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THREE MILE ISLAND NUCLEAR STATION
UNIT 1

FIRE HAZARDS ANALYSIS REPORT

METROPOLITAN EDISON COMPANY

Prepared by: [signature]
W. A. Brannen, P.E.
Fire Protection Engineer
Gilbert Associates, Inc.

Approved by: [signature]
R. M. Klingaman, P.E.
Fire Protection Engineer
Metropolitan Edison Compa

190
5819

Gilbert Associates, Inc.
P. O. Box 1498
Reading, Pennsylvania 19603

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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The Nuclear Regulatory Commission (NRC), in a letter dated May 11, 1976, requested that Metropolitan Edison Company conduct an examination of the Three Mile Island Nuclear Station Unit 1 (TMI-1). The purpose of the investigation was to compare existing fire protection provisions with the guidelines presented in Standard Review Plan (SRP) 9.5.1, "Fire Protection," dated May 1, 1976, which includes Branch Technical Position APCSB 9.5-1. Metropolitan Edison was specifically requested to:

a. Identify and discuss those guidelines which are satisfied.

b. Identify those guidelines for which modifications, procedural changes, or enhanced training of personnel are required, indicating those that are being developed or planned.

c. Identify those guidelines which are not satsified and will not be satisfied, providing a basis of justification for this position.

In a subsequent letter dated September 30, 1976, the NRC transmitted Appendix A to APCSB 9.5-1, which provides certain acceptable alternatives to the positions given in APCSB 9.5-1 for plants already in operation. Therefore, the evaluation has been performed and the point-by-point comparisons have been made with respect to those guidelines in Appendix A identified as applicable to "plants under construction or operating plants." In addition, the NRC stressed that for purposes of evaluation, a fire hazards analysis must be performed to the level of detail indicated by Enclosure 2 to the NRC's letter, "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation." It was requested that the analysis be conducted under the technical direction of a qualified fire protection engineer. In addition to the fire hazards analysis, proposed technical specifications for the existing fire protection systems were requested to be submitted. These were transmitted by Metropolitan Edison to the NRC on February 10, 1977.

The purpose of this report is to present the results of the fire protection program evaluation, including the fire hazard analysis, for Three Mile Island Nuclear Station Unit 1 in accordance with the aforementioned NRC requirements. Gilbert Associates, Inc., Reading, Pennsylvania assisted Metropolitan Edison in the performance of this evaluation. Mr. W. A. Brannen of Gilbert Associates, Inc., was the qualified fire protection engineer for the project.

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1.2 SUMMARY OF PLANNED MODIFICATIONS

As a result of the fire hazards analysis, certain TMI-1 modifications are planned. These modifications, discussed in the conclusion section for each fire zone, are summarized below.

Building	Fire Area/Zone	Description of Change (Section)
Reactor Building	All zones	Add fire detection system to allow for early warning. (4.1)
	Inside Secondary Shield (Elevation 281')	Add curbs inside secondary shield. (4.1.6.3, 4.1.7.3)
	Inside Secondary Shield, West (Elevation 281')	Add thermal insulation to decay heat valve, DH-V1. (4.1.7.3)
	Outside Secondary Shield, Southwest (Elevation 281')	Add thermal insulation to decay heat valve, DH-V2. (4.1.3.3)
Auxiliary Building	Decay Heat Pit A	Add fire damper in the HVAC supply and return duct; seal cable and pipe penetrations. (4.2.1.3)
	Decay Heat Pit B	Same as above. (4.2.2.3)
	Heat Exchanger Vault	Add a fire hose reel. (4.2.3.1.3)
	Pipe Penetration Area (Elevation 281')	Install ionization fire detection system and automatic water spray system. (4.2.3.4.3)
	Makeup & Purification Pump Cubicle B (Elevation 281')	Add fire damper in HVAC duct penetrating the concrete wall adjacent to cubicle A; seal penetrations. (4.2.3.2.3)
Intermediate Building	Elevation 295'	Add fire barrier to reactor building emergency cooling valves. (4.3.1.3) Add fire detection system to allow for early warning. (4.3.1.3 through 4.3.4.3)
	Elevation 305'	Replace door to turbine building with Class A door. (4.3.5.3)

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Building	Fire Area/Zone	Description of Change (Section)
Intermediate Building (Cont'd)	Elevation - All	Seal joints where intermediate building wall abuts reactor building. (4.8.3)
Control Building	Adjacent Stairwell Area (Elevations 322', 338'-6", 355', and 380')	Add fire hoses at each elevation. (4.7.5.3)
	Walls, Ceilings and Floor (Elevations 322', 338'-6", 355', and 380')	Add fire dampers in each duct penetration. (4.4.2.3 through 4.4.11.3; 4.4.13.3 through 4.4.16.3)
	Control Room (Elevation 355')	Alter window and door to provide appropriate fire resistance rating; Add Halon system to computer room subfloor. Install ionization detectors in panels. (4.4.14.3)
	E.S. Actuation (Elevation 338'-6")	Enclose cable in fire retardant material or add sprinklers. (4.4.11.3)
	Elevations 306', 322', 338'-6", 355', and 380'	Seal cable and pipe penetrations. (4.4.1.3 through 4.4.11.3; 4.4.13.3, 4.4.15.3, 4.4.16.3)
	Elevations 306', 322', 338'-6", 355', and 380'	Doors to fuel handling building to be Class A doors. (4.4.1.3, 4.4.4.3, 4.4.11.3 4.4.12.3, 4.4.13.3 through 4.4.16.3)
Diesel Generator Building	DG-2 (Elevation 305')	Replace access door from service building with Class A door. (4.5.2.3)
Fuel Handling Building	Elevation 281'	Coat those control trays which constitute significant fire loading or add automatic sprinkler system. (4.7.1.3)
Fuel Handling Building to Reactor Building access hatch	Elevation 305'	Upgrade door to A label. (4.7.2.3)
	Elevation - All	Seal joints where fuel handling building wall abuts reactor building.

Building	Fire Area/Zone	Description of Change (Section)
Fuel Handling Building to Control Building	Elevations 322' to 380'	Replace unlabeled doors with Class A doors. (4.7.5.3)
Turbine Building	Elevation - All	Seal joints and penetrations. Replace unlabeled doors with Class A doors. (4.8.3)
Service Building		Replace violated Class A door with approved A labeled door. (4.9.3)

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2.0 METHODOLOGY - FIRE HAZARDS ANALYSIS

2.1 INTRODUCTION

A major task within the Fire Protection Evaluation program was the fire hazards analysis. This task consisted of determining the severity of a fire at any location within TMI-1, and then judging what affect a fire at that location would have on the ability to accomplish safe shutdown.

The objective of this effort was to evaluate whether a single fire could prevent safe reactor shutdown. Where it was determined that a single fire might jeopardize safe reactor shutdown, a modification has been planned to prevent loss of reactor shutdown capability. A summary of planned modifications is presented in Section 1.2 of this report.

The fire hazards analysis was performed in two phases: the first was an information collection process, and the second was the actual analysis and effects evaluation.

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2.2 INFORMATION COLLECTION

Before the fire hazards analysis could be performed, information about TMI-1 was compiled. The effort involved determining equipment required for safe shutdown, including investigating cable and equipment separation, inventorying combustibles, structural fire barrier review, fire detection/protection systems review, and then presenting this information on fire hazards analysis layout drawings.

2.2.1 Safe Shutdown Equipment

The essential functions which must be preserved for safe reactor shutdown are the ability to: remove decay heat from the core, maintain reactor coolant system water inventory, ensure core subcriticality, and control reactor coolant system pressure and temperature. Heat removal capability at hot conditions requires the capability to dump main steam to a heat sink and the ability to control steam generator pressure and water level. This, in turn, provides for reactor coolant system temperature control. Heat removal capability at low temperature conditions requires use of the decay heat removal system and those supporting systems required for effective decay heat removal.

Safe shutdown equipment is defined as the mechanical, electrical, and ventilation equipment including instrumentation, controls, and cable which are required for safe shutdown operation. The following are the bases for the inclusion of the equipment referenced in Section 3.0.

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a. The reliability of the offsite and onsite power sources, the physical separation of redundant equipment, and the fire resistance and nonflame propagating properties of the cable in the electrical systems for TMI-1 are described in Chapter 8 of the FSAR and indicate that a total loss of all offsite electrical power is very unlikely. However, for the purpose of this analysis, a total loss of offsite electrical power to TMI-1 has been assumed; thus only the emergency core cooling system (ECCS) equipment and the onsite emergency power system, which provides ECCS electrical power, have been relied upon to effect TMI-1 safe shutdown. This assumption is considered the most conservative condition, since the availability or restoration of TMI-1 offsite electrical power would allow the use of additional equipment for which no credit has been taken.

b. Manual operation of valves or local control of equipment is considered acceptable since most operations do not require immediate action to maintain safe shutdown conditions. This approach was used to reduce the quantity of equipment required; however, enough equipment is identified in the fire hazards analysis to ensure that the cooldown will always be under the control of the operators.

c. The following categories of valves are considered in the analysis:

(1) Valves for which a change in position is required during the shutdown sequence. Included are both manually and

remotely operated valves. Valves which are in the required position before a postulated fire are assumed not to change position or lose pressure retaining capability.

(2) Valves which have a "fail safe" feature and do not fail in the position required for shutdown. It is assumed that those that fail in the position required for shutdown will do so as a result of loss of electric power or air supply due to a fire. If the electrical or air supplies are available, these valves can be remotely positioned by operator action.

(3) Valves which have the backup or redundant valve in the same zone or area without physical barriers or fire barriers.

(4) Valves which are remote from associated equipment. Valves in the same area as the associated equipment were not considered if the function of this equipment was assumed to be lost.

d. The selection of the instrumentation to be considered in this analysis was based upon the need to:

(1) Maintain the minimum level of redundancy in the reactor protection system to ensure an automatic reactor trip should a fire result in an unsafe condition.

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(2) Provide sufficient information so the operator can ascertain the safety status of the reactor.

(3) Provide sufficient information for the operator to control reactor cooldown in accordance with shutdown procedures.

(4) Protect the engineered safeguards actuation systems which are not required for safe shutdown of the reactor, but whose actuation would adversely affect shutdown procedures.

2.2.2 Inventory of Combustibles

The types of combustibles considered included petroleum products, cable insulation, charcoal filters, and maintenance and operating supplies.

a. Petroleum Products

Petroleum products are defined, for the purposes of this report, as lubricants and diesel fuel utilized at TMI-1. Lubricants were tabulated for all equipment containing one quart or more. Lubrication of equipment requiring smaller quantities of oil is normally accomplished through sealed bearings or oil/grease cup arrangements and is required in negligible amounts.

All transformers within TMI-1 buildings are of the dry construction type and, hence, contain no petroleum products.

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b. Cable Insulation

Cable insulation for power, control, and instrumentation cable installed in cable trays within the reactor building was included in the fire loadings. These loadings were considered even though vendor test reports confirm the nonflame propagating properties of the cable insulation. In the remaining areas of TMI-1 only the control and instrument cable installed in cable trays was considered, since the power cable is provided with an interlocked armored jacket and is not considered to contribute to the fire loading. Cables installed within conduit were not considered to contribute to the fire loadings. Cable insulation is primarily Kerite (approximately 95 percent), and is fire resistant and nonflame propagating. The Kerite cable has been qualified by tests to be of fire resistant construction. Copies of these tests are on file with Metropolitan Edison. The instrument cable that is not Kerite is Continental Wire silicone rubber with a fiberglas outer covering. This cable is also fire resistant and nonflame propagating. Although, as stated, the cabling has been demonstrated by test to be of fire resistant construction, to meet the conservative requirements imposed by Appendix A, the cable insulation has been assumed to be combustible with a calorific value of 10,000 Btu/lb.

Control and instrument cables installed in cable trays are multiple layer, random fill, whereas power cables are installed in a single layer.

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Cable insulation quantity was estimated using the following procedure. For each tray considered within an area, the number of circuits contained was determined from the tray circuit listing. The insulation quantity was then determined by multiplying the number of circuits, by the tray length by the weight of the insulation of an average cable size representative of the tray loading. The total insulation weight for an area was the result of the summation of the individual trays. Since most circuits do not run the full length of a tray, this process yields a conservative (high) estimate of cable insulation quantities.

Instrument and control cabinets, motor control centers, and switchgear equipment were evaluated to determine their potential contribution to the fire loading. Considering the small amounts of fire resistant and nonflame propagating wiring in this type of equipment, together with the metal enclosure, the contribution to the fire loading is considered negligible.

c. Charcoal Filters

The quantity of charcoal in the filters was determined from the filter manufacturer's data.

d. Maintenance and Operating Supplies

Maintenance and operating supplies consist of paper, cloth, plastic, combustible and flammable liquids, and other items required for normal operations. In contrast to the first

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three categories of combustibles, which are permanent and part of the design, these supplies are transient, may vary with time, and can be moved about. Because of these characteristics, they are subject to administrative control. Certain areas of TMI-1, however, require a continual replentishment of these supplies. The controlled access dressing area, for instance, will always contain clothing and associated supplies. For the fire hazards analysis, a survey of the maintenance and operating supplies, records, and furnishings was conducted. The fire loadings used for these transient supplies are representative of what was determined during that survey.

2.2.3 Structural Fire Barrier Review

The structural review consisted of determining fire ratability of existing fire barriers and structures between fire areas within TMI-1. Included in this review was a survey of wall and floor penetrations between fire areas.

2.2.4 Fire Detection/Protection Systems Review

The existing TMI-1 fire detection and protection systems were reviewed to determine their adequacy in protecting safe shutdown equipment.

2.2.5 Fire Hazards Analysis Layout Drawings

These drawings, numbered E-023-001 through E-023-019, show each fire area; separating fire barriers; the safe shutdown equipment

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required within each area, and the existing fire suppression equipment within each area. These form the basis for the zonal fire hazards analysis presented in Section 4.0.

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2.3 FIRE HAZARDS ANALYSIS

The fire hazards analysis presented in Section 4.0 was performed using the steps discussed below.

2.3.1 Identification of Fire Areas and Zones

TMI-1 was divided into fire areas in accordance with the definitions of Appendix A to Branch Technical Position APCSB 9.5-1. For analytical purposes, certain fire areas were subdivided into fire zones. Each fire area and zone is identified and described in Section 4.0.

2.3.2 Review of Safe Shutdown Equipment within Areas and Zones

The safe shutdown equipment is described in Section 3.0 and is shown on the fire hazard analysis layout drawings E-023-001 through E-023-019. The drawings also show the relative position of mechanical equipment, instrument sensors or transmitters, control and power centers, and trays carrying safety related cables. Although not shown on the drawings, separation between redundant cabling was considered during the analysis.

The purpose of the review was to ensure that, in the event of a fire, TMI-1 can be safely shut down. The considerations for each zone are discussed in Section 4.0.

2.3.3 Calculation of Area or Zone Fire Load

The combustible materials located within each area or zone were listed and the fire loading, was calculated in Btu/ft^2. This number was used to verify the adequacy of the existing fire barriers, in accordance with Table 6-8A of the <u>NFPA Fire Protection Handbook</u>, 14th Edition.

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2.3.4 **Review of the Ventilation Systems**

Ventilation systems were evaluated by areas and zones based upon the following considerations:

a. What effect might the ventilation scheme have on a fire within an area or zone?

b. Where would products of combustion be routed through the ventilation system?

c. Would the ventilation system help to spread a fire to another area or zone?

d. What is the affect of shutting down the ventilation system in an area or zone in the event of a fire?

e. Are there any fire or smoke dampers in the ventilation ducts?

2.3.5 **Examination of Existing Area or Zone Fire Detection/Suppression/ Containment**

Examination consisted of determining how a fire within the area or zone would be extinguished, once detected. It was assumed that any permanently installed fire protection equipment would function as designed. The review assured that a fire would be contained within a fire area until extinguished.

2.3.6 **Degree of Compliance with the Specific Separation Criteria of Regulatory Guide 1.75 (Revision 1, 1/75)**

2.3.6.1 Introduction

Regulatory Guide 1.75 "Physical Independence of Electrical Systems" addresses the separation requirements for redundant circuits used in nuclear plant safety systems. The level of redundancy of the reactor protection system at TMI-1 is described in detail in Chapter 8 of the FSAR. For the purpose of this report the following is a summary description.

a. Reactor Protection System (RPS)

The RPS is a four-channel, redundant system in which the four protection channels are brought together in four identical 2-out-of-4 logic networks of the reactor trip modules. A trip in any two of the four protection channels initiates a trip of the four logic networks. The system to this point has the reliability and advantages of a pure 2-out-of-4 system. Each of the reactor trip modules (2-out-of-4 logic networks) controls a control rod drive breaker or contactor. Thus, a trip in any two of the four protection channels initiates a trip of all the breakers and contactors.

The wiring associated with the input signal to the reactor protection system is segregated in four independent instrument channels (identified as A, B, C, and D channels) which run in either totally enclosed instrument cable trays or conduits. Circuit wiring from the reactor protection system to the trip breaker, as well as the cross circuit wiring between the reactor protection rack subassembly, is routed exclusively in physically separated and independent steel conduits.

b. Engineered Safeguards Actuation System

Except for reactor building spray actuation, which is not required for safe shutdown following a fire, the engineered safeguards actuation system has a 2-out-of-3 logic developed in a 1-out-of-2 actuation channel.

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The wiring associated with the input signals is segregated in three independent instrument channels (identified as A, B, and C channels) which are installed in either totally enclosed instrument cable trays or steel conduits. The output wiring is separated into two independent actuation channels (identified as A and B) and routed in physically separate and independent control cable trays or steel conduit.

Some auxiliaries are controlled by either "A" or "B" actuation channels. These have been identified as being controlled by a "C" actuation channel and have been kept physically separated from both "A" and "B" channels. The "C" channel alone does not provide 100 percent of the safe shutdown equipment requirements. Usually the equipment assigned to the "C" channel represents excess redundancy such as is obtained by the use of three 100 percent capacity items of equipment. Except for the interlocked armored jacketed power cable for the makeup pump and nuclear service cooling pumps, "C" channel equipment may be lost in a fire simultaneously with either A or B equipment.

2.3.6.2 Analysis

Regulatory Guide 1.75, Revision 1, sets forth requirements for the physical independence of redundant circuits and electrical equipment to be provided to ensure that potential hazards will not prevent the successful operation of the protective functions required during and following any design basis accident (DBA). Since within the context of this report, fire is the only

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postulated hazard and no DBA has to be considered simultaneously, all requirements of Regulatory Guide 1.75 need not be evaluated in this report.

The requirements most relevant to this fire hazards analysis are those relative to the separation of cable raceways in the cable spreading room, main control room and TMI-1 balance-of-plant (BOP) areas.

Chapter 8 of the FSAR describes the separation requirements which have been followed in the design and construction of TMI-1. The following provides an evaluation of the degree of compliance with Regulatory Guide 1.75 separation requirements for the purpose of supporting the conclusions of this report.

a. General Separation Features

The amount of physical separation used throughout TMI-1 between redundant safety related equipment and wiring is commensurate with the postulated, internally generated cable fire hazards (uninterrupted circuit faults).

Since most of the safety related equipment is also required for safe shutdown of TMI-1 following a fire, the as-built separation provides adequate protection against internally generated fires.

Inherent features of the TMI-1 equipment locations have been used to provide maximum separation. The most important of

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these features are the following:

(1) The two emergency diesel generators are each located in an independent, separate concrete bu. .ding.

(2) The redundant engineered safeguards switchgear (4160 and 480 volt) are located in independent rooms bounded by 3 hour fire walls.

(3) The redundant batteries and inverters are also located in independent rooms bounded by 3 hour fire walls.

(4) Particular precautions have been taken to ensure that the redundant cables entering the relay room/cable spreading room are provided with spatial separation and/or UL listed fire barriers.

(5) Safety related cables inside the reactor building have been run in steel conduit.

Redundant cables were not routed in areas where concentrated combustible materials exist. Class 1E cables and non-Class 1E cables are installed in safety related raceways. These cables have been color coded to identify their channel association, as well as to discriminate between their classification. Non-Class 1E cables, color coded to indicate association with a particular channel, have not been run with any redundant channel cabling.

b. General Design Basis

The specific separation criteria discussed in items c, d and e for safety related cabling were utilized in the construction of TMI-1. These criteria are based upon the following:

(1) Use of open ventilated steel tray for power and control cable.

(2) No cable splices in raceways.

(3) No cable tray overfill.

(4) Limitation of fire hazards to failures or faults internal to the electric equipment or cable circuits.

(5) Use of flame retardant and nonflame propagating cables. Manufacturer test reports are on file with Metropolitan Edison.

c. General Area Criteria

(1) In areas of TMI-1 containing redundant color coded wiring, a 3 foot minimum separation has been maintained between wiring of mutually redundant channels. A 3 foot separation in the vertical or horizontal direction is maintained between raceways of different channels, where possible.

(2) If the minimum separation of item c.(1). was not maintained, a UL listed fire barrier three times the width of the widest raceway involved (minimum width of barriers is 18 inches), either vertically or horizontally, has been installed. Barrier material

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consists of Johns-Manville Marinite 65 type A insulation with a minimum 1/2 inch thickness listed by UL. Where practical, the vertical barriers extend from one foot below the cable tray to the ceiling.

d. Relay Room Area Criteria

This room also serves as the cable spreading area for cable entering the control room. The following separation is provided in the relay room:

(1) Where cable trays parallel each other in the horizontal plane, the 3 foot separation is maintained.

(2) Where cable trays of different channels parallel or cross over each other, and a 3 foot separation could not be maintained, a fire barrier was installed.

(3) Where a channelized conduit parallels a channelized cable tray, a 6 inch separation is maintained in any plane, except when a channelized conduit is above a channelized tray; in this case a three foot separation is maintained.

(4) A channelized conduit intersecting a channelized cable tray at any angle maintains a 3 foot separation above the tray, and a six inch separation below the tray.

(5) Conduits of different channels maintain a 6 inch separation.

e. Control Room Criteria

In the control room, separation is provided for safety related component cables and wiring located inside cabinets and

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consoles. The components mounted in control cabinets are arranged to maintain a three foot physical separation for items of mutually redundant engineered safeguards channels. Where this separation distance cannot be maintained a fire barrier has been installed. Floor slots and raceways have been arranged in a manner to comply with the separation requirements. Field wiring between the raceway and cabinet terminal blocks is arranged to maintain separation between channels. This separation is 3 feet where possible, but 6 inches is the minimum acceptable without fire barriers. Internal cabinet wiring of safety related circuits is identified and separated by channels. Wiring of mutually redundant channels is separated by at least six inches free space or by a fireproofing type barrier material installed between channels.

2.3.6.3 Evaluation - Conclusion

While Regulatory Guide 1.75, Revision 1, did not constitute design criteria for TMI-1, the separation criteria established were based upon drafts of IEEE 384. The criteria that were used meet the intent and, in many instances, exceed the requirements of Regulatqry Guide 1.75. The most important difference is the Regulatory Guide requirement for 5 feet vertical spatial separation between redundant cable tray run in general areas rather than the 3 feet used. It is considered that, within the context of this report, the consequences of this difference in separation requirement are not significant.

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2.3.7 Containment of Radioactivity

The reactor, auxiliary and fuel handling buildings house equipment that normally contains radioactivity. The methods of containing radioactive leakage and releases from these buildings are as follows:

a. Reactor Building

Liquid spillage or leakage, from equipment within the reactor building, drains into the building sump. From the reactor building sump liquid drains to the auxiliary building sump, where it is pumped to the miscellaneous waste storage tank in the auxiliary building for normal liquid waste processing. Section 11.2.1 of the FSAR details the handling and containing of liquid radioactive wastes.

Gaseous release or leakage within the reactor building is retained within the building until released in a controlled manner. These releases are controlled by existing procedures and are released through the containment purge exhaust system to the environment.

b. Auxiliary and Fuel Handling Buildings

Liquid spillage or leakage from equipment within these buildings drains into either the spent fuel pit sump or the auxiliary building sump. From either sump, it is pumped to the miscellaneous waste storage tank in the auxiliary building for normal liquid waste processing. Section 11.2.1 of the FSAR details the handling and containing of liquid radioactive wastes.

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Radioactive gases from equipment leakage pass into the auxiliary and fuel handling exhaust ventilation systems and through the associated roughing, HEPA, and charcoal filters. The release of radioactive gases to the environment is controlled by existing procedures.

Radioactive liquids and gases are normally contained within piping and process equipment, such as tanks, pumps, compressors, demineralizers, filters, and evaporator packages. The major sources of radioactivity would be the storage tanks which are located in shielded cubicles having very low fire loadings. Tanks are provided with over pressure devices which will operate if a fire causes pressure buildup within the equipment. Liquid releases would be collected through the floor drain system and would be released as described above. Releases from the gaseous radioactive waste system would be limited to the waste gas decay tanks since the gaseous spaces of the other tanks are interconnected through the waste gas vent header system. This would allow the gaseous expansion due to a fire in one area to be accommodated throughout the entire system. The waste gas decay tanks, which are isolated from the vent header, are each located in a cubicle that has no permanent combustible fire loading. The cubicles are connected by access openings. Except for periods when maintenance is being performed, no combustible materials will be present in these cubicles. Therefore, no fire which cannot be readily extinguished is postulated.

Another possible problem resulting from a fire is that the water used to fight the fire may become radioactively contaminated. However, such contamination does not result in uncontrolled releases. The fire fighting water will be contained and controlled in the same manner as equipment spillage or leakage described above.

2.3.8 Basis For Conclusions

Conclusions regarding the adequacy of existing fire protection in the fire hazards analysis are based upon the following:

a. If the existing fire barriers or barriers with planned modifications (sealing penetrations, adding fire dampers in ducts, installing rated access doors, etc.) are adequate to prevent the spread of a fire based upon the calculated loading, to redundant equipment or cable, no further modifications were considered. The adequacy of fire barriers for the calculated fire loadings was based upon requirements in the NFPA Fire Protection Handbook, 14th Edition, Page 6-81 Table 6-8A. Changes to existing fire barriers to achieve the required rating of walls, floors, or ceilings are included as recommended design modifications in Section 1.2.

b. If the spatial separation between redundant equipment or cable is sufficient to prevent a fire, based upon the calculated loading, from causing loss of function of both items, then no further modifications were considered. If the existing fire protection systems are considered adequate for the types of potential fires, then no modifications to these systems are required. The adequacy of spatial separation for electrical equipment is based upon Regulatory Guide 1.75, Revision 1, as discussed in Section 2.3.6.

c. No modifications to the existing fire protection were required for the following:

   (1) In areas or zones where the calculated fire loading is minimal.

   (2) Where no redundant safe shutdown equipment or cables are located.

   (3) Where the fire protection equipment is considered adequate for the types of potential fire.

   It is concluded that a single fire in these areas or zones will not affect more than one channel of equipment or cable. Therefore, such a fire will not jeopardize the safe shutdown capability of TMI-1.

d. The existing fire protection equipment for each area or zone was reviewed to determine if it is adequate for the calculated fire loading and the type of potential fire that can be expected. If it was concluded that an additional or different type of fire protection equipment was required, it was included in the recommended modifications in Section 1.2.

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e. Where redundant electrical equipment with ambient temperature limitations is located in the same room or fire area, the significant combustibles are either protected with automatic extinguishing systems or enclosed in fire retardant materials. Where redundant electrical equipment with temperature limitations is located in adjacent rooms and fire dampers are installed in the common HVAC duct at the separating walls, the effects of the loss of cooling were evaluated. It was concluded that for the worst case situation, more than one hour is available to extinguish the fire and establish backup cooling by means of portable fans. This would enable cooling air to circulate from areas not affected by the fire. This is considered adequate time for the fire brigade to respond to this type of situation.

f. In areas or zones where automatic fire suppression systems have been installed, it is concluded that safe shutdown equipment and cable are adequately protected to prevent loss of function of both channels or to prevent the spread of fire to areas containing redundant safe shutdown equipment or cable.

g. In areas or zones containing safe shutdown valves, where the temperature effects of the fire could impair valve functions, it was concluded that a thermal barrier or automatic fire suppression system, dependent upon location, was necessary. This would protect valve operators and permit manual operation after the fire was extinguished. The thermal barrier and automatic fire suppression system location is included in the design modifications listed in Section 1.2.

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3.0 SAFE REACTOR SHUTDOWN

The main consideration of the fire hazards analysis was to evaluate the capability of safe reactor shutdown. The safe shutdown procedure was assumed to start with TMI-1 at full power and end with the reactor coolant system in long term cooling operation utilizing the decay heat removal system.

Section 3.1 presents the shutdown sequence upon which the analysis was based. Section 3.2 contains brief descriptions of the systems required for safe reactor shutdown. Table 3-1 is a list of equipment necessary for safe shutdown.

3.1 SHUTDOWN SEQUENCE

The following shutdown sequence was derived from existing shutdown emergency procedures. For the fire hazards analysis, the shutdown sequence starts with a reactor trip, actuated automatically or manually from the control room or the control rod drive trip breaker area. Once actuated, no further control rod motion is required.

Following a reactor shutdown or trip, emergency feedwater flow to the steam generators is established. Throughout the cooldown, steam generator water level is maintained by manually controlling the emergency feedwater control valves. Reactor coolant system cooldown is initiated by relieving main steam through the atmospheric steam dump valves. Reactor coolant system water

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inventory is maintained by operation of the makeup pumps. Primary coolant letdown is isolated and the makeup pumps are cycled to maintain pressurizer level which otherwise would decrease due to reactor coolant system contraction during cooldown.

The procedure, assumed for purposes of defining safe shutdown equipment for the fire hazards analysis, is to borate while making up for reactor coolant temperature contraction. The reactor coolant contraction during cooldown allows for injection of sufficient boric acid solution from the borated water storage tank to achieve a 1 percent subcritical margin in the cold condition as described in the basis of Technical Specification 3.2.

Decay heat removal is established at its normal point during the reactor cooldown sequence. Once decay heat removal is established, the emergency feedwater and steam dump are secured. Cooldown continues until cold shutdown conditions are achieved and long term decay heat removal is established, thereby ending the cooldown process.

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3.2 DESCRIPTION OF SAFE SHUTDOWN SYSTEMS/EQUIPMENT

The systems and equipment required for a cold shutdown of the r - . a-e discussed herein. These systems and/or equipment include:

a. Makeup and Purification

b. Decay Heat Removal

c. Decay Heat Closed Cycle Cooling Water

d. Decay Heat River Water

e. Nuclear Services Closed Cycle Cooling Water

f. Emergency Diesel Generators

g. Emergency Feedwater

h. Main Steam

i. Reactor building Emergency Cooling

j. Instrumentation and Control Equipment

k. Electrical Equipment

3.2.1 <u>Makeup and Purification System</u>

Normal operation of the makeup and purification system is described in Section 9.1 of the FSAR. For reactor shutdown this system has two functions:

a. To inject water into the reactor coolant system at high pressure for maintaining the required reactor coolant volume during thermal contraction due to the temperature decrease.

b. To inject boric acid from the borated water storage tank into the reactor coolant system to increase boron concentration to that required for cold shutdown.

