FIRE PROTECTION

SAFETY EVALUATION REPORT

BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

U.S. NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF

DAIRYLAND POWER COOPERATIVE

LACROSSE BOILING WATER REACTOR

DOCKET NO. 50-409

Date: July 27, 1979

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1.0 INTRODUCTION

Following a fire at the Browns 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 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 Report for Nuclear Power Plants," NUREG-75/087, Section 9.5.1, "Fire Protection," May 1976, which includes "Guidelines for Fire Protection for Nuclear Power Plants" (BTP APCSB 9.5-1), May 1, 1976.

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

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

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

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

- "Manpower Requirements for Operating Reactors," May 11, 1978.

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

We have reviewed the licensee's analyses and have visited the plant to examine the relationship of safety-related components, systems and structures with both combustibles and the associated fire detection and suppression systems. Our review was based on the fire protection review team's site visit of October 31-November 2, 1978 and the licensee's proposed program for fire protection as described in the following docketed information:

(1) Application for Operating License, LAC8WR.

(2) "Fire Hazards Analysis of the LaCrosse Boiling Water Reactor," docketed February 14, 1977.

(3) Licensee responses to requests for additional information and staff position, by letters of October 18, 1978 and November 15, 1978.

Our review has been limited to the aspects of fire protection with the NRC's jurisdiction, i.e., those aspects related to the protection of public 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 Dairyland Power Cooperative's LaCrosse Boiling Water Reactor. The chronology of our evaluation is summarized in Appendix A of this report.

2.0 FIRE PROTECTION GUIDELINES

2.1 General Design Criterion 3 - "Fire Protection"

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

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

2.2 Supplementary Guidance

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

Appendix A provides guidance on the preferred and, where applicable, acceptable alternatives to fire protection design for those nuclear power plants for which applications for construction permits were docketed prior to July 1, 1976.

Although this appendix provides specific guidance, alternatives may be proposed by licensees. These alternatives are evaluated by the NRC staff on a case-by-case basis.

Additional guidance which provides clarification of fire protection matters has been provided by the NRC staff in the following documents:

> "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation," October 21, 1976.
>
> "Sample Technical Specifications," May 12, 1977.
>
> "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," June 14, 1977.

"Manpower Requirements for Operating Reactors," May 11, 1978.

When the actual configuration of combustibles, safety-related structures, systems or components, and the fire protection features are not as assumed in the development of Appendix A or when the licensee has proposed alternatives to the specific recommendations of Appendix A, we have evaluated such unique configurations and alternatives using the defense-in-depth objectives outlined below:

(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 materials if fires occur.

In our evaluation, we assure that these objectives are met for the actual relationship of combustibles, safety-related equipment and fire protection features of the facility.

Our goal is a suitable balance of the many methods to achieve these individual objectives; increased strength, redundancy, performance, or reliability of one of these methods can compensate in some measures for deficiencies in the others.

3.0 SUMMARY OF MODIFICATIONS, INCOMPLETE ITEMS AND REQUIREMENTS

3.1 Modifications

The licensee plans to make certain plant modifications to improve the fire protection program as a result of the licensee's and the staff's evaluation. The proposed modifications are summarized below. Further detail is provided in the licensee's submittals. The section of this report which discusses the modifications are noted in parentheses. The schedule for completion of all modifications is listed in Table 3.1.

Certain items listed below are marked with an asterisk (*) to indicate that the NRC staff requires additional information, in the form of design details to assure that the design is acceptable, prior to actual implementation of these modifications. The other modifications have been described in an acceptable level of detail.

3.1.1 Exterior Hose Houses (4.3.1.3)

(1) Two additional exterior hose houses will be provided on the yard fire loop, one accessible to the "B" diesel generator area and one accessible to the northwest entrance to the turbine building. Each exterior hose house will include the following equipment:

(a) sufficient lengths of 2½" hose to reach from the hydrant location to the building entrance,

(b) 200' - 1½" hose,

(c) 2 - 1½" fog nozzles with ball type shutoff valves,

(d) 2 - 2½" gate valves,

(e) 1 - 2½" x 1½" x 1½" gated wye,

(f) 1 - universal type hydrant wrench,

(g) 2 - 2½" hose spanners, universal type,

(h) 2 - 1½" hose spanners, universal type,

(i) 2 - 1½" coupling gaskets, and

(j) 2 - 2½" coupling gaskets.

In addition:

(2) Administrative control procedures will be established to provide for the clearing and removal of snow in the area of the exterior hose houses to ensure accessibility.

(3) Administrative control procedures will be established to provide a semiannual inspection (Fall and Spring) of exterior hydrants to ensure the barrel is dry and that the threads are properly lubricated.

(4) Administrative control procedures will be established to provide a monthly inspection of each hose house to ensure that the fire fighting equipment is in good working condition and properly stored.

(5) Administrative control procedures will be established to provide annual hydrostatic testing of hose stored in exterior hydrant hose houses.

3.1.2 Fire Fighting Equipment (4.4.3, 4.3.1.4, 4.3.1.5)

The equipment listed below will be added to the existing inventory of manual fire fighting equipment. This equipment will be stored in a central location and be readily accessible to the brigade at all times.

(1) One fire fighting type, explosion proof, smoke ejector rated for 5000 CFM.

(2) Protective clothing (coats, boots, gloves and fire fighters helmet) for a minimum of eight men.

(3) Two double female adaptors - 2½".

(4) Six automatic sprinkler stopper wedges.

(5) Six spare sprinkler heads.

(6) One sprinkler head wrench.

(7) Spare hose gaskets.

(8) One spare hose nozzle 1½".

3.1.3 Interior Hose Stations (4.3.1.4)*

(1) Hose reach tests will be performed and additional hose stations provided as necessary to assure that all points in safety-related areas (including those areas protected by automatic suppression systems) and other plant areas which contain major fire hazards, can be effectively reached by at least one hose stream.

(2) Tests and/or calculations will be performed that will confirm that the (flowing) pressure at each fire hose station outlet is greater than or equal to 65 psig at 100 gpm flow rate.

(3) Administrative controls will be established to prevent access to manual fire fighting equipment from being restricted by temporary storage of materials within the plant.

(4) 1½-inch diameter 100% polyester, single jacketed, lined, FM or UL listed fire hose factory test rated at not less than 300 psig, will be provided for those hose stations which protect safety-related systems and components.

3.1.4 Fixed Suppression Systems (4.3.1.5, 5.2.6, 5.3.6, 5.4.6, 5.6.6)*

(1) The automatic sprinkler system protecting the turbine oil reservoir will be extended to also protect the associated piping.

(2) An automatic water fire suppression system, or an oil shield and collection system, will be provided to protect or prevent an oil fire at the reactor coolant recirculation pumps.

(3) An automatic fire suppression system will be provided to protect the "A" diesel-generator room.

(4) A fixed dry pipe sprinkler system capable of quick connection to a manual hose will be provided at the exterior side of the cable penetration of containment.

** (5) An automatic water fire suppression system will be provided to protect against a fire at outside transformers.

3.1.5 Heat Detector Circuit Supervision (4.3.2)*

The circuits of heat detectors which actuate the carbon dioxide suppression system protecting the "B" diesel-generator room will be electrically supervised for power failure, ground faults or circuit breaks to alarm and annunciate in the control room these abnormal conditions.

3.1.6 Breathing Air (4.4.3)*

A 6-hour onsite breathing air reserve will be provided for each of the existing eight breathing units based on 20 minutes of air per bottles. Two spare bottles will be provided for each unit.

3.1.7 Diesel Oil Shutoff (5.3.6)

Capability to shut off oil transfer to "A" diesel day tank from outside the room will be provided.

** As a result of our evaluation, we identified these additional modifications that we deem necessary to improve the fire protection program. They were discussed with the licensee during the meeting at the site on June 7, 1979. At this meeting and the subsequent telephone conversations the licensee agreed to provide these modifications.

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3.1.8 Flame Retardant Coating (4.8)

The licensee will spot check the thickness of the flame retardant coating on the cables in each safety-related area, where such coating is applied, and repair as necessary, to ensure that the coating thickness is in accordance with the manufacturer's specification.

3.1.9** Piping Penetration Seal (4.9.4)

The licensee will close all unsealed pipe penetrations with a noncombustible material to provide fire resistance required of the barriers.

3.1.10 Emergency Lighting (4.6)

Fixed, sealed beam, 8-hour rated battery powered emergency lights will be provided in all safety-related areas, and their access and egress, to facilitate emergency shutdown operation and fire fighting.

3.1.11 Hydrogen Detectors (4.4.4)

A hydrogen detector has been installed in the electrical equipment room and in the "B" diesel room, which contain the station batteries, to alarm in the control room an excessive hydrogen concentration.

3.1.12 Exposed Steel Protection (5.3.6)

Three-hour protection will be provided for the exposed steel structure supporting the ceiling of the machine shop.

3.1.13 Protection of Service Water Piping (5.2.6)

The licensee has provided protection for the service water pipes and their supports in the oil storage room against a fire in the room.

3.1.14 Neutron Shields (5.6.6)*

Polyethylene neutron shield blocks around the control rod drive system below the reactor will be replaced with those of noncombustible material.

3.1.15 Diesel Tank Filler Cap (4.3.1.2, 5.9.6)

A locking filler cap has been provided for each of the diesel-driven high pressure service water pump fuel oil storage tanks.

3.1.16** Relocation of Cascade System (4.4.3)

The licensee will relocate the cascade system, which is currently located in the southeast corner of the turbine building basement, to an area where a fire in the area will not require its use.

3.1.17** Fire Door Replacement (4.9.1)

The licensee will replace the 1-1/2-hour rated fire doors from the "A" diesel room to the machine shop and from the machine shop to the penetration room with 3-hour rated fire doors.

3.1.18** Fire Door Supervision (4.9.1)

All fire doors in the plant, except the two doors discussed in Section 4.9.1 of this report, will either be locked closed or electrically supervised to provide a time delayed alarm in a constantly occupied area.

3.1.19** Fire Dampers (4.9.3)

The ventilation duct penetrations of fire barriers between the instrument repair shop and the electrical equipment room will be protected by fusible link actuated fire dampers with appropriate fire resistance rating.

3.1.20** Unrated Barrier (4.11, 5.3.6)*

The licensee will upgrade the unrated barrier between the "A" diesel room and the machine shop to provide the fire resistance commensurate with hazards on both sides of the barrier.

3.1.21** Relocation of Chemicals (5.2.6)

Miscellaneous chemicals stored in the flammable liquid storage cabinets in the oil storage room will be relocated.

3.1.22** Protection for the Electrical Equipment and the Control Rooms (5.7.6)*

The licensee will

(1) relocate record file cabinets stored in the electrical equipment room out of safety-related areas,

(2) provide an automatic suppression for the electrical equipment room, and

(3) provide additional protection, such as enclosure, coating, or automatic suppression for cables in the concealed space above the control room.

3.1.23** Interior Hoses (4.3.1.4)

The length of the hose at all interior hose stations will be limited to 75 feet maximum. The 3/4-inch hoses and nozzles inside the containment have been replaced by 1½-inch, UL or FM listed fire hoses and nozzles.

