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SVP-97-300

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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Quad Cities Nuclear Station Units 1 and 2
Fire Protection Program Enhancement
NRC Docket Numbers 50-254 and 50-265

In preparation for our upcoming meeting with the NRC staff on Tuesday, December 16, 1977, I want to take this opportunity to follow-up on our November meetings on fire protection activities at the station. This letter summarizes in some detail the actions that Quad Cities has been taking to enhance its fire protection program since we obtained the result of the study of the Individual Plant Examination of External Events (IPEEE). Quad Cities' management has responded to the technical and Appendix R compliance issues raised by the IPEEE and subsequently discovered fire protection issues by making several significant improvements in the station's fire protection program.

Recent Fire Safety Enhancements

Most recently, for Unit 1, we have developed a substantially simplified alternative safe shutdown (SSD) strategy which reduces the calculated fire-induced core damage frequency (CDF), halves the number of unit specific implementing procedures from 8 to 4, simplifies operator actions and, for the first time, reduces reliance on opposite unit equipment for safe shutdown by using the Station Blackout (SBO) diesels to power safe shutdown equipment in the event of a fire in one unit.

The result of these activities has been an overall reduction in fire risk for both units. For example, when the Unit 2 EDG was recently taken out-of-service for maintenance, Unit 1, for the first time, did not have to rely on that EDG because the SBO diesels were available to provide emergency power. Similarly, additional fire safety enhancements, including risk

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reduction and compliance with Appendix R, will be realized with the installation of the Independent Shutdown Pumps (ISP), which we have already discussed with you, and the completion of other hardware and procedure changes.

Evolution of Fire Protection Improvements

Fire protection enhancements at Quad Cities have been elevated in priority since we obtained the IPEEE value for the CDF. Promptly after the IPEEE results were confirmed, we took the immediate and aggressive actions which were described in several communications and summarized in detail in my September 30, 1997 letter to the NRC. As we reported, the station implemented the Interim Alternate Shutdown Method (IASM) to reduce the Unit 1 CDF by a factor of 5 (from 5.4 E-03/reactor year to 9.9 E-04/reactor year), with both units operating. The IASM achieved this reduction in the CDF by providing an independent power supply for injecting water into the vessel in the event of a fire.

Significant compensatory measures also were taken consistent with the NRC's general understanding that equivalent levels of fire protection can be attained by strengthening different combinations of the four echelons of an overall fire protection program, prevention, detection, suppression and passive resistance. Station actions further strengthened the fire protection program by enhancing the Fire Watch Program, establishing a Quick Response Team, constructing a fire wall, and reducing the combustible load in high vulnerability areas by removing approximately 29 million BTU's of transient combustibles. Additional efforts to reduce the CDF will be undertaken through a Fire Protection Risk Reduction Project.

Despite these fire protection enhancements, we recognized the need to further reduce the fire-induced CDF. Accordingly, the station committed to the ISP alternative strategy of using two independent pumps to supply reactor make-up water during an Appendix R SSD scenario, powering those pumps with the SBO diesels, and controlling reactor pressure by using the relief valves which will be isolated from the fire area. Other modifications will also be made to the process for attaining cold shutdown. Recognizing the need to promptly further reduce the CDF, we completed the conceptual work four months ahead of the original schedule. When completed, the ISP and procedure changes are expected to reduce the CDF to about 8.3 E-05/reactor year.

Development of the Improved Safe Shutdown Methodology

In the course of revalidating the IPEEE analysis as part of ISP implementation, a cable was discovered to have been routed through a fire area. A Licensee Event Report (LER)

was submitted to the NRC in July 1997. While pursuing the corrective actions described in the LER, the station discovered additional discrepancies between the Appendix R safe shutdown analysis (SSA) and the SSD procedures. Essentially, the procedures were based on the presence of breaker coordination which, the station has subsequently learned, had been implemented but had not been incorporated in the SSA. As a result of the discovered inconsistency between the SSA and the SSD procedures, the station relied on an operability logic to find that the SSD paths were inoperable because the procedures did not support the ability of the SSD equipment to perform its intended safety functions, even though the equipment itself was operable.

The NRC was promptly informed of this situation, has been kept fully informed of the station's subsequent actions to resolve it, and will continue to be informed, as at the upcoming December 16 meeting. Communication of this situation will also be made to other two-unit plants of the same vintage to alert them to our experience.

