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To: Allan.haeger@Exeloncorp.com
Date: 7/4/01 3:36PM
Subject: EPU mechanical and civil engineering questions

Our review of the Dresden and Quad Cities extended power uprate (EPU) amendment requests has identified several questions in the mechanical and civil engineering area. The questions are attached. Please let me know if you would like a call to discuss them.

CC: Anthony Mendiola; Cheng-Ih Wu; Stewart Bailey

Docket Nos. 50-237, 50-249, 50-254, 50-265

DRESDEN AND QUAD CITIES EXTENDED POWER UPRATE
REQUEST FOR ADDITIONAL INFORMATION
MECHANICAL AND CIVIL ENGINEERING

The following questions apply to Dresden Nuclear Power Station, Units 2 and 3 (DNPS) and Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS.) The Sections given are from references 2 and 3.

1. In reference to Section 3.3.4 for the reactor internal structural evaluation, you stated that the structural assessment used guidelines and procedures similar to those in the design basis analyses. All applicable service levels, namely normal, upset, emergency, and faulted are considered consistent with the current design basis analyses. The loads considered in the evaluation include the reactor internal pressure differences, seismic loads, flow induced and acoustic loads due to the postulated recirculation line break (RLB-LOCA), thermal load effects, dead weight, and flow loads.

   A) Confirm whether the loads considered for the evaluation of the reactor internal components include the fuel lift loads, the safety relief valve discharge loads, annulus asymmetric pressurization and jet reaction loads during a main steam or a feedwater line break.

   B) Discuss the effects of the proposed extended power uprate (EPU) on the RLB-LOCA load and other design basis loads mentioned above.

2. A) In Section 3.3.2, you indicated that the reduction in some fatigue usage factors (CUFs) in Table 3-3a is a result of reduction in the conservatism and/or number of thermal cycles from the original analysis. Describe how you arrived at an accurate representation of the fatigue cycles which resulted in a reduction of CUF from 0.94 to 0.862 for the shroud support as provided in Table 3-3a.

   B) In regard to Section 3.3.4, provide the maximum calculated stress and CUFs for the reactor internal components evaluated for both the current design condition and the uprate power condition, the allowable code limits, and the code and code edition used in the evaluation for the power uprate. If different from the code of record, provide your justification.

3. In Section 3.3.5, you evaluated the effects of the EPU on the potential for flow-induced vibration of the reactor internal components due to the increase in steam produced (>20%) in the core, the increase in the core pressure drop, and the increase in the recirculation pump speed. You indicated that the evaluation was based on the vibration data for the reactor internal components recorded during the startup testing of DNPS and QCNPS plants and on operating experience from similar plants. The expected vibration levels under EPU conditions were estimated by extrapolating the vibration data recorded during startup testing at the DNPS and QCNPS units.

   A) Discuss whether and how the recorded vibration data can be applicable for your calculation of the flow induced vibration stress level after the steam separators and dryers hardware modifications that are required for the EPU.

B) Provide a sample evaluation for the most critical components (i.e., steam dryers and steam separators) and the basis for using the operating experience of similar plants.

C) Discuss the potential for flow-induced vibration of the reactor internal components due to various mechanisms, including, in particular, the fluid-elastic instability in the steam separators and dryers at the proposed power level. If the details of the analysis and the results are documented in a report, submit the report for staff review.

D) Provide a discussion on the potential for excessive vibrations, high noise levels, and the instrument lines leakage that might be caused by the increased recirculation pump speed or flow for the proposed power uprate, as described in the NRC Information Notice 95-16.

4. A) In reference to Sections 3.3.2 and 3.3.4, provide a discussion of the methodology, assumptions and loading combinations used for evaluating the reactor vessel and internal components with regard to the stresses and fatigue usage for the power uprate.

   B) Were the analytical computer codes used in the evaluation different from those used in the original design-basis analysis? If so, identify the new codes used and provide your justification for their use by specifying how were these codes bechmarked for such applications.

5. In Section 4.1.2.3 regarding the subcompartment pressurization, you stated that the increase in actual asymmetrical loads on the vessel, attached piping and biological shield wall, due to the postulated main steam and feedwatwer pipe breaks in the annulus between the reactor vessel and biological shield wall is minor. You also indicated that the biological shield wall and component designs remain adequate, because there is sufficient pressure margin available.

   Discuss quantitatively how will the biological shield wall and the reactor vessel and internals be affected by the proposed power uprate as a result of increase in the applied asymmetrical pressurization and jet loads.

6. In the evaluation of the reactor jet pumps in Section 3.3.4, you stated that additional engineering evaluations will be performed to determine if the jet pump riser brace will be susceptible to vibration from the recirculation pump vane passing frequency (VPF). The evaluations will determine if modifications are required to alter the natural frequency of the jet pump braces.

   A) Provide your evaluation associated with the possible VPF vibrations due to the EPU.

   B) Confirm whether and how your evaluation for the structural integrity of jet pumps will be affected by the VPF vibrations due to EPU at DNPS and DCNPS.

7. In Section 3.3.6, you stated that EPU conditions result in an increase in saturated steam generated in the reactor core. For constant core flow, this in turn results in an increase in the separator inlet quality and dryer face velocity and a decrease in the water level inside the dryer skirt, all of which affect the steam separator-dryer performance. The

results of the evaluation demonstrate that the steam separator-dryer performance remains acceptable up to some portion of extended power prior to any substantive hardware modification. To reduce the moisture content, hardware modifications are required. These modifications will be completed before EPU implementation.