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3.1.24** Fire Hazard in the Waste Handling Building (5.8.6)*

The licensee will provide the results of an analysis which demonstrate that a fire in the waste handling building, including the off-gas system, will not cause the release of a significant amount of radioactive materials.

3.1.25** Gas Suppression System Actuation (4.3.2)*

The licensee will (1) provide the actuation power for the carbon dioxide system that protects the "B" diesel room from the essential service bus which derives the onsite backup power from the "A" diesel generator, and (2) modify the emergency manual release of the carbon dioxide system to conform to the provisions of NFPA 12-1977, Section 1-8.3.5.

3.1.26** Drains and Curbs (4.5, 5.1.6, 5.2.6, 5.3.6, 5.5.6)

Curbs will be added or upgraded in the following areas to contain the entire content of oil in each area plus additional 10% capacity for fire water:

(1) The turbine oil reservoir
(2) "A" diesel room
(3) "B" diesel room

The licensee will also provide an opening at the floor level of the oil storage room which will drain a possible oil accumulation in the room toward the yard area.

3.1.27** Combined Water Demand (4.3.1.3)*

The licensee will provide the results of an analysis to demonstrate that the combined water demand for fire fighting and for safety-related functions can be satisfied under any fire emergency or accident.

3.1.28** Cable Penetration Seal (4.9.3)

The licensee will modify the existing electrical cable penetration seal to a design with established adequate fire resistance.

3.1.29** Signaling System (4.2)*

The licensee will:

(1) Test the sprinkler system water flow alarm at 2-month intervals.

(2) Perform sprinkler system drain tests following operation of system control valves.

(3) Install a timer for each detector zone to provide warning when a detector zone has been bypassed for a certain period of time.

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 incomplete items. The sections of this report which discuss these incomplete items are noted in parentheses. We will address the resolution of incomplete items in a supplement to this report. The schedule for the completion of the licensee action on these incomplete items is given in Table 3.2. This schedule will permit any additional modifications, such as may be required, to be implemented on a schedule which is consistent with that noted in Section 3.1 of this report.

3.2.1 Safe Shutdown Analysis (4.1)

The licensee will provide an analysis to demonstrate that the safe shutdown capability exists independent of cabling and equipment in any one fire area or to verify the effectiveness of the barriers, spatial separation, tray covers and/or fire stops in preventing simultaneous damage to redundant safety systems required for safe shutdown from a possible exposure fire involving the fixed combustibles in the area and a reasonable amount of transient combustible materials, which may be in the area for routine plant operations and maintenace. In addition to damage resulting from elevated temperatures, the analysis will consider the effects of:

(1) Smoke and heat propagation via open stairways and hatches, and unrated penetrations in barriers.

(2) Water spray damage from fire hose streams.

(3) Simultaneous fire and loss of offsite power.

** The licensee will propose, at the completion of the safe shutdown analysis, modifications to assure that the plant's shutdown capability will meet the following criteria:

(1) Following any fire, the plant can be brought to hot shutdown conditions using equipment and systems that are free of fire damage.

(2) The plant should be capable of maintaining hot shutdown conditions for an extended time period significantly longer than 72 hours.

(3) Fire damage to systems necessary to achieve and maintain cold shutdown conditions should be limited so that repairs can be made and cold shutdown conditions achieved within 72 hours.

(4) Repair procedures for cold shutdown systems should be prepared now and material needed for such repairs should be on the site.

(5) The hot shutdown condition must be achievable with power from the offsite power system, and upon its loss, with power from the onsite

power system. A dedicated power supply may be substituted for the onsite power systems.

(6) The power needed to achieve the cold shutdown condition may be obtained from any one of the offsite power, onsite power, and dedicated power systems.

(7) When these minimum systems are provided, their adequacy shall be verified by a thorough evaluation of:

(a) Systems required for hot shutdown;
(b) Systems required for cold shutdown;
(c) Fire damage to power distribution systems; and
(d) Interactions caused by fire damage to power and water supply systems and to supporting systems, i.e., component cooling water supply.

3.2.2 Fire Water System (4.3.1.2, 4.3.1.3)

The licensee will provide the results of a study of the arrangement of fire pumps and the yard main piping which will assure that a sufficient number of pumps are available to meet the fire water demand at all times taking into account the possibility of a fire involving both diesel driven fire pumps, failure of a fire pump, or failure of a section of the fire water piping system. The study will include the consideration for (1) separate pump feeds to the yard main, (2) additional sectional valves, and (3) interconnection with the fire water system at adjacent fossil units.

3.2.3 Fire Pump Performance

The licensee will provide the results of a full-range fire pump flow test for the electric water driven fire (HPSW) pump and each diesel engine driven fire (HPSW) pump. Each test report will cover the range of pump discharge from shut off to 150% of rated capacity, with the associated discharge pressure.

3.2.4 Exposed Structural Steel in Turbine Building (4.11)

The licensee will provide the results of an analysis of a fire in the turbine building damaging exposed structural steel and the safety consequences of such damage.

3.2.5 Security Modification on Fire Doors (4.9.1)

The licensee has provided further documentation to demonstrate that the fire resistance rating of those fire door assemblies provided with physical security modification are not reduced by the modification. We are presently reviewing this information.

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3.2.6 In-Situ Detector Testing (4.2)

The licensee has provided a description and acceptance criteria for the in-situ tests of the fire detectors. This information is currently being reviewed.

3.2.7** Circuit Interaction Study (4.1)

The licensee will identify cables which, if exposed to a fire, have a potential of being damaged to produce an adverse effect on safe shutdown. Additional protection will be proposed for these cables to preserve the safe shutdown capability of the plant.

3.2.8** Fire Water Supply Reliability (4.3.1.2, 5.9.6)

The licensee is studying the feasibility of interconnecting the fire water system with that of Unit 3 to improve the reliability of the fire water supply. The diesel-driven fire pump and relevant portion of the fire water piping in Unit 3 will be included in the surveillance program of LaCrosse Boiling Water Reactor.

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TABLE 3.1

IMPLEMENTATION DATE FOR MODIFICATIONS

	ITEM	DATE
3.1.1	Exterior Hose Houses	8-1-80
3.1.2	Fire Fighting Equipment	7-31-79
3.1.3*	Interior Hose Stations	10-1-79
3.1.4	Fixed Suppression Systems	6-1-80
3.1.5*	Heat Detector Circuit Supervision	9-1-79
3.1.6*	Breathing Air	9-1-79
3.1.7	Diesel Oil ShutOff	10-1-79
3.1.8	Flame Retardant Coating	9-1-79
3.1.9	Piping Penetration Seal	10-1-79
3.1.10	Emergency Lighting	1-1-80
3.1.11	Hydrogen Detectors	Completed
3.1.12	Exposed Steel Protection	9-1-79
3.1.13*	Protection of Service Water Piping	Completed
3.1.14*	Neutron Shields	3-1-80
3.1.15	Diesel Tank Filler Cap	Completed
3.1.16	Relocation of Cascade System	9-1-79
3.1.17	Fire Door Replacement	12-1-79
3.1.18	Fire Door Supervision	12-1-79
3.1.19	Fire Dampers	12-1-79
3.1.20*	Unrated Barrier	12-1-79
3.1.21	Relocation of Chemicals	10-1-79
3.1.22*	Protection for the Electrical Equipment and the Control Rooms	12-1-79
3.1.23	Interior Hoses	10-1-79
3.1.24*	Fire Hazards in the Waste Handling Building	9-1-79
3.1.25*	Gas Suppression System Actuation	10-1-79
3.1.26	Drains and Curbs	10-1-79
3.1.27*	Combined Water Demand	10-1-79
3.1.28	Cable Penetration Seal	1-30-80
3.1.29*	Signaling System	3-1-80

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TABLE 3.2

COMPLETION SCHEDULE FOR IMCOMPLETE ITEMS

	ITEM	DATE
3.2.1	Safe Shutdown Analysis.....	Deferred to SEP
3.2.2	Fire Water System.....	9-1-79
3.2.3	Fire Pump Performance.....	9-1-79
3.2.4	Exposed Structural Steel in Turbine Building.....	10-1-79
3.2.5	Security Modification on Fire Doors.....	Completed
3.2.6	In-Situ Detector Testing.....	Completed
3.2.7	Circuit Interaction Study.....	9-1-79
3.2.8	Diesel Fire Pump Reliability.....	6-30-80

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4.0 EVALUATION OF PLANT FEATURES

4.1 Safe Shutdown Systems

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

(1) Reactivity Control

Shutdown of the reactor is normally accomplished by inserting control rods. The reactor can be scrammed automatically on abnormal operating conditions by the reactor protecting system or by the action of the operator in the control room. The control rod drive utilizes both the electric and the hydraulic drive systems. The hydraulic drive provides the high speed insertion required for the reactor scram while the electric drive provides backup to insert the control rods. Each control rod drive contains its own hydraulic accumulator which is constantly pressurized so that the reactor can be scrammed even if the electric power is not available.

In the event that one or more control rods failed to insert, the boron injection system provides an alternate means of reactivity control. The system is manually controlled from the control room to pump a boron solution into the reactor using high pressure core spray pumps.

(2) Reactor Cooling

In a normal plant shutdown, the main condenser is used to dissipate the decay heat generated in the reactor and the reactor coolant inventory is maintained by the feedwater system. During the initial stage of the normal shutdown, the decay heat is also dissipated through steaming to air ejectors and gland seals, and the seal injection and the purification flows also add coolant to the reactor.

Other means of cooling the reactor are available using safety-related systems. The shutdown condenser system and the high pressure core spray system have the capability to provide cooling following reactor shutdown at all decay heat levels, reactor water temperature and pressure while the decay heat cooling system and the alternate core spray system provide cooling at a reduced reactor pressure and temperature.

The shutdown condenser automatically functions when the reactor is isolated from the main condenser or if the reactor pressure exceeds 1,325 psig. It is a fail-safe system in that the loss of instrument air or electric power will cause the steam inlet valves, the condensate return valves and the shell side water supply valves to open. Cooling is provided by boiling off water in the shell side of the condenser. Water is supplied by the demineralized water system or, alternatively, by the high pressure service water system which also serves as the fire water system.

The shutdown condenser can cool the reactor down to about 300°F. To cool the reactor to a lower temperature, the decay heat cooling system is used. The decay heat is carried away from the reactor by the decay heat system and transferred to the component cooling water system which, in turn, rejects the heat to the service water system to be dissipated eventually to Mississippi River.

If the decay heat cooling system were unavailable, cooldown can be accomplished alternatively by using the alternate core spray system. Decay heat blowdown valves will be used to maintain the reactor water level in this application.

The high pressure core spray system provides backup to the shutdown condenser for cooling the reactor when the pressure is above 150 psig. Alternatively, the reactor can be depressurized and cooldown accomplished by using either the decay heat system or the alternate core spray system. When using the core spray systems for reactor cooling, it is necessary to control the reactor water inventory by periodically blowing down to the main condenser.

