

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

August 22, 2003

SVP-03-093

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Quad Cities Nuclear Power Station, Unit 2
Facility Operating License No. DPR-30
NRC Docket No. 50-265

Subject: Licensee Event Report 265/03-004, "Reactor Shutdown due to Degraded Reactor Steam Dryer as a Result of Increased Steam Velocities from Extended Power Uprate"

Reference: Letter from Keith R. Jury (EGC) to USNRC, "Commitments for Resolution of Steam Dryer Degradation Issue," dated June 27, 2003

Enclosed is Licensee Event Report (LER) 265/03-004, "Reactor Shutdown due to Degraded Reactor Steam Dryer as a Result of Increased Steam Velocities from Extended Power Uprate," for Quad Cities Nuclear Power Station, Unit 2

This report is submitted as a voluntary report, as discussed in the referenced letter.

Should you have any questions concerning this report, please contact Mr. W. J. Beck at (309) 227-2800.

Respectfully,



Timothy J. Tulon
Site Vice President
Quad Cities Nuclear Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

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| NRC FORM 366 (7-2001) | | U.S. NUCLEAR REGULATORY COMMISSION | | APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004 <small>Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to bis1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.</small> | | | |
| LICENSEE EVENT REPORT (LER) | | | | | | | |
| 1. FACILITY NAME | | | 2. DOCKET NUMBER | | 3. PAGE | | |
| Quad Cities Nuclear Power Station Unit 2 | | | 05000265 | | 1 of 4 | | |
| 4. TITLE Reactor Shutdown due to Degraded Reactor Steam Dryer as a Result of Increased Steam Velocities from Extended Power Uprate | | | | | | | |
| 5. EVENT DATE | | | 6. LER NUMBER | | 7. REPORT DATE | | |
| MO | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO | | |
| 06 | 12 | 03 | 03 | - 004 - | 00 | | |
| | | | 08 | 22 | 03 | | |
| | | | 8. OTHER FACILITIES INVOLVED | | | | |
| | | | FACILITY NAME | | DOCKET NUMBER | | |
| | | | N/A | | N/A | | |
| | | | FACILITY NAME | | DOCKET NUMBER | | |
| | | | N/A | | N/A | | |
| 9. OPERATING MODE | | 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) | | | | | |
| 5 000 | | 20.2201(b) | | 20.2203(a)(3)(ii) | | 50.73(a)(2)(ii)(B) | |
| | | 20.2201(d) | | 20.2203(a)(4) | | 50.73(a)(2)(iii) | |
| | | 20.2203(a)(1) | | 50.36(c)(1)(i)(A) | | 50.73(a)(2)(iv)(A) | |
| | | 20.2203(a)(2)(i) | | 50.36(c)(1)(ii)(A) | | 50.73(a)(2)(v)(A) | |
| | | 20.2203(a)(2)(ii) | | 50.36(c)(2) | | 50.73(a)(2)(v)(B) <input checked="" type="checkbox"/> | |
| | | 20.2203(a)(2)(iii) | | 50.46(a)(3)(ii) | | 50.73(a)(2)(v)(C) | |
| | | 20.2203(a)(2)(iv) | | 50.73(a)(2)(i)(A) | | 50.73(a)(2)(v)(D) | |
| | | 20.2203(a)(2)(v) | | 50.73(a)(2)(i)(B) | | 50.73(a)(2)(vii) | |
| 20.2203(a)(2)(vi) | | 50.73(a)(2)(i)(C) | | 50.73(a)(2)(viii)(A) | OTHER Specify in Abstract below or in NRC Form 366A Voluntary Report | | |
| 20.2203(a)(3)(i) | | 50.73(a)(2)(ii)(A) | | 50.73(a)(2)(viii)(B) | | | |
| 12. LICENSEE CONTACT FOR THIS LER | | | | | | | |
| NAME | | | | TELEPHONE NUMBER (Include Area Code) | | | |
| Wally Beck, Regulatory Assurance Manager | | | | (309) 227-2800 | | | |
| 13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT | | | | | | | |
| CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO EPIX | CAUSE | SYSTEM | |
| | | | | | | | |
| 14. SUPPLEMENTAL REPORT EXPECTED | | | | | 15. EXPECTED SUBMISSION DATE | | |
| YES (If yes, complete EXPECTED SUBMISSION DATE) | | | | | MONTH DAY YEAR | | |
| X NO | | | | | | | |

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On June 10, 2003, after evaluation of indications of a degraded steam dryer, Unit 2 was shut down to allow inspection and repair of the steam dryer. On June 12, 2003, inspections identified cracking in the steam dryer. Failure analysis and repairs to the Unit 2 dryer were completed over the following 18 days and the reactor was returned to service.

The root cause of the failure of the steam dryer has been determined to be the high cycle fatigue cracking caused by the increased vibration loadings created by high steam velocities.

The safety significance of this event was minimal. The dryer is a non-safety related component whose only safety function is to remain intact such that it will not prevent a safety related component from performing its function. At the time of discovery, all dryer components remained constrained within the dryer/separator envelope.

This report is being submitted as a voluntary report.

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PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor, 2957 Megawatts Thermal Rated Core Power

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

EVENT IDENTIFICATION

Reactor Shutdown due to Degraded Reactor Steam Dryer as a Result of Increased Steam Velocities from Extended Power Uprate

A. CONDITION PRIOR TO EVENT

Unit: 2 Event Date: June 12, 2003 Event Time: 0931 hours
Reactor Mode: 5 Mode Name: Refueling Power Level: 000%

Refueling (5) - Mode switch in the Shutdown or Refueling position with fuel in the reactor vessel and with one or more vessel head closure bolts less than fully tensioned or with the head removed.

