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COMPREHENSIVE REVIEW AND EVALUATION OF THE NEW YORK POWER AUTHORITY REPORT

"SAFE SHUTDOWN CAPABILITY REASSESSMENT 10CFR50 APPENDIX R J.A. FITZPATRICK NUCLEAR POWER PLANT"

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Enclosure

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EXECUTIVE SUMMARY

By letter dated October 26,1992 the New York Power Authority (NYPA) forwarded to NRC a report titled "Safe Shutdown Capability Reassessment 10CFR50 Appendix R." This report documents the results of a reassessment of the post-fire safe shutdown capability of the J.A. FitzPatrick Nuclear Power Plant. At the request of the NRC Office of Nuclear Reactor Regulation, the Engineering Technology Division of Brookhaven National Laboratory (BNL) performed a comprehensive review of the Licensee's post-fire safe shutdown methodology and analysis of associated circuits, as described in the above referenced submittal. This report provides the results of the evaluation. The review concentrated on Post-Fire Safe Shutdown Capability, Associated Circuits and the Licensee's separation analysis methodology.

NYPA has developed four shutdown methods (Method 1, 2, 3, and 4) capable of bringing the plant to a cold shutdown condition in the event of fire. The capability of each shutdown method to meet the post-fire, safe shutdown performance goals of Appendix R was evaluated.

With the exception of Method 3, the methods proposed by the Licensee to accomplish safe shutdown are acceptable. Method 3 relies on the use of low-pressure injection systems (ADS/LPCI or ADS/CS) from the control room in the event of fire in areas not requiring an alternative shutdown capability, Shutdown Method 3 proposes the use of low pressure injection systems (ADS/LPCI or ADS/Core Spray) as a means of achieving safe shutdown conditions in the event of fire in five (5) areas (Fire Areas IX, X, XI, XVII, and XVIII). These areas are described in the Licensee's revised analysis as satisfying the separation/protection requirements of Section III.G.2 of Appendix R. The use of low pressure injection systems represents a change from the Licensee's previously approved methodology which only credited the use of low pressure injection systems as an alternative shutdown capability in one area (Fire Area XV, Torus).

The Licensee's proposed reliance on the use of low pressure injection systems to achieve safe shutdown conditions in the event of fire in areas not requiring alternative shutdown does not satisfy Appendix R Section III.G.1 to the extent that its use will not allow hot-shutdown conditions to be maintained. Additionally, this approach does not satisfy the shutdown system performance criteria of Section III.L of the regulation. As discussed in Section V of Information Notice 84-09, the shutdown system performance criteria of Section III.L are also applicable to non-alternative shutdown systems. As a result of this finding, it is recommended that the Licensee ensure the availability of a high pressure injection system (i.e., RCIC or HPCI) in the event of fire in Fire Areas IX, X, XI, XVII, and XVIII, or seek an exemption from the regulation. Details of this issue are discussed in Section 2.3.2 of this report.

The Licensee's Appendix R separation analysis methodology was found to be satisfactory. The Licensee's analysis was performed systematically and was based upon detailed review of the FitzPatrick as-built condition and proposed modifications. The safe shutdown separation analysis was performed using an interactive data base management system to collect information on a fire area basis. The data base was computer processed

through various constraints and iterations to determine the systems, components, cables, manual actions, procedures, and modifications required to demonstrate achievement of a safe shutdown capability for each plant fire area.

1. REVIEW CRITERIA

The criteria used in reviewing the Licensee's submittal are contained in the following documents:

1. "Fire Protection Program for Operating Nuclear Power Plants," 10CFR50 Appendix R, (45 FR76611, November 19, 1980, and 46 FR 44735, September 8, 1981).

2. Generic Letter 81-12, dated February 20, 1981

3. NRC Memorandum To: D.G. Eisenhut From: R.J. Mattson, SUBJECT: "Fire Protection Rule Appendix R" dated March 22, 1982 (Clarification of Generic letter 81-12)

4. NRC Memorandum TO: R.H. Vollmer, From: R.H. Mattson, SUBJECT: "Position Paper on Allowable Repairs for Alternative Shutdown and the Appendix R Requirements for Time Required to Achieve Cold Shutdown," dated July 21, 1982.

5. Generic Letter 83-33, dated October 19, 1983

6. NRC IE Information Notice 84-09, "Lessons learned from NRC inspections of Fire Protection Safe Shutdown Systems"

7. NRC IE Information Notice 85-09, "Isolation Transfer Switches and Post-Fire Safe Shutdown Capability"

8. Generic Letter 86-10, "Implementation of Fire Protection Requirements," April 24, 1986

2. POST-FIRE SAFE SHUTDOWN CAPABILITY

2.1 Separation of Safe Shutdown Functions

Where components of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside the containment, the Licensee has provided one of the following three means of ensuring that one train of safe shutdown equipment remains free of fire damage: (1) Separation of equipment, cabling and associated circuits of redundant safe shutdown systems by a fire barrier having a 3-hour fire rating; (2) Separation of equipment, cabling and associated circuits of redundant safe shutdown systems by a horizontal distance of more than 20 feet free of intervening combustibles or fire hazards (in addition, automatic fire detection and suppression systems are installed in such areas); and (3) Separation of equipment, cabling, and associated circuits of redundant safe shutdown systems by a fire barrier having a 1-hour fire rating (in addition, automatic fire detection and suppression systems are installed in this area).

The Licensee's criteria for providing fire protection for safe shutdown functions satisfies Section III.G of Appendix R, and, therefore, is acceptable.

