October 9, 1998

Mr. M. Wadley
President, Nuclear Generation
Northern States Power Company
414 Nicollet Mall
Minneapolis, MN 55401

SUBJECT: NRC FIRE PROTECTION FUNCTIONAL INSPECTION (FPFI)
REPORTS 50-282/98016(DRS); 50-306/98016(DRS)

Dear Mr. Wadley:

On August 28, 1998, the NRC completed an inspection at your Prairie Island Nuclear Generating Plant. The enclosed report presents the results of that inspection.

Areas examined during the inspection included the fire protection program and the results of your recently performed Appendix R self-assessment. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

The inspectors concluded that your fire protection self-assessment project contained acceptable administrative controls to identify, track, and resolve issues; to review, identify, and control commitments; and to ensure configuration management controls were appropriate. No cited violations of NRC requirements were identified at this time. However, we were concerned that your self-assessment activities did not identify the significant safe shutdown deficiencies subsequently identified by the NRC inspection team.

During this inspection period, three apparent violations of NRC requirements were identified by the inspectors which are being considered for escalated enforcement action in accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions" (Enforcement Policy), NUREG-1600. These apparent violations pertain to: 1) the failure to identify and protect safe shutdown equipment which could be susceptible to fire damage; 2) the failure to maintain fire wrapping for safe shutdown equipment identified by NRC approved exemptions as being required to assure safe shutdown in the event of a postulated fire in Fire Areas 32 and 58/73; and 3) the susceptibility of valves to fire-induced mechanical damage as described in Information Notice 92-18. Although your preliminary reviews of these issues were documented in Licensee Event Reports 1-98-10, 1-98-12, 1-98-14, and 1-98-15, we understand that these issues are still being evaluated by your staff for safety significance. Accordingly, no Notice of Violation is presently being issued for these inspection findings. In addition, please be advised that the number and characterization of apparent violations described in the enclosed inspection report may change as a result of further NRC review of your completed analyses of safety significance. You will be advised, by separate correspondence, of the results of our deliberations on this matter.

During this inspection, we also identified that the fire-resistive performance of the Kaowool fire barrier system used extensively at Prairie Island to protect safe shutdown equipment was indeterminate. We understand that your staff has implemented and will maintain appropriate compensatory actions until this issue is resolved. We request that you respond within 30 days of the date of this letter describing your project plan for addressing this issue.

In accordance with 10 CFR 2.790 of the NRC's "Rules and Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Original /s/ J. A. Grobe

John A. Grobe, Director
Division of Reactor Safety

Docket Nos.: 50-282; 50-306
License Nos.: DPR-42; DPR-60

Enclosure: Inspection Reports 50-282/98016(DRS); 50-306/98016(DRS)

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John A. Grobe, Director
Division of Reactor Safety

Docket Nos.: 50-282; 50-306
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Enclosure: Inspection Reports 50-282/98016(DRS); 50-306/98016(DRS)

cc w/encl: Plant Manager, Prairie Island
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State Liaison Officer, State of Wisconsin
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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos:	50-282; 50-306
License Nos:	DPR 42; DPR 60
Report No:	50-282/98016(DRS); 50-306/98016(DRS)
Licensee:	Northern States Power
Facility Name:	Prairie Island Units 1 and 2
Location:	1717 Wakonade Dr. East Welch, MN 55089
Dates:	August 10 - 28, 1998
Inspectors:	David Butler, Reactor Engineer, RIII Team Leader Patrick M. Madden, Senior Fire Protection Engineer, Office of Nuclear Reactor Regulation (NRR), Technical Team Leader Doris Chyu, Reactor Engineer, RIII Kenneth Sullivan, Electrical Engineer, Brookhaven National Laboratory (BNL) Richard Deem, Reactor Systems Engineer, BNL
Approved by:	Ronald N. Gardner, Chief Engineering Specialists Branch 2 Division of Reactor Safety

Executive Summary

Prairie Island Nuclear Generating Plant, Unit 1 and Unit 2
NRC Inspection Report 50-282/98016(DRS); 50-306/98016(DRS)

The purpose of this inspection was to review PINGP's fire protection project self-assessment and to perform independent reviews, as necessary, to substantiate self-assessment conclusions and corrective actions.

Plant Support

- The inspectors concluded that the licensee's fire protection self-assessment project contained acceptable administrative controls to identify, track, and resolve issues; to review, identify, and control commitments; and to ensure configuration management controls were appropriate (Details).

- The inspectors identified that eight residual heat removal (RHR) containment sump suction valves were not analyzed in the Safe Shutdown Analysis (SSA). Spurious operation of these nonessential safe shutdown valves could cause a flow diversion that could adversely affect post-fire safe shutdown capability. This was considered an apparent violation (Section F2.1.b.1).

- The inspectors identified that conduits associated with the Train B auxiliary feedwater (AFW) pump suction valve in Fire Area 32 were missing the required one-hour rated fire barriers. In addition, the licensee identified a similar issue with conduits associated with the Train B safety injection (SI) pump suction valve in Fire Area 58/73. Therefore, the subject equipment, necessary to achieve and maintain hot standby condition, would not be free of fire damage. This was considered an apparent violation (Section F2.1.b.3).

- The inspectors concluded that the actual fire-resistive performance of the Kaowool fire barrier system installed at PINGP was indeterminate. However, the licensee implemented and will maintain appropriate compensatory measures until the Kaowool issue is resolved (Section F2.2).

- Fire door No. 62 did not meet installation criteria identified on plant drawings. In addition, the fire fighting strategies and the location of fire fighting equipment could contribute to fire brigade actions that would expose redundant post-fire safe shutdown systems to the effects of a common fire by requiring them to breach the fire barrier that separate these trains (Section F2.3).

- The inspectors identified a weakness where the licensee's timeline analysis did not assume a fire-induced transient condition so that reasonable time limits could be determined for achieving safe shutdown (Section F3.1).

- The inspectors concluded that the reactor coolant pump oil collection system assessment was comprehensive and that the licensee took appropriate corrective actions for deficiencies (Section F2.6).

- The licensee identified 32 Appendix R related motor operated valves (MOVs) that were susceptible to physical damage due to fire induced hot shorts. This was considered an apparent violation (Section F8.1).

- The licensee identified several inadequate Appendix R fire barriers and unsealed fire barrier penetrations. The inspectors concluded that the corrective actions as described in LER 50-306/98003 were adequate (Section F8.2).

- The licensee identified that the separation of pressurizer level indication channels was not in compliance with 10 CFR 50, Appendix R, Section III.G.2. The inspectors concluded that the corrective actions as described in LER 50-282/97017 were adequate (Section F8.3).

Report Details

During the week of August 10 - 28, 1998, a team of Region III, NRR and Brookhaven National Laboratories (BNL) engineers conducted the fourth planned pilot Fire Protection Functional Inspection (FPFI) at the Prairie Island Nuclear Generating Plant (PINGP), Unit 1 and Unit 2. In comparison to prior "full-scope" pilot FPFIs performed at other facilities, this inspection focused on evaluating the adequacy of the licensee's previously conducted FPFI self-assessment.

The purpose of this inspection was to validate PINGP's fire protection self-assessment project and to perform independent reviews, as necessary, to substantiate PINGP's conclusions and corrective actions. The inspectors concluded that PINGP's fire protection project self-assessment had acceptable administrative controls to identify, track, and resolve issues; to review, identify, and control commitments; and to ensure configuration management controls were appropriate. However, the inspectors identified several concerns, such as the inappropriate removal of fire wrapping from the AFW pump No. 12 suction valve control circuit conduit and not identifying eight RHR containment sump suction valves as flow diversion paths in the SSA, that had not been identified by the self-assessment. In addition, several weaknesses were identified by the inspectors in areas reviewed by the self-assessment that the self-assessment did not identify.

IV. Plant Support

F1 Conduct of Fire Protection Activities

F1.1 Systems Required to Achieve and Maintain Post-Fire Safe Shutdown

a. Inspection Scope

The inspectors reviewed the licensee's post-fire safe shutdown methods to determine if the systems defined for use to achieve and maintain safe shutdown conditions satisfied the reactor performance goals established by 10 CFR 50, Appendix R.

b. Observations and Findings

Safe Shutdown, as defined by Northern States Power (NSP), included the following plant conditions:

- Hot Shutdown: The reactor coolant system temperature is equal or greater than 350°F and K_{eff} is less than 0.99,

- Cold Shutdown: The reactor coolant system temperature is equal to or less than 350°F and K_{eff} is less than 0.99, and

- Cooldown: The transient condition between hot and cold shutdown.