(3) Instrumentation

In addition to those instruments associated with the systems discussed above, the following instrumentation is needed for the safe shutdown:

- Neutron monitor
- Reactor level and pressure indication

(4) Plant auxiliary power sources are the two service transformers which are fed by either the offsite or the unit generated power. They provide 2,400-volt power to large plant loads as well as 480-volt buses A and B. Each 480-volt bus supplies one 480-volt essential service (ES) bus in addition to various motor control centers (MCC). Each ES bus has a diesel generator for a backup power supply. The two ES buses can be tied to each other by a common feed.

125-volt buses fed from station batteries provide the DC power source for various DC loads and to inverters which in turn supply power to 120-volt AC noninterruptible buses.

The original design and construction of LaCrosse Boiling Water Reactor did not include divisional redundancy for systems important to safety. Many systems required for shutdown and cooldown of the reactor, however, were provided with alternate means of fulfilling the safety-related function in the event that the system is unavailable. In subsequent backfits, the licensee has provided redundancy in certain functions.

The Fire Hazard Analysis of the LaCrosse Boiling Water Reactor, dated February 14, 1977 discussed how the reactor can be brought to a hot shutdown condition postulating a fire in any one plant area. The analysis, however, did not provide assurance that the plant can be brought to and maintained at a cold shutdown condition during and following a major fire in each fire area. Moreover, the analysis postulates a mechanistic loss of cables which could be damaged by the fire but did not address the possibility that cables could be damaged to produce undesirable actions which could have adverse effects on safe shutdown operations.

The licensee will provide an analysis to demonstrate that the safe shutdown capability exists independent of cabling and equipment in any one fire area or to verify the effectiveness of the barriers, spatial separation, tray covers and/or fire stops in preventing simultaneous damage to redundant safety systems required for safe shutdown from a possible exposure fire involving the fixed combustibles in the area and a reasonable amount of transient combustible materials, which may be in the area for routine plant operations and maintenance. In addition to damage resulting from elevated temperatures, the analysis will consider the effects of:

(1) Smoke and heat propagation via open stairways and hatches, and unrated penetrations in barriers.

(2) Water spray damage from fire water application.

(3) Simultaneous fire and loss of offsite power.

The licensee will propose, at the completion of the shutdown analysis, modifications to assure that the plant's shutdown capability will meet the following criteria:

(1) Following any fire, the plant can be brought to hot shutdown conditions using equipment and systems that are free of fire damage.

(2) The plant should be capable of maintaining hot shutdown conditions for an extended time period significantly longer than 72 hours.

(3) Fire damage to systems necessary to achieve and maintain cold shutdown conditions should be limited so that repairs can be made and cold shutdown conditions achieved within 72 hours.

(4) Repair procedures for cold shutdown systems should be prepared now and material needed for such repairs should be on the site.

(5) The hot shutdown condition must be achievable with power from the offsite power system, and upon its loss, with power from the onsite power system. A dedicated power supply may be substituted for the onsite power systems.

(6) The power needed to achieve the cold shutdown condition may be obtained from any one of the offsite power, onsite power, and dedicated power systems.

(7) When these minimum systems are provided, their adequacy shall be verified by a thorough evaluation of:

(a) Systems required for hot shutdown;

(b) Systems required for cold shutdown;

(c) Fire damage to power distribution systems; and

(d) Interactions caused by fire damage to power and water supply systems and to supporting systems, e.g., component cooling water supply.

The licensee will also conduct a study to identify critical cables which have a potential of producing adverse effects on safe shutdown if damaged. Additional protection for these cables will be proposed.

We will address the safe shutdown capability of the plant, during and following a fire, in a supplement to this report.

4.2 Fire Detection and Signaling Systems

The plant has a protective signaling system which transmits various fire alarm and supervisory signals to the control room. In addition to signals from smoke detectors located in selected areas in the plant, the system also transmits alarm and supervisory signals concerning diesel fire pump operation or impairment, fire main pressure, carbon dioxide system actuation or trouble, and water flow in the automatic sprinkler systems.

The signaling system is provided with backup power in the event of a loss of offsite power by a connection to the noninterruptible bus supplied by the 1B emergency diesel generator.

The signaling system does not comply with NFPA 72D in that tests of sprinkler waterflow alarm devices are performed at intervals greater than that permitted by NFPA 72D, sprinkler system drain tests are not made following system control valve operations, and the zone indicating units of the signaling system have been modified by the licensee in a manner that would permit loss of detection in part of the system without knowledge of the operators. A bypass switch has been installed into the circuit of each detector zone, with a neon light to indicate when the zone has been

bypassed. This arrangement could permit a zone to be bypassed indefinitely because the bypass indicating lights are not visible from the part of the control room which are normally occupied. The licensee agreed to test sprinkler system waterflow alarm at 2-month intervals and perform sprinkler system drain tests following operation of system control valves. The licensee will also install a timer for each detector zone to provide a warning when a detector zone has been bypassed for a certain period of time.

Smoke detectors have been provided in selected areas of the plant. Heat detectors have also been provided for actuation of a carbon dioxide extinguishing system. The licensee indicated that in-situ tests were conducted, using canned smoke, to verify the adequacy of the type, number, and distribution of detectors in each plant area. The procedure and acceptance criteria of the tests have been provided and are currently being reviewed.

Alarm, supervisory, and trouble signals are annunciated in the control room visually, and audibly by a common alarm bell which is distinctive from other plant system alarms. A local predischarge alarm is provided at the area where the carbon dioxide system is installed.

Smoke detectors at the air intakes to the turbine building are arranged to close the air intake dampers upon activation.

We find that, subject to implementation of the above described modifications, the fire detection and signaling systems satisfies the objectives identified in Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.3 Fire Control Systems

4.3.1 Water Systems

The fire protection water system is also the high pressure service water system (HPSW). In addition to supplying water for fire protection, the HPSW system supplies water for safety-related and nonsafety-related services as identified in Section 4.3.1.3. The schematic of the fire water piping system is shown in Figure 4.3.1.

4.3.1.1 Water Supply

The fire protection water supply for the plant is provided by the Mississippi River, which also serves as the ultimate heat sink. Water is channelled to the fire pumps in the crib house by a reinforced concrete flume.

We find that the water supply satisfies the objectives identified in Appendix A of BTP 9.5-1 and is, therefore, acceptable.

4.3.1.2 Fire Pumps

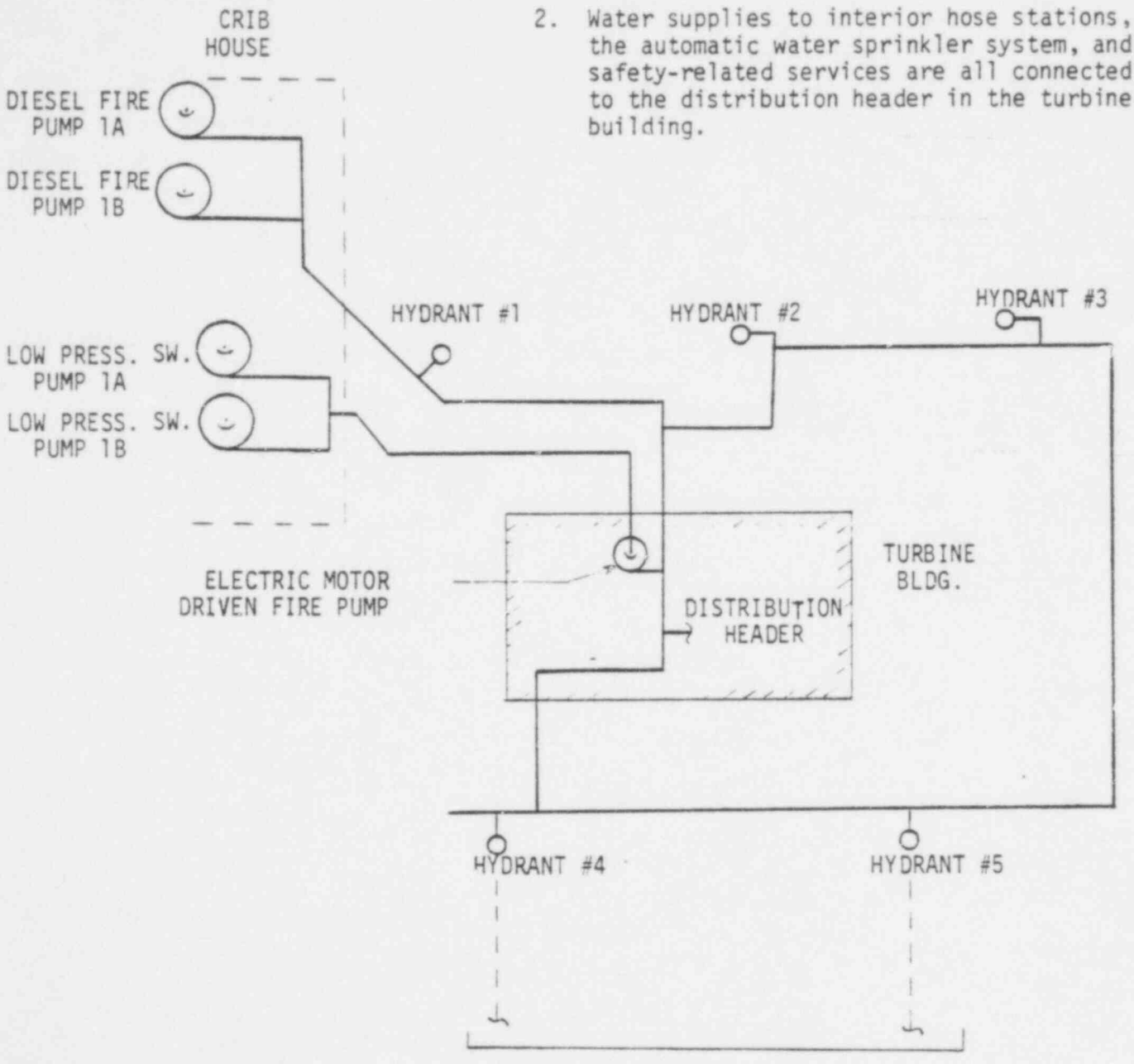
The water supply is developed by two diesel driven vertical shaft centrifugal fire pumps, each with a rated output of 750 gpm at 125 psig, and a motor

FIRE WATER PIPING SCHEMATIC

NOTE:

1. Fire pumps are also high pressure service water pumps; and

2. Water supplies to interior hose stations, the automatic water sprinkler system, and safety-related services are all connected to the distribution header in the turbine building.



POSSIBLE CONNECTIONS TO UNIT 3 (Fossil Plant)

FIG. 4.3.1

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driven horizontal shaft centrifugal booster pump with a rated output of 500 gpm at 65 psig. The diesel pumps, which take suction through suction lines from a common sump, are adjacent to each other in the crib house. The motor driven pump is on the grade floor of the turbine building and takes suction from the 16-inch low pressure service water main. The low pressure service water system is supplied by two redundant 3000 gpm at 145-foot head motor driven pumps in the crib house.

