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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 Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

Reference: (1) Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

(2) Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company), Dresden and Quad Cities – Extended Power Uprate - Health Physics Request for Additional Information," dated April 25, 2001

In Reference 1, Commonwealth Edison (ComEd) Company, now Exelon Generation Company (EGC), LLC, submitted a request for changes to the operating licenses and Technical Specifications (TS) for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, to allow operation with an extended power uprate (EPU). In Reference 2, the NRC requested additional information regarding these proposed changes. In a verbal conversation between Mr. L. W. Rossbach of the NRC and Mr. A. R. Haeger, it was agreed that this information would be provided by June 1, 2001. The attachment to this letter provides the requested information.

A001

Should you have any questions concerning this letter, please contact Mr. A. R. Haeger at (630) 657-2807.

Respectfully,

R. M. Krich
Director – Licensing
Mid-West Regional Operating Group

Attachments:
Affidavit
Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Dresden Nuclear Power Station
NRC Senior Resident Inspector - Quad Cities Nuclear Power Station
Office of Nuclear Facility Safety - Illinois Department of Nuclear Safety

bcc: NRC Project Manager, NRR - Dresden Nuclear Power Station, Units 2 and 3
NRC Project Manager, NRR – Quad Cities Nuclear Power Station, Units 2 and 3
Manager of Energy Practice - Winston and Strawn
Director-Licensing, Mid-West Regional Operating Group
Manager-Licensing, Dresden and Quad Cities Stations
Regulatory Assurance Manager - Dresden Nuclear Power Station
Regulatory Assurance Manager – Quad Cities Nuclear Power Station
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STATE OF ILLINOIS	**)**	
COUNTY OF DUPAGE	**)**	
IN THE MATTER OF	**)**	
EXELON GENERATION COMPANY, LLC	**)**	**Docket Numbers**
DRESDEN NUCLEAR POWER STATION UNITS 2 AND 3	**)**	**50-237 AND 50-249**
QUAD CITIES NUCLEAR POWER STATION UNITS 1 AND 2	**)**	**50-254 AND 50-265**

SUBJECT: Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

R. M. Krich
Director - Licensing
Mid-West Regional Operating Group

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 29th day of May, 2001.

Notary Public

" OFFICIAL SEAL "
Timothy A. Byam
Notary Public, State of Illinois
My Commission Expires 11/24/2001

Attachment
Dresden Nuclear Power Station, Units 2 and 3
Quad Cities Nuclear Power Station, Units 1 and 2
Additional Health Physics Information
Supporting the License Amendment Request to Permit Uprated Power Operation

<u>Question</u>

1. *The Dresden 2 & 3 and Quad Cities 1 & 2 skyshine offsite external dose components (related to the 40 CFR 190 annual dose limit of 25 mrem) over the past three years (1997-99) have increased by about a factor of two and seven, respectively. What are the underlying reasons for these increases, and how will the extended power uprate (EPU) impact this apparent trend? Please identify the dose receptor for the skyshine component. Is it a member of the public in a nearby private residence, or a non-occupational licensee employee (a member of the public) working onsite?*

<u>Response</u>

The skyshine dose reported in the Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) annual reports is calculated from Equation A-34 in Appendix A of the Offsite Dose Calculation Manual (ODCM).

The general form of this equation as follows.

[Annual dose] =
[constant] * [distance factor] * {(MWHe w/o HWC) + (H-factor) * (MWHe w/ HWC)}

The parameters in this equation were determined from on-site measurements. The modeling assumes that the dose is proportional to the total electric output (i.e., megawatt hours-electric (MWHe)) produced. Because of the difference in N-16 carry-over when hydrogen water chemistry (HWC) is employed, the power production term is separated into two parts - one when power is produced without employment of HWC (i.e., the term MWHe w/o HWC) and another (i.e., MWHe w/ HWC) when HWC is employed. In order to account for higher N-16 carry-over associated with HWC, the MWHe w/ HWC power generation term is multiplied by a factor (i.e., the H-factor) which ranges from 3 to 5 in the above equation.

Two factors account for the trend in increasing skyshine doses in the 1997 to 1999 time period. One is the employment of HWC and the second is the trend in increased annual electric power production at both DNPS and QCNPS. Specifically, between 1997 and 1999, the DNPS total electrical output in megawatt-hours increased 28% and the QCNPS total electrical output increased 59%. Further, the relative fraction of power produced with HWC increased significantly over this time period for both DNPS and QCNPS. For DNPS, the fraction of total power produced with HWC increased from 58% in 1997 to approximately 78% in 1999. For QCNPS, the fraction of total power produced with HWC increased from 80% in 1997 to approximately 91% in 1999.

The ODCM model assumes that the skyshine dose is proportional to the generated megawatt hours as noted above. The radiological impact of the proposed Extended Power Uprate (EPU) on skyshine dose will continue to be assessed using the ODCM formulation, and will reflect the actual power produced by the plant. Thus, the calculated skyshine dose will increase proportionally to the EPU. The ODCM model will be reassessed as alternate methods of water chemistry are employed. As experience is gained with the recent reductions in HWC injection rates due to injection of noble metals, the H-factor discussed above may be reduced, thus reducing the calculated skyshine dose.

