FIRE PROTECTION

SAFETY EVALUATION REPORT

BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

U.S. NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION

DOCKET NO. 50-312

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1.0 INTRODUCTION

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

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

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

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

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

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

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

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

We have reviewed the Sacramento Municipal Utility District (licensee or SMUD) analyses and have visited the Rancho Seco Nuclear Generating Station (the facility) to examine the relationship of safety-related components, systems and structures with both combustibles and the associated fire detection and suppression systems. Our review has been limited to the aspects of fire protection related to the protection of the public from the standpoint of radiological health and safety. We have not considered aspects of fire protection associated with life safety of onsite personnel and with property protection, unless they impact the health and safety of the public due to the release of radioactive material.

This report summarizes the results of our evaluation of the fire protection program at Sacramento Municipal Utility District's Rancho Seco Nuclear Generating Station. The chronology of our evaluation is summarized in Appendix A of this report.

By letter dated August 31, 1976, SMUD submitted their response to BTP 9.5-1 which was supplemented by letters dated November 16, 1976, February 1, 1977, August 1, 1977, November 25, 1977, December 8, and 16, 1977, and February 1, 1978.

2.0 FIRE PROTECTION GUIDELINES

2.1 Overall Objectives

The overall objectives of the fire protection program in a nuclear power plant are to:

(1) reduce the likelihood of occurrence of fires;

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

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

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

2.2 General Design Criterion 3 - "Fire Protection"

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

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

Guidance on the implementation of General Design Criterion 3 for existing nuclear power plants is provided in Appendix A of Branch Technical Position 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants." We have used the guidance in Appendix A, where appropriate. We have also evaluated alternatives proposed by the licensee to assure that the overall objectives outlined in Section 2.1 are met for the actual relationship of combustibles, safety-related equipment, and fire protection features.

3.0 SUMMARY OF MODIFICATIONS AND INCOMPLETE ITEMS

3.1 Modifications

The licensee plans to make certain plant modifications to improve the fire protection program as a result of both his and the staff's evaluations. Such proposed modifications are summarized below. The sections of this report which discuss the modifications are noted in parentheses following each item. Further detail is contained in the licensee submittals. All modifications will be completed in accordance with the scheduled dates given in Table 3.1. Certain items listed below are marked with an asterisk to indicate that the NRC staff will require additional information in the form of design details to assure that the design is acceptable prior to actual implementation of these modifications. The balance of the other modifications have been described in acceptable level of detail.

Modifications to the expansion joint are not related to safe shutdown capability but are nevertheless being done by the licensee as a prudent protective measure.

3.1.1 Control and Computer Room (5.1)

* (1) Install thermal insulation on functionally redundant Channel A, C and D conduits.

(2) Install ionization detectors in all computer and control room cabinets that contain control pushbuttons and indication required for safe shutdown and cooldown and the panels adjacent to them.

(3) Relocate ionization detectors.

(4) Remove suspended ceiling in computer room.

(5) Cover with a flame retardant compound the coils of factory preassembled connector cables located in all control and computer room cabinets.

(6) Replace the non-Underwriter's Laboratory labeled ventilation duct dampers in east wall of the computer room with fire dampers.

* (7) Modify lube oil pump control circuits associated with the high pressure injection system to prevent loss due to fires in cabinet H1RC.

(8) Installation of water or Halon type 1211 portable Class A extinguishers in the control/computer room (4.3.3).

* (9) Development of procedure for placing the diesel generators in operation locally for fires in control room panel H2ES.

TABLE 3.1

IMPLEMENTATION DATES FOR PROPOSED MODIFICATIONS

ITEM		DATE
3.1.1	Control and Computer Room	end of 1978 refueling outage
3.1.2	Instrument Shop	end of 1979 refueling outage
3.1.3	Chemical Storage Room	end of 1979 refueling outage
3.1.4	Reactor Building Entrance Area	end of 1979 refueling outage
3.1.5	Turbine Deck Corridor	end of 1979 refueling outage
3.1.6	West Battery Room	end of 1979 refueling outage
3.1.7	West AC/DC Panel Room	end of 1978 refueling outage
3.1.8	West 480 Volt Switchgear Room	end of 1979 refueling outage
3.1.9	West Cable Shaft	end of 1978 refueling outage
3.1.10	East Cable Shaft	end of 1978 refueling outage
3.1.11	East 480 Volt Switchgear Room	end of 1979 refueling outage
3.1.12	East AC/DC Panel Rooms	end of 1978 refueling outage
3.1.13	Air Conditioning Equipment Room	end of 1978 refueling outage
3.1.14	South Communications Room	end of 1978 refueling outage
3.1.15	Ventilation Equipment Room and Electrical Penetration Area	end of 1978 refueling outage
3.1.16	Electrical Penetration Area Mezzanine Level	end of 1978 refueling outage
3.1.17	Main Corridor Mezzanine Level	end of 1979 refueling outage
3.1.18	West 4 KV Switchgear Room	end of 1979 refueling outage
3.1.19	East 4 KV Switchgear Room	end of 1979 refueling outage
3.1.20	East Nuclear Service Battery Room	end of 1978 refueling outage
3.1.21	Electrical Penetration Area-Grade Level	end of 1979 refueling outage
3.1.22	Main Corridor-Grade Level	end of 1979 refueling outage
3.1.23	North Diesel Generator Room	end of 1978 refueling outage
3.1.24	South Diesel Generator Room	end of 1978 refueling outage
3.1.25	Waste Solidification Area	end of 1978 refueling outage
3.1.26	Main Corridor-Below Grade	end of 1979 refueling outage
3.1.27	Corridor to (-) 47 Level-Below Grade	end of 1979 refueling outage
3.1.28	High Pressure Injection Pump "A" Room	end of 1979 refueling outage
3.1.29	Containment Penetration Valve Area West	end of 1979 refueling outage
3.1.30	Containment Penetration Valve Area East	end of 1979 refueling outage
3.1.31	Makeup Pump Room	end of 1979 refueling outage
3.1.32	High Pressure Injection Pump "B" Room	end of 1978 refueling outage
3.1.33	Reactor Building	50% by end of 1978 r.o.; 50% by end of 1979 r.o.
3.1.34	Fenced Yard Area	end of 1978 refueling outage
3.1.35	Turbine Building	end of 1978 refueling outage
3.1.36	General	end of 1979 refueling outage
3.1.37	Smoke Detectors	end of 1978 refueling outage
3.1.38	Emergency Air Supply	end of 1978 refueling outage
3.1.39	Radio Communications - Reactor Building	end of 1978 refueling outage
3.1.40	Fire Doors	end of 1978 refueling outage

3.1.2 Instrument Shop (4.9.3)

(1) Install fire dampers in all ducts to fire area 14 - Turbine Deck Corridor.

3.1.3 Chemical Storage Room

(1) Install 1-1/2 hour fire damper in wall ventilation opening (4.9.3).

(2) Upgrade the expansion joint between the floor slab and the reactor building wall.

3.1.4 Reactor Building Entrance Area

(1) Install 1-1/2 hour fire damper in ventilation ducts terminating in the fire area (4.9.3).

(2) Upgrade the expansion joint between the floor slab and the reactor building wall.

3.1.5 Turbine Deck Corridor

(1) Install fire dampers in all duct penetrations except the emergency control room ventilation ducts (4.9.3).

* (2) Upgrade the metal panels above the fire doors between fire areas 14 and 71/1 and between fire areas 36 and 71/3 to be equivalent to the fire door. (4.9.1)

3.1.6 West Battery Room (5.2)

(1) Install fire dampers in each duct penetration to this room and in duct openings in the ceiling.

(2) Install a means to detect and alarm loss of ventilation flow.

3.1.7 West AC/DC Panel Room (5.2)

(1) Replace the door to corridor 207, fire area 29, with an Underwriter's Laboratory "B" rated door.

3.1.8 West 480 Volt Switchgear Room (5.2)

* (1) Install a thermal barrier around conduits containing Channel B cables associated with: high pressure injection systems; auxiliary feedwater systems; remote control circuits for decay heat system valves; Channels B, C, and D control rod drive trip system circuits; and Channels B and C safety features actuation.

(2) Install a fire damper in the duct which enters this room from fire area 1.

3.1.9 West Cable Shaft (5.4)

(1) Check and pack all penetrations to minimize air in-leakage.

3.1.10 East Cable Shaft (5.4)

(1) Check and pack all penetrations to minimize air in-leakage.

3.1.11 East 480 Volt Switchgear Room (5.3)

* (1) Install thermal barriers over all Channels A, C, and D conduits containing cables required for safe shutdown.

(2) Install a fire damper in the duct which enters this room from fire area 1.

3.1.12 East AC/DC Panel Rooms (5.2)

(1) Replace doors to corridors 206 and 207, fire area 29, with Underwriter's Laboratory "B" rated doors.

3.1.13 Air Conditioning Equipment Room

(1) Replace the doors to corridor 206, fire area 29, with a 1-1/2 hour fire rated Underwriter's Laboratory "B" type door (4.6 2).

3.1.14 South Communications Room

(1) Replace the door to corridor 207, fire area 29, with an Underwriter's Laboratory "B" rated door (4.9.2).

3.1.15 Ventilation Equipment Room and Electrical Penetration Area

(1) Replace door to fire area 29, corridor 207, with an Underwriter's Laboratory, Class "B", 1-1/2 hour fire rated door (4.9.1).

(2) Install a temperature detector in reactor building purge unit A-536 (5.5.6).

(3) Upgrade the expansion joint between the floor slab and the reactor building wall.

(4) For penetrations which contain circuits for safe shutdown or cool-down, check electrical penetration terminal box covers and seal those for cases where water could cause problems (5.5.6).

3.1.16 Electrical Penetration Area Mezzanine Level

(1) For penetrations which contain circuits for safe shutdown or cool-down, check electrical penetration terminal box covers and seal those for cases where water could cause problems (5.5.6).

(2) Upgrade the expansion joint between the floor slab and the reactor building wall as required.

3.1.17 Main Corridor Mezzanine Level (5.6)

(1) Provide additional separation, fire stops or barriers as required to prevent loss of redundant cooldown systems.

(2) Modify the 480 volt non-segregated phase bus duct to protect it from water damage.

(3) Install fire rated panel on penetrations to fire area 38 ventilation shafts.

3.1.18 West 4 KV Switchgear Room (5.7)

(1) Install a fire damper in duct to fire area 17.

3.1.19 East 4 KV Switchgear Room (5.7)

(1) Install a fire damper in the duct to fire area 20.

3.1.20 East Nuclear Service Battery Room (5.2)

(1) Replace unrated door to corridor 104, fire area 36 with a Underwriters Laboratory "C" rated door.

(2) Install means to detect and alarm loss of ventilation flow in the ventilation ducts (5.2.6).

3.1.21 Electrical Penetration Area-Grade Level (5.5)

(1) Install fire dampers in ducts to fire area 36.

(2) Install temperature detectors for alarm and automatic damper actuation at charcoal filters.

(3) Upgrade the expansion joint between the floor slab and the reactor building wall.

* (4) Install a fire stop to prevent a cable tray fire from bridging the gap between redundant channels.

(5) For penetrations which contain circuits for safe shutdown or cooldown, check electrical penetration terminal box covers and seal those for cases where water could cause problems.