A UL listed automatic fire pump controller is located in the same area with each diesel fire pump. Each of these pumps can be manually started or stopped from the control room or at the individual controller. Pump running, driver nonavailability, and pump driver trouble signals are annunciated in the control room. Additional annunciation is provided at each fire pump controller. One diesel pump will start at a fire main pressure of 70 psig. The second diesel pump will start when the pressure drops to about 60 psig.

The electric motor driven pump operates automatically to keep fire main pressure between 80 and 120 psig. There is no automatic or manual fire pump controller for this pump, because it also supplies water for other purposes. See Section 4.3.1.3 of this report for discussion of these other purposes. It is controlled from a switch in the control room, and can be stopped at a breaker in the turbine building. All fire pump controls in the control room are located together on a single panel board, along with the controls for the low pressure service water pumps. Administrative controls require at least one diesel driven fire pump control to be in the "automatic" position at all times.

Power for the electric motor driven pump is supplied from the normal AC system. Each diesel engine driven fire pump is provided with a fuel tank containing enough fuel to operate the engine for at least 8 hours. The licensee has provided a locking filler cap to each tank to prevent a possible tampering. The fuel tanks are buried so that the bottom of the tank is approximately 6 feet below the fuel pump on the associated diesel engine. This arrangement is not permitted by the current edition of NFPA 20, although it was allowed by the code when the plant was built. In addition, fuel lines are not interconnected so that all engines may continue to operate even though one fuel tank may be out of service or empty. Interconnection of fuel supplies is now required by NFPA 20, although it was not required by the code when the plant was built. To improve the reliability and availability of fire water, the licensee is studying the feasibility of interconnecting the fire water system with that of Unit 3 (fossil fuel generating unit) of the plant and include the diesel fire pump and the relevant portion of fire water piping in the Unit 3 fire water system in the surveillance program.

The diesel fire pumps discharge into 6-inch diameter overhead lines in the crib house which parallel one another before joining together into a single 6-inch diameter line which supplies the 6-inch yard main.

The 6-inch overhead line inside the crib house also supplies the two 3-inch diameter lines for the traveling screen wash. Locked open valves are installed to isolate either pump discharge line, but there are several piping sections in which a break could not be isolated without causing the nonavailability of both diesel driven pumps. See Section 4.3.1.3 of this report for more details. The motor driven fire pump discharges into the 6-inch fire main in the turbine building.

Calculations indicate that the fire suppression water requirements for the largest sprinkler system plus 500 gpm for hose streams, will exceed the capacity of any one of the three existing fire pumps. The licensee is studying the situation to find an arrangement which will assure that a sufficient number of pumps are available at all times to meet the fire suppression system requirements for water. Arrangements suggested to the licensee include providing one of the diesel engine driven fire pumps with a separate connection to yard fire main loop independent of the existing 6-inch pipe from the crib house and providing an appropriate fire barrier to separate the diesel engine driven fire pumps from each other, or providing a permanent connection between LACBWR yard fire main loop and the adjacent fossil plant yard fire main loop and assuring that a reliable automatic fire pump with a rated capacity with at least 750 gpm at 125 psig is available at all times from the adjacent plant.

Recent fire pump test data did not cover the entire range of pump discharge from 0 to 150% of rated capacity. Without this information, the staff cannot complete its evaluation of the adequacy of fire pumps at the plant. The licensee will provide the results of a full range fire pump flow test for each fire pump, covering the range of pump discharge from shut off to 150% of rated capacity, with the associated discharge pressure and pump speed. We will address the acceptability of the fire pumps in a supplement to this report.

4.3.1.3 Fire Water Piping System

The 6-inch discharge line from the crib house supplies the 6-inch underground loop main which encircles the plant on three sides and passes through the turbine building to complete the loop. All yard fire hydrants, automatic water suppression systems, and interior hose stations are supplied by this loop main. Only two key operated (curb) valves are provided as sectional valves on the exterior portion of this loop. These valves are in locked curb boxes which are checked weekly. The valves themselves are cycled twice yearly. No sectional valves are provided on the interior portion of the system. This arrangement is unsatisfactory because a single failure in certain locations could cause the loss of both primary and backup suppression systems in the plant. The licensee is considering providing additional visually indicating sectional valves to assure availability of at least two sources of supply to the fire protection water system and preclude the loss of primary (automatic) and backup (manual) water suppression capability to areas so protected. Valves controlling water flow into sprinkler systems are sealed and checked weekly.

Yard fire hydrants have been provided at intervals of 200 to 250 feet around the exterior of the plant, except that hydrant #5 is on the outside of the chain link security fence around the plant. However, other hydrants are within reasonable distances of building openings and yard areas, so the present arrangement is acceptable. The lateral to each hydrant is controlled by a key-operated (curb) valve. Two hose houses are in the yard. Each hose house contains several lengths of 1½-inch hose, hydrant wrenches, hose nozzles, and other equipment. The licensee will provide additional manual fire fighting equipment as itemized in Section 3.1.1(1) of this report, and two additional hose houses. The new hose houses will be located near the northwest entrance to the turbine building and in the vicinity of the "B" diesel generator area. Administrative procedures as identified in Section 3.1.1(2) through (5) of this report will be established to assure the availability of the yard hydrants. Threads on hydrant outlets and hose connections throughout the plant are National Standard Fire Hose Connection Screw Thread, and are compatible with those of fire departments which serve the plant.

The plant fire protection water system is also the high pressure service water system (HPSW). In addition to supplying water for fire protection, the HPSW supplies water for the alternate core spray system, the high pressure core spray system (back up water supply only), the air compressor cooling system (back up only), the shutdown condenser supply (back up for demineralized water system), the eductor on the turbine condenser monitor (back up only), and the crib house traveling screen wash. Except during an emergency accident condition, the last two systems are the only ones which normally place a demand on the HPSW. The required flow is about 75 gpm, most of which is for the screen wash at the crib house.

The licensee contends that although the fire water system combines the function of the service water, emergency shutdown and cooldown of the reactor can be accomplished without using the HPSW system. In this operation, reactor cooling is provided by the shutdown condenser using the demineralized water system so that during the period of fire fighting there is a separation between the fire water system and the system providing the function of the service water.

The licensee will provide the results of an analysis which demonstrate that the combined water demand for fire fighting and for safety-related functions can be satisfied under any fire emergency or accident. Postulated fires need not be considered concurrent with other plant accidents. However, accident induced failure or malfunction of the fire suppression system, such as a steam line break opening the sprinkler heads, or a broken pipe whipped to break fire water piping, will be considered.

We will address the adequacy of the fire water piping system in a supplement to this report.

4.3.1.4 Interior Hose Stations

Five interior hose stations equipped with 75 feet of 1½-inch diameter unlined linen fire hose are provided in the turbine building, and a similar hose station is provided in the waste disposal building. A hose reel with 50 feet of 1½-inch diameter lined and jacketed fire hose is provided in the "B" diesel generator electrical equipment room. A fog nozzle is provided on each of the above hoses. Four hose cabinets, each with 75 feet of 3/4-inch unlined linen hose and an adjustable garden type nozzle are provided in the containment building.

Present hose station locations may not provide sufficient hose reach in all plant areas for effective application of water for suppressing a fire. System pressure losses may result in inadequate flows or pressures at hose nozzles. Access to some interior hose stations in the plant is presently blocked by storage areas. Interior hose stations provided for protection of safety-related areas of the plant are presently equipped with linen hose, which is not suitable for industrial fire fighting. Three-quarter inch hoses and nozzles provided inside containment will produce excessive pressure drop and are, therefore, inadequate for fire fighting.

The licensee will perform hose reach tests and provide additional hose stations as necessary to assure that all points in safety-related areas, including those areas protected by automatic suppression systems, and other plant areas which contain major fire hazards can be reached effectively by at least one hose stream. The licensee will further perform tests and/or calculations to confirm that the flowing pressure at each hose station outlet is greater than or equal to 65 psig at 100 gpm flow rate. Administrative controls will be established to prevent access to manual fire fighting equipment from being restricted by temporary storage of materials within the plant. The existing linen hoses will be replaced by 1½-inch 100% polyester, single jacketed lined, FM or UL listed fire hoses, factory test rated at not less than 300 psig, for those hose stations which are provided to protect safety-related systems and components. Additional equipment as listed in Section 3.1.2(1), (2), (3), (7) and (8) of this report will be provided to facilitate manual fire fighting. The length of the hose at all interior hose stations will be limited to 75 feet maximum and the 3/4-inch hoses and nozzles inside the containment have been replaced with 1½-inch UL or FM listed fire hoses and nozzles.

We find that, subject to implementation of the above described modifications, the interior fire hose stations satisfy the objectives identified in Appendix A of BTP 9.5-1 and are, therefore, acceptable

4.3.1.5 Water Suppression Systems

Wet-pipe automatic sprinkler systems have been provided in the turbine building to protect the turbine oil reservoir, and in the office building to protect the oil storage room.

The main control valve for each sprinkler system is locked open and checked weekly. Water flow in these systems is alarmed and annunciated in the control room.

The licensee has proposed to extend coverage of the sprinkler system protecting the turbine oil reservoir to include the associated piping in the same area.

In addition, the licensee will:

(1) Provide an automatic water suppression system, or an oil shield and collection system at the reactor coolant recirculation pumps.

(2) Provide an automatic fire suppression system (water or other suitable agent) to protect the "A" diesel generator room.

(3) Provide a fixed dry pipe sprinkler system capable of quick connection to a manual hose at the exterior cable penetration of the containment building.

(4) Provide additional equipment as listed in Section 3.1.2(4) through (6) of this report.

(5) Provide an automatic water fire suppression system to protect against a fire at outside transformers.

We find that, subject to implementation of the above described modifications, the automatic sprinkler systems satisfy the objectives identified in Appendix A of BTP 9.5-1 and are, therefore, acceptable.

4.3.2 Gas Fire Suppression Systems

A total flooding carbon dioxide suppression system is provided for the "B" diesel generator room. The system is automatically actuated by 160°F rate compensation type heat detectors at the ceiling of the room, or manually actuated either at the fire alarm panel in the control room or at the switchgear room adjacent to the diesel generator room. An alarm bell and a 30-second release delay are incorporated for personnel evacuation. Actuation of this system is annunciated on the control room fire alarm panel. Pressure switches actuated by carbon dioxide discharge close room ventilation dampers and shutoff the room exhaust fan.

The heat detector circuit is not supervised, and a failure in this detection system would preclude automatic operation of the suppression system. The licensee will supervise the heat detection system for power failure, ground faults, and ciruit breaks and to annunciate the supervisory signals in the control room.

The extinguishing system requires electrical power for automatic actuation of agent discharge. The actuation power is provided from Breaker #11 which is connected to the 120-volt AC essential bus that derives onsite backup power from the diesel generator the system is designed to protect.

It is possible, therefore, that in the event of a fire at "B" diesel room, the extinguishing system will be without onsite power backup. Moreover, it was verified that the emergency manual control of the carbon dioxide system does not conform to the provisions in Section 1-8.3.5 of NFPA 12-1977. The licensee will provide the actuation power for the carbon dioxide system from the essential bus which derives backup onsite power from the other diesel-generator. He will also modify the emergency manual release of the system to conform with the provisions of NFPA 12-1977.

