SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
CONSUMERS POWER COMPANY
BIG ROCK POINT PLANT
DOCKET NO. 50-155
ALTERNATIVE SHUTDOWN CAPABILITY - APPENDIX R TO 10 CFR PART 50

1.0 INTRODUCTION

On February 17, 1981, the fire protection rule for nuclear power plants, 10 CFR 50.48 and Appendix R to 10 CFR 50, became effective. This rule required all licensees of plants licensed prior to January 1, 1979, to submit by March 19, 1981 (1) plans and schedules for meeting the applicable requirements of Appendix R, (2) a design description of any modifications proposed to provide alternative safe shutdown capability pursuant to Paragraph III.G.3 of Appendix R, and (3) exemption requests for which the tolling provision of Section 50.48(c)(6) was to be invoked. Section III.G of Appendix R, "Fire Protection of Safe Shutdown Capability," was retrofit to all pre-1979 plants regardless of previous SER positions and resolutions.

The staff's previous fire protection Safety Evaluation Report dated April 4, 1979, concerning Branch Technical Position APCSB 9.5-1, indicated that in several areas redundant systems could be damaged by a single fire which would affect safe shutdown. The staff requested the licensee to provide alternative shutdown capability for the following areas of the plant: the control room, the electrical equipment room, the exterior cable penetration room, the containment electrical penetration area, the condensate pump room, and the turbine generator room.

By submittals dated March 19, 1981; April 1, 1981; May 19, 1981; September 24, 1981; February 25, 1982; July 9, 1982; and September 28, 1982, the licensee described proposed modifications to the Big Rock Point plant to meet the requirements of Appendix R to 10 CFR 50, Item III.G. Additional information and clarification was obtained through a telephone conference on July 8, 1981, and through meetings at

the plant on July 28, 1981, and September 8 and 9, 1982.

2.0 DISCUSSION OF SYSTEMS USED FOR POST-FIRE SAFE SHUTDOWN

A. Systems Required for Safe Shutdown

Safe shutdown is initiated from the control room by a manual scram of the control rods. In order to maintain primary system inventory, the CRD pumps will be used to provide make-up water. For hot shutdown, decay heat removal will be accomplished using the main feedwater system including the turbine bypass valve and the main condenser. If the main feedwater system is unavailable due to a fire or loss of offsite power, the emergency condenser will be used for decay heat removal. The demineralized water system or the fire water system will provide make-up water to the emergency condenser.

For cold shutdown, decay heat removal will be accomplished using the shutdown cooling water system and the reactor cooling water system. The service water system or the fire water system will be used to service the reactor cooling water system heat exchangers.

The above systems will be monitored and controlled from the control room or the auxiliary shutdown control station and local control stations. Power for operation of the above systems will be provided by the offsite power source or the diesel generator and a 125V battery source.

B. Areas Where Alternative Safe Shutdown is Proposed

The NRC staff, in its fire protection SER dated April 4, 1979, requested that the licensee provide alternative shutdown capability for the control room, the electrical equipment room, the exterior cable penetration room, the containment

electrical penetration area, the condensate pump room, and the turbine generator room. By letter dated March 19, 1981, the licensee indicated that the alternative shutdown capability modifications would provide the capability for safe hot shutdown via the emergency condenser in the event of a fire in the control room, the electrical equipment room or any other areas (including those previously listed above) containing equipment, circuitry or power sources supporting the condensate, feedwater, and condenser systems. Repairs are utilized to provide the capability for cold shutdown in these areas.

C. Remaining Plant Areas

The proposed alternative shutdown modifications provide the capability for safe hot shutdown for a majority of the plant areas. In the event of a fire in the remaining plant areas, systems in separate fire areas exist to assure safe cold shutdown.