The equipment and systems used to achieve and maintain hot shutdown conditions must be free of fire damage to accomplish this goal. Additionally, the equipment and

systems used to achieve and maintain cold shutdown conditions must be either free of fire damage or the damage must be limited to allow repair of the systems necessary to achieve and maintain cold shutdown conditions from either the control room or emergency control station(s) within 72 hours.

b.1 Reactivity Control Function

Reactivity controls were required to maintain the reactor core subcritical (K_{eff} < 0.99) from reactor trip through cold shutdown. The reactor could be manually tripped from the control room. Reactivity monitoring was accomplished using the excore neutron flux instrumentation in the control room or the neutron flux instrumentation located on the Hot Shutdown Control Panel. Additionally, reactivity controls were provided by the charging or safety injection pumps to inject borated water into the Reactor Coolant System (RCS) via the Chemical and Volume Control System makeup flowpath. The source of borated water was the Refueling Water Storage Tank (RWST).

b.2 Reactor Coolant System Inventory and Pressure Control

RCS inventory control employing natural circulation to cooldown was different from a normal reactor trip cooldown. With normal letdown isolated, required makeup had to be minimized to prevent the pressurizer from going solid. Therefore, the operators were required to reduce the RCS water volume during RCS cooldown. The only need for makeup was RCS boration and reactor coolant pump (RCP) seal cooling (if the RCPs were not stopped and component cooling water was unavailable for seal cooling).

The pressurizer safety relief valves provided RCS over-pressure protection in hot shutdown. During a controlled cooldown, the pressurizer power operated relief valve (PORV) and the pressurizer were designed to ensure that the RCS pressure - temperature limits were not exceeded. To prevent inadvertent RCS depressurization, the pressurizer auxiliary spray and the normal letdown flow paths were isolated. The preferred pressure control method used pressurizer level to monitor normal inventory makeup and shrinkage. The pressurizer PORV was only operated if an increased depressurization rate was required. During cooldown, RCS pressure and temperature were monitored to verify that the plant did not exceed the 25°F/hr cooldown limits.

b.3 Secondary Side Pressure and Level Control

The RCS consisted of two similar heat transfer loops connected in parallel to the reactor vessel. Each loop contained a RCP, a steam generator (SG) and associated piping and instrumentation. The RCS natural circulation capability provided a means to remove decay and sensible heat when the RCPs were unavailable. The AFW system was required to support RCS decay heat removal and to provide steam generator inventory control. The AFW system on each unit included one turbine-driven and one motor-driven pump. Both pumps could be used to feed both steam generators. Each AFW system used a condensate storage tank (CST) as its water source. In the event of a fire requiring safe shutdown, AFW flow was sufficient to restore and maintain steam generator water levels.

b.4 Process Monitoring System

The following process instruments were required for safe shutdown:

- Pressurizer Level
- Steam Generator Level
- Steam Generator Pressure
- Reactor Coolant System Temperature
- Pressurizer Pressure
- Excore Neutron flux
- CST Level
- RWST Level

These instruments provided the process monitoring information required to achieve and maintain the reactor coolant makeup, pressure control, and decay heat removal functions. Additionally, the process monitoring instrumentation supported the monitoring of natural circulation conditions, core reactivity, RCS subcooling margin, and compliance with the pressure/temperature and cooldown limits in Technical Specifications.

b.5 Support Systems

The following support systems were required for safe shutdown:

- Emergency power distribution system
- Cooling Water (CW) system
- Component Cooling Water (CCW) system
- Instrument Air system

These systems were used to perform safe shutdown required support functions, such as ac/dc power, lubrication, and process cooling.

b.6 Cold Shutdown

The RHR system was placed in service when the RCS temperature was reduced to less than 350°F. Reactor coolant was directed from the RCS to the RHR pumps through the RHR heat exchangers for heat transfer to the CCW system. The inlet (suction) lines to the RHR system were connected to the RCS hot legs and the RHR return (discharge) lines were connected to the RCS cold legs. The desired RCS cooldown rate was maintained by throttling the flow through the RHR heat exchangers.

c. Conclusions

The inspectors concluded that the post-fire safe shutdown program portions reviewed adequately described the means to limit fire damage and to ensure the capability to safely shutdown the plant. However, the inspectors identified several concerns discussed below where components and equipment may not be available to support safe shutdown.

F1.2 National Fire Protection Association (NFPA) Code Compliance Review

a. Inspection Scope

The inspectors selectively audited the licensee's code compliance review of the fire detection system, cable spreading/relay room Carbon Dioxide suppression system, and fire door installations.

b. Observations and Findings

Due to the incomplete status of the licensee's self-assessment in this area, the inspectors did not specifically select any plant fire protection feature for a detailed code compliance review. At the time of this inspection, the licensee had completed an NFPA Code of Record assessment and was developing a systematic approach for verifying code compliance. The licensee's validation of various fire protection systems, and features should be completed by December 31, 1999.

c. Conclusions

The inspectors concluded that the licensee's code compliance review plan was reasonable.

F2 Status of Fire Protection Facilities and Equipment

F2.1 Fire Protection of Safe Shutdown Capability and Associated Circuits

a. Inspection Scope

The inspectors reviewed selected fire areas to determine if structures, systems, and components that could directly or indirectly affect the plant's safe shutdown capability had been identified and evaluated. This included the following circuit analyses:

- Circuits which shared a **common power supply** (e.g., switchgear, motor control center, fuse panel) with circuits of equipment required to achieve and maintain safe shutdown

- Circuits which shared a **common enclosure**, (e.g., raceway, conduit, junction box, etc.) with cables of equipment required to achieve and maintain safe shutdown

- Circuits of equipment whose **spurious operation or mal-operation** may adversely affect the successful accomplishment of required shutdown functions.

The inspectors concentrated their review on the adequacy of protection provided for equipment whose fire-induced spurious operation or mal-operation may adversely affect the successful completion of required shutdown functions.

b. Observations and Findings

b.1 Inadequate Evaluation of Fire Damage Effects to Equipment and Systems Not Directly Required to Perform Shutdown Function

The licensee's evaluation methodology identified the required shutdown functions and the redundant systems necessary to perform these functions. Piping and instrumentation diagrams (P&IDs) of each redundant system were reviewed to identify the set of components whose operation would be required to support proper system function. From this information, a list of electrically and pneumatically operated components located in the required system flow path was compiled to produce the Safe Shutdown Equipment List (SSEL - Appendix A to SSA, GEN-PI-026). A circuit analysis was then performed to evaluate the potential effects of fire on power and control circuits for each component on the SSEL.

The inspectors reviewed the potential for rapid depressurization of the RCS due to a fire-induced initiation of pressurizer auxiliary spray, the effect of false engineered safety features (ESF) actuation signals, the effect of fire damage to nonessential equipment circuit breaker control cables and control circuit interlocks. Through a comparison of the SSEL to the plant P&IDs, the inspectors identified eight motor operated valves (MOVs) whose spurious operation or mal-operation could degrade the plant's safe shutdown capability. The following valves were not included in the SSEL:

Valve No.	Unit No.	Train
MV-32075	1	A
MV-32077	1	A
MV-32076	1	B
MV-32078	1	B
MV-32178	2	A
MV-32180	2	A
MV-32179	2	B
MV-32181	2	B

These valves were required to isolate their associated containment sump from their associated RHR pump suction line. The valves were arranged such that two in-series Train A valves were in parallel with two in-series Train B valves for each unit. The inboard containment isolation valve was located inside an enclosure that formed part of the containment boundary. For a postulated fire, multiple shorts caused by control cable damage (hot shorts) could spuriously open a series of valves providing a flow diversion path draining the RWST to Containment Sump B through the RHR system. RWST water was required for charging pump or SI pump operation during hot shutdown conditions. Assuming RCP seal failure, about 7 hours of RWST inventory was available for charging pump operation or 6.4 hours for safety injection pump operation following drain down. The licensee concluded in Condition Report 19982008 that sufficient time existed to establish another make-up source or to pump the water in containment back to the RWST. The overall probability that such an event could occur was determined by the licensee to be less than 1E-8 per reactor year. The licensee also documented this

finding in LER 50-282/98015 and committed to evaluate the valves for IN 92-18 damage concerns.

10 CFR 50.48 (a) required, in part, that each operating nuclear power plant must have a fire protection plan. This fire protection plan (SSA) must describe, in part, the means to limit fire damage to structures, systems, or components important to safety so that the capability to safely shutdown the plant is ensured. The inspectors identified that the licensee failed to include the eight RHR to Containment Sump B suction valves in the SSA and failed to evaluate this flow diversion path as susceptible to multiple spurious equipment operations. This is considered an apparent violation (EEI 50-282/98016-01; EEI 50-306/98016-01) of 10 CFR 50.48 requirements pending licensee review of the safety significance of spurious valve operation and the valves' susceptibility to mechanical damage as described in IN 92-18.

c.1 Conclusions

The inspectors concluded that failure to include the RWST to Containment Sump B suction valves in the fire protection plan and the failure to adequately evaluate the flow diversion path, was considered an apparent violation.

b.2 Potential for Fire to Cause More Than One Spurious Actuation

Section 3.8, "Spurious Operation," of the SSA (GEN-PI-026, Rev.2, 6/10/98) stated, in part, that in several fire areas redundant valves or valves of similar functions may be subject to spurious operation. The licensee further stated that the multiple spurious operations analysis relied on the guidance provided by the NRC in response to Generic Letter 86-10. Question 5.3.10 stated, "The safe shutdown capability should not be adversely affected by any one spurious actuation or signal resulting from fire in any one plant area." However, the SSA further stated, "Evaluation of the acceptability of spurious valve operation addressed the ability to fulfill the required function in the event of one spurious operation."