The primary agent supply is from four 100-pound high pressure cylinders with a connected reserve supply of four more 100-pound cylinders. All of these cylinders are in the room they protect, although NFPA 12-1977 indicates that they should not be located where they will be exposed to a fire. However, because the detector circuit will be supervised, emergency power will be provided, and there will be an emergency manual release for the system, we find the arrangement of storage cylinders acceptable.

We find that the design of the carbon dioxide extinguishing system satifies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

The licensee has also agreed to install automatic fire suppression systems to protect the "A" diesel generator room and the electrical equipment room. Preliminary information received indicates that they will be gas systems. We will evaluate these systems when design data are received.

4.3.3 Portable Fire Extinguishers

Portable fire extinguishers have been provided throughout the plant in accordance with the provisions of NFPA 10.

We find that the type and distribution of portable fire extinguishers complies with the provision of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.4 Ventilation Systems and Breathing Equipment

4.4.1 Smoke Removal

Ventilation systems are provided for all indoor plant areas, but these systems are not designed specifically for smoke removal. Nevertheless, installed air handling systems are capable of exhausting limited volumes of smoke, generally directed to the outside. Major exceptions include the turbine building, containment building, and waste treatment building, which discharge into the plant stack.

Ventilation system discharge from the reactor building, turbine building, and waste treatment building is monitored for radioactive contamination. In case high radiation levels are detected in these areas, system air intake and exhaust are terminated automatically. If smoke exhaust operations are in progress, these will also be terminated. The licensee has on

hand three portable smoke removal fans, each rated at about 1,000 cubic feet per minute, and several 15-foot lengths of 12-inch diameter flexible duct. The licensee will provide one additional fire fighting type explosion-proof smoke ejector, rated at 5,000 cubic feet per minute.

We find that, subject to implementation of the above described modification, the provisions for smoke removal comply with the requirements of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.4.2 Filters

A charcoal filter is installed in the off-gas line from the air ejector, located in the 4,500 gallon waste tank room in the turbine building tunnel. HEPA filter elements are located in the same housing as the charcoal filters. The filters are contained in steel casings and there are no ignition sources located near the filters, nor can the buildup of radioactive products generate sufficient heat to cause ignition. The amount of combustibles in the area of these filters, other than the filters themselves, is also low.

We find that the fire protection for the charcoal filters complies with the requirements of Section 2.2 of this report and is, therefore, acceptable.

4.4.3 Breathing Equipment

The plant currently has on hand eight air masks, each with one ½-hour rated air bottle, and a total of six spare bottles of the same rating. A cascade system is currently located in the southwest corner of the turbine building basement. The licensee will relocate the cascade system to a plant area where a fire in the area will not require its use. This system currently does not provide sufficient onsite reserve air supply. The licensee will provide a 6-hour onsite breathing air reserve for each of the existing eight breathing units, based on 20 minutes of air per bottle. Two spare bottles will be provided for each unit.

We find that breathing equipment complies with the provisions of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.4.4 Battery Room Ventilation

There are two battery rooms. One is the electrical equipment room and one is a separate room in the "B" diesel generator building. The batteries in the electrical equipment room supply the turbine building static inverter and the reactor building motor generator set. Ventilation air here is supplied from the control room HVAC system and is exhausted into the turbine building.

The other batteries supply the diesel generator building standby 125-volt D.C. distribution bus. Ventilation is by a unit-type air conditioner and separate exhaust fan in outside walls of the battery room. Hydrogen

monitors which alarm and annunciate in the control room have been installed in each battery room.

We find that protection against hydrogen accumulation in battery rooms complies with the provisions of Appendix A of Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.5 Floor Drains and Curbs

In general, safety-related equipment is mounted on pedestals. Where there are floor drains, they are adequate to remove fire fighting water prior to the equipment being flooded. In safety-related areas where no drains are supplied, fire water will be satisfactorily drained through door openings.

The diked area around the outdoor fuel oil storage tank is adequate to contain the entire content of fuel oil in a full tank plus an additional capacity for fire fighting agent. The curbed areas around the oil storage room, the turbine lube oil reservoir and the "B" diesel generator day tank are not sufficient to contain the content of oil in each area. There are no curbs to contain an oil leakage in the "A" diesel room. Since a clogged drain is not uncommon, in the event of a major oil leakage, there is a possibility oil fire may spread. The licensee will add or upgrade curbs in the following areas to contain the entire content of oil in each area plus additional 10% capacity for fire water: (1) the turbine oil reservoir, (2) "A" diesel room and (3) "B" diesel room. An opening will be provided at the floor level of the oil storage room which will drain a possible oil accumulation in the room toward the yard area.

The plant's drainage systems are separated so that no areas containing flammable liquids have drains that are common to drains from safety-related areas. Therefore, a fire could not spread from an area containing flammable liquids to a safety-related area by way of the drainage system.

We find that the floor drains and curbs satisfy the objectives identified in Section 2.2 of this report and are, therefore, acceptable.

4.6 Lighting System

The emergency lighting consists of DC lighting units powered from the station batteries and AC units that have diesel backup power source. In addition there are a few fixed sealed beam lighting units. The arrangement of the lighting systems in the plant is such that both AC and DC emergency lighting systems as well as the normal lighting system are subject to loss due to a single fire.

The licensee will provide fixed, sealed beam, 8-hour rated battery-powered emergency lights in all safety-related areas and their access and egress to facilitate emergency shutdown operation and fire fighting.

We conclude that subject to implementation of the above described modifications, the lighting system will provide adequate lighting under the fire emergency and is, therefore, acceptable.

4.7 Communication

The internal communication systems throughout the plant consists of: sound-powered phones, private paging and conference telephone system, FM and HF radio. There are no repeater stations; however, communications into the containment is achieved through the 5-watt radio system. There is a possibility that both the sound-powered phone system and the private paging and conference telephone system could be lost to a single fire, but the radio systems provide adequate backup.

We find that the plant's communication system meets the provisions of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.8 Electrical Cables

The majority of the electrical cables for this plant were purchased and installed prior to the publication of IEEE 383 Standard for Flame Testing of Electrical Cables and do not meet this standard. The original cables installed in the plant are mostly cross-linked polyethylene and polyvinyl chloride. The cross-linked polyethylene cable was tested under IPCEA S-19-81 and the polyvinyl chloride cables were tested under IPCEA S-61-402. These tests are not as demanding as the IEEE 383 Standard test, but these original cables have been provided with the fire retardant coating. The more recently installed cables are made of newer compounds of cross-linked polyethylene that have passed the IEEE 383 Standard.

The flame retardant coating, where it is provided, appeared to be applied in an uneven manner and, in some cases, were not applied to all cables in an individual tray. The licensee agreed to spot check the coating thickness in each safety-related area and repair, as necessary, to provide a thickness which conforms to the manufacturer's recommendation.

We find that, subject to implementation of the above described modification, electrical cables comply with the provisions of Appendix A to BTP 9.5-1 and is, therefore acceptable.

4.9 Fire Barrier Penetrations

Fire barriers in most plant areas are penetrated by doorways, ventilation ducts, electrical cables, and pipes.

4.9.1 Doorways

Fire barriers separating various fire areas or zones are penetrated by numerous doorways, most of which are protected by 3-hour rated doors. The remaining doorways are provided with 1½-hour rated doors, except that the

air lock doors to the containment building are not rated. The licensee will replace the 1½-hour rated doors from the "A" diesel generator room to the machine shop, and from the machine shop to the penetration room with 3-hour rated fire doors. The air lock doors are acceptable because of their heavy steel construction and secure latching mechanisms. Other 1½-hour rated doors are considered acceptable because the estimated fire severity on either side of the doorway is less than 1½-hours.

Various doors have been modified for security purposes. The licensee has provided further documentation to demonstrate that the fire resistance ratings of these door assemblies have not been reduced by such modifications. We are presently reviewing this information.

Most fire doors in the plant are either normally closed and locked, or will be electrically supervised. Two exceptions identified by the licensee are the door between the control room and the office area hallway and the door between the change room and the hallway. The former is in a constantly watched area and the latter separating two nonsafety-related areas. We conclude that these exceptions are acceptable.

The information submitted by the licensee, however, did not indicate if all fire doors in the plant were included in his review of the door supervision. The submittal also failed to specify how and where the alarm will be provided.

In the subsequent discussion the licensee agreed to verify that, except for the two doors discussed above, all fire doors in the plant will either be locked closed or electrically supervised with a time delayed alarm in a constantly occupied area.

We find that, subject to implementation of the above described modifications, protection for doorways complies with the requirements of Section 2.2 of this report and is, therefore, acceptable as described above.

4.9.2 Ventilation Duct Penetrations

Fire barriers are penetrated by ventilation duct penetrations in two areas of the plant. One area is the ventilation opening between the change room in the office building and the mezzanine floor of the turbine building. The opening is protected by a 1½-hour rated fire damper operated by fusible link. The other area is between the electrical equipment room and the instrument repair room on the mezzanine floor of the office building. The ventilation duct supplying air from the control room air conditioning system in the electrical equipment room penetrates the wall to the instrument repair room without fire dampers at these penetrations. An additional duct penetration for the instrument repair room to the electrical equipment room is also not provided with a fire damper. The licensee will protect these ventilation duct penetrations by installing fusible link actuated, 1½-hour rated fire dampers.

We find that, subject to implementation of the above described modifications, the protection of ventilation duct penetrations is adequate to prevent the spread of a fire via the ventilation ducts.

4.9.3 Electrical Cable Penetrations

Cable tray and conduit penetrations of fire barriers were not sealed in the original design of the plant. Following the fire hazard analysis conducted to compare the fire protection program at LaCrosse with the guidelines of BTP 9.5-1 and Appendix A, the licensee sealed all cable penetrations outside containment by filling the opening with mineral wool and covered by a flame retardant coating. This sealing arrangement has not been tested in accordance with ASTM E-119 and the fire resistance of this arrangement cannot be established by the information currently available.

The licensee has agreed with the staff's recommendation to modify the existing electrical cable penetration seals to a design with established adequate fire resistance.

We find, subject to implementation of the above described modification, fire protection of the cable penetrations comply with the provision of Appendix A to BTP 9.5-1 and is, therefore, acceptable.

4.9.4 Piping Penetrations

Piping penetrations through fire barriers, except for those into the reactor building, are not sealed. The licensee has proposed to close all such unsealed pipe penetrations with a noncombustible material, except where limited by seismic consideration. Because resilient materials are available to provide fire resistant penetration seals that will not affect the seismic characteristics of piping systems and because the penetration seals are not required to withstand the safe shutdown earthquake, we recommended that all piping penetrations should be sealed. The licensee agreed to seal all piping penetrations and provide information concerning the material and construction which will establish the fire resistance of the seal.