2.2 Post-Fire Safe Shutdown Methodology - General Plant Areas

2.2.1 Analysis Methodology

The Licensee's methodology for assessing compliance with the separation/ protection requirements of Section III.G of Appendix R consisted of: (1) determining the required plant functions (e.g., reactivity control, decay heat removal, etc.) necessary to achieve and maintain safe shutdown conditions; (2) developing safe shutdown logics that describe the various methods available to accomplish the required shutdown functions; (3)developing an interactive safe shutdown data base management system that identifies locations of equipment, routing of cables, power sources, power and control cables for shutdown related equipment and sort this information on a fire area basis; (4) identifying one or more safe shutdown methods for each plant fire area; (5) relocating cables and equipment, providing fire barriers and fire detection and suppression systems so as to meet the separation/protection requirements of Section III.G. of Appendix R.

The Licensee's post-fire safe shutdown analysis methodology conforms to the requirements of Appendix R to 10 CFR 50, and is, therefore, acceptable.

2.3 Safe Shutdown Capability

Safe shutdown conditions are achieved when the reactor is subcritical, the reactor coolant inventory is above the top of the core and decay heat is being removed at a rate that is approximately equal to its generation. The Licensee's safe shutdown analysis demonstrates that redundancy exists for systems needed for hot and cold shutdown, and has developed four shutdown methods capable of achieving safe shutdown conditions in the

event of a fire. The four methods are: (1) HPCI operated from the control room, (2) RCIC operated from the control room, (3) CS or LPCI operated from the control room, and (4) LPCI operated from the alternative control stations.

Shutdown of the reactor and initial reactivity control are accomplished by control rod insertion (scram) from the control room or by alternate means outside the control room. Reactor coolant inventory is provided by isolation of the RCS and the use of either high or low pressure injection systems. Decay Heat Removal is initially accomplished by the RHR system in the suppression pool cooling mode. The alternate shutdown cooling mode of RHR (water solid) provides long term core cooling necessary to achieve and maintain cold shutdown conditions.

2.3.1 Evaluation of Post-Fire Safe Shutdown Systems

For post-fire safe shutdown, Appendix R to 10CFR50 provides the following performance goals as criteria for achieving and maintaining safe shutdown conditions:

- **Reactivity Control**: capable of achieving and maintaining cold shutdown reactivity conditions. (For FitzPatrick cold shutdown is defined as a plant condition in which the reactor is subcritical and the reactor coolant temperature is less than 212° F).

- **Reactor Coolant Makeup**: capable of maintaining the reactor coolant level above the top of the core .

- **Decay Heat Removal**: capable of removing decay heat and provide sufficient capability to allow the transition from hot to cold shutdown conditions

- **Process Monitoring**: capable of providing direct readings of the process variables necessary to perform and control the above functions

- **Support Functions**: capable of providing the process cooling, lubrication, etc., necessary to permit the operation of the equipment used for the above safe shutdown functions

In accomplishing the shutdown performance goals outlined above, the equipment and systems used to achieve and maintain hot shutdown conditions should remain free of fire damage and capable of maintaining such conditions for 72 hours, using offsite or on-site emergency power.

2.3.1.1 Reactivity Control Function

Reactivity control is accomplished by insertion of the control rods, either automatically by the Reactor Protection System or manually by operator action to initiate a reactor trip (scram). A manual scram may be accomplished from the control room or by alternate means outside the control room by opening RPS trip breakers in the relay room, opening the output

breakers for the RPS Motor Generator Sets in the East and West Electric Bays or by isolating and venting the CRD instrument air header. Verification of control rod insertion is also available outside the control room at the Hydraulic Control Unit Scram Valves.

2.3.1.2 Reactor Coolant Makeup Control Function

Reactor Coolant Makeup will be achieved by isolation of the Reactor Coolant System (RCS) and the use of either a high or low pressure injection system to control coolant level in the reactor. The High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) systems provide water injection at high pressure using steam turbine-driven pumps that are normally aligned to draw suction from the Condensate Storage Tank (CST). The Licensee states that the CST is of sufficient capacity to replace water lost from the reactor vessel for over eight hours. If required, operators may align the HPCI or RCIC pumps to the suppression pool.

For fire events that may render the normally preferred high pressure injection systems unavailable, the analysis credits the use of the Automatic Depressurization System (ADS) valves in conjunction with Core Spray (CS) or Low Pressure Coolant Injection (LPCI) mode of the Residual Heat Removal (RHR) system. With this approach, the ADS valves are manually actuated to rapidly depressurize the reactor to a point below the shut-off head of one pump of the Core Spray or RHR system (LPCI mode). The CS or LPCI pumps take suction from the suppression pool. The Licensee's proposed use of low pressure injection systems in areas not requiring an alternate shutdown capability is discussed further in Section 2.3.2 of this report.

To ensure RCS inventory and pressure control, the integrity of the RCS pressure boundary must be maintained. The Licensee states that maintaining RCS pressure boundary integrity will be accomplished by the Reactor Vessel Isolation/High Low Pressure Interface System (RVIS/High Low). This system, which was specifically created by the Licensee to address Appendix R High/Low pressure interface concerns, provides the capability to isolate the main steam isolation valves and other valves connected to either the reactor vessel or reactor recirculation piping. Operation of the RVIS/High Low system is required regardless of the system being used to provide reactor coolant makeup.

2.3.1.3 Reactor Coolant Pressure Control Function

Prior to a controlled cooldown and depressurization, the isolated reactor vessel is protected from overpressurization by eleven (11) relief valves that mechanically self-actuate when pressure is greater than their setpoints. To provide a controlled depressurization of the reactor vessel (maximum 100°F/hr cooldown rate), each of the eleven relief valves is provided with remote-manual operating capability.