The inspectors informed the licensee that their interpretation of the NRC's response to Question 5.3.10 was not appropriate to the evaluation of fire-induced spurious equipment operations and may have contributed to the deficiencies identified below. The licensee indicated that whenever they identified a single fire that could cause a blockage or flow diversion due to the spurious actuation of multiple valves, they assumed that all valves may be affected and credited manual operator actions as a "backup" means to mitigate or prevent the event. As described in the following case, implementation of this approach (i.e., assumption of one spurious operation and reliance on manual operator actions in lieu of fire protection features) may result in a level of fire protection that was
not sufficient to satisfy the requirement that one train of equipment necessary to achieve and maintain hot shutdown conditions remains free of fire damage.

The inspectors identified in Fire Area 32 that AFW flow could be lost due to control cable fire-induced damage to AFW Pump 12 motor operated discharge valves (MV32381 and MV32382). The SSA assumed the loss of all Train A AFW equipment for a fire in this area. As a result, Train B AFW components (including valves MV32381 and MV32382)

were credited for accomplishing the hot shutdown decay heat removal function for Unit 1. Both valves were normally open and were used to control AFW pump discharge flow to either SG11 (MV32381) or SG12 (MV32382). To accomplish the decay heat removal function, one of these valves must be free of fire damage. Both valves and an unprotected junction box containing their control circuits were found to be located in close proximity to each other in Fire Area 32. Given this configuration, the inspectors were concerned that a fire in Fire Area 32 could damage both valve control circuits in the unprotected junction box. In response, the licensee provided the inspectors an NRC approved exemption request for this fire area. The exemption stated, in part, that only Train B conduits had to be protected. The Train B conduits to and leaving the junction box were wrapped with a 1-hour rated fire barrier. The inspectors considered the junction box to be an extension of the conduit systems. The licensee committed to enclose the unprotected junction box in a 1-hour rated fire barrier.

c.2 Conclusions

The inspectors concluded that the licensee's commitment to enclose the junction box with a fire barrier was appropriate.

b.3 Failure to Conform to Approved Exemptions - Fire Areas 32 and 58/73

In the event of a fire in Fire Area 32, Train B AFW equipment would be relied on to accomplish the hot shutdown decay heat removal function for Unit 1. However, the inspectors identified that No.12 AFW pump suction valve MV32335 control circuits would be vulnerable to fire damage in this area. Damage to these circuits could cause the normally open pump suction valve to close tripping the credited AFW pump on low suction pressure. The suction valve control circuits were routed through Fire Area 32 in a conduit which at one time had been protected by a 1-hour rated fire barrier in accordance with the approved NRC exemption for this area (ref: Letter dated May 4, 1983, From R. Clark, NRC to D. Musolf, NSP). The exemption stated, in part, that "The 'B' Division conduit in the area will be wrapped with ASTM one-hour-rated fire wrapping to ensure protection of one division and to comply with Appendix R." The licensee stated that the fire barrier wrap was removed in April 1998 under their revised SSA process and fire barrier wrap reduction program. The licensee committed to reinstall the fire barrier wrap on the Train B AFW suction valve control cable conduit. The licensee documented this finding in LER 50-282/98014 and committed to evaluate the issue's safety significance.

In the event of a fire in Fire Area 58/73, Train B SI equipment would be relied on to accomplish the hot shutdown decay heat removal function for Unit 1. The licensee identified, similar to Fire Area 32, that this area also had an approved exemption that committed to the installation of a 1-hour rated fire wrap for Train B circuits. The licensee had removed the fire wrap from the RWST suction supply valve to the SI pump in April 1998. The removal of this wrap could require operators to enter the fire affected area to manually operate the valve. Subsequent to the exit meeting, the licensee reinstalled the fire wrap on the SI suction valve control cable conduit. In addition, the licensee verified that no other fire wraps had been removed that were required to meet similar fire area exemption requests. The licensee documented this finding in LER 50-282/98012 and committed to evaluate the issue's safety significance

c.3 Conclusions

The inspectors concluded that the licensee failed to maintain the required fire protection configuration for Fire Areas 32 and 58/73 as described in an approved NRC exemption by removing the required one-hour barrier from the Train B equipment. This is considered an apparent violation (EEI 50-282/98016-02; EEI 50-306/98016-02) of 10 CFR 50, Appendix R, Section III.G.1 and III.G.2 pending licensee review of safety significance to determining whether alternate methods were available to achieve and maintain hot shutdown.

F2.2 Electrical Raceway Fire Barrier Systems Used to Protect Safe Shutdown Capability

a. Inspection Scope

The licensee, as part of their fire protection program self-assessment, also performed a "Kaowool" fire barrier system analysis. The purpose of this analysis was to confirm that PINGP had established an acceptable basis for this fire barrier system. The inspectors reviewed the technical adequacy of the "Kaowool" fire barrier material, its installation and application as a fire barrier system for the protection of safe shutdown functions, and the fire endurance testing which substantiated the fire barrier system construction/installation attributes and its ability to perform as a 1-hour rated fire barrier. The inspectors reviewed the following documents:

- Fire Protective Cable Tray Fire Test, Melvin S. Abrams, June 1979, Construction Technology Laboratories (CTL), a division of the Portland Cement Association

- Underwriters Laboratories (UL), Inc., File R8758 project 78NK5345, dated September 6, 1978, entitled "Report on Cable Raceway Protection Systems Fire Investigation for Babcock and Wilcox of Augusta Georgia."

- Ceramic Fiber Technology, Dated October 24, 1978, entitled "Tests for Fire Protection for Complete Fire Engulfment of Cable Trays and Conduits Containing Grouped Electrical Conductors," Charles E. Chaille

b. Observations and Findings

Fire protection features required to satisfy General Design Criterion (GDC) 3, "Fire Protection," included features to ensure that one train of those systems necessary to achieve and maintain safe shutdown conditions be maintained free of fire damage. One means for complying with this requirement was to separate one safe shutdown train from its redundant train with fire-rated barriers. The level of fire resistance required, 1-hour or 3-hours, depended on the other fire protection features provided in the fire area of concern.

The NRC issued guidance on acceptable methods of satisfying the regulatory requirements of GDC 3 in Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guideline for Fire Protection for Nuclear Power Plants;" Appendix A to BTP APCSB 9.5-1; BTP Chemical Engineering Branch (CMEB) 9.5-1 "Fire Protection for Nuclear Power Plants," July 1981, and Generic Letter

(GL) 86-10. In the BTPs and in GL 86-10, the staff stated, in part, that the fire resistance rating of fire barriers should be established in accordance with National Fire Protection Association (NFPA) Standard 251, "Standard Methods of Fire Tests of Building Construction and Materials." A test specimen should represent the materials, workmanship, method of assembly, dimensions, and configuration for the fire rating desired. In GL 86-10, the staff included guidance on fire test acceptance criteria and for evaluating deviations from tested configurations.

The NFPA Standard 251 fire endurance test criteria were discussed during the 1984 Appendix R implementation workshops, and in Information Notice (IN) 84-09. The NRC reconfirmed the need to have barriers fire resistance "rated" by being exposed to a "standard test fire" as defined by ASTM E-119.

The NRC in its 1984 Appendix R workshop and in GL 86-10 specifically stated that “Conduits and cable tray enclosure materials accepted by the NRC as 1-hour fire barrier prior to Appendix R (e.g., Kaowool and 3M materials) and already installed by licensees need not be replaced even though they may not have met the 325°F criteria.” In addition, the NRC provided additional guidance for evaluating newly installed raceway fire barrier systems in GL 86-10. This guidance stated, in part, “for newly identified conduits and cable trays requiring such wrapping new material which meets the 325°F criterion should be used, or justification should be provided for use of material which does not meet the 325°F criterion. This may be based on an analysis demonstrating that the maximum recorded temperature is sufficiently below the cable insulation ignition temperature.”

As stated above, the fire resistance testing acceptance criteria established by the BTPs and GL 86-10 were covered in NFPA Standard 251. This standard established the temperature rise limits for the fire barrier material unexposed surface, the barrier condition following the fire exposure and the hose stream test. The maximum average temperature rise limit established was 250°F above the ambient air temperature at the start of the test. In addition, the barrier had to withstand fire endurance and hose stream tests without passage of flame and combustion gases.