The receptor for skyshine dose is identified in the ODCM in Table 2-2 as a person who spends time at his residence and fishing in waters near the station.

Question

2. *The recent refueling outage at Quad Cities demonstrated a significant unexpected adverse effect following the noble metal injection process (NMIP). Rather than reducing area dose rates as expected, external dose rates in some work areas were significantly elevated. The EPU application takes credit for an effective NMIP by assuming a net reduction in hydrogen gas injection rate, thereby reducing the resultant N-16 radiation levels during plant operations and in the plant environs.*

   What corrective, remedial actions are planned or have been initiated (and what is the estimated time frame) to ensure the NMIP process positively contributes to a reduction in radiation levels? Describe the overall impact on radiation levels (from an occupational and 40 CFR 190 skyshine perspective) given the unexpected adverse effect following the NMIP.

Response

The hydrogen injection rate has been reduced at both DNPS and QCNPS as result of the NMIP, and this has reduced area dose rates during on-line operation as expected. For example, with the initial hydrogen injection rates prior to NMIP, the radiation dose rates measured by the area radiation monitors in the vicinity of the main steam lines had increased to a value of approximately four to five times their pre-HWC values at both QCNPS and DNPS. Following NMIP, these dose rates have decreased so that they are now approximately 1.2 times the pre-HWC values at QCNPS and approximately 1.1 times and 1.6 times the pre-HWC values at DNPS Units 2 and 3 respectively.

The increase in shutdown dose rates at QCNPS Unit 1 during the Fall 2000 refueling outage was a result of increased transport of Co-60 from the fuel related to the zinc injection rates and the timing of noble metal injection following zinc application. The results of this increase are expected to have little to no impact on skyshine. The effect on occupational dose during reactor operation has also been minimal. Reactor water zinc is now being maintained at higher levels to offset any affect on Co-60 transport following noble metal injection. No similar effects on shutdown dose rates were seen on QCNPS Unit 2 during a February 2001 maintenance outage. This Unit 2 outage occurred subsequent to the use of NMIP.

Question

3. *NUREG-0737, Item II.B.2, states that the occupational dose guidelines in GDC 19, 10 CFR 50, Appendix A shall not be exceeded during the course of the accident. This ensures that operators can access and perform required duties and actions in designated vital areas. In Section 8.5.3, Post-Accident, the applicant notes that the change in post-accident source*

term and resulting radiation levels due to EPU are not expected to increase by more than the percentage increase in power level. Additionally, a coincident change to a 24-month fuel cycle also impacts post-accident dose rate levels.

The staff requests that the applicant provide a summary of the vital area gamma dose estimates (whole body, deep dose) equivalent for all the identified tasks (missions) in the current licensing basis; and compare these mission doses with the calculated Post-Uprate/24-month fuel cycle doses for the same missions. Some of these missions may include, for example, sample collections for gaseous effluent release points, and PASS sampling and in-lab analysis. Clarify and explain the changes (from the original "conservative" methods) in dose estimate methodology used for the calculation of post-uprate post-accident operator doses resulting from duties and actions in designated vital areas and for dose rates in the technical support center and emergency operations facility.

<u>Response</u>
The impact of EPU on the radiation doses received while accessing or occupying vital areas following a Loss of Coolant Accident (LOCA) was evaluated by use of a scaling factor developed based on a comparison of the original design basis source terms to the EPU source terms. A bounding scaling factor analysis was developed to address the impact of EPU and a 24-month fuel cycle.

The EPU reactor core inventory was used to develop the post-LOCA gamma energy release rates by energy group over time for the various post-LOCA radiation sources (i.e., drywell atmosphere, reactor building atmosphere, reactor steam, torus water, pressurized recirculating fluid and halogen buildup on filter media/plateout).

For unshielded areas, the scaling factor was estimated by ratioing the gamma energy release rates as a function of time and radiation source for the EPU to the corresponding source terms for the original design basis power level. To develop the scaling factor for shielded areas, the current as well as power uprate source terms discussed above were weighted by the concrete reduction factors for each energy group.

The unshielded and shielded gamma dose rate scaling factors were determined at one hour, one day, and one week following a LOCA. Because the EPU core reflects a 24 month fuel cycle and the more advanced fuel burnup modeling and libraries currently utilized by the computer code ORIGEN (i.e., as compared to the computer code used in the original analyses), the calculated uprate gamma dose rate scaling factors vary from approximately 11% to a maximum of 45%.

<u>*Technical Support Center (TSC) and Emergency Operations Facility (EOF) Habitability*</u>
In accordance with the guidance of NUREG-0737, "Clarification of TMI Action Plan Requirements," Item II.B.2, the EPU LOCA doses in the TSC for both DNPS and QCNPS remain within the regulatory dose limits. The post-LOCA whole body, thyroid and beta doses in the

QCNPS Cities TSC following EPU are estimated to be 3.8 Rem, 11 Rem and 18.3 Rem, respectively. The corresponding whole body, thyroid and beta doses in the DNPS TSC following a LOCA are estimated to be 4.01 Rem, 5.5 Rem and 4.34 Rem, respectively.

