fire Test Performance, ASTM STP464, American Society for Testing and Materials (1970).

9) Harmathy, T.Z., "The Possibility of Characterizing the Severity of Fires by a Single Parameter," Fire and Materials, V4, N2 (1980).

10) Tewarson, A., "Experimental Evaluation of Flammability Parameters of Polymeric Materials," FMRC J. 1.1A6R1, Prepared for Products Research Committee, National Bureau of Standards by Factory Mutual Research Corporation under Grant RP-75-1-33A, Norwood, MA February, 1979.

11) Tewarson, A., Lee, J.L., and Pion, R.F., "The Influence of Oxygen Concentration on Fuel Parameters for Fire Modeling," Eighteenth Symposium (International) on Combustion, The Combustion Institute, 1981.

12) Tewarson, A. and Pion, R.F., "A Laboratory Scale Test Method for the Measurement of Flammability Parameters," FMRC No. 22524, Prepared for Products Research Committee by Factory Mutual Research Corporation under Grant No. RP-75-1-33A, Norwood, MA, October 1977.

13) Tewarson, A., Lee, J.L. and Pion, R.F., "Categorization of Cable Flammability Part 1: Laboratory Evaluation of Cable Flammability Parameters," NP-1200, Part 1, Electric Power Research Institute, Palo Alto, CA, October 1979.

14) Delichatsios, M.A., "Categorization of Cable Flammability Detection of Smoldering and Flaming Cable Fires," NP-1630, Electric Power Research Institute, Palo Alto, CA, November 1980.

15) Newman, J.S. and Hill, J.P., "Assessment of Exposure Fire Hazards to Cable Trays," NP-1675, Electric Power Research Institute, January 1981.

16) Modak, A.T., "Ignitability of High Fire Point Liquid Spills," NP-1731, Electric Power Research Institute, Palo Alto, CA, March 1981.

17) Lee, J.L., "A Study of Damageability of Electrical Cables in Simulated Fire Environments," NP-1767, Electric Power Research Institute, Palo Alto, CA, March 1981.

18) Tewarson, A., "Fire Hazard Evaluation of Mine Materials," Technical Report RC80-T-77, Factory Mutual Research Corporation, Norwood, MA, October 1980.

19) Boccio, J.L., "Requirements for Establishing Detector Siting Criteria in Fires Involving Electrical Cable Materials," BNL-29939, Department of Nuclear Engineering, Brookhaven National Laboratory, Upton, NY, May 1981.