B. DESCRIPTION OF EVENT

On June 10, 2003, Unit 2 was shut down to allow inspection and repair of the reactor steam dryer [DRY]. On June 12, 2003, inspections identified that the steam dryer had multiple cracks in the vertical hood plates on both sides of the dryer.

During a refueling outage in March 2002, modifications were installed on Unit 2 to support an Extended Power Uprate (EPU). Following the refuel outage, Unit 2 was brought to full EPU power.

From June 7, 2002, through July 11, 2002, various plant transients involving reactor level, reactor pressure, steam flow and moisture carryover were observed on Unit 2. On July 11, 2002, the unit was shut down to repair the steam dryer (reference LER 265/02-003). During the outage, the dryer was inspected and repaired. Following the outage, Unit 2 was returned to full EPU power.

On April 16, 2003, a Unit 2 main steam relief valve [RV] went fully open and could not be reseated. The reactor was scrammed, the relief valve was replaced, and the reactor was started back up on April 20, 2003, and returned to full EPU power.

Following reactor startup on April 20, 2003, moisture carryover from the reactor to the turbine was higher than prior to the outage. Daily sampling of moisture carryover was initiated May 6, 2003.

On May 8, 2003, the reactor was shut down so that two additional main steam relief valves could be replaced. The reactor was started up on May 11, 2003, and returned to full EPU power.

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On May 28, 2003, following a decrease in power to suppress a suspected fuel defect and a return to full EPU power, the moisture carryover was higher than prior to the down power. In response to the increased moisture carryover, reactor power was reduced to pre-EPU full power.

On June 10, 2003, in response to technical evaluations of the potential degraded condition and the possibility of creating a loose part that would compromise safety-related equipment, Unit 2 was shut down to inspect and repair the suspected degraded steam dryer. Initial inspection found a fracture in the vertical hood to top plate region, matching the suspected degraded area, which was the 90-degree side adjacent to the A and B Main Steam inlet nozzles. After removal of the dryer from the reactor cavity, further inspections from inside the dryer found incipient cracks on the 270-degree side in a similar location. In addition, three braces attached to the hood area interior were found broken and on top of the separator. The dryer was repaired and Unit 2 was returned to pre-EPU full power. Pending resolution of issues associated with the event, Unit 2 was returned to full EPU power.

On July 25, 2003, in a meeting with NRC, a summary of the technical evaluation of the dryer failure and the extent of condition review for Quad Cities Unit 2 were provided. Also, the adequacy and acceptability of the dryer repairs were discussed in light of the results of the root cause evaluation.

C. CAUSE OF EVENT

The root cause of the failure of the steam dryer has been determined to be high-cycle fatigue driven by a low-frequency pressure pulsation caused by the EPU increased steam velocities.

Further technical information can be found in the August 15, 2003, letter from P.R. Simpson (EGC) to USNRC, "Update to Information Supporting the License Amendment Request to Permit Up-rated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station," prepared by EGC and General Electric Company.

D. SAFETY ANALYSIS

The safety significance of this event was minimal. The dryer is a non-safety related component whose only safety function is to remain intact such that no loose parts will prevent a safety related component from performing its function. At the time of discovery, all dryer components remained constrained within the dryer/separator envelope. This report is being submitted as a voluntary report.

E. CORRECTIVE ACTIONSCorrective Actions Completed

Repairs were installed to the Unit 2 dryer that are designed to withstand the defined operating and transient loads expected to occur.

F. PREVIOUS OCCURRENCES

LER 265/02-003, "Reactor Shutdown due to Failure of Reactor Steam Dryer from

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Flow-Induced Vibrations as a Result of Extended Power Uprate," was submitted on September 9, 2002. This event involved a shutdown on July 11, 2002. An operability assessment had previously been performed in response to indications of a damaged reactor steam dryer (initial indications started on June 7, 2002). TS 3.0.3 was conservatively entered when those indications changed such that, based on the analysis of the changed indications, reasonable assurance of continued operability of connected safety systems could no longer be supported. Following the unit shutdown, an inspection of the Unit 2 reactor internals on July 13, 2002, revealed that a steam dryer cover plate had failed. Fragments were found in a main steam line and a main turbine stop valve inlet screen.

The root cause of the steam dryer failure was determined to be a lack of industry experience and knowledge of flow-induced vibration dryer failures. The dryer failed as a result of fatigue caused by flow-induced vibrations created by higher steam flows due to EPU conditions.

Corrective actions included repair to the Unit 2 steam dryer and further evaluation of resonant frequency issues. The resonant frequency review was still in progress at the time of the June 10, 2003, event.

Had the investigation in 2002 looked at a wider frequency range of vibration information, it might have identified other low margin components that needed to be addressed. This combined with the dryer component natural frequency review performed at that time, might have identified that the dryer hood plate was susceptible to a low frequency driver. However, since the previous event was determined to be caused by resonance with a high frequency vibration driver, these actions were not structured to detect and/or evaluate the low frequency -high cycle failure mode determined present in the 2003 event.

G. COMPONENT FAILURE DATA

The Steam Dryer was manufactured by Stearns-Roger.