Kaowool fire barrier systems were used at PINGP to maintain one train of post-fire safe shutdown capability free of fire damage and to provide the needed assurance that one train of post-fire safe shutdown capability would be immediately available to perform their intended function. About 1100 linear feet of Kaowool raceway fire barrier material were installed. This fire barrier system was installed on aluminum cable trays and steel conduits. The licensee performed an analysis of the Kaowool electrical raceway fire barrier systems and documented the results in report No. GEN-PI-032, "Kaowool Electrical Raceway Fire Barrier Analysis," dated August 5, 1998. The purpose of this analysis was to establish an acceptable basis for the PINGP Kaowool fire barriers. The licensee's acceptance criteria for this analysis were: 1) successful cable functionality (integrity) performance against a Standard ASTM E-119 exposure fire; 2) to establish a direct relationship between independently tested and/or witnessed Kaowool raceway fire barrier configurations submitted by PINGP for NRC review; and 3) to obtain documentation from the NRC stating that Kaowool met the requirements of a 1-hour rated barrier and could be installed at PINGP.

The inspectors performed the following assessment of the licensee's Kaowool analysis:

b.1 Successful cable functionality (integrity) performance against Standard ASTM E-119 exposure fire

The licensee indicated that at the time of the Kaowool fire barrier selection and installation (1985), specific regulatory guidance had not been established to specify requirements for fire exposure type, raceway fire barrier sample size, pass fail criteria, or post-fire hose stream application. However, the NRC had provided fire barrier qualification testing guidance in BTP APCSB 9.5-1, dated July 1976. This guidance relied on the test methods, test specimen guidance and acceptance criteria (e.g., fire barrier unexposed surface temperature determination and hose stream/barrier integrity testing) established by nationally recognized testing standards such as NFPA 251/ASTM E-119. The inspectors determined that the licensee's analysis did not consider the NRC's fire barrier guidance, relied on Kaowool raceway fire barrier tests results that were performed prior to the promulgation of Appendix R, and relied on electrical circuit integrity to demonstrate fire barrier acceptability.

Typical cable installations used steel conduits and open ladder type aluminum cable trays. The inspectors reviewed the Underwriters Laboratories (UL) test report (five conduit/cable tray specimen tests), and specifically reviewed aluminum tray configuration Test No. 3. This 18" x 4" Aluminum cable tray test configuration contained a cross-sectional cable fill of about 32%. The Kaowool fire barrier system associated with this specimen consisted of 2" of Kaowool and two 1″ blankets wrapped in four foot

sections around the tray with an overlapping butt joint. The following summarizes the thermal response of test specimen No. 3:

KAOWOOL - THERMAL PERFORMANCE
TEST SPECIMEN NO. 3

TIME (MINUTES)	MAX. CABLE TEMP (° F)	CABLE TRAY TEMPERATURE
00:10	120	NOT RECORDED
00:20	200	NOT RECORDED
00:30	390	NOT RECORDED
00:40	550	NOT RECORDED
00:50	700	NOT RECORDED
01:00	(greater than) 850	NOT RECORDED

The UL post-test observations noted that the Okolon cable jacket material changed to white ash while the PVC cable jacket material decomposed exposing copper sheaths and leaving a black residue char. In addition, the test report noted that the Kaowool blanket prevented oxygen from reaching the cables and caused the cables to char rather than burn.

The cable tray specimen was tested in a small-scale furnace (furnace fire box dimensions approximately 36" x 36") and the maximum length of the 18" x 4" cable tray specimens exposed to the fire test environment was 24 inches. The inspectors determined that the test program did not bound various cable tray sizes, different radial bend types or vertical cable runs, and did not subject the test specimen to a structural fragility/impact (hose stream) test.

The inspectors compared the UL/Babcock and Wilcox (B&W) Kaowool fire barrier system test results (Test No. 3) with the NEI Thermo-Lag baseline fire barrier system tests. Since the UL/B&W (1978 test) and the NEI -Thermo-Lag baseline fire barrier tests were conducted in dissimilar furnaces and under different conditions, a direct comparison between the thermal performance of these two fire barrier systems was indeterminate. However, using engineering judgement, a reasonable comparison could be made between the thermal performance of the B&W Kaowool cable tray fire barrier test specimen and NEI Test 2-7, Tray A (a baseline 24″ wide cable tray protected by a 1-hour Thermo-Lag 330-1 fire barrier system) test specimens. It should be noted that the NRC's review of the NEI test program did not consider the Thermo-Lag 330-1 fire

barrier test specimen to meet the fire resistive performance expected for a 1-hour fire barrier. The following table summarizes the thermal performance test results:

COMPARISON - THERMAL PERFORMANCE
KAOWOOL, V.S. THERMO-LAG 330-1

TIME (MINUTES)	CABLE TEMP (°F) WRAPPED IN KAOWOOL	CABLE TEMP (°F) WRAPPED IN THERMO-LAG
00:10	120	104
00:20	200	205
00:30	390	305
00:40	550	427
00:50	700	506*
00:60	850	

* NEI (Thermo-Lag) test was terminated at 48 minutes.

The inspectors reviewed Engineering Manual Section 4.3.1-E, "Fire Barrier Construction Standard - Engineering Design, Fabrication and Installation Summary for Fire Barriers," dated May 7, 1998, and the tested Kaowool fire barrier specimen construction attributes. The cable tray fire barrier test specimen consisted of 2″ of Kaowool, two 1″ blankets wrapped in four foot sections around the tray with an overlapping butt joint. In addition, the Test No. 3 specimen had 1″ of Kaowool placed in the cable tray on top of the cables and covered the cables from tray side rail to side rail. A 1″ thick Kaowool blanket yielded a density of 9.4 pounds per cubic foot. The inner and outer Kaowool (1″ layers) fire barrier layers had a 1½′ offset in their butt joints. The horizontal seams of the fire barrier system were also offset. This seam was located on the top of the cable tray. The inner layer of Kaowool was wrapped around the cable tray. The position of the inner layer seam was at the outer edge of the cable tray where the Kaowool was overlapped toward the center of the tray by 4″. The inner fire barrier layer was held in place around the tray with fiberglass tape. The second layer of Kaowool was wrapped around the first layer with the position of the outer layer seam at the centerline of the cable tray. The Kaowool was overlapped in the same direction as the inner layer and away from the tray centerline by 4¼ ″. This assembly was then held together by hinged holding brackets formed from 1½″ wide by 0.130 inch thick steel. A steel holding bracket was installed within 3″ of each butt joint location. Each bracket was tightened and bolted together with ¼″ by 1″ machine screws. The following table identifies the differences between the

design and construction attributes of the Kaowool fire barrier test specimen (Test No. 3) and those used PINGP:

Comparison of Design and Construction Attributes
Kaowool Electrical Raceway Fire Barrier Systems

Attribute	Tested Configuration	PINGP Configuration
Kaowool (1-inch) cable tray cover	installed	not installed
Inner and Outer Butt joint over-lap	18-inches	12-inches
Horizontal seam over-lap	4-inches	3-inches
Banding	Steel bracket (1-1/2 inch wide by 0.130 inches thick)	Steel banding (no dimensions specified in engineering manual)
Spacing of banding	3-inches on either side of outer butt joint. General spacing of bands not established by this small scale test.	2-inches on either side of the outer butt joint.
Kaowool minimum density	9.4 pounds per cubic foot	8 pounds per cubic foot

The inspectors identified the following test deficiencies:

- The standard time-temperature exposure fire was not monitored by the minimum number of thermocouples as required by ASTM E-119 (NFPA 251).

- The test was a small-scale rather than a large-scale test resulting in the installation methods not representing actual plant conditions. For example, the test did not bound various plant raceway sizes (e.g., cable trays, conduits, pull boxes, junction boxes) and cable fill configurations. In addition, the test did not represent typical PINGP horizontal and vertical cable tray runs, cable tray Tee section, or radial bend fire barrier installations.

- The test specimen was not subjected to a hose stream test. Therefore, the structural barrier integrity from the effects of cooling and erosion were not evaluated.

- The fire barrier system was considered acceptable by B&W on the basis of circuit continuity monitoring. Circuit continuity does not provide an indication that the cables in the test specimen could perform their intended function during or after an ASTM E-119 exposure fire. Post-fire cable observations identified signs of insulation fire damage.

b.2 Documented results to establish a direct relationship between independently tested and/or witnessed Kaowool raceway fire barrier configurations and those submitted by PINGP for NRC review

In September 6, 1978, UL independently witnessed B&W Ceramic Fiber Technology Kaowool testing. The following UL observations were noted:

- In general, small-scale tests do not represent all factors associated with fire performance under actual field considerations. The suitability of this test method for predicting full scale performance has not been approved by UL.

- Based on circuit failure times, the tray protection systems with two complete layers of insulation protection provided 11 to 21 minutes more resistance against fire damage than a tray protection system with only one complete insulation layer.

