

April 20, 2006

MEMORANDUM TO: File

FROM: Maitri Banerjee, Senior Project Manager */RA/*
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 - STEAM
DRYER INSPECTION RESULTS (TAC NO. MC0878)

The purpose of this memorandum is to document the Nuclear Regulatory Commission (NRC) staff's decision to not object to (1) continued operation of Quad Cities Nuclear Power Station (Quad Cities), Unit 1 at the original licensed thermal power (OLTP) power level until its shutdown on May 5, 2005; and (2) startup of Quad Cities, Unit 2 and operation at OLTP conditions except for a short period (normally less than 24 hours) at extended power uprate (EPU) conditions for testing and collection of data at EPU, following the steam dryer inspection and repairs performed during the recently completed Quad Cities, Unit 2 refueling outage.

The NRC staff's decision is based on Exelon Generation Company, LLC's (Exelon's) reported actions to address recent steam dryer and electromatic relief valve (ERV) performance problems. In a letter dated April 14, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML061070354), Exelon stated that it would return Quad Cities, Unit 2 to OLTP conditions following the data collection and not exceed that power level until completing the steam dryer inspection at Quad Cities, Unit 1 in May 2006. The Quad Cities, Unit 1 steam dryer inspection scope will consist of, as a minimum, those areas necessary to confirm conclusions reached regarding the cause of the Quad Cities, Unit 2 steam dryer damage. Exelon indicated that it would continue the dialogue and interactions with the NRC staff regarding the long-term operation of Quad Cities, Units 1 and 2 at EPU conditions. Exelon also noted that its commitments regarding EPU operation at Quad Cities specified in its letter dated January 26, 2006 (ADAMS Accession No. ML060270526), remain in effect.

In May 2005, Exelon installed, in both Quad Cities units, two brand new steam dryers, designed and fabricated to be much more robust than the original dryers and thus better able to handle the EPU loads. The units operated at EPU power levels following the dryer replacement until December 2005, when damage was found in several ERVs at both units. Following brief shutdowns in early January 2006, Exelon has not operated the units beyond the OLTP conditions. As a result, since their installation in May of 2005, the new steam dryers operated under the EPU conditions for approximately 5 months.

On March 24, 2006, Exelon shut down Quad Cities, Unit 2 for a regularly scheduled refueling and maintenance outage. The outage scope included inspections of the steam dryer. This inspection found a large crack, over 6 feet long, in the dryer skirt area at the 135 degree azimuth. Numerous other cracks, much smaller in size were found on the inside surface of the dryer. Exelon took boat samples from several areas of the large crack and performed a root cause analysis. Exelon concluded that the majority of the cracks, including the large crack,

resulted from a stress riser created by problems experienced during installation of the dryer in May 2005. This stress riser worked as a crack initiator and vibrations caused by operation at EPU conditions propagated the crack. Exelon repaired the larger cracks and left some small cracks unrepaired based on an engineering analysis that these cracks are not expected to propagate. Exelon concluded that the Quad Cities, Unit 1 steam dryer would not have any significant cracking in light of the absence of installation difficulties with that dryer.

On April 10, 2006, the NRC staff held a conference call with Exelon to discuss the Quad Cities, Unit 2 dryer inspection results, crack repairs and the root cause. The presentation slides are available in ADAMS under Accession No. ML061080570. The NRC staff sent a request for additional information to Exelon on April 12 (ADAMS Accession No. ML061080610) and held conference calls with Exelon on April 13 and 17, 2006.

During the April 13 telephone conference, Exelon stated that after startup of Quad Cities, Unit 2 it would not operate at EPU power level, except for a short period of less than 24 hours to collect data, until the Quad Cities, Unit 1 steam dryer is inspected and the results validate the root cause for Quad Cities, Unit 2 dryer damage. Exelon agreed to provide timely information to the NRC staff during the power ascension at Quad Cities, Unit 2. During the April 17, 2006 conference call, some steam dryer cracks, considered to be trans-granular-stress-corrosion-cracks in the dryer skirt to base plate weld, were discussed. Exelon stated that these subsurface cracks were shallow, not expected to grow much and would be monitored to detect if any reached the surface. Because of the location and size of these cracks and Exelon's monitoring plan, the NRC staff concluded that there was no near term safety concern.

The NRC staff considers the continued operation of Quad Cities, Unit 1 at the OLTP conditions until its steam dryer inspection in May 2006, and Quad Cities, Unit 2 startup and operation at the OLTP conditions (except for a short time period at EPU to collect plant data) to be acceptable based on the following reasons:

1. The licensing basis function of the steam dryers is to maintain their structural integrity such that (1) the safety function of the reactor (coolant flow and reactivity control) is not impeded, and (2) loose parts are not created that could block reactor coolant flow or impede the safety functions of other components, such as closure of the main steam isolation valve. At Quad Cities, Unit 2, Exelon repaired the recently identified steam dryer cracks as necessary, and performed a root cause analysis of the steam dryer cracking. The licensee's experience with steam dryer operation indicates limited cracking may occur as a result of material fatigue, but does not present a safety concern. The NRC staff does not believe that the licensing basis function of the steam dryers will be challenged by operation of the Quad Cities units at OLTP conditions, including the limited operation of Quad Cities, Unit 2 at EPU conditions to collect data.
2. Analyses and testing performed by Exelon indicate that large pressure loads on the Quad Cities steam dryers and high vibration loads on main steam and connected system components are generated from acoustic resonances in the main steam system at certain frequencies during EPU operation. These loads and vibration are much less significant at OLTP conditions as supported by plant data and years of successful operation at OLTP conditions. During the recently completed refueling outage, Exelon

installed a modification intended to reduce the acoustic resonances in the main steam system.

3. Exelon has developed a steam dryer inspection plan at Quad Cities following the guidance of GE Nuclear Energy Services Information Letter (SIL) 644, "BWR/3 Steam Dryer Failure."
4. Exelon has performed an analysis to evaluate the potential effects of a large loose part on Quad Cities, Unit 1 operation, based on the size of the large crack found in Quad Cities, Unit 2 dryer skirt if it were to break free. Exelon concluded that such a loose part would not impact the safe operation of Quad Cities, Unit 1. A loose part generated from a crack in the dryer skirt area is not expected to reach the main steam lines. Further, various instruments are available to detect reactor flow, reactivity anomaly and performance of plant systems.

The NRC staff is continuing to review Exelon's actions in response to the steam dryer cracking at Quad Cities, Unit 2 and the ERV performance problems at both Quad Cities units. The NRC staff is also reviewing Exelon's loose parts analysis for Quad Cities, Unit 1. The NRC staff will continue to closely monitor Exelon's activities during the continued operation and steam dryer inspection at Quad Cities, Unit 1, and the startup and power ascension, including the data collection at EPU conditions, at Quad Cities, Unit 2. The NRC staff will evaluate whether any safety concerns exist with the return of Quad Cities, Units 1 and 2 to EPU conditions after reviewing the results of the steam dryer inspection at Quad Cities, Unit 1 in May 2006 and the plant data collected at Quad Cities, Unit 2.

The NRC staff finds that the corrective actions taken by Exelon thus far and their plan to startup Quad Cities, Unit 2 and operate both units below EPU level (except for a short time to collect data on Quad Cities, Unit 2 at EPU) provide reasonable assurance of the health and safety of the public.

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The NRC staff finds that the corrective actions taken by Exelon thus far and their plan to startup Quad Cities, Unit 2 and operate both units below EPU level (except for a short time to collect data on Quad Cities, Unit 2 at EPU) provide reasonable assurance of the health and safety of the public.

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