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3.2.2 Decay Heat Removal System

Normal operation of the decay heat removal system is described in Section 9.5 of the FSAR. The functions of this system during reactor cooldown are as follows:

a. Remove core decay heat and reactor coolant system sensible heat during the latter stages (below 250°F reactor coolant temperature) of cooldown until complete cold shutdown conditions are achieved.

b. Following cooldown, remove core decay heat to maintain constant reactor coolant system temperature at cold shutdown conditions.

c. Provide auxiliary spray to the pressurizer to complete pressurizer cooldown.

d. Provide a source of boric acid from the borated water storage tank for the makeup pump to borate the reactor coolant system to the cold shutdown conditions.

3.2.3 Decay Heat Closed Cycle Cooling Water

Normal operation of the decay heat closed cycle cooling water system is described in Section 9.6 of the FSAR. The functions of this system during reactor cooldown are as follows:

a. Transfer the heat removed from the reactor coolant system through heat exchangers to the decay heat river water system. (This is the same as the normal function of this system.)

b. Provide backup cooling water for makeup pump motors and bearings.

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3.2.4 Decay Heat River Water

Normal operation of the decay heat river water system is described in Section 9.6 of the FSAR. The function of this system during reactor shutdown is to circulate river water through the decay heat service coolers. This is the same as the normal function for this system.

3.2.5 Nuclear Services Closed Cycle Cooling Water System

Normal operation of the nuclear services closed cycle cooling water system is described in Section 9.6 of the FSAR. Auxiliaries needed for reactor cooldown and to maintain cold shutdown conditions, which require cooling water from the nuclear services closed cycle cooling water system, are as follows:

a. Spent fuel coolers.

b. Reactor building recirculation unit fan motor coolers.

c. Makeup pump and motor (MU-P1B).

d. Emergency feedwater pump rooms and instrument air compressor room air coolers.

e. Nuclear service closed cycle cooling pump area and decay heat closed cycle cooling pump area air coolers.

f. Spent fuel pump area air coolers.

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For reactor cooldown and under cold shutdown conditions, the loop with the intermediate coolers can be isolated. The river water to the intermediate coolers can be isolated and the additional flow made available to the nuclear services coolers by operator action. Also, the cooling water to the above services represents only a portion of the normal cooling water requirements. This reduced closed cycle cooling water requirement, combined with the additional river water available due to the shutdown of the intermediate coolers, permits use of minimum equipment that must remain operational for reactor cooldown and maintenance of cold shutdown conditions.

3.2.6 Emergency Diesel Generators

Upon loss of the normal sources of electrical power, power is supplied from two automatic, fast startup diesel generators. The ratings of each emergency diesel generator are indicated in Chapter 8 of the FSAR. Each emergency diesel generator feeds one of the engineered safeguards 4160 volt busses, and is capable of continuously supplying the engineered safeguards load and selected balance-of-plant loads connected to the associated bus. These loads encompass the safe shutdown functions.

Sufficient fuel is stored onsite in the main storage tank to allow one diesel generator to supply power re[illegible]ements for seven days. Fuel storage at each diesel generator (in day tanks) is sufficient for approximately three hours of full load operation. Fuel level in the day tanks is automatically maintained

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from the main storage tank using an a-c motor driven pump associated with each diesel generator. A redundant d-c motor driven pump is provided for each diesel generator.

The diesel generators are separately enclosed and located in an annex on the opposite side of the building from the 230 kv substation and transformers.

Each diesel engine is automatically started upon the occurrence of a loss of voltage on the 4160 volt engineered safeguards bus with which the emergency diesel generator is associated. Loss of voltage detection uses 2-out-of-3 logic. The generator is automatically connected to the bus when it reaches operating speed and voltage. The sequence following the starting signal is as follows:

a. Automatic tripping of all feeder breakers.

b. Automatic closure of the emergency diesel generator circuit breaker after the generator comes up to speed and voltage.

c. Automatic and manual starting of equipment required for safe operation.

3.2.7 Emergency Feedwater System

The normal function of the emergency feedwater system is described in Section 10.2 of the FSAR. For normal shutdown of the reactor, the main feedwater system provides feedwater to the steam generators for removal of decay heat when the reactor coolant temperature is above 250°F. Assuming the complete loss of offsite electrical power, the emergency feedwater system will automatically take over the decay heat removal function of the main feedwater system.

3.2.8 Main Steam System

The normal function of the main steam system is described in Section 10.2 of the FSAR. For normal shutdown of the reactor, the steam produced in the steam generators by decay heat is bypassed to the condenser through the steam dump system at reactor coolant temperatures above 250°F. Assuming complete loss of offsite electrical power to TMI-1, the steam is discharged to the atmosphere via the main steam safety valves and the controlled atmospheric relief valves until the reactor coolant system temperature is reduced to 250°F. After cooling to 250°F, the decay heat removal system is used to achieve cold shutdown conditions in the reactor coolant system.

3.2.9 Reactor Building Emergency Cooling System

The normal operation of the reactor building emergency cooling system is described in Section 9.6 of the FSAR. During normal shutdown of the reactor, the reactor building ventilation system removes heat from the reactor building as described in Section 5.6 of the FSAR. Assuming complete loss of offsite electrical power, the reactor building emergency cooling system will remove heat from the reactor building.

3.2.10 Instrumentation and Control Systems

Table 3-1 identifies the instrumentation which has been considered based upon the criteria outlined in Section 2.2.1, item d.

Following an automatic trip by the reactor protection system or an operator initiated shutdown, sufficient instrumentation will be available for the operator to ascertain the safety status of the reactor coolant system and to control primary system cooldown. The reactor protection parameters measured by redundant instruments, together with the diverse control rod indication (actual and inferred), will indicate primary system status.

If required, the reactor coolant primary system will be isolated by closing all letdown paths, and pressurizer level will be maintained by control of the makeup pump which takes suction from the borated water storage tank. Reactor coolant temperature and pressure will also be maintained within the cooldown envelope by manual control of feedwater level in either one or both of the steam generators.

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TABLE 3-1 (Page 1 of 6)

SAFE SHUTDOWN RELATED EQUIPMENT

a. Mechanical Equipment

Makeup and Purification System	Identification	No. Required	Location
Makeup pumps and associated oil pumps	MU-P1A,B,C	1	Auxiliary building, Elevation 281'
Borated water storage tank to makeup pump suction isolation valves	MU-V14A,B	1	Auxiliary building, Elevation 281'
Makeup pump discharge lines (safety injection lines) to reactor coolant system isolation valves	MU-V16A,B,C,D	1	Auxiliary building, Elevation 281' and 305'
Decay Heat Removal System			
Decay heat removal coolers	DH-C1A,B	1	Auxiliary building, Elevation 261'
Decay heat removal pumps	DH-P1A,B	1	Auxiliary building, Elevation 261'
Borated water storage tank	DH-T1	1	Outdoors, at grade
Reactor coolant system outlet to decay heat removal pumps suction, isolation valves	DH-V1	1	Reactor building, Elevation 281'
	DH-V2	1	Reactor building, Elevation 281'
	DH-V3	1	Auxiliary building, Elevation 281'
Reactor coolant system inlet valves from decay heat removal pump discharge, isolation valves	DH-V4A,B	1	Auxiliary building, Elevation 281'
Decay heat removal pumps suction lines, isolation valves	DH-V12A,B	1	Auxiliary building, Elevation 281'

	Identification	No. Required	Location
Decay Heat Closed Cycle Cooling Water System			
Decay heat closed cycle cooling water pumps	DC-P1A,B	1	Auxiliary building, Elevation 305'
Decay heat closed cycle coolers	DC-C2A,B	1	Auxiliary building, Elevation 271'
Decay heat closed cycle cooling surge tanks	DC-T1A,B	1	Auxiliary building, Elevation 329'
Decay Heat River Water System			
Decay heat river water pumps	DR-P1A,B	1	Intake screen and pump house, Elevation 308'
Nuclear Services River Water Systems			
Nuclear services river water pumps	NR-P1A,B,C	1	Intake screen and pump house, Elevation 308'
Nuclear Services Closed Cycle Cooling Water Systems			
Nuclear services closed cycle coolers	NS-C1A,B,C,D	2	Auxiliary building, Elevation 271'
Nuclear services closed cycle cooling water pumps	NS-P1A,B,C	1	Auxiliary building, Elevation 305'
Nuclear services closed cycle cooling surge tank	NS-T1	1	Fuel handling building, Elevation 348'
Emergency Diesel Generator Systems			
Diesel generators and related auxiliaries	EG-Y-1A,B	1	Diesel generator building, Elevation 305'

	Identification	No. Required	Location
Emergency Feedwater System			
Emergency feedwater pumps	Motor driven EF-P2A,B	2	Intermediate building, Elevation 295'
	or		
	Turbine driven EF-P1	1	
Condensate storage tanks	CO-T1A,B	1	Outdoors, Elevation 305'
Emergency feedwater control valves	EF-V30A,B	1	Intermediate building, Elevation 295'
Main Steam System			
Controlled atmospheric relief valves	MS-V4A,B	1	Intermediate building Elevation 295'
Main steam safety valves	MS-V17A,B,C,D	All	Intermediate building, Elevation 322'
	MS-V18A,B,C,D	All	
	MS-V19A,B,C,D	All	
	MS-V20A,B,C,D	All	
	MS-V21A,B	All	
Reactor Building Emergency Cooling System			
Reactor building emergency cooling units	RR-C1A,B,C	2	Reactor building, Elevation 281'
Reactor building emergency cooling pumps	RR-P1A,B	1	Intake screen and pump house, Elevation 308'
Reactor building cooling unit river water outlet isolation valves	RR-V4A,B,C,D	2	Intermediate building, Elevation 295'

b. Instrumentation and Control Equipment

Description	Identification	No. Required	Location
Out of core detectors	NI-5, NI-6 NI-7, NI-8	2 of 4	Reactor building inside primary shield
Reactor coolant pressure	RC3A-PT1, RC3B-PT2 RC3B-PT1, RC3A-PT2	2 of 4	Reactor building around secondary shield, Elevation 346'
	RC3A-PT3, RC3A-PT4 RC3B-PT3	2 of 3	
Reactor coolant temperature	RC4A-TE2, RC4B-TE2 RC4A-TE3, RC4B-TE3	2 of 4	Reactor building inside secondary shield (primary system piping)
Reactor coolant flow	RC14A-ΔPT1, RC14A-ΔPT2 RC14A-ΔPT3, RC14A-ΔPT4	2 of 4	Reactor building outside secondary shield, Elevation 308'
	RC14B-ΔPT1, RC14B-ΔPT2, RC14B-ΔPT3, RC14B-ΔPT4	2 of 4	
Reactor building pressure	BS-282-PT, BS-285-PT, BS-288-PT	2 of 3	Auxiliary building, Elevation 281'
	BS-283-PS, BS-286-PS, BS-289-PS	2 of 3	Auxiliary building, Elevation 281'
	BS-284-PS, BS-287-PS, BS-290-PS	2 of 3	Auxiliary building, Elevation 281'
Engineered safeguards actuation racks	ES Bistable Cabinets 1,2,3	2 of 3	Control building, Elevation 338'-6"

Description	Identification	No. Required	Location
	ES Actuation Relay Cabinets 1A, 2A, 3A	1 out of 2 sets of cabinets	Control building, Elevation 338'-6"
	ES Actuation Relay Cabinets 1B, 2B, 3B		Control building, Elevation 338'-6"
	ES Actuation Cabinets 4, 5	1 of 2	
Reactor protection racks	Sub-assembly A, B, C, D	2 of 4	Control building control room, Elevation 355'
Steam generator steam pressure	SP6A-PT1, SP6A-PT2 SP6B-PT1, SP6B-PT2	One of either A or B	Reactor building, El. 281'
	PS-600, PS-601 PS-602, PS-603	1 of 2 twice	
	PS-604, PS-605 PS-606, PS-607	1 of 2 twice	
Steam generator feedwater level	SP1-A-LT1, SP1-B-LT1	1 of 2	Reactor building, El. 281'
Control rod position indication switches		1 of 2	Reactor building, inside primary shield
Control rod drive control, relative rod position indication	N/A		Control building, El. 338'-6" relay room
Auxiliary relay cabinet	XCC, XCL, XCR	1 of 3	Control building, El. 338'-6" relay room
Main control room console	Section CC, CL, CR	-	Control building control room, El. 355'

c. Electrical Equipment

Description	Identification	No. Required	Location
Emergency diesel	DG1, DG2	1 of 2	Diesel generator building, DG-1 and DG-2
4160 V switchgear	1D, 1E	1 of 2	Control building, Elevation 338'-6"
480 V switchgear	1P, 1S	1 of 2	Control building, Elevation 322'
Engineered safeguards motor control center	1A, 1B	1 of 2	Control building, Elevation 322'
Batteries	A and C, B and D	1 of 2 sets	Control building, Elevation 322'
Inverters	1A and 1C, 1B and 1D	1 of 2 sets	Control building, Elevation 322'
Distribution panels	A,B	1 of 2	Control building, Elevation 322'
AC and DC transfer switch		-	Control building, Elevation 322'
Screen house 480 V switchgear	A,B	1 of 2	Intake screen and pump house
Screen house motor control center	A,B	1 of 2	Intake screen and pump house

4.0 FIRE HAZARDS ANALYSIS

4.1 REACTOR BUILDING

The reactor building houses the nuclear steam supply system. This equipment is shown on drawings E-023-002, E-023-003, E-023-005, E-025-007, E-023-009, and E-023-010.

The building is bounded on the north by the intermediate building, on the east by the turbine building, on the south by the fuel handling building and on the southwest by the auxiliary building. The walls, dome, and floors of the reactor building are of reinforced concrete construction. The inside surface of the reactor building is lined with a carbon steel liner to ensure a high degree of leak tightness during operation and accident conditions. Access to the area is through personnel and equipment access hatches. The building has three floor elevations with open stairways and other openings between the stairs. The steam generators, reactor coolant pumps, and pressurizer are located within a concrete secondary shielding, open at the top, and accessible at the lower elevation through a shielded labyrinth. The biological shield around the reactor vessel, and the refueling pool above it, divide the secondary shield into two parts. Each part contains one steam generator and two reactor coolant pumps.

The reactor building comprises a single fire area which, for the purpose of analysis, has been divided into seven fire zones as described in the following sections.

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4.1.1 Reactor Building Outside Secondary Shield, North at RB-1a (Elevation 281')

4.1.1.1 Description

The safe shutdown equipment located in this zone consists of reactor building emergency cooling units A, B and C (see drawing E-023-002, coordinate E-15).

4.1.1.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result, there is a total fire loading of 4,925 Btu/ft^2 in a 6,550 ft^2 area. Fire protection for this zone consists of water fire extinguishers as shown on drawing E-023-002, and accessible Halon fire extinguishers as shown on drawing E-023-003.

4.1.1.3 Conclusion

Due to the limited amount of combustible material in this zone and the separation between the enclosed, redundant reactor building emergency cooling units, the existing fire protection for this zone is considered adequate. However, because of limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.1.2 Reactor Building Outside Secondary Shield, Southeast at RB-1b (Elevation 281')

4.1.2.1 Description

The safe shutdown equipment located in this zone consists of instrumentation for the measurement of steam generator A feedwater and pressurizer levels (E-023-002, B-12).

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4.1.2.2 Analysis

The combustibles in this zone are negligible. Three pressurizer level transmitters are located in this zone with wiring in metallic conduit to the reactor building termination boxes. There is no permanent combustible material close to the transmitters and their wiring. Fire protection for this zone consists of a water fire extinguisher as shown on drawing E-023-002, and accessible Halon fire extinguishers as shown on drawing E-023-003.

4.1.2.3 Conclusion

Due to the negligible amount of combustible material in this zone, the spatial separation between steam generator A and B level instrumentation, and the absence of combustible material in the vicinity of the pressurizer level transmitters and associated wiring, the fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.1.3 Reactor Building Outside Secondary Shield, Southwest at RB-1c (Elevation 281')

4.1.3.1 Description

The safe shutdown equipment located in this zone consists of instrumentation for measurement of steam generator B feedwater level, decay heat removal valve (DH-V2), and safety related cable. (E-023-002, E-11).

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4.1.3.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result, there is a total fire loading of 9,300 Btu/ft^2 in a 1,700 ft^2 area. Fire protection for this zone consists of water fire extinguishers as shown on drawing E-023-002, and accessible Halon fire extinguishers as shown on drawing E-023-003.

4.1.3.3 Conclusion

The results of the analysis indicate that thermal protection will be required for the decay heat removal valve. Due to the limited amount of combustible material in this zone, the spatial separation between steam generators A and B level instrumentation and the thermal protection to be provided for the decay heat valve, the fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.1.4 Reactor Building Outside Secondary Shield at RB-2 (Elevation 308')

4.1.4.1 Description

The safe shutdown equipment located in the zone consists of instrumentation for measurement of steam generators A and B steam pressure (E-023-003 and E-023-005, E-14).

4.1.4.2 Analysis

The combustibles in this zone consist of charcoal in the kidney filter plenum, cable insulation and transient material. As a

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result, there is a total fire loading of 17,500 Btu/ft^2 in a 9,850 ft^2 area. Fire protection for this zone consists of two water fire extinguishers and a self-contained automatic deluge water system for the charcoal in the kidney filter plenum. The detection and deluge actuator system for the kidney filter plenum is connected to the emergency power. Emergency power is not provided for the two 90 gpm pumps.

4.1.4.3 Conclusion

Due to the limited combustible material in this zone, the spatial separation between redundant instrumentation, and the automatic deluge water system provided for the charcoal in the kidney filter plenum, the existing fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.1.5 <u>Reactor Building Outside Secondary Shield at RB-3 (Elevation 346')</u>

4.1.5.1 Description

The safe shutdown equipment located in this zone consists of instrumentation for measurement of reactor coolant pressure. (E-023-003, D-11; E-023-005, D-12; E-023-007, E-13; E-023-009, E-6).

4.1.5.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result, there is a total fire loading of 3,250 Btu/ft^2 in a 9,850 ft^2 area. The fire protection for this

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zone consists of water and dry chemical fire extinguishers as shown on drawing E-023-007, and accessible Halon fire extinguishers as shown on drawing E-023-003.

4.1.5.3 Conclusions

Due to the limited amount of combustible material in this zone and the spatial separation between redundant safe shutdown instrumentation, the existing fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.1.6 Reactor Building Inside Secondary Shield, East at RB-1d (Elevation - All)

4.1.6.1 Description

The safe shutdown equipment located in this zone consists of steam generator A, the pressurizer and associated relief valves, and instrumentation for measurement of pressurizer and reactor coolant temperature. (E-023-002, D-12; E-023-003, C-12; E-023-005, C-12; E-023-007, D-12; E-023-009, C-6).

4.1.6.2 Analysis

The combustibles in this zone consist of oil in the reactor coolant pump motor lubrication system and cable insulation. As a result, there is a total fire loading of 240,000 Btu/ft^2 in a 1,700 ft^2 area. Of this amount, the oil contained in each reactor coolant pump motor contributes approximately 100,000 Btu/ft^2 to the fire loading. Each motor is equipped with an oil splash guard designed to collect the lubricating oil in case of a spill or from breakage of the oil pipe or the oil reservoir.

The splash guard essentially encloses the upper bearing housing and is surrounded by a collection gutter. Three 2 inch lines are combined to drain, through a common 2-1/2 inch drain line, any accumulated oil to a collector. The lower bearing is equipped with a collection pan, also connected to the 2-1/2 inch drain line. The auxiliaries required for reactor coolant pump motor lubrication are located in the upper bearing housing. The upper bearing oil reservoir has a capacity of 120 gallons and the lower bearing oil reservoir has a capacity of 18 gallons. The fire protection for this zone consists of accessible water fire extinguishers and accessible Halon fire extinguishers.

4.1.6.3 Conclusion

Considering that the existing splash guard, which collects spilled oil, appreciably reduces the probability that lubricating oil will be in contact with hot pipes, the potential for a reactor coolant pump oil fire is very low. In the event of a fire, sufficient spatial separation exists between redundant safe shutdown instrumentation and between the redundant steam generators to ensure safe shutdown. Therefore, the existing fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire. Also, a curb will be added to ensure that any oil spilled in this zone does not spread.

4.1.7 Reactor Building Inside Secondary Shield, West at RB-1e (Elevation - All)

4.1.7.1 Description

The safe shutdown equipment located in this zone consists of the steam generator B, decay heat removal valve (DH-V1), and instrumentation for measurement of reactor coolant temperature. (E-023-002, F-12; E-023-003, F-12; E-023-005, F-12; E-023-007, F-12; E-023-009, F-6).

4.1.7.2 Analysis

The combustibles in this zone consist of cable insulation and oil from the reactor coolant pump motor lubrication system. As a result, there is a total fire loading of 201,000 Btu/ft^2 in a 1,700 ft^2 area. Of the total fire loading, the oil contained in each reactor coolant pump motor contributes approximately 100,000 Btu/ft^2. Each motor is equipped with an oil splash guard designed to collect the lubricating oil in case of a spill, breakage of the oil pipe, or breakage of the oil reservoir.

The splash guard essentially encloses the upper bearing housing and is surrounded by a collection gutter. Three 2 inch lines are combined, through a common 2-1/2 inch drain line, to drain any accumulated oil to a collector. The lower bearing is equipped with a collection pan, which is also connected to the 2-1/2 inch drain line. The auxiliaries required for reactor coolant pump motor lubrication are located in the upper bearing housing. The upper bearing oil reservoir has a capacity of 120 gallons and the lower bearing reservoir has a capacity of 18 gallons. The fire protection for this zone consists of a water fire extinguisher and an accessible Halon fire extinguisher.

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4.1.7.3 Conclusion

The results of the analysis indicate that thermal protection will be required for the decay heat removal valve. Considering that the existing splash guard, which collects spilled oil, appreciably reduces the probability that lubricating oil will be in contact with hot pipes, the potential for a reactor coolant pump oil fire is very low. In the event of a fire, sufficient spatial separation exists between redundant safe shutdown instrumentation and between the redundant steam generators to ensure safe shutdown. Therefore, the existing fire protection for this zone is considered adequate. However, because of the limited access to the reactor building, a fire detection system will be added in this zone for early warning in the event of a fire. Also, a curb will be added to ensure that any oil spilled in this zone does not spread.

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4.2 AUXILIARY BUILDING

The auxiliary building houses auxiliary equipment for the nuclear reactor. This equipment includes waste handling and safe shutdown equipment as shown on drawings E-023-002, E-023-003, E-023-005, E-023-011, E-023-012, and E-023-013.

The building is bounded on the northeast by the reactor building and on the east by the fuel handling building. Remaining portions of the north, west and south walls are exposed to grade. The walls of the auxiliary building have a 3 hour minimum fire resistance rating, except for the wall dividing the auxiliary building and the fuel handling building. This wall has unprotected openings such as doorways, cable penetrations, and duct penetrations. Wall, floor, and roof construction consists of reinforced concrete. Within the auxiliary building, stairways are open between floors. A metal enclosed building with Factory Mutual (FM) Class 1 roof is provided on top of the auxiliary building to house non-safety related equipment.

The auxiliary building consists of three fire areas: decay heat removal pits A, B, and the remainder of the building which is divided into eight fire zones.

4.2.1 Decay Heat Removal Pit A (Elevation 261')

4.2.1.1 Description

Safe shutdown equipment located in decay heat removal pit A consists of decay heat removal pump A, decay heat removal cooler A, and associated valves. The pit area has reinforced concrete walls

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and floor and is covered with a reinforced concrete slab provided with sealed concrete equipment access hatch covers. The ceiling is penetrated by air handling supply and return ducts, cable trays, piping, and steel personnel access hatches. (E-023-005, J-16).

4.2.1.2 Analysis

The combustibles in this area consist of pump lube oil and cable insulation. As a result, there is a total fire loading of 3,600 Btu/ft^2 contained within a 900 ft^2 area. The fire protection for this area consists of dry chemical fire extinguishers and accessible fire hose as shown on drawing E-023-002.

4.2.1.3 Conclusion

The results of the analysis indicate, that to contain a fire of the above loading, the boundaries of the fire area must have a fire resistance rating of 1/2 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, cable penetrations, and piping penetrations. To obtain the required 1/2 hour fire resistance rating, fire dampers will be installed in the HVAC ducts and all penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.2.2 Decay Heat Removal Pit B (Elevation 261')

4.2.2.1 Description

Safe shutdown equipment located in decay heat removal pit B consists of decay heat removal pump B, decay heat cooler B, and associated valves. The pit area has reinforced concrete walls and

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floor and is covered with a reinforced concrete slab provided with sealed concrete equipment access hatch covers. The ceiling is penetrated by air handling supply and return ducts, cable trays, piping, and steel personnel access hatches. (E-023-005, J-15).

4.2.2.2 Analysis

The combustibles in this area consist of pump lube oil and cable insulation. As a result, there is a total fire loading of 3,350 Btu/ft^2 contained within a 1,000 ft^2 area. The fire protection for this area consists of dry chemical fire extinguishers and accessible fire hose as shown on drawing E-023-002.

4.2.2.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading the boundaries of the fire area must have a fire resistance rating of 1/2 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, cable penetrations, and piping penetrations. To obtain the required 1/2 hour fire resistance rating, fire dampers will be installed in the HVAC ducts and all penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.2.3 Remainder of Auxiliary Building (Elevations 271', 281' and 305')

For the purposes of fire analysis, this area has been divided into nine fire zones, each of which is described in detail below.

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4.2.3.1 Heat Exchanger Vault (Elevation 271')

4.2.3.1.1 Description

The safe shutdown equipment located within this zone consists of nuclear service heat exchangers A, B, C, and D, decay heat removal service coolers A and B, and associated valves. (E-023-002, B-6).

4.2.3.1.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result, there is a total fire loading of 2,700 Btu/ft^2 contained within a 7,000 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. Fire protection in the zone consists of a dry chemical fire extinguisher as shown on drawing E-023-002.

4.2.3.1.3 Conclusions

Due to the limited amount of combustible material in the zone and the separation between redundant equipment and cable trays, fire protection for this zone is considered adequate. However, the safe shutdown equipment in this area is not within reach of the nearest fire hose. Therefore, to meet the requirements of Appendix A, a fire hose will be installed for backup protection.

4.2.3.2 Makeup and Purification Pumps A, B, and C Cubicles (Elevation 281')

4.2.3.2.1 Description

The safe shutdown equipment contained within each cubicle consists of a makeup pump and associated auxiliaries. (E-023-002, G-9).

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4.2.3.2.2 Analysis

Each cubicle consists of concrete walls, floor, and ceiling with a hollow, metal, louvered door providing access to a common corridor. The combustibles in each cubicle consist of pump lube oil and cable. As a result, there is a maximum fire loading of 58,500 Btu/ft^2 contained within cubicle A, 15,200 Btu/ft^2 in cubicle B, and 14,000 Btu/ft^2 in cubicle C. Each cubicle has an area of 220 ft^2. A common non-safety related HVAC duct penetrates each cubicle at 16 feet above the floor. Floor drains are provided for each cubicle. The fire protection for the cubicles consists of a dry chemical fire extinguisher and accessible fire hose as shown on drawing E-023-002.

4.2.3.2.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading in cubicle A, the barrier between cubicle A and cubicle B must have a fire resistance rating of 1 hour. To obtain this rating, a fire damper will be installed in the HVAC duct penetration and the cable penetrations will be adequately sealed. Due to the limited amount of combustible material in cubicles B and C, and the concrete wall between them, fire cannot spread from one cubicle to another. Therefore, a fire inside or adjacent to one cubicle will not spread or cause damage to the other cubicles. Once upgraded as discussed above, the fire protection for this zone will be considered adequate.

1413 064

4.2.3.3 Valve Gallery (Elevations 281' and 295')

4.2.3.3.1 Description

There is no safe shutdown equipment located within this zone other than the safety related cables which are above elevation 295'. (E-023-002, F-9).

4.2.3.3.2 Analysis

The only combustible in this zone is cable insulation. As a result, there is a total fire loading of 3,600 Btu/ft^2 contained within a 300 ft^2 area. Marinite barriers or spatial separation between the redundant cable trays are provided as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of dry chemical fire extinguishers and accessible fire hoses as shown on drawing E-023-002.

4.2.3.3.3 Conclusions

Due to the limited amount of combustible material in the zone and the separation between redundant trays, the fire protection for this zone is considered adequate.

4.2.3.4 Penetration Area at Elevation 281'

4.2.3.4.1 Description

The safe shutdown equipment located within this zone consists of decay heat removal valves (DH-V4A, B and DH-V12A, B), makeup and purification valves (MU-V14A, B and MU-16A, B, C, D), safety related cable and instrumentation. (E-023-002, F-11).

4.2.3.4.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result, there is a total fire loading of

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41,300 Btu/ft^2 contained within a 750 ft^2 area. Marinite barriers or spatial separation between the redundant cable trays are provided as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of dry chemical fire extinguishers and accessible fire hoses as shown on drawing E-023-002.

4.2.3.4.3 Conclusions

Due to the amount of combustible material in this zone, an automatic deluge water system initiated by ionization detectors will be provided. Once upgraded as discussed above, the fire protection for this zone will be considered adequate.

4.2.3.5 Remainder of Elevation 281'

4.2.3.5.1 Description

The only safe shutdown equipment located in this zone is safety related cable. Liquid and gaseous radioactive material is contained within this zone. The bulk of this material is contained in evaporators and steel tanks. (E-023-002, H-6).

4.2.3.5.2 Analysis

The combustibles in this zone consist of pump lube oil, cable insulation and transient material. As a result, there is a total fire loading of 20,500 Btu/ft^2 contained within a 14,000 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of dry chemical fire extinguishers and accessible fire hoses as shown on drawing E-023-002.

1413 066

4.2.3.5.3 Conclusion

Due to the limited amount of combustible material in the zone, the separation provided between the redundant cable trays, and the absence of safe shutdown equipment, the existing fire protection for this zone is considered adequate.

4.2.3.6 Demineralizers and Motor Control Centers (Elevation 305')

4.2.3.6.1 Description

The safe shutdown equipment contained within this zone consists of the makeup and purification system valves and the engineered safeguards motor control centers 1A and 1B. The bulk of the radioactive material in the zone is contained in the demineralizers. (E-023-003, G-9).