The inspectors determined that the PINGP installed Kaowool fire barrier system was not representative of the tested configuration. In addition, this 1978 UL/B&W test report indicated that the small-scale thermal performance test did not predict fire barrier performance under full-scale conditions.

b.3 Obtain documentation from the NRC stating that Kaowool met the requirements of a 1-hour rated barrier and could be installed at PINGP

The licensee, in letters dated February 17 and March 11, 1983 and supplemented by letters dated May 16, and September 2, 1983, requested an exemption from installing an automatic fixed fire suppression system in Fire Areas 58/73 and 59/74. The NRC approved the exemption including the installation of 1-hour fire wrap materials to protect safe shutdown electrical circuits.

During this inspection, the inspectors reviewed licensee report GEN-PI-032 and its referenced Kaowool fire endurance test results. The following issues regarding Kaowool fire barrier thermal performance were identified:

- The 1978 B&W tests were not controlled or conducted under the auspices of an independent fire testing laboratory.

- The 1978 B&W tests were small-scale and did not bound the cable tray and cable fill configurations installed at PINGP. In addition, the B&W furnace was not a full scale type, therefore, the tests did not represent typical fire barrier material installations for horizontal and vertical tray runs, cable tray Tee sections, or radial bends.

- There were no records to show that the thermocouple used to control the B&W furnace was calibrated to the ASTM E-119 standard time-temperature curve or was the type specified by ASTM E-119. In addition, only one thermocouple was used during the B&W test to control furnace temperature. This configuration did not meet the ASTM E-119 standard for furnace control.

- The B&W and CTL test specimens were not subjected to a hose stream test.

- The B&W Kaowool fire barrier system acceptance criteria were based on circuit continuity monitoring not cable insulation monitoring. The cables exhibited significant signs of fire damage at the conclusion of the fire test.

- The application of Kaowool fire barrier material and the design details used to install this material on the raceways and conduits at PINGP were not consistent with the tested configurations.

In response, the licensee declared the fire resistive rating of the Kaowool fire barriers to be indeterminate until the technical issues associated with these barrier systems could be resolved and instituted appropriate compensatory measures (e.g., roving fire watch). The licensee committed to replace the Kaowool with an alternative 1-hour fire rated barrier system or to eliminate PINGP reliance on Kaowool through other design means, such as cable rerouting. In addition, this commitment would be provided by letter to the NRC. This was acceptable to the inspectors.

c. Conclusions

The inspectors concluded that the actual fire resistive performance of the Kaowool fire barrier system installed at PINGP was indeterminate. However, the licensee implemented and will maintain appropriate compensatory measures until the Kaowool issue is resolved. In addition, the inspectors concluded that the B&W 1978 fire endurance test did not provide reasonable assurance that the cables protected by the Kaowool fire barrier system would be unaffected by a standard ASTM E-119 test fire, and be capable of performing their intended post-fire safe shutdown function during and following the postulated fire exposure.

F2.3 Fire Areas 31/32 Fire Protection Design Review

a. Inspection Scope

The inspectors reviewed the design basis fire protection attributes associated with Fire Areas 31 and 32. In addition, the inspectors reviewed the fire fighting logic associated with these fire areas to determine if fire brigade actions could effect redundant post-fire safe shutdown functions.

b. Observations and Findings

The inspectors reviewed the design and installation of fire door No. 62. This door was installed in the fire barrier wall separating the Unit 1 AFW pump room (Fire Area 32) from the Unit 2 AFW pump room (Fire Area 31). The door was a UL listed sliding tin clad Class A (3-hour fire resistive rating) fire door. The door used a fusible link fastened to a bracket close to the front edge of the door as an automatic releasing device. The fusible link was installed so that its position was ahead of the door. The link was attached to a chain that passed over a sheave on the back door bumper and was fastened to the weight holder. The door was maintained in the open position and closed automatically upon thermal activation and release of the fusible link. The inspectors reviewed the door manufacturer's installation instructions and drawings, and the NFPA Code of Record relating to fire door installations. In addition, a walkdown of this door and a similar door (No. 33) installed in the turbine oil storage room was performed. The inspectors noted that the location and the number of automatic releasing devices for these doors were different. Door No. 33 had three fusible links as compared to one for door No. 62. Installation drawings indicated that the doors should be installed according to Elevation G which identified the use of multiple automatic releasing devices (e.g., fusible links). Door No. 33 was installed according to this Elevation. The inspectors determined that door No. 62 did not meet this criterion. In response, the licensee has initiated a work order to install a second fusible link. This was considered a weakness for not ensuring fire door No. 62 had been installed properly.

The inspectors noted that the turbine building pipe trench which passed through Fire Areas 31 and 32 was covered with a steel checker plate. This plate was installed to prevent burning oil from a turbine fire from flowing into the pipe trench and exposing Fire Areas 31 or 32 to the fire's effects. The inspectors requested the licensee to verify that this trench cover was covered by plant administrative fire barrier controls to ensure that the appropriate fire protection compensatory measures would be taken if the cover was removed. As a result, the licensee initiated a work order (WO9819564) to identify the trench cover as a penetration seal. This was acceptable to the inspectors.

For a fire in Fire Area 32, Unit 1 AFW Pump Room, the closest readily accessible hose station was located along column line G in the Unit 2 Turbine Building. The hose station located on the Unit 1 Turbine Building side was located between the main feedwater pumps. This hose station was located such that additional hose would have to be connected by the fire brigade for a fire in Fire Area 32. Therefore, the fire brigade would use the Unit 2 Turbine Building fire hose station and have to enter Fire Area 31 through the Unit 2 AFW pump room. This fire brigade action would breach the fire barrier wall separating the two pump rooms by opening sliding fire door No. 62 to fight a fire in Fire Area 32. The fire effects (e.g., smoke and heat) could expose Fire Area 31 to the smoke environment and impede operators from performing their required post-fire safe shutdown actions. This was considered a weak fire fighting strategy by the inspectors.

c. Conclusions

The inspectors concluded that the licensee's Code of Record self-assessment validation process would have identified that fire door No. 62 did not meet the installation criteria. This was considered a weakness for not installing fire door No. 62 correctly.

The inspectors concluded that the fire fighting strategies and the location of fire fighting equipment could contribute to fire brigade actions that could expose redundant post-fire safe shutdown systems to the effects of a common fire if a fire barrier had to be breached. This was considered a weak fire fighting strategy.

F2.4 Emergency Lighting and Communications

a. Inspection Scope

The inspectors reviewed the licensee's self-assessment to ensure that communications and emergency lighting were evaluated and properly integrated into the Appendix R safe shutdown procedures.

b. Observations and Findings

A darkened condition test had to be performed to determine the adequacy of emergency lighting. The licensee indicated that a test under somewhat darkened conditions was carried out in 1988 and recent attempts to perform a more comprehensive verification test were planned. However, the planned test involved a potential unreviewed safety question if the plant Incandescent Emergency Lighting System was disabled. The test was postponed pending resolution of the unreviewed safety question.

Hand-held radios were used to provide a secured communications capability during implementation of alternative shutdown procedures. The licensee's self-assessment determined that a fire in the relay room could render 12 of the 13 talk groups inoperable. The remaining talk group would have to support communications between the fire brigade, operations, and security. In response, the licensee developed a project plan to resolve this issue, and initiated a design change (98CU01) to re-power the auxiliary building with an uninterruptable power supply that was not routed through the MCR or relay room.

c. Conclusions

The inspectors concluded that the licensee was taking appropriate actions to address emergency lighting and communications.

F2.5 Penetration Fire Seal Review

a. Inspection Scope

The inspectors reviewed QUAD 5-80-008, "Specification for Installation of Electrical and Mechanical Penetration Seals at PINGP," dated February 24, 1992.

b. Observations and Findings

The inspectors evaluated the design and bounding test report for penetration seal No. 1153. The 3-hour fire rated RHR heat exchanger hatch opening plug consisted of a 6′ by 7′ metal frame whose top and bottom were covered with Marinite boards. The voids between the boards were filled with Kaowool. The inspectors reviewed engineering evaluation ECR No. 170 associated with this seal. However, the ECR 170 did not discuss any fire or bounding configuration tests. The inspectors were concerned that a fire could burn through the bottom Marinite boards releasing the Kaowool fire barrier material. The licensee initialed condition report No. 19982009 to evaluate the lack of a suitable engineering justification for this penetration seal.

The inspectors evaluated electrical penetration seal No. 1129A. The structures passing through this penetration, included two cable trays, three ¾″ conduits, two 1½″ conduits, and one 2″ conduit. The penetration opening was about 2′ by 3′. The penetration design specifications were documented in Section 3.2.11 of QUAD-5-80-008. However, the specification did not discuss if fire test reports existed to bound this seal design.

The inspectors evaluated penetration seal No. 1977. This penetration was not identified in QUAD-5-80-008 even though CHAMPS identified some design details on penetration drawing No. P41. However, drawing No. P41 did not show the dimensions of the tested opening, the size of the conduits or pipes passing through the penetration, the fire barrier material used, the type of wire contained in the conduits, and the parameters measured during fire testing.