In the event of a fire which destroys both control rod drive pumps, coincident with a loss of offsite power, the low pressure make-up system would be used to maintain primary system inventory. A cooldown rate which reduces primary system pressure to allow use of the low pressure make-up would be used. Low pressure make-up is provided by the fire system through the core spray valves. Water level would be maintained above the top of the core. Other safe shutdown functions would not be effected by a fire in the control rod drive pump area.

In the event of a fire which destroys the CRD booster pump, coincident with a loss of offsite power, low pressure make-up would be provided by the fire system through the core spray valves as described above. For hot shutdown, decay heat would be removed by the alternative shutdown system. The cold shutdown function would not be effected by a fire in the area of the CRD booster pump.

In the event of a fire which destroys both shutdown cooling system pumps, coincident with a loss of offsite power, the normal cold shutdown capability would be lost. The licensee indicated that the preferred method of operation would be to use the emergency condenser to maintain hot shutdown conditions (just above 212°F). Hot shutdown conditions would be maintained until the shutdown cooling system pumps could be repaired. Cold shutdown capability does exist without repair; however, use of this method is not preferred by the licensee. Cold water could be added to the primary system by use of the control rod drive pumps or the fire water system. Warm water would then be bled off thorugh the normal cleanup system blowdown path. This method would eventually reduce primary system temperature below 212°F (cold shutdown).

In the event of a fire which destroys both reactor cooling water pumps, coincident with a loss of offsite power, the same procedures as described above for loss of the shutdown cooling system pumps would be used. The same procedures would also be used in the event of a fire in the screenhouse which disables both fire water pumps.

The two diesel generators are located in separate areas and would not be disabled by a single fire.

D. Alternative Safe Shutdown Systems

The alternative shutdown capability consists of the auxiliary shutdown control station and power supply. The auxiliary shutdown control station and power supply will be located in and within the immediate vicinity of the core spray equipment room. The panel, components and cabling located in the core spray equipment room

will be separated from the core spray equipment by a 3-hour rated fire barrier. The auxiliary shutdown control station will contain controls for the emergency condenser outlet valves, the main steam isolation valve and the valves for fire water make-up to the emergency condenser and instrumentation for reactor pressure, drum level and emergency condenser water level. The power supply will be a 125V battery.

The design of the auxiliary shutdown control station includes transfer switches which disconnect the valve operator, its power supply and its control system from the main control panel in the control room. Operation of the transfer switches at the auxiliary shutdown control station will be annunciated in the main control room. The transfer switches can be used to electrically isolate the auxiliary shutdown control station from the control room fire; however, the transfer switches cannot be used to electrically isolate the control room from a fire at the auxiliary shutdown control station. The discussion of the effects of a fire at the auxiliary shutdown control station is contained in the succeeding paragraphs.

A fire which destroys the control/power cables of the emergency condenser outlet valves (this includes a fire at the auxiliary shutdown control station) or a fire which results in a hot short and maloperation of the control cables for the emergency condenser inlet valves (closure) would disable the emergency condenser. In the event of a fire disabling the emergency condenser, the main feedwater system or the control rod drive pumps and the main condenser, would be used to achieve safe shutdown if offsite power was available. If offsite power was not available and the emergency condenser was disabled by a fire, the reactor depressurization and core spray systems could be used to achieve cold shutdown. However, the reactor depressurization and core spray systems could not maintain the reactor coolant system process variables within those predicted for

a loss of normal ac power. Thus, the licensee, by letter dated September 28, 1982, requested an exemption from Section III.L of Appendix R as it pertains to the criteria of the alternative shutdown system.

The licensee provided the following justifications for the exemption request.

(1) The likelihood of a fire involving the control/power cables of the emergency condenser outlet valves and a coincident random loss of offsite power is extremely remote. A random loss of offsite power is needed because the alternative shutdown system and its power supply do not connect to the offsite power distribution buses. Additionally (as stated in the staff's SER dated April 4, 1979), due to the small size of the Big Rock plant compared to the system capability, it is relatively unlikely that trips of the plant due to a fire would cause a loss of offsite power.