Soon after finding that the SSD paths were inoperable, station management concluded that Unit 2 should be shut down as a conservative measure. It remains shut down pending a station determination that normal, two unit operation can be resumed safely. For Unit 1, the station followed its procedures, Section D.3.f of QCAP 1500-02, to conservatively enter what is now called an Administrative Technical Requirement (ATR), which gave the unit 67 days to restore the ability of inoperable fire protection equipment to perform its intended functions. In retrospect, the station now concludes that it could alternatively have applied its corrective action program at the outset to address the issues which had been identified through the reviews of the SSD procedures. In any event, several of these issues were included in the corrective action program.

The breaker coordination issue was resolved in about 15 days into the ATR. However, the ATR was not terminated at that time because the ongoing procedure review revealed other problems with the SSD procedures. Ultimately, 146 potential issues, ranging from typographical errors to procedure inadequacies, were discovered. This number of issues led station management to consider whether a more ambitious alternative to modifying the existing SSD strategy should be pursued.

Late in October, in consultation with recognized industry fire protection experts, the station identified a substantially modified alternative SSD strategy, the Improved Safe Shutdown Methodology (ISSM), which enhances fire safety by using the SBO diesels to reduce reliance on opposite unit equipment for safe shutdown in the event of a fire, thereby eliminating a number of the fire protection concerns. A multi-discipline team was assembled to develop the alternative strategy and the associated implementing procedures. In mid-November, the multi-discipline team began its review of the new strategy and procedures against Appendix R and the known deficiencies. Corporate engineering support included calculations, analyses, and assessments as well as reviews of specific

issues by the Chief Engineers. Station fire protection personnel also were extensively involved throughout the entire process. Of the 146 potential issues identified, 136 were dispositioned as either not concerns, resolved, or addressed by either procedure changes or compensatory measures, as appropriate. The remaining 10 issues were analyzed for their impact on the station's ability to perform the fire protection safety functions in Appendix R. Based on engineering judgment, none of these issues was found to prevent fulfillment of those safety functions, as discussed in the operability review.

The review of these issues led to the identification of some non-compliances with Appendix R. Where the non-compliances could not be removed, actions were taken either to mitigate their effect by adopting compensatory measures or by modifying the procedures. In light of these actions, their safety significance was considered as part of the overall safety assessment which was conducted to determine if Unit 1 could safely exit the 67 day ATR. None of them, either individually or collectively, was determined to be safety significant. However, due to the operability orientation of the ATR, completion of the Appendix R review was deferred in favor of a more functionally oriented safety assessment.

The Unit 1 safety assessment conducted by the station was called an "operability review" because it applied the normal procedure review process to the functional safe shutdown aspects of Appendix R. Included in that review process were an independent technical review of the new procedures by operators, Appendix R functional reviews by a senior fire protection engineer, selected reviews to assure that cables for SSD equipment were not in the fire zones for which they are needed to support SSD, and determinations that there would be no spurious or mal-operations. When these reviews resulted in changes to procedures, those changes were re-reviewed by engineering. Response times were validated for the two most difficult procedures. The comprehensiveness of these processes is reflected in the completeness of the operability review. Examination of that operability review shows that it addressed the safety concerns applicable to the continued operation of Unit 1.

Validity of the operability review was corroborated by its being subjected to three days of intense scrutiny and review by the Plant Operational Review Committee (PORC). All of the outstanding issues were evaluated for their impacts on the station's ability to perform the Appendix R safe shutdown functions and all of the procedures were reviewed for their ability to implement those safe shutdown functions. Most station fire protection experts participated extensively in the review process and their comments are reflected in the operability review. Operators were trained on the new procedures before they were adopted.

Based on this operability review, the ISSM has been implemented for Unit 1. Among the safety benefits of the ISSM are that it has halved the number of unit specific implementing

procedures from 8 to 4, simplified those procedures, eliminated reliance on the station's 125 V dc and 250V dc systems, and reduced reliance on opposite unit equipment, thereby enhancing each unit's ability to shutdown safely in the unlikely event of a design basis fire. The 4 new procedures were derived from the 8 prior procedures by applying the simplifications afforded by the interim application of the ISSM strategy. A safety evaluation under 10 CFR 50.59, SE-97-164, was performed for the procedure changes and no USQ was identified. A safety evaluation also is being conducted on the use of the SBO diesels instead of the EDGs to shut the plant down safely in the event of a fire. Finally, a safety evaluation for the change to the SSD strategy in the Final Safety Analysis Report (FSAR) will be conducted when the new SSD strategy is substituted for the current SSD strategy in the FSAR.

