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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Renewed 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
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Technical Documentation Related to Analysis and Design of Quad Cities Replacement Steam Dryers

Reference: Letter from K. R. Jury (Exelon Generation Company, LLC) to U. S. NRC, "Commitments and Plans Related to Extended Power Uprate Operation," dated July 26, 2005

In the reference, Exelon Generation Company, LLC (EGC) made several commitments regarding the extended power uprate (EPU) operation of Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, including a commitment to submit detailed evaluations of the QCNPS Unit 1 replacement steam dryer. These evaluations are required to be submitted within 80 days of steam dryer data collection at the maximum reactor thermal power level achieved during the startup test. The maximum reactor thermal power level achieved during the startup test for QCNPS Unit 1 occurred on June 5, 2005; therefore, the 80-day report is due to be submitted to the NRC no later than August 24, 2005. The enclosures to this letter contain the information committed to be provided in the reference letter.

Enclosure 1 contains a summary of the engineering assessments related to the steam dryer design project. Enclosure 2 provides the detailed evaluations of data collected on QCNPS Unit 1 during startup and power ascension testing following steam dryer replacement. The attached reports include detailed evaluations of comparisons of the predicted QCNPS Unit 1 steam dryer loads, developed using the acoustic circuit model, with the actual QCNPS Unit 1 loads obtained from main steam line strain gauge data and the instrumented steam path.

EGC provided General Electric (GE) Report GENE-0000-0043-5391-01, "Quad Cities Unit 1 Replacement Steam Dryer Stress and Fatigue Analysis at EPU Power Level of 2957 MWt

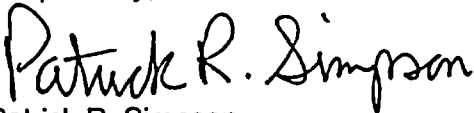
APO1

Based on Measured EPU Conditions," (i.e., Attachments 10 and 11 of Enclosure 2) to the NRC via electronic mail on August 17, 2005. Subsequently, this report was revised to illustrate the change in damping coefficients applied during analysis of the skirt area of the QCNPS Unit 1 steam dryer. Figure 6-14, "Frequency Response QC1D – 10%: Skirt," was deleted, and Figure 6-18, "Frequency Response QC1B +10%: Skirt," was modified to include results of the revised damping coefficient. Attachments 10 and 11 of Enclosure 2 provide the revised report.

Attachment 10 of Enclosure 2 contains information considered proprietary to GE. Therefore, EGC requests that this information be withheld from public disclosure in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," paragraph (a)(4), and 10 CFR 9.17, "Agency records exempt from public disclosure," paragraph (a)(4). An Affidavit attesting to the proprietary nature of this document is included in the attachment, and a non-proprietary version of the report is provided in Enclosure 2, Attachment 11.

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

Respectfully,



Patrick R. Simpson
Manager – Licensing

Enclosures:

1. Quad Cities Nuclear Power Station, Unit 1 – Summary of 80-Day Report to the NRC
2. Engineering Evaluation of the Quad Cities Unit 1 Replacement Steam Dryer

Attachments:

1. Exelon Report Number AM-2005-013, "Quad Cities Unit 1 New Steam Dryer Outage Startup Test Report," Revision 0, dated July 28, 2005
2. Structural Integrity Associates Letter KKF-05-036, "Quad Cities Unit 1 Main Steam Line Strain Gage Reductions," dated July 6, 2005
3. Exelon Report Number AM-2005-003, "Engineering Evaluation of Reduced Strain Gage Data Sets on the Quad Cities Unit 1 Test Condition 15A," dated June 29, 2005
4. Exelon Report Number AM-2005-006, "Comparison of Acoustic Circuit Dryer Loads for Missing MS Line Strain Gages to Acoustic Circuit Dryer Loads with All MS Line Strain Gages," Revision 0, dated July 19, 2005
5. Exelon Report Number AM-2005-008, "An Assessment of the Effects of Uncertainty in the Application of Acoustic Circuit Model Predictions to the Calculation of Stresses in the Replacement Quad Cities Units 1 and 2 Steam Dryers," Revision 0, dated August 19, 2005
6. Exelon Report Number AM-2005-007, "AM-2005-007 Assessment of the Revised QC1 Minimum Error ACM Loads Using All Main Steam Line Strain Gages," Revision 0, dated August 2, 2005
7. Structural Integrity Associates Letter KJO-05-004, "Vibration Comparison of Quad Cities Units 1 and 2 Power Ascension Accelerometer Spectra Data," dated July 14, 2005