4.2.3.6.2 Analysis

The combustibles in this zone consist of cable insulation and transient material. As a result there is a total fire loading of 22,000 Btu/ft^2 contained within a 4,500 ft^2 area. Spatial separation is provided between redundant cable trays as stated in Chapter 8 of the FSAR. The engineered safeguards motor control centers 1A and 1B are separated by a minimum distance of 5 feet. The fire protection for this zone consists of dry chemical and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing E-023-003.

1413 067

4.2.3.6.3 Conclusion

Due to the limited amount of combustible material in the zone and the separation between redundant equipment and cable trays, fire protection for this zone is considered adequate.

4.2.3.7 Decay Heat Removal and Nuclear Service Closed Cycle Cooling Pump Area (Elevation 305')

4.2.3.7.1 Description

The safe shutdown equipment contained within this zone consists of the decay heat closed cycle cooling pumps A and B, the nuclear service closed cycle cooling pumps A, B, and C and the decay heat and nuclear service cooling pumps air handling units A and B. (E-023-003, H-11).

4.2.3.7.2 Analysis

The combustibles in this zone consist of pump lube oil, cable insulation and transient materials. As a result, there is a total fire loading of 9,000 Btu/ft^2 contained within a 1,200 ft^2 area. Each pump is located in a reinforced concrete cubicle with front wall and ceiling openings to a common area. The safety related cables within this zone are located above the cubicles. Marinite barriers or spatial separation are provided between the redundant trays as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of dry chemical and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing E-023-003.

1413 068

4.2.3.7.3 Conclusion

Due to the limited amount of combustible material in this zone and the separation between redundant equipment and cable trays, fire protection for this zone is considered adequate.

4.3.2.8 Gas Decay Tanks (Elevation 305')

4.2.3.8.1 Description

There is no safe shutdown equipment located within this zone. Radioactive material in this zone is contained within steel tanks (E-023-003, J-8).

4.2.3.8.2 Analysis

There are no combustible materials in this zone. Fire protection for this zone consists of dry chemical and carbon dixoide extinguishers and accessible fire hoses as shown on drawing E-023-003.

4.2.3.8.3 Conclusion

Due to the absence of combustible material and safe shutdown equipment, fire protection for this zone is considered adequate.

4.2.3.9 Remainder of Elevation 305'

4.2.3.9.1 Description

There is no safe shutdown equipment located within this zone. Radioactive material in the zone is contained within steel tanks and charcoal filter housings. (E-023-003, H-8).

1413 069

4.2.3.9.2 Analysis

The combustibles in this zone consist of charcoal, cable insulation, a plastic tank, polyvinyl chloride (PVC) pipe and transient materials. As a result, there is a total fire loading of 23,700 Btu/ft^2 contained within a 9,000 ft^2 area. The bulk of the combustible material consists of charcoal which is protected by automatic deluge water systems. Fire protection for the remaining portion of this zone consists of dry chemical and carbon dioxide fire extinguishers, and accessible fire hoses as shown on drawing E-023-003.

4.2.3.9.3 Conclusion

Because of the existing deluge systems for the charcoal filters, the limited amount of combustible material in the remaining portion of the zone, and the absence of safe shutdown equipment, fire protection for this zone is considered adequate.

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4.3 INTERMEDIATE BUILDING

The intermediate building houses auxiliary turbine cycle equipment. The safe shutdown equipment within the building is shown on drawings E-023-004, E-023-006, E-023-008, and E-023-015.

The building is bounded on the northwest by the diesel generator building, the northeast by the service building, the east by the turbine building, the south by the reactor building, with the west side exposed to grade. The walls, floor, and roof are constructed of reinforced concrete. Access to the intermediate building is through an unlabeled, 1-1/2 hour fire resistance rated door. The stairways inside the intermediate building are open between floors.

The intermediate building is considered to be one fire area divided into seven fire zones.

4.3.1 Valve Gallery and Penetration Room (Elevation 295')

4.3.1.1 Description

Safe shutdown equipment located in this zone consists of reactor building emergency cooling valves (RR-V4A, 4B, 4C, 4D) and safety related cable. (E-023-004, F-8).

4.3.1.2 Analysis

The only combustible in this zone is cable insulation. As a result, there is a total fire loading of 8,500 Btu/ft^2 contained within a 400 ft^2 area. Marinite barriers or spatial separation are provided between the redundant cable trays as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of water and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing E-023-004.

1413 071

4.3.1.3 Conclusion

The results of the analysis indicate that additional fire barriers are required to prevent loss of function of the reactor building emergency cooling valves in the event of a fire. Due to the limited amount of combustible material in the zone, the separation between redundant cable trays, and the proposed addition of fire barriers discussed above, fire protection for this zone will be considered adequate. However, because of the limited access to the intermediate building, a fire detection system will be added in this zone for early warning in the event of fire.

4.3.2 Turbine Driven Emergency Feedwater Pump Room (Elevation 295')

4.3.2.1 Description

The safe shutdown equipment located within this zone consists of the turbine driven emergency feedwater pump and steam supply valves. (E-023-004, E-8).

4.3.2.2 Analysis

This zone is separated from redundant equipment in the area by concrete walls and ceiling, which are penetrated by cable, pipe, an unlabeled metal access door, and a Class A rated access door. Combustibles in this zone are pump and turbine lube oil, transient material, and cable insulation. As a result, there is a total fire loading of 14,400 Btu/ft^2 contained within a 600 ft^2 area. Marinite barriers or spatial separation are provided between the redundant cable trays as stated in Chapter 8 of the FSAR. Floor drains are provided in the room. Fire protection for this zone consists of water and carbon dioxide fire extinguishers, and accessible fire hoses as shown on drawing E-023-004.

1413 072

4.3.2.3 Conclusion

Due to the limited amount of combustible material in this zone, the spatial separation and partial barriers between redundant and other safe shutdown equipment in the area, and the separation between redundant cable trays, the existing fire protection for this zone is considered adequate. However, because of limited access to the intermediate building, a fire detection system will be added in this zone for early warning in the event of a fire.

4.3.3 <u>Motor Driven Emergency Feedwater Pump Area (Elevation 295')</u>

4.3.3.1 Description

The safe shutdown equipment contained within this zone consists of emergency feedwater valves (EF-V30A, 30B) and motor driven emergency feedwater pumps A and B, and emergency feedwater pump area air handling units A and B. (E-023-004, C-8).

4.3.3.2 Analysis

The combustibles in this zone consist of pump and air compressor lube oil, transient materials and cable insulation. As a result, there is a total fire loading of 7,100 Btu/ft^2 contained within a 1,800 ft^2 area. Floor drains are provided throughout this zone. Marinite barriers or spatial separation are provided between redundant cable trays as stated in Chapter 8 of the FSAR. Spatial separation exists between redundant equipment. Fire protection for this zone consists of water and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing F-023-004.

1413 073

4.3.3.3 Conclusion

Due to the limited amount of combustible material in this zone, the spatial separation and partial barriers between redundant and other safe shutdown equipment in the area, and the separation between redundant cable trays, the existing fire protection for this zone is considered adequate. However, because of limited access to the intermediate building, a fire detection system will be added in this zone for early warning in case of a fire.

4.3.4 <u>Remainder of Elevation 295'</u>

4.3.4.1 Description

No safe shutdown equipment is located in this zone other than safety related cable. (E-023-004, D-8).

4.3.4.2 Analysis

The only combustible in this zone is comprised of transient materials. As a result, there is a total fire loading of 1,900 Btu/ft^2 contained within a 1,700 ft^2 area. Adjacent zones in the area are separated by walls and ceiling which are penetrated by cable, pipe, and access openings. Fire protection for the zone consists of water and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing E-023-004.

4.3.4.3 Conclusion

Due to the limited amount of combustible material and absence of safe shutdown equipment, the existing fire protection for this zone is considered adequate. However, because of limited access to the intermediate building, a fire detection system will be added in this zone for early warning in case of a fire.

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4.3.5 Intermediate Building at Elevation 305'

4.3.5.1 Description

No safe shutdown equipment or safety related cable is located in this zone. (E-023-004, E-9).

4.3.5.2 Analysis

The only combustible in this zone is comprised of transient materials. As a result, there is a total fire loading of 1,900 Btu/ft^2 contained in a 1,700 ft^2 area. Fire protection for this zone consists of water and carbon dioxide fire extinguishers and accessible fire hoses as shown on drawing E-023-004.

4.3.5.3 Conclusion

Due to the limited amount of combustible material and absence of safe shutdown equipment, the existing fire protection for this zone is considered adequate. However, a Class A door will be installed between the turbine and intermediate building to maintain the required 3 hour fire barrier between buildings.

4.3.6 Intermediate Building at Elevation 322'

4.3.6.1 Description

The safe shutdown equipment located in this zone consists of the main steam safety valves (MS-V17A, B, C, D; 18A, B, C, D; 19A, B, C, D; 20A, B, C, D; 21A, B). (E-023-006, E-8).

4.3.6.2 Analysis

Combustibles in this zone consist of cable insulation and transient materials. As a result, there is a total fire loading of 6,200 Btu/ft^2 contained within a 6,600 ft^2 area. Fire protection for this

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zone consists of accessible fire hoses as shown on drawings E-023-004, E-023-006 and E-023-008, and accessible water and carbon dioxide fire extinguishers as shown on drawing E-023-004.

4.3.6.3 Conclusion

Due to the limited amount of combustible material and the spatial separation between redundant safe shutdown equipment, the existing fire protection is considered adequate for this zone.

4.3.7 Intermediate Building at Elevation 355'

4.3.7.1 Description

No safe shutdown equipment or safety related cable is located in this zone. (E-023-008, E-8).

4.3.7.2 Analysis

The only combustible in this zone is comprised of transient materials. As a result, there is a total fire loading of 800 Btu/ft^2 contained within a 4,000 ft^2 area. Fire protection for this zone consists of accessible fire hoses as shown on drawing E-023-008.

4.3.7.3 Conclusion

Due to the limited amount of combustible material and absence of safe shutdown equipment, the existing fire protection for this zone is considered adequate.

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4.4 CONTROL BUILDING

The control building houses the control room, electrical equipment, offices, repair shops, and laboratories. The safe shutdown equipment is on drawings E-023-016 and E-023-017.

The building is bounded on the north and east by the turbine building, on the west by the fuel handling building, while the south side is exposed to grade. The walls of the control building have a minimum 3 hour fire resistance rating. Wall, floor, and the roof are constructed of reinforced concrete.

The building has five levels connected by a 3 hour fire resistance rated stairwell. This stairwell serves common elevations of the fuel handling building and control building. As will be discussed in Section 4.7.5.3, the results of the analysis of the fuel handling building identify the need for installing fire hoses in this stairwell area to provide protection at elevations 322', 338', 355' and 380'.

The control building is analyzed as 16 fire areas which are described below.

4.4.1 <u>Control Building Area CB-1 (Elevation 306')</u>

4.4.1.1 Description

The only safe shutdown equipment located in this area is safety related cables. (E-023-017, C-13).

1413 077

4.4.1.2 Analysis

The combustibles in the area consist of stored and transient materials and cable insulation. As a result, there is a total fire loading of 53,000 Btu/ft^2 contained within a 6,000 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. This area is separated from the fuel handling building by a 3 hour fire resistance rated wall, with the exception of the access door, cable and piping penetrations. Fire protection for this area consists of an automatic sprinkler system and dry chemical and water fire extinguishers as shown on drawing E-023-017.

4.4.1.3 Conclusion

The results of the analysis indicate that to separate the control building from the fuel handling building, the access door must be replaced with a Class A door. The cable and piping penetrations will be adequately sealed. Due to the absence of safe shutdown equipment, separation between redundant cable trays, and the presence of the automatic sprinkler system, fire protection for this area will be considered adequate, when upgraded as discussed above.

4.4.2 Control Building Area CB-2a (Elevation 322')

4.4.2.1 Description

The safe shutdown equipment in this area consists of engineered safeguards 480 volt switchgear 1P and motor control center 1A. (E-023-016, F-8).

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4.4.2.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 75,000 Btu/ft^2 contained within an 800 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. The area is bounded by 3-hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable, piping and HVAC ducts. Access to this area is through Class A rated or unlabeled metal doors. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.2.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of one hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the unlabeled metal doors, HVAC ducts, cable and piping penetrations.

The existing unlabeled metal doors have an accepted 1-1/2 hour fire resistance rating. Cable and piping penetrations will be adequately sealed and fire dampers will be installed in the HVAC duct penetrations to comply with the required one hour fire resistance rating for the area. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

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4.4.3 Control Building Area CB-2b (Elevation 322')

4.4.3.1 Description

The safe shutdown equipment in this area consists of engineered safeguards 480 volt switchgear 1S, motor control center 1B, and switchgear area booster fans A and B. (E-023-016, G-8).

4.4.3.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 45,000 Btu/ft^2 contained within an 800 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. The area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to the area is through Class A rated and unlabeled metal doors. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.3.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of one hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the unlabeled metal doors, HVAC ducts, cable and piping penetrations.

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The existing unlabeled metal doors have an accepted 1-1/2 hour fire resistance rating. Cable and piping penetrations will be adequately sealed and fire dampers will be installed in the HVAC duct penetrations to comply with the required one hour fire resistance rating for this area. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.4 Control Building Area CB-2c (Elevation 322')

4.4.4.1 Description

The safe shutdown equipment in this area consists of the engineered safeguards AC transfer switch for valve motor control center 1C, and the DC transfer switch for panel 1M. (E-023-016, H-8).

4.4.4.2 Analysis

Combustibles in this area consist of cable insulation, and transient and stored materials. As a result, there is a total fire loading of 52,000 Btu/ft^2 contained within a 1,000 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to this area is through Class A rated or unlabeled metal doors. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

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4.4.4.3 Conclusion

The results of the analysis indicate that in order to contain a fire of the above loading, the boundaries of this fire area must have a 1 hour fire resistance rating. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the unlabeled metal doors, HVAC ducts, cable and piping penetrations.

To obtain the 1 hour fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and cable and pipe penetrations will be adequately sealed. The existing unlabeled doors have an accepted 1-1/2 hour fire resistance rating. Class A doors to the fuel handling building will be provided to maintain the required 3 hour fire barrier between buildings. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.5 <u>Control Building Area CB-2d (Elevation 322')</u>

4.4.5.1 Description

The safe shutdown equipment in the area consists of battery chargers A, B, and E, inverters 1A, 1C, and 1E, and AC and DC distribution panels. (E-023-016, F-6).

4.4.5.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 74,000 Btu/ft^2 contained within a 600 ft^2 area. This area is bounded by a 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access doors to this area are Class A rated. Fire

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protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.5.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, cable and piping penetrations. To obtain the required 1 hour fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and the cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.6 Control Building Area CB-2e (Elevation 322')

4.4.6.1 Description

The safe shutdown equipment in the area consists of battery chargers C, D, and F, inverters 1B and 1D, and AC and DC distribution panels. (E-023-016, H-6).

4.4.6.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 62,000 Btu/ft^2 contained within a 600 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access doors to this area are Class A rated. Fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.6.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, and cable and piping penetrations. To obtain the required 1 hour fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and the cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.7 Control Building Area CB-2f (Elevation 322')

4.4.7.1 Description

The safe shutdown equipment in the area consists of batteries A and C. (E-023-016, G-5).

4.4.7.2 Analysis

Combustibles in this area consist of cable insulation and battery cases. As a result, there is a total fire loading of 21,000 Btu/ft^2 contained within a 600 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access doors

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to this area are Class A rated. Fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.7.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 30 minutes. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, and cable and piping penetrations. To obtain the required 30 minute fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and the cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.8 <u>Control Building Area CB-2g (Elevation 322')</u>

4.4.8.1 Description

The safe shutdown equipment in the area consist of batteries B and D. (E-023-016, H-5).

4.4.8.2 Analysis

Combustibles in this area consist of cable insulation and battery cases. As a result, there is a total fire loading of 12,000 Btu/ft^2 contained within a 600 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access doors

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to this area are Class A rated. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.8.3 Conclusion

The results of the analysis indicate that in order to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 30 minutes. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, and cable and piping penetrations. To obtain the required 30 minute fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and the cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.9 Control Building Area CB-3a (Elevation 338'-6")

4.4.9.1 Description

The safe shutdown equipment in the area consists of engineered safeguards 4160 volt switchgear 1D. (E-023-016, G-15).

4.4.9.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 61,000 Btu/ft^2 contained within an 800 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to this area is through Class A rated doors. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.9.3 Conclusion

The results of the analysis indicate that in order to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of HVAC ducts, cable and piping penetrations. Cable and piping penetrations will be adequately sealed and fire dampers will be installed in the HVAC duct penetrations to comply with the required one hour fire resistance rating for this area. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.10 <u>Control Building Area CB-3b (Elevation 338'-6")</u>

4.4.10.1 Description

The safe shutdown equipment in the area consists of engineered safeguards 4160 volt switchgear 1E. (E-023-016, H-15).

4.4.10.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 59,000 Btu/ft^2 contained within an 800 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to this area is through Class A rated and unlabeled metal doors. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.10.3 Conclusion

The results of the analysis indicate that in order to contain a fire of the above loading, the boundaries of this fire area must have a fire resistant rating of 1 hour. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the unlabeled metal doors, HVAC ducts, cable and piping penetrations. The existing unlabeled metal doors have an accepted 1-1/2 hour fire resistance rating. Cable and piping penetrations will be adequately sealed and fire dampers will be installed in the HVAC duct penetrations to comply with the required one hour fire resistance rating for this area. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.11 Control Building Area CB-3c (Elevation 338'-6")

4.4.11.1 Description

The safe shutdown equipment in the area consists of actuation cabinets A, B, and engineered safeguards relay cabinets 1, 2, and 3. (E-023-016, J-15).

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4.4.11.2 Analysis

The only combustible in this area is cable insulation. As a result, there is a total fire loading of 30,000 Btu/ft^2 contained within a 1,000 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to this area is by Class A rated and unlabeled metal doors. Fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room and dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.11.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 30 minutes. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the unlabeled metal doors, HVAC ducts, cable and piping penetrations. To obtain the 30 minute fire resistance rating, fire dampers will be installed in the HVAC duct penetrations and cable and piping penetrations will be adequately sealed. The existing unlabeled doors have an accepted 1-1/2 hour fire resistance rating. To prevent loss of function to the redundant safe shutdown equipment located in this area, cables will be enclosed in fire retardant material or sprinkler protection will be provided for the cable trays. Class A doors to the fuel handling building will be provided to maintain the required 3 hour fire barrier between buildings. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.12 Control Building Area CB-3d (Elevation 338'-6")

4.4.12.1 Description

The safe shutdown equipment in the area consists of relay cabinets XCC, XCL, and XCR. (E-023-016, H-12).

4.4.12.2 Analysis

Combustibles in this area consist of cable insulation and transient material. As a result, there is a total fire loading of 191,000 Btu/ft^2 contained within a 2,800 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by cable and HVAC ducts. Access to this area is through Class A rated or unlabeled metal doors. Fire protection for this area consists of a low pressure carbon dioxide system actuated by heat detectors, dry chemical and Halon fire extinguishers and accessible carbon dioxide extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.12.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 3 hours. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the doors to the fuel handling building. These will be replaced with Class A doors to maintain the required 3 hour fire barrier between buildings. With the existing carbon dioxide system, fire extinguishers, and future fire house installation, the fire protection for this area will be considered adequate.

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4.4.13 Control Building Area CB-4a (Elevation 355')

4.4.13.1 Description

No safe shutdown equipment is located in this area (E-023-016, B-7).

4.4.13.2 Analysis

Combustibles in this area consist of stored and transient material. As a result, there is a total fire loading of 82,000 Btu/ft^2 contained within a 2,900 ft^2 area. This area is bounded by 3 hour and 2 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by HVAC ducts, cable and pipe penetrations. Access doors to this area are unlabeled. The fire protection for this area consists of HVAC duct smoke detectors and ionization detectors at selected locations. Dry chemical and carbon dioxide fire extinguishers are shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.13.3 Conclusion

The results of the analysis indicate that in order to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1-1/2 hour. The walls, floor and ceiling have a minimum of 2 hour fire resistance rating with the exception of the HVAC ducts, cable and pipe penetrations. The existing unlabeled doors have an accepted 1-1/2 hour fire resistance rating. Fire dampers will be installed in the HVAC duct penetrations and cable and pipe penetrations will be adequately sealed to meet the required

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1-1/2 hour fire resistance rating for the area. Once upgraded as discussed above, the fire protection for the area will be considered adequate.

4.4.14 Control Building Area CB-4b (Elevation 355')

4.4.14.1 Description

The safe shutdown equipment in this area consists of nuclear instrumentation and reactor protection panels A, B, C, and D, and safety related control consoles and panels. (E-023-016, B-5).

4.4.14.2 Analysis

Combustibles in this area consist of cable insulation and transient material. As a result, there is a total fire loading of 58,000 Btu/ft^2 contained within a 3,100 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, floor and ceiling, with the exception of the adjacent computer room, which is bounded by 2 hour fire resistance rated walls and ceiling, which are penetrated by HVAC ducts. Access doors to this area and the adjacent computer room are unlabeled metal doors. The fire protection for this area consists of ionization detectors, which actuate alarms in the control room, and dry chemical, carbon dioxide, and halon fire extinguishers as shown on drawing E-023-016. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

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4.4.14.3 Conclusion

The results of the analysis indicate, that to prevent a fire from entering this area, the fire resistance ratings must be maintained as follows:

(a) Floor - 3 hours

(b) Walls - 1-1/2 hours (control building)
1 hour (fuel handling building)
3 hours (turbine building)

(c) Ceiling - 30 minutes

The floor and turbine building wall have a 3 hour fire resistance rating with the exception of HVAC ducts. The remaining walls and ceiling have a minimum of 2 hour fire resistance rating with the exception of HVAC ducts, recessed window and unlabeled doors. To obtain the required fire resistance ratings, fire dampers will be installed in the HVAC ducts, while the recessed window and door to the computer room will be altered to provide a B level rating. Class A doors to the fuel handling building will be provided to maintain the required 3 hour fire barrier between buildings. To provide additional protection for the safe shutdown control panels, ionization detectors will be installed in the panels for early warning. An automatic Halon system will be provided for the underfloor area of computer room and adjacent cable trench. Once upgraded as discussed above, the fire protection inside and adjacent to this area will be considered adequate.

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4.4.15 Control Building Area CB-5a (Elevation 380')

4.4.15.1 Description

The safe shutdown equipment in this area consists of HVAC normal duty supply fan A, emergency ventilating supply fan A, and ventilating exhausts fans A and B. (E-023-016, B-14).

4.4.15.2 Analysis

Combustibles in this area consist of cable insulation and charcoal. As a result, there is a total fire loading of 16,000 Btu/ft^2 contained within a 3,000 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling, which are penetrated by HVAC ducts. Access to this area is through an unlabeled metal door which is contained within movable steel partitions. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and water fire extinguishers as shown on drawing E-023-016. The charcoal contained within the air filters is provided with heat sensors for detection and a deluge water system for fire protection of the charcoal. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

4.4.15.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistant rating of 30 minutes. The walls, a floor and a ceiling have a 3 hour fire resistance rating with the exception of the HVAC ducts, cable penetrations, and door openings. To obtain the required 30 minute fire resistant rating, fire dampers will be installed in the HVAC duct penetrations. The existing door and partition to the fuel handling building will be replaced with a Class A door and 3 hour fire resistance rated wall to maintain a 3 hour barrier between buildings. Cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.4.16 Control Building Area CB-5b (Elevation 380')

4.4.16.1 Description

The safe shutdown equipment in the area consists of HVAC normal duty supply fan B, and emergency ventilating supply fan B. (E-023-016, B-13).

4.4.16.2 Analysis

Combustibles in this area consist of cable insulation and charcoal. As a result, there is a total fire loading of 15,000 Btu/ft^2 contained within a 3,000 ft^2 area. This area is bounded by 3 hour fire resistance rated walls, a floor and a ceiling penetrated by HVAC ducts. Access to this area is through an unlabeled metal door which is contained within movable steel partitions. The fire protection for this area consists of HVAC duct smoke detectors, which actuate alarms in the control room, and dry chemical and water fire extinguishers as shown on drawing E-023-016. The charcoal contained within the air filters is provided with heat sensors for detection and a deluge water system for fire protection of the charcoal. A fire hose will also be available in the adjacent stairwell area as will be discussed in Section 4.7.5.3.

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4.4.16.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistant rating of 30 minutes. The walls, floor and ceiling have a 3 hour fire resistance rating with the exception of the HVAC duct, cable penetrations, and door openings. To obtain the required 30 minute fire resistance rating, fire dampers will be installed in the HVAC duct penetrations. The existing door and partition to the fuel handling building will be replaced with a Class A door and 3 hour fire resistance rated wall to maintain a 3 hour barrier between buildings. Cable and piping penetrations will be adequately sealed. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

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4.5 DIESEL GENERATOR BUILDING

The diesel generator building houses two independent diesel generator units, as well as related auxiliaries. The diesel generators are Class 1E and are required for safe shutdown of TMI-1. The safe shutdown equipment and auxiliaries are shown on drawings E-023-004, E-023-006, E-023-008, and E-023-015.

The diesel generator building is constructed of reinforced concrete divided into two fire areas separated by a 3 hour fire resistance rated concrete wall. Access between the two fire areas within the diesel building is provided by Class A fire doors. The interior fire wall of the building serves as a barrier between the two independent units. Further discussion of the two fire areas is given in the following sections.

4.5.1 Diesel Generator Building Area DG-1 (Elevation 305')

4.5.1.1 Description

The safe shutdown equipment contained within this area includes the A emergency diesel generator and engine, the diesel fuel day tank, the fuel transfer pumps, the diesel generator air receivers, the diesel generator room air handling unit, and the diesel generator control panel. (E-023-004, F-13).

4.5.1.2 Analysis

The combustibles in this area consist of lube oil in the engine, fuel oil in the day tank and transient material. As a result, a total fire loading of 96,000 Btu/ft^2 is contained within a 3,650 ft^2 area. Electrical equipment in this area is enclosed and therefore adds no additional fire loading.

The fire protection for this area consists of an automatic sprinkler and deluge system designed to NFPA Standards 13 and 15 and accessible dry chemical fire extinguishers.

4.5.1.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1-1/2 hours. Since the building is designed for a 3 hour fire resistance rating and is provided with automatic sprinkler and deluge system, fire protection for the area is considered adequate.

4 5.2 Diesel enerator Building Area DG-2 (Elevation 305')

4.5.2.1 Description

The safe shutdown equipment cont ined within this area includes the B emergency diesel generator and engine, the diesel fuel day tank, the fuel transfer pumps, the diesel generator air receivers, the diesel generator room air handling unit, and the diesel generator control panel. (E-023-004, F-11).

4.5.2.2 Analysis

The combustibles in this area consist of lube oil in the engine, fuel oil in the day tank and transient material. As a result, a total fire loading of 96,000 Btu/ft^2 is contained within a 3,650 ft^2 area. Electrical equipment in this area is enclosed and therefore adds no additional fire loading. The rating of the Class A door between the diesel generator building and the service building has been negated by adding a screen.

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The fire protection for this area consists of an automatic sprinkler and deluge system designed to NFPA Standards 13 and 15 and accessible dry chemical fire extinguishers.

4.5.2.3 Conclusion

The results of the analysis indicate that to contain a fire of the above loading, the boundaries of this fire area must have a fire resistance rating of 1-1/2 hour. The building is designed for a 3 hour fire resistance rating and is provided with automatic sprinkler and deluge system. The door between the diesel generator building and service building will be replaced with an actual Class A door. Once upgraded as discussed above, the fire protection for this area will be considered adequate.

4.5.3 <u>Diesel Fuel Oil Storage Tank (Underground)</u>

4.5.3.1 Description

The only equipment within the area is a buried 30,000 gallon fuel oil storage tank located north of the diesel generator building. (E-023-004, E-15).

4.5.3.2 Analysis

Due to the underground location of the storage tank, no analysis is necessary.

4.5.3.3 Conclusion

No fire protection is required.

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4.6 INTAKE SCREEN AND PUMPHOUSE

The intake screen and pumphouse contains equipment for TMI-1 water supply. This equipment includes safe shutdown and fire protection components as shown on drawing E-023-018.

The building is located west of the TMI-1 complex along the Susquehanna River. The building is constructed of reinforced concrete with all four walls exposed to grade, except for a portion of the north wall which is attached to the building that houses the diesel driven fire pump and related equipment.

For purposes of analysis, the building is considered as a single fire area at elevation 308'.

4.6.1 Description

Safe shutdown equipment located in this area consists of screen house air handling units A and B, screen house 480 volt switchgear, screen house 480 volt motor control centers, decay heat river water pumps A and B, nuclear service river water pumps A, B, and C, reactor building emergency cooling pumps A and B, and associated valving. (E-023-018, D-11).

4.6.2 Analysis

The combustibles in this area consist of lube oil, cable insulation, and transient materials. As a result, there is a total fire loading of 10,000 Btu/ft^2 contained within a 10,000 ft^2 area. Fire protection for this area is comprised of an automatic sprinkler system, and dry chemical and water fire extinguishers.

4.6.3 Conclusion

Due to the limited amount of combustible material in this area, the separation between redundant equipment, and the automatic sprinkler system provided for this area, the existing fire protection is considered adequate.

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4.7 FUEL HANDLING BUILDING

The fuel handling building is used for receiving, storing, preparation, handling and transfer of fuel. Equipment for safe shutdown is shown on drawings E-023-002, E-023-003, E-023-005, E-023-007, E-023-009, E-023-012, E-023-013, E-023-014, E-023-016, and E-023-017.

The building is bounded on the north by the reactor building, on the east by the control complex, on the south by the fuel handling building for TMI-2, and on the west by the auxiliary building. The walls of the fuel handling building have a minimum 3 hour fire resistance rating, with the exceptions of the walls dividing the auxiliary building and the fuel handling building. These walls have unprotected openings such as doorways, cable and duct penetrations. There is also a common area between the TMI-1 and TMI-2 fuel handling buildings. Wall, floor, and roof construction is of reinforced concrete. Grating is provided for the different elevations in the zone between the fuel pool (east wall) and the control building. The fuel handling building stairways are open between floors.

The fuel handling building consists of one fire area which has been divided into six fire zones as described below.

4.7.1 <u>Fuel Handling Building at Elevation 281'</u>

4.7.1.1 Description

The only safe shutdown equipment located in this zone is safety related cable. Electrical penetrations between the fuel handling and reactor buildings are provided on the north wall of this zone.

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Radioactive material in the zone is contained within steel enclosures. (E-023-002, E-7).