Consistent with the ongoing, extensive interactions with NRC personnel in this area, drafts of all of the new SSD procedures and a flow chart which explains the inter-relationships were provided to the NRC. NRR personnel were briefed on the ISSM on November 13, 1997. NRC Regional and NRR personnel received a detailed description of the ISSM on November 20, 1997. Implementation of the procedure was demonstrated in a table-top review with NRC personnel.

Subsequent ISSM Concerns

Since the ISSM was implemented, it has resulted in 15 Problem Identification Forms (PIF). Five serve a well-established station tracking function. Two document the NRC's questions regarding application of Section III.L.1 of Appendix R and protecting the new SBO cable. Three note that workarounds were created by the ISSM.

Three identify minor implementation discrepancies of the kind that can be expected to accompany the implementation of any new procedure. Two of these were identified by the Quality Safety and Assurance (QSA) department overview.

Seven identify fire protection procedures that required correction. Six of these were associated with the new strategy and one was a carry-over from the previous strategy. Two of the six new procedure concerns were identified by applying the station's corrective action process to an investigation into the extent of condition of one of the other six PIFs. All but the most recent of the PIFs have already been determined to have minimal safety significance both individually and collectively. The most recent PIF is still under review. The cause of all seven of the procedure concerns was identified by the PIF writers to be a lack of Appendix R review of the new strategy. Station management did not concur with that characterization because no meaningful final Appendix R review can be conducted until the new SSA is completed.

Ongoing Fire Protection Enhancements for Unit 2 and Dual Unit Operation

Several actions are ongoing to support the successful extension of the ISSM to Unit 2. The new SSA for the ISSM strategy is being supported by Sargent & Lundy. Procedures for Unit 2 (which may result in changes to the Unit 1 procedures) and for dual unit operation, also are under development. It should be noted, however, that because these efforts will not be completed until after the planned date for Unit 2 restart, a functional review, comparable to the one performed for Unit 1, will be conducted for Unit 2. Lessons learned from Unit 1 are being applied. Unit 2 will be returned to service only after the procedures are completed, reviewed and approved, the PORC recommends restart based on its safety conclusions, and the Site Vice President determines that restart is safe. By using this new strategy and procedures, dual unit operation will result in a further reduction in the CDF from the value initially calculated in the IPEEE. Accordingly, from a fire protection perspective, dual unit operation will be safer than before.

As noted with respect to Unit 1, despite the enhancement in SSD strategy, both units at Quad Cities currently do have a limited number of fire protection issues that remain to be resolved. Some of them involve deviations from compliance with requirements in Appendix R. As with any non-compliances, especially those which require modifications, these also unavoidably require time to resolve in accordance with station processes and procedures. They will be resolved as the station implements the schedule which has been established to complete implementation of the ISP and remove any non-compliances with Appendix R. A copy of that schedule is attached for your consideration.

In the interim, until the non-compliances are removed, the number and character of the Appendix R non-compliances can be expected to vary as the units change mode, including implementation of fire protection modifications during plant outages. Where necessary to assure safety, either compensatory actions or procedural modifications have been instituted until these deviations can be removed. Consistent with NRC analyses, these compensatory actions are based on the flexibility inherent in the four echelon approach to fire protection. One or more of the elements of prevention, detection, suppression or passive resistance are emphasized to compensate for the technical non-compliance. Accordingly, both units of Quad Cities can operate consistent with reasonable assurance of fire safety until the current issues are resolved.

Conclusion

In conclusion, I want to reiterate that we are taking the IPEEE results seriously and are vigorously pursuing fire protection improvements. Our interim actions have already measurably reduced the risk due to fire. The CDF has been lowered, we have reduced our reliance on opposite unit equipment to safely shutdown a unit which has a fire, we have reduced the number of procedures and simplified them, and we have eliminated reliance on certain systems to achieve safe shutdown. The combined impact of these changes is that dual unit operation will be demonstrably safer, from a fire safety perspective, than it was before.