3.1.22 Main Corridor-Grade Level (5.8)

(1) Install a fire damper in duct to fire area 34.

* (2) Reroute, apply thermal barrier over conduits, etc., to all Channel B cables associated with auxiliary feedwater systems, decay heat removal system and diesel generator.

3.1.23 North Diesel Generator Room (5.9)

(1) Install 6" of fire resistant concrete on east wall to provide three-hour fire rating.

* (2) Provide for tripping of the fuel oil pumps by actuation of the CO_2 system.

(3) Replace unrated door to outdoor area in diesel generator room east wall with a 1-1/2 hour fire rated Underwriter's Laboratory "B" door.

(4) Install trapped floor drain with quench pit.

3.1.24 South Diesel Generator Room (5.9)

(1) Install 6" of fire resistant concrete on east wall to provide a three-hour fire rating.

* (2) Arrange for tripping of fuel oil pumps by actuation of the CO_2 system.

(3) Replace unrated door to outdoor area in diesel generator room east wall with a 1-1/2 hour rated Underwriter's Laboratory "B" door.

(4) Install trapped floor drain with quench pit.

3.1.25 Waste Solidification Area

(1) Provide a minimum Underwriter's Laboratory "C" rated door in doorway to room 110, fire area 34 (4.9.2).

3.1.26 Main Corridor-Below Grade

(1) Install ionizaton detectors to alarm in the control room (5.10).

(2) Add Underwriter's Laboratory "C" rated louvered doors between fire areas 58 and 59, and between fire area 46 and fire areas 47 and 59 (4.9.1).

(3) Install fire dampers in ducts to fire areas 48, 56, 57, 58 and 59 (4.9.2).

3.1.27 Corridor to (-) 47 Level-Below Grade (5.11)

* (1) Reroute cables, apply heat shield on cables in tray or install thermal barriers to protect redundant high pressure infection and decay heat removal systems.

(2) Install ionization detectors.

(3) Replace unrated door to Room 001, fire area 56 and 002, fire area 57 with a Underwriter's Laboratory "C" rated door.

3.1.28 High Pressure Injection Pump "A" Room (5.12)

(1) Install a fire damper in duct to fire area 47.

(2) Install Underwriter's Laboratory "C" rated fire door to fire area 49.

(3) Add two (2) ionization detectors.

3.1.29 Containment Penetration Valve Area West (5.14)

(1) Install fire dampers in floor openings and ducts to fire areas 56 and 57.

* (2) Reroute, install fire barriers, or insulate conduits, etc., associated with the high pressure injection and decay heat systems.

3.1.30 Containment Penetration Valve Area East (5.14)

(1) Install fire dampers in ducts to fire areas 46, 58 and 59.

* (2) Reroute, install fire barriers, or insulate conduits, etc., associated with the high pressure injection system.

3.1.31 Makeup Pump Room (5.15)

(1) Insulate all silver soldered pipe within fire areas 58, 50, 49 and 48 with calcium silicate insulation and stainless steel jacket.

(2) Reroute, install fire barriers, or insulate conduits, etc., associated with the high pressure injection system.

(3) Provide wet pipe sprinkler system for this area.

3.1.32 High Pressure Injection Pump "B" Room (5.12)

(1) Add ionization type smoke detectors.

3.1.33 Reactor Building (5.16)

* (1) Provide all cable trays which cross or which can propogate a fire across a fire zone line with a fire barrier.

(2) Provide hose carts and hose in the reactor building.

3.1.34 Fenced Yard Area (5.17)

(1) Relocate fill connection on diesel fuel oil storage tank T8878, located east of nuclear yard area, to the other side of the road.

(2) Replace the small oil filled transformer adjacent to the emergency air lock with a dry type transformer.

(3) Reroute the "B" fuel oil pipe line to remain underground until it is inside the diesel generator room. Reroute cable, add thermal barrier, etc. for conduit to protect emergency feedwater control valve bypass cables.

(4) Install a curb valve on the lateral for fire hydrant No. 3.

3.1.35 Turbine Building (5.18)

(1) Add pressure sensor alarms in hydrogen piping.

3.1.36 General

(1) Modify current licensee cable procurement specifications to require conformance to IEEE-383 test methods.

(2) Install 100-foot hoses on hose stations serving fire areas 13, 14, 17, 18, 19, 20, 31, 32, 46, 49, 50, 56, 57, 58 and 59 and install one new hose station with 100 feet of hose at elevation -20 of the auxiliary building, column lines V and 9.1 to serve fire areas 46, 58 and 59 (4.3.1).

(3) Relocate ductwork from the battery charger and panel distribution room to a more accessible location (4.4.1).

(4) Electrical supervision of the CO_2 system main shutoff valve will be provided (4.3.2).

* (5) Door alarms will be provided for all doors of safety-related areas as defined in the fire hazards analyses (4.9.1).

(6) The licensee will provide fixed sealed-beam battery powered lights in all accessways to safety related areas.

*3.1.37 Smoke Detectors

The licensee has proposed that smoke detectors be installed so that detectors are located in all safety-related areas containing combustibles (4.2). Requirements for testing smoke detectors are under review.

3.1.38 Emergency Air Supply

The licensee has proposed to provide an air compressor of sufficient capacity to furnish a continuous air supply to recharge self contained breathing apparatus (4.4.3).

*3.1.39 Radio Communications Reactor Building

The licensee has proposed to provide capability to communicate to the control room from the reactor building using portable radio communications units (4.7).

3.1.40 Fire Doors

The licensee has proposed to upgrade fire doors in five locations (4.9.1).

(1) Between fire areas 27 and 28.

(2) Between fire areas 27 and 29.

(3) Between fire areas 28 and 29.

(4) Between fire areas 36 and 34.

(5) Between fire areas 58 and 50.

3.2 Incomplete Items

In addition to the licensee's proposed modifications, several incomplete items remain, as discussed below. The licensee will complete the evaluations necessary to resolve these items in accordance with the schedule contained in Table 3.2. This schedule has been established such that should these evaluations identify the need for additional modifications, they can be implemented on a schedule consistent with completion of the modifications identified in Section 3.1. We will address the resolution of these incomplete items in a supplement to this report.

3.2.1 Fire Stop Qualification

The licensee has committed to test cable penetration fire stops to demonstrate a rating equivalent to that required of the fire barrier (4.9.3).

3.2.2 Effects of Fire Water Piping Failures

The licensee has committed to analyze the effect on suppression system capability for moderate energy line breaks [4.3.1(3)].

3.2.3 Class II Instrumentation

The licensee is reviewing the effects of fires on Class II instrumentation required for safe shutdown and has committed to perform the required modifications (4.10).

3.2.4 Thermal Barriers

The licensee is presently testing to determine the adequacy of thermal barriers (4.10).

3.2.5 Fire Zones

The licensee has been requested to provide the basis for establishing fire zones within the reactor building (5.16).

3.2.6 Administrative Controls

Certain administrative control matters are incomplete as identified in Section 6.0 of this report (6.0).

TABLE 3.2

LICENSEE SUBMITTAL DATES FOR INCOMPLETE ITEMS

ITEM		DATE
3.2.1	Fire Stop Qualification Test Results	March 1, 1978
3.2.2	Effects of Fire Water Piping Failures	March 1, 1978
3.2.3	Class II Instrumentation Modification Description	December 31, 1978
3.2.4	Thermal Barriers	March 1, 1978
3.2.5	Fire Zones	February 17, 1978
3.2.6	Administrative Controls	July 1, 1978

4.0 EVALUATION OF PLANT FEATURES

4.1 Safe Shutdown Systems

There are several arrangements of safe shutdown systems which are capable of shutting down the reactor and cooling the core during and subsequent to a fire. The exact arrangement available in a fire situation will depend upon the effects of the fire on such systems, their power supplies and control stations. To preclude a single event from affecting redundant systems, these systems are separated into two safety divisions, either of which would be capable of achieving safe shutdown.

During or subsequent to a fire, safe shutdown could be achieved using equipment such as: the reactor trip system; various reactor coolant and steam generator instrumentation; high pressure injection system and portions of the makeup system; decay heat system; auxiliary feedwater system; nuclear service raw water system; and nuclear service cooling water. Supporting systems and equipment such as: engineered safety features batteries; emergency diesel generators; 4160 and 480 volt buses, switchgear, and motor control centers; room coolers; and various valves to properly align required systems and isolate systems not required, would also be required.

We have evaluated the separation between the various systems which can be used for safe shutdown to determine that they are either adequately separated or that adequate fire protection is provided such that a fire will not cause the loss of capability to perform the safe shutdown function. The adequacy of separation of safe shutdown equipment is discussed in other sections of this report.

4.2 Fire Detection and Signalling Systems

The plant has a protective signalling system which transmits fire alarm and supervisory signals to the control room where audible and visual operator notification is provided. Local alarms are also provided throughout the plant. The system transmits actuation and trouble signals from fire detectors, sprinklers, deluge and carbon dioxide systems, and the fire pumps; actuation signals from manual fire alarm stations and fire protection system valve tamper switches are also transmitted.

The signalling system is provided with battery backup power in the event that normal plant AC power is lost. The system complies with those provisions of NFPA 72D (Class B) which are considered essential for this type of facility.

Smoke detection has been provided in several plant areas, and in many of these areas the smoke detectors are used to actuate a carbon dioxide fire suppression system as well as to provide personnel notification. Heat detectors are provided in the diesel generator room and actuate the carbon

dioxide system in this area. Infra-red flame detectors are provided on the reactor coolant pump motors.

There are some areas containing safety-related equipment that are not provided with fire detection; many, but not all of these areas are protected by automatic sprinkler systems, the actuation of which will also provide an alarm signal.

The licensee has proposed that detectors be installed so that detectors are located in all safety-related areas containing combustibles. In addition, the existing fire detectors in the control room are to be rearranged to provide improved response. Requirements for testing smoke detectors are under review.

We find that, subject to implementation of the above described review and modifications, the fire detection and signalling system conforms to the provisions of Appendix A to BTP 9.5-1.

4.3 Fire Control Systems

4.3.1 Water Systems

(1) Water Supply

The fire protection water supply for the plant consists of two fire pumps. One pump takes suction from the circulating water basins which have a capacity of six million gallons. The other pump takes suction from the plant water supply pipeline that extends from the plant reservoir, which contains three thousand acre-feet of water.

A 4-inch line extends from the fire system to provide an emergency supply to the nuclear service spray pond. This line is provided with two normally closed manual shut-off valves and a check valve to prevent any degradation of the ultimate heat sink.

We conclude that the basic water supply system conforms to the provisions of Appendix A to BTP 9.5-1. Accordingly, we find the fire water supply acceptable.

(2) Fire Pumps

The centrifugal fire pumps each have a rated capacity of 2,000 gpm at 125 psi. One pump is diesel engine driven with a fuel oil daytank located at the pump. The second pump is electric motor driven.

The diesel pump is housed in a pump house of fire resistive construction. The electrical pump is installed in the open. The two pumps are well separated from each other, precluding damage to both units from a single fire incident.

A small-orifice connection to the service water system maintains a constant pressure on the fire loop. The fire pumps are arranged to start automatically when the loop pressure drops due to a large water demand. Fire pump running and trouble signals are transmitted to the control room.

