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U. S. Nuclear Regulatory Commission
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Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Information Regarding Request for Extended Power Uprate NRC Safety Evaluation

Reference: Letter from Patrick R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, " Additional Information Regarding Request for Extended Power Uprate NRC Safety Evaluation," dated April 9, 2004

On October 15, 2003, the NRC requested additional information to support a revision of the EPU Safety Evaluation for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. Exelon Generation Company (EGC), LLC provided the requested information in the referenced letter. The NRC identified a discrepancy in the information provided in Attachment 1 of the April 9, 2004, letter where references were reversed in the response to Question 1. This letter corrects this discrepancy.

Should you have any questions concerning this letter, please contact Mr. Thomas G. Roddey at (630) 657-2811.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager – Licensing

Attachment: Additional Information Regarding NRC Safety Evaluation Revision for Dresden and Quad Cities Extended Power Uprate

A001

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
Illinois Emergency Management Agency - Division of Nuclear Safety

Additional Information Regarding NRC Safety Evaluation Revision for Dresden and Quad Cities Extended Power Uprate

NRC RAI 1

Based on your design basis calculation using the ISCOR computer code, the pressure drop estimate across the dryer was found to be underestimated when a revised analysis was performed using the CFD computer code. Your modification of the dryer at QCNPS 2 after the 2003 event appears to resolve the issue of overstress in the outer hood plates.

Since the design of the dryers in the other three units of Dresden and Quad Cities was based on the ISCOR computer code, which was determined to be unconservative, discuss your intended action to address the strong likelihood of overstress in the dryers in these three units.

Response

The steam dryers for Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) were designed to ensure that loose parts were not generated under the pressure loading conditions for the main steam line break outside containment faulted condition. The faulted condition loading bounds the steady state flow pressure drop loads during normal operation. The original dryer design calculations did not address the oscillating pressure loads that occur during normal operation. Oscillating pressure loads are believed to have caused the fatigue failures observed at QCNPS, Units 1 and 2, and the fatigue cracking observed at DNPS, Unit 2.

The ISCOR code does not calculate the pressure drop across the steam dryer. The ISCOR code is used to calculate the reactor heat balance conditions. The resulting steam flow rate from the core is then used to calculate the pressure drop through the dryer vane banks. The steam flow calculated by ISCOR is used in the dryer vane bank pressure drop calculation, whether the calculation is performed using empirical correlation methodology (as was done for Extended Power Uprate (EPU)) or as input to the dryer Computer Fluid Design (CFD) model. Both the empirical correlation method and the CFD model calculate approximately the same pressure drop for the flow through the dryer vane banks. The CFD model also calculates the additional pressure drop across the outer hood panels caused by the fluid velocity and acceleration from the dome region to the vessel steam nozzle.

The CFD model and the empirical correlation method do not predict the oscillating pressure loads on the dryer. These approaches calculate the steady state flow pressure drop loads, which are constant (not oscillating) and do not induce fatigue failure in the dryer components. The additional pressure drop across the outer hoods was also included in the dryer design assessment calculations for BWR/4-6 plants. However, this calculation was not retrofit to the BWR/3 vintage dryer designs because, as described above, the design basis for the BWR/3 steam dryers was to maintain structural integrity for the faulted condition. As stated in the response to NRC RAI 2 below, the LAMB code used for calculating the design basis faulted pressure differences does include the pressure drop associated with the flow across the outer hood. Therefore, the EPU dryer evaluations for the main steam line break faulted condition are still acceptable for BWR/3 plants.

As a result of the QCNPS Unit 2 dryer degradation found in 2003, Exelon Generation Company, LLC (EGC) made a commitment, in a letter dated June 27, 2003, to monitor key reactor and plant parameters at DNPS and QCNPS to provide early indication of potential dryer structural integrity issues. These actions included the following initiatives.

Additional Information Regarding NRC Safety Evaluation Revision for Dresden and Quad Cities Extended Power Uprate

1. Daily monitoring of moisture carryover and other key reactor and plant parameters

   A monitoring program was implemented on QCNPS, Units 1 and 2, and DNPS, Units 2 and 3, to provide early indication of potential dryer damage or structural integrity problems. If indications of steam dryer damage or structural integrity concerns are identified, power will be reduced on the affected unit to pre-EPU levels and further corrective actions will be taken. As discussed with the NRC, elevated moisture carryover is considered a positive indication of dryer damage.

2. Additional inspections

   Additional inspections will be performed during the next refueling outage on all four units. In addition, detailed finite element modeling of the steam dryer for each unit will be performed to determine the susceptible areas, both inside and outside of the dryer hood.

QCNPS Unit 1 used these methods to identify dryer degradation and failure. On October 26, 2003, QCNPS Unit 1 experienced main steam line (MSL) flow perturbations identified during dryer monitoring. Flow increased in MSL "D" by 0.5 million pounds mass per hour (Mlb/hr), with corresponding flow reductions in the other MSLs. On October 27, moisture carryover (MCO) was observed to increase to 0.068%. On October 31, MCO trend results exceeded the predetermined notification threshold of 0.1%. QCNPS increased the MCO sampling frequency to twice daily. With MCO continuing to trend upward for several days, on November 3, 2003, EGC reduced power on QCNPS Unit 1 to pre-EPU levels. On November 12, 2003, QCNPS Unit 1 shutdown to inspect and repair the dryer.

In addition to these measures, EGC reduced power on DNPS Unit 3 to pre-EPU levels on November 15, 2003, pending a detailed review of the QCNPS Unit 1 dryer failure and revision of the existing operability determination. On December 6, DNPS Unit 3 shutdown to inspect and repair the dryer. The previous operability determination concluded that a dryer failure does not adversely impact operation of any equipment important to safety during all normal and accident modes. Analysis of the QCNPS Unit 1 failure has not changed this finding.

The fatigue cracking found on the 270° side of the QCNPS Unit 2 dryer during the June 2002 inspection is representative of the fatigue cracking that occurred in the other three units. In November 2003, fatigue cracking was observed in the outer hoods in the DNPS Unit 2 dryer following a full two-year operating cycle at EPU power. Operation with a failed lower cover plate contributed to the accelerated crack growth and subsequent damage observed in the second failure at QCNPS Unit 2. These lower cover plates have been replaced on all DNPS and QCNPS units.

EGC continues to address the potential for overstress in the steam dryers at DNPS and QCNPS by continuing to modify the steam dryers to reduce stresses, and utilizing increased parameter monitoring with trigger points. The Boiling Water Reactor Owners Group (BWROG) and General Electric (GE) representatives outlined several key industry actions to address the dryer failure issue generically, including creation of a steam dryer committee to develop an action plan to address dryer failures. GE Service Information Letter (SIL) No. 644, Supplement 1, "BWR steam dryer integrity," dated September 5, 2003, provides recommendations for monitoring during operation and short-term inspection guidance. EGC implemented the recommendations of GE SIL No. 644, Supplement 1.

Additional Information Regarding NRC Safety Evaluation Revision for Dresden and Quad Cities Extended Power Uprate

NRC Information Notice 2002-26, "Additional Flow-Induced Vibration Failures After a Recent Power Uprate," Supplement 2, dated January 9, 2004, states that it is very unlikely that loose parts would adversely affect the safe shutdown of a plant, though it is important to understand the extent of damage that might be caused by steam dryer failures. In addition, a Commission briefing on October 15, 2003, stated that, based on current information, steam dryer cracking incidents do not pose an immediate safety concern.