The EOF is located approximately fifty miles from DNPS and over 100 miles from QCNPS. Therefore, the post LOCA dose for personnel manning the facility is expected to be negligible.

Operator Exposure During Post LOCA Sampling Activities.
Reference 1 noted that the only credited post-accident operator actions outside of the control room and TSC are reactor coolant and containment air sampling activities.

Reference 2 provided estimated operator exposure while obtaining and analyzing a reactor coolant sample and a containment air sample. The impact of EPU on the previously submitted dose estimates is provided in Table 1. Note that for conservatism, the worst case EPU dose rate scaling factor of 1.45 is used to develop the operator exposure following EPU. Table 1 demonstrates that operator exposure will not exceed the guidance of NUREG-0737 II.B.2.

Attachment
Dresden Nuclear Power Station, Units 2 and 3
Quad Cities Nuclear Power Station, Units 1 and 2
Additional Health Physics Information
Supporting the License Amendment Request to Permit Uprated Power Operation

TABLE 1 : ESTIMATED INTEGRATED DOSE PER SAMPLE [1]

Reactor Coolant Sample

Activity	Time Min	Original Dose Rate mrem/hr	Original Dose mrem	EPU [2] Dose mrem
0. Getting to and from vestibule	30	-----	500	725
1. Assemble in vestibule	10	2.5	0.42	0.61
2. Perform valve lineup at control panel	10	2.5	0.42	0.61
3. Perform manipulations on the LSP	35	100-400	100	145
4. Withdraw shielded cart to vestibule for Transport to hot lab	5	100	8.3	12.04
Total	90		609	883

Containment Air Sample

Activity	Time Min	Original Dose Rate mrem/hr	Original Dose mrem	EPU [2] Dose mrem
0. Getting to and from vestibule	30	-----	500	725
1. Assemble in vestibule	10	2.5	0.42	0.61
2. Perform valve lineup, initiate auto sequencer	10	2.5	0.42	0.61
3. Capture sample	8	2.5	0.33	0.48
4. Wait for sequencer to complete panel purge	7	2.5	0.29	0.42
5. Withdraw sample cartridges [3]	1	1000	16.67	24.17
6. Prepare Partitioner for Purge	0.5	1000	8.33	12.08
7. Purge Partitioner	7	2.5	0.29	0.42
8. Transport Sample in shielded cart to vestibule	1	1.5	0.25	0.36
Total	74.5		527	764

Notes:
1 With the exception of the EPU dose estimate, all information presented in this Table is obtained from Table 2 of Reference 2.
2 EPU dose developed using worst case EPU dose rate scaling factor of 1.45
3 During this activity, the original estimated dose to the operator's hands is 1.22 rem. EPU dose = 1.77 rem

Attachment
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Question

4. *A previous Boiling Water Reactor power uprate submittal projected that activation, corrosion and wear product (ACWP) would increase in the reactor coolant by the square of the percentage of the power uprate. This would result in up to 37% and 39% ACWP increases above existing coolant concentration for Dresden and Quad Cities, respectively.*

   Given these calculated increases, provide the impact on the ACWP design basis after EPU. What is the overall projected resultant percentage increase of the ACWP design basis? If this squared function was not used, explain the basis that was used to estimate dose rate increases, curie loading for resin waste shipments and other related issues.

Response

The previous referenced submittal was based upon a generic General Electric (GE) Company assessment performed in the late 1980's, prior to the availability of historical data associated with power uprates. This assessment attempted to provide bounding coolant activity evaluations of the ACWP concentrations. It was based upon an assumption that the corrosion products injected via the feedwater to the reactor pressure vessel were constant in terms of mass density (i.e., milligrams of corrosion product per kilogram of feedwater). Under this assumption, the coolant concentration would increase due to both the increase in feedwater flow and the increase in power, thus resulting in a squared function of the power increase. This was considered a bounding method to scope the maximum potential increase.

For the DNPS and QCNPS power uprates, in-plant measurements were reviewed to determine the extent to which the feedwater concentrations and mass input varied with feedwater flow. The measurements showed no discernable change with flow (i.e., the corrosion products concentration did not increase with flow as was assumed above). Therefore, the increase in expected activation corrosion products is predicted to be linearly proportional to the power increase, and the resulting increases in ACWP are not expected to exceed 17% and 18% for DNPS and QCNPS, respectively.

References

1. Letter from D. L. Peoples (Commonwealth Edison) to H. R. Denton (U. S. NRC), "Commitments to meet Near-Term Requirements of the Lessons Learned Task Force," dated July 1, 1980

2. Letter from T. J. Rausch (Commonwealth Edison) to D. G. Eisenhut (U. S. NRC), "Information Concerning NUREG 0737 Item II.B.3, Post Accident Sampling System," dated December 29, 1982