Either of the two fire pumps has sufficient capacity to supply the maximum design sprinkler demand with adequate reserve available for fire hoses.

We find that the fire pumps conform to the provisions of Appendix A to BTP 9.5-1 and are, therefore, acceptable.

(3) Fire Water Piping System

The fire pumps have separate discharge lines into the fire loop which encircles the plant. Valving is arranged so that a single piping break will not remove both pumps from service. The underground piping system was installed and tested in accordance with NFPA 24 "Outside Protection." The header from the fire loop supplying the Auxiliary Building is underground or supported on seismic Class I structures.

All yard hydrants, fixed water suppression systems and interior fire hose lines are supplied by the fire loop. Sectionalizing valves of the post indicator type are provided on the loop to allow isolation of various sections for maintenance. Since both sprinkler and interior hose stations are supplied by a common piping system, a single break could affect the primary and backup fire suppression in many areas containing safety-related equipment. The licensee has committed to analyze the effect on suppression capability of a moderate energy line break in this regard.

Yard fire hydrants have been provided at 200-300 foot intervals around the exterior of the plant. The hydrants have not been equipped with an auxiliary gate valve and hydrant repair or maintenance could result in impairment of interior suppression systems. The licensee has committed to install auxiliary gate or curb valves on each hydrant lateral where isolation of the lateral could cause loss of suppression water to safety-related areas.

The position of fire water system control valves is monitored by electrical supervision.

Fire hose and other manual fire fighting equipment has been provided at hose cabinets and fire equipment enclosures in the yard area. The hydrant hose threads are compatible with those of the local fire department.

We find that, subject to completion of the above modifications and subject to acceptable results from the moderate energy line break analysis described above, the fire water piping system is acceptable.

(4) Interior Hose Stations

Interior hose stations equipped with 1-1/2 inch lined fire hose have been provided in some areas of the plant. The licensee has proposed to provide additional hose stations so that all areas, except the reactor building, which contain safety-related equipment, will be within reach of a 100-foot hose line. The licensee has committed to install hose carts and hose to draw from the miscellaneous water system for fighting fires within the reactor building (5.16).

Combination fog and straight-stream nozzles are provided in all areas.

We conclude that with the implementation of these modifications, the interior hose installation will meet the provisions of Appendix A of BTP 9.5-1.

(5) Sprinkler Systems

Automatic wet-pipe sprinkler systems have been provided in the turbine building and in a significant portion of the auxiliary building. Areas in the auxiliary building having electrical cable trays more than three tiers in height are protected by ceiling level sprinklers. Ceiling level sprinklers may not provide effective fire control in some areas containing multiple tiers of cable trays. However, the licensee proposes to protect redundant cables in these areas with spacing, fire stops or barriers. The sprinkler systems have been designed in accordance with NFPA 13 "Sprinkler Systems" with the turbine building sprinklers being hydraulically calculated and the auxiliary building sprinklers installed according to the ordinary hazard pipe schedule.

Automatic water spray systems are provided on combustible liquids hazards in the turbine building (hydrogen seal oil unit, feedwater pumps, and turbine oil pumps and reservoirs) and on oil-filled transformers in the yard area. These systems are actuated by pneumatic rate-of-rise heat detectors. The general design of the water spray systems complies with NFPA 15 "Water Spray Fixed Systems."

The licensee has proposed extension of automatic sprinkler protection into the makeup pump room.

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

(6) Foam

The plant maintains three portable foam nozzle units each having 30 gallons of Aqueous Film Forming Foam concentrate. This provides manual fire fighting capability for combustible liquid hazards. We

find that the foam equipment conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

(7) Affects of Suppression Systems on Safety Systems

We have considered the effects of: (1) breaks in fire protection piping that may result in water flooding damage to safety-related equipment; (2) cracks in fire protection piping that may result in water spray damage to safety-related equipment; and (3) inadvertent fire protection system actuation in terms of flooding or water spray damage to safety-related equipment.

The licensee has performed an analysis indicating that the drainage system in all areas containing safety-related equipment is adequate to handle expected sprinkler and hose stream discharge during fire fighting operations. This analysis also indicates that sufficient time is available for operator action to prevent flooding damage due to sprinkler pipe breakage. In most areas, safety-related equipment susceptible to water damage is protected by floor drains or grating, or mounted sufficiently above the floor to prevent flooding damage. Flooding damage is considered unlikely since flow out through doors is available and buildup of water would be negligible.

In one location, water spray from sprinkler operation could damage safety-related electrical equipment; however, the redundant division would not be affected. Actuation of either the carbon dioxide system or the sprinkler system in a diesel generator room could prevent operation of that diesel under certain conditions; however, the redundant diesel generator would not be affected.

We conclude that the potential for actuation or failure of fire protection systems to prevent safe shutdown is minimal and is, therefore, acceptable.

4.3.2 Gas Fire Suppression Systems

An automatic total flooding low-pressure carbon dioxide system provides fire suppression for the following areas: diesel generator rooms, 480V and 4 kV switchgear rooms, battery rooms, communication rooms, cable shafts, and AC/DC panel rooms. The system is actuated on an individual area basis using cross-zoned smoke detectors. The carbon dioxide system is also being extended to protect the main turbine-generator unit bearings and exciter enclosure; heat detectors will be used to actuate the system at the turbine-generator. Total reliance is not being placed on the effectiveness and reliability of the carbon dioxide system to maintain safe shutdown capability. In areas protected by the carbon dioxide system, redundant systems are also being separated by spacing, insulation or fire barriers to prevent their involvement in the same fire incident.

The carbon dioxide system is designed to conform to the requirements of NFPA 12 "Carbon Dioxide Systems." The system has also been designed to meet 10 CFR 50 Appendix B QA criteria and seismic Class I criteria. The carbon dioxide system is provided with acceptable emergency power sources. The 7.5 ton refrigerated carbon dioxide storage tank is located in the

yard with the agent being directed to various protected areas using automatic selector valves in the discharge piping system. The licensee has proposed to electrically supervise the manual shutoff valve in the main carbon dioxide system discharge header.

Subject to implementation of the above described modification, we find the carbon dioxide system meets the requirements of Appendix A of BTP 9.5-1, and accordingly find the system acceptable.

4.3.3 Portable Fire Extinguishers

Portable carbon dioxide and dry chemical fire extinguishers have been installed throughout all areas of the plant in accordance with the requirements of NFPA 10 "Portable Fire Extinguishers."

In addition, the licensee has proposed to provide water or Halon 1211 portable Class A extinguishers in the control-computer room area to combat deep-seated fires in electrical insulation.

Upon implementation of this modification, we find the portable fire extinguishers will conform to the provisions of Appendix A of BTP 9.5-1, and accordingly is acceptable.

4.4 Ventilation Systems and Breathing Equipment

4.4.1 Smoke Removal

The plant does not have exhaust systems designed specifically for smoke removal. However, the normal ventilation systems in most areas can be used for smoke removal. The effectiveness of these systems may be limited because fans and other equipment may not be able to withstand high temperatures and could be rendered inoperative by the heat from a significant fire. Some ventilation system power supply cables may also be affected by a fire. In view of the potential limitations created by dependence solely on the normal air handling systems the licensee has provided four smoke removal fans and portable ducting for backup to normal systems and for areas where the ventilation system would not be effective.

We find that the smoke removal capability satisfies the objectives identified in Section 2.1 of this report, and is, therefore, acceptable.

4.4.2 Filters

The high efficiency particulate filters throughout the plant are of noncombustible mineral fiber construction and as such are not fire hazards to safety-related equipment. All prefilters are qualified to U.L. Class I requirements and do not contribute fuel when attacked by flame. The charcoal filter units are enclosed in substantial metal housings which protect them from ignition sources and are generally separated from ignition sources. The contained radioactive material in these charcoal filters is small and as such the isotopic decay heat is insufficient to cause ignition.

Hose stations are within access of all these filters with the exception of those in the reactor building. As an added measure, the licensee has proposed to provide temperature detectors to alarm and to close air dampers to contain any possible fire. The filters in the reactor building are remotely located from safety-related equipment and as such would have no effect on safe shutdown equipment.

Subject to implementation of the above described modification, we find that fire protection for the filters satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

4.4.3 Breathing Equipment

A sufficient number of self-contained breathing units are provided at the facility to supply the operating crew and fire brigade plus some spare bottles. We are currently reviewing the licensee's proposal to provide air compressors of sufficient capacity to furnish a continuous air supply to recharge bottles.

We find, subject to completion of our review and implementation of the described modification, the portable breathing equipment conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.5 Floor Drains

Floor drains are provided in various areas to drain off suppression water. In other areas water is directed by curbs or flows out of doors or through grating to lower elevations such that standing water would not affect safety-related equipment. The drains for the diesel generator rooms drain to the turbine building condenser sump. These drain lines are not now trapped. To prevent a fire from being spread between diesel generator rooms via the drain system, the licensee has proposed to install a quenching kit with a trapped drain in each diesel generator room. The only other flammable liquid hazards in rooms having drains are the high pressure injection pumps. However, each of these rooms drain to separate sumps, which also only drain areas containing equipment from the same division.

We find that, subject to implementation of the modifications described above, adequate floor drains are provided for removal of suppression water, adequate means are provided to prevent the spread of fire through the drain system, and floor drains conform to the provisions of Appendix A to BTP 9.5-1. Accordingly, we find the floor drains acceptable.

4.6 Lighting Systems

In addition to the normal plant lighting, fixed lighting units which transfer to a battery supply are located throughout the plant in rooms and accessways to serve as emergency lighting. Sealed beam battery operated handlights will be provided for use during fire emergencies. In a number of areas fires may cause loss of normal a.c. powered lighting and emergency d.c. lighting systems which provide access to the fire area.

The licensee has agreed to provide fixed sealed-beam battery powered lights in all accessways to safety-related areas. We find that, subject to implementation of the above modification, the lighting systems are acceptable.

4.7 Communication Systems

Normal communication within the plant is provided by a fixed telephone system. An additional communication method is provided by a sound-powered phone system with jacks at various key locations throughout the plant.

Additionally, several portable radio units are provided for fire brigade use, which can be used in all areas of the plant with the exception of between the reactor building and other areas. The licensee has proposed to provide the capability to use portable radio equipment between the reactor building and control room.

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

4.8 Electrical Cable Combustibility

The cable insulation used in the plant consists mainly of crosslinked polyethylene (a thermosetting plastic) with a neoprene jacket. An insignificant amount of polyvinyl-chloride cable is used in the radiation monitoring system. Although IEEE 383 was not in existence at the time the Rancho Seco electrical cabling was purchased and installed, cables, with exception of the PVC cables, were required to pass a flame-resistance test in accordance with IPCEA S-19-81 or U.L. 83 vertical flame test. The cables constructed of the crosslinked polyethylene with and without neoprene jacket were required to pass a 20 minute integrity test in addition to the vertical flame tests. The results show that in the configurations and with the ignition source used in the tests the cable insulation burns reluctantly. We find that retest to the IEEE 383 procedures and criteria would not provide information that would alter our recommendations or conclusions. Accordingly, we find the electrical cables used at the Rancho Seco plant acceptable.