We find that, subject to implementation of the above described modifications, protection for piping penetrations of fire barriers complies with the requirements of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

4.10 Cable Separation

The design and construction of the LaCrosse plant predate IEEE Standard 384 on criteria for separation of Class 1E equipment and circuits. Although many plant systems important to safety are provided with alternate means to achieve the safety functions, the original plant design did not include divisional redundancy, and consequently divisional separation, for safety-related cables and equipment.

Subsequent to the issuance of the provisional operating license, another train of diesel generator and station batteries were added to provide redundant AC and DC power sources for certain systems important to safety. However, no criteria were established to physically separate redundant cables or cables serving alternate systems. Redundant cables or cables serving alternate systems were observed to be routed in the close proximity of each other without barrier interposition; in many cases redundant cables are routed in a common tray. Safety-related cables are not marked as required by industry standards and difficult to identify.

The licensee will conduct an analysis to determine if safe shutdown capability exists independent of cabling and equipment in any single fire area, or to demonstrate the effectiveness of barriers, spatial separation, tray covers and/or fire stops in preserving the safe shutdown capability against the effects of a major fire in any one fire area. If the results of such analysis could not provide reasonable assurance that the capability to safely shut down and cool down the reactor can be maintained during and following a fire, additional modifications will be required to preserve such capacity.

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

4.11 Fire Barriers

Most fire areas are separated from each other by walls, floors, and ceilings which have at least 3-hour fire resistance ratings. Safety-related areas separated from each other or from nonsafety-related areas by barriers rated less than 3 hours were evaluated and it was concluded that the barriers around these areas are adequate to prevent the spread of fire or protect the safety-related areas against hazards from nonsafety-related areas.

There are other safety-related areas separated from each other or from nonsafety-related areas by barriers for which a rating has not been determined, including:

- The oil storage room and mezzanine level of the office area. Although the depth of cover of the reinforcing steel in the 6-inch concrete floor between the two areas is unknown, this arrangement is considered acceptable because of the limited hazard presented to the oil storage room by the office area.

- The "A" diesel generator room and the machine shop.

- The turbine building and the main and auxiliary transformers.

The licensee will upgrade the barrier between the "A" diesel room and the machine shop to provide fire resistance adequate to contain fire hazards

in the diesel room. An automatic water fire suppression system will be installed to protect the turbine building from a fire at outside transformers.

There are also several plant areas in which the failure of exposed structural steel supporting fire barriers could impair the safe shutdown capability of the plant. These areas include the machine shop and turbine building. The licensee has proposed to protect the exposed steel supporting the machine shop ceiling with a 3-hour rated fire barrier. The licensee is also analyzing the possibility of a fire in the turbine building damaging exposed structural steel and the safety consequences of such damage. Additional modifications will be proposed if the results of such analysis reveal the need for protection of exposed structural steel.

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

4.12 Access and Egress

Most safety-related areas are reasonably accessible for manual fire fighting. From an entrance on the grade floor, an enclosed stairway joins all three levels of the main building - grade level, mezzanine level, and main level. In addition, access to various plant areas in the main building is also possible from the machine shop and from the turbine building via open stairways.

During normal operation, the containment is sealed. Access and agress is available through an interlocked double-door air lock at elevation 642'-9". Special procedures must be followed to gain access. The crib house has two doors for access and egress, but the building is somewhat congested with equipment which could slow up manual fire fighting.

In those safety-related areas where access for manual fire fighting is limited, additional protection in the form of automatic water suppression, hazard containment, and/or alternate shutdown capability will be provided or required to compensate for such shortcoming. Such areas are discussed in Section 5 of this report.

It is therefore concluded that, subject to the above described modification, access and egress to various plant areas are adequate for fire fighting. This satisfies the objectives identified in Section 2.2 of this report and is, therefore, acceptable.

4.13 Toxic and Corrosive Combustion Products

The products of combustion of many polymers are toxic to humans and corrosive to metals. Prompt fire detection and extinguishment are relied upon to reduce the quantity of such products produced during a fire. Means of

smoke removal, as discussed in Section 4.4.1, are provided as an aid in fire fighting access. Members of the fire brigade will be provided with, and trained in the use of, emergency breathing apparatus for fighting fires involving such materials.

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

4.14 Nonsafety-Related Areas

We have evaluated the separation by distance or by fire barriers between safety-related and nonsafety-related areas to determine that fires in nonsafety-related areas will not adversely affect the ability to safely shut down 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

It was verified that air-operated valves required for safe shutdown will fail in safe positions in the event of a fire-induced loss of the instrument air system. Therefore, safe shutdown will not be prevented if instrument air is lost.

5.0 EVALUATION OF SPECIFIC PLANT AREAS

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

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

The licensee has committed to perform additional studies on issues listed in Section 3.2 of this report to identify problematic areas and propose, if necessary, additional modifications. Exactly which plant area(s) will be affected by these studies are not known a priori. The conclusions made in the following sections for various plant areas are based on the assumption that additional modification(s), consistent with the objectives of Section 2.2 of this report, will be provided should any one of these plant areas be identified by such studies to have a problem not identified previously.

5.1 Turbine Building

5.1.1 Safety-Related Equipment

High pressure service and demineralized water supplies, component cooling water for the decay heat removal system, main steam valves, and associated switchgear and motor control centers are in the turbine building.

5.1.2 Combustibles

The major combustible materials include 4,000 gallons of turbine oil in the turbine oil reservoir and piping, 40 gallons of hydraulic oil for the main steam bypass valve, 1,500 pounds of cable insulation, and 400 pounds of miscellaneous combustibles.

5.1.3 Consequences if No Fire Suppression

The turbine oil reservoir is on the grade floor of the turbine building. The area over the reservoir is open to the underside of the main floor. A fire involving the contents of this reservoir or associated piping would, therefore, expose the unprotected structural steel supports of both floors above. Collapse of these supports could degrade the safe shutdown ability of the plant.

It has not been demonstrated that a fire or explosion involving the transformers outside the west end of the turbine building will not affect the safe shutdown capability of the plant. The exterior wall at the main floor level is insulated metal of undetermined fire resistance, and there are large non-rated air intake louvers in this wall.

The licensee's fire hazard analysis has not demonstrated that safe shutdown can be achieved and maintained given a fire at any location in the turbine building.

5.1.4 Fire Protection Systems

An automatic sprinkler system is installed over the turbine oil reservoir. Five interior hose stations, each provided with 75 feet of 1½-inch diameter unlined linen hose, are in the turbine building. Portable extinguishers are also provided.

Ionization-type smoke detectors are located in most areas, including the downstream side of the turbine building air intake louvers. Detectors in this latter area are arranged to close the louvers upon detection of smoke from a fire outside the turbine building.

5.1.5 Adequacy of Fire Protection

The automatic sprinkler system is not adequate to control or suppress a fire involving the turbine oil piping on the grade floor away from the turbine oil reservoir. Curbed area around the reservoir is not adequate to contain the content of oil in the reservoir. Portable extinguishers would not be adequate for control of a large turbine oil fire. Interior hose might also be inadequate to control such a fire. In addition, the existing unlined linen hose is not suitable for fire fighting in industrial buildings.

Unprotected structural steel may not be capable of supporting a load when exposed to a fire involving combustible liquids.

The protection of the turbine building from fire or explosion in one of the outside oil-filled transformers has not been shown to be adequate.

5.1.6 Modifications

The licensee will:

(1) Extend the automatic sprinkler system to protect the turbine oil piping west of the turbine oil service tank.

(2) Conduct a study to determine the need for protection of exposed structural steel.

(3) Install an automatic water fire suppression system to protect the turbine building from a fire at transformers.

(4) Upgrade the curbs around the reservoir to a capacity sufficient to contain the entire content of oil plus 10% additional capacity for fire water.

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

5.2 Oil Storage Room

5.2.1 Safety-Related Equipment

A 6-inch high pressure service water line and a low pressure service water line run through this room.

5.2.2 Combustibles

The major combustible materials include the contents of the 4,000-gallon clean turbine oil tank, 4,000-gallon dirty turbine oil tank, 1,000-gallon auxiliary boiler fuel oil tank, six 55-gallon drums of lubricating oil, various containers of flammable and combustible liquids stored in three flammable liquids storage cabinets, and a large compressed gas cylinder containing 10 percent methane and 90 percent argon for use in the laboratory. The 4,000-gallon clean oil tank is normally empty. Containers for acids and other chemicals are also stored in the UL listed flammable liquids storage cabinets in this room.

5.2.3 Consequences if No Suppression

The licensee has not provided an evaluation of consequences of an unmitigated fire in this room. However, it is likely that a severe fire could result, exposing the service water lines and its hangers to high temperatures for a considerable length of time.

5.2.4 Fire Protection Systems

An automatic sprinkler system is installed to protect the room contents. The sprinklers are located 2½ feet below the ceiling, somewhat in excess of the maximum allowed by NFPA 13.

Ionization-type smoke detectors are installed here. Portable fire extinguishers and interior hose lines are available from adjacent areas.

5.2.5 Adequacy of Fire Protection

Fire protection in this room is not adequate, because of the possibility of damage to the service water lines or their hangers, and because the curb is not high enough to contain the entire content of oil in the event of a major break to the tanks or associated piping.

Ionization-type smoke detectors should provide prompt detection of fires in this area. The installed automatic sprinkler system should be capable of controlling fires in this room, although sprinkler activation time will probably be greater than if the sprinklers had been installed closer to the ceiling in accordance with NFPA 13.

Acids and other chemicals should not be stored in the flammable liquid storage cabinets because of the possibility that the flammable liquid container or cabinet may be damaged by these acids and chemicals and that the chemical reaction may provide an ignition source.

5.2.6 Modifications

The licensee has provided protection for the service water piping and its supports. The miscellaneous acids and chemicals will be removed from this room and stored elsewhere in a suitable cabinet, and an opening will be provided at the floor level to drain away a possible oil accumulation in the room toward the yard area.

We find that, subject to implementation of the above described modifications, fire protection for the oil storage room complies with the requirements of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

5.3 Machine Shop Area and "A" Diesel Generator Room

5.3.1 Safety-Related Equipment

The "A" diesel generator and certain cable tray runs between the penetration room (5.6) and the electrical equipment room (5.9) are in this area. The diesel generator is in a separate room, separated from the rest of the area by a 6-inch masonry wall. The doorway to this room from the machine shop is protected by a pair of Class B labelled fire doors.

5.3.2 Combustibles

The combustible materials in this area include 100 gallons of diesel fuel oil in the diesel generator day tank located in the diesel generator room cable insulation, and several hundred pounds of ordinary combustibles in the machine shop area.

5.3.3 Consequences If No Fire Suppression

An unmitigated fire here could damage the "A" diesel generator and electrical cables between the penetration room and the electrical equipment room. However, the licensee's fire hazards analysis has not provided sufficient information to permit the staff to conclude that an unmitigated fire in this area would have no effect on the safe shutdown capability of the plant. A major fire in this area could also damage exposed steel at the ceiling which supports the electrical equipment room floor.

5.3.4 Fire Protection Systems

An ionization-type smoke detector which alarms and annunciates in the control room is installed in the emergency diesel generator room. Portable extinguishers and interior hose are available from adjacent areas. Ionization-type smoke detectors are also installed in the electrical shop portion of the machine shop.