4.7.1.2 Analysis

The combustibles in this zone consist of pump lube oil, transient materials, and cable insulation. As a result, there is a total fire loading of 33,000 Btu/ft^2 contained within a 7,500 ft^2 area. Marinite boards are provided between redundant cable trays as stated in Chapter 8 of the FSAR. Fire protection for this zone consists of dry chemical fire extinguishers and accessible fire hoses as shown on drawing E-023-002.

4.7.1.3 Conclusion

The total fire loading for this zone is not excessive, and marinite board and spatial separation are provided between redundant trays. However, the concentration of the redundant channels in the zone warrants either coating of those control cable trays or adding an automatic sprinkler system for the zone. With either of these alternatives implemented, the existing fire protection will be considered adequate.

4.7.2 <u>Fuel Handling Building at Elevation 305'</u>

4.7.2.1 Description

The only safe shutdown equipment located within this zone is safety related cable. (E-023-003, D-5).

4.7.2.2 Analysis

Combustibles in this zone consist of cable insulation and transient materials. As a result, there is a total fire loading of 32,200

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Btu/ft^2 contained within a 7,000 ft^2 area. Access to this area is through a type B door. Fire protection in this zone is comprised of dry chemical and carbon dioxide fire extinguishers, a sprinkler system between the east wall of the fuel pool and the control building, and accessible fire hoses as shown on drawing E-023-003.

4.7.2.3 Conclusion

Due to the limited amounts of combustible material in this zone, the separation between redundant cable trays, and the absence of safe shutdown equipment, the existing fire protection is considered adequate, provided the control building door is replaced with a Class A door.

4.7.3 <u>Fuel Handling Building at Elevations 329' and 331'</u>

4.7.3.1 Description

The safe shutdown equipment contained within this zone consists of the decay heat closed surge tanks A and B and safety related cable. (E-023-005, E-6; E-023-016, J-7).

4.7.3.2 Analysis

Combustibles in this zone consist of cable insulation and transient materials. As a result, there is a total fire loading of 2,800 Btu/ft^2 contained within a 4,000 ft^2 area. Fire protection for this zone consists of an accessible fire hose and water and carbon dioxide fire extinguishers in adjacent zones as shown on drawing E-023-005.

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4.7.3.3 Conclusion

Due to the limited amount of combustible material in this zone and the separation provided between redundant cable trays, the existing fire protection is considered adequate.

4.7.4 Fuel Handling Building at Elevation 348'

4.7.4.1 Description

The only safe shutdown equipment contained within this zone is the nuclear service closed cooling surge tank. Spent radioactive fuel is stored under water within the fuel pools. New fuel is stored in either the dry fuel storage pits or the spent fuel storage pools. (E-023-007, E-6).

4.7.4.2 Analysis

The combustibles in this zone consist of fuel handling bridge and crane lube oil, transient materials, and cable insulation. As a result, there is a total fire loading of 1,000 Btu/ft^2 contained within a 7,900 ft^2 area. Fire protection in this zone consists of dry chemical, water and carbon dioxide fire extinguishers and an accessible fire hose as shown on drawings E-023-007 and E-023-009.

4.7.4.3 Conclusion

Due to the limited amount of combustible material in this zone, the existing fire protection is considered adequate.

4.7.5 Zone Between Fuel Pool (East Wall) and Control Building (Elevations 322' to 380')

4.7.5.1 Description

The only safe shutdown equipment located in this zone is safety related cable. (E-023-016; J-7, J-14, D-7, D-14).

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4.7.5.2 Analysis

The combustibles in this zone consist of cable insulation and transient and stored materials. As a result, there is a total fire loading of 77,000 Btu/ft^2 contained within a 2,500 ft^2 area. Access to this area is through unlabeled metal doors. Floors within this zone above elevation 322' consist of grating. Fire protection for this zone consists of dry chemical and carbon dioxide fire extinguishers as shown on drawing E-023-016.

4.7.5.3 Conclusion

Due to the amount of combustible material, fire hoses will be provided at each elevation and unlabeled doors to the control building will be replaced with Class A doors. Once upgraded as discussed above, the fire protection for this zone will be considered adequate since the loss of the safety-related cable will not compromise safe shutdown.

4.7.6 Air Conditioning Equipment Room (Elevation 285')

4.7.6.1 Description

No safe shutdown equipment is located in this zone. (E-023-017, H-14).

4.7.6.2 Analysis

The only combustible in this zone is lube oil. As a result, there is a total fire loading of 375 Btu/ft^2 contained within a 900 ft^2 area. Fire protection for this zone consists of a dry chemical fire extinguisher as shown on drawing E-023-017.

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4.7.6.3 Conclusion

Due to the limited amount of combustible material in this zone and the absence of safe shutdown equipment, the existing fire protection is considered adequate.

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4.8 TURBINE BUILDING

The turbine building houses the turbine generator and its auxiliaries and is shown on drawing E-023-001.

The building is bounded on the north by the service building, on the west by the intermediate building, fuel handling building, reactor building and the control building. The east and south walls are exposed to grade.

For the purposes of analysis, the building is considered to be a single fire area.

4.8.1 Description

There is no safe shutdown equipment located within this area. Safety-related channel C cable passes through the area enroute to the reactor building from the control building. (E-023-001, E-10).

4.8.2 Analysis

The walls separating the turbine building from other portions of TMI-1 containing safe shutdown equipment have a minimum 3 hour fire resistance rating, with the exception of unlabeled doors, cable and piping penetrations, and the structural joints between the reactor building buttresses and the turbine building wall. The safety related cable which passes through the area is for one channel only, and therefore may be disabled without causing loss of function. In the event of a fire within the turbine building,

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access to the reactor building via the personnel access hatch may not be possible. In this case, accessability will be ensured by the equipment access hatch located in the northwest quadrant of the reactor building.

4.8.3 Conclusion

The results of the analysis indicate that to ensure that the walls will adequately contain any fire within the turbine building, the unlabeled doors must be replaced with Class A doors, and cable and piping penetrations and the structural joints must be adequately sealed. Although the personnel access hatch to the reactor building is unlabeled, it is considered adequate because of the air lock construction.

Due to the absence of safe shutdown equipment within the area and the isolation provided between this area and safe shutdown areas of TMI-1, once upgraded as discussed above, the fire protection will be considered adequate.

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4.9 SERVICE BUILDING

The service building houses offices, shops, lockers, and also provides for storage and is shown on drawing E-023-001.

The building is bounded on the south by the turbine building, on the southwest by the intermediate building, and on the west by the diesel generator building, with the north and east walls being exposed to grade.

For the purpose of analysis, the building is considered to be a single fire area.

4.9.1 Description

There is no safe shutdown equipment or safety related cable located within the area. (E-023-001, E-13).

4.9.2 Analysis

The wall separating the service building from other portions of TMI-1 containing safe shutdown equipment has a minimum 3 hour fire resistance rating which was negated by the cutting of the Class A door.

4.9.3 Conclusion

The results of the analysis indicate that in order to separate the service building from other areas, the violated Class A door must be replaced with an approved A labeled door. Due to the absence of safe shutdown equipment and the isolation provided between this area and safe shutdown areas of the TMI-1, once upgraded as discussed above, the fire protection is considered adequate.

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4.10 AIR INTAKE TUNNEL

An air intake tunnel is provided to admit outside air to TMI-1 and is shown on drawings E-023-002, E-023-011, E-023-014, and E-023-019. The tunnel is designed to provide adequate separation between TMI-1 and the outside air intake in the event of a hypothetical aircraft incident. Fire protection inside the tunnel is provided in accordance with FSAR Section 9.8.6.

The air tunnel is constructed of reinforced concrete. It is located southwest of TMI-1 and connects to the auxiliary building and fuel handling building. Except for tha intake structure, the tunnel is located underground.

For purposes of analysis, the air intake tunnel was considered as one fire area.

4.10.1 Description

The only safe shutdown equipment located in this area is safety related cable routed in conduit. (E-023-019, F-9).

4.10.2 Analysis

Although no appreciable amount of combustible material is present in the area, fire protection is provided to prevent the spread of fire along the air intake tunnel in the event of the hypothetical aircraft incident. This fire protection consists of an automatic Halon suppression system actuated by ultraviolet or pressure detectors, an automatic deluge water system activated by heat detectors, and smoke detectors to actuate alarms in the control room.

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4.10.3 Conclusion

The multiple levels of fire protection discussed for the hypothetical aircraft incident are more than adequate for the fire hazards considered in this analysis.

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4.11 YARD AREA

The yard area contains storage tanks for the turbine cycle systems and reactor systems; these tanks are located at grade. The tanks required for safe shutdown are shown on drawing E-023-001.

The areas considered in the analysis are the portions of the grade adjacent to the two condensate storage tanks, and the borated water storage tank. One condensate storage tank is located north of the turbine building and east of the service building, while the other is located north of the auxiliary building and west of the diesel generator building. The borated water storage tank is north of the auxiliary building and west of the reactor building.

4.11.1 Condensate Storage Tanks Area

4.11.1.1 Description

The actual condensate storage tanks A and B are the only safe shutdown equipment in this area. (E-023-001, D-12).

4.11.1.2 Analysis

Condensate storage tank A is located adjacent to the auxiliary boiler fuel oil storage tank. There is no significant amount of combustible material in the area adjacent to condensate storage tank B. The two condensate storage tanks are more than 400 feet apart with the service and diesel generator buildings located between them. Fire protection for the area consists of fire hydrants.

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4.11.1.3 Conclusion

Because of the physical separation between the two redundant tanks, the existing fire protection for the area is considered adequate.

4.11.2 Borated Water Storage Tank Area

4.11.2.1 Description

The borated water storage tank is the only safe shutdown equipment located in this area. (E-023-001, G-11).

4.11.2.2 Analysis

There is no significant amount of combustible material in this area adjacent to the tank. Fire protection for this area consists of fire hydrants.

4.11.2.3 Conclusion

Due to the negligible amount of combustible material in this area, the existing fire protection is considered adequate.

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5.0 POINT-BY-POINT COMPARISON TO APPENDIX A

This section contains a point-by-point comparison to NRC Branch Technical Position APCSB 9.5-1 Appendix A.

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Positions

A. Overall Requirements of Nuclear Plant Fire Protection Program

1. Personnel

Responsibility for the overall fire protection program should be assigned to a designated person in the upper level of management. This person should retain ultimate responsibility even though formulation and assurance of program implementation is delegated. Such delegation of authority should be to staff personnel prepared by training and experience in fire protection and nuclear plant safety to provide a balanced approach in directing the fire protection programs for nuclear power plants. The qualification requirements for the fire protection engineer or consultant who will assist in the design and selection of equipment, inspect and test the completed physical aspects of the system, develop the fire protection program, and assist in the fire-fighting training for the operating plant should be stated. Subsequently, the FSAR should discuss the training and the updating provisions such as fire drills provided for maintaining the competence of the station fire-fighting and operating crew, including personnel responsible for maintaining and inspecting the fire protection equipment.

Metropolitan Edison Response:

Responsibility for the overall fire protection program lies with the Vice President - Generation. Currently, the Vice President - Generation utilizes the Manager-Generation Engineering, the Manager-Generation Quality Assurance, and the Manager-Generation Administration, to assist in formulating, and assuring implementation of the fire protection program. These managers meet the standards of ANSI N18.1. Station management and supervision personnel are responsible for day-to-day implementation of fire protection program activities. Documentation of assigned responsibilities are accomplished by means of a "Fire Protection Program Plan" which was issued by the Vice President - Generation on April 1, 1977. At present, the FSAR does not specifically discuss the training and updating provisions regarding fire protection. The FSAR will be updated to comform to this position by September 1, 1977.

The Manager-Generation Engineering is designated as Met-Ed's "Fire Protection Engineer". The qualifications and experience of the incumbent are set forth in Appendix 5A. As part of the effort necessary to respond to Appendix A, the design of the fire protection system, and the associated equipment, was reviewed under the direction of a consultant who is a member of

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	the Society for Fire Protection Engineers (SFPE). The fire protection equipment has been inspected, and test program results reviewed, by a number of different organizations and individuals with special expertise in fire protection systems and equipment such that Met-Ed is assured of the ability of the installed systems to function as necessary to meet their design objectives. System improvements, modifications, and additions necessary as a result of the aforementioned design review in response to APCSB 9.5-1 will be designed under the direction of a consultant who is a member of SFPE as appropriate. The Met-Ed Fire Protection Engineer shall periodically review the technical adequacy of the fire fighting training program.
The fire protection staff should be responsible for:	
(a) coordination of building layout and systems design with fire area requirements, including consideration of potential hazards associated with postulated design basis fires,	Building layout and systems design review are the responsibility of the Met-Ed Fire Protection Engineer. Consultants will be used as necessary when additional specialized qualifications are needed.
(b) design and maintenance of fire detection, suppression, and extinguishing systems,	Design control of systems is the responsibility of the Manager-Generation Engineer (MGE). Maintenance is the responsibility of the TMI-1 Superintendent.

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(c) fire prevention activities,	Fire prevention activities are included in the industrial safety program under the Manager - Generation Administration.
(d) training and manual fire-fighting activities of plant personnel and the fire brigade.	Training of TMI-1 personnel is the responsibility of the Manager - Operation Quality Assurance.
(NOTE: NFPA 6 - Recommendations for Organization of Industrial Fire Loss Prevention, contains useful guidance for organization and operation of the entire fire loss prevention program.)	Supervision of manual fire fighting activities is the responsibility of the TMI-1 Superintendent and he has assigned specific fire fighting responsibilities to station personnel in the Station Emergency Plan. The managers listed above all have available the assistance of the TMI-1 Safety Supervisor for coordination and direction of the implementation of these activities.
2. Design Bases	
The overall fire protection program should be based upon evaluation of potential fire hazards throughout the plant and the effect of postulated design basis fires relative to maintaining ability to perform safety shutdown functions and minimize radioactive releases to the environment.	Section 4.0 of this report (Fire Hazards Analysis) provides this comparison. Likewise, emergency procedures are based on maintaining TMI-1 in a safe condition.
3. Backup	
Total reliance should not be placed on a single automatic fire suppression system. Appropriate backup fire suppression capability should be provided.	In all areas where automatic suppression systems are or will be provided, adequate manual suppression equipment including fire hose stations and/or portable fire extinguishers are available.
4. Single Failure Criterion	
A single failure in the fire suppression system should not impair both the primary and backup fire suppression capability. For example, redundant fire water pumps with independent power supplies and controls should be provided. Postulated	The fire suppression systems meet the single failure criteria and are described in Position C.

fires or fire protection system failures need not be considered concurrent with other plant accidents or the most severe natural phenomena. The effects of lightning strikes should be included in the overall plant fire protection program.

5. Fire Suppression Systems

Failure or inadvertent operation of the fire suppression system should not incapacitate safety related systems or components. Fire suppression systems that are pressurized during normal plant operation should meet the guidelines specified in APCSB Branch Technical Position 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment."

Metropolitan Edison Response: Failure or inadvertent operation of the fire suppression system will not incapacitate safety related systems or components. Fire suppression systems that are pressurized during normal operation meet the guidelines specified in APCSB Branch Technical Position 3-1.

6. Fuel Storage Areas

Schedule for implementation of modifications, if any, will be established on a case-by-case basis.

Metropolitan Edison Response: N/A

7. Fuel Loading

Schedule for implementation of modifications, if any, will be established on a case-by-case basis.

Metropolitan Edison Response: N/A

8. Multiple-Reactor Sites

On multiple-reactor sites where there are operating reactors and construction of remaining units is being completed, the fire protection program should provide continuing evaluation and include additional fire barriers, fire protection capability, and administrative controls necessary to protect the operating units from construction fire hazards. The superintendent of the operating plant should have the lead responsibility for site fire protection.

Metropolitan Edison Response: TMI-1 (operating unit) is completely isolated from TMI-2 (facility under construction) and protected by the security fence, except for the common connection between the fuel handling buildings. The common connection between the fuel handling buildings is sealed off by a fence and security guard preventing TMI-2 construction personnel from entering TMI-1. The fire protection provided in the TMI-1 fuel handling building will adequately protect the operating facility (see Section 4.7). Also, the spatial separation, in conjunction with 3 hour fire barriers between structures housing

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	safety related equipment, precludes the need for any additional fire protection evaluation for potential construction fire hazards. The superintendent will have the lead onsite responsibility for fire protection.
9. <u>Simultaneous Fires</u>	
Simultaneous fires in more than one reactor need not be postulated, where separation requirements are met. A fire involving more than one reactor unit need not be postulated except for facilities shared between units.	N/A
B. <u>Administrative Procedures, Controls and Fire Brigade</u>	
1. Administrative procedures consistent with the need for maintaining the performance of the fire protection system and personnel in nuclear power plants should be provided. Guidance is contained in the following publications: NFPA 4 - Organization for Fire Services NFPA 4A - Organization for Fire Department NFPA 6 - Industrial Fire Loss Prevention NFPA 7 - Management of Fire Emergencies NFPA 8 - Management Responsibility for Effects of Fire on Operations NFPA 27 - Private Fire Brigades	Procedures covering these subjects are in effect. The TMI-1 fire brigade organization is in accordance with NFPA recommendations and has been audited by NELPIA and the NRC.
2. Effective administrative measures should be implemented to prohibit bulk storage of combustible materials inside or adjacent to safety related buildings or systems during operation or maintenance periods. Regulatory Guide 1.39, "Housekeeping Requirements for Water-Cooled Nuclear Power Plants", provides guidance on housekeeping, including the disposal of combustible materials.	Administrative measures controlling storage of combustible material are now in effect. Additionally, periodic fire hazards inspections are performed by the General Public Utilities (GPU) Fire Task Force. These inspections include audits of follow-up on open items.

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3. Normal and abnormal conditions or other anticipated operations such as modifications (e.g., breaking fire stops, impairment of fire detection and suppression systems) and refueling activities should be reviewed by appropriate levels of management and appropriate special actions and procedures such as fire watches or temporary fire barriers implemented to assure adequate fire protection and reactor safety. In particular:	Normal and abnormal conditions which are associated with maintenance and operations and which have the potential to adversely affect reactor safety are controlled by procedures approved by the TMI-1 Superintendent. Similarly, the Manager-Generation Engineering is responsible for insuring modifications are conducted in accordance with procedures which ensure reactor safety. These members of management are responsible for prescribing action necessary to compensate for any temporary reduction in fire protection or increased risk of fire as a result of off-normal conditions.
(a) Work involving ignition sources such as welding and flame cutting should be done under closely controlled conditions. Procedures governing such work should be reviewed and approved by persons trained and experienced in fire protection. Persons performing and directly assisting in such work should be trained and equipped to prevent and combat fires. If this is not possible, a person qualified in fire protection should directly monitor the work and function as a fire watch.	Position 3(a) and 3(b) are currently met at TMI-1.
(b) Leak testing, and similar procedures such as air flow determination, should use one of the commercially available aerosol techniques. Open flames or combustion generated smoke should not be permitted.	
(c) Use of combustible material, e.g., HEPA and charcoal filters, dry ion exchange resins or other combustible supplies, in safety related areas should be controlled. Use of wood inside buildings containing safety related systems or equipment should be permitted only when suitable non-combustible substitutes are not available. If wood must be used, only fire retardant treated wood (scaffolding, lay down blocks) should be permitted. Such	The use of combustible material in the TMI-1 controlled area is limited. Non-treated wood is not used inside buildings containing safety related systems.

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materials should be allowed into safety related areas only when they are to be used immediately. Their possible and probable use should be considered in the fire hazard analysis to determine the adequacy of the installed fire protection systems.	
4. Nuclear power plants are frequently located in remote areas, at some distance from public fire departments. Also, first response fire departments are often volunteer. Public fire department response should be considered in the overall fire protection program. However, the plant should be designed to be self-sufficient with respect to fire fighting activities and rely on the public response only for supplemental or backup capability.	TMI-1 is self-sufficient with respect to fire fighting activities. The Manager-Generation Administration has primary responsibility for optimizing the supplemental or backup capability of public fire departments.
5. The need for good organization, training and equipping of fire brigades at nuclear power plant sites requires effective measures be implemented to assure proper discharge of these functions. The guidance in Regulatory Guide 1.101, "Emergency Planning for Nuclear Power Plants", should be followed as applicable.	
(a) Successful fire fighting requires testing and maintenance of the fire protection equipment, emergency lighting and communication, as well as practice as brigades for the people who must utilize the equipment. A test plan that lists the individuals and their responsibilities in connection with routine tests and inspections of the fire detection and protection systems should be developed. The test plan should contain the types,	While we are confident that the intent of the provisions delineated here are currently being met, some of the documentation and procedure formalization implied in this position may not be overtly stated. All additional documentation and procedural formalization has been included in TMI's Fire Protection Program Plan which was submitted by letter GQL-0428 to the NRC on April 1, 1977.

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frequency and detailed procedures for testing. Procedures should also contain instructions on maintaining fire protection during those periods when the fire protection system is impaired or during periods of plant maintenance, e.g., fire watches or temporary hose connections to water systems.	
(b) Basic training is a necessary element in effective fire fighting operation. In order for a fire brigade to operate effectively, it must operate as a team. All members must know what their individual duties are. They must be familiar with the layout of the plant and equipment location and operation in order to permit effective fire-fighting operations during times when a particular area is filled with smoke or is insufficiently lighted. Such training can only be accomplished by conducting drills several times a year (at least quarterly) so that all members of the fire brigade have had the opportunity to train as a team, testing itself in the major areas of the plant. The drills should include the simulated use of equipment in each area and should be preplanned and post-critiqued to establish the training objective of the drills and determine how well these objectives have been met. These drills should periodically (at least annually) include local fire department participation where possible. Such drills also permit supervising personnel to evaluate the effectiveness of communications within the fire brigade and with the on scene fire team leader, the reactor operator in the control room, and the off-site command post.	This position is, at present, met at TMI-1. Local fire companies have agreed to assist at TMI; will participate in drills and are receiving annual training at the site. In the future, this training will include practical demonstrations of fire fighting peculiar to a nuclear plant. With respect to the implied fixed location, pre-designated offsite command post, it is our position that this is not necessary. During the conduct of fire fighting, remote location command posts are established as needed on a case by case basis. The optimum location for such command posts is quite often onsite and virtually impossible to pre-designate. Drills will include the simulated use of equipment in each area. These drills will be preplanned and post-critiqued to establish the training objective of the drills and to determine how well these objectives have been met.

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(c) To have proper coverage during all phases of operation, members of each shift crew should be trained in fire protection. Training of the plant fire brigade should be coordinated with the local fire department so that responsibilities and duties are delineated in advance. This coordination should be part of training course and implemented into the training of the local fire department staff. Local fire departments should be educated in the operational precautions when fighting fires on nuclear power plant sites. Local fire departments should be made aware of the need for radioactive protection of personnel and the special hazards associated with a nuclear power plant site.	Members of all shifts are trained in fire protection. Local fire companies are annually instructed in the areas listed. In the future, this annual training will be coordinated insofar as this coordination is and remains within the control of Met-Ed.
(d). NFPA 27, "Private Fire Brigade" should be followed in organization, training, and fire drills. This standard also is applicable for the inspection and maintenance of fire fighting equipment. Among the standards referenced in this document, the following should be utilized: NFPA 194, "Standard for Screw Threads and Gaskets for Fire Hose Couplings", NFPA 196, "Standard for Fire Hose," NFPS 197, "Training Standard on Initial Fire Attacks", NFPA 601, "Recommended Manual of Instructions and Duties for the Plant Watchman on Guard." NFPA booklets and pamphlets listed on page 27-11 of Volume 8, 1971-72 are also applicable for good training references. In addition, courses in fire protection and fire suppression which are recognized and/or sponsored by the fire protection industry should be utilized.	This position is currently met at TMI-1.

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C. Quality Assurance Program Quality assurance (QA) programs of applicants and contractors should be developed and implemented to assure that the requirements for design, procurement, installation, and testing and administrative controls for the fire protection program for safety related areas as defined in this Branch Position are satisfied. The program should be under the management control of the QA organization. The QA program criteria that apply to the fire protection program should include the following:	The fire protection system for TMI-1 will be under the scope of the existing OQA plan. Met-Ed will include the fire protection system under Table 1 of the Operational Quality Assurance Plan. This table identifies those systems which are covered, in whole or in part, by the OQA plan. Those items of the Fire Protection System. which were considered necessary in the fire hazards analysis, will be entered on the QA systems list. Necessary changes to the procedures implementing the OQA plan will be made to prescribe the level of control appropriate for the fire protection system. These changes will reflect those items which are and, will continue to be, of commercial quality. The OQA program for fire protection will be under the management control of the QA organization. The changes discussed above, will be implemented by December 31, 1977. The sections of Met-Ed's OQA plan listed below cover the ten criteria shown herein.
1. Design Control and Procurement Document Control Measures should be established to assure that all design-related guidelines of the Branch Technical Position are included in design and procurement documents and that deviations therefrom are controlled.	Section 8.1, pp. 12 and 13 Section 9, pp. 15 and 16
2. Instructions, Procedures and Drawings Inspections, tests, administrative controls, fire drills and training that govern the fire protection program should be prescribed by documented instructions, procedures or drawings and should be accomplished in accordance with these documents.	Section 10, pp. 16 and 17
3. Control of Purchased Material, Equipment and Services Measures should be established to assure that purchased material, equipment and services conform to the procurement documents.	Section 12, pp. 18, 19, 20, 21 and 22

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4. **Inspection**	
A program for independent inspection of activities affecting fire protection should be established and executed by, or for, the organization performing the activity to verify conformance with documented installation drawings with test procedures for accomplishing the activities.	Section 15, pp. 24 and 25
5. **Test and Test Control**	
A test program should be established and implemented to assure that testing is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. The tests should be performed in accordance with written test procedures; test results should be properly evaluated and acted on.	Section 16, pp. 25 and 26
6. **Inspection, Test and Operating Status**	
Measures should be established to provide for the identification of items that have satisfactorily passed required tests and inspections.	Section 19, pp. 28 and 29
7. **Non-Conforming Items**	
Measures should be established to control items that do not conform to specified requirements to prevent inadvertent use of installation.	Section 20, pp. 29, 30 and 31
8. **Corrective Action**	
Measures should be established to assure that conditions adverse to fire protection, such as failures, malfunctions, deficiencies, deviations, defective components, uncontrolled combustible material and non-conformances are promptly identified, reported and corrected.	Section 21, pp. 31 and 32

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9. Records	
Records should be prepared and maintained to furnish evidence that the criteria enumerated above are being met for activities affecting the fire protection program.	Section 22, pp. 32 and 33
10. Audits	
Audits should be conducted and documented to verify compliance with the fire protection program including design and procurement documents; instructions; procedures and drawings; and inspection and test activities.	Section 23, pp. 33, 34, 35 and 36
D. General Guidelines for Plant Protection	
1. Building Design	
(a) Plant Layouts should be arranged to: (1) Isolate safety related systems from unacceptable fire hazards, and	The fire hazards analysis portion of this report identifies the fire areas and the safe shutdown equipment within each area.
(2) Alternatives:	
(a) Redundant safety related systems that are subject to damage from a single fire hazard should be protected by a combination of fire retardant coatings and fire detection and suppression systems, or	Locations where redundant systems are exposed to a single fire hazard are identified in the fire hazards analysis. Adequate fire protection is, or will be, provided for these areas.
(b) a separate system to perform the safety function should be provided.	
(b) In order to accomplish 1.(a) above, safety related systems and fire hazards should be identified throughout the plant. Therefore, a detailed fire hazard analysis should be made. The fire hazards analysis should be reviewed and updated as necessary. Additional fire hazards analysis should be done after any plant modification.	See the fire hazards analysis in Section 4.0.

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(c) Alternative guidance for constructed plants is shown in Section E.3, "Cable Spreading Room."	
(d) Interior wall and structural components, thermal insulation materials and radiation shielding materials and sound-proofing should be non-combustible. Interior finishes should be non-combustible or listed by a nationally recognized testing laboratory, such as Factory Mutual or Underwriters' Laboratory, Inc. for flame spread, smoke and fuel contribution of 25 or less in its use configuration (ASTM E-84 Test), "Surface Burning Characteristics of Building Materials").	TMI-1 structural components meet this criterion.
(e) Metal deck roof construction should be non-combustible (see the building materials directory of the Underwriters Laboratory, Inc.) or listed as Class I by Factory Mutual System Approval Guide. Where combustible material is used in metal deck roofing design, acceptable alternatives are (i) replace combustibles with non-combustible materials, (ii) provide an automatic sprinkler system, or (iii) provide ability to cover roof exterior and interior with adequate water volume and pressure.	Roof construction is of reinforced concrete to give a noncombustible rating, with the exception of the auxiliary building which has FM Class I roof, as described in Section 4.0.
(f) Suspended ceilings and their supports should be of non-combustible construction. Concealed spaces should be devoid of combustibles. Adequate fire detection and suppression systems should be provided where full implementation is not practicable.	TMI-1 areas meet these criteria.

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(g) High voltage - high amperage transformers installed inside buildings containing safety related systems should be of the dry type or insulated and cooled with non-combustible liquid. Safety related systems that are exposed to flammable oil filled transformers should be protected from the effects of a fire by: (i) replacing with dry transformers or transformers that are insulated and cooled with non-combustible liquid; or (ii) enclosing the transformer with a three-hour fire barrier and installing automatic water spray protection.	All inside transformers are dry type.
(h) Buildings containing safety related systems, having openings in exterior walls closer than 50 feet to flammable oil filled transformers should be protected from the effects of a fire by: (i) closing of the opening to have fire resistance equal to three hours, (ii) constructing a three-hour fire barrier between the transformers and the wall openings; or (iii) closing the opening and providing the capability to maintain a water curtain in case of a fire.	Outdoor transformers are within 50 feet of openings in the turbine building wall. Transformers are adequately protected by fixed automatic water spray systems. The turbine building wall is protected by a water curtain which operates with the water spray systems. No safety related systems are exposed to the transformers.
(i) Floor drains, sized to remove expected fire fighting water flow should be provided in those areas where fixed water fire suppression systems are installed. Drains should also be provided in other areas where hand hose lines may be used if such fire fighting water could cause unacceptable	Floor drains are designed to remove the expected fire fighting water flow from areas where fixed water fire suppression systems are installed or where fire hose may be used. Equipment is installed on pedestals. For modifications identified in this report, the adequacy of existing floor drains will be addressed. Protection of exposed equipment to

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damage to equipment in the area. Equipment should be installed on pedestals, or curbs should be provided as required to contain water and direct it to floor drains. (See NFPA 92M, "Waterproofing and Draining of Floors.") Drains in areas containing combustible liquids should have provisions for preventing the spread of fire throughout the drain system. Water drainage from areas which may contain radioactivity should be sampled and analyzed before discharge to the environment. In operating plants or plants under construction, if accumulation of water from the operation of new fire suppression systems does not create unacceptable consequences, drains need not be installed.	water damage will be provided as required. Drains in areas containing combustible liquids are designed to prevent the spread of fire throughout the drain system. Water drainage is pumped from areas which may contain radioactivity to the miscellaneous waste storage tank in the auxiliary building for normal liquid waste processing. Section 11.2.1 of the FSAR details the handling and containing of liquid radioactive wastes.
(j) Floors, walls and ceilings enclosing separate fire areas should have minimum fire rating of three hours. Penetrations in these fire barriers, including conduits and piping, should be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself. Door openings should be protected with equivalent rated doors, frames and hardware that have been tested and approved by a nationally recognized laboratory. Such doors should be normally closed and locked or alarmed with alarm and annunciation in the control room. Penetrations for ventilation system should be protected by a standard "fire door damper" where required. (Refer to NFPA 80, "Fire Doors and Windows.") The fire hazard in each area should be evaluated to determine barrier requirements. If barrier fire resistance cannot be made adequate, fire detection	The fire hazards analysis identifies the fire barriers and determine the requirements for maintaining their integrity. Door openings are protected with equivalent rated doors, frames and hardware that have been tested and approved by a nationally recognized laboratory. Such doors are normally closed and will be posted with signs saying "Keep Closed." Only some selected doors are locked. Penetrations for ventilation systems will be protected by fire dampers where deemed necessary by the fire hazards analysis. The fire hazard in each area has been evaluated to determine barrier requirements. Where barrier fire resistance is not adequate, additional fire detection and suppression is or will be provided as described in (i), (ii) and (iii).