The licensee recognized that many as-built penetration seal configurations were not readily supported by fire test reports. Fire Protection Procedure (FPP) 10, "Fire Penetration Seal Review Process," Revision 2, had been written to document and review the penetration seal program. As part of FPP-10, walkdowns were to be performed in October 1998 to identify penetration seal configurations that were not covered by a fire test report.

c. Conclusions

The inspectors concluded that the licensee was taking appropriate actions to address this issue. In addition, the licensee had recognized this weakness, and was developing a program to reconstitute penetration seal design and test configurations.

F2.6 Reactor Coolant Pump (RCP) Oil Collection System Review

a. Inspection Scope

The inspectors reviewed the licensee's RCP oil collection system. The following documents were reviewed:

- Project No. 97FP02-DOC-01, "Compliance Review of 10 CFR 50, Appendix R, Section III.O, RCP Lube Oil Collection System," Revision 0, dated February 15, 1998
- NRC Inspection Report 50-282/306-97004
- Project No. 21-7450-291.5, "Seismic Analysis - Oil Drip Pans for RC Pump," dated June 16, 1981
- Work Order Nos. 9715120, 9800500, and 9800499
- Design Change No. 97FP02
- Condition Report No. 19971325.
- "Request for Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50," dated April 5, 1984

b. Observation and Findings

Licensee submittal "Request for Exemption from the Requirements of Section III.O of Appendix R to 10 CFR Part 50," dated April 5, 1984, stated, in part, that a series of drip pans and deflectors were located around the pump such that the leakage from all potential pressurized and unpressurized leakage sites in the reactor coolant pump (RCP) lube oil systems were collected and piped to the adjacent floor drain which empties into Sump A in the containment basement. In addition, a series of drip pans and deflectors were located around the pumps to collect potential pressurized and un-pressurized leakage sources. Oil collected in the reactor coolant pump (RCP) lube oil collection system was piped to an adjacent floor drain which emptied into Containment Sump A. By letter dated July 31, 1984, the NRC granted an exemption to Appendix R, Section III.O, allowing the collected lube oil to be transferred to the sump before being pumped to a vented container.

During an assessment conducted by a contractor in preparation for the FPFI, the contractor identified a potential pressurized leakage site near the RCP oil lift pump. The oil lift pump was designed to operate for 2 minutes before starting its associated RCP and 1 minute following RCP start. The potential existed for this pressurized oil source to spray nearby equipment without being collected. In response, the licensee designed a stainless steel shell to enclose the oil lift pumps. Unit 1 enclosures were installed during its 1997 refueling outage and Unit 2 enclosures were installed in February 1998.

c. Conclusions

The inspectors concluded that the RCP oil collection system assessment was comprehensive and that the licensee took appropriate corrective actions.

F3 Fire Protection Procedure and Documentation

F3.1 Time-line Analysis

a. Inspection Scope

The inspectors evaluated the licensee's methods for determining alternative post-fire safe shutdown system entry conditions and fire-induced transients used to establish the time-lines associated with the implementation of critical safe shutdown functions.

b. Observations and Findings

The licensee's self-assessment identified the need to perform a time-line analysis. Subsequent to that review, a series of safe shutdown time-line calculations were documented in time-line analysis GEN-PI-030, Rev.0. The inspectors reviewed the calculations and determined that the time-line analysis was incomplete because the calculations did not consider spurious equipment operation. In addition, the licensee did not identify the worst case spurious actuation or signal during the development of the time-line analysis. This was not consistent with guidance provided by the staff in response to GL 86-10, Question 5.3.10, "Design Basis Plant Transient." Furthermore, the licensee did not consider actual operator time to perform manual actions. Specifically, the licensee's validation walkdown did not address the time necessary for operators to perform certain procedural actions such as gaining access to components, donning protective gear, and/or manipulating equipment. This was not consistent with the manual actions evaluation presented in Section 2 of the SSA which stated that "the effects of inoperability or spurious operations were considered with respect to the time available before safe shutdown would be jeopardized." This information was necessary to establish entry conditions and functional priorities for alternative shutdown procedures.

c. Conclusions

The inspector concluded that the licensee's time-line analysis was not consistent with the guidance in GL 86-10, Question 5.3.10, "Design Basis Plant Transient." This was considered a weakness. Specifically, this guidance establishes the criteria for bounding an assumed fire-induced transient condition so that reasonable time limits can be determined for achieving safe shutdown.

F3.2 Post-Fire Safe Shutdown Operating Procedures

a. Inspection Scope

The inspectors reviewed the operating procedures used to implement alternative post-fire safe shutdown (F5 Appendix B, Rev.19), and for achieving safe shutdown conditions in general plant fire areas not requiring control room abandonment (F5 Appendix D, Rev.4). The scope of review focused on ensuring functions required for post-fire safe shutdown and the corresponding equipment necessary to perform those functions were included in the procedures.

b. Observations and Findings

When the current SSA was developed, the licensee's operating philosophy assumed that operator actions specified for fires in areas other than those requiring control room evacuation could be accommodated within existing normal and off-normal operating procedures. The basis for this philosophy was that the existing operating procedures provided enough detail to enable the operators to shutdown the fire affected unit, augmented with the identification of fire affected equipment and alternative shutdown paths.

The licensee recently initiated efforts to reduce the amount of fire barrier material in the plant. As a result, manual actions were added to safe shutdown procedures. The inspectors were concerned that the safety margin may have been reduced from that which had been previously reviewed and accepted by the NRC. Based on a postulated fire in Fire Area 32, the inspectors concluded that the licensee's reliance on manual operator actions in lieu of fire protection features (1-hour rated fire barrier wrap) did not satisfy the current fire protection licensing basis. The potential existed for one train of systems necessary to achieve and maintain hot shutdown conditions to not be immediately available and free of fire damage. Additionally, the inspectors' review of the licensee's post-fire safe shutdown procedures for this area (F5 Appendix D) showed that the credited method for accomplishing hot shutdown may be lost as a result of a fire-induced AFW pump trip on low suction pressure. The procedure did not identify that pump operation could be affected for a fire in this area (also see Section F2.1.b.3)

The licensee had walked down the procedures to verify that manual actions could be performed within certain time frames (the walkdown associated with time-line verification); however, no integrated walkdown was performed to verify procedure implementation. Discussions with the licensee indicated that considerations were being given to performing an integrated alternative safe shutdown procedure walkdown verification.

c. Conclusions

The inspectors concluded that the licensee's incorporation of procedure manual actions in F5 Appendix D indicated a judgment error by the licensee when they revised the safe shutdown analysis methodology. The licensee committed to reinstall fire wraps where manual actions were mistakenly credited in the revised SSA.

F5 Fire Protection Staff Training and Qualification

F5.1 Operator Training

a. Inspection Scope

The inspectors reviewed portions of the licensee's training program to determine the adequacy of integrating the safe shutdown required actions into the overall operator training program. The inspectors also reviewed the licensee's self-assessment to ensure that operator training and re-qualification in safe shutdown procedures had been evaluated. The following documents were reviewed:

- JPM MS-1, Rev.11, Verify/Close main steam isolation valves outside the MCR

- JPM F5-4, Rev.5, Evacuate Control Room Due to Fire and Locally start D-1 Emergency Diesel Generator
- JPM F5-6-2, Rev.3, Local Start-up of D5 After MCR Evacuation

b. Observations and Findings

The licensee maintained Job Performance Measures (JPMs) for licensed operator training and re-qualification. The inspectors did not identify any deficiencies and found the JPMs to adequately reflect the current safe shutdown procedures. Additionally, the licensee's self-assessment adequately addressed operator training and re-qualification in safe shutdown procedures.

c. Conclusions

The inspectors concluded that the JPMs reviewed adequately integrated safe shutdown required actions into the overall operator training program.

F5.2 Post-Fire Safe Shutdown Implementation Staffing

a. Inspection Scope

The inspectors reviewed the operating shift and fire brigade staffing requirements to accomplish post-fire safe shutdown operations, and Administrative Procedure No. SWI-0-2, "Shift Organization, Operation and Turnover," Revision 32.

b. Observations and Findings

The licensee's procedure for implementing alternative shutdown capability from outside the main control room (MCR) (F5 Appendix B, Rev.19), stated, in part, that seven operators were required to accomplish a dual unit shutdown from outside the MCR, excluding fire brigade members. Procedure SWI-0-2 stated, in part, that the normal shift complement was 15 operators and the Technical Specification required operating shift compliment was 13. Five operators would be available to staff the fire brigade. The licensee's self-assessment showed that the minimum fire brigade staffing could be met.

d. Conclusions

The inspectors concluded that the minimum operating shift and fire brigade staffing requirements were satisfied.