5.3.5 Adequacy of Fire Protection

The installed smoke detectors should provide early warning of fire in the protected areas. Portable extinguishers and interior hose lines should be adequate to limit fire damage to the machine shop area. Fires in the diesel generator room will likely damage cables and equipment in the machine shop area before they are extinguished. The exposed steel supports for the ceiling of the machine shop are subject to failure resulting from exposure to a severe fire. There is no curb around the day tank area to prevent the spread of a possible liquid fire in the event of a major oil leakage. No oil shutoff is available from outside of the room to cut off the oil flow if the day tank or makeup piping leaks.

5.3.6 Modifications

The licensee will:

(1) Provide 3-hour protection for the exposed structural steel supporting the ceiling of the machine shop.

(2) Provide automatic fire suppression to the diesel generator room and the capability to shut off oil transfer to the diesel generator day tank from outside the room.

(3) Provide capability to shutoff oil transfer to "A" diesel day tank from outside the room.

(4) Provide curbs around the day tank of "A" diesel to contain the entire content of the tank, plus 10% additional capacity for fire water, in the event of a major leakage in the oil system.

(5) Upgrade the barrier between the "A" diesel room and the machine shop to provide an adequate fire resistance and replace the existing door with a 3-hour rated fire door.

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

5.4 Penetration Room

5.4.1 Safety-Related Equipment

The safety-related equipment in this area consists of essential bus switchgear 1A, a portion of the core spray line, and safety-related cables.

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5.4.2 Combustibles

The combustibles in this area consist of cable insulation and electrical components in the essential bus switchgear 1A.

5.4.3 Consequences if No Fire Suppression

An unmitigated fire could damage many cables entering containment through this area and cause the loss of essential bus 1A. The control rod drive system will shut down the reactor on the loss of electric power. Core cooling could be provided by the shutdown condenser using local manual control and visual observation of instrument inside containment. The licensee, however, did not analyze the effects of a fire damage in this area on the long-term cooling capability of the plant, and the possibility of circuit interaction among damaged cables.

5.4.4 Fire Protection System

Ionization-type smoke detecters are installed to provide early warning. Manual suppression capability is provided by portable extinguishers and 1½-inch interior hose lines.

5.4.5 Adequacy of Fire Protection

Manual fire fighting would be adequate to suppress a fire in this area except the access to the penetrations is obstructed by the fiber glass panels installed to protect the penetrations from rupture of water pipes. The 1½-hour rated fire doors may not provide adequate protection against fire hazards from the outside.

5.4.6 Modifications

The licensee will provide a fixed dry pipe sprinkler suppression system, capable of quick connection to a manual hose, to facilitate fire fighting at the penetration. The licensee will also replace the Class B, 1½-hour doors with Class A, three hour doors.

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

5.5 "B" Diesel Generator Building

5.5.1 Safety-Related Equipment

The safety-related equipment in this area consists of the "B" diesel generator, essential bus 1B switchgear; the station standby battery bank, and cables that feed safety-related equipment.

5.5.2 Combustibles

The combustibles in this area consist of diesel oil, polystyrene battery cases, and cable insulation. Hydrogen could be generated in the batteries.

5.5.3 Consequences if No Fire Suppression

A fire in this area could disable the essential bus 1B and the station standby battery bank. The plant would be deprived of onsite power to one emergency core spray pump, one seal injection pump and the reactor building motor control center 1A. The reactor, however, can be tripped manually from the control room, or automatically on loss of power to the control rod drive system. The capability to cool the reactor will not be affected.

5.5.4 Fire Protection System

A total flooding carbon dioxide system is installed to protect this area. The system is actuated automatically by fixed temperature heat detectors and can also be initiated manually. Ionization-type smoke detectors are provided in addition to those heat detectors actuating the CO_2 system. Portable extinguishers and manual hoses, from both the interior hose station and the outside hydrant, are available for manual fire fighting.

5.5.5 Adequacy of Fire Protection

The automatic carbon dioxide system would be adequate to suppress a fire in this area. The circuit of heat detectors that actuate the automatic carbon dioxide system is not supervised and, therefore, does not have desired reliability. The actuation power of the carbon dioxide system is provided from the essential bus that derives onsite power from the very diesel the system is designed to protect. It is possible, therefore, that in event of a fire at "B" diesel, the extinguishing system will be without onsite power backup. The manual release of the carbon dioxide system does not conform to the provisions of NFPA 12-1977 which tends to reduce the reliability of the manual release. There is no provision to detect a possible hydrogen buildup in the room. Curbed area in the room is inadequate to contain oil in the day tank.

5.5.6 Modifications

Electrical supervision for power failure, grounds and circuit breaks will be provided to the circuit of heat detectors that actuate the CO_2 system. The actuation power for the CO_2 system will be provided from the essential bus which derives the onsite backup power from the "A" diesel generator. The emergency manual release of the CO_2 system will be modified to conform with the provisions of NFPA 12-1977. The curbs will be upgraded to provide sufficient capacity for the entire content of the day tank plus 10% additional capacity for fire water. A hydrogen monitor has been installed to alarm and annunciate in the control room a high hydrogen concentration.

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

5.6 Containment

5.6.1 Safety-Related Equipment

The containment structure contains the reactor, associated piping and instrumentation, the decay heat pump, the shutdown condenser and the containment ventilation system.

5.6.2 Combustibles

Combustible materials inside containment include lubrication oil and hydraulic fluid in the reactor coolant recirculation pumps, borated polyethylene neutron shield blocks around the control rod drives, cables, and some miscellaneous combustibles that include wood, paper and plastics.

5.6.3 Consequences if No Fire Suppression

A major fire involving combustible liquid of the recirculation pumps and/or polyethylene blocks could damage the control drive mechanism, the decay heat removal system, main steam valves, as well as instrumentation in the area. The reactor can be shutdown by injecting boron, using high pressure core spray pumps.

5.6.4 Fire Protection Systems

Ionization-type smoke detectors which alarm and annunciate in the control room have been installed throughout the containment. Portable extinguishers and four 75-foot lengths of 3/4-inch unlined linen hose are available in the containment for manual fire fighting.

5.6.5 Adequacy of Fire Protection

Fire protection in the containment is not adequate. Existing fire suppression equipment is not capable of timely suppression of oil fires. In addition, the existing unlined linen hose is not suitable for industrial fire fighting.

5.6.6 Modifications

The licensee will:

(1) Replace existing interior hose station standpipe so that a minimum of 100 gpm is available at each hose station outlet at a residual pressure of at least 65 psig. The 3/4-inch hoses and nozzles will be replaced with 1½-inch, UL or FM listed, fire hoses and nozzles.

(2) Provide an acceptable modification to prevent or suppress a fire in the recirculation pump area.

(3) Replace polyethylene neutron shielding with noncombustible materials.

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

5.7 Electrical Equipment Room and Control Room

5.7.1 Safety-Related Equipment

Safety-related equipment includes the main control console which extends from the control room to the electrical equipment room below; the reactor building and the general plant batteries and associated switchgear and inverters; AC and DC motor control centers; and cables.

5.7.2 Combustibles

The combustibles in this area consist of electrical cable insulation, electrical components, polystyrene battery cases and a large quantity of paper - operational manuals, logs and drawings in the control room, and a number of file cabinets full of paper records stored in the electrical equipment room.

5.7.3 Consequences if No Fire Suppression

The electrical equipment room is the cable spreading area for the control room consoles. The two rooms are not separated by a fire barrier so that a fire in the electrical equipment room is likely to also affect cabling and components in the control room consoles. The reactor will be scrammed on loss of non-interruptive bus and the shutdown condenser will be available for core cooling. However, capability of bringing the reactor down to a cold shutdown condition may not be preserved because the decay heat system could be disabled. Furthermore, both onsite AC and DC power systems could be damaged by a fire in this area. It has not been demonstrated conclusively that safe shutdown can be accomplished without onsite and offsite electric power. There also is a possibility of circuit interaction among cables damaged by a fire producing effects unfavorable to safe shutdown.

5.7.4 Fire Protection System

Ionization-type smoke detectors are located throughout the electrical equipment room, the ceiling of the control room and ventilation air return duct from the control room consoles. One and one-half inch manual hoses with fog nozzles are available from the turbine building. Portable extinguishers are provided within and around the area. Most cables are provided with a flame retardant coating.

5.7.5 Adequacy of Fire Protection

Fire protection for this area is inadequate. Storage of a large quantity of record file in this area exposes cabling and components in this critical

area to an unnecessary hazard. Manual suppression may not be adequate to extinguish a fire before it inflicts a significant amount of damage. It has not been demonstrated that safe shutdown capability can be preserved during and following a fire in this area. There is no provision for detecting or preventing a possible accumulation of hydrogen generated in the batteries. The cables above the ceiling in the control room present a fire hazard in an area where fire fighting is difficult.

5.7.6 Modifications

A hydrogen detector has been installed in the battery area of the electrical equipment room to provide an alarm in the control room.

The licensee will:

(1) Relocate all file cabinets stored in the electrical equipment room out of the safety-related areas. Storage of combustible materials not essential for the routine operation and maintenance in this area will be prohibited.

(2) Provide automatic fire suppression to the electrical equipment room.

(3) Provide additional protection, possibly enclosure in conduits, for cables in the concealed space above the control room ceiling.

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

5.8 Waste Handling Building

5.8.1 Safety-Related Equipment

Radwaste systems are located in this area.

5.8.2 Combustibles

Combustibles in this area include solid wastes such as paper, plastic, and filter elements; ion exchange resin; and charcoal in the off-gas system.

5.8.3 Consequences if No Fire Suppression

No cable or equipment in this area is required for safe shutdown. An unmitigated fire in this area could release radioactive materials. The licensee has not analyzed the radiological consequences of a fire in this area.

5.8.4 Fire Protection Systems

Ionization-type smoke detectors are installed to provide alarm in the control room. An interior hose station, an outside fire hydrant and portable extinguishers are available for manual fire fighting.

5.8.5 Adequacy of Fire Protection

Adequacy of fire protection in preventing excessive release of radioactive materials from a fire in this area has not been analyzed by the licensee.

5.8.6 Modifications

The licensee will provide the results of an analysis which demonstrate that a fire in the waste handling building will not cause the release of significant amount of radioactive materials. Such analysis will include, but not be limited to, a charcoal fire in the off-gas system and the fire hazards associated with the storage of spent resin.

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

5.9 Crib House

5.9.1 Safety-Related Equipment

The two redundant low pressure service water electric pumps which supply water to the high pressure service water system, and the two alternate core spray diesel-driven pumps which also supply water to the high pressure service water system (HPSW) are in this area. The HPSW system is also the fire water system.

5.9.2 Combustibles

Diesel fuel oil in the pipes to the diesel pumps, and electric cable insulation are the major combustibles in this area. The diesel fuel supply tanks are buried outside, and the small gravity tank for each diesel is on the outside wall of the crib house.

5.9.3 Consequences if No Fire Suppression

The licensee's fire hazard analysis has not provided sufficient information to support a staff conclusion that safe shutdown capability would not be impaired by a fire in the crib house.