2.3.1.4 Decay Heat Removal

In the event of a reactor trip coincident with a loss of off-site power, decay heat will initially be removed by natural circulation within the reactor and mechanical operation of the Relief Valves (RVs). Steam discharged from the RVs is condensed in the suppression pool.

Cooling of the suppression pool will be accomplished by the RHR system in the suppression pool cooling mode. The Licensee states that separate analyses performed by General Electric (GE), demonstrate that one RHR heat exchanger loop, in the suppression pool cooling mode, is sufficient to maintain suppression pool temperatures within acceptable limits. These analyses include the case where low pressure injection systems are used to accomplish safe shutdown.

2.3.1.5 Process Monitoring

The process monitoring capability provided to accomplish post-fire safe shutdown includes the following instrumentation:

- Reactor Pressure
- Reactor Water Level
- Suppression Pool Temperature
- Suppression Pool Level
- Drywell Temperature
- Drywell Pressure

The Licensee states that sufficient diagnostic instrumentation (e.g., flow and pressure) for the HPCI, RHR, RCIC, and CS systems is available to monitor system performance.

The instrumentation provided by the Licensee satisfies the requirements of Appendix R for post-fire safe shutdown, and is, therefore, acceptable.

2.3.1.6 Support Functions

Systems and equipment available to support post fire safe shutdown include:

- AC Emergency Power System - includes EDGs, EDG support components and distribution system switchgear
- 125 V DC Emergency Power System
- Emergency Service Water (ESW) System
- Essential HVAC

With the exception of the Licensee's proposed use of low pressure injection systems as a means of accomplishing reactor coolant Makeup function in the event of fire in areas not requiring an alternative shutdown capability, the systems identified by the Licensee for achieving and maintaining safe shutdown in the event of fire are acceptable.

2.3.2 Use of Low Pressure Injection Systems in the event of fire in areas not requiring an alternative shutdown capability (Fire Areas IX, X, XI, XVII and XVIII)

Discussion:

Section III.G.1.a of Appendix R requires one train of systems necessary to achieve and maintain hot shutdown conditions to remain free of fire damage. Additionally, the safe shutdown system performance criteria specified in Section III.L.1 and III.L.2 of Appendix R to 10CFR50 require, in part, that during the post-fire shutdown the reactor coolant system process variables remain within those predicted for a loss of normal a.c. power and that the reactor coolant makeup function be capable of maintaining the reactor coolant level above the top of the core.

By letter dated February 13, 1984, the NRC staff issued Information Notice 84-09 (IN 84-09), "Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems (10 CFR 50 Appendix R)." The stated purpose of IN 84-09 was to provide guidance to power reactor facilities conducting analyses or making modifications to implement the requirements of Appendix R. With regard to safe shutdown systems and components identified in the fire hazard analysis or associated documentation, Section V of IN 84-09 states, in part: "The systems and equipment needed for post-fire safe shutdown are those systems necessary to perform the shutdown functions defined in section III.L of Appendix R...The acceptance criterion for systems performing these functions is also defined in Section III.L...These guidelines apply to the systems needed to satisfy both Section III.G and III.L of Appendix R."

Based on the staff guidance provided in IN 84-09, the safe shutdown performance criteria of Section III.L appear to be applicable to all fire areas, including those for which an alternate shutdown capability is not required (i.e. fire areas that satisfy the redundant train separation criteria of Section III.G.2 of Appendix R).

The Licensee proposes the use of ADS/LPCI or ADS/CS as a means of achieving and maintaining post-fire safe shutdown conditions in fire areas which do not require an alternate shutdown capability. However, this approach will not allow hot shutdown conditions to be maintained, and will result in a short-term uncovery of the core. Therefore, its use does not appear to satisfy Sections III.G or L of the regulation.

Evaluation:

The Licensee's revised (1992)analysis proposes the use of low pressure injection systems (ADS/LPCI or ADS/Core Spray) as a means of achieving safe shutdown conditions in the event of fire in five (5) areas not requiring an alternative shutdown capability. Specifically, these areas include:

Fire Area IX, Reactor Building East Side El. 272',
Fire Area X, Reactor Building West Side El.272',
Fire Area XI, South Cable Tunnel El 286',
Fire Area XVII, Reactor Building East Crescent Area,
and Fire Area XVIII, Reactor Building West Crescent Area.

This represents a change from the Licensee's previously approved methodology which only credited the use of low pressure injection systems as an alternative shutdown capability and in the event of fire in Fire Area XV (Torus). The use of low pressure injection systems in lieu of the normally preferred high pressure systems (i.e., HPCI or RCIC) in the event of fire in these areas has been previously evaluated and approved by NRC in separate exemptions granted on a case-by-case basis. Specifically, by letters dated April 26, 1983, September 15, 1986, and September 10, 1992, the NRC granted exemptions approving the use of ADS/LPCI as an alternate shutdown capability in the event of a fire in Fire Area VII (Control Room, Relay Room and Cable Spreading Room), Fire Area ID (North Cable Tunnel) and Fire Area XVI (Battery Rooms Corridor Area).