8. C.D.I. Technical Note No. 05-34, "Test Condition TC15a Load Comparison for Quad Cities Unit 1," Revision 0, dated August 2005
9. GE Report GE-NE-0000-0041-9435, "Quad Cities 1 & 2 Steam Dryer Replacement – 4% Structural Damping for Steam Dryer Skirt FIV Analysis," dated June 16, 2005
10. Affidavit and GE Report GENE-0000-0043-5391-01-P, "Quad Cities Unit 1 Replacement Steam Dryer Stress and Fatigue Analysis at EPU Power Level of 2957 MWt Based on Measured EPU Conditions," Revision 1, GE Proprietary, dated August 16, 2005
11. GE Report GENE-0000-0043-5391-01, "Quad Cities Unit 1 Replacement Steam Dryer Stress and Fatigue Analysis at EPU Power Level of 2957 MWt Based on Measured EPU Conditions," Revision 1, Non-Proprietary, dated August 2005
12. Structural Integrity Associates Letter KKF-05-037, "Comparison of Quad Cities Unit 1 and Quad Cities Unit 2 Main Steam Line Strain Gage Data," Revision 1, dated July 18, 2005

General Electric Company

AFFIDAVIT

I, Louis M. Quintana, state as follows:

- (1) I am Manager, Licensing, General Electric Company ("GE"), have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.
- (2) The information sought to be withheld is contained in GE proprietary report, GENE-0000-0043-5391-01-P, *Quad Cities Unit 1 Replacement Steam Dryer Stress and Fatigue Analysis at EPU Power Level of 2957 MWt Based on Measured EPU Conditions*, Revision 1, Class III (GE Proprietary Information), dated August 2005. The proprietary information is delineated by a double underline inside double square brackets. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation⁽³⁾ refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.
- (3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).
- (4) Some examples of categories of information which fit into the definition of proprietary information are:
 - a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;
 - b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;
 - c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;
 - d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a and (4)b above.

- (5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.
- (6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.
- (7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.
- (8) The information identified in paragraph (2), above, is classified as proprietary because it documents the dynamic, stress and fatigue analyses that demonstrate the adequacy of the replacement BWR steam dryer using GE-developed structural analysis techniques and methodology. Development of the test methods, the instrumented dryer, the methodology for analysis of this information and the steam dryer performance, and its application for the design, procurement and analyses methodologies and processes for the Steam Dryer Program was achieved at a significant cost to GE, on the order of approximately two million dollars.

The development of the dryer performance evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

- (9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 23th day of August 2005.



Louis M. Quintana
General Electric Company

ENCLOSURE 1

Quad Cities Nuclear Power Station, Unit 1 – Summary of 80-Day Report to the NRC

Quad Cities Nuclear Power Station, Unit 1 – Summary of 80-Day Report to the NRC

Executive Summary

After experiencing steam dryer degradation at Quad Cities Nuclear Power Station (QCNPS) during extended power uprate (EPU) operations, Exelon Generation Company, LLC (EGC) and General Electric (GE) embarked on a project to design new steam dryers for both QCNPS units.

Dryer Design Is More Robust and Less Susceptible to Flow-Induced Vibration

The new dryer design relied on operating experience, data previously collected on instrumented steam dryers, and the advanced boiling water reactor (BWR) steam dryer design. Every effort was made to eliminate stress concentration points by using full penetration welds wherever possible, use of pre-shaped components that moved welds from high-stress areas of the dryer, and implementing BWR Vessel Internals Project (BWRVIP)-84 material and fabrication guidelines to minimize IGSCC susceptibility. In addition, new dryer components were fabricated using thicker material sections, which significantly improved the dryer's load carrying capacity. This is especially evident in the front hood areas, which were increased to 1-inch thick plate material. The overall effect was a new dryer with significantly improved design margin for fatigue life. EGC previously submitted reports that described this design effort.

Comprehensive Analysis of Design

Design Loads

Because the dryer loads were not clearly defined, two design basis load cases were developed. The first was based on QCNPS Unit 2 in-plant data from two water reference legs, four venturi instrument lines, and one strain gauge, along with acoustic circuit (AC) analysis that included the new dryer shape. The second load case was derived from scale model tests (SMT) of the QCNPS Unit 1 steam path. After performing an evaluation of the ability of the AC analysis to transfer loads, the measured pressures from the SMT at EPU conditions were transformed into refined load cases for finite element analysis (FEA) of the new dryer. Both load cases consisted of approximately 15,000 node points that defined the differential pressure across the dryer surface for the FEA of the dryer. EGC previously submitted reports that described this design effort.

FEA

To assist in validating analytical methodologies, GE and XGEN Engineering (XGEN) developed two completely independent finite element models (FEMs) of the new dryer. Both load cases were run on the GE model. To ensure the analysis adequately accounted for potential variations between the FEM and the physical dryer natural frequencies, three time history analyses were executed for both load cases as follows:

- Minus 10% on the time step
- Nominal time step
- Plus 10% on the time

The XGEN model was analyzed using the QCNPS Unit 2 in-plant load case with a nominal time step as an independent verification of the GE model and analysis results.

Based on the most conservative of the seven finite element analysis evaluations, modifications were added to the new dryer design to lower the stress concentrations across

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the entire structure to within the design criteria. EGC previously submitted reports that described this design effort.

Independent Review

EGC's Independent Review Team, consisting of MPR Associates and Structural Integrity Associates (SIA), reviewed the new dryer design activities, including load definition, dryer design, dryer fabrication, and stress analyses. Review comments were addressed with closure issued by formal documentation from EGC.