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and suppression should be provided, such as: (i) water curtain in case of fire, (ii) flame retardant coatings, (iii) additional fire barriers.	
2. Control of Combustibles	
(a) Safety related systems should be isolated or separated from combustible materials. When this is not possible because of the nature of the safety system or the combustible material, special protection should be provided to prevent a fire from defeating the safety system function. Such protection may involve a combination of automatic fire suppression, and construction capable of withstanding and containing a fire that consumes all combustibles present. Examples of such combustible materials that may not be separable from the remainder of its system are: (1) Emergency diesel generator fuel oil day tanks (2) Turbine-generator oil and hydraulic control fluid systems (3) Reactor coolant pump lube oil system	The fire hazards analysis identifies these hazards and the protection afforded.
(b) Bulk gas storage (either compressed or cryogenic), should not be permitted inside structures housing safety-related equipment. Storage of flammable gas such as hydrogen, should be located outdoors or in separate detached buildings so that a fire or	Bulk gas is stored in outside areas in accordance with OSHA 1910.101. A fire or explosion will not adversely affect any safety related systems or equipment.

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explosion will not adversely affect any safety related systems or equipment.	
(Refer to NFPA 50A, "Gaseous Hydrogen Systems.")	
Care should be taken to locate high pressure gas storage coutainers with the long axis parallel to building walls. This will minimize the possibility of wall penetration in the event of a container failure. Use of compressed gases (especially flammable and fuel gases) inside buildings should be controlled. (Refer to NFPA 6, "Industrial Fire Loss Prevention.")	The hydrogen storage containers have their long axis at right angles to the east wall of the turbine building. The hydrogen is stored to the north east of the transformer area, 138 feet from the east turbine building wall.
(c) The use of plastic materials should be minimized. In particular, haloginated plastics such as polyvinyl chloride (PVC) and neoprene should be used only when substitute non-combustible materials are not available. All plastic materials, including flame and fire retardant materials, will burn with an intensity and BTU production in a range similar to that of ordinary hydrocarbons. When burning, they produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA. The haloginated plastics also release free chlorine and hydrogen chloride when burning which are toxic to humans and corrosive to equipment.	The quantity of plastic material throughout is negligible. It has always been Met-Ed policy to avoid the use of polyvinyl chloride (PVC) and neoprene, unless substitute, noncombustible materials are not available. At present, Met-Ed has specified and is purchasing Griffolyn Type 55 Fire Retardant plastic sheeting for all maintenance activities. Griffolyn Type 55 FR sheeting is classified by Underwriters Laboratories Test No. 723 as follows: Flame Spread — 10 Fuel Contribution — Not determinable Smoke Developed — 45
(d) Storage of flammable liquids should, as a minimum, comply with the requirements of NFPA 30, "Flammable and Combustible Liquids Code."	Flammable liquids are stored in accordance with the requirements of NFPA 30 and OSHA 1910.106.
3. <u>Electric Cable Construction, Cable Trays and Cable Penetrations</u>	
(a) Only non-combustible materials should be used for cable tray construction.	Cable trays are of noncombustible metal construction.

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(b) See Section E.3 for fire protection guidelines for cable spreading rooms.	
(c) Automatic water sprinkler systems should be provided for cable trays outside the cable spreading room. Cables should be designed to allow wetting down with deluge water without electrical faulting. Manual hose stations and portable hand extinguishers should be provided as backup. Safety related equipment in the vicinity of such cable trays, that does not itself require water fire protection, but is subject to unacceptable damage from sprinkler water discharge, should be protected from sprinkler system operation or malfunction. When safety related cables do not satisfy the provisions of Regulatory Guide 1.75, all exposed cables should be covered with an approved fire retardant coating and a fixed automatic water fire suppression system should be provided.	Automatic water spray systems or cable coatings will be provided in areas of concentrated cable loading in accordance with the fire hazards analysis. (See Section 2.3.6 for degree of compliance to Regulatory Guide 1.75). Potential water damage will be considered if water sprays are used.
(d) Cable and cable tray penetration of fire barriers (vertical and horizontal) should be sealed to give protection at least equivalent to that fire barrier. The design of fire barriers for horizontal and vertical cable trays should, as a minimum, meet the requirements of ASTM E-119, "Fire Test of Building Construction and Materials," including the hose stream test. Where installed penetration seals are deficient with respect to fire resistance, these seals may be protected by covering both sides with an approved fire retardant material. The adequacy of using such material should be demonstrated by suitable testing.	Cable penetrations in fire barriers have been sealed with kaowool, marinite board and flamemastic or will be sealed with silicone foam consistent with fire barrier fire resistance requirements.

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(e) Fire breaks should be provided as deemed necessary by the fire hazards analysis. Flame or flame retardant coatings may be used as a fire break for grouped electrical cables to limit spread of fire in cable ventings. (Possible cable derating owing to use of such coating materials must be considered during design.)	Additional fire breaks are not deemed necessary as the result of the fire hazards analysis.
(f) Electric cable constructions should as a minimum pass the current IEEE No. 383 flame test. (This does not imply that cables passing this test will not require additional fire protection.) For cable installation in operating plants and plants under construction that do not meet the IEEE No. 383 flame test requirements, all cables must be covered with an approved flame retardant coating and properly derated.	Electric cable construction meets the current IEEE 383 flame test.
(g) Applicable to new cable installations.	New cable will meet IEEE 383 flame test.
(h) Cable trays, raceways, conduit, trenches, or culverts should be used only for cables. Miscellaneous storage should not be permitted, nor should piping for flammable or combustible liquids or gases be installed in these areas. Installed equipment in cable tunnels or culverts, need not be removed if they present no hazard to the cable runs as determined by the fire hazards analysis.	This criterion is met.
(i) The design of cable tunnels, culverts and spreading rooms should provide for automatic or manual smoke venting as required to facilitate manual fire fighting capability.	The cable trench is not provided with automatic or manual smoke venting. The cable spreading area does have provisions for manual smoke venting. Gaseous suppression systems are, or will be, installed to provide extinguishment prior to the generation of any appreciable amount of smoke. Portable fans will exhaust any smoke from the control building through doors to the fuel handling building, and then exhaust the smoke to the outside through overhead doors.

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(j) Cables in the control room should be kept to the minimum necessary for operation of the control room. All cables entering the control room should terminate there. Cables should not be installed in floor trenches or culverts in the control room. Existing cabling installed in concealed floor and ceiling spaces should be protected with an automatic total flooding halon system.	Cables in the control room come primarily through the floor from the relay room and terminate in control panels, consoles or equipment. However, some cabling is installed in a floor trench from the I/O cabinet to the computer area where they are installed in a concealed floor. An automatic Halon suppression system will be installed for the protection of the cable trench and concealed floor.
4. Ventilation	
(a) The products of combustion that need to be removed from a specific fire area should be evaluated to determine how they will be controlled. Smoke and corrosive gases should generally be automatically discharged directly outside to a safe location. Smoke and gases containing radioactive materials should be monitored in the fire area to determine if release to the environment is within the permissible limits of the plant Technical Specifications. The products of combustion which need to be removed from a specific fire area should be evaluated to determine how they will be controlled.	Ventilation for critical areas is evaluated in Sections 2.0 and 4.0 of this report. Areas containing radioactive material release potentials are also outlined. Monitoring of radioactive contamination is discussed in Chapter 11 of the FSAR. Monitoring of specific areas will be accomplished in accordance with existing TMI-1 procedures when necessary.
(b) Any ventilation system designed to exhaust smoke or corrosive gases should be evaluated to ensure that inadvertent operation or single failures will not violate the controlled areas of the plant design. This requirement includes containment functions for protection of the public and maintaining habitability for operations personnel.	No systems are designed solely for smoke removal. Existing ventilation systems which would be used for smoke removal meet these criteria.

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(c) The power supply and controls for mechanical ventilation systems should be run outside the fire area served by the system.	The power supply and controls for the mechanical ventilation systems used to cool redundant safe shutdown equipment have been run in the same area as the applicable equipment. These controls meet the separation requirements outlined in Chapter 8 of the FSAR.
(d) Fire suppression systems should be installed to protect charcoal filters in accordance with Regulatory Guide 1.52, "Design Testing and Maintenance Criteria for Atmospheric Cleanup Air Filtration."	Charcoal filters are not engineered safety features. However, automatic deluge systems are provided for the protection of the charcoal filters.
(e) The fresh air supply intakes to areas containing safety related equipment or systems should be located remote from the exhaust air outlets and smoke vents of other fire areas to minimize the possibility of contaminating the intake air with the products of combustion.	Fresh air supply intakes are remotely located with respect to exhaust air outlets, thus minimizing the possibility of contaminating the intake air with the products of combustion.
(f) Stairwells should be designed to minimize smoke infiltration during a fire. Staircases should serve as escape routes and access routes for fire fighting. Fire exit routes should be clearly marked. Stairwells, elevators and chutes should be enclosed in masonry towers with minimum fire rating of three hours and automatic fire doors at least equal to the enclosure construction, at each opening into the building. Elevators should not be used during fire emergencies. Where stairwells or elevators cannot be enclosed in three-hour fire rated barrier with equivalent fire doors, escape and access routes should be established by pre-fire plan and practiced in drills by operating and fire brigade personnel.	The control building stairwell is enclosed as indicated on the layout drawings attached to this report. All other stairways are open between floors. Elevators are not used during fire emergencies. Escape and access routes have been established by pre-fire plan and are practiced in drills by operating and fire brigade personnel. All fire exit routes are clearly posted throughout TMI-1.

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(g) Smoke and heat vents may be useful in specific areas such as cable spreading rooms and diesel fuel oil storage areas and switchgear rooms. When natural-convection ventilation is used, a minimum ratio of 1 sq. foot of venting area per 200 sq. feet of floor area should be provided. If forced-convection ventilation is used, 300 CFM should be provided for every 200 sq. feet of floor area. See NFPA No. 204 for additional guidance on smoke control.	Forced convection ventilation is provided throughout TMI-1 and is in excess of 300 cfm for each 200 ft^2 of floor area.
(h) Self-contained breathing apparatus, using full face positive pressure masks, approved by NIOSH (National Institute for Occupational Safety and Health - approval formerly given by the U. S. Bureau of Mines) should be provided for fire brigade, damage control and control room personnel. Control room personnel may be furnished breathing air by a manifold system piped from a storage reservoir if practical. Service or operating life should be a minimum of one half hour for the self-contained units.	Self-contained breathing apparatuses using full face positive pressure masks approved by NIOSH, are provided for the fire brigade, damage control and control room personnel. Each self-contained breathing apparatus has two spare bottles. Also, there is an air compressor and cascade system at TMI-1 for unlimited air supply.
At least two extra air bottles should be located onsite for each self-contained breathing unit. In addition, an onsite 6-hour supply of reserve air should be provided and arranged to permit quick and complete replenishment of exhausted supply air bottles as they are returned. If compressors are used as a source of breathing air, only units approved for breathing air should be used. Special care must be taken to locate the compressor in areas free of dust and contaminants.	Precautions have been taken to locate the compressor in areas free of dust and contaminants.

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(i) Where total flooding gas extinguishing systems are used, area intake and exhaust ventilation dampers should close upon initiation of gas flow to maintain necessary gas concentration. (See NFPA 12, "Carbon Dioxide Systems", and 12A, "Halon 1301 Systems.")	Where required, ventilation dampers close on actuation of a gaseous extinguishing system.
5. Lighting and Communication	
Lighting and two way voice communication are vital to safe shutdown and emergency response in the event of fire. Suitable fixed and portable emergency lighting and communication devices should be provided to satisfy the following requirements:	Emergency lighting for the control room is provided from AC safety related distribution panels; additional lighting is from electrical DC power.
(a) Fixed emergency lighting should consist of sealed beam units with individual 8-hour minimum battery power supplies.	Emergency lighting for means of egress lighting is provided throughout TMI-1 and is powered from emergency AC safety related switchgear. The emergency AC power is more reliable and does not present the maintenance problems associated with sealed beam units.
(b) Suitable sealed beam battery powered portable hand lights should be provided for emergency use.	Sealed beam battery powered, portable hand lights are provided for emergency use.
(c) Fixed emergency communication should use voice powered head sets at pre-selected stations.	Headsets, powered by 110V safety related switchgear can be plugged into jacks throughout TMI-1. No voice powered headsets are available.
(d) Fixed repeaters installed to permit use of portable radio communication units should be protected from exposure fire damage.	At TMI-1, a fixed repeater is located in the pretreatment area, which is near the geographic center of the station. This enables portable radio communication throughout the station. The repeater is not protected from exposure fire damage; however, it is located in an area with limited amount of combustible material, thereby representing a low fire potential.

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E. Fire Detection and Suppression	
1. Fire Detection	
(a) Fire detection systems should as a minimum comply with NFPA 72D, "Standard for the Installation Maintenance and Use of Proprietary Protective Signaling Systems." Deviations from the requirements of NFPA 72D should be identified and justified.	Fire detection systems comply with NFPA 72D, except that no recorder is provided. This deviation is acceptable since adequate records are kept.
(b) Fire detection system should give audible and visual alarm and annunciation in the control room. Local audible alarms should also sound at the location of the fire.	Fire detection systems give audible, and visual alarm through the TMI-1 annunciation system in the control room. Local alarms do not sound at the location of the fire.
(c) Fire alarms should be distinctive and unique. They should not be capable of being confused with any other plant system alarms.	Fire alarms have standard annunciator tone. However, engraved flashing windows are provided for the fire alarm in the control room.
(d) Fire detection and actuation systems should be connected to the plant emergency power supply.	The fire detection and deluge actuation systems are connected to TMI-1 emergency power supply.
2. Fire Protection Water Supply Systems	
(a) An underground yard fire main loop should be installed to furnish anticipated fire water requirements. NFPA 24 - Standard for Outside Protection - gives necessary guidance for such installation. It references other design codes and standards developed by such organizations as the American National Standards Institute (ANSI) and the American Water Works Association (AWWA). Lined steel or cast iron pipe should be used to reduce internal tuberculation. Such tuberculation deposits in an unlined pipe over a period of years can significantly reduce water flow through the combination of increased friction and reduced pipe diameter. Means for treating and flushing the systems should be	The underground yard fire main loop is installed in accordance with NFPA Standard 24. Section 9.8.7.4 of the FSAR gives a detailed description of the system. Underground pipe is carbon steel (ASTM A-53 Gr. B, or ASTM A 134 or API 5L, Gr. B), shop coated for underground service with hot coal tar enamel and asbestos felt per AWWA Spec. C-203. Above ground pipe is carbon steel, ASTM A-106. Flushing is accomplished by using fire hydrants. No means for treatment is available. Sectional control valves (post indicator valves) are provided to isolate portions of the main for maintenance or repair without shutting off the entire system. Position

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provided. Approved visually indicating sectional control valves, such as Post Indicator Valves, should be provided to isolate portions of the main for maintenance or repair without shutting off the entire system. Visible location marking signs for underground valves is acceptable. Alternative valve position indicators should also be provided.	indicators are provided with the sectional control valves.
The fire main system piping should be separate from service or sanitary water system piping. For operating plants, fire main system piping that can be isolated from service or sanitary water system piping is acceptable.	The fire main piping is separate from the domestic and sanitary water service piping.
(b) A common yard fire main loop may serve multi-unit nuclear power plant sites, if cross-connected between units. Sectional control valves should permit maintaining independence of the individual loop around each unit. For such installations, common water supplies may also be utilized. The water supply should be sized for the largest single expected flow. For multiple reactor sites with widely separated plants (approaching 1 mile or more), separate yard fire main loops should be used. Sectionalized systems are acceptable.	A common yard fire main loop serves TMI-1 and TMI-2. Sectional control valves (post indicator valves) are provided to permit independence of the individual loop around each unit. (See FSAR, Fig. 9-25). The water supply is sized for the largest single expected flow.
(c) If pumps are required to meet system pressure or flow requirements, a sufficient number of pumps should be provided so that 100% capacity will be available with one pump inactive (e.g., pumps). The connection to the yard fire main loop from each fire pump should be widely separated, preferably located on opposite sides of the plant. Each pump should have its own driver with independent power	Three fire pumps (2500 gpm @ 125 psig; two diesel driven and one electrically motor driven) are provided for TMI-1, thereby meeting this requirement. Connections to the yard fire main loop are at least 50 feet apart. One additional 2500 gpm @ 125 psig diesel driven fire pump is located at the TMI-2 intake screen and pumphouse. Two of the fire pumps are separated by a 3 hour fire wall in the intake screen and pumphouse. The other two fire pumps are

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supplies and control. At least one pump (if not powered from the emergency diesels) should be driven by non-electrical means, preferably diesel engine. Pumps and drivers should be located in rooms separated from the remaining pumps and equipment by a minimum three-hour fire wall. Alarms indicating pump running, driver availability, or failure to start should be provided in the control room.	spatially separated: one on the TMI-1 side in the circulating water pump house, and the other at the TMI-2 screenhouse. Alarms indicating pump running, driver availability, and failure to start are provided in the control room.
Details of the fire pump installation should as a minimum conform to NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."	The fire pump installation conforms to NFPA 20.
(d) Two separate reliable water supplies should be provided. If tanks are used, two 100% (minimum of 300,000 gallons each) system capacity tanks should be installed. They should be so interconnected that pumps can take suction from either or both. However, a leak in one tank or its piping should not cause both tanks to drain. The main plant fire water supply capacity should be capable of refilling either tank in a minimum of eight hours.	Water supply is from the Susquehanna River and the circulating water flume.
Common tanks are permitted for fire and sanitary or service water storage. When this is done, however, minimum fire water storage requirements should be dedicated by means of a vertical standpipe for other water services.	A 100,000 gallon filtered water altitude tank is connected into the fire main piping. For fire protection, 90,000 gallons is held in reserve. Internal piping permits 10,000 gallons to flow to the makeup demineralizers.
(e) The fire water supply (total capacity and flow rate) should be calculated on the basis of the largest expected flow rate for a period of two hours, but not less than 300,000 gallons.	The maximum flow demand is 2575 gpm to the most remote deluge system, plus 1000 gpm for manual hose streams. A single pump is designed to run at 150 percent of rated capacity and provide 3750 gpm at 80 psig.

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This flow rate should be based (conservatively) on 1,000 gpm for manual hose streams plus the greater of: (1) all sprinkler heads opened and flowing in the largest designed fire area; or (2) the largest open head deluge system(s) operating.	
(f) Lakes or fresh water ponds of sufficient size may qualify as sole source of water for fire protection, but require at least two intakes to the pump supply. When a common water supply is permitted for fire protection and the ultimate heat sink, the following conditions should also be satisfied: (1) The additional fire protection water requirements are designed into the total storage capacity; and (2) Failure of the fire protection system should not degrade the function of the ultimate heat sink.	N/A
(g) Outside manual hose installation should be sufficient to reach any location with an effective hose stream. To accomplish this hydrants should be installed approximately every 250 feet on the yard main system. The lateral to each hydrant from the yard main should be controlled by a visually indicating or key operated (curb) valve. A hose house, equipped with hose and combination nozzle, and other auxiliary equipment recommended in NFPA 24, "Outside "Protection", should be provided as needed but at least every 1,000 feet.	Fire hydrants are located approximately 250 ft apart around the perimeter of TMI-1 and TMI-2. The lateral to each fire hydrant is controlled by a key operated (curb) valve. Each fire hydrant is provided with a hose house containing 250 feet of 2-1/2 inch hose, combination fog nozzle, and auxiliary equipment. Hose houses around the perimeter of TMI-1 will meet the inventory requirements of NFPA 24.

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Threads compatible with those used by local fire departments should be provided on all hydrants, hose couplings and standpipe risers.	Threads are compatible with those used by most local fire departments; however, adapters are always available where necessary.
3. <u>Water Sprinklers and Hose Standpipe Systems</u>	
(a) Each automatic sprinkler system and manual hose station standpipe should have an independent connection to the plant underground water main. Headers fed from each end are permitted inside buildings to supply multiple sprinkler and standpipe systems. When provided, such headers are considered an extension of the yard main system. The header arrangement should be such that no single failure can impair both the primary and backup fire protection systems.	Headers for each building containing safe shutdown equipment are fed from each end. The automatic sprinkler systems and manual hose station standpipe are fed from headers. These headers are arranged such that each is isolable, thereby ensuring that no single failure can impair the header function. Fire suppression systems outlined in the fire hazards analysis will address the case of a single failure impairing both the primary and backup fire protection systems.
Each sprinkler and standpipe system should be equipped with OS&Y (outside screw and yoke) gate valve, or other approved shut off valve, and water flow alarm. Safety related equipment that does not itself require sprinkler water fire protection, but is subject to unacceptable damage if wetted by sprinkler water discharge should be protected by water shields or baffles.	Each sprinkler and standpipe system is equipped with an OS&Y gate valve. Each sprinkler system is equipped with a water flow alarm. Standpipe systems are not equipped with a water flow alarm. Safety related equipment has been protected from water damage.
(b) All valves in the fire water systems should be electrically supervised. The electrical supervision signal should indicate in the control room and other appropriate command locations in the plant (See NFPA 26, "Supervision of Valves.") When electrical supervision of fire protection valves is not practicable, an adequate management supervision program should be provided. Such a	Shutoff valves controlling sprinkler and deluge systems are electrically supervised and alarm in the control room. All valves are supplied with tamper proof seals. Additionally, a management supervision program exists that requires visual inspection.

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program should include locking valves open with strict key control; tamper proof seals; and periodic, visual check of all valves.	
(c) Automatic sprinkler systems should as a minimum conform to requirements of appropriate standards such as NFPA 13, "Standard for the Installation of Sprinkler Systems", and NFPA 15, "Standard for Water Spray Fixed Systems."	Sprinkler systems throughout TMI-1 meet the design and installation requirements of NFPA 13 and/or NFPA 15.
(d) Interior manual hose installation should be able to reach any location with at least one effective hose steam. To accomplish this, standpipes with hose connections equipped with a maximum of 75 feet of 1-1/2 inch woven jacket lined fire hose and suitable nozzles should be provided in all buildings, including containment, on all floors and should be spaced at not more than 100-foot intervals. Individual standpipes should be at least 4-inch diameter for multiple hose connections and 2-1/2-inch diameter for single hose connections. These systems should follow the requirements of NFPA No. 14 for sizing, spacing and pipe support requirements (NELPIA).	Hose reels are provided throughout TMI-1 as indicated on the layout drawings attached to this report. Fire hose is 1-1/2 in. synthetic braided rayon cord pile hose which does not require drying after use and testing. The pipe size and arrangement are adequate. Additional hose reels will be provided in accordance with the fire hazard analysis, Section 4.0. These systems meet the requirements of NFPA 14.
Hose stations should be located outside entrances to normally unoccupied areas and inside normally occupied areas. Standpipes serving hose stations in areas housing safety related equipment should have shut off valves and pressure reducing devices (if applicable) outside the area.	Hose stations are mainly located outside entrances to normally unoccupied areas. Shutoff valves and pressure reducing devices are provided at each hose station and in the main feed to the standpipe. 1413 144
(e) The proper type of hose nozzles to be supplied to each area should be based on the fire hazard analysis. The usual combination spray/straight-	All areas are provided with combination fog-straight stream nozzles. Personnel are adequately trained to make proper use of hose stations.

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stream nozzle may cause unacceptable mechanical damage (for example, the delicate electronic equipment in the control room) and be unsuitable. Electrically safe nozzles should be provided at locations where electrical equipment or cabling is located.	
(f) Certain fires such as those involving flammable liquids respond well to foam suppression. Consideration should be given to use of any of the available foams for such specialized protection application. These include the more common chemical and mechanical low expansion foams, high expansion foam and the relatively new aqueous film forming foam (AFFF).	There are no major flammable liquid hazards in TMI-1. Areas involving combustible liquids are adequately protected.
4. Halon Suppression Systems	
The use of Halon fire extinguishing agents should as a minimum comply with the requirements of NFPA 12A and 12B, "Halogenated Fire Extinguishing Agent Systems - Halon 1301 and Halon 1211." Only UL or FM approved agents should be used.	A total flooding Halon 1301 system is provided in the supervisors office at elevation 322' of the control building. Halon 1301 systems are provided in the air intake tunnel (see FSAR Sections 9.8.6 and 9.8.7), which comply with NFPA standards.
In addition to the guidelines of NFPA 12A and 12B, preventative maintenance and testing of the systems, including check weighing of the Halon cylinders should be done at least quarterly.	Preventative maintenance and testing of systems are performed quarterly. Halon cylinders are not check weighed; however, cylinder pressure is checked and recorded quarterly, which would indicate any mass loss.
Particular consideration should also be given to:	Consideration has been given to items (a), (b) and (c).
(a) minimum required Halon concentration and soak time	
(b) toxicity of Halon	
(c) Toxicity and corrosive characteristics of thermal decomposition products of Halon.	

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5. **Carbon Dioxide Suppression Systems**	
The use of carbon dioxide extinguishing systems should as a minimum comply with the requirements of NFPA 12, "Carbon Dioxide Extinguishing Systems."	A carbon dioxide system is provided for the protection of the relay room at elevation 338'.
Particular consideration should also be given to:	The carbon dioxide system is designed in accordance with NFPA 12 to deliver a concentration of 50 percent by volume.
(a) minimum required CO_2 concentration and soak time;	
(b) toxicity of CO_2;	Consideration has been given to items (a) through (f).
(c) possibility of secondary thermal shock (cooling) damage;	
(d) offsetting requirements for venting during CO_2 injection to prevent overpressurization versus sealing to prevent loss of agent;	
(e) design requirements from overpressurization; and	
(f) possibility and probability of CO_2 systems being out-of-service because of personnel safety consideration. CO_2 systems are disarmed whenever people are present in an area so protected. Areas entered frequently (even though duration time for any visit is short) have often been found with CO_2 systems shut off.	
6. **Portable Extinguishers**	
Fire extinguishers should be provided in accordance with guidelines of NFPA 10 and 10A, "Portable Fire Extinguishers, Installation, Maintenance and Use." Dry chemical extinguishers should be installed with due consideration given to cleanup problems after use and possible adverse effects on equipment installed in the area.	Portable fire extinguishers are provided and maintained in accordance with NFPA 10.

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F. Guidelines for Specific Plant Areas	
1. Primary and Secondary Containment	
(a) Normal Operation	
Fire protection requirements for the primary and secondary containment areas should be provided on the basis of specific identified hazards. For example:	
°Lubricating oil or hydraulic fluid system for the primary coolant pumps	
°Cable tray arrangements and cable penetrations	
°Charcoal filters	
Fire suppression systems should be provided based on the fire hazards analysis.	The fire hazards analysis outlines the protection for containment areas.
Fixed fire suppression capability should be provided for hazards that could jeopardize safe plant shutdown. Automatic sprinklers are preferred. An acceptable alternate is automatic gas (Halon or CO_2) for hazards identified as requiring fixed suppression protection.	
An enclosure may be required to confine the agent if a gas system is used. Such enclosures should not adversely affect safe shutdown, or other operating equipment in containment.	
Automatic fire suppression capability need not be provided in the primary containment atmospheres that are inerted during normal operation. However, special fire protection requirements during refueling and maintenance operations should be satisfied as provided below.	

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(b) Refueling and Maintenance	
Refueling and maintenance operations in containment may introduce additional hazards such as contamination control materials, decontamination supplies, wood planking, temporary wiring, welding and flame cutting (with portable compressed fuel gas supply). Possible fires would not necessarily be in the vicinity of fixed detection and suppression systems.	Procedures shall provide control for additional hazards during refueling and maintenance operations. Work involving ignition sources such as welding and flame cutting shall be done under closely controlled conditions governed by procedures.
Management procedures and controls necessary to assure adequate fire protection are discussed in Section 3a.	
Equivalent protection from portable systems should be provided if it is impractical to install standpipes with hose stations.	
2. Control Room	
The control room is essential to safe reactor operation. It must be protected against disabling fire damage and should be separated from other areas of the plant by floors, walls and roofs having minimum fire resistance ratings of three hours.	The control room is separated from the fuel handling building and turbine building by 3 hour fire resistance rated walls, and from the control building by a 3 hour fire resistance rated floor and minimum 2 hour fire resistance rated walls and ceiling. The exceptions are the HVAC ducts, the recessed window and unlabeled doors. Section 4.4.14.3 also discussed these ratings and outlines the protection for the control room.
Control room cabinets and consoles are subject to damage from two distinct fire hazards: (a) Fire originating within a cabinet or console; and (b) Exposure fire involving combustibles in the general room area.	
Hose stations adjacent to the control room with portable extinguishers in the control room are acceptable.	Hose stations will be provided adjacent to the control room. Portable extinguishers are provided in the control room.