5.9.4 Fire Protection Systems

Two ionization-type smoke detectors are installed in the crib house. One is over the area of the two diesel pumps, and the other is over a cable tray near the other side of the crib house. Portable extinguishers are available from both inside and outside the crib house, and exterior 1½-inch fire hose lines are also available.

5.9.5 Adequacy of Fire Protection

The licensee's fire hazards analysis does not provide sufficient information to support a staff conclusion that safe shutdown capability would not

be impaired by a fire in the crib houses. The fuel tanks for diesels are located below the fuel pump and fuel lines to the two diesels that are not interconnected; both in deviation from the provision of NFPA 20-1975.

5.9.6 Modifications

The licensee will provide the results of an analysis which demonstrates that safe shutdown capability will not be impaired by a fire in the crib house. A locking filler cap has been provided for the diesel fuel oil storage tank filler pipe.

To improve the reliability of fire water supply, the licensee is studying the feasibility of interconnecting the fire water system with that of LaCrosse, Unit 3 (fossil plant) and include the diesel fire pump and relevant portion of fire water piping in Unit 3 in his surveillance program.

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

5.10 Yard Area and Transformers

5.10.1 Safety-Related Equipment

No safety-related equipment is in the yard area.

5.10.2 Combustibles

Major combustible materials in the yard area include 20,000 gallons of fuel oil in an aboveground tank, transformer oil in the main power transformer and reserve auxiliary transformer, and various quantities of ordinary combustibles in several warehouses and at the records storage building. The fuel oil storage tank is about 90 feet from the crib house and about 105 feet from the turbine building in a diked area capable of containing the tank contents. The two transformers are in a stone-filled yard about 8 feet west of the turbine building. The warehouses and records storage building are separated from other buildings at the plant.

5.10.3 Consequences if No Fire Suppression

An unmitigated fire involving the contents of the fuel oil storage tank will not impair the safe shutdown capability of the plant. The consequences of an unmitigated fire in one or both transformers is discussed in Section 5.1 of this report. An unmitigated fire in the warehouses or records storage building will not affect the safe shutdown capability of the plant.

5.10.4 Fire Protection Systems

Ionization-type smoke detector systems are provided in each warehouse and in the records storage building. Portable extinguishers and outside hydrants and hose are available for manual fire fighting.

5.10.5 Adequacy of Fire Protection

Fire protection for the transformers adjacent to the turbine building has not been shown adequate to preserve the safe shutdown capability of the plant in case of a fire or explosion in this area. Fire protection for other parts of the yard area, including the warehouses and records storage building, is considered adequate to preserve the safe shutdown capability of the plant in case of a fire in these areas.

5.10.6 Modifications

The licensee will install an automatic water fire suppression system to protect the turbine building from transformer fires.

We find that, subject to implementation of the above described modifications, the fire protection for the yard area and transformers complies with the requirements of Appendix A to Branch Technical Position 9.5-1 and is, therefore, acceptable.

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6.0 ADMINISTRATIVE CONTROLS

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 original licensee's description of the administrative controls is not adequate to permit a conclusion by the staff. The licensee has reviewed his administrative controls using the guidelines set forth in "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," and submitted a detailed fire plan describing how the administrative control guidelines will be met.

We are continuing to review this fire plan and will address our evaluation of the administrative controls for fire protection in a supplement to this report.

7.0 TECHNICAL SPECIFICATIONS

The Technical Specifications have been modified (License Amendment No. 10, dated February 28, 1978) 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 summary, 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. Upon implementation of the modifications summarized in Section 3, we find that the provisions of Section 2.0 are satisfied and that:

(1) Combustibles in safety-related areas are limited to the extent practicable;

(2) Fire detection and suppression systems will minimize, consistent with other safety requirements, the effects of fire on safety-related systems and will not in themselves significantly impair the capability of safety-related systems;

(3) A fire in any fire zone will not damage safety-related structures such that they cannot perform their safety function;

(4) The fire protection organization has the professional qualifications to implement the fire protection program, and administrative controls are adequate to maintain control of combustibles, ignition sources, and the fire protection organization; and

(5) A fire in any fire zone will not cause the release of amounts of radioactive material in excess of those considered in previous safety evaluations.

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.

In the report of the Special Review Group of the Browns Ferry Fire (NUREG-0050) dated February 1975, 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 the Special Review Group's conclusion that the operation of the facility need not be restricted for public safety.

> "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 1978 (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 recognize that the "Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission," NUREG/CR-0400 (The Lewis Committee Report), states that this Review Group is unconvinced of the correctness of the WASH-1400 conclusion that fires contribute negligibly to the overall risk of nuclear plant operation.

However, it is our conclusion that the operation of the facility, pending the implementation of all facility modifications, does not present an undue risk to the health and safety of the public. This is based on our concurrence with the Browns Ferry Special Review Group's conclusions identified above as well as the significant improvements in fire protection already made at the facility since the Browns Ferry fire. These include establishment of administrative controls over combustible materials and use of ignition sources, training and staffing of a fire brigade, and issuance of technical specifications to provide limiting conditions for operation and surveillance requirements on fire protection systems.

We have determined that the license 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 5.15(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

Brookhaven National Laboratory under contract to the NRC has provided the services of fire protection consultants who participated in the evaluation of the fire protection program. They have also participated in the preparation and review of this safety evaluation report. Their report, "Fire Protection in Operating Nuclear Power Stations, La Crosse Boiling Water Reactor Safety Evaluation Report Review," dated April 6, 1979 discusses many items which have been addressed in this report. The consultants' recommendations which we have not totally adopted are discussed in Appendix "B." Our basis for not adopting these recommendations is given therein.

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 Review Plan 9.5.1, "Fire Protection," was issued, incorporating the various recommendations contained in NUREG-0050.

By letter dated May 11, 1976, Dairyland Power Cooperative 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.

On May 27, 1976, Dairyland Power Cooperative replied to the Commissioner's correspondence of May 11, 1976, and indicated that the evaluation of the fire protection program at LaCrosse Boiling Water Reactor will be completed by October 1, 1976.

On February 14, 1977, Dairyland Power Cooperative submitted the fire hazard analysis for LACBWR in response to the NRC request of May 11, 1976.

By letter of June 16, 1977, Dairyland Power Cooperative was requested to submit technical specifications on existing fire protection equipment and administrative controls.

On July 20, 1977, Dairyland Power Cooperative submitted proposed addition to technical specifications in response to our request of June 16, 1977.

By letter of August 4, 1977, Dairyland Power Cooperative was requested to review the fire protection program at LaCrosse with NRC staff guidelines "Nuclear Plant Fire Protection Functional Responsibilities."

By letter of November 28, 1977, Dairyland Power Cooperative was notified that a revision to technical specifications is necessary pertaining to e protection.

On December 16, 1977, Dairyland Power Cooperative requested a meeting in Bethesda, Maryland to discuss the revision to technical specification. The meeting was held on December 19, 1977.

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On January 11, 1977, Dairyland Power Cooperative submitted revised technical specifications in response to NRC letter of November 28, 1977 and applied for an amendment to Provisional Operating License No. DPR-45.

By letter of February 3, 1978, Dairyland Power Cooperative was provided the staff guideline document entitled, "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Control and Quality Assurance," and was requested to review the fire protection program at LaCrosse for conformance with the guideline.

By letter of April 13, 1978, Dairyland Power Cooperative was provided our requests for additional information and staff positions pertaining to fire protection at LaCrosse Boiling Water Reactor.

On September 27, 1978, Dairyland Power Cooperative submitted an application for amendment to Provisional Operating License No. DPR-45 concerning fire detection. The application was approved and Amendment 14 to the license was issued on October 11, 1978.

On October 18, 1978, Dairyland Power Cooperative provided responses to staff requests of February 3, 1978 and April 13, 1978.

On October 31 - November 2, 1978 the NRC fire protection review team visited the LaCrosse Boiling Water Reactor facility. On November 2, 1978, a meeting was held in Dairyland Power Cooperative headquarters in LaCrosse at which the review team presented numerous staff positions. Dairyland Power Cooperative adopted most of these staff positions.

By letter of November 15, 1978, Dairyland Power Cooperative was requested to provide (1) the schedule for implementing the staff's positions which he agreed at the November 2 meeting to adopt, and (2) responses to the remaining staff positions which were identified, but not agreed on, during the November 2 meeting.

On December 19, 1978, Dairyland Power Cooperative provided responses to the staff requests of November 15, 1978.

On June 7, 1979, the NRC fire protection review team met the representatives of Dairyland Power Cooperative at the La Crosse Boiling Water Reactor facility to resolve the remaining open issues concerning the fire protection program at the plant.

APPENDIX B

DISCUSSION OF CONSULTANTS' REPORT

Under contract to the Nuclear Regulatory Commission, Brookhaven National Laboratory has provided the services of fire protection consultants who participated in the evaluation of the licensee's fire protection program and the preparation of the Safety Evaluation Report (SER). Their report, "Fire Protection in Operating Nuclear Power Stations - LaCrosse Boiling Water Reactors Safety Evaluation Report Review," dated April 6, 1979, presents certain recommendations and comments. The consultant's recommendations and comments which are not included in the SER, and our resolution of these matters is given below.

Valve Supervision

It is recommended that the electrical supervision (of certain fire protection system valves) be extended to (include) all sectional valves and valves controlling the supply of water for fire protection.

Staff Response

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

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

Ventilation

SER Item 4.4.1 indicates that portable smoke ejectors and flexible ducting will be provided to aid in manual smoke removal activities in the plant in addition to the installed ventilating systems which serve many plant areas, and that these measures consistute acceptable provisions for smoke removal during fires. Reevaluation of this aspect of nuclear power plant fire protection has produced additional concerns on my part.

Effective smoke removal is essentially the transporting of smoke from the fire area at a rate which will limit its effects on property and personnel to tolerable levels. Estimating the rate of generation of the smoke, and its character, are necessary first steps in evaluating the effectiveness of a smoke removal plan. The rate of generation of smoke depends on the

rate of burning, which has not been estimated by the licensee. The character of the smoke depends on the material being burned and the nature of the burning, neither of which have been adequately quantified by the licensee. Installed systems may have to be significantly altered to provide effective smoke removal in all plant areas. I would recommend that a complete evaluation of smoke generation potential and smoke removal methods be made by the licensee so that conclusions drawn by the NRC staff will have a firm technical basis.

Staff Response

Modification of the plants' ventilation system in those areas without adequate fixed smoke removal systems, is unwarranted because portable smoke removal equipment can be used and because self-contained breathing apparatus are available for the fire fighters and plant operators. The portable smoke exhaust systems are recommended by the manual fire fighting consultant's based on their evaluation of the fire fighting capabilities at this plant.

Hose Testing

SER Item 3.1.1 calls for testing of exterior hoses, but no pressure for testing is stipulated. Our consultant recommends that the exterior hoses be tested at 200 psi.

Staff Response

The requirements of the hose test are included in the technical specifications for fire protection. The test pressure of 200 psi will be specified therein.