4.9 Fire Barrier Penetrations

4.9.1 Fire Doors

Some doorway penetrations of fire barriers have doors with a lower fire resistance rating than the barrier requirements. The licensee has proposed to upgrade certain doorway penetrations of fire barriers to the required rating of the barriers which they penetrate. Doorways not protected to the rating of the fire barrier are found acceptable on the basis of the light combustible loading or that redundant safe shutdown equipment will not be jeopardized if the barrier is breached.

The licensee has also proposed to install alarms on all doors in fire barriers of safety-related areas with alarm signals extending to a manned security console.

We find that, subject to implementation of the above described modifications, the doorway penetrations of fire barriers conform to the provisions of Appendix A to BTP 9.5-1, and are, therefore, acceptable.

4.9.2 Ventilation Duct Penetrations

Ventilation ducts pass through fire barriers at many locations with no fire damper inside the duct at the penetration. The licensee has proposed to install fire dampers in most of these penetrations having a rating at least equal to the fire barrier requirements as determined by the licensee's fire hazards analysis. As a minimum, fire dampers are provided in all ventilation duct penetrations of fire barriers protecting safety-related areas.

We find that, subject to implementation of the above modifications, ventilation duct penetrations satisfy the objectives identified in Section 2.1 of this report and are, therefore, acceptable.

4.9.3 Electrical Cable and Piping Penetrations

Electrical cable penetrations of fire barriers have been sealed with a 1/4-inch glass fiber reinforced polyester board, sprayed on one side with a 1/8-inch coating of fire resistant mastic. Small openings around the cable trays are stuffed with ceramic fiber.

These penetration seals have not been subjected to an ASTM E-119 type fire test. The licensee proposes to install seals where none are provided and to perform additional testing on the present penetration seal design, upgrading existing seals if the test results indicate this is necessary to maintain the required barrier fire resistance.

We will review the results of these tests and further address cable penetration seals in a supplement to this report.

4.10 Separation Criteria

The licensee has stated that the separation of redundant cables of the reactor protection system and safety features is accomplished by spatial separation in accordance with the following criteria:

(1) "Separate cable tray conduit and penetration systems are installed for the following classes of cable: 15 kV, 5 kV, 600-volt power and control, and instrumentation cable. Class I 600-volt power and control cables of one channel are run together in trays that belong to the same channel. Class I instrumentation circuits are routed in rigid metal conduits as explained in paragraph (2) below. These two different and independent routing methods preclude the possibility of fire in a tray carrying power and control cables propagating to instrumentation circuits. In general power cable trays carrying cables greater than 600 volts are not installed parallel to and below conduits carrying Class I instrumentation cables or trays carrying Class I 600-volt power and control cables. In the few instances

where conduits carrying Class I instrumentation cables are installed parallel to and above power cable trays the conduits are wrapped with 1" thick insulation thermobestos for protection.

(2) Reactor protection system and safety features actuation system instrumentation each have their channels routed in separate conduits and are physically separated from each other throughout the plant.

(3) Reactor protection system and safety features actuation system power and control, Channels A and B, are separated physically and have separate raceway systems. Nonsafety-related circuits may be run in these trays.

(4) Reactor protection system Channels C and D and safety features actuation system Channel C power are separated physically by channel and are separated from any other channel source or nonsafety-related power and control source.

(5) Power and control circuits are not mixed with instrumentation circuits in any raceway for the systems.

(6) The minimum horizontal distance between trays of different channels is 3 feet-0 inches.

(7) Paralleling trays of different channels in a vertical stack is not permitted.

(8) The minimum vertical distance between trays of different channels crossing each other is 18 inches. Additionally, at tray crossings, a 1/4-inch thick Haysite polyester board fire barrier is installed between the trays for protection."

In general, separation between redundant division far exceeds these minimum requirements and is such that most fires would not cause functional loss of redundant safe shutdown equipment. The separation criteria does not preclude the crossing of such cables nor does it consider the possibility of heat buildup in a room. However, the licensee has performed a detailed fire hazards analysis for each area of the plant containing safety-related equipment to determine the possible effects of fires on safe plant shutdown. Each of these areas is discussed in more detail in Section 5.0 of this report. In various areas the licensee has proposed to reroute cables, provide thermal barriers, or fire stops, where the existing cable separation was found inadequate to preclude fire damage to redundant safe shutdown equipment. The specific areas where this additional protection is to be provided are identified in Section 5.0 of this report. We find that the concept of the proposed modifications is acceptable. The licensee has further proposed to perform tests to demonstrate the adequacy of the barriers and fire stops. We will review the results of these tests and further address cable separation in a supplement to this report.

Class II instrumentation required for safe shutdown are not routed in accordance with the above criteria. Consequently, redundant Class II instrumentation may have wiring of its redundant counterpart in the same tray. The licensee has proposed to redesign and reroute Class II instrumentation such that a fire will not cause loss of required instrumentation. The licensee has not as yet completed the review and redesign of Class II instrumentation required for safe shutdown. We will address the adequacy of separation for Class II instrumentation in a supplement to this report.

4.11 Fire Barriers

The fire barriers provided have fire resistance rating of 1 hour or more depending upon the construction of the barrier. The licensee's fire hazards analysis concludes that the basic wall, floor and ceiling structures bounding each fire zone have adequate fire resistance to prevent the spread of an unsuppressed fire through the barriers. Areas not having a 3-hour rating are found acceptable on the basis of the light combustible loading or that redundant safe shutdown equipment will not be jeopardized if the barrier is breached.

There are certain deficiencies in the licensee's methodology for determining potential fire severity and hence the fire barrier requirements. However, critical fire barriers throughout the plant have been reviewed by the staff, and it is concluded that upon completion of the proposed modifications discussed in other sections of this report, barriers will be adequate to prevent redundant safe shutdown systems from being involved in the same fire incident.

4.12 Access and Egress

All safety-related areas are reasonably accessible for manual fire fighting except the containment and some concealed ceiling spaces. These excepted areas are addressed in other sections of this report.

4.13 Toxic and Corrosive Combustion Products

The products of combustion of many polymers are toxic to humans and corrosive to metals. Prompt fire detection and extinguishment are relied on to minimize the quantity of such products. Additionally, means for smoke removal are provided or will be added as discussed in Section 4.4 of this report. The fire brigade will also be provided with and trained in the use of emergency breathing apparatus for fighting fires involving such materials. We conclude that after implementation of the modifications described in this report, the potential for development of toxic and corrosive combustion products will be minimized and will satisfy the objectives detailed in Section 2.1 of this report. Accordingly, we find the measures taken to minimize the development of toxic and corrosive combustion products to be acceptable.

4.14 Nonsafety-Related Areas

We have evaluated the separation by distance or by fire barriers of nonsafety-related areas to determine that fires in such areas will not adversely affect the ability to safely shutdown the plant. Nonsafety-related areas which potentially pose a fire hazard to safe shutdown equipment are addressed in Section 5.0 of this report.

4.15 Instrument Air

Plant instrument air is not required for safe shutdown of the plant and was, therefore, not considered in this evaluation.

5.0 EVALUATION OF SPECIFIC PLANT AREAS

The licensee has performed a fire hazards analysis of the facility to determine the fire loading of various plant areas, to identify the consequences of fires in safety-related and adjoining nonsafety-related areas, and to evaluate the adequacy of existing and proposed fire protection systems.

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

5.1 Control and Computer Room

5.1.1 Safety-Related Equipment

The control and computer room contains safety-related control cabinets and consoles. At the present time, certain of these panels contain cables and controls required for safe shutdown of the plant. This area also contains a large amount of cabling including safe shutdown cables in an above ceiling space.

5.1.2 Combustibles

The combustibles in the area consist mainly of electrical cable insulation and a small amount of Class A combustibles such as log books, computer paper, and drawings. The electrical cabling is both in cabinets and in open cable trays overhead in the computer area. One of the two redundant divisions of safe shutdown cables is in conduit and a portion of the other division is in conduit; the remaining cable, which is in open trays, is not required for safe shutdown.

5.1.3 Consequences If No Suppression

An unmitigated cable fire in the above ceiling space could affect redundant cables required for safe shutdown and increase the difficulty of achieving safe shutdown. Smoke and fumes may cause the control room to be uninhabitable. Certain control room cabinets or panels contain redundant safe shutdown equipment or cabling which if damaged could cause loss of control from the control room but the equipment could still be operated locally. Cabinet H2ES contains redundant diesel generator controls which, if involved in a fire, may cause the loss of capability to operate the diesels until shorts or grounds are removed by making repairs. Cabinet H1SS contains controls for redundant auxiliary feedwater pumps which, if involved in a fire, may cause loss of control of the pumps from the control room, but they may still be operated locally.

5.1.4 Fire Protection Systems

Wet pipe sprinkler systems are provided for the surrounding offices and the corridor, but not in the control and computer room proper. Portable CO_2 extinguishers and a cart mounted CO_2 unit are provided. Hose stations are located within easy access of the room. Ionization type smoke detectors are installed in the above ceiling space but not in the safety-related panels.

5.1.5 Adequacy of Fire Protection

Due to the lack of access to fight fires in the above ceiling space and the lack of physical separation, a fire could damage redundant cables required for safe shutdown. Lack of prompt smoke detection capability in these cabinets and lack of physical separation may allow a fire in a few panels or cabinets to damage redundant safe shutdown equipment which would necessitate repair prior to operation of the equipment.

5.1.6 Modifications and Recommendations

The licensee proposes the following improvements for this area:

(1) Install thermal insulation on functionally redundant Channel A, C and D conduits to prevent loss of redundant functions that are located in Channel B trays and/or conduit (see Section 4.10).

(2) Install ionization smoke detectors in all computer and control room cabinets that contain control pushbuttons and indication required for safe shutdown and cooldown and the panels adjacent to them;

This will include cabinets and panels which have required circuits as well as panels and cabinets adjacent to required cabinets which contain no required circuits;

(3) Relocate ionization detectors to be able to quickly detect cable tray fire;

(4) Remove suspended ceiling in computer room for better access to combat any potential fire;

(5) Cover with a flame retardant compound the coils of factory preassembled connector cables located in all control and computer room cabinets. The cables are used for instrumentation and/or control signals which are low level signals;

(6) Replace the non-U.L. labeled HVAC dampers in east wall of the computer room with fire dampers. Automatic actuation to be initiated by fire in adjacent areas to prevent propagation of smoke and fire into the control room;

(7) Modify the control circuits for the high pressure injection and makeup lube oil pumps to insure that no fire in HIRC will prevent operation of these lube oil pumps when required.

(8) Add water or Halon type 1211 Class A portable extinguishers for use in the control/ computer room; and

(9) Develop procedures for placing the diesel generators in operation locally for fires in control room panel H2ES.

(10) Install isolation switches at the 4160V switchgear for both auxiliary feedwater pumps to isolate the local control circuit from Panel H1SS.

We find that, subject to implementation of the above described modifications, fire protection for the control/computer room will conform to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.2 East and West Nuclear Service Battery Rooms and Battery Charger Rooms

5.2.1 Safety-Related Equipment

The east room has the battery and cables for one division of safe shutdown equipment. The west room has the battery and cables redundant to those in the east room. The two battery charger rooms have equipment and cables of only one safety division.

5.2.2 Combustibles

The significant combustibles in the battery rooms are the plastic battery cases and a small amount of electrical cable insulation. The charger rooms have a small amount of electrical cables.

