U.S. NUCLEAR REGULATORY COMMISSION
REGION III

Report Nos. 50-454/94009(DRP); 50-455/94009(DRP)

Docket Nos. 50-454; 50-455 License Nos. NPF-37; NPF-66

Licensee: Commonwealth Edison Company
Opus West III
1400 Opus Place
Downers Grove, IL 60515

Facility Name: Byron Station, Units 1 and 2

Inspection At: Byron Site, Byron, Illinois

Inspection Conducted: April 19 through May 31, 1994

Inspectors: H. Peterson

Approved By: B. Jorgensen 6-16-94
Bruce Jorgensen, Chief Date
Reactor Projects Section 1A

Inspection Summary

Special inspection from April 19 through May 31, 1994 (Report Nos. 50-454/94011(DRP); 50-455/94011(DRP)).
Areas Inspected: Special safety inspection conducted by the senior resident inspector of the previously identified unresolved item associated with the auxiliary feedwater tunnel flood seal openings, (50-454/455-94007-01 (DRP)).

Results: The unresolved item was determined to be a violation of 10 CFR 50.59. Underlying problems included the failure to recognize the need for and to apply elements of 10 CFR 50, Appendix B, Criterion III, " Design Control."

DETAILS

1. Management Interview (30702, 30703)

The inspector met with the licensee representatives denoted in paragraph 6 during the inspection period and at the conclusion of the inspection on May 31, 1994. The inspector summarized the scope and results of the inspection and discussed the likely content of the report as described in these Details. The licensee acknowledged the information and did not indicate that any of the information disclosed during the inspection could be considered proprietary in nature.

Engineering and Technical Support

The licensee's performance in this area was considered to be satisfactory despite the violation. The licensee's engineering organization adequately supported and briefed the inspector during the investigation process. Also, the licensee's engineering group displayed a high degree of professionalism and spent considerable time and manpower in developing and reviewing all probable corrective actions. However, the violation and underlying causes reflected failure in maintaining current knowledge of the design basis (in this case the auxiliary feedwater system), challenging proposed configuration or other changes against design requirements, and effectively utilizing all available tools (i.e., system engineers, PIF process, 10 CFR 50.59 process, etc.) to recognize when there was a design-related impact. These failures raise concerns about the effectiveness of the engineering organization.

Safety Assessment/Quality Verification

During this inspection period, the inspector reviewed the licensee's utilization of the integrated reporting process (IRP). In regards to the IRP, the inspector reviewed the problem identification form (PIF) process, and noted that improvements were evident, including the notification of more pre-existing problems. However, a need for enhancing the PIF screening was evidenced by the lack of timely and insightful review of the PIF associated with the auxiliary feedwater flood seals. It took two weeks following the initial PIF screening, before the apparent design deviation was identified and the required notification to the NRC was made. Continued licensee management attention and support towards lowering PIF threshold and improving the screening process appeared appropriate.

2. Auxiliary Feedwater Tunnel Flood Seals

This issue was originally identified and tracked as an unresolved item, (454/455-94007-01 (DRP)), pending further review by the inspector of design basis requirements and the licensee's corrective actions.

a. Background

On March 14, 1994, a problem identification form (PIF) identified a potential problem associated with the Auxiliary Feedwater (AFW) tunnel flood seal opening (FSO). The AFW tunnel runs underneath the Main Steam (MS) tunnel. These FSOs are located within the MS tunnel, and isolate the two tunnels. The PIF noted these FSOs are routinely opened for surveillances, and preventive and corrective maintenance. These activities include emergency lighting preventive maintenance, valve surveillance, and valve preventive maintenance. The PIF questioned that the removal of the AFW tunnel FSOs may constitute operation outside the design basis, by exposing the non-environmentally qualified AF013 valves (AFW header to steam generator isolation valve) to the effects of a postulated main steam or feed line break accident. It was noted that the UFSAR section C3.6, MS tunnel pressurization report, did not list the AFW tunnel as a flowpath to the postulated accident. Consequently, this PIF relayed concerns about allowing the FSOs to be opened, based on plant design basis.

On March 15, 1994, the PIF was brought to the attention of the licensee's PIF screening group. This PIF was classified a level 4 and dismissed the concern towards a steam tunnel accident affecting the AFW valves. Also, as a level 4 PIF, the NRC inspector did not receive a notification of the problem. The screening meeting notes stated that the motor operated valves (AF013) in the AFW tunnel are not required to perform a safety function during a steam tunnel accident; therefore, the FSO status was not an environmental qualification (EQ) concern. The screening group failed to recognize and address the UFSAR and design concerns associated with flooding, main feedwater, or main steamline break (MSLB) accidents. Also, the screening group incorrectly concluded that there were no safety functions associated with the AF013 valves. Questions about timely and insightful PIF screening review are being followed under a previous inspector concern item, (454/455-94004-03(DRP)). Although the initial screening appeared inadequate, the licensee did assign the PIF to the Regulatory Assurance group for followup review.

