Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

www.exeloncorp.com

Exelon Nuclear

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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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: Clarification of Responses to Request for Additional Information Concerning Risk Informed Inservice Inspection Program Alternative to the ASME Boiler and Pressure Vessel Code Section XI Requirements for Class 1 and 2 Piping Welds

Reference: Letter from T. J. Tulon (Exelon Generation Company, LLC) to U.S. NRC, "Response to Request for Additional Information Concerning Risk Informed Inservice Inspection Program Alternative to the ASME Boiler and Pressure Vessel Code Section XI Requirements for Class 1 and 2 Piping Welds," dated August 10, 2001

In the reference letter, Exelon Generation Company (EGC), LLC, provided responses to the NRC's Request for Additional Information (RAI) regarding the proposed Risk Informed Inservice Inspection Plan for the Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. In an October 16, 2001, telephone conversation between S. Bailey of the NRC and J. Dubon, EGC, the NRC requested clarification of some of the RAI responses contained in the reference letter. The attachment to this letter provides the requested information.

A047

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

Respectfully,

P. R. Simpson
Manager – Licensing
Mid-West Regional Operating Group

Attachments: Affidavit
Clarification of RAI Responses

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

STATE OF ILLINOIS	)	
COUNTY OF DUPAGE	)	
IN THE MATTER OF	)	
EXELON GENERATION COMPANY, LLC	)	**Docket Numbers**
QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2	)	**50-254 AND 50-265**

SUBJECT: Clarification of Responses to Request for Additional Information Concerning Risk Informed Inservice Inspection Program Alternative to the ASME Boiler and Pressure Vessel Code Section XI Requirements for Class 1 and 2 Piping Welds

AFFIDAVIT

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

P.R. Simpson

P. R. Simpson
Manager – Licensing
Mid-West Regional Operating Group

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 31st day of October, 2001.

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

Timothy Byam
Notary Public

Clarification of RAI Responses

NRC Question # 1:

There seems to be a typographical error in response to Question # 1 or 2. EGC's response to Question # 2 states that the RI-ISI program will start with the 3rd Period at 64% of inspections complete for Unit 1. However, the Table in response to Question # 1(b) specifies this percentage to be 63%. Please clarify.

Response:

The correct answer is 63% completed for Unit 1.

NRC Question # 2:

EGC response to # 6 states that in deviation of Table 4-1 of EPRI TR-112657, for socket welds, Quad Cities will perform VT-2 examinations regardless of the degradation mechanism. The staff has reviewed this issue in some previous RI-ISI submittals and concluded that VT-2 examinations for socket welds is acceptable except socket weld locations susceptible to external chloride stress corrosion cracking (ECSCC) or other outside diameter (OD) initiated degradation mechanisms should be examined by surface examination methods. Please clarify that Quad Cities socket welds do not meet the susceptibility criteria for ECSCC and no other OD initiated degradation mechanism has been identified for socket welds.

Response:

Our evaluation did consider ECSCC and in each case it was determined that ECSCC was not a viable degradation mechanism. As far as other socket welds, Quad Cites Nuclear Power Station has not experienced any indication of ECSCC or any other outside diameter initiated degradation mechanism in the areas surrounding socket welds

NRC Question # 3:

There is a difference between Table 10B in the RAI's and Table 8 in the submittal. The tables give the system and the total delta CDFs and LERFs for Unit 2. In Table 8 they are 3.05E-9 and 4.66E-10 (best estimate). In Table 10B they are 1.52E-09 and 3.13E-10 (best estimate). The system numbers are the same in both tables and add up the results in Table 10B. Is this right and Table 8 is a typo? The Unit 1 numbers match.

Response:

In response to the above question, we reviewed the response provided to NRC Question # 10 in the reference letter. We determined that some corrections were warranted. The revised response is provided below and replaces the response provided for Question # 10 in the reference letter. The revised sections of the response have been identified with revision bars in the margin.

NRC Question #10:

Please provide the estimates of the change in core damage frequency (CDF) and large early release frequency (LERF) calculated using the bounding failure frequencies without the IEF.

Revised Response:

A simplified and conservative risk impact calculation, not using the Markov model calculation of pipe break frequency, was performed for Quad Cities Units 1 and 2. This calculation was performed using the same approach as was implemented for the previously approved relief request for South Texas Project which was performed by ERIN. The change in risk for a particular system was calculated using the following:

$$\Delta CDF_j = \sum_i [FR_{i,j} * (SXI_{i,j} - RISI_{i,j}) * CCDP_{i,j}] \quad (1)$$

where

ΔCDF_j = Change in CDF for system j
$FR_{i,j}$ = Rupture frequency per element for risk segment i of system j
$SXI_{i,j}$ = Number of Section XI inspection elements for risk segment i of system j
$RISI_{i,j}$ = Number of RISI inspection elements for risk segment i of system j
$CCDP_{i,j}$ = Conditional core damage probability given a break in risk segment i of system j

The total change in risk for all systems within the RISI evaluation scope is calculated by summing the changes in risk for each individual system, as follows:

$$\Delta CDF_{TOTAL} = \sum_{j} \Delta CDF_{j} \qquad (2)$$

Similar calculations were performed using the CLERP (conditional large early release probability) to determine the change in LERF for each system and the total change in LERF due to implementing the RISI program. The risk impact calculations were also performed excluding the Low risk category welds from the calculation. Results of these calculations are presented in Tables 10A and 10B, for Quad Cities Unit 1 and Unit 2, respectively. Also shown in Table 10A and Table 10B are the results of the Markov model calculation of the change in risk, for comparison purposes.