Hydrogen buildup is prevented by continuously operating exhaust fans which are monitored in the control room for motor overload and open circuits.

5.2.3 Consequences If No Suppression

An unsuppressed fire in a battery room or its charger room could cause the loss of one of the redundant batteries, but would not affect the redundant battery or safe shutdown of the plant.

5.2.4 Fire Protection Systems

The fire protection for these rooms consists of ionization smoke detectors and automatic total flooding CO_2 systems. Backup manual extinguishers and hose stations are also available.

5.2.5 Adequacy of Fire Protection

Considering the limited quantity of combustibles in these areas, the fire protection is adequate to extinguish fires in these rooms. However, certain mechanical failures of the room exhaust fans for the battery rooms may go unnoticed, such as broken shaft or loose fan blade, resulting in a hydrogen buildup without warning.

5.2.6 Modifications and Recommendations

The licensee has committed to install flow detection devices to detect the loss of flow and to alarm in the control room.

We find that, subject to implementation of this modification, the fire protection for the battery rooms and charger rooms will conform to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.3 480 Volt Switchgear Rooms

5.3.1 Safety-Related Equipment

There are two 480 volt switchgear rooms each containing primarily one safety division cable but with a few of the redundant division cables located in each room. The rooms contain the 480 volt switchgear for its respective safety division. The east switchgear room also contains the control rod drive power supplies.

5.3.2 Combustibles

The significant combustible in these rooms consists of a large quantity of cable insulation.

5.3.3 Consequences If No Suppression

A fire in either of these areas would affect equipment required for safe shutdown from one division. A few cables of the opposite divison are located in each room. Their loss has been analyzed and shown to not affect the safe shutdown of the plant due to the availability of redundant equipment not affected by the fire. However, in the east 480 volt switchgear room, all three channels of instrumentation for sensing reactor coolant pressure could be lost in a fire which would increase the difficulty to make an orderly shutdown.

5.3.4 Fire Protection Systems

Each of the 480 volt switchgear rooms is equipped with an automatic total flooding CO_2 system with ionization smoke detectors which actuate the CO_2 system and alarm in the control room. Manual hose stations and portable CO_2 extinguishers are located in the hallway adjacent to the rooms.

5.3.5 Adequacy of Fire Protection

Some damage could occur to one division of safety-related equipment but the automatic CO_2 system should prevent a large fire from occurring until manual hoses can be used to extinguish any fire which is not extinguished by the CO_2. In any case, safe shutdown capability would not be lost for fires in these areas.

5.3.6 Modifications and Recommendations

The licensee proposes to provide thermal barriers over the entire length of all Channel A, C and D conduits containing cables for safe shutdown to

prevent their loss for the design basis fire in the event the CO_2 system should fail (see Section 4.10).

In addition the licensee has proposed to perform qualification tests to show the thermal barriers are adequate to prevent the cables loss for the design basis fire.

We find that, subject to implementation of this modification and successful qualification of the thermal barriers, the fire protection for the 480 volt switchgear rooms will conform to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.4 East and West Cable Shafts

5.4.1 Safety-Related Equipment

Each of the cable shafts contains only one division of cables required for safe shutdown of the plant.

5.4.2 Combustibles

The cable shafts contain a large quantity of electrical cable insulation in open cable trays. No other combustibles are located in these shafts.

5.4.3 Consequences If No Suppression

The cable shafts are separated from each other and other areas by a three-hour fire-rated enclosure. A fire in one shaft would not affect the cables in the other shaft. The loss of all the cables in one shaft would not affect safe shutdown capability since the redundant systems and instrumentation are located in the unaffected cable shaft.

5.4.4 Fire Protection Systems

Fire protection for each cable shaft is provided by a total flooding CO_2 system actuated by ionization smoke detectors which also provide alarm in the control room. Portable extinguishers and manual hose stations are within easy access of the cable shafts.

5.4.5 Adequacy of Fire Protection

Some damage could occur to safety-related systems, but fire barriers would be adequate to limit involvement to one division. The capability to safely shutdown the plant would be maintained.

5.4.6 Modifications and Recommendations

The licensee has proposed to check and seal all cable penetrations to minimize air inleakage. This will also minimize CO_2 outleakage making the CO_2 system more effective.

We find that, subject to implementation of this modification, the fire protection for the cable shafts conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.5 Electrical Penetration Areas

5.5.1 Safety-Related Equipment

There are three electrical penetration areas. Two of these areas contain a few safe shutdown cables for one division. The third has cables to both divisions of some safe shutdown equipment.

5.5.2 Combustibles

The significant combustibles in these areas are a large quantity of electrical cable insulation. One of the areas contains a charcoal filter encased in a steel enclosure.

5.5.3 Consequences If No Suppression

Damage could occur to one division of safe shutdown cables in any of these penetration areas. Some damage could occur to both division of cables in one of the areas, however, analysis shows that the loss of these cables would not cause the loss of safe shutdown capability.

5.5.4 Fire Protection Systems

Fire protection is provided by automatic wet pipe sprinkler systems for each area. Manual extinguishers and hose stations are also available.

5.5.5 Adequacy of Fire Protection

The fire protection is adequate to suppress fires in these areas, however, it is not adequate to prevent unnecessary damage to safe shutdown equipment even though safe shutdown capability would not be lost. Lack of incipient fire detection capabilty would allow a fire to become large and to damage, unnecessarily safe shutdown cables.

5.5.6 Modifications and Recommendations

The licensee has proposed to provide gasket seals on electrical terminal boxes, to upgrade the expansion joint between the floor slab and the reactor building wall to resist the design basis fire, to install temperature detectors for alarm and automatic damper actuation at charcoal filters, and to install a fire stop to prevent a fire from bridging the gap between redundant channels.

In addition, the licensee has proposed to install smoke detectors in these areas to alarm in the control room for early warning of fire.

We find that, subject to implementation of the above described modifications, fire protection for these areas satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.6 Main Corridor-Auxiliary Building, Mezzanine Level

5.6.1 Safety-Related Equipment

The safety-related equipment at this elevation consists of electrical cabling in conduit and cable trays. Certain of these cables would be required for safe shutdown.

5.6.2 Combustibles

Combustibles are limited mainly to electrical cable insulation, with the potential for transient combustibles transported through the hallways. The cables are located in an above ceiling space over a hung ceiling. Most of the ceiling area has steel grating above the ceiling tiles making access difficult.

5.6.3 Consequences If No Suppression

A fire in this area could potentially cause loss of redundant systems required to achieve cold shutdown. Cables are located in two parallel stacks, stacked up to four high, with cables from the redundant divisions separated by approximately 64 feet. Heat buildup trapped in the ceiling space would be the source of damage to redundant systems.

5.6.4 Fire Protection Systems

Automatic suppression coverage is provided by a wetpipe sprinkler system above and below the ceiling. Manual suppression is provided by portable extinguishers and manual hose stations. Automatic smoke detection is not provided.

5.6.5 Adequacy of Fire Protection

The suppression system provided may not be adequate to suppress fires since water from the ceiling mounted heads would be shielded from reaching lower trays. Fires may still affect redundant safe shutdown systems. Lack of smoke detectors may allow a fire to develop and become large.

5.6.6 Modifications and Recommendations

The licensee has proposed to add fire stops and barriers to prevent involvement of redundant safe shutdown systems in a fire (see Section 4.10). The details on these modifications have not as yet been provided. We find the concept acceptable, but will evaluate the details of the design as details are developed to assure the adequacy of the design.

The licensee has also proposed to upgrade penetrations and to provide protection for the bus duct to prevent water damage. These modifications are discussed further in Sections 4.9.1 and 4.3.1(7), respectively, of this report.

In addition, the licensee has proposed to provide smoke detectors in all safety-related areas, as discussed in Section 4.2 of this report.

We find that, subject to implementation of the above described modifications fire protection for the auxiliary building mezzanine level corridor satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.7 4 kV Switchgear Rooms

5.7.1 Safety-Related Equipment

There are two redundant 4 kV switchgear rooms. Each room contains the switchgear to one of the redundant divisions of safe shutdown equipment and the associated cables.

5.7.2 Combustibles

The combustibles in these areas consist of a large quantity of electrical cable insulation.

5.7.3 Consequences If No Suppression

In either switchgear room, an unsuppressed fire could result in severe damage to the electrical cables and switchgear of the associated safety division. The loss of this equipment would not prevent safe shutdown due to the availability of the redundant unaffected division of safe shutdown equipment.

5.7.4 Fire Protection Systems

Fire protection for each switchgear room is provided by a total flooding CO_2 system actuated by ionization smoke detectors. Portable extinguishers and hose stations are within easy access of the switchgear rooms.

5.7.5 Adequacy of Fire Protection

Some damage could occur to one division of safety-related equipment but the automatic CO_2 system should prevent a large fire from occuring until manual hoses can be used to extinguish any fire which is not extinguished by the CO_2. In any case, safe shutdown capability would not be lost for fires in these areas.

5.7.6 Modifications and Recommendations

We find that fire protection for the 4 kV switchgear rooms conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.8 Auxiliary Building - Main Corridor at Grade Level

5.8.1 Safety-Related Equipment

The safety-related equipment in this area consists of electrical control cables associated with the redundant auxiliary feedwater systems, the decay heat removal systems, and the diesel generators. The area also contains instrumentation cables from one safety division for monitoring the reactor coolant system pressure and the hot leg temperature.

5.8.2 Combustibles

The significant combustible material in this area is a substantial amount of electrical insulation on cable in trays above the suspended ceiling.

5.8.3 Consequences If No Suppression

An unsuppressed fire in the corridor would result in the loss of both diesel generators. Under such conditions, the simultaneous loss of normal a.c. power would prevent cold shutdown of the reactor. According to the licensee's analysis, hot shutdown could still be accomplished and approximately two hours would be available to restore electrical power required to achieve cold shutdown; during this period decay heat would be removed using the steam driven auxiliary feedwater pump and the safety relief valves.

An unsuppressed fire in this area could also result in the loss of control from the control room of both decay heat removal pumps and the valves between the reactor coolant system and the decay heat pumps. These valves can be manually operated in the reactor building. The pumps can be started manually from the 4 kV switchgear rooms; however, a fire in this corridor might make the switchgear rooms inaccessable to personnel.

An unsuppressed fire could also cause loss of control from the control room of one pump and one valve in the auxiliary feedwater system which are on opposite channels; this pump and valve can be manually operated locally.

Instrumentation losses would not effect safe shutdown/cooldown because monitoring can be accomplished from redundant channels that do not have cables passing through this area.

5.8.4 Fire Protection Systems

This area is protected by wet pipe automatic sprinklers installed above and below the suspended ceiling. Manual hose stations and carbon dioxide extinguishers are also provided in the area.

5.8.5 Adequacy of Fire Protection

It may be difficult for the ceiling level sprinklers to effectively prevent involvement of redundant safe shutdown cables. The lack of early fire detection devices and the concealed nature of the cable area will hamper manual fire control.

5.8.6 Modifications and Recommendations

The licensee has proposed to provide separation and/or fire barrers to prevent the loss of redundant safe shutdown equipment (see Section 4.10). In addition, the licensee has proposed to install smoke detectors in this area to provide early warning to increase the effectiveness of manual suppression.

We find that, subject to implementation of the above described modifications, fire protection for this area satisfies the objectives of Section 2.1 of this report and is, therefore, acceptable.