On March 29, 1994, two weeks following the initial PIF review, the licensee determined that the removal of the AFW tunnel FSOs constituted a four hour reportable event. The removal of the FSOs could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident, per 10 CFR 50.72(b)(2)(iii)(D). The licensee determined the FSOs are relied upon to separate the equipment in the AFW tunnel from the environmental condition created in the event of a MS line failure in the MS tunnel, and to ensure a water tight environment in the AFW tunnel in the event of turbine building flooding.

In evaluating this matter, the inspector also performed an overview of the PIF process and observed improvements in the overall number and nature of events being reported. This included pre-existing conditions or practices now being reported as concern areas for improvement or correction. Continued management attention to reducing PIF threshold and supporting staff identification of problems, to preclude any negative connotations, appeared appropriate.

b. Investigation

Administrative procedures allowed FSOs to be removed (impaired), and direct compensatory measures to be taken during their impairment. The compensatory measures included shiftly check by the equipment attendant and an hourly fire/flood watch. The licensee had adequately performed the hourly watches; however, the procedure itself appears inadequate. The procedure directs that the Shift Engineer is to be notified for FSOs opened more than 1 hour, and likewise the Operations Engineer for FSOs left open for more than 24 hours. However, the procedure was open ended and did not set a finite time period the FSOs could be left impaired. Additionally, it did not consider the technical merit and design requirements associated with the need for the FSOs. This appears to contradict the UFSAR and the Safety Evaluation Report design basis for which the plant was licensed.

The inspector identified that on August 10, 1988, the original flood watch procedure, BAP 380-3, "Control of Water Tight Doors and Flood Seal Openings," was deleted and incorporated into the new fire watch procedures, BAP 1100-3, "Fire Protection Systems, Fire Rated Assemblies, Radiation, Ventilation, and Flood Seal Impairments," and BAP 1100-16, "Fire/Flood Watch Inspections." This procedural change was to take advantage of utilizing the same fire watch personnel to perform the hourly flood seal inspections. A 10 CFR 50.59 evaluation was performed; however, it appears it was less than adequate. The change was viewed as administrative in nature, and no technical or engineering review was conducted, although the licensee had the opportunity to identify and determine the technical adequacy and the design restriction of removing these FSOs during plant operation.

This item concerning the FSOs appears to be a design basis issue. That is, the licensee did not recognize and apply design basis information properly. These seals were routinely opened and left open for a considerable duration. For example, both unit's AFW tunnel FSOs were opened from December 1993 to mid February 1994. Further review of records indicated that the FSOs on operating units, on a periodic basis, had been left open for durations of several days up to three months. A review of the licensee's records identified this routine action was also apparent during 1990, and potentially as far back as the original FSO procedures which were in effect in 1988.

c. Licensee's Corrective Actions

The licensee initiated immediate corrective actions following the identification of the required reportability of the event. These actions included verifying the AFW tunnel FSO plates were in place on both units, and requiring the FSO plates to remain in place until this issue was evaluated and an acceptable resolution achieved. Furthermore, the licensee additionally caution tagged all the FSOs to alert personnel not to remove the plates without Shift Engineer approval.

The licensee's engineering and regulatory assurance departments have identified several options for long term corrective actions. These options are presently all under review by the licensee.

3. Design Basis

The equipment in the AFW tunnel includes safety related cabling and safety related AFW motor operated valves (MOV). The associated MOVs are the auxiliary feedwater header isolation valves to the steam generators, AF013 A through H. There are two valves per steam generator, each an isolation valve for the two trains of AFW. The AFW tunnel lies below the MS tunnel. The tunnels are interconnected with the FSOs. Access to these valves can be made through any of the four AFW FSOs. These valves are also considered as containment isolation valves, per Technical Specification 3.6.3.

The following describes the design basis associated with the AFW FSOs. Each item summarizes the regulatory basis and interpretation describing the overall requirement for the FSOs. This includes the basis for the separation of the AFW and MS tunnels, the environmental qualification differences, and the need for the flood seals.

a. NUREG 0876, "Safety Evaluation Report Related to the Operation of Byron Station, Units 1 and 2," February 1982

1) Section 3.6.1, "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," pages 3-14, requires the auxiliary feedwater system components to be protected from the environmental conditions resulting from the postulated main steamline failure in the safety valve house or main steam pipe tunnel.