Using this method to calculate the change in risk requires making several assumptions. Those assumptions are as follows:

- Inspections are 100% successful at finding flaws and preventing ruptures.
- Increased probability of detection (POD) due to inspection for cause is not credited.
- Pipe failure rates and rupture frequencies are constant, not age dependent.

RESULTS

The results of the Quad Cities 1 risk impact calculation are shown in Table 10A. Even using the simplified risk impact approach and including all of the welds in the RISI scope, none of the systems came close to the change in CDF criterion of 1.0E-07 per system. The largest change in CDF came from the feedwater system, at 1.16E-08. The total change in CDF was 1.59E-08, well below the criterion of risk significance from Regulatory Guide 1.174 of 1.0E-06 for all systems combined. Similarly, the change in LERF values were all well below the criterion of 1.0E-08 per system. Again, the largest change came from the feedwater system, at 2.96E-09. The total change in LERF was 5.35E-09, well below the criterion of risk significance from Regulatory Guide 1.174 of 1.0E-07 for all systems combined.

The results of the Quad Cities 2 risk impact calculation are shown in Table 10B. Even using the simplified risk impact approach and including all of the welds in the RISI scope, none of the systems came close to the change in CDF criterion of 1.0E-07 per system. The largest change in CDF came from the feedwater system, at 9.60E-09. The total change in CDF was 1.47E-08, well below the criterion of risk significance from Regulatory Guide 1.174 of 1.0E-06 for all systems combined. Similarly, the change in LERF values were all well below the criterion of 1.0E-08 per system. Again, the one of the largest changes came from the feedwater system, at 2.50E-09. The total change in LERF was 5.20E-09, well below the criterion of risk significance from Regulatory Guide 1.174 of 1.0E-07 for all systems combined.

Compared to the more realistic calculation of risk impact using the Markov model, the simplified method produced changes in CDF for a single system as much as a factor of 3 higher than the Markov model results. The largest differences between the simplified approach and the Markov method are observed in the feedwater system. These differences are mainly due to a single risk segment at each unit with a relatively high CCDP that credited an enhanced POD in the Markov model calculation that is not credited in the simplified approach. The simplified risk impact calculation for other systems results in ΔCDFs and ΔLERFs that are generally less than a factor of 2 higher than the Markov model results.

In preparation of this RAI response, supplements to the Tier 2 documentation were prepared to document these calculations on a segment by segment basis. In most cases, the conservative values are less than a factor of 2 higher than the associated realistic values, but in a few cases, the increase is as much as a factor of 3 or so. Nonetheless, the risk acceptance criteria for all analyzed systems at Quad Cities Units 1 and 2 are still met with a large margin.

These conservative results are regarded as a sensitivity study as they only reflect upper bounds on the expected risk impacts. The results obtained using the Markov model are considered more reasonable and realistic for the following reasons.

- There were many cases in which the effectiveness of the inspection will be increased as a result of the application of the "inspection for cause" principle in which the knowledge of the applicable damage mechanisms and the application of mechanism specific inspection methods provide a reasonable basis to expect enhanced inspection effectiveness. A good example is the case of locations susceptible to thermal fatigue in which the EPRI RISI exams call for an expanded examination volume into the Heat Affected Zone (HAZ) of the weld in comparison with ASME Section X examination requirements. This expanded volume recommendation is based on insights from service experience that indicate the location of cracks in the areas of welds caused by thermal fatigue. These inspection for cause effects are ignored in the bounding evaluations.

- The conservative calculation assumes that all the change in risk in a given risk segment comes from the net change in the number of exams; which implies that there can be no change from redistributing a fixed number of welds. This does not reflect the true philosophy of risk management as expressed in RG 1.178, RG 1.174, or the EPRI Topical Report regarding the balancing of resources away from areas with marginal risk impact toward areas of more significant risk impact.

- The risk impact of changing the inspection strategy of a given weld is one of the factors that was considered in the element selection. If that input to the selection is skewed by conservative assumptions that do not uniformly impact across the elements in the program, the goal of an optimized program is not as well supported in comparison with the case where realistic assumptions are used for all the welds in the examination.

- The inspection effectiveness factors obtained using the Markov model provide a more realistic perspective on the benefits of ISI exams. This permits better tradeoffs in balancing the combined influences of removing exams, redistributing exam locations, and enhancing the effectiveness of exams through the inspection for cause principle.

- This approach of performing a realistic risk impact assessment provides a better basis to normalize risks and risk impacts across different risk informed initiatives such as RISI, RIST, and risk informed technical specifications, in contrast to limiting the analysis for RISI to a conservative bounding assessment. If one of these applications uses conservative bounding estimates and the remaining ones use realistic treatment, the balancing of resources expected from risk informed regulation is not