Confirm whether and how your evaluation in Section 3.3.4 for the structural integrity of steam separators and dryers will be affected by the required hardware modifications due to the proposed EPU at DNPS and DCNPS.

8. A) In reference to Section 3.5, provide a discussion of the methodology and assumptions used for evaluating the reactor coolant pressure boundary piping systems for the proposed power uprate.

   B) Provide the calculated maximum stresses and fatigue usage factors at the current design basis and the proposed power uprate conditions, corresponding critical locations and piping systems, allowable stress limits, and the code and code edition used in the evaluation for the power uprate. If different from the Code of record, justify and reconcile the differences.

9. A) Provide a summary of your evaluation of the pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchors at the power uprate condition. The evaluation should include the methodology, assumptions, and the results of evaluation for the critical piping systems affected by the proposed power uprate.

   B) Were the analytical computer codes used in the evaluation different from those used in the original design-basis analysis? If so, identify the new codes and provide your justification for their use by specifying how these codes were bechmarked for such applications.

10. A) In Section 3.5.5, you indicated that the main steam (MS) and feedwater (FW) piping will experience increased vibration levels, approximately proportional to the square of the flow velocities. For the proposed power uprate, the flow rates and flow velocities will increase by more than 20 percent of the flow rate at the original rated thermal power for the MS and FW piping systems.

    Provide an evaluation of the cumulative fatigue usage factor (in addition to the startup and shutdown cycles), and the potential for flow-induced vibration in the MS and FW piping (during the normal and upset operations) and in heat exchangers following the power uprate.

    B) In Section 10.4.3, you indicated that the vibration level may even be higher if other flow induced vibration mechanisms occur.

    Provide a discussion on the potential for flow-induced vibration of the main steam and feedwater piping due to various mechanisms, including, in particular, the fluid-elastic instability at the proposed power level.

11. A) Discuss the functionality of safety-related mechanical components (i.e., all safety-related valves and pumps, including air-operated valves (AOV) and safety and relief valves) affected by the proposed power uprate to ensure that the performance specifications and technical specification requirements (e.g., flow rate, close and open times) will be met for the proposed power uprate.

B) Confirm that safety-related AOV and motor-operated valves (MOVs) will be capable of performing their intended function(s) following the proposed power uprate including such affected parameters as fluid flow, temperature, pressure and differential pressure, and ambient temperature conditions.

C) Identify the mechanical components that were not evaluated at the uprated power level.

D) Discuss the effects of the proposed power uprate on the pressure locking and thermal binding of safety-related power-operated gate valves for Generic Letter (GL) 95-07.

E) Provide an evaluation of the effect of increased temperature due to power uprate on thermally-induced pressurization of piping runs penetrating the containment that were evaluated in response to Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions."

12. A) In reference to Section 3.11, provide a summary addressing your evaluation of the effects of the proposed power uprate on the ballance-of-plant (BOP) piping, components, and pipe supports, nozzles, penetrations, guides, valves, pumps, heat exchangers and anchorages.

B) Provide the calculated maximum stresses and fatigue usage factors for the most critical BOP piping systems, the allowable limits, the code of record and code edition used for the power uprate conditions. If different from the code of record, justify and reconcile the differences.

C) In Appendix G of the submittal, you indicated that some feedwater heater relief valves will be adjusted or replaced and the heaters will be rerated to compensate for the increased feedwater flow and the associated pressure change. You also indicated that condenser tube staking is planned for the main condensers to provide adequate protection against tube vibration damage at uprated power conditions. Provide a summary of your evaluation of the main condenser tubes at the uprated condition.

D) Provide a discussion on the potential for flow-induced vibration of the main condenser tubes, and heat exchangers due to increased temperature and flow in the mainsteam and feedwater systems.

13. A) In reference to Sections 3.5 and 4.1.2, provide a discussion of the evaluation of piping systems attached to the torus shell, vent penetrations, pumps, and valves, that are affected by increased torus temperature and changes in LOCA dynamic loads (pool swell, condensation oscillation, and chugging) and increased temperature and flow in the main steam and feedwater systems due to the proposed power uprate.

    B) Identify supports and piping systems that require modifications as a result of the proposed extended power uprate.

14. In Appendix G of the submittal, you indicated that restriction orifices to the stator water cooling system will be resized to accommodate the increased heat load. Additional cooling towers will be installed to ensure that the temperature of the water released to the environment remains within existing limits.

    Confirm whether the proposed power uprate will increase the accident temperature, pressure and sub-compartment pressurization that affect the design basis analyses for steel and concrete in the containment, steam tunnel and the spent fuel pool. If the structural steel and concrete will be affected, provide the design basis margin and margins after considering increased accident loading due to the proposed power uprate.

REFERENCES:

1. Letter from R. M. Krich (Commonwealth Edison Company) to U.S. NRC, "Request for License Amendment for Power Uprate - Dresden Nuclear Power Station, Units 2 and 3

2. GE Licensing Topical Report, NEDC-32962P, "Safety Analysis Report for Dresden Nuclear Power Station, Units 2 and 3 Extended Power Uprate," December 2000

3. GE Licensing Topical Report, NEDC-32961P, "Safety Analysis Report for Quad Cities Nuclear Power Station, Units 1 and 2 Extended Power Uprate," December 2000