By letter dated May 18, 1994 the staff forwarded a Request for Additional Information (RAI) to the Licensee seeking additional information and clarification with regard to the Licensee's proposed methodology. In its response, dated July 22, 1994, the Licensee states that in its view the safe shutdown system performance requirements specified in Section III.L apply only when alternate or dedicated shutdown systems are used to achieve and maintain cold shutdown. The Licensee's position appears to be based on its determination that since ADS/LPCI or ADS/Core Spray are not considered to be an alternate shutdown capability, the five additional areas in which it proposes to credit their use do not need to satisfy the system performance criteria specified in Section III.L of Appendix R. Based on this interpretation, the Licensee concludes that an exemption from the performance requirements of Section III.L is not required. The use of low-pressure injection systems (ADS/LPCI or ADS/CS) is not a preferred means of achieving safe shutdown conditions in a BWR. In its response to the staff's RAI, the Licensee concurs with this position and states that this approach (i.e. ADS/LPCI or ADS/Core Spray) will only be used when all other means of shutting down the reactor are not available or when the use of high pressure systems must be avoided. While not the preferred approach, ADS/LPCI and ADS/CS do provide an approved capability for shutting down the reactor and, as discussed in NRC Memorandum From: L. S. Rubenstein, To: R. J. Mattson, dated December 3, 1982, have been accepted by the staff for use as an alternative shutdown capability (emphasis added). It is important to note that the staff has only categorically accepted the use of low pressure injection systems without an exemption as a means of providing an alternative shutdown capability. The basis for this acceptance rests, in part, with the fact that Section III.G.3 of Appendix R requires fire detection and fixed fire suppression systems to be installed in all areas requiring an alternative shutdown capability. The additional fire safety features provided for these areas serve to limit the probability of fire growth and damage thereby reducing the plant's reliance on the alternate capability to accomplish safe shutdown conditions. Under the regulations, areas of the plant which do not require an alternate shutdown capability may not be provided with an equivalent level of fire protection.

Conclusion:

The provisions of Sections III.L.1 and III.L.2 of Appendix R require that systems relied on to achieve safe shutdown be capable of maintaining the reactor coolant level above the top of the core. NRC staff interpretations and guidance, as presented in Information Notice 84-09 and NRC Memorandum From: L. S. Rubenstein, To: R. J. Mattson, dated December 3, 1982, indicate that the performance criteria of Section III.L are applicable to systems

provided to satisfy Section III.G of Appendix R (i.e. non-alternate shutdown systems) and the use of low pressure injection systems (ADS/LPCI or ADS/Core Spray) without an exemption from Section III.L is generally accepted only as an alternative shutdown capability. Additionally, from a review of historical fire protection licensing issues related to the J. A. FitzPatrick post-fire safe shutdown capability, it appears that in cases where the Licensee had previously proposed the use of low pressure injection systems it had recognized that the system performance limitations did not satisfy specified performance criteria, and requested an exemption.

The Licensee's stated position with regard to the applicability of shutdown system performance criteria contained in Section III.L of the regulation appears to contradict NRC staff position presented in Section V of Information Notice 84-09.

Based on the above, it is recommended that the Licensee change the shutdown method for the 5 areas in question, or seek an exemption from the safe shutdown performance criteria of Sections III.L.1 and III.L.2 of Appendix R for Fire Areas IX, X, XI, XVII and XVIII. The exemption process will enable the staff to fully evaluate the Licensee's proposed approach against the specific fire hazards and protection features provided for each area in a manner that is consistent with previous licensing actions.

2.4 Alternate Shutdown Capability

2.4.1 Areas Requiring Alternate Shutdown Capability

A fire occurring in the following areas has the potential to prevent shutdown from the control room:

- Fire Area VII; consisting of the Control Room, Cable Spreading Room and Relay Room
- Fire Area ID; North Cable Tunnel at 286' El.
- Fire Area XVI; Battery Rooms Corridor Area

The Licensee has provided an alternate shutdown capability that is independent of the main control room for the above areas. The alternate shutdown system utilizes existing plant systems and equipment as identified in Section 2.2, in conjunction with ten (10) remote and auxiliary control stations from which post-fire safe shutdown can be accomplished. The alternative shutdown capability includes a Remote Shutdown Panel, designated 25-RSP, and five alternate shutdown panels, designated 25-ASP-1, 2, 3, 4, and 5. The doors of each panel are key-locked and are provided with anti-tampering switches which alarm in the control room when the doors are opened. In addition the alternative shutdown capability relies on the use of the following four local control stations:

(1) The Automatic Depressurization System (ADS) relief valve control panel (02ADS-71) located adjacent to the Remote Shutdown Panel (25-RSP). This panel provides local control capability for eleven safety relief valves

(2) The local control panels for Emergency Diesel Generator (EDG) B and D located in the Diesel Generator Room and in the Emergency Switchgear Room. In addition to providing electrical isolation of the EDGs from the control room, these panels provide local control, indication and metering capabilities for the B and D EDGs and the 4.16kV Emergency Bus Breakers.

(3) The reactor building vent and cooling panel located near 25ASP-1, which contains isolation switches for the Division B Crescent Area Coolers, and

(4) Instrumentation rack 25-6 located opposite the Remote Shutdown Panel 25-RSP.

Where necessary, the alternate shutdown systems include transfer/isolation switches to provide electrical isolation of safe shutdown components from the fire affected areas. The Isolation/Transfer switch design complies with the operability guidelines for alternate shutdown systems outlined in Information Notice (IN) 85-09.

The Licensee states that communications necessary to coordinate operator activities outside the control room are available and emergency lighting units, having an 8-hour rating, are provided to enable operators to perform required activities.

The Licensee states that actions required to achieve stable hot shutdown conditions can be accomplished within the first thirty (30) minutes following control room evacuation by six operating personnel (five operators and an Engineer on Shift). Within thirty (30) minutes from the initiation of the fire event, required safe shutdown systems and components will be available such that reactor vessel depressurization and RHR/LPCI injection can be performed. The Licensee states that the extended operator action time of 30 minutes has been evaluated in an analysis performed by GE which concluded that the thirty minute operator action time does not pose any threat to the fuel cladding integrity or the suppression pool integrity. The adequacy of the GE analysis has been reviewed previously by NRC in evaluations dated April 26, 1983 and September 15, 1986 and found to be acceptable.