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Nozzles that are compatible with the hazards and equipment in the control room should be provided for the manual hose station. The nozzles chosen should satisfy actual fire fighting needs, satisfy electrical safety and minimize physical damage to electrical equipment from hose stream impingement.	Multi-purpose combination fog-straight stream nozzles will be provided. Personnel are trained in their safe use.
Fire detection in the control room cabinets, and consoles should be provided by smoke and heat detectors in each fire area. Alarm and annunciation should be provided in the control room. Fire alarms in other parts of the plant should also be alarmed and annunciated in the control room.	Smoke detectors are provided in the ceiling of the room as well as in the ventilation exhaust duct for the building. Additional protection is outlined in the fire hazard analysis. (Refer to Section 4.4.14).
Breathing apparatus for control room operators should be readily available. Control room floors, ceiling, supporting structures, and walls, including penetrations and doors, should be designed to a minimum fire rating of three hours. All penetration seals should be air tight.	Breathing apparatuses for control room operators are readily available. For fire ratings of the control room floors, walls and ceiling see Section 4.4.14.3
Manually operated ventilation systems are acceptable.	
If such concealed spaces are used, however, they should have fixed automatic total flooding halon protection.	The concealed space beneath the computer room subfloor and adjacent cable trench will be provided with a total flooding Halon system.
3. <u>Cable Spreading Room</u>	
(a) The preferred acceptable methods are:	
(1) Automatic water system such as closed head sprinklers, open head deluge, or open directional spray nozzles. Deluge and open spray systems should have provisions for manual operation at a remote station;	The relay room or cable spreading room (elevation 338') is protected by an automatic low pressure CO_2 system. The room is completely sealed to give a 3 hour fire resistance rating, with the exception of the CRDM bus duct which has a louvered enclosure and penetrates the west wall. Pressure release devices are actuated by CO_2 discharge

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however, there should also be provisions to preclude inadvertent operation. Location of sprinkler heads or spray nozzles should consider cable tray sizing and arrangements to assure adequate water coverage. Cables should be designed to allow wetting down with deluge water without electrical faulting. Open head deluge and open directional spray systems should be zoned so that a single failure will not deprive the entire area of automatic fire suppression capability. The use of foam is acceptable, provided it is of a type capable of being delivered by a sprinkler or deluge system, such as an Aqueous Film Forming Foam (AFFF).	pressure in the discharge lines, allowing doors and dampers to close, isolating the relay room. Relief dampers are being provided in accordance with NFPA 12 to prevent a pressure buildup. Water spray is not advocated because of the potential damage to relay cabinets in the relay room/cable spread areas.
(2) Manual hoses and portable extinguishers should be provided as backup.	Portable fire extinguishers are provided. Hose reels will be installed in accordance with the fire hazards analysis.
(3) Each cable spreading room of each unit should have divisional cable separation, and be separated from the other and the rest of the plant by a minimum three-hour rated fire wall (Refer to NFPA 251 or ASTM E-119 for fire test resistance rating).	Divisional cable separation for TMI-1 is in accordance with Regulatory Guide 1.75, and cable spreading rooms are widely separated. The cable spreading room is separated from the rest of TMI-1 by a 3 hour fire resistance rating, with the exception of the CRDM bus duct which has a louvered enclosure and penetrates the west wall.
(4) At least two remote and separate entrances are provided to the room for access by fire brigade personnel; and	Three remote entrances are provided to the room. (See drawing D-023-016).

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(5) Aisle separation provided between tray stacks should be at least three feet wide and eight feet high.	Cable trays are installed well above floor level. Access for manual fire suppression activities is adequate.
(b) For cable spreading rooms that do not provide divisional cable separation of a(3), in addition to meeting a(1), (2), (4), and (5) above, the following should also be provided:	N/A
(1) Divisional cable separation should meet the guidelines of Regulatory Guide 1.75, "Physical Independence of Electric Systems."	
(2) All cabling should be covered with a suitable fire retardant coating.	
(3) As an alternate to a(1) above, automatically initiated gas systems (Halon or CO_2) may be used for primary fire suppression, provided a fixed water system is used as a backup.	
(4) Plants that cannot meet the guidelines of Regulatory Guide 1.75, in addition to meeting a(1), (2), (4), and (5) above, an auxiliary shutdown system with all cabling independent of the cable spreading room should be provided.	
4. Plant Computer Room	
Safety related computers should be separated from other areas of the plant by barriers having a minimum three-hour fire resistant rating. Automatic fire detection should be provided to alarm and annunciate in the control room and alarm locally. Manual hose stations and portable water and halon fire extinguishers should be provided.	TMI-1 computers are not safety related.

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5. Switchgear Rooms	
Switchgear rooms should be separated from the remainder of the plant by minimum three-hour rated fire barriers to the extent practicable. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Fire hose stations and portable extinguishers should be readily available.	Safety related switchgear rooms are separated from the remainder of TMI-1 by 3 hour fire resistance rated walls, floors and ceiling. The fire hazards analysis outlines the protection requirements for these areas. Portable fire extinguishers are readily available. Fire hose stations will be installed as discussed in Section 4.7.5.3.
Acceptable protection for cables that pass through the switchgear room is automatic water or gas agent suppression. Such automatic suppression must consider preventing unacceptable damage to electrical equipment and possible necessary containment of agent following discharge.	Water or gas suppression systems are not provided where cables pass through the switchgear room. However, adequate seals will be provided where these cables penetrate the fire barriers.
6. Remote Safety Related Panels	
The general area housing remote safety related panels should be provided with automatic fire detectors that alarm locally and alarm and annunciate in the control room. Combustible materials should be controlled and limited to those required for operation. Portable extinguishers and manual hose stations should be provided.	Combustible materials are controlled in these areas. HVAC duct smoke detectors are provided which alarm in the control room only. Manual fire suppression equipment is provided for these areas. The fire hazard analysis details these areas.
7. Station Battery Rooms	
Battery rooms should be protected against fire explosions. Battery rooms should be separated from each other and other areas of the plant by barriers having a minimum fire rating of three-hours inclusive of all penetrations and openings. (See NFPA 69, "Standard on Explosion Prevention Systems.") Ventilation systems in the battery	The battery rooms are separated from other areas by 3 hour fire resistance rated walls, floors and ceiling. The fire hazards analysis outlines the protection requirements for these areas.

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rooms should be capable of maintaining the hydrogen concentration well below 2 vol. % hydrogen concentration. Standpipe and hose and portable extinguishers should be provided.	The ventilation system will maintain the hydrogen concentration well below 2 percent by volume. Portable fire extinguishers are provided and a hose reel will be installed.
Alternatives:	
(a) Provide a total fire rated barrier enclosure of the battery room complex that exceeds the fire load contained in the room.	N/A
(b) Reduce the fire load to be within the fire barrier capability of 1-1/2 hours.	
OR	
(c) Provide a remote manual actuated sprinkler system in each room and provide the 1-1/2 hour fire barrier separation.	
8. Turbine Lubrication and Control Oil Storage and Use Areas	
A blank fire wall having a minimum resistance rating of three hours should separate all areas containing safety related systems and equipment from the turbine oil system. When a blank wall is not present, open head deluge protection should be provided for the turbine oil hazards and automatic open head water curtain protection should be provided for wall openings.	No safety related equipment is exposed to the turbine oil storage areas.
9. Diesel Generator Areas	
Diesel generators should be separated from each other and other areas of the plant by fire barriers having a minimum fire resistance rating of three hours.	The diesel generator areas meet this criterion.

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When day tanks cannot be separated from the diesel-generator one of the following should be provided for the diesel generator area: (a) Automatic open head deluge or open head spray nozzle system(s) (b) Automatic closed head sprinklers (c) Automatic AFFF that is delivered by a sprinkler deluge or spray system (d) Automatic gas system (Halon or CO_2) may be used in lieu of foam or sprinklers to combat diesel generator and/or lubricating oil fires.	As outlined in the fire hazard analysis, the diesel generator is protected by combination open head deluge and closed head sprinkler systems.
10. <u>Diesel Fuel Oil Storage Areas</u> Diesel fuel oil tanks with a capacity greater than 1100 gallons should not be located inside the buildings containing safety related equipment. They should be located at least 50 feet from any building containing safety related equipment, or if located within 50 feet, they should be housed in a separate building with construction having a minimum fire resistance rating of three hours. Buried tanks are considered as meeting the three hour fire resistance requirements. See NFPA 30, "Flammable and Combustible Liquids Code", for additional guidance. When located in a separate building, the tank should be protected by an automatic fire suppression system such as AFFF or sprinklers. In operating plants where tanks are located directly above or below the diesel generators and cannot reasonably be moved, separating floors and main structural members	Diesel fuel for the emergency generators is stored in a 30,000 gallon underground tank. 1413 154

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should, as a minimum, have fire resistance rating of three hours. Floors should be liquid tight to prevent leaking of possible oil spills from one level to another. Drains should be provided to remove possible oil spills and fire fighting water to a safe location.

One of the following acceptable methods of fire protection should also be provided:

(a) Automatic open head deluge or open head spray nozzle system(s)

(b) Automatic closed head sprinklers; or

(c) Automatic AFFF that is delivered by a sprinkler system or spray system

11. Safety Related Pumps

Pump houses and rooms housing safety related pumps should be protected by automatic sprinkler protection unless a fire hazards analysis can demonstrate that a fire will not endanger other safety related equipment required for safe plant shutdown. Early warning fire detection should be installed with alarm and annunciation locally and in the control room. Local hose stations and portable extinguishers should also be provided.

The screen house containing the service water pumps is protected with a wet pipe, sprinkler system (which alarms in the control room only). Portable fire extinguishers are provided. The fire hazard analysis identifies other safety related pumps and protection.

Equipment pedestals or curbs and drains should be provided to remove and direct water away from safety related equipment.

Equipment is installed on concrete pads. Adequate drainage for water is provided.

Provisions should be made for manual control of the ventilation system to facilitate smoke removal if required for manual fire fighting operation.

Smoke removal will be provided by portable fans, if required.

Position For Plants Under Construction and Operating Plants	Metropolitan Edison Response
12. New Fuel Area	
Hand portable extinguishers should be located within this area. Also, local hose stations should be located outside but within hose reach of this area. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Combustibles should be limited to a minimum in the new fuel area. The storage area should be provided with a drainage system to preclude accumulation of water.	Manual suppression equipment such as hose stations and portable fire extinguishers are provided. Automatic detection is provided in the exhaust ventilation ducts.
The storage configuration of new fuel should always be so maintained as to preclude criticality for any water density that might occur during fire water application.	The fuel assemblies are stored in parallel racks having a nominal center-to-center distance of 21-1/2 inches in both directions. This spacing is sufficient to maintain a K_{eff} of less than 0.9 when flooded with unborated water; this is based on fuel with an enrichment of 3.5 percent by weight of U^{235}.
13. Spent Fuel Pool Area	
Protection for the spent fuel pool area should be provided by local hose stations and portable extinguishers. Automatic fire detection should be provided to alarm and annunciate in the control room and to alarm locally.	Manual suppression equipment such as hose stations and portable extinguishers are provided. Automatic detection is provided in the exhaust ventilation ducts. No local alarms are provided.
14. Radwaste Building	
The radwaste building should be separated from other areas of the plant by fire barriers having at least three-hour ratings. Automatic sprinklers should be used in all areas where combustible materials are located. Automatic fire detection should be provided to annunciate and alarm in the control room and alarm locally. During a fire, the ventilation systems in these areas should be capable of being isolated. Water should drain to liquid radwaste building sumps.	The plant has no radwaste building per se. These facilities are provided in the auxiliary building. Automatic detection is provided in the main exhaust ventilation duct which is automatically isolated upon detection of smoke. No local alarms are provided. See the fire hazards analysis for the auxiliary building. (Section 4.2).

Position For Plants Under Construction and Operating Plants	Metropolitan Edison Response
Acceptable alternative fire protection is automatic fire detection to alarm and annunciate in the control room, in addition to manual hose stations and portable extinguishers consisting of hand held and large wheeled units.	
15. Decontamination Areas	
The decontamination areas should be protected by automatic sprinklers if flammable liquids are stored. Automatic fire detection should be provided to annunciate and alarm in the control room and alarm locally. The ventilation system should be capable of being isolated. Local hose stations and hand portable extinguishers should be provided as backup to the sprinkler system.	The personnel decontamination area is located in the control building at elevation 306'. The equipment decontamination area is located in the auxiliary building at elevation 305'. The fire hazards analysis outlines the protection for these areas.
16. Safety Related Water Tanks	
Storage tanks that supply water for safe shutdown should be protected from the effects of fire. Local hose stations and portable extinguishers should be provided. Portable extinguishers should be located in nearby hose houses. Combustible materials should not be stored next to outdoor tanks. A minimum of 50 feet of separation should be provided between outdoor tanks and combustible materials where feasible.	The fire hazards analysis outlines the protection for this area.
17. Cooling Towers	
Cooling towers should be of non-combustible construction or so located that a fire will not adversely affect any safety related systems or equipment. Cooling towers should be of non-combustible construction when the basins are used for the ultimate heat sink or for the fire protection water supply. Cooling towers of combustible	Cooling towers are not required for safe shutdown.

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construction, so located that a fire in them could adversely affect safety related systems or equipment should be protected with an open head deluge system installation with hydrants and hose houses strategically located.	
18. Miscellaneous Areas	
Miscellaneous areas such as records storage areas, shops, warehouses, and auxiliary boiler rooms should be so located that a fire or effects of a fire, including smoke, will not adversely affect any safety related systems or equipment. Fuel oil tanks for auxiliary boilers should be buried or provided with dikes to contain the entire tank contents.	The record storage areas, shops, warehouses and auxiliary boiler room are protected by automatic sprinklers, and are separated from safety related systems or equipment by fire barriers. Therefore, fire or smoke would not affect safety related systems or equipment. The fuel oil tank for the auxiliary boiler is provided with a dike.
G. Special Protection Guidelines	
1. Welding and Cutting, Acetylene - Oxygen Fuel Gas Systems	
This equipment is used in various areas throughout the plant. Storage locations should be chosen to permit fire protection by automatic sprinkler systems. Local hose stations and portable equipment should be provided as backup. The requirements of NFPA 51 and 51B are applicable to these hazards. A permit system should be required to utilize this equipment. (Also refer to 2f herein.)	Storage of all oxygen/acetylene is maintained out-of-doors. Tanks in use by maintenance and/or contractor personnel are closely supervised and are covered by a Met-Ed procedure which incorporates a permit system. No automatic fire suppression systems are afforded.
2. Storage Areas for Dry Ion Exchange Resins	
Dry ion exchange resins should not be stored near essential safety related systems. Dry unused resins should be protected by automatic wet pipe sprinkler installations. Detection by smoke and heat detectors should alarm and annunciate	There are no dry ion exchange resins at TMI-1.

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in the control room and alarm locally. Local hose stations and portable extinguishers should provide backup for these areas. Storage areas of dry resin should have curbs and drains. (Refer to NFPA 92M, "Waterproofing and Draining of Floors.")	
3. Hazardous Chemicals	
Hazardous chemicals should be stored and protected in accordance with the recommendations of NFPA 49, "Hazardous Chemicals Data." Chemicals storage areas should be well ventilated and protected against flooding conditions since some chemicals may react with water to produce ignition.	The hazardous chemicals at TMI-1, as defined in NFPA 49, are sodium hydroxide, sulfuric acid and chlorine gas, and are presently stored and protected in accordance with the recommendations of NFPA 49. Chemical storage areas are well ventilated and protected against flooding.
4. Materials Containing Radioactivity	
Materials that collect and contain radioactivity such as spent ion exchange resins, charcoal filters, and HEPA filters should be stored in closed metal tanks or containers that are located in areas free from ignition sources or combustibles. These materials should be protected from exposure to fires in adjacent areas as well. Consideration should be given to requirements for removal of isotopic decay heat from entrained radioactive materials.	Spent ion exchange resins will always be completely contained and will, therefore, never be exposed to ignition sources or combustibles. Spent charcoal filters and HEPA filters will be exposed only during their removal from service. After removal, they will be stored in metal drums that will completely contain them from any ignition sources or combustibles. For discussion of fire protection for these materials refer to Sections 2.3.7, 4.2.3.8 and 4.2.3.9. Filtering systems (charcoal) are protected by deluge fire protection systems as discussed in the applicable sections of the fire hazards analysis.

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APPENDIX 5A

RESUME

OF

FIRE PROTECTION ENGINEER

1413 160

R. M. Klingaman
Fire Protection Engineer
Metropolitan Edison Company

Mr. Klingaman received a B.S. Degree in Mechanical Engineering from the Pennsylvania State University in 1952 and received additional training in nuclear power reactor engineering in 1967 from the University of Michigan. He has been a licensed professional engineer in the Commonwealth of Pennsylvania since 1963. This individual has 25 years practical engineering experience associated with design, construction, testing, and operation of various types of mechanical equipment with emphasis on combustion, steam generation, and electrical generation equipment. For the past 13 years, he has been primarily associated with fossil and nuclear generating stations. The first 5 of these years were spent on the operating staff of a two unit, fossil-fires 400 MW electrical generating station. This position required intimate knowledge of design, inspection, operation, maintenance, and testing of fire protection systems and training of the in-plant fire brigade. During the most recent 8 years, he was involved with the design and operation of one 800 MW nuclear unit and the design of a 900 MW nuclear unit. These efforts included participation in the establishment of fire protection design parameters and selection of equipment, involvement in the determination of test requirements and acceptance criteria for the physical fire protection system, and involvement in developing the overall station fire protection program.

1413 161

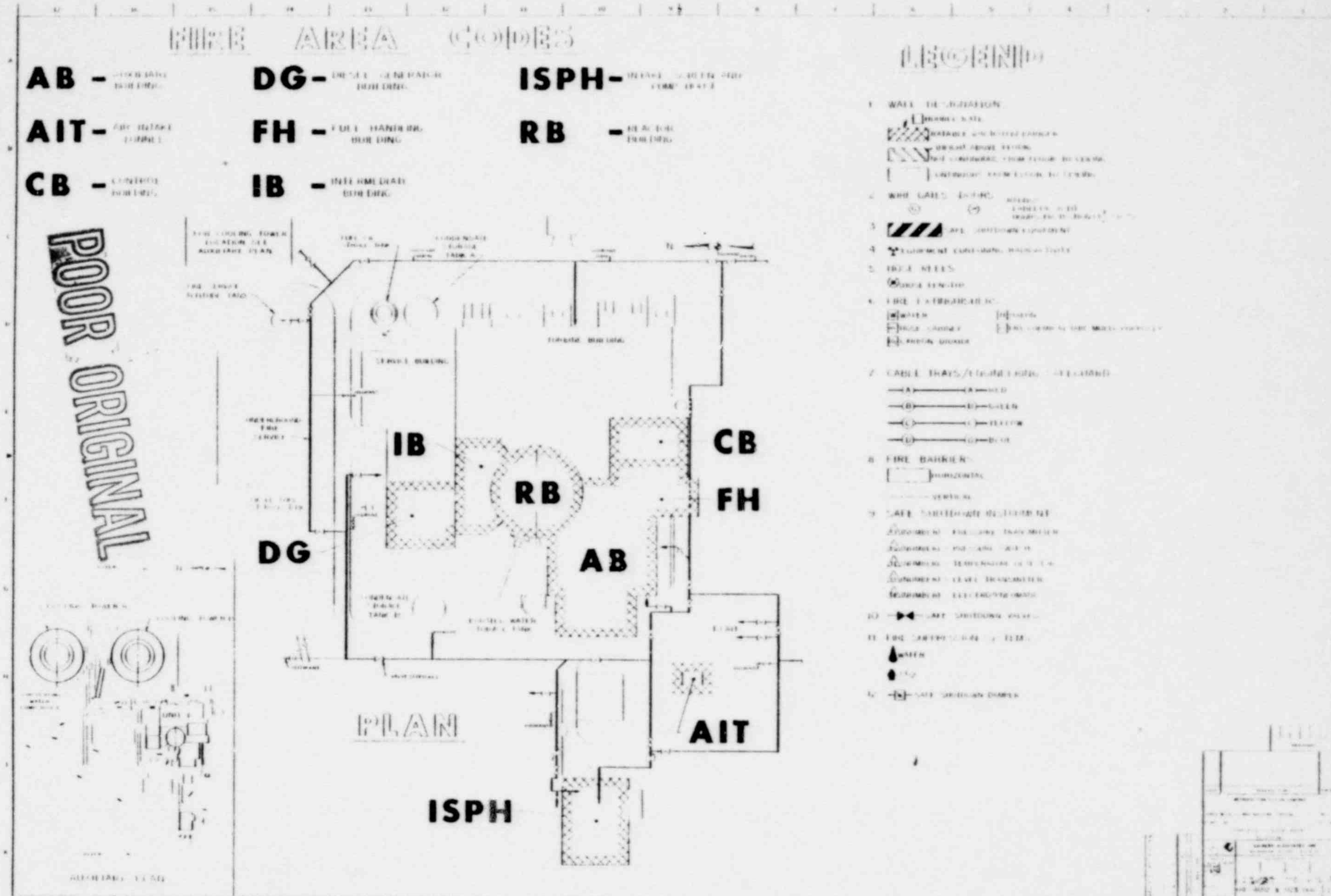
LAYOUT DRAWINGS

E-023-001

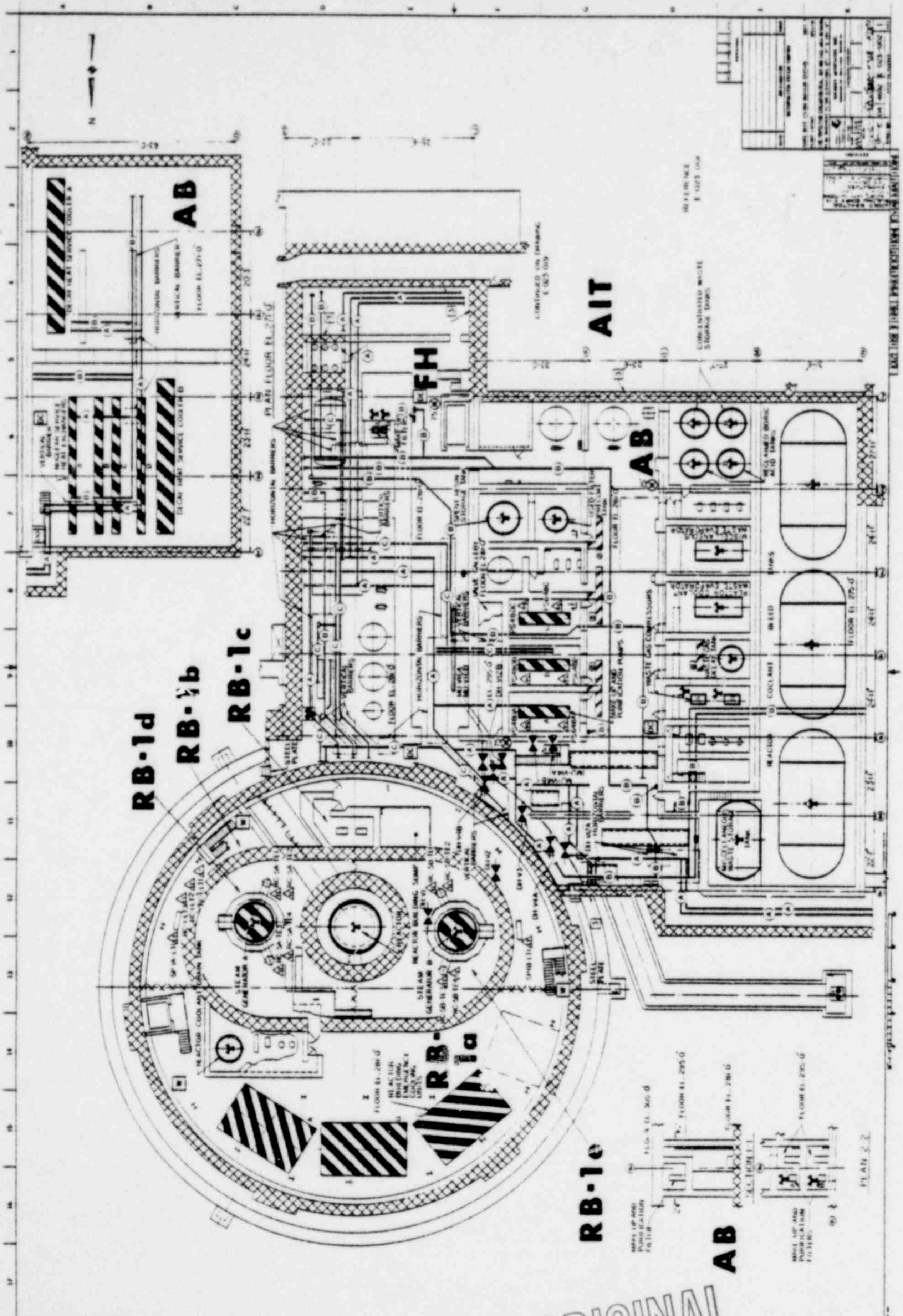
through

E-023-019

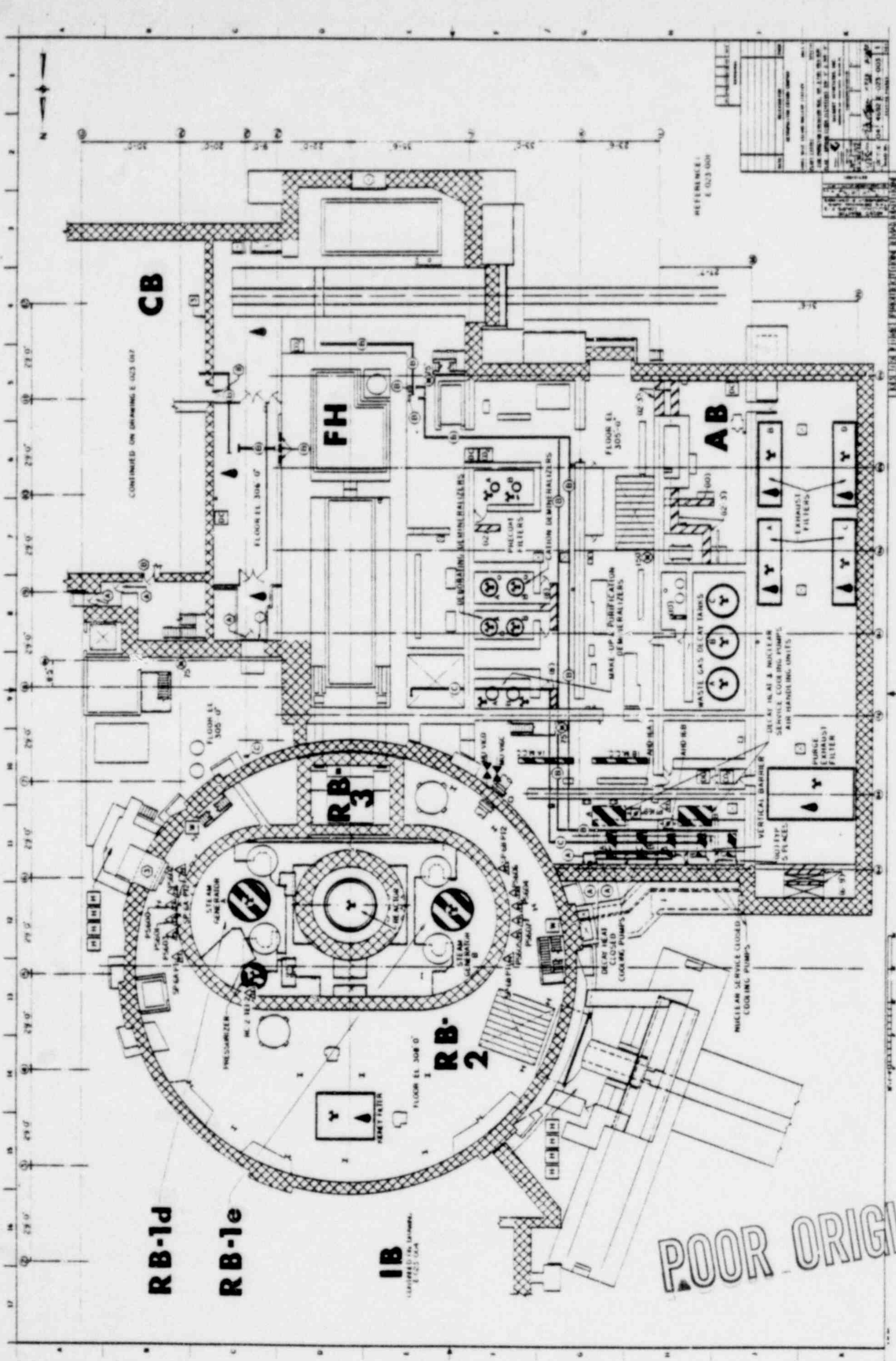
1413 162

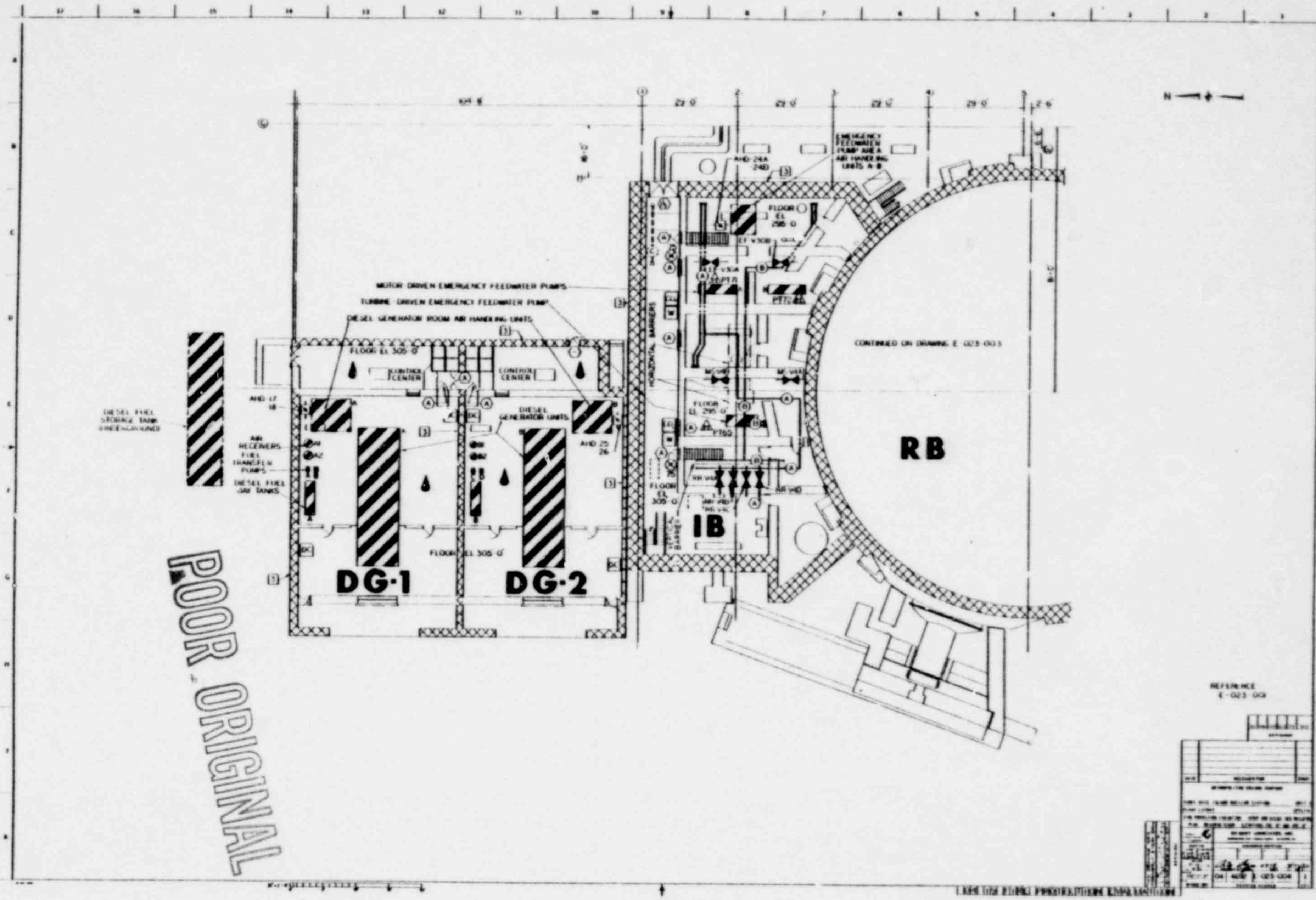

FIRE AREA CODES
AB - AUXILIARY BUILDING
AIT - AIR INTAKE TUNNEL
CB - CONTROL BUILDING
DG - DIESEL GENERATOR BUILDING
FH - FUEL HANDLING BUILDING
IB - INTERMEDIATE BUILDING
ISPH -
RB - REACTOR BUILDING
LEGEND
POOR ORIGINAL
TURBINE BUILDING
SERVICE BUILDING
IB
RB
CB
FH
AB
DG
AIT
ISPH
PLAN