5.9 Diesel Generator Rooms

5.9.1 Safety-Related Equipment

Each of the two redundant diesel generator rooms contains one emergency diesel generator unit along with associated cabling and local controls. One diesel generator is necessary for safe shutdown upon loss of normal a.c. power.

5.9.2 Combustibles

The significant combustibles are diesel fuel, lube oil and cable insulation. The diesel fuel is contained in a heavy steel wall tank built into the diesel generator base.

5.9.3 Consequences If No Suppression

Inasmuch as there are two redundant and diverse suppression systems for each room, the likelihood of suppression system failure is extremely low. If such an event were to occur, there is no effect on the safe shutdown capability of the plant.

5.9.4 Fire Protection Systems

Each diesel room has a total flooding CO_2 system actuated by heat detectors and a wet pipe sprinkler system. These systems are backed up by portable extinguishers and hose stations.

5.9.5 Adequacy of Fire Protection

The fire protection provided for these areas is adequate to suppress fires characteristic of these areas. Safe shutdown capability would be maintained for a fire in either of these areas.

5.9.6 Modifications and Recommendations

The licensee has proposed the following modifications to enhance the existing fire protection for these areas:

Install 6" of fire resistant concrete to east wall with a three-hour fire rating to assure containment of a fire in the area;

Provide for tripping of the fuel oil pumps by actuation of the CO_2 system;

Replace unrated door to outdoor area in D.G. room east wall with 1-1/2 hour rated U.L. "B" door;

Install trapped floor drain with quench pit.

Subject to implementation of the above described modifications, the fire protection for the diesel generator rooms conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

5.10 Main Corridor - Below Grade - Elevation (-)20 Feet

5.10.1 Safety-Related Equipment

Safety-related equipment at this area includes electrical cables of one safety-division that may be required for safe shutdown.

5.10.2 Combustibles

The significant combustible in this area is a moderate amount of electrical cable insulation.

5.10.3 Consequences If No Suppression

A postulated cable fire in this area may cause loss of function of certain safe shutdown systems in one division, but would not affect systems in the redundant division.

5.10.4 Fire Protection Systems

Automatic wet pipe sprinklers are provided over cable trays stacked three or more deep. Manual suppression capability is provided by portable extinguishers and manual hose stations. No automatic smoke detection devices are provided.

5.10.5 Adequacy of Fire Protection

The automatic suppression provided in this fire area would be adequate to control fires, although shielding of lower trays may require manual suppression to fully suppress a fire and lack of detection devices may allow fires to become larger before being suppressed. Hose stored at hose stations would not be able to reach all points in the area.

5.10.6 Modifications and Recommendations

The licensee has proposed to replace existing hose with 100-foot lengths of hose, to add an additional hose station in this fire area, and to provide smoke detectors in all safety-related areas to afford prompt detection, as discussed in Section 4.2 of this report.

We find that, subject to implementation of the above described modifications, fire protection for the main corridor-below grade satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.11 Auxiliary Building - Corridor To -47 Foot Elevation

5.11.1 Safety-Related Equipment

The safety-related equipment in this area consists of electrical power and control cables from redundant divisions associated with the nuclear service cooling water, decay heat removal, and high pressure injection systems.

5.11.2 Combustibles

The significant combustible material in this area is electrical insulation on cable in trays.

5.11.3 Consequences If No Suppression

An unsuppressed fire could cause loss of the decay heat removal system by affecting power cables to both redundant decay heat removal pumps and the pump room coolers. The fire could also render the high pressure injection system inoperative by damaging power cables to both redundant injection pumps and the makeup pump. Such a fire would impair the capability to achieve cold shutdown. An unsuppressed fire could cause loss of control of one channel of Nuclear Service Cooling System valves, however, these valves could still be operated manually.

5.11.4 Fire Protection Systems

There are no automatic fire detection or suppression systems in this area. Manual fire suppression equipment is available in the form of an interior hose station and a carbon dioxide fire extinguisher.

5.11.5 Adequacy of Fire Protection

The fire protection provided would not be adequate to prevent loss of redundant safe shutdown systems.

5.11.6 Modifications and Recommendations

The licensee proposes to provide separation and/or fire barriers to prevent loss of redundant functions for the design basis fire (see Section 4.10). The licensee also proposes to install automatic smoke detectors in the area.

We find that, subject to implementation of the above described modifications, the fire protection for this area satisfies the objectives of Section 2.1 of this report and is, therefore, acceptable.

5.12 High Pressure Injection Pump Rooms

5.12.1 Safety-Related Equipment

Safety-related equipment in these rooms required for safe shutdown includes piping and cables for safe shutdown systems and high pressure injection pumps, and pump room coolers.

Each of the two pump rooms contain equipment of only one safety division.

5.12.2 Combustibles

The significant combustible in these rooms is lube oil associated with the pump motors. There is also a small amount of electrical cable insulation in these rooms.

5.12.3 Consequences If No Suppression

A postulated unsuppressed fire in either of these rooms may cause loss of certain safe shutdown systems within one safety division, but would not prevent safe shutdown since the redundant systems would be available.

5.12.4 Fire Protection Systems

There are no automatic detection or suppression systems in these rooms. Manual suppression capability is afforded by hose stations nearby the rooms.

5.12.5 Adequacy of Fire Protection

Manual suppression means would be adequate to control and suppress fires in these rooms, although lack of detection devices would not assure prompt detection.

5.12.6 Modifications and Recommendations

The licensee has proposed to install smoke detection devices in these rooms.

We find that, subject to implementation of the above described modification, fire protection for the high pressure injection pump rooms satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.13 Decay Heat Removal Pump Rooms

5.13.1 Safety-Related Equipment

These rooms each contain decay heat removal pumps, piping, electrical cabling, and pump room cooler which would be required for safe shutdown. Each room contains safe shutdown equipment of only one safety division, except that some decay heat removal system piping of both safety divisions is located in the "east" decay heat removal pump room.

5.13.2 Combustibles

The significant combustible in these rooms is a small amount of electrical cable insulation.

5.13.3 Consequences If No Suppression

A postulated unsuppressed fire in either of these rooms may cause loss of function of decay heat removal equipment in one division, but would not affect the availability of the redundant division decay heat removal system. Fire loading in the "east" decay heat removal pump room is not large enough to cause failure of redundant division decay heat removal piping.

5.13.4 Fire Protection Systems

Ionization type smoke detectors are provided in these rooms. One room has a portable fire extinguisher. Existing hose at hose stations cannot reach both these rooms.

5.13.5 Adequacy of Fire Protection

The detection devices in these rooms would afford prompt detection, but adequate capability is not provided to suppress fires and limit its effects.

5.13.6 Modifications and Recommendations

The licensee has proposed to place 100 feet of hose at the hose station outside of these two rooms to provide adequate coverage of the rooms.

We find that, subject to implementation of the above described modification, fire protection for the decay heat removal pump rooms satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.14 Auxiliary Building - Containment Penetration Valve Areas

5.14.1 Safety-Related Equipment

The east and west containment penetration valve areas contain safety-related valves and electrical cabling associated with the decay heat removal, high pressure injection, and nuclear service water cooling systems, all of which would be required for safe shutdown of the reactor. The areas also contain valves and electrical cable associated with the low pressure injection system which is not essential for safe shutdown.

5.14.2 Combustibles

The significant combustible material in these two areas is the electrical insulation on cables in trays.

5.14.3 Consequences If No Suppression

An unsuppressed fire in the west area could affect power cables to both redundant high pressure injection pumps and the high pressure makeup pump, preventing safe reactor cooldown. The valves and other electrical cable in this area are associated with a single channel, damage to which would not prevent safe shutdown due to the availability of the redundant channel. However, certain valves on the decay heat removal and nuclear service cooling water systems may have to be manually operated in the fire area to utilize the redundant system.

An unsuppressed fire in the east area could cause loss of both a high pressure injection pump and the high pressure makeup pump. The makeup pump serves as a standby injection pump when either of the redundant injection pumps is out of service; therefore, a fire at such a time could cause loss of all high pressure injection capability. A fire in this area would also effect electrical control to valves on the decay heat removal and nuclear service cooling water systems on one channel only.

5.14.4 Fire Protection Systems

Automatic smoke detectors are provided in both containment penetration valve areas. Ceiling level automatic sprinklers are provided over electrical cable trays which are four tiers in height in one room of the east area. Manual fire suppression equipment is provided in the form of a hose station and carbon dioxide extinguishers.

5.14.5 Adequacy of Fire Protection

Ceiling level automatic sprinklers and manual fire suppression may not be sufficient to prevent a fire from involving electrical cable trays on redundant systems required for safe shutdown.

5.14.6 Modifications and Recommendations

The licensee proposes to provide additional separation and/or fire barriers to prevent involvement of redundant cables in the high pressure injection and decay heat removal systems (see Section 4.10).

We find that, subject to implementation of the above described modifications, the fire protection for these areas satisfies the objectives of Section 2.1 of this report and is, therefore, acceptable.

5.15 Makeup Pump Room

5.15.1 Safety-Related Equipment

Safe shutdown equipment in this room includes cabling associated with high pressure injection pump "B", redundant nuclear service raw water piping, and valves and other piping of one safety division, and valves and associated cabling from both safety divisions. The makeup pump, its lube oil pump, and room cooler are also located in this area. When operating with high pressure injection pump "A" out of service, the makeup pump serves as the "A" high pressure injection pump.

5.15.2 Combustibles

The significant combustibles in this room are 76 gallons of lube oil and a small amount of cabling.

5.15.3 Consequences If No Suppression

A postulated unsuppressed fire in this area may cause loss of redundant nuclear service raw water, which is required for safe shutdown. These systems may be lost due to potential fire damage to silver soldered copper piping.

A postulated unsuppressed fire in this room when operating with high pressure injection pump "A" out of service may cause loss of function of high pressure injection pump "B" and the makeup pump, and thus loss of all high pressure injection capability.

5.15.4 Fire Protection Systems

There are no automatic suppression or detection systems provided in this area. No hose station within reach of this area is provided. Portable extinguishers nearby the area are available.

5.15.5 Adequacy of Fire Protection

The fire protection provided would not be adequate to assure prompt detection and suppression of fires, or to prevent loss of function of redundant safe shutdown systems.

5.15.6 Modifications and Recommendations

The licensee has proposed to:

(1) Install an additional hose station with 100 feet of hose to provide coverage of this area;

(2) Insulate silver soldered copper pipe with calcium silicate insulation with stainless steel jacket with a thickness adequate for the fire severity in the areas; and

(3) Reroute, install fire barriers, or insulate conduit associated with high pressure injection system to prevent loss of both makeup pump and the division "B" high pressure injection pump.

(4) Install a wet pipe sprinkler system in this area.

(5) Install smoke detection devices in all safety-related areas, as discussed in Section 4.2 of this report.

We find that, subject to implementation of the above described modifications, fire protection for the makeup pump room satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.16 Reactor Building

5.16.1 Safety-Related Equipment

Safety-related equipment in the reactor building, which may be required for safe shutdown, includes the reactor vessel and steam generators, piping, safety valves, instrumentation, isolation valves, and associated cabling.