2.4.3 Safe Shutdown Procedures and Manpower

For alternate shutdown from outside the main control room the Licensee has developed plant abnormal operating procedure AOP-43, Plant Shutdown from Outside the Control Room. The procedure contains the steps necessary to implement ADS/LPCI method of shutdown from remote and auxiliary shutdown panels outside the main control room. The Licensee states that sufficient plant staff and time are available to accomplish safe shutdown.

2.4.4 Repairs

No repair activities are required to achieve hot shutdown conditions. With the exception of establishing emergency ventilation fans for the Battery Room and Emergency Service Water Pump Rooms discussed below, no repair activities are required to achieve cold shutdown conditions.

A fire in the Battery Room Corridor, Station Battery Charger Room A, Station Battery Room A, Station Battery Charger Room B, Station Battery Room B, Control Room, Relay Room, or Cable Spreading Room, may cause the loss of Station Battery Room and Charger Room ventilation equipment. In the event of fire in these areas the Licensee has developed abnormal operating procedure AOP-58, Station Battery Room Emergency Ventilation, to provide operator guidance for establishing an emergency ventilation capability through the use of portable fans powered from a mobile diesel generator. The restoration of ventilation for these areas is not an immediate operator action. The Licensee states that the establishment of emergency ventilation within two hours is sufficient to ensure continued operability of the charger and battery.

The restoration of Battery Room ventilation is not an immediate operator action and all required activities are governed by written procedures. On this basis, the Licensee's method of providing an emergency ventilation capability for the Station Battery Room in the event of fire in the Battery Room Corridor, Station Battery Charger Room A, Station Battery Room A, Station Battery Charger Room B, Station Battery Room B, Control Room, Relay Room, or Cable Spreading Room, is acceptable.

A fire in certain areas of the plant may render the Safety-Related Pump Room Ventilation System inoperable. Fire damage to this system could impact the operability of RHR and ESW SW pumps. The establishment of area ventilation is described by the Licensee in its procedures as a long term action item to accomplish safe shutdown. In its 1992 submittal, the Licensee states that a plant modification has been implemented to assure area cooling of one train of RHRSW/ESW pumps during a postulated fire. Required modifications will be completed by the end of the next refueling outage. In the interim, the Licensee has implemented procedures (AOP-28, Section 10) which provide direction for operators to use portable fans powered by a mobile diesel generator as a temporary compensatory measure.

Pending the Licensee's completion of proposed modifications necessary to achieve long-term compliance, the proposed interim measures of providing emergency ventilation to the Safety-Related Pump Room are acceptable.

The alternative shutdown capability provided for a fire in Fire Area VII, consisting of the Control Room, Cable Spreading Room and Relay Room; Fire Area ID, North Cable Tunnel at 286' El.; and Fire Area XVI, Battery Rooms Corridor Area, meets the requirements of Appendix R and is, therefore, acceptable.

3. ASSOCIATED CIRCUITS

3.1 Common Power Supply Associated Circuit Concern

The common power supply associated circuit concern arises when equipment required for safe shutdown shares a common power source (e.g., switchgear, MCC, circuit breaker or fuse panel) with non-safe shutdown equipment and fire-induced electrical faults in the non-essential loads will cause a loss of the power source due to inadequate fire protection features (i.e. protection per Section III.G of Appendix R) or circuit protective device coordination. Proper coordination of electrical protection devices ensures that the protective device located nearest the fault will operate prior to any protective device located upstream of a required power source.

As part of the conduct of its safe shutdown separation analysis, the Licensee identified all required electrical power sources. Protection for the associated circuit common power supply was then demonstrated by the performance of circuit coordination studies. These studies confirmed that Proper coordination per Appendix R exists and that required power supplies are adequately protected. Where circuits were identified as not being properly coordinated they were included as required circuits in the Appendix R separation analysis.

The Licensee has also evaluated for the effects of fire-induced high-impedance faults on power cables associated with required power supplies. If it was determined that the total load current resulting from such faults was greater than the trip setting of the main supply breaker, a high-impedance fault concern was identified and compensatory actions (i.e., shedding of non-essential loads) are taken to isolate the faulted cables.

The Licensee's method of protection for the common power supply associated circuit concern satisfies Appendix R requirements and is, therefore, acceptable.

3.2 Common Enclosure Associated Circuit Concern:

The common enclosure associated circuit concern occurs when non-safe shutdown circuits are routed together with cables of required equipment and they are not provided with a suitable level of electrical protection, or fire can destroy both circuits due to inadequate fire protection features.

The Licensee states that all electrical distribution equipment and cabling is provided with suitably sized electrical fault protective devices which provide the necessary degree of protection from electrical fault and overload conditions. Additionally, the Licensee states that fire stops are placed between safe shutdown raceways where a fire could propagate and damage redundant divisions.

The Licensee's method of protection for the common enclosure associated circuit concern satisfies Appendix R requirements, and is, therefore, acceptable.

3.3 Spurious Signal Concern

As part of its Appendix R safe shutdown separation analysis the Licensee analyzed safe shutdown and associated circuit cables for potential spurious signal concerns. When cables of equipment whose spurious operation could affect safe shutdown were identified they were then included as required cables into the Appendix R separation analysis. The identified cables and equipment were then treated in the same manner as active and passive main and support components required to achieve and maintain safe shutdown of the reactor in the event of fire.