Extensive Startup Testing

Data collection efforts on QCNPS Unit 1 included installation of strain gauges and accelerometers on the main steam lines (MSLs) and steam path components. This information was used to evaluate AC analysis and MSL vibration. Prior to startup, detailed go/no-go criteria were developed for strain gauges and accelerometers. The startup test included 15 data collection power levels up to the maximum thermal power achievable at 2902 megawatts-thermal (MWt). The QCNPS Unit 1 Startup Test Report (i.e., Reference 1) provides the results of the evaluations performed on the data collected during the startup test program.

Evaluation of the QCNPS Unit 1 Startup Test

Five different analyses were conducted with the startup test data, including the following.

- Evaluation of AC analysis
- Evaluation of SMT
- Finite element analysis of the new dryer using an AC in-plant load case
- MSL vibration
- Moisture carryover (MCO)

AC Analysis

The AC analysis methodology was evaluated using data collected on QCNPS Unit 2. EGC first compared the AC analysis predictions to the in-plant dryer pressure measurements without providing the data to Continuum Dynamics, Inc. (CDI). After the first evaluation, CDI was provided with the in-plant dryer pressure transducer data to refine the AC load prediction methodology.

By comparing the predicted and measured pressure amplitudes and frequency content, these assessments provide confidence that realistic dryer pressure loads are defined for the QCNPS Unit 1 dryer finite element analysis. Loads are accurately predicted on the outer hoods where most of the historical dryer issues and highest loads occur. The AC analysis "modified prediction" in Reference 3 tended to under-predict at low-pressure locations, and over-predicted pressures acting on the skirt. Comparing the strain gauge data from the new dryer finite element analysis with actual in-plant dryer strain measurements gave additional assurance that the AC load definition provided reliable structural response.

SMT

The QCNPS Unit 1 in-plant pressure data was compared to QCNPS Unit 1 SMT results. The conclusion for the interim SMT report is that low to mid-range frequencies are over-predicted and higher frequencies above 135 hertz are under-predicted. Additional efforts are underway that include using more detailed as-built information of the Safety/Relief Valves (S/RVs) and Electromatic Relief Valves (ERVs), and scale model testing of the

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QCNPS Unit 2 as-built steam path, so that a direct comparison can be made. Reference 4 contains the interim SMT report.

Finite Element Analysis

Part of the new dryer design strategy is to compare the finite element analysis actual in-plant loads with the new dryer design load cases. To accomplish this, all MSL and QCNPS Unit 2 new dryer instrumentation data was provided to CDI to develop a refined load case using the AC methodology after it was evaluated at the highest thermal power level achieved.

- Finite element analysis results indicate that dryer integrity is assured at 2957 MWt with acceptable margin. This analysis includes a conservative shift in the defined load frequency content of +/- 10 % to address uncertainties in the FEM dynamic characteristics. These analyses showed that the stresses on the outer hood areas where the historical dryer damage occurred, and where the dryer loads are the highest, are very low.
- Since the highest thermal power achieved during startup was still approximately 70 MWt below full EPU power, finite element analysis stresses were scaled upward by a factor of 1.10. This represents a stress increase that is based on a steam velocity to the fourth power increase. This analysis showed that the new dryer is structurally adequate for EPU power levels up to 2957 MWt.

Reference 5 contains the GE stress report that summarizes the dynamic, stress, and fatigue analyses that demonstrates that the replacement steam dryer is adequate for EPU operations.

MSL Vibration Evaluation

As part of the QCNPS Unit 1 startup, both strain gauge and accelerometer data was collected on the four MSLs. This information was evaluated during the startup test and determined to be acceptable for EPU operation. Reference 1 contains the QCNPS Unit 1 startup test results.

MCO

As part of the QCNPS Unit 1 MCO evaluation, data was collected at various power levels. This information was assessed during the startup test and determined to be acceptable for current EPU operation. Reference 1 contains the QCNPS Unit 1 startup test results.

Quad Cities Nuclear Power Station, Unit 1 – Summary of 80-Day Report to the NRC

References

- 1) Exelon Report Number AM-2005-013, "Quad Cities Unit 1 New Steam Dryer Outage Startup Test Report," Revision 0, dated July 28, 2005
- 2) Exelon Report Number AM-2005-002, "Acoustic Circuit Benchmark, Quad Cities Unit 2 Instrumented Steam Path, 790 and 930 MWe Power Levels," dated June 15, 2005
- 3) CDI Report Number 05-10, "Benchmark of Continuum Dynamics, Inc. Steam Dryer Load Methodology Against Quad Cities Unit 2 In-Plant Data," dated July 2005
- 4) GE Report GENE-0000-0042-7471-01, "Interim Comparison of Quad Cities Unit 1 Scale Model Test Data with Quad Cities Unit 2 Plant Data," dated July 2005
- 5) GE Report GENE-0000-0043-5391-01-P, "Quad Cities Unit 1 Replacement Steam Dryer Stress and Fatigue Analysis at EPU Power Level of 2957 MWt Based on Measured EPU Conditions, GE Proprietary, dated August 16, 2005

ENCLOSURE 2

Engineering Evaluation of the Quad Cities Unit 1 Replacement Steam Dryer