F8 Miscellaneous Fire Protection Issues

F8.1 (Open) LER 50-282/306-98010: On August 7, 1998, the licensee identified that 32 Appendix R related motor operated valves (MOVs) were susceptible to physical damage due to fire-induced hot shorts. The following Appendix R credited MOVs were identified:

MV-32064, 1 reactor vessel injection isolation MV A
MV-32065, 1 reactor vessel injection isolation MV B
MV-32084, 11 RWST to 11 RHR pump isolation MV
MV-32165, 1 RCS loop a hot leg RHR supply (outside) MV
MV-32195, 1 pressurizer isolation A MV
MV-32196, 1 pressurizer PORV isolation B MV
MV-32238, 11 AFW to 11 SG MV
MV-32239, 11 AFW to 12 SG MV
MV-32333, 11 TD AFW pump suction from CST
MV-32167, 2 reactor vessel isolation MV A
MV-32168, 2 reactor vessel isolation MV B
MV-32187, 21 RWST to 21 RHR pump isolation MV
MV-32193, 2 RCS loop A hot leg RHR supply (outside) MV
MV-32197, 2 pressurizer PORV isolation A MV
MV-32198, 2 pressurizer PORV isolation B MV
MV-32246, 22 AFW to 21 SG MV
MV-32247, 22 AFW to 22 SG MV
MV-32345, 22 TD AFW pump suction from CST MV
MV-32383, 21 AFW to 21 SG MV
MV-32336, 21 MD AFW pump suction from CST MV
MV-32382, 12 AFW to 12 SG MV
MV-32335, 12 MD AFW pump suction from CST MV
MV-32085, 11 RWST to 12 RHR pump isolation MV
MV-32094, 12 RHR heat exchanger CC inlet MV
MV-32202, SI test to 11 RWST isolation MV A
MV-32203, SI test to 11 RWST isolation MV B
MV-32382, 12 MD AFW pump discharge to 12 SG MV
MV-32188, 21 RWST to 22 RHR pump isolation MV
MV-32129, 22 RHR heat exchanger CC inlet MV
MV-32204, Si test to 21 RWST isolation MV A
MV-32205, SI test to 21 RWST isolation MV B
MV-32231, 1 RCS loop B hot leg RHR supply (outside) MV
MV-32233, 2 RCS loop B hot leg RHR supply (outside) MV

The license initiated hourly fire watches in the affected areas as compensatory measures.

As part of the PINGP fire protection project self-assessment, the licensee re-evaluated NRC Information Notice (IN) 92-18, “Potential for Loss of Remote Shutdown Capability During a Control Fire.” Initially, the licensee determined that the MOVs were protected by their individual thermal overload. However, a valve weak-link analysis was not performed to determine if the valves could be mechanically damaged due to fire induced

spurious operation (hot shorts) that bypassed the valve limit or torque switches. If a valve suffered mechanical damage, an operator may not be able to reposition the valve to support safe shutdown during a fire. The safe shutdown procedures at Prairie Island rely on operator manual valve manipulations. Subsequently, the licensee has determined that 16 valves per unit could be effected. The licensee initiated a calculation to determine if any of the valves would sustain mechanical damage. Preliminary results indicate that the valves would retain their pressure boundary capability. Evaluations were continuing to determine if manual valve operation would be affected.

10 CFR 50, Appendix R, Section III.G.1 requires that fire protection features be provided to limit fire damage so that one train of systems necessary to achieve and maintain hot shutdown is free of fire damage. Section III.G.2 specifies separation requirements for cables and equipment, including associated circuits, as a means of ensuring that one redundant train of safe shutdown equipment remains free of fire damage. The licensee identified for those 32 valves that they had not ensured they would remain free of fire damage due to fire induced hot shorts in the valve control circuitry. This item is considered an apparent violation (EEI 50-282/98016-03; EEI 50-306/98016-03) of 10 CFR 50, Appendix R, III.G.2. The safety significance of this apparent violation is continuing to be evaluated.

The licensee identified the following corrective actions:

- Compensatory actions will be maintained in each affected fire area until the MOVs affected in that fire area have been evaluated or modified.

- Re-evaluate MOVs to identify alternate shutdown systems, components, or flow paths that were not susceptible to damage and revise the Safe Shutdown Analysis accordingly.

- Modify MOVs mechanically to prevent mechanical damage, such as a smaller motor.

- Modify MOVs electrically to prevent hot short susceptibility, such as opening the MOV circuit breaker or rewiring the MOV control circuit.

- Submit a schedule for completing corrective actions when the engineering reviews have been completed.

The licensee stated in LER 50-282/98010 that significant engineering reviews remain to be completed to determine the best solution for each valve.

The inspectors initiated an LER review. However, since additional licensee reviews have to be completed, the inspectors could not fully evaluate the safety significance of the hot short issue.

F8.2 (Closed) LER 50-306/98003: Inadequate Appendix R fire barriers and unsealed fire barrier penetrations. In the first instance, the door and trench beneath the door between Fire Areas 66 and 70 did not meet the 3-hour fire rating requirement. A vent was added to the door, however, the trench was not provided with a 3-hour fire barrier. A postulated

fire in these areas could render both direct current (DC) power trains inoperable. As a result, breakers at Buses 25 and 26 in the D5 and D6 buildings could not be remotely operated. Operations Manual Section F5, Appendix B, "Control Room Evacuation(Fire)," Revision 19, dated July 9, 1998, provided guidance on how to manually operate the breakers . In addition, a postulated fire in this area could cause a loss of MCC 2AC1 and 2AC2. This would result in the loss of process monitoring capability in about one hour. These MCCs could be re-powered from Unit 1 by using unit operating procedures 1C20.8 and 2C20.8, "Instrument AC Distribution System."

In the second instance, the licensee identified unsealed penetrations between Fire Areas 74 and 75. Fire area 74 contained Train A and B safe shutdown equipment. Train B was designated as the protected train. Fire Area 75 contained only Train B equipment, therefore, Train A equipment was designated as the safe shutdown path. There were 14 unsealed floor penetrations between these areas. For a postulated fire in either area, the wide range pressure, wide range level, Loop B hot leg temperature, and Loop B cold leg temperature instruments were effected. The licensee implemented appropriate compensatory measures and planned to seal these openings by the end of 1998. However, the failure to provide adequate 3-hour rated fire barriers between Fire Areas 74 and 75 is considered a violation of 10 CFR 50, Appendix R, Section III.G.2.a. This non-repetitive, licensee-identified and corrected violation is being treated as a non-cited violation (NCV 50-306/98016-04), consistent with Section VII.B.1 of the NRC Enforcement Policy. This item is closed.

F8.3 (Closed) LER 50-282/97017: Separation of pressurizer level indication channels not in compliance with 10 CFR 50, Appendix R, Section III.G.2. The licensee identified that the existing pressurizer level channel cable routings inside containment did not maintain the required 20′ cable separation between level transmitters 1LT-433 and 1LT-426. This condition did not exist on Unit 2.

In response, the licensee installed a noncombustible radiant heat shield around cabling to transmitter 1LT-433. However, the failure to provide adequate pressurizer level channel cable separation inside containment is considered a violation of 10 CFR 50, Appendix R, Section III.G.2.. This non-repetitive, licensee-identified and corrected violation is being treated as a non-cited violation (NCV 50-282/98016-05), consistent with Section VII.B.1 of the NRC Enforcement Policy. This item is closed.

F8.4 (Closed) VIO 50-282/306-98012-03: Failure to complete penetration surveillance inspection. The inspectors identified that eight penetration seals had not received their required 18-month visual inspection. The licensee initiated work order (WO) 9704500 to inspect the eight seals. Seven seals were found acceptable with the remaining seal requiring minor repairs. The licensee quarantined Surveillance Procedure (SP) 1192, "Safeguards Electrical and Mechanical Penetrations Surveillance Inspection," Revision 7, use until a sign off sheet could be developed to better document that all visual penetration seal inspections had been completed. In addition, the licensee was developing more explicit operability inspection criteria to be included in Maintenance Procedure D52, "Installation Guidelines for the Permanent & Temporary Sealing of Electrical/Mechanical Openings Between Established Fire Areas." This item is closed.

F8.5 (Closed) IFI 50-282/306-97012-04: A lack of acceptance criteria for determining emergency lighting unit battery failure voltage and emergency light aiming. The inspectors reviewed Surveillance Procedure (SP) 1785, "Safe Shutdown Emergency Lighting Monthly Test," Revision 3, which now included final battery voltage and lamp aiming criteria. This item is closed.

F8.6 (Closed) VIO 50-282/306-97012-06: Failure to correctly implement Administrative Work Instruction (AWI) 5AWI 3.13.0. Originally, the licensee gave credit for control room coverage during fire brigade drills to meet the annual drill requirement. This was done by crediting on-shift individuals even though they did participate in the fire drill. The licensee has since stopped this practice. Currently, fire protection personnel review drill critique sheets and only credit those individuals who participate in the fire drill. The inspectors reviewed the August 4, 1998, fire drill critique sheets and concluded that proper drill participation credit had been given. This item is closed.

F8.7 (Closed) IFI 50-272/306-97012-07: Development of a training tracking system for fire brigade members. Fire protection personnel developed a qualification and training matrix for all brigade members. The matrix included fire drill dates, hands-on training dates, annual training dates, and respirator fit testing dates. The inspectors reviewed several fire drill reports and verified that the matrix was up-to-date. This item is closed.