The Licensee's method of protection for the spurious signal associated circuit concern satisfies Appendix R requirements, and is, therefore, acceptable.

3.4 High/Low Pressure Interfaces

A high/low pressure interface consists of the boundary between the high pressure reactor coolant system and any low pressure system piping. In the event of a fire-initiated spurious opening of valves which comprise the high/low pressure interface boundary, a flow path would develop into the low pressure system piping resulting in an unisolable loss of coolant accident (LOCA).

The following are high/low pressure interfaces: RHR Shutdown Cooling Isolation Valves and the RHR Steam Condensing Isolation and Control Valves. The means for preventing the spurious operation of these valves is as follows: Spurious operation of RHR Shutdown Cooling Isolation Valve interface is precluded by pre-fire strategy to ensure that the remote disconnect switch for one valve 10MOV-18) is locked open during normal power operation. Spurious operation of the RHR Steam Condensing Isolation Valve interface is precluded by pre-fire strategy to ensure that the feedbreaker of the affected valves is locked open during normal power operation. It should also be noted that in addition to the pre-fire strategy of de-energizing the high/low pressure interface components during power operation, the Licensee has been granted an exemption (reference: NRC SER dated April 26, 1983) from the requirement to provide protection against simultaneous three-phase AC and two-wire DC circuit faults.

As part of its analysis, the Licensee has identified the following reactor coolant system boundary valves whose fire-induced spurious operation, while not causing a breach of a high/low pressure interface, would cause a significant loss of inventory: HPCI Steam Line Isolation Valves, RCIC Steam Line Isolation Valves, Main Steam Line Isolation Valves, Main Steam Line Drain Isolation Valves, Main Steam Relief Valves, and RV Head Vents. The Licensee has evaluated the potential for spurious operation of these valves on a fire area basis. Where necessary, plant modifications have been implemented to ensure the isolation of these valves.

The Licensee's method of protection for High/Low pressure interfaces is in accordance with Appendix R requirements and Generic Letter 86-10, and is, therefore acceptable.

4. CORRECTIVE ACTIONS

During its post-fire safe shutdown reverification and separation analysis the Licensee identified conditions of non-compliance with Appendix R and has initiated permanent corrective actions necessary for their resolution. Conformance measures include the following modifications:

4.1 LPCI Alternate Power Supply Circuit Modification

This modification provides a control scheme which will enable plant operators in the control room, to isolate the LPCI injection valve independent power supplies and connect a maintenance bypass (Alternate Feed) from another safety related emergency MCC in the same safety division to the valve bus.

4.2 Upgrade of CST Level Instrument Loop Power Supply

The Condensate Storage Tank (CST) level instrumentation loop is powered from a non-UPS backed power source. In the event of a loss of offsite power, CST level indication would be lost. To ensure continuous CST level indication, this modification provides an uninterruptable source for CST level instrumentation.

4.3 Isolation of Main Steam Isolation Valves

The existing MSIV isolation capability did not satisfy Appendix R requirements. Specifically, there was no provision to isolate the AC and DC solenoid control circuits for the MSIVs at the at Auxiliary Shutdown Panel 25ASP-1. Therefore, a fire-induced hot short resulting from fire in the control room, could keep either the AC or DC solenoids, or both, from de-energizing, thereby preventing closure of the MSIVs.

This modification installs four dedicated Isolation Switch/Indication Light Modules (one module for each of the four MSIVs) on a new Auxiliary Shutdown Panel (25ASP-4) located outside the control room at elevation 300' of the Administration Building. The AC and DC coil circuits and indicating light circuitry are isolable from 25ASP-4.

4.4 Isolation of Safety Relief Valves

There are eleven DC operated Safety Relief Valves (SRVs), of which seven Automatic Depressurization System (ADS) valves are automatically controlled by relay logic circuits. The remaining four SRVs are manually controlled. For each valve, one of the two solenoids is operable from the control room. The other solenoid is operated from the Local SRV Control Panel (02ADS-071) located at the 300' elevation of the Reactor Building. The solenoids are powered from redundant DC power sources. In the event of fire requiring control room evacuation, all eleven SRVs can be operated manually at the Local SRV Control Panel. However, there was no provision for isolating the SRV solenoids from the control room. A Control Room or Reactor Building fire could induce a hot short and spuriously open these valves irrespective of the position of control switches located in the Control Room.

This modification installs a dedicated isolation switch for each of the eleven SRVs in a new Auxiliary Shutdown Panel (25ASP-5) located outside the control room on the 300' elevation of the Administration Building. Thus, upon isolation, a control room fire will not impact circuitry required for SRV operation.

4.5 Safety Related RHRSW/ESW Pump Room Ventilation

To assure area cooling of one train of RHR/ESW Pumps during a postulated fire, this modification will modify the Safety Related Pump Room Ventilation System. It should be noted that the Licensee has been granted a temporary exemption with respect to the Safety Related Pump Room Ventilation System (Reference NRC evaluation dated September 10, 1992).

4.6 Isolation of RHR Valves for Reactor Building Fire

To preclude the spurious operation of eight RHR Valves (10MOV-16A, 10MOV-16-B, 10MOV-25A, 10MOV-27A, 10MOV-25B, 10 MOV-27B, 10MOV-66A, and 10MOV-66B) as a result of fire in the Reactor Building, this modification provides eight (8) key-locked selector switches with indicating lights that will enable the control room operator to bypass (manually override) logic and control for the RHR valves. The key-locked switches are two-position (normal and bypass) devices with the key removable in the normal position. Additionally, as part of this modification, cable 1RHRBBC120 which is required to support the operation of RHR valve 10MOV-16B, will be rerouted outside the area (Fire Area X) where operation of 10MOV-16B is required.