1413 163



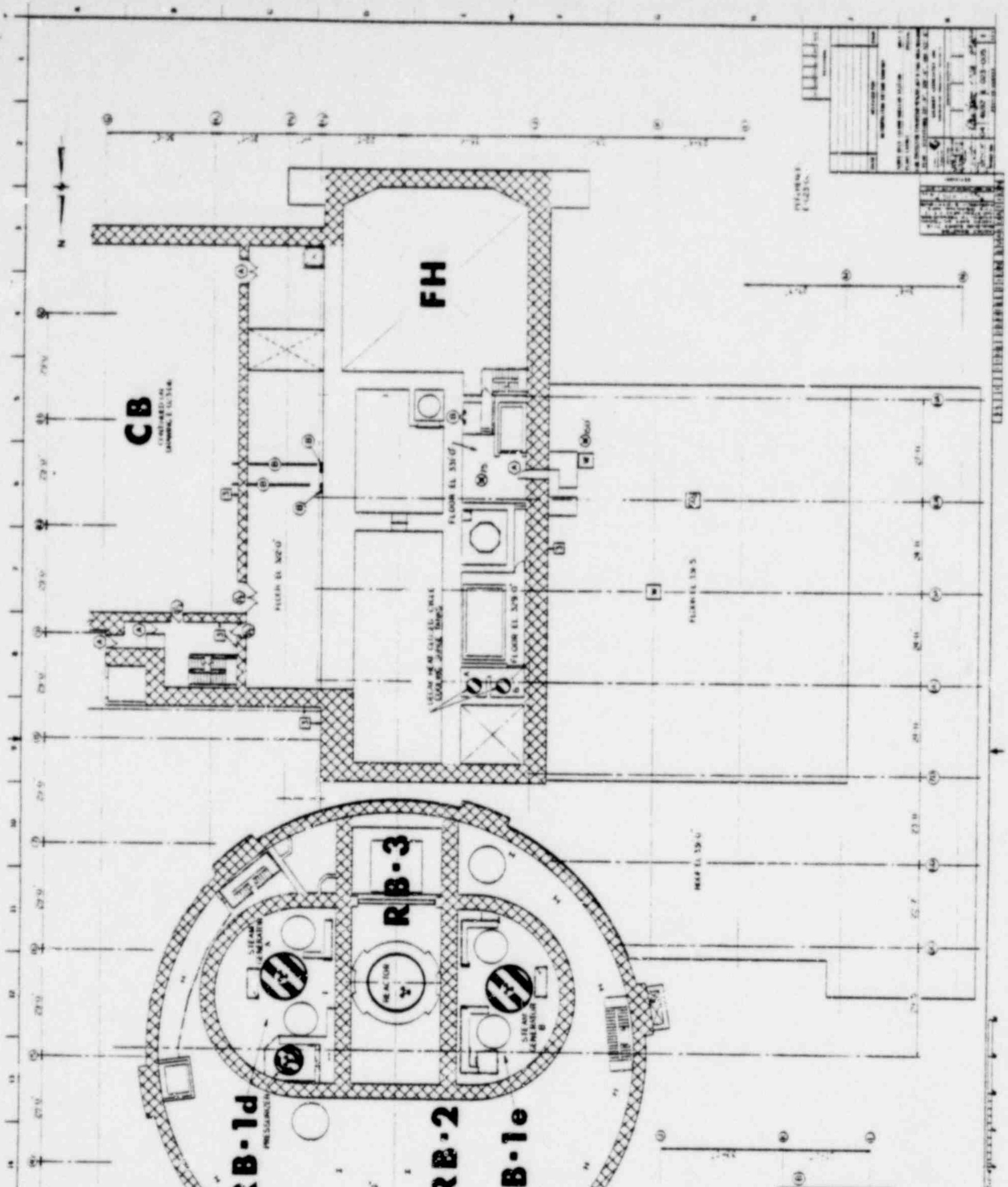
1413.164


CB
FH
AB
RB-3
RB-2
RB-1d
RB-1e
IB
WASTE GAS DECAY TANKS
EXHAUST FILTERS
PURGE EXHAUST FILTER
VERTICAL BARRIER
STEAM GENERATOR
REACTOR
PRESSURIZER
MAKE-UP & PURIFICATION DEMINERALIZERS
DECAY HEAT CLOSED COOLING PUMPS
NUCLEAR SERVICE CLOSED COOLING PUMPS
POOR ORIGINAL



POOR ORIGINAL

1413 166



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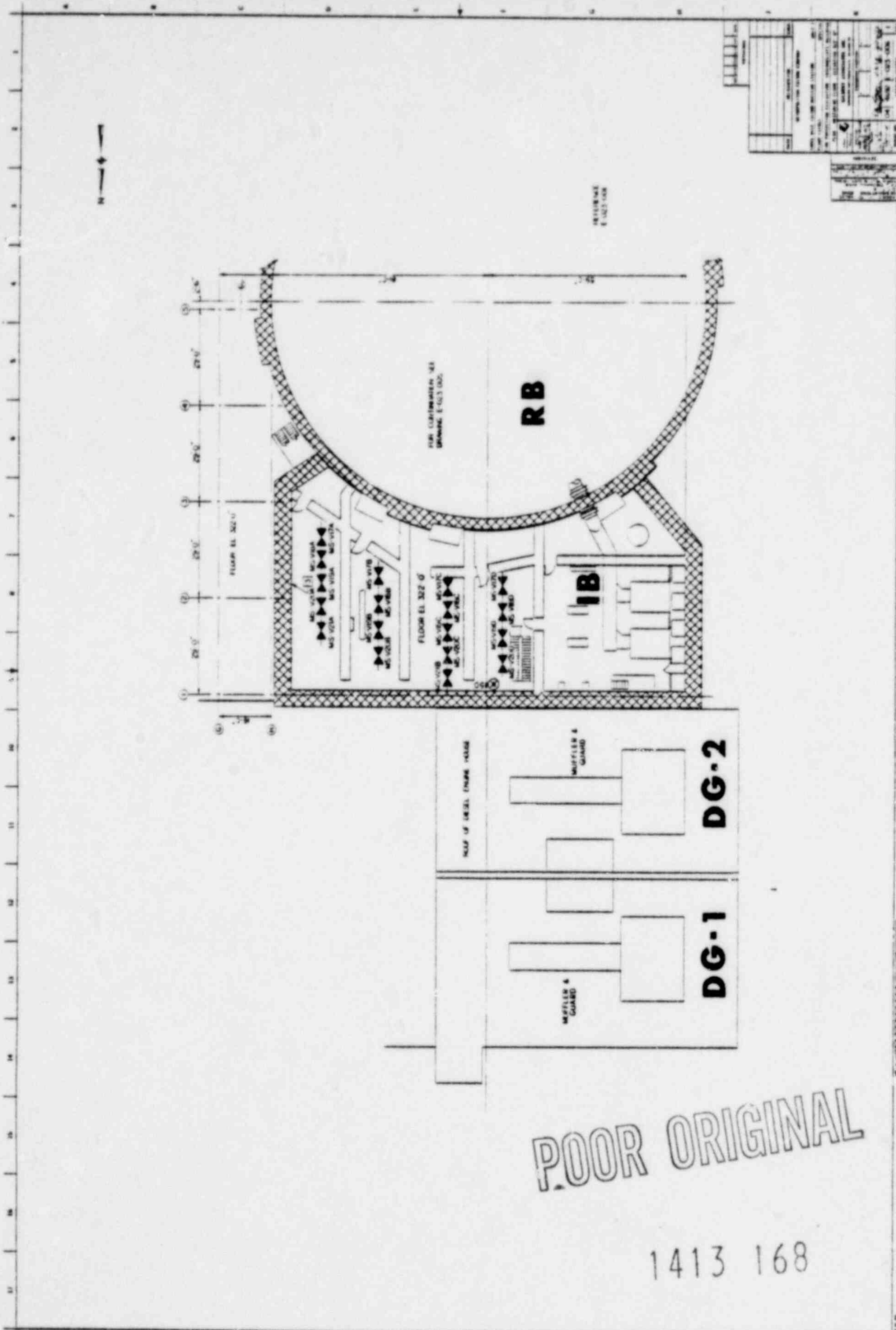

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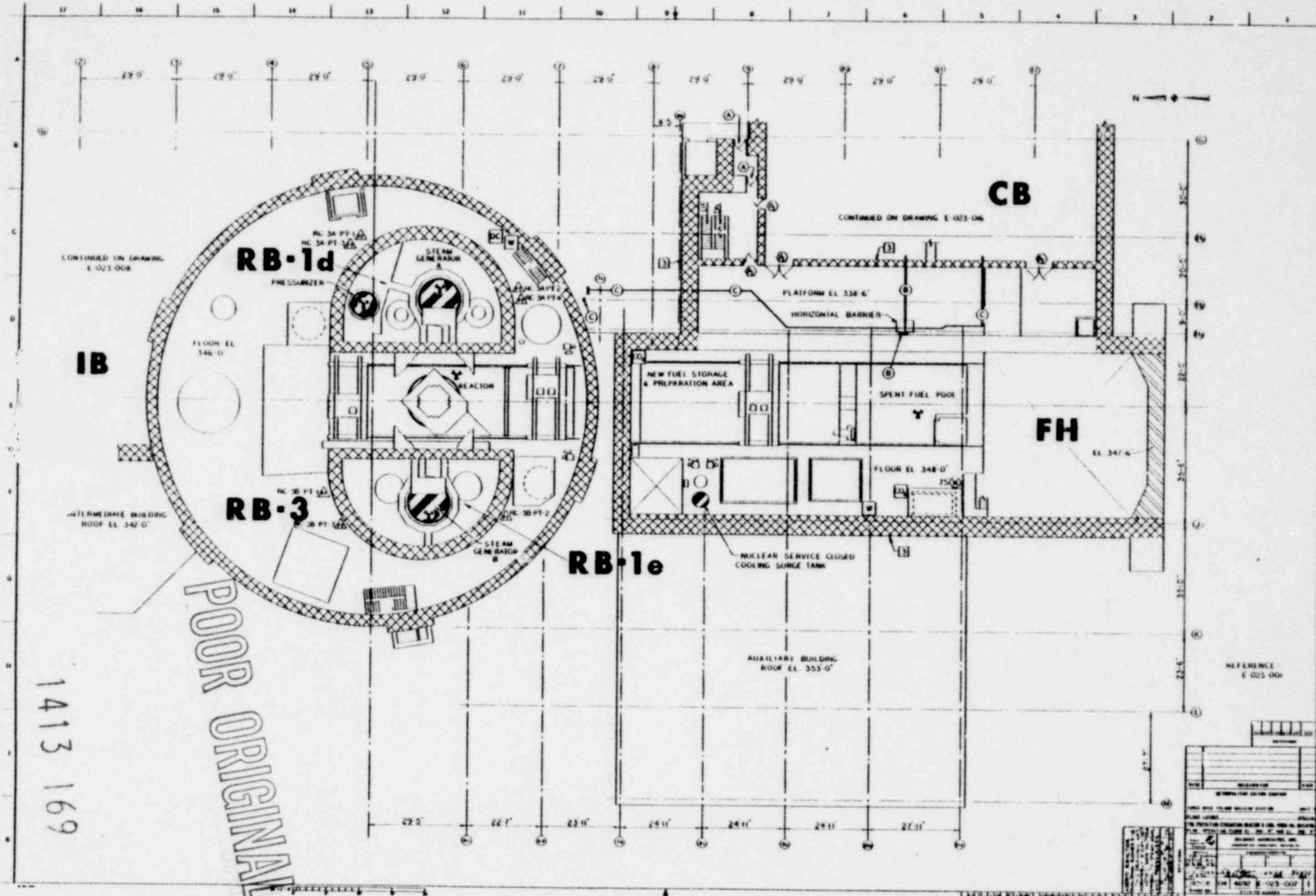
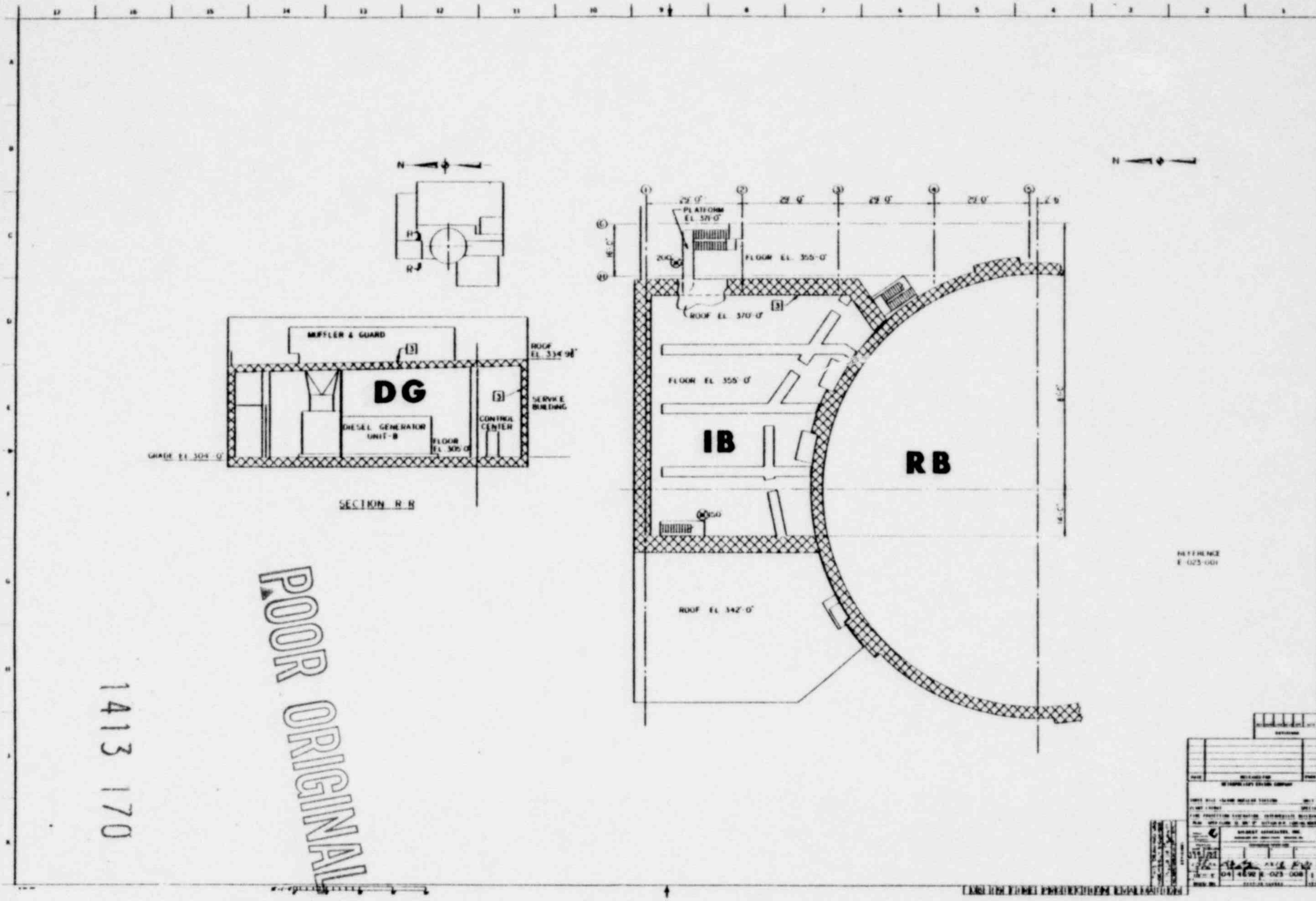

CB
CONTINUED ON DRAWING E 023-016
PLATFORM EL 338'-6"
HORIZONTAL BARRIER
FH
EL 347'-6"
NEW FUEL STORAGE & PREPARATION AREA
SPENT FUEL POOL
FLOOR EL 348'-0"
NUCLEAR SERVICE CLOSED COOLING SURGE TANK
AUXILIARY BUILDING ROOF EL 353'-0"
REFERENCE: E 023-001
IB
CONTINUED ON DRAWING E 023-008
FLOOR EL 346'-0"
INTERMEDIATE BUILDING ROOF EL 342'-0"
RB-1d
RB-3
RB-1e
PRESSURIZER
STEAM GENERATOR A
STEAM GENERATOR B
REACTOR

1413 169



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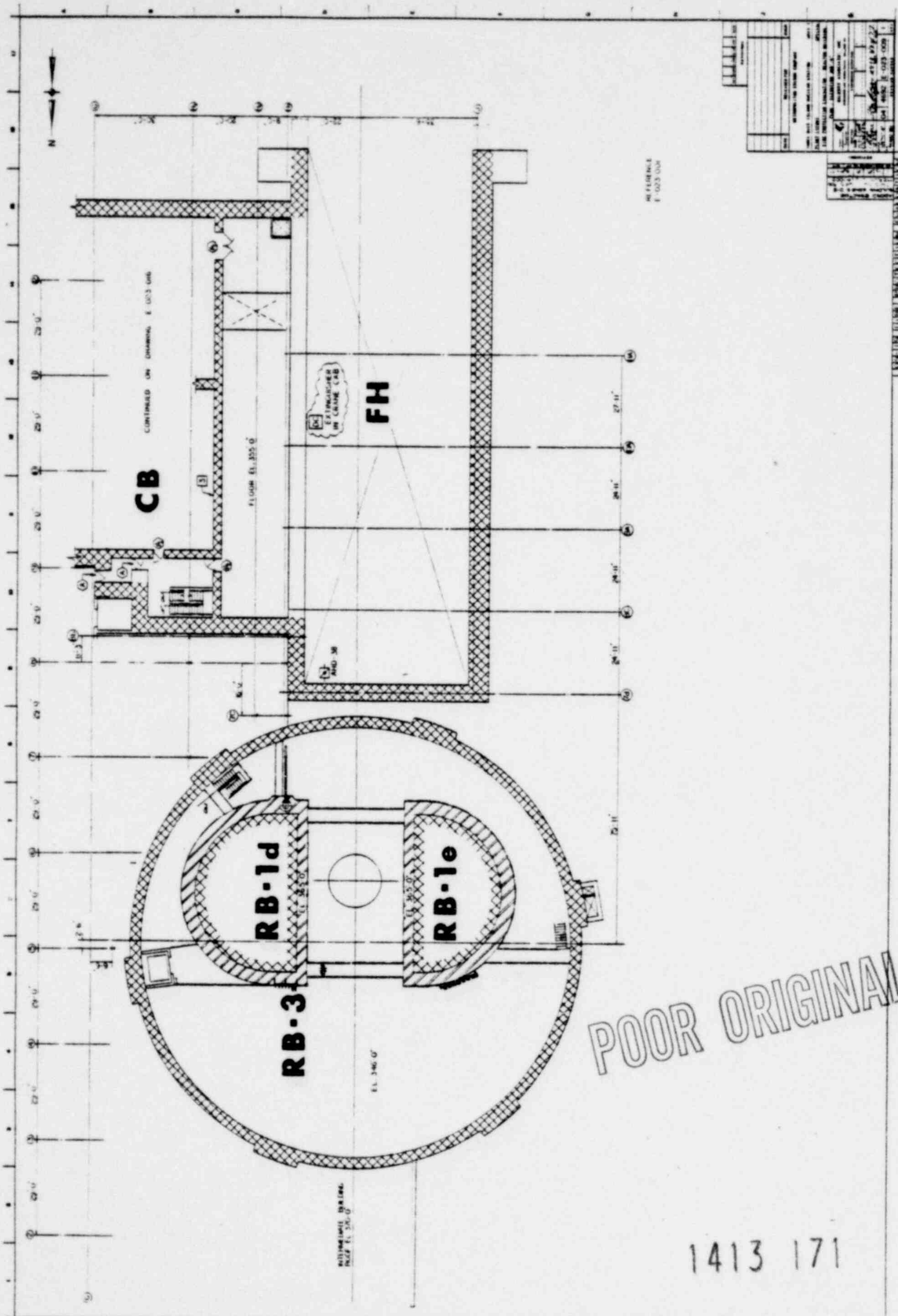
1413 170



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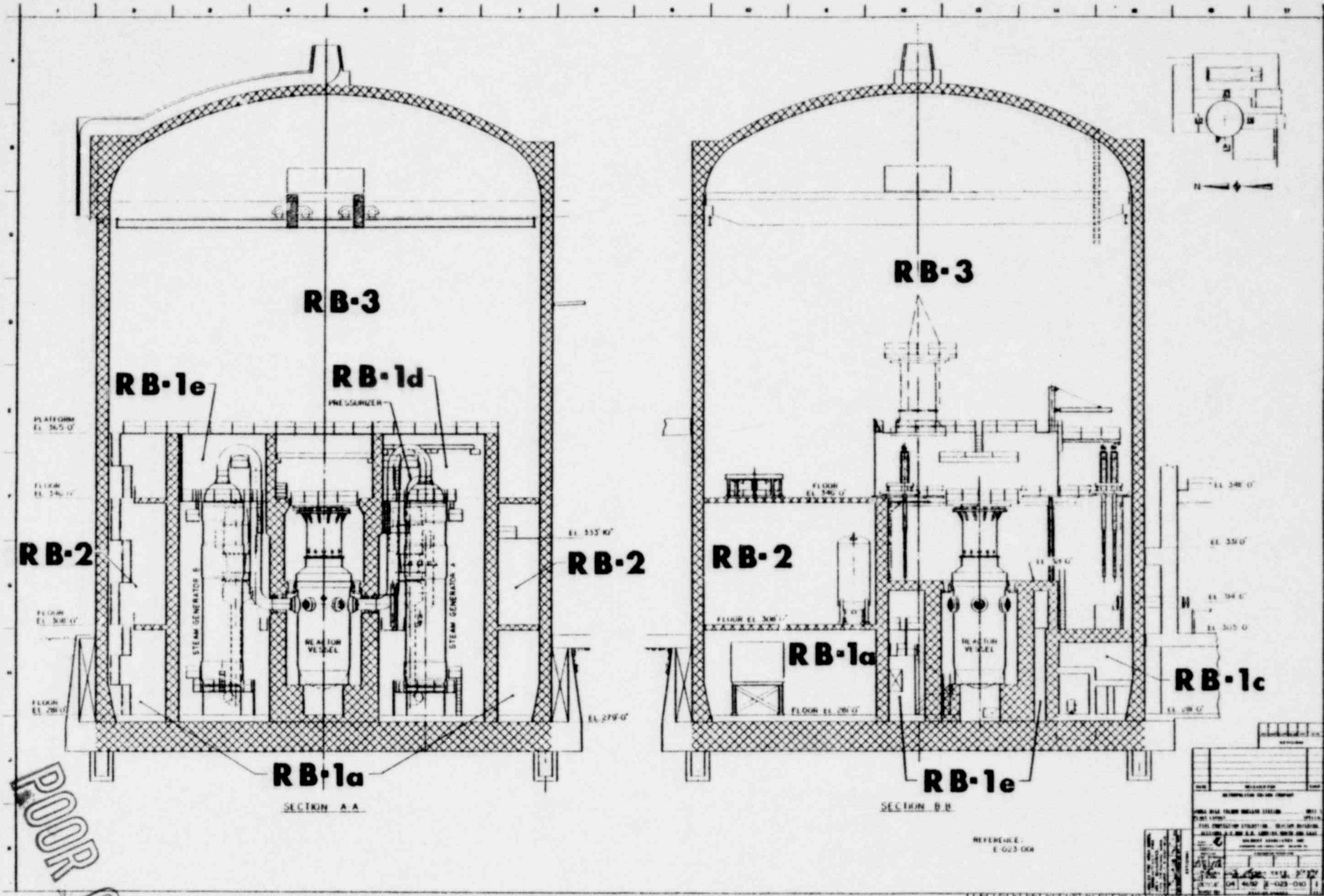

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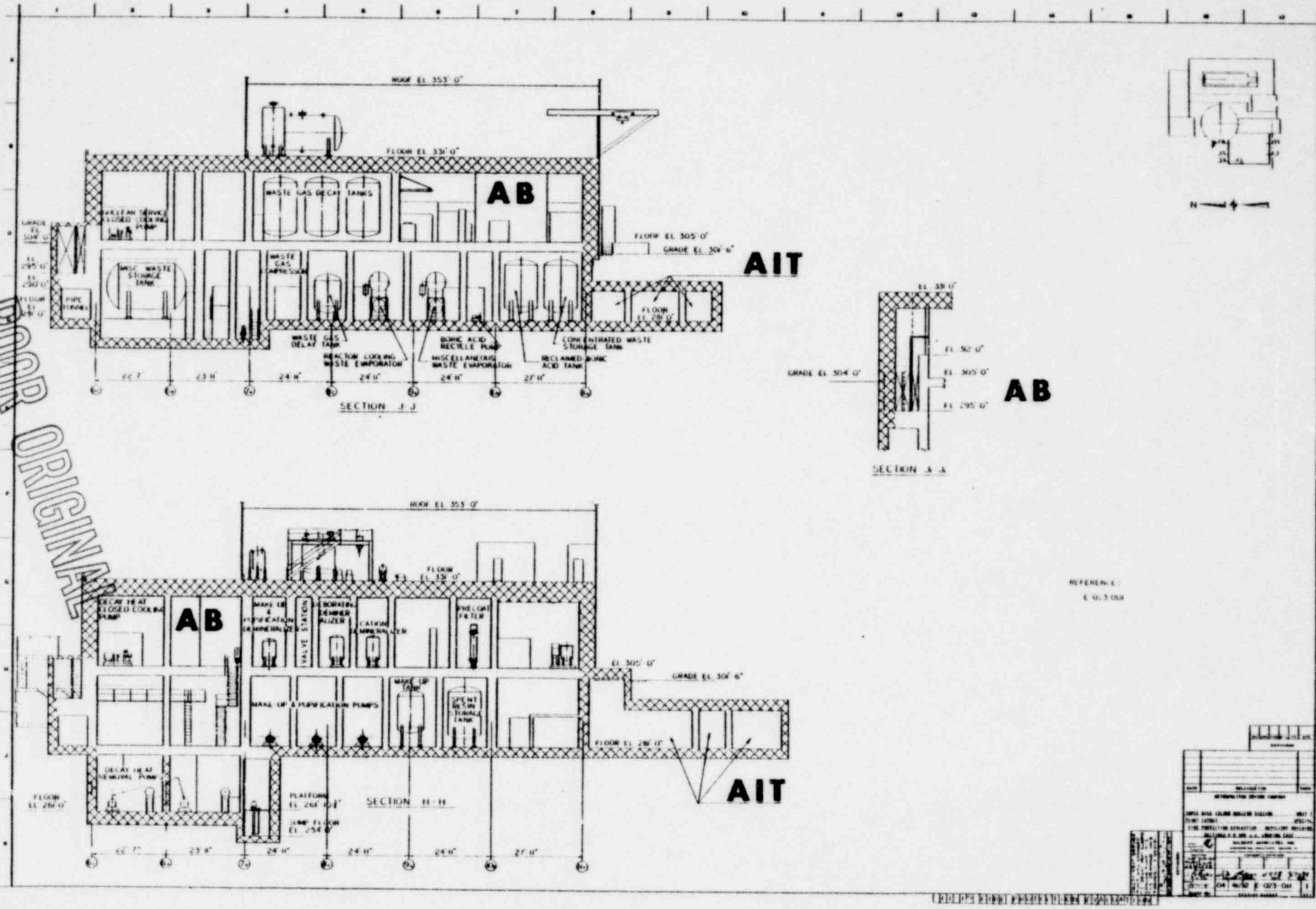
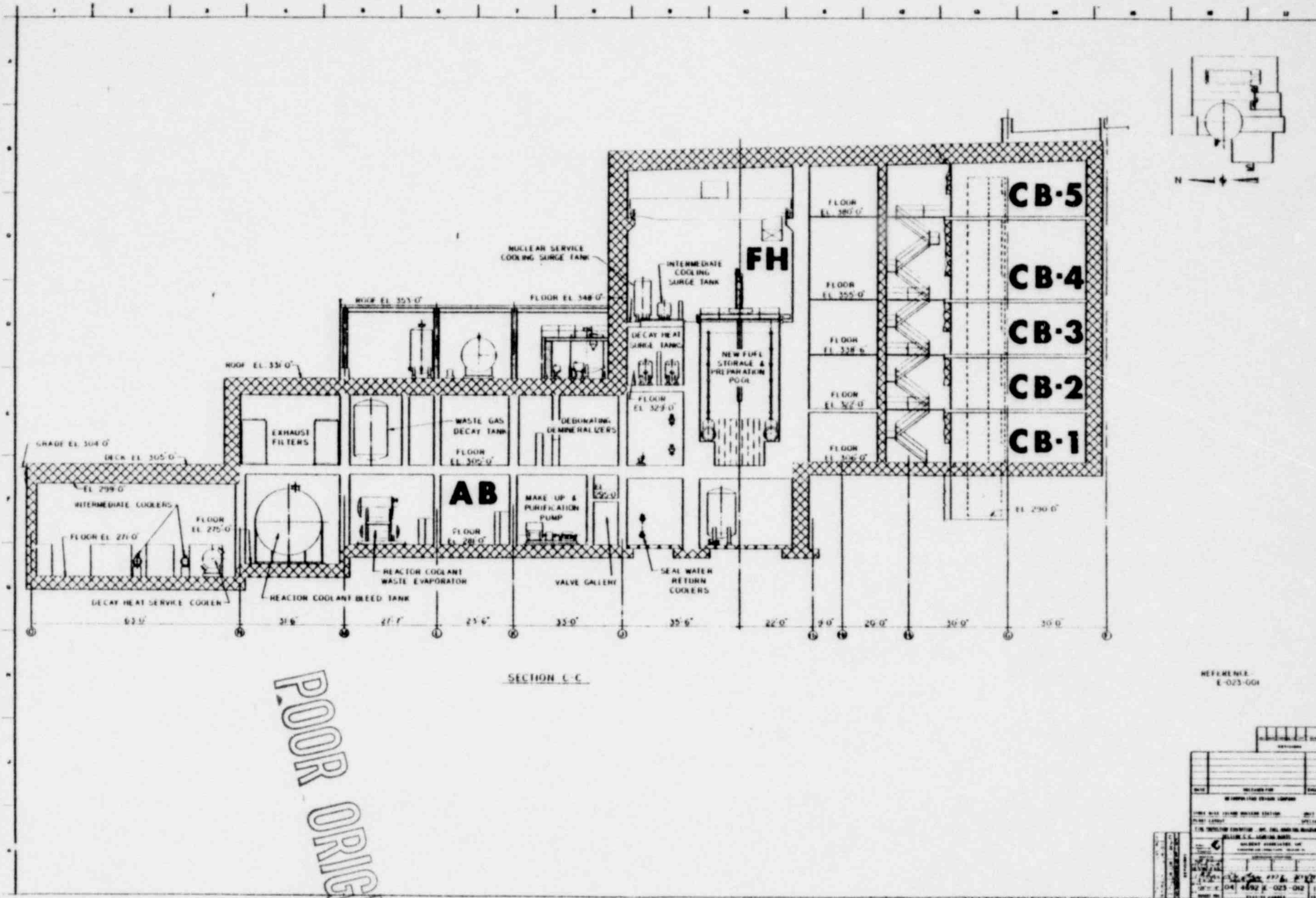