5.16.2 Combustibles

Significant combustibles in the reactor building include 190 gallons of lube oil in each of four reactor coolant pumps, charcoal in filter units, and a moderate amount of electrical cable insulation.

5.16.3 Consequences If No Suppression

A postulated unsuppressed lube oil fire would not affect safe shutdown capability due to the oil catch system.

Postulated cable insulation fires, if contained within a fire zone, will not affect redundant safe shutdown equipment although a fire may cause loss of function of Class II instrumentation required for safe shutdown. If Class II instrumentation required for safe shutdown is in any of the fire zones, modifications will be made as discussed in Section 4.1 of this report to assure that required functions are not lost. See Section 5.16.6 for modifications to assure that a fire is contained with a fire zone.

An unsuppressed charcoal filter fire will not significantly affect reactor building air temperature or pressure, and will not damage safe shutdown equipment.

5.16.4 Fire Protection Systems

Firestops are provided at approximately twenty-foot intervals in vertical runs of cabling. A steel oil catch basin is provided on each of the reactor coolant pumps to contain oil leakage or spill. Infra-red type detectors are located in the area of each reactor coolant pump. Ionization type smoke detectors are provided over electrical cabling runs and the electrical penetration area.

5.16.5 Adequacy of Fire Protection

Detection devices would promptly detect reactor building fires. Portable fire extinguishers would not be adequate to suppress all reactor building fires.

5.16.6 Modifications and Recommendations

The licensee has proposed to provide fire barriers to prevent fire from being transmitted from one fire zone to another (see Section 4.10). The licensee has been requested to provide the bases for determining that a fire will be contained within fire areas in the reactor building and whether heat buildup and radiant energy effects were considered.

In addition, the licensee has agreed to provide hoses and equipment within containment to fight fires using the miscellaneous water system.

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

5.17 Yard Area

5.17.1 Safety-Related Equipment

The yard area contains the redundant pumps for auxiliary feedwater and nuclear service cooling water, and the redundant bypass valves for emergency feedwater control. The electrical cables associated with this equipment also pass through the yard area with some underground and some in overhead racks.

The yard area also contains the redundant buried diesel fuel tanks and spray ponds for the ultimate heat sink.

5.17.2 Combustibles

The combustibles, which were considered because of their potential for exposure to safety-related systems, included oil-filled transformers, two underground diesel fuel storage tanks, an aboveground diesel fuel tank, and diesel fuel delivery trucks. There is also electrical insulation on cables associated with the auxiliary feedwater and nuclear service cooling water equipment, and hydrogen storage cylinders.

5.17.3 Consequences If No Suppression

In general, an unsuppressed fire in the yard area would not present a significant fire exposure to safety-related systems because of the intervening distance or barriers.

A small oil-filled transformer is located near the nuclear service cooling water pumps which could present a fire exposure to this safe shutdown equipment.

The fill connection for one underground diesel fuel tank is near the nuclear service cooling water pumps, and a fire involving a fuel delivery truck could damage the pumps.

An unsuppressed electrical cable tray fire could cause loss of remote control for both redundant valves in the emergency feedwater control valve bypass; however, the valves could be operated manually if necessary.

Fuel supply lines to the redundant diesel generators are in proximity to each other and could be damaged by a single fire incident.

5.17.4 Fire Protection Systems

The oil-filled transformers west of the turbine building are protected by automatic water spray systems. Yard hydrants, hose and portable foam nozzles are available for manual fire fighting in the yard area.

5.17.5 Adequacy of Fire Protection

The automatic water spray systems on the oil-filled transformers should confine fire damage to one transformer and prevent direct damage to safety-related systems. Manual suppression should be adequate to control other fires in the yard area.

5.17.6 Modifications and Recommendations

The licensee proposes to make the following changes in the yard area: (1) relocate the fill connections on the diesel fuel tank so that a fire at a delivery truck will not expose safety-related systems, (2) replace the small oil-filled transformer exposing the nuclear service cooling water pumps with a dry-type transformer, (3) reroute one of the diesel generator

fuel lines underground to reduce the potential for loss of both diesel generators from a single fire, (4) reroute or shield the electrical cables to the auxiliary feedwater system valves to prevent fire damage to the redundant cables, and (5) install a curb valve on the lateral for fire hydrant No. 3.

We find that, subject to implementation of the above described modifications, fire protection in the yard area satisfies the objectives detailed in Section 2.1 of this report, and is, therefore, acceptable.

5.18 Turbine Building

5.18.1 Safety-Related Equipment

Safety-related equipment which may be required for safe shutdown, includes auxiliary feedwater pump autostart interlock switches with the main feedwater pumps, cooling water piping for diesel generator "A", and the 4160 to 480 volt station service transformers.

5.18.2 Combustibles

Significant combustibles in the turbine building include: lube oil in the main feedwater pumps, turbine, and turbine lube oil piping, main and auxiliary lube oil reservoir, new and used lube oil storage tanks; hydrogen piping; oil in the hydrogen seal oil unit; and electrical cable insulation.

5.18.3 Consequences If No Suppression

Postulated unsuppressed fires in the turbine building may cause loss of auxiliary feedwater pump autostart capability; however, the pumps could still be started manually by the operator from the control room to maintain steam generator inventory. Loss of cooling capability to diesel generator "A" would not affect safe shutdown capability since diesel generator "B" would continue to be available. Due to physical separation of service transformers from hazards, postulated unsuppressed turbine building fires would not affect the 4160 to 480 volt service transformers.

5.18.4 Fire Protection Systems

Automatic deluge type suppression systems are provided over major oil hazards in the turbine building. A wet pipe suppression system protects the west wall of the turbine building from a transformer fire in the yard area. A wet pipe sprinkler system provides area coverage over all areas below the turbine deck. Total flooding carbon dioxide systems are provided on the turbine generator exciter housing and low pressure bearing housing, and local application carbon dioxide systems are provided on the high pressure bearing enclosures. The pressurized sections of the turbine lube oil piping are protected with a guard pipe around the primary pipe to contain oil leaks. Portable extinguishers and manual hose stations are provided throughout the turbine building.

5.18.5 Adequacy of Fire Protection

Since the major sources of combustibles are protected with automatic suppression systems and because fires in the turbine building would not prevent safe shutdown of the plant, we conclude that the fire protection for the turbine building satisfies the objectives identified in Section 2.1 of this report and is, therefore, acceptable.

5.18.6 Modifications and Recommendations

The licensee has proposed to add pressure sensing alarms in hydrogen piping to assure prompt detection of hydrogen leaks so hydrogen may be isolated. We find this modification acceptable.

6.0 ADMINISTRATIVE CONTROLS

6.1 General

The administrative controls for fire protection consist of the fire protection organization, the fire brigade's training, the controls over combustibles and ignition sources, the prefire plans and procedures for fighting fires, and the quality assurance provisions for fire protection. The licensee has provided a description of the elements of his administrative controls for fire protection, as detailed in the following sections. By letter dated December 8, 1977, the licensee submitted a response to staff comments, and provided additional information by letter dated February 1, 1978. Various improvements needed in his administrative controls are also detailed in the following sections.

6.2 Organization

The licensee's present fire protection organization description contains: (1) the composition of the Fire Brigade; and (2) the functional responsibilities and the lines of communication between almost all positions involved in the fire protection program.

The licensee has proposed a fire brigade of at least three members to be maintained onsite at all times. This excludes two members of the minimum shift crew necessary for safe shutdown of the plant and personnel required for other essential functions during a fire emergency. In order to achieve expeditious implementation of the fire protection Technical Specifications, Specification 6.2.2.f was issued on February 14, 1978 with the minimum number of onsite fire brigade members specified as 3 as the licensee proposed. This number is less than the minimum number given in the generic staff position, Minimum Fire Brigade Shift Size, which was an attachment to the Safety Evaluation Report issued with the NRC's letter to SMUD dated November 25, 1977. However, we are presently evaluating the licensee's justification for this smaller brigade size and when the evaluation is completed, the minimum number will be increased if we do not agree with the licensee's position.

The fire protection organization contains positions extending from the Assistant General Manager, Chief Engineer down to the Plant Superintendent and the Safety Technician. These management and staff positions are responsible for formulation, implementation, and assessment of the fire protection program. The organizational responsibilities are delineated for design, selection, installation, testing, maintenance, modification, and review of fire protection systems and for fire brigade training. Qualification requirements have been established for the training instructors, and the positions responsible for formulating and implementing the fire protection program.

We find the fire protection organization acceptable, except that: (1) the fire brigade requirements do not require periodic physical examinations to perform strenuous activity; and (2) the fire brigade composition and size, as previously stated, is under review. We are presently evaluating the licensee's proposal for physical qualification of fire brigade members. We will take any necessary action regarding items (1) and (2) upon completion of our evaluation of the licensee's justification. The licensee will revise their procedures for contractor indoctrination and the handling of accidental events such as leaks and spills. These revisions are scheduled for completion in June 1978.

Subject to implementation of the above described matters, the fire protection organization conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable. We will address the acceptability of measures to implement the above in a supplement to this report.

6.3 Fire Brigade Training

The fire brigade training program consists of classroom instructions, fire drills, practice in fire fighting and proposed training program revisions scheduled for implementation in June 1978 to assure compliance with NRC's training requirements.

The fire brigade training program contains the following essential elements: use of fire fighting equipment, fire fighting principles and techniques, use of fire fighting procedures, periodic practices in actual fire fighting and periodic fire drills to assess brigade effectiveness. These drills also provide practice in the use of equipment, fire fighting procedures, and brigade leadership. Records of fire brigade members training and drills are maintained and available for review.

We find that the fire brigade training program conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

6.4 Control of Combustibles

The controls currently in effect and those under development minimize the amount of combustibles that a safety-related area may be exposed to.

These controls limit the use and storage of combustibles in safety-related areas; establish work controls and required additional fire protection where transient fire loads are introduced; assure the removal of waste, debris, and scrap materials following work activities; and provide for periodic housekeeping inspections.

All work requests involving plant equipment or systems are reviewed by the individual department supervisors and cognizant Shift Supervisors who authorize the work to be performed, and not by the Safety Technician. The Shift Supervisor may consult the Safety Technician. Work requests involving plant systems in safety-related areas are reviewed for fire protection impact by the Safety Technician or a Shift Supervisor who is equally qualified in these matters. This review should assure the incorporation of proper fire protection provisions, such as the control of ignition sources and combustibles and provisions for additional fire suppression capability if appropriate.

We find that the control of combustibles conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

6.5 Control of Ignition Sources

The control of ignition sources minimizes the potential for fire resulting from work involving ignition sources such as welding, cutting, grinding, and open flame work or smoking. The controls on ignition sources require: use of a work permit authorized by a qualified individual prior to performing cutting, welding, grinding, or other flame work; removal of moveable combustible material; use of trained and equipped fire watches; provisions for protection by curtains or covers when cutting, welding, grinding, or other flame work; and restrictions on smoking in safety-related areas. Use of open flames or combustion generated smoke for leak detection has been prohibited.