4.7 Reroute/Wrap Safe Shutdown Cables

The Licensee's revised safe shutdown separation analysis identified the need to re-route four cables (1DMSBBK015, 1FPSNNC233, 1FPSNNC235, AND 1RHRDBH004) and provide a one-hour fire rated wrap for power cable 1ABVBBK055. Specifically, this modification includes the following four activities:

(1) Rerouting of cable 1DMSBBK015 out of Fire Areas IA, VII, and XVI, to protect the reactor isolation capability by ensuring that valves 23MOV-60 and 23MOV-77 can be maintained in the closed position in the event of fire in these areas,

(2) Failure of either 1FPSNNC233 or 1FPSNNC235 as a result of fire in Fire Area II could cause the Train A (71H05) Switchgear Room CO2 System to spuriously actuate. Since Fire Area II relies on A-Train power for safe shutdown, this modification will reroute these cables outside the affected fire area (Fire Area II).

(3) RHR Pump power cable 1RHRDBH004 is re-routed outside Fire Area IA to ensure the availability of RHR Pump 10P-3D in the event of fire in this area.

(4) To ensure the availability of Battery Room B Ventilation, the raceway containing cable 1ABVBBK005 will be wrapped in Fire Area IC.

4.8 Emergency Service Water Pump Isolation

The Emergency Service Water Pump (46P-2B) is fed from 600V Switchgear 71L26. The breaker closing circuit for this pump is monitored by a loss of power relay located in Aux Relay Cabinet AR-6B, via cable 1ESWBBC098. In the event of fire in Fire Area VII (Control Room Cable Spreading Room or Relay Room), a short could develop in this cable, which could cause a loss of breaker control from Auxiliary Shutdown Panel 25ASP-3 after Control Room Evacuation.

This modification ensures the operation of ESW Pump 46-2B from the Auxiliary Shutdown Panel 25ASP-3 by providing an isolation capability for the relay circuit which enables the operator to override a possible short in cable 1ESWBBC098.

4.9 Reactor Head Vent Valves

Reactor Head Vent valves (02AOV-17) and (02AOV-18) are in series and could spuriously open in the event of a fire in the following fire areas: Fire Area VII (Control Room, Cable Spreading Room and Relay Room), Fire Area IC (West Cable Tunnel; El. 260'), and Fire Area X (Reactor Building; El. 272'). At least one of these valves must remain closed to maintain pressure integrity of the reactor.

To ensure that at least one valve will remain closed in the event of a Control Room fire (Fire Area VII), this modification uses a spare contact in an existing isolation switch located on remote shutdown panel 25RSP, to provide control isolation capability for valve 02AOV-17. Additionally, the control circuits for both valves (02AOV-17 and 02AOV-18) are separated by installing a new cable for valve 02AOV-18. This cable will be routed through different fire areas and a different penetration than those accessed by the cable run for 02AOV-17.

4.10 Containment Spray Valves

Containment Spray Valves (10MOV-26B and 10MOV-31B) are in series and may spuriously open in the event of a fire in Fire Area VII (Control Room, Cable Spreading Room and Relay Room). These valves must remain closed to maintain proper operation of the RHR system.

To ensure that at least one of the two series Containment Spray Valves will remain closed in the event of a control room fire, this modification provides isolation capability and alternate controls for valve 10MOV-26B on Auxiliary Shutdown Panel 25ASP-3.

4.11 Relocation of Fire Protection Panel 76CO2-PNL-8

Panel 76CO2-PNL-8 actuates the CO2 system for the North Emergency Switchgear Room and closes the emergency ventilation dampers for the room. The North Emergency Switchgear Room provides power for Division B safe shutdown systems. Panel 76CO2-PNL-7 actuates the CO2 system for the South Emergency Switchgear Room and closes the emergency ventilation dampers for the room. The South Emergency Switchgear Room provides power for Division A safe shutdown systems.

Equipment powered from Safe Shutdown Division B is used in the event of fire in the Screenwell Area. However, a fire in the Screenwell may impact either or both of these panels. Since Safe Shutdown Division B equipment is used in the event of fire in either the South Emergency Switchgear Room or the Screenwell area, this modification relocates fire protection panel 76CO2-PNL-8 to the Turbine Building, where Safe Shutdown Division A equipment will be relied on to achieve safe shutdown.

4.12 HPCI Valve Circuit Modification

Steam supply line isolation is necessary to shutdown the HPCI turbine. A fire in Fire Area IX (Reactor Building at El. 272') may cause cable damage which would prevent steam supply line isolation. In addition, fire damage to cables associated with HPCI valve logic circuits could cause spurious operation of valves that may prevent HPCI isolation or HPCI turbine operation.

To ensure the capability to isolate the HPCI turbine steam supply line during a plant fire, affected cables were rerouted and control circuits for the HPCI trip solenoid valve were modified. To ensure proper operation of HPCI valves (23MOV-15 and 23-MOV-16) HPCI valve logic bypass switches are provided for each valve. The bypass switch will allow the operator to bypass the HPCI logic and control valve operation in the event of fire.

4.13 RCIC Valve Control Circuit Modification

A fire in Fire Areas II, VI, VIII, and X may disable RCIC control, prevent the operation of the RCIC speed controller, or prevent the ability to isolate the RCIC steam line or operate the RCIC turbine.