ROOF EL 353'0"
FLOOR EL 331'0"
AB
AIT
FLOOR EL 305'0"
GRADE EL 301'6"
WASTE GAS DECAY TANKS
MISC WASTE STORAGE TANK
WASTE GAS DECAY TANK
REACTOR COOLING WASTE EVAPORATOR
BORIC ACID RECYCLE PUMP
MISCELLANEOUS WASTE EVAPORATOR
CONCENTRATED WASTE STORAGE TANK
RECLAIMED BORIC ACID TANK
PIPE TUNNEL
SECTION J-J
SECTION A-A
GRADE EL 304'0"
EL 295'0"
VALVE STATION
MAKE UP & PURIFICATION PUMPS
MAKE UP TANK
PRECOAT FILTER
DECAY HEAT REMOVAL PUMP
EL 305'0"
FLOOR EL 281'0"
PLATFORM
SUMP FLOOR EL 254'0"
SECTION H-H
24'11"
27'11"
23'11"
REFERENCE:
POOR ORIGINAL

1413 173

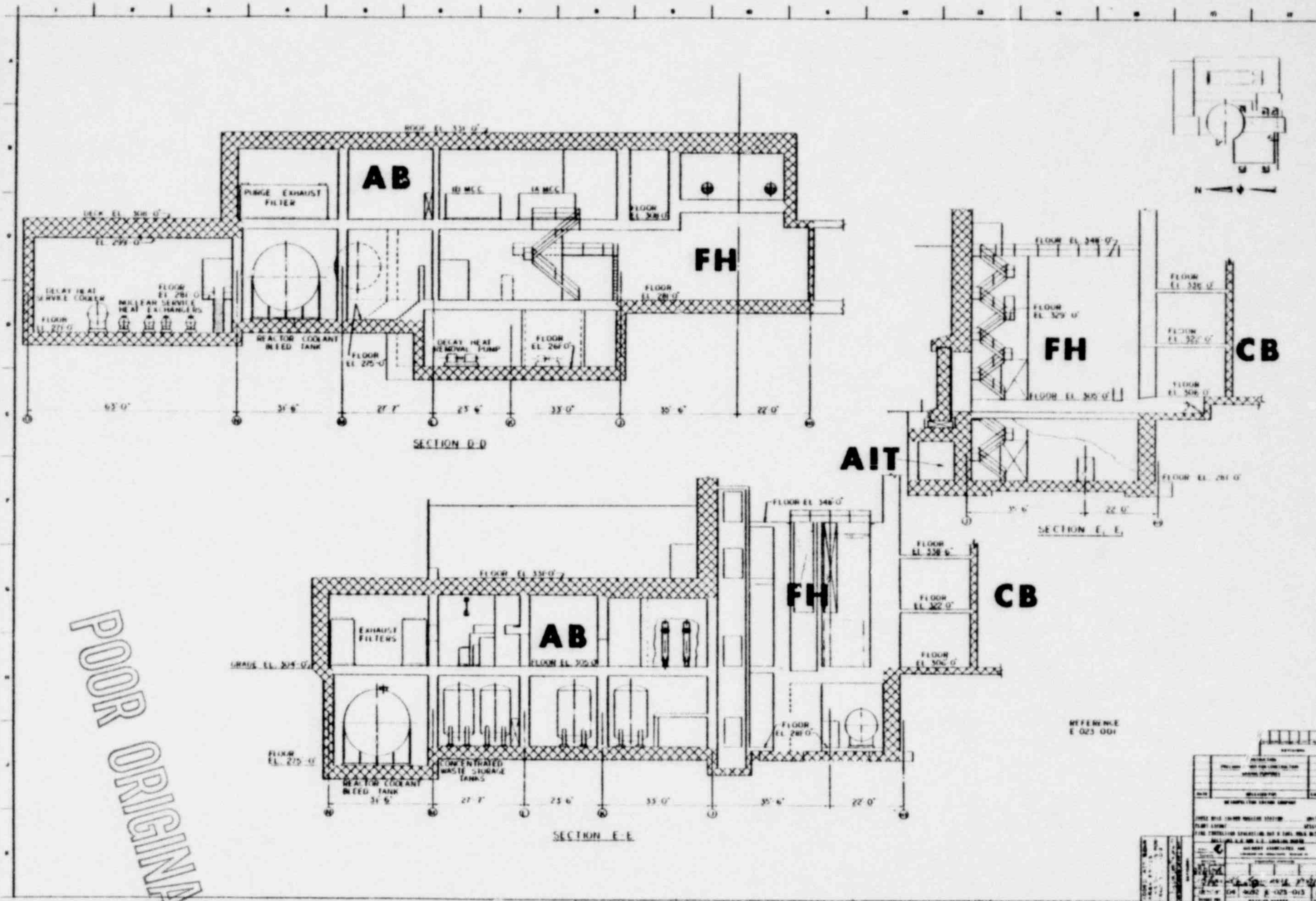


SECTION C-C

REFERENCE
E-023-001

POOR ORIGINAL

1413 174



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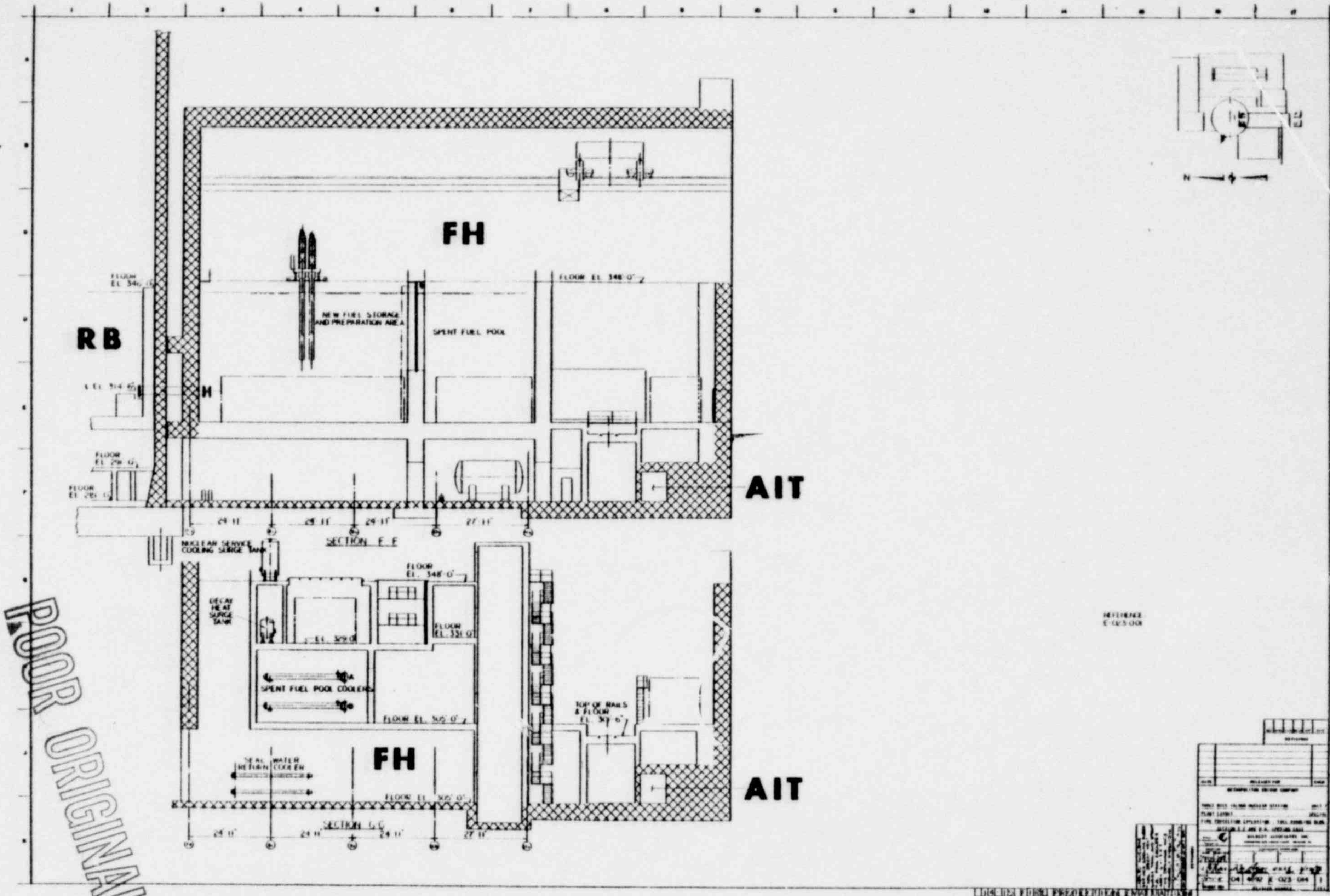

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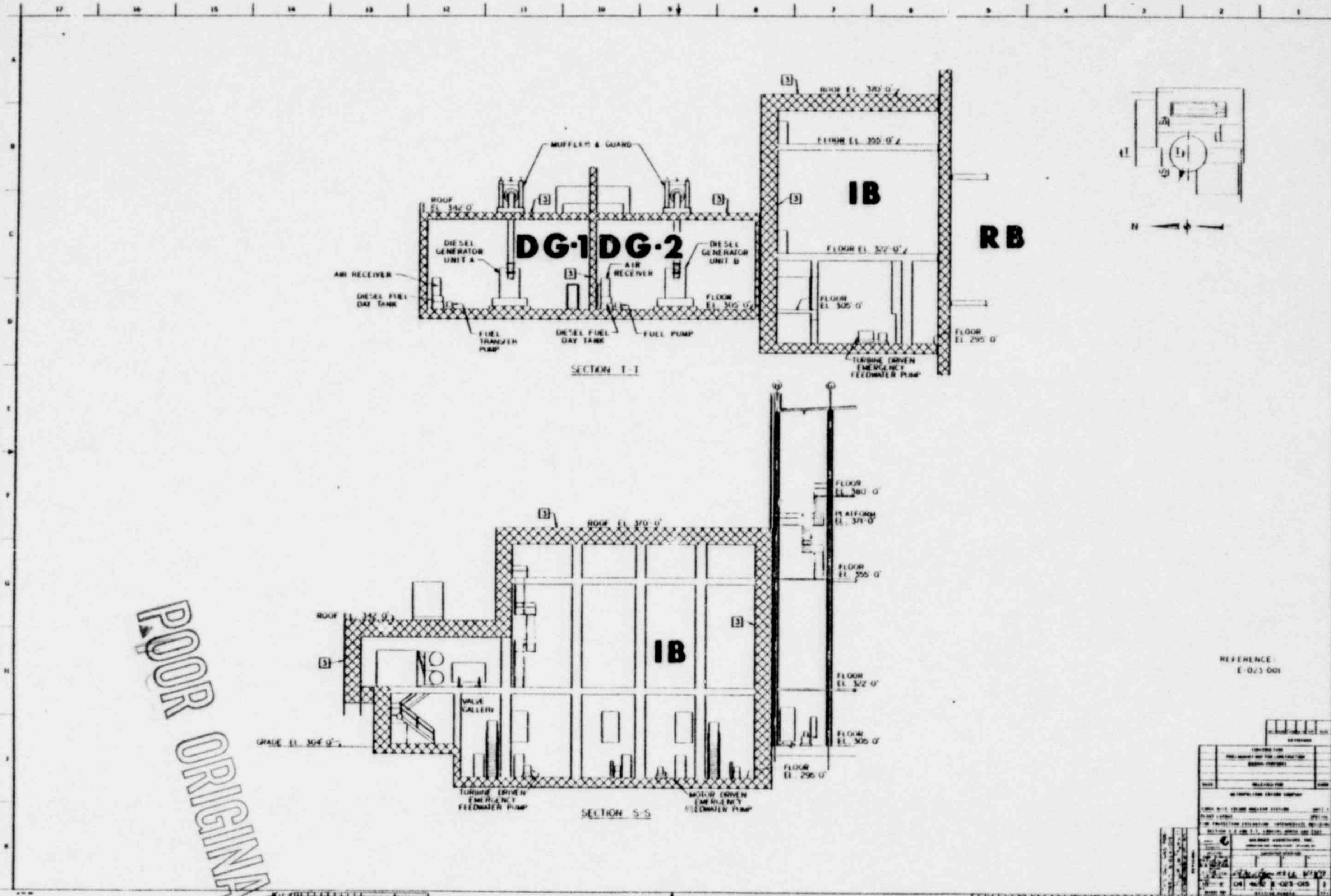

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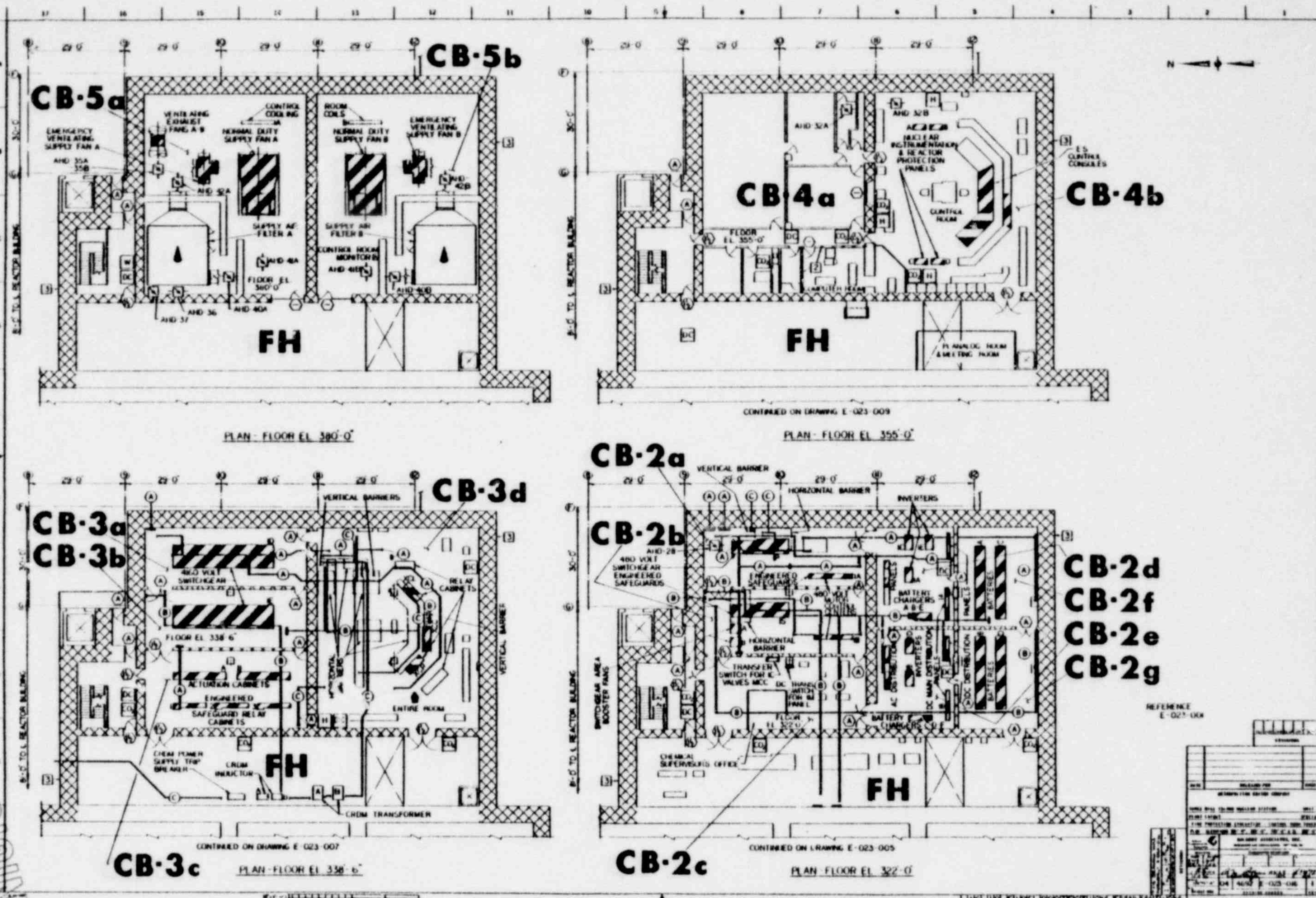

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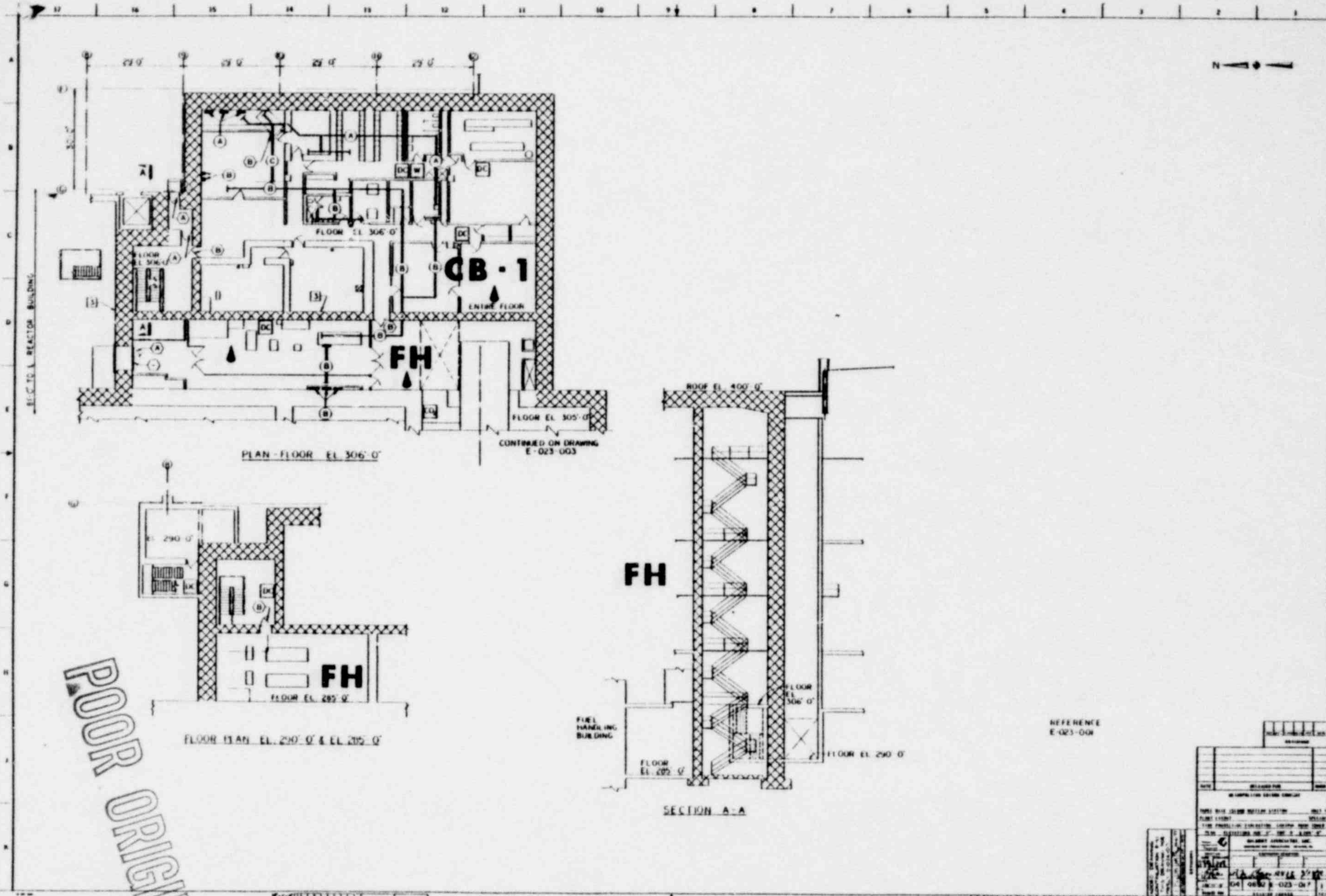
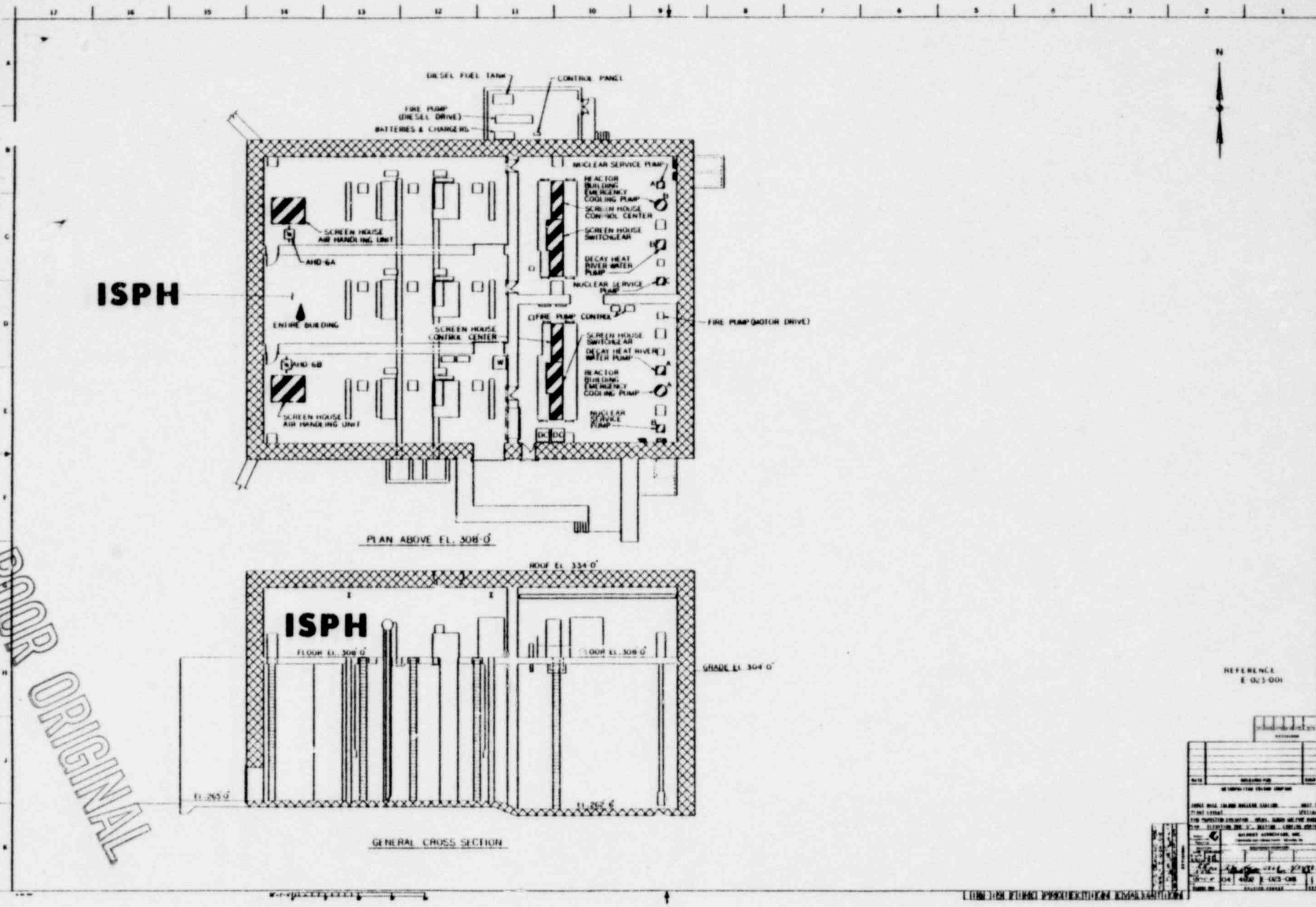


CB · 1
ENTIRE FLOOR
FH
FLOOR EL 306'-0"
FLOOR EL 305'-0"
CONTINUED ON DRAWING E-023-003
PLAN - FLOOR EL 306'-0"
EL 290'-0"
FLOOR EL 285'-0"
FLOOR PLAN EL 290'-0" & EL 285'-0"
ROOF EL 400'-0"
FLOOR EL 306'-0"
FLOOR EL 290'-0"
FLOOR EL 285'-0"
FUEL HANDLING BUILDING
SECTION A-A
REFERENCE E-023-001

1413 179



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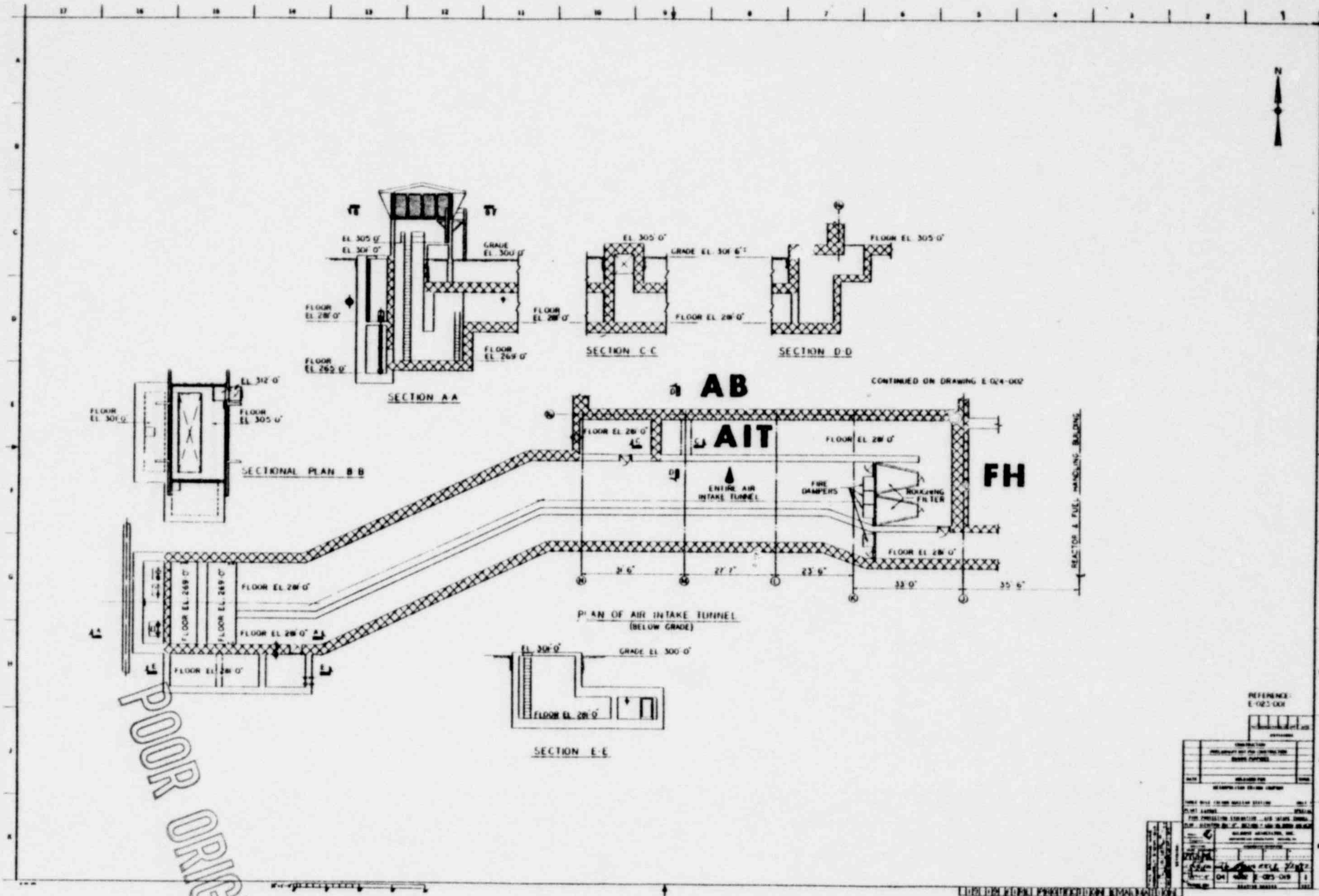

POOR ORIGINAL

1413 181