F8.8 (Closed) URI 50-282/306-97012-08: Requirement for the number of drills required for each brigade member per year. This inspectors identified that the licensee's administrative process required each brigade member to participate in at least one fire drill per year. In a letter to the NRC, dated May 2, 1979, the licensee stated, in part, that drills will be scheduled so that each fire brigade member will participate in at least two drills per year. This statement was consistent with the two drills per year as discussed in Generic Letter 86-10. This licensee was unable to locate any documentation which changed the requirement of two drills per year expectation to one drill per year. The licensee revised Plant Safety Procedure F5 Appendix J, "Fire Drills," Revision 5, to require individual fire brigade member to actively participate in at least two drills per year. This item is closed.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management on August 28, 1998. In addition, the inspectors re-exited with the licensee by telephone on September 22, 1998. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

K. Albrecht, General Superintendent Engineering
T. Amualdson, General Superintendent Engineering
R. Best, PRA/IPEEE Engineering
K. Carlson, Engineering
J. Goldsmith, Engineering
J. Hill, Quality Manager
K. Holmstrom, Fire Detection System Engineer
K. Kivi, Licensing
T. Lillehei, Electrical Engineering
S. Northarp, Manager-Nuclear Projexts
B. Peterson, Design Basis Documents
T. Silverbergs, General Superintendent Operations
B. Sitek, Fire Protection Engineer
J. Sorensen, Plant Manager
P. Valtakis, Engineering
M. Wadley, President Nuclear Generation and CNO
M. Werner, FPFI Plant Sponsor

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P. Barbeduro
R. Bashall
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J. Human
C. Moulton
D. Neve
G. Thomforde

NRC

P. Krohn, Resident Inspector, Prairie Island
S. Thomas, Resident Inspector, Prairie Island

INSPECTION PROCEDURES USED

TI 2515/XXX	Fire Protection Functional Inspection
IP92904	Followup - Engineering

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-282/306-98016-01	EEI	Failure to identify 8 RHR valves as essential equipment for potential draining RWST.
50-282/306-98016-02	EEI	Failure to maintain the required fire protection features for 12 AFW pump suction valve in Fire Area 32 and Train B SI pump suction valve in Fire Area 58/73.
50-282/306-98016-03	EEI	MOVs susceptible to mechanical damages as described in IN 92-18
50-306/98016-04	NCV	Inadequate Appendix R fire barrier and unsealed fire barrier penetration
50-282/98016-05	NCV	Separation of pressurizer level indication channels not in compliance with 10 CFR 50, Appendix R, Section III.G.2.

Closed

50-306/98016-04	NCV	Inadequate Appendix R fire barrier and unsealed fire barrier penetration
50-282/98016-05	NCV	Separation of pressurizer level indication channels not in compliance with 10 CFR 50, Appendix R, Section III.G.2.
50-282/98010	LER	32 Appendix R related MOVs susceptible to physical damage by fire induced hot shorts.
50-306/98003	LER	Inadequate Appendix R fire barrier and unsealed fire barrier penetration
50-282/97017	LER	Separation of pressurizer level indication channels not in compliance with 10 CFR 50, Appendix R, Section III.G.2.
50-282/306-98012-03	VIO	Failure to complete penetration surveillance inspection.
50-282/306-98012-04	IFI	A lack of acceptance criteria for determining emergency lighting unit battery failure voltage and emergency light aiming.
50-282/306-98012-06	VIO	Failure to correctly implement administrative procedure.
50-282/306-98012-07	IFI	Development of a training tracking system for fire brigade members.
50-282/306-98012-08	URI	Requirement for the number of drills required for each brigade member per year.

PARTIAL LIST OF DOCUMENTS REVIEWED

Letters, Reports, and Analyses

1. GEN-PI-026, Rev.2, dated 6/17/98, “Safe Shutdown Analysis”

2. GEN-PI-030, Rev.0, dated 7/18/98, “Safe Shutdown Procedure Time-line Verification”

3. GEN-PI-032, "Kaowool ELECTRICAL Raceway Fire Barrier Analysis," dated August 5, 1998.

4. Calculation ENG-ME-58, Rev.0, “Control and Relay Room Cooling”

5. Report FPP-8, “Review the Adequacy of Appendix R Post-Fire Shutdown Procedures, dated 8/14/98

6. Prairie Island Fire Protection preparation Project, Question and Issue Database, dated 8/12/98

7. Northern States Power Prairie Island Station Fire Protection Program Assessment Final Report, Proto-Power Corporation Project No: 16-030, June 5, 1998

8. Letter from: D. Musolf, NSP, to: Director NRR, Fire Protection Safe Shutdown Analysis and Compliance with Section III.G of Appendix R, Including Requests for Relief, June 30, 1982

9. Letter from: D. Musolf, NSP, to: Director NRR, Clarification of Information Provided in Support of Request for Exemption From Requirements of 10 CFR Part 50, Appendix R, Section III.G, October 22, 1982

10. Letter from: D. Musolf, NSP, to: Director NRR, Clarifying Information in Support of Exemption Requests for Fire Areas 58, 59, 73, and 74, May 16, 1983

11. Letter from: D. Musolf, NSP, to: Director NRR, Supplementary Information to Exemption Request for Fire Areas 58, 59, 73, and 74

12. Letter from: J. Sorensen, NSP, to: U.S. NRC, Transmittal of Fire Protection Program Self Assessment, July 13, 1998

13. Letter from: D. Musolf, NSP, to: Director NRR, Fire Protection Safe Shutdown Analysis and Compliance with Section III.G and III.O of 10 CFR 50, Appendix R

14. NRC Inspection Manual Temporary Instruction 2515/XXX, Fire Protection Functional Inspection (FPFI), Draft, April 6, 1998

15. NSP Design Basis Document for the Fire Protection/Appendix R, DBD TOP-6, August 7, 1998

16. Underwriters Laboratories (UL), Inc., File R8758 project 78NK5345, dated September 6, 1978, entitled "Report on Cable Raceway Protection Systems Fire Investigation for Babcock and Wilcox of Augusta Georgia."

17. Ceramic Fiber Technology, Dated October 24, 1978, entitled "Tests for Fire Protection for Complete Fire Engulfment of Cable Trays and Conduits Containing Grouped Electrical Conductors," Charles E. Chaille.

18. Engineering Manual Section 4.3.1-E, Fire Barrier Construction Standard - Engineering Design, Fabrication and Installation Summary for Fire Barriers, Dated May 7, 1998.

19. Fire Protective Cable Tray Fire Test, Melvin S. Abrams, June 1979, Construction Technology Laboratories, a division of the Portland Cement Association (William H. Zimmer Nuclear Power Plant).

20. FPP-5, NFPA Code Compliance Review, Revision 1, dated July 9, 1998

21. NFPA No. 80-1968, Fire Doors and Windows

Drawings

1. Piping and Instrument Drawings:	NF39222, NF39218, NF88740, NF39245, NF39216, NF39223, NF39219, NF39250, NF39246, NF39217,NF39244, NF39232, NF39603, XH-1-31, XH-1-44.
2. Single Line Diagrams:	NF40022, NF40301, NF40302, NF92880, NF40018, NF94831, NF40547, NF40528, NF94831, NF40422, NE119871, NF40002, NF40416, NF116742, and NF11641.
3. Architectural Door Schedule	NF38542

LIST OF ACRONYMS USED

AFW	Auxiliary Feedwater
APCSB	Auxiliary and power conversion system branch
AWI	Administrative work instruction
BNL	Brookhaven National Laboratory
BTP	Branch Technical Position
CCW	Component cooling water
CFR	Code of Federal Regulations
CMB	Chemical Engineering Cranch
CST	Condensate storage tank
CTL	Construction Technology Laboratory
CW	Cooling water
DC	Direct Current
DRS	Division of Reactor Safety
EEI	Escalated Enforcement Item
ESF	Engineered safety feature
FPFI	Fire protection functional inspection
FPP	Fire protection procedure
GDC	General design criterion
GL	Generic Letter
IFI	Information Followup Item
IN	Information Notice
IP	Inspection Procedure
JPM	Job performance measure
LER	Licensee Event Report
MCR	Main Control Room
MOV	Motor operated valve
NEI	Nuclear Electric Institute
NFPA	National fire protection association
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSP	Northern States Power Company
P&ID	Piping and instrumentation diagram
PINGP	Prairie Island Nuclear Generating Plant
PORV	Power operated relief valve
RCP	Reactor coolant pump
RCS	Reactor coolant system
RHR	Residual Heat Removal
RWST	Refueling water storage tank
SG	Steam generator
SI	Safety Injection
SSA	Safe shutdown analysis
SSEL	Safe shutdown equipment list
TI	Temporary Instruction
UL	Underwriter Laboratory
URI	Unresolved Item
VIO	Violation