A fire in Fire Area II could impact the existing control fuses for the RCIC control circuitry, thereby disabling RCIC. To ensure that a fire in these areas will not disable RCIC control this modification adds separate fuses that are wired upstream of the existing RCIC control circuit fuses.

A fire in Fire Areas II, VI, and VIII may impact cables associated with the RPV low level water permissive to the RCIC system. This would prevent RCIC from initiating. This modification provides a RCIC manual initiation pushbutton switch, to ensure a fire will not prevent the operation of RCIC due to a loss of low RPV level permissive logic signals.

A fire in Fire Area X could preclude the ability to isolate the RCIC steamline. Isolation of the RCIC steamline is necessary to support the operation of the LPCI/ADS shutdown method. To ensure that a fire will not prevent RCIC steamline isolation, this modification re-routes the affected cable out of Fire Areas X and II, the trip circuitry for RCIC valve 13HOV-1 is rewired to a separate power supply, and a bypass switch capability has been provided for the RCIC logic valve 13MOV-16.

4.14 Installation of Additional Emergency Lighting Units

This modification resolves the emergency lighting inadequacies identified during the NRC Appendix R inspection and during the reanalysis of Appendix R compliance. The plant areas covered within the scope of this modification are the Heater Bay, Electrical Bay, Administration Building and Emergency Diesel Generator Building.

4.15 Relocation of Fire Protection Panel 76CO2-PNL-4

Panel 76CO2-PNL-4 actuates the CO2 system and closes the emergency ventilation dampers for the Relay Room, an alternate shutdown fire area. The panel is located in the Administration Building Hallway and control cables for the Relay Room ventilation dampers are routed through the South Cable Run Room. A fire in the Administration Building Hallway or the South Cable Run Room could actuate the CO2 system, close the Relay Room dampers and de-energize the air handling units, thereby preventing adequate ventilation to the Relay Room.

This modification relocates fire protection panel 76CO2-PNL-4 and it associated pressure switch from the Administration Building Hallway to the Control Room Ventilation Room located in Fire Area VII/Zone CR-1 at the 300' elevation. Some cable routing for panel 76CO2-PNL-4 will remain in the South Cable Run Room. However, due to changes in the functions of these cables, a fire in this area will no longer impact the Relay Room ventilation system.

4.16 Torque Switch Rewiring for Alternate Shutdown MOVs

This modification was performed in response to NRC Information Notice 92-18 and requires the rewiring of torque switches for 22 motor-operated valves required to operate for alternate shutdown. This modification will prevent the bypassing of the torque and associated limit switches by hot shorts in the valve control circuitry that may occur as a result of a Control Room fire.

4.17 Alternate Appendix R Reactor Vessel Level Instrumentation

A fire in Fire Areas VIII or IX of the Reactor Building may impact the operability of redundant reactor vessel level transmitters by causing the water contained in the instrumentation tubing to boil, resulting in an erroneous indication in the control room.

To ensure the availability of reactor vessel level indication, this modification installs an alternate level indicator in Fire Area X.

4.18 Ensure Availability of Motor Control Center and Unit Coolers and Re-route Cables for a Fire in Fire Area IA and VII

To ensure the availability of required electrical distribution system equipment (4160V SWGR 71L26, 600VMCCs 71MCC-263 and 71MCC-261, and 125VDC panels 71BCB-2B and 71BMCC-4) in the event of fire in Fire Area IA, this modification re-routes the following cables outside of Fire Area IA: (1)600V power feeder cables (1C2EFBL085 and 1C2EFBL086) between Switchgear 71L26 and MCC 71MCC-263 and (2) 125VDC feeder cables (1DMSBBL001, 1DMSBBL002, 1DMSBBL0013, 1DMSBBL004, 1DMSBBL005, and 1DMSBBL006).

In the event of fire in Fire Area VII (Control Room, Cable Spreading Room and Relay Room) Electric Bay Unit Coolers 67UC-16B1 and 67UC-16B2 are required to be operational. To ensure the availability of this equipment, this modification relocates the combination starters for the Unit Coolers from their existing MCC (71MCC-261) to a new power source (71MCC-262). Since a fire in Fire Area VII will have no effect on the operation of 71MCC-262, Electric Bay Unit Cooler operation will no longer be susceptible to loss as a result of fire in this area.

4.19 Conclusion

The corrective actions described above provide acceptable methods of resolving the identified conditions of non-compliance, and are, therefore, acceptable.

ATTACHMENT 2

SPLB SALP INPUT

Plant Name: James A. Fitzpatrick Nuclear Power Plant

SER Subject: Evaluation of licensee's safe shutdown reassessment and capability TAC No. M84780

Summary of Review/Inspection Activities

The licensee submitted its safe shutdown reassessment and capability. This evaluation was performed by our contractor Brookhaven National Laboratory (BNL).

Narrative Discussion of Licensee Performance Functional Area

The licensee provided sufficient information to perform the subject review. The technical information and supporting justifications for reassessment of safe shutdown capability provided in their submittal was acceptable.

Principal Contributor: A. Singh
Date:

Our contractor, Brookhaven National Laboratory (BNL) reviewed the submittal and the post-fire safe shutdown methodology and analysis of associated circuits. Enclosed is the Technical Evaluation Report (TER) from BNL. The NRC staff has reviewed the TER and agrees with the BNL conclusions. It is recommended that you seek an exemption from the requirements of Section III.L of Appendix R for the five additional areas. Alteratively, you can ensure the availability of a high pressure injection system for these areas. The details of this issue are discussed in Section 2.3.2 of the attached TER.

Sincerely,

Original signed by:

C. E. Carpenter, Jr., Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-333

Enclosure: Technical Evaluation Report

cc w/encl: See next page

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