2) Section 10.4.5, "Circulating Water System," pages 10-11, addresses General Design Criterion (GDC) 4 with respect to protection against environmental effects (flooding) on safety-related equipment due to failure (pipe breaks) in the circulating water system. This section states, in part:

"The applicant indicates, however, that the main steam tunnel that connects directly to the turbine building will be flooded. Flooding of the auxiliary feedwater tunnel is

prevented by water-tight closures on the openings to the main steam tunnel."

3) Supplement No. 2, Section 3.6.1, "Plant Design Against Effects Associated with the Postulated Rupture of Piping," page 3-1, states, in part:

"The auxiliary feedwater system piping and components are routed in a separate pipe tunnel and compartment that is located below the main steam pipe tunnel and that is sealed against the main steam pipe break environment. Thus, qualification of the auxiliary feedwater system valves to the steamline break environment is not required."

b. Byron Updated Final Safety Analysis Report (UFSAR), Rev 1, December 1989

1) Section 10.4.5, "Circulating Water System," page 10.4-10, states, in part:

"All below grade pipe penetrations into the auxiliary building are sealed, therefore, no safety-related equipment would be disabled by the flooding. The auxiliary feedwater tunnel is watertight for the protection of safety-related cables which are routed therein."

Also:

"The auxiliary building is completely watertight below grade at the turbine building/auxiliary building interface, except for the main steam tunnel. Watertight closures prevent flooding of the main steam tunnel from affecting the auxiliary feedwater tunnel, the containment, or any other auxiliary building areas."

2) Section 3.11, "Environmental Design of Mechanical and Electrical Equipment," page 3.11-10 and Table 3.11-2, "Plant Environmental Conditions," identifies the auxiliary feedwater piping tunnel as having normal environmental conditions. Normal environmental conditions are those conditions expected to occur regularly and for which the plant equipment is expected to perform its function, as required, on a continuous steady-state basis. There are no indications for the AFW tunnel for any abnormal or accident environmental conditions. The main steam pipe tunnels and safety valve enclosures are rated for an accident environmental condition of a maximum temperature of 419 degrees F, relative humidity of 100% and maximum pressure of 28 psig. The accident environmental condition are those conditions which may occur during plant operation and which constitute a harsh environment that results from component failure or external event such as OCA, MSLB, and HELB. For environmental zones in which the

conditions are not affected by high energy line breaks, the normal levels are specified as the accident conditions.

This indicates that the AFW tunnel was expected not to experience the accident conditions within the main steam tunnel and safety valve area. This would only be valid if the tunnels are physically isolated. To ensure this condition, the AFW tunnel flood seals must be in place to preclude the accident conditions in the main steam tunnel and the safety valve area from affecting the AFW tunnel area.

3) Section 3.6, "Protection Against Dynamic Effects Associated with the Postulated Break of Piping," indicates that all appropriate evaluation associated with pressurization and temperature rise studies for postulated breaks and flooding for inside and outside containment are addressed in UFSAR attachments A3.6, C3.6, and D3.6.

- UFSAR attachment A3.6 does not address the AFW tunnel.

- Attachment D3.6 states that the ability to safely shut down the plant will be unimpaired during postulated flooding of some subcompartments because equipment is enclosed in waterproof areas as required.

- Attachment C3.6, "Main Steamline Break in Main Steam Tunnel," assumes that the AFW tunnel initial conditions are the normal environmental conditions. But, the study does not evaluate any flow paths or accident conditions within the AFW tunnel from either the main steam tunnel or the valve area. This further indicates that the AFW tunnel was not expected or evaluated to withstand the accident conditions of a main steamline break in the main steam tunnel or the safety valve area.

In conclusion, based on the above design basis, the AFW tunnel flood seal openings are required to be closed and in place during plant operation to satisfy the requirements of General Design Criterion 4, "Environmental and Dynamic Effects Design Basis."

4. Safety Significance

The auxiliary feedwater system (AFW) was designed to supply feedwater to all four steam generators during emergency and accident situations. The postulated accidents reviewed in the UFSAR were flooding from the circulating water system, and high energy line breaks (main steamline, main feedwater line) inside and outside containment. One design criterion was for the system to be able to provide adequate feedwater to the unfaulted steam generators in the event of a main feedwater or steamline break, coupled with a single active or passive failure in the AFW. This situation would result in the injection of a disproportionately large fraction of the AFW flow to the faulted steam generator rather than to the

other intact generators. The UFSAR notes that the system design must allow for terminating, limiting, or minimizing the fraction of the AFW flow which would be delivered to a faulted loop, or spill through a break, in order to ensure that sufficient flow will be delivered to the remaining effective steam generators.