Nevertheless, as discussed above, we will continue to review and resolve the remaining issues. If new issues arise in the course of that review, they will be evaluated carefully for their impact on fire safety. Issues will be considered both individually and cumulatively. As with the decision to exit the ATR and continue operation at Unit 1, the PORC will be routinely involved in assessing the readiness of Unit 2 to restart safely. Only after PORC has made a positive safety finding will I consider that recommendation and, upon consultation with other executives in the Nuclear Generation Group, make a decision on whether to restart the plant.

If you have questions concerning this letter, please contact Mr. Charles Peterson, Regulatory Affairs Manager, at (309) 654-2241, extension 3609.

Respectfully,

L. W. Pearce

L. W. Pearce
Site Vice President

Attachment A: Non-Conformances with Appendix R Safe Shutdown

cc: A. B. Beach, Regional Administrator, Region III
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NON-CONFORMANCES WITH APPENDIX R SAFE SHUTDOWN

No.	Non-Conformance with Preliminary SSDA	App R Non-Compliance	Current Disposition per Operability Review	Estimated Date for Full Compliance	Comments
1	RCIC/RHR Floor Plugs Need to be Removed to Ensure Adequate Cooling to Equipment (RCIC/RHR Repair)	III.G.1	Comp Measure via Procedure (Remove Floor Plugs)	Under Evaluation	Mod Reqrired
2	Jumper to be Installed to Ensure Adequate Supply of Fuel Oil to SBO, Repair	III.G.1	Comp Measure via Procedure (Install Jumper)	3/31/98	Mod Required
3	MSL Drain Valves (Hi/Lo) Pressure Interface	III.L.1	Comp Measure via OOS (Take Valve OOS)	3/31/98 (Unit 1)	GL 86-10 Evaluation
4	Rx & TB HVAC Not Available to Ensure Equipment Operability and Personnel Habitability	III.G.1	Eng Judgment and Procedure Modified to Monitor Temperature and to Establish Additional Ventilation as Required	3/31/98	Evaluation
5	SBO (Cable) Not Adequately Protected from the Appendix R Fire	III.G.1	Modification In Progress to Relocate Cable	Temp Mod 12/16/97	Perm Mod Reqd 11/98
6	RCIC & RHR Room Coolers Not Available	III.G.1	Special Personnel Cooldown Area Established	Under Evaluation	Evaluation
7	Timeline for SSD Assumes MSIV Closure	III.L.1	Eng. Judgment (Operator Close In Control Room)	Under Evaluation	Evaluation
8	Emergency Lights Needed in Additional Areas	III.J	Comp Measure via Temp and Portable Lights	U1 Temp Alt in Place, U2 in Progress	Mods Required
9	Spurious Op of RHR & RHRSW Results in Deadheading Pumps	III.G.1	Comp Measure via Procedure (to Trip Pumps Locally)	Under Evaluation	Mod Required
10	RWCU (Hi/Lo) Pressure Interface	III.L.1	Comp Measure via OOS (Take valve OOS)	02/04/98	GL 86-10 Evaluation
11	Common Enclosure (250VDC, 4KV)	III.G.1	Comp Measure via Procedure (Local Trip of Power Supplies)	U1-10/98 U2-03/99	Design in Progress
12	Feed Pump Spurious Start	III.G.1	Comp Measure via Procedure (Trip Feed Pumps Locally)	U1-10/98 U2-03/99	Design in Progress
13	Effect on Non-Fire Unit	III.G.1	Unit 1: Has Procedures Available For All Fire Areas Unit 2: To Be Evaluated via the U2 Op Review	Under Evaluation	Complete Procedures
14	U-2 RCIC Keep Fill, Spurious Start of RCIC w/o Min Flow (Unit 2 Only)	III.G.1	Mod - In Progress	U1 Done U2 12/16	Modification
15	RCIC RV to Protect Barometric Condenser (Unit 2 Only)	III.G.1	Mod - In Progress	U1 Done U2 12/19	Modification
16	RECIRC/ADS Penetration Protection to Allow Post-Fire Repairs (Unit 2 Only)	III.G.1	Mod - In Progress	U1 Done U2 12/19	Modification
17	Unreviewed Safe Shutdown Analysis	Unknown	Review in Progress	Under Evaluation	Potential Additional Deficiencies