We find that the control of ignition sources conforms to the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

6.6 Fire Fighting Procedures

The licensee has provided a description of the current fire fighting procedure and the procedural elements to be changed in the near future. The fire fighting procedures identify the actions to be taken by the individual discovering the fire, action to be taken by the control room operators, and the fire brigade actions.

fighting fires in all safety-related areas and areas presenting a hazard to safety-related equipment. These strategies will identify for each area the combustibles, methods of fighting fires in various areas, access and egress routes and their identification, designation of vital heat sensitive components and equipment, system and equipment location, identification of toxic hazards in fire zones, ventilation and smoke removal equipment operations. The validity of the pre-planning strategies will be tested by appropriate full-dress drills to check the logic of the strategy, the adequacy of the equipment, personnel understanding and to uncover unforeseen problems.

We find that the licensee's provisions for fire fighting procedures are acceptable.

6.7 Quality Assurance

The licensee has elected to meet NRC's fire protection QA criteria by applying their existing QA program under 10 CFR Part 50, Appendix B, to fire protection. This QA program was approved March 15, 1974 and should adequately cover the quality assurance provisions for fire protection in safety-related areas such as the control of the design, procurement, installation, testing and maintenance of fire protection equipment. These provisions include fire protection requirements; establishment of procedures to implement the fire protection program; evaluation of potential suppliers and inspection of equipment on receipt; inspection and testing of fire protection equipment following maintenance and modification; installation and periodic inspection of penetration seals and fire retardant coatings; periodic testing of fire protection equipment; identification and evaluation of nonconforming fire protection equipment; corrective action for failures, deviations, and defective materials; records of fire protection activities; and audits to verify proper implementation of the fire protection program.

We find that the licensee's commitment to implement NRC's fire protection QA criteria as part of their existing approved QA program under 10 CFR Part 50, Appendix B, conforms to the guidelines of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

7.0 TECHNICAL SPECIFICATIONS

The Technical Specifications have been modified to incorporate interim Technical Specifications which include limiting conditions for operation and surveillance requirements for existing fire protection systems and administrative controls. Following the implementation of the modifications of fire protection systems and administrative controls resulting from this review, the Technical Specifications will be similarly modified to incorporate the limiting conditions for operation and surveillance requirements for these modifications.

8.0 CONCLUSIONS

The licensee has performed a fire hazards analysis and has proposed certain modifications to improve the fire protection program. Additional modifications have been proposed by the licensee during the course of our review, which are based upon the fire hazards analysis and our onsite evaluation of the fire protection program. These proposed modifications are summarized in Section 3.1. In addition, we have concluded that the licensee should implement certain evaluations or improvements related to the fire protection program. These are summarized in Section 3.2. Significant steps are being taken to provide additional assurance that safe shutdown can be accomplished and the plant can be maintained in a safe condition during and following potential fire situations. Additional evaluation of incomplete items, discussed in the preceding sections, will be necessary before we can conclude that the overall fire protection at the Rancho Seco facility will satisfy the provisions of BTP 9.5-1 and Appendix A thereto, which the Staff has established for satisfactory long-term fire protection.

We find that the licensee's proposed modifications described herein are acceptable both with respect to the improvements in the fire protection program that they provide and with respect to continued safe operation of the facility, while the remaining items are completed. In the report of the Special Review Group of the Browns Ferry Fire (NUREG-0050) dated February 1976, consideration of the safety of operation of all operating nuclear power plants pending the completion of our detailed fire protection evaluation was presented. The following quotations from the report summarize the basis for our conclusion that the operation of the facility, pending resolution of the incomplete items and the implementation of all facility modifications, does not present an undue risk to the health and safety of the public.

"A probability assessment of public safety or risk in quantitative terms is given in the Reactor Safety Study (WASH-1400). As the result of the calculation based on the Browns Ferry fire, the study concludes that the potential for a significant release of radioactivity from such a fire is about 20% of that calculated from all other causes analyzed. This indicates that predicted potential accident risks from all causes were not greatly affected by consideration of the Browns Ferry fire. This is one of the reasons that urgent action in regard to reducing risks due to potential fires is not required. The study (WASH-1400) also points out that 'rather straightforward measures, such as may already exist at other nuclear plants, can significantly reduce the likelihood of a potential core melt accident that might result from a large fire.'

"Fires occur rather frequently; however, fires involving equipment unavailability comparable to the Browns Ferry fire are quite infrequent (see Section 3.3 of [NUREG-0050]). The Review Group believes that steps already taken since March 1975 (see Section 3.3.2) have reduced this frequency significantly.

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

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

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

9.0 CONSULTANTS REPORT

Under contract to Nuclear Regulatory Commission, Brookhaven National Laboratory has provided the services of fire protection consultants who participated in the evaluation of the licensee's fire protection program and in the preparation of this report. Their report, Fire Protection in Operating Nuclear Power Stations - Rancho Seco Nuclear Generating Station, Unit 1, (letter R. E. Hall to R. L. Ferguson dated February 14, 1978), discusses several matters which have been addressed in this report. Those elements of the consultants recommendations which we have not adopted are identified in Appendix B along with our bases therefor.

Dated: February 28, 1978

APPENDIX A

CHRONOLOGY

In February 1976 the report by the NRC Special Review Group was issued as NUREG-0050, "Recommendations Related to the Browns Ferry Fire."

On May 1, 1976, Standard Reveiw Plan 9.5.1 "Fire Protection" was issued, incorporating the various recommendations contained in NUREG-0050.

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

By letters of September 30, 1976, Sacramento Municipal Utility District was requested to provide the results of a fire hazards analysis and propose Technical Specifications pertaining to fire protection. SMUD was also provided a copy of Appendix A which includes acceptable alternatives to the guidelines of SRP 9.5.1.

By letter of December 7 and 14, 1976, we provided model Technical Specifications and requested submittal of fire protection Technical Specifications.

On August 31, 1976, SMUD provided a submittal responding to our request of May 11.

On October 19-22, 1976, the DOR fire protection review team visited the Rancho Seco facility.

On November 16, 1976, SMUD submitted responses to questions raised during the site visit.

On January 10, 1977, SMUD submitted interim Technical Specifications.

On February 1, 1977, we submitted requests for additional information to SMUD.

On April 15, 1977, we submitted staff positions to SMUD.

On June 16, 1977, we submitted changes in interim Technical Specifications to SMUD.

On August 1, 1977, SMUD submitted their Fire Hazards Analysis, response to staff positions, and interim Technical Specifications.

On November 25, 1977, we submitted a 20-day letter regarding interim Technical Specifications to SMUD.

On December 8, 1977, SMUD submitted their response to administrative controls positions.

On December 16, 1977, SMUD submitted their response to the 20-day letter.

On January 18, 1978, we submitted requests for additional information to SMUD.

On February 1, 1978, SMUD responded to our requests of January 18, 1978.

APPENDIX B

CONSULTANT'S EXCEPTIONS

1. Consultant's Comment: Damage Limits

SER Item 8.0 (2) concludes that fire detection and suppression will minimize the effects of fire on safety-related systems. The consultant does not concur in this conclusion. There are usually several protective approaches that can be utilized for a given fire hazard, with each approach offering certain advantages and disadvantages in terms of limiting the fire extent, damage due to the fire suppression agents employed, system reliability, and cost-effectiveness. In most cases, it is technically possible to reduce the damage potential to a very low level, but cost penalties often become severe. The fire protection systems that are being provided and recommended are to assure safe shutdown capability and will not necessarily minimize fire damage to all safety-related systems.

Staff Response:

We agree with the consultants' comments and realize that additional steps could always be taken to reduce physical damage to structure systems and components important to safety. In Appendix A to BTP 9.5-1 the term minimize, as found in GDC3 means fire protection systems that are being provided and recommended are to assure safe shutdown capability and will not necessarily reduce physical damage to all safety related systems.

2. Consultant's Comment: Turbine Building

SER Item 5-18 concludes that fire protection in the turbine building is acceptable. However, the licensee's fire hazard analysis does not adequately address the consequences of an unsuppressed lube oil fire in the turbine building (see October 24, 1977 letter from L. P. Herman to R. E. Hall on this subject).

Staff Response:

The staff has evaluated the safe shutdown systems that would be affected in this area of the plant as in all other areas. One of the diesel generators could be lost due to affected cooling water piping. This would not affect safe shutdown. The purpose of considering an unsuppressed fire is to determine the measures of fire protection to be provided to protect safe shutdown capability. In the case of the turbine building, it was determined that all the major oil hazards are protected by automatic deluge type suppression systems. Wet pipe sprinkler systems protect the turbine building from outside transformer fires and all areas below the turbine deck. The pressurized sections of lube oil pipe are equipped with a guard pipe around the main piping and the sections of

the turbine generator exciter housing and bearing housing are equipped with total flooding CO_2 systems. The high pressure bearing enclosures are provided with local application CO_2 systems. The main generator frame has been designed to be explosion safe.

Rather than analyzing an unsuppressed turbine building fire, the evaluation considered the effects of a turbine building fire giving credit for existing suppression systems.

The staff feels that adequate protection is being provided in the turbine building and that further analysis will not provide information which will alter our conclusions or the protection provided and therefore is not required.

3. Consultant's Comment: Seismic Damage

The SER does not consider the effect of seismic damage on primary and back-up fire protection systems, although Branch Technical Position 9.5-1 addresses this item for new plants. It is recommended that the potential that a seismic event could cause both a fire and damage to the protective features provided to cope with the fire be further evaluated. This should include fires started in non-seismically qualified systems or areas that spread to safety-related systems because protective systems are damaged.

Staff Response:

The guidelines of Appendix A to BTP 9.5-1 do not require seismic design criteria for fire protection systems. To the extent that our systematic evaluation program shows a need to look more thoroughly into overall seismic qualification for all plants we will do so. Seismic qualification of the fire protection system was not a part of this evaluation.

4. Consultant's Comment: Smoke Removal

SER Item 4.4.1 indicates that portable fans and ducts will be accepted as a means for removing smoke from many plant areas. Fires in electrical insulation can generate copious amounts of dense smoke which hamper fire control efforts by rendering the atmosphere toxic and reducing visibility in the area. Properly used, self-contained breathing apparatus can minimize the problem of toxic atmosphere, but little can be done to improve visibility except to remove the smoke from the building.

Massive changes will be required in most areas of this plant if effective permanent smoke removal systems are required, the design of which would also have to include consideration of radioactivity releases. While portable fans and ducts may be effective for smoke control in many instances, there is concern that they will not be sufficient for a major fire in some areas of the plant. It is recommended that this item be held open until better guidelines are developed for the evaluation of smoke generation potential and smoke removal system design.

Staff Response:

Additional information and improved equipment would provide some benefit in the design and construction of fixed ventilation systems to be used for smoke removal in future plants. However, a massive plant redesign of current plant ventilation systems is not warranted because portable smoke removal equipment can be used in those plant areas with inadequate fixed-system smoke removal capability. Portable smoke removal units have been used in fire service for a sufficient length of time so that the limits on their use is well understood.

In plants where smoke removal is dependent on such equipment, smoke removal is not generally initiated until the room atmosphere is cooled sufficiently, by fixed sprinkler operation or manual hose fogging to permit entry by fire fighting personnel. Ventilation prior to this time serves no purpose but to add oxygen to active fire sites. The current temperature capability to remove smoke when the hot gases are cooled enough for fire brigade entry. The manual fire fighting consultants have made their evaluations of the fire fighting capabilities of a number of plants, and we have considered their recommendations in determining acceptable smoke removal means. We require the licensees to develop pre-fire plans which include the proper use of ventilation equipment in each plant area of concern.