Two design features are provided; the AFW restricting flow orifice, and the motor operated isolation valves, AF013, located within the auxiliary feedwater tunnel. These AF013 isolation valves are safety related and are also categorized as containment isolation valves within the technical specification, section 3.6.3. Also, per the UFSAR Table 10.4-4, "Auxiliary Feedwater System Failure Modes-Effects Analysis," the AF013 valves are relied upon to stop the AFW flow to the faulted steam generator.

A restricting flow orifice was provided in each line so that an auxiliary feedwater pump can deliver at least 160 gpm to each of the three unfaulted steam generators within 1 minute following an accident, and continue with no operator action necessary for 30 minutes. The orifice was also provided to prevent pump runout. However, within the scope of the 30 minutes, operator actions are necessary to isolate the AFW to the faulted steam generator. In the Byron Emergency Procedure, BEP-2, "Faulted Steam Generator Isolation," operator actions are required to close the affected AF013 valves to stop AFW flow to the faulted generator. This would be accomplished by manual operator action in the control room or, if necessary, locally closing the valve in the AFW tunnel. The overall safety significance associated with Core Damage Frequency (CDF) was determined to be of major significance if the faulted steam generator accident was a leak inside containment. For a faulted steam generator outside containment, the affects towards CDF and threat to containment integrity would be less significant; however, the AF013 valves are still relied upon as the primary isolation, as noted in the UFSAR and the station Emergency Procedures, to preclude the effects of the accident.

5. Conclusion

The Code of Federal Regulations (CFR), in 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, that measures shall be established to assure the design basis, as defined in 10 CFR 50.2, is correctly translated into specifications and procedures; and that design changes, including field changes, shall be subject to design control measures. Further, 10 CFR Part 50.59, "Changes, Tests, and Experiments," stipulates that the licensee may not make changes in the facility as described in the safety analysis report (or involving a change in the technical specifications incorporated in the license), without prior NRC approval, unless a determination has been made and documented that the change does not involve an unreviewed safety question.

Based on the design and regulatory requirements, the flood seals were established to ensure a watertight condition of the tunnel in the event of flooding. Furthermore, the seals were also relied upon to ensure separation of the auxiliary feedwater tunnel from the main steam tunnel

and the safety valve area to preclude the effects from the postulated design basis accidents of a main steamline and/or main feedwater breaks outside containment. The removal of the flood seals during power operation placed the plant in an unanalyzed and compromising situation by potentially rendering the system and components (the technical specification containment isolation valves AF013s and cabling) in the tunnel inoperable. The equipment and cables within the auxiliary feedwater tunnel were not environmentally qualified for accident environmental conditions. This constitutes a departure from design control and a potential unreviewed safety question. Therefore, it was concluded that the licensee failed to understand and implement the design control and 10 CFR 50.59 requirements, by routinely removing the design basis required auxiliary feedwater tunnel flood seals during power operations. This condition had existed on numerous occasions, dating at least as far back as 1990, for extended periods of time without performing a 50.59 review for the temporary design change. The unresolved item, 50-454/455-94007-01 (DRP), was considered closed; however, this issue is now considered a violation of NRC requirements associated with 10 CFR 50.59, "Changes, Tests, and Experiments," (50-454/455-94011-01 (DRP)). Underlying the violation was a failure to recognize the need for and to properly apply elements of 10 CFR 50 Appendix B, Criterion III, "Design Control."

6. Persons Contacted

Commonwealth Edison Company (CECo)

K. Graesser, Site Vice President
*K. Schwartz, Station Manager
*T. Gierich, Operations Manager
*D. St. Clair, Site Engineering Construction (SEC) Manager
*P. Johnson, Technical Service Superintendent
*M. Snow, Work Control Superintendent
*D. Brindle, Regulatory Assurance Supervisor
*L. Zech, Regulatory Assurance Licensing Group Leader (GL)
*B. Wegner, Shift Operations Supervisor
A. Javorik, Technical Staff Supervisor
T. Schuster, Site Quality Verification Director
P. O'Neil, SQV Supervisor
*K. Passmore, Station Support & Engineering (SSE) Supervisor
*P. Enge, NRC Coordinator
*R. Gesior, SEC SSE Mechanical Lead
*J. Feimster, SEC SSE Mechanical Engineer
*P. Reister, System Engineering Department Thermal GL

*Denotes those attending the exit interview conducted on May 31, 1994.

The inspectors also had discussions with other licensee employees, including members of the technical and engineering staffs, reactor and auxiliary operators, and shift engineers and foremen.