(2) A fire involving the control cabling of the emergency condenser inlet valves could disable the emergency condenser only if the circuits for both valves were shorted and maloperation of both valves occurred.

(3) The reactor depressurization and core spray systems do not maintain the primary system process variables within those predicted for a loss of normal ac power; however, the integrity of the fission product boundary would not be adversely affected by a shutdown utilizing these systems.

The control/power cables of the emergency condenser outlet valves from the alternative shutdown panel to the outlet valves will be separated from the reactor depressurization and core spray system by one of the methods identified in Section III.G.2 of Appendix R. The control cables of the emergency condenser inlet valves will be separated

from the reactor depressurization and core spray system by one of the methods identified in Section III.G.2 of Appendix R except for the control room and the deck of the steam drum enclosure. For these two areas, the licensee has requested an exemption from the requirements of Appendix R, Section III.G.2. This exemption is addressed in the Fire Protection SER (Enclosure 3 to the letter which forwarded this SER to the licensee). The use of the reactor depressurization and core spray system for shutdown was accepted for SEP Topic VII-3, "Systems Required for Safe Shutdown," review. Therefore, since the emergency condenser is separated from the reactor depressurization and core spray system and since the use of reactor depressurization and core spray system is an acceptable method of shutdown, we conclude that the exemption from Section III.L is acceptable.

3.0 EVALUATION

A. Performance Goals

For post-fire shutdown, the performance goals of the alternative safe shutdown capability will be met using the existing systems and equipment listed in Section A above. Reactivity control will be provided by a manual scram of the control rods from the control room. Reactor coolant make-up will be provided by the control rod drive pumps. Decay heat removal will initially be provided by the emergency condenser and then by the shutdown cooling water system for cold shutdown. Process monitoring for safe shutdown will be provided by the instrumentation at the auxiliary shutdown control station. The instrumentation at the control panel will provide steam drum level, steam drum pressure, emergency condenser low-level alarm, indication of make-up fire water flow to the emergency condenser and battery off-normal alarm. The support systems available will be the reactor cooling water system, fire water system, 125V battery and diesel generators.

B. 72-Hour Requirement

The alternative shutdown systems have the capability of achieving cold shutdown within 72 hours. The alternative shutdown systems can accomplish cold shutdown using only onsite power sources.

C. Repairs

In the event of a fire in the control room, the electrical equipment room (cabling spreading area), the exterior cable penetration or the containment, the licensee has provided a method for the repair of the power cables to the pumps which are needed for safe shutdown. The licensee's contingency plan provides for repair of power to a control rod drive pump, the control rod drive booster pump, a shutdown cooling water pump, a reactor cooling water pump and a spent fuel pool cooling pump.

The licensee's proposed modification includes the installation of a new power feeder through containment near the containment equipment lock. The power cable for one control rod drive pump will be rerouted through the new power feeder electrical penetration to a dual interlocked nonautomatic circuit breaker. The breaker will switch the control rod drive pump motor to either its normal source (a 480V source) or an alternative source. The alternative source will be provided by a power cable which will be installed and connected to the diesel generator. Cabling will also be available to connect the control rod drive booster pump motor to the new power feeder being supplied by the diesel generator.

The above described repair does not comply with Section III.G.1 of Appendix R in that the repair is required for hot shutdown. Appendix R allows repairs only to cold shutdown equipment. Thus, the licensee has requested an exemption from this

requirement of Appendix R for the control rod drive pump and booster pump. The licensee has provided the results of an analysis which indicates the primary system make-up would not be needed for 9 hours. The analysis assumed the maximum system leakage and a slow cooldown rate. Additionally, to facilitate the repairs, the replacement cabling will be provided properly sized with plug-in connector. Since the pumps are not needed for 9 hours assuming conservative conditions and since the repair is well planned, we conclude that the exemption from Section III.G.1 is acceptable.

Repairs for cold shutdown will consist of providing power for a shutdown cooling pump, a reactor water cooling pump, and a spent fuel pool cooling pump. The repair will consist of connecting a power cabling from the needed pump motor to the new power feeder inside containment. A power cable would then be connected from the power feeder outside containment to a diesel generator if it had not been provided for the control drive pump. The pumps would be controlled locally at the pumps.

Procedures will be prepared for all repairs. Material needed for the repairs will be stored onsite.

D. Associated Circuits

By letter dated September 28, 1982, the licensee provided the results of their associated circuits review for the control room, electrical equipment room (cable spreading area), turbine generator building, condensate pump room, exterior penetration room and containment. The results identified the associated circuits of concern in these areas and the proposed methods for protecting the safe shutdown capability from fire-induced failures of these circuits. The proposed methods for

protecting the safe shutdown capability are consistent with the guidelines provided by the staff.

1. Power Source Case - For hot shutdown, the alternative shutdown system is provided with a dedicated battery power source. For all fire areas there are no power circuits connected to the alternative shutdown system's dedicated power supply. For cold shutdown, the licensee will utilize repairs to restore power to essential pumps.

2. Spurious Signal Case - The licensee's analysis identified a number of circuits whose fire-induced failures may adversely affect the safe shutdown capability. The licensee has proposed methods for protecting the safe shutdown capability consistent with the severity of the problem. For prevention of a possible fire-induced LOCA, the power for the redundant electrically controlled valves at the high/low pressure interface of the shutdown cooling system will be disconnected prior to raising the pressure of the reactor coolant. For maloperation that has delayed effects on safe shutdown operation or that would prevent operation of cold shutdown equipment, the licensee will utilize manual operations or repairs to overcome spurious operations caused by a fire. Some repairs simply consist of disconnecting the damaged circuitry to permit manual operation of the valve. The licensee has verified that sufficient time exists to perform the repair or manual operation before safe shutdown is adversely affected.

3. Common Enclosure Case - The licensee has identified two control room panels and a motor control center (MCC) in the electrical equipment room that constitute a common enclosure. The control room panel contains the controls and indication

for emergency condenser outlet valves and the main steam isolation valves. These valves are also controlled from the auxiliary shutdown control station and can be electrically isolated from the control room panels by the transfer switches at the auxiliary shutdown control station. The MCC in the electrical equipment room is a common enclosure to the control rod drive pump and all other MCC circuits. However, the control rod drive pump can be electrically isolated from the MCC by the transfer switch provided at the new power feeder located outside the containment equipment lock.

E. Safe Shutdown Procedures and Manpower

The licensee will develop and implement written procedures for obtaining a safe shutdown condition given a fire event. This commitment is documented in a licensee's letter dated May 19, 1981. The manpower necessary for safe shutdown from either the control room or the auxiliary shutdown control station is available. No fire brigade members are included in the shutdown manpower requirements.

The licensee will provide Technical Specifications concerning operability of the auxiliary shutdown control station. Each refueling outage, the emergency condenser outlet valves and the main steam isolation valve will be demonstrated to be operable from both the control room and the auxiliary shutdown control station.

4.0 CONCLUSION

Based on our review, we conclude that the licensee's request for exemption from Section III.G.1 of Appendix R concerning repair of the control rod drive pump and booster pump is acceptable. Also, the licensee's request for exemption from Section III.L of Appendix R concerning use of the reactor depressurization and core spray systems is acceptable. The design of the Big Rock Point plant provides one

train of systems necessary to achieve and maintain hot conditions from either the control room or the auxiliary shutdown control station. Additionally, systems necessary to achieve and maintain cold shutdown within 72 hours are available. Therefore, we conclude that Big Rock Point plant complies with the requirements of Section III.G of Appendix R as it pertains to systems with the exception noted above. Additionally, the proposed alternative shutdown system complies with the requirements of Section III.L of Appendix R with the exception noted above.

5.0 ACKNOWLEDGEMENTS

This evaluation has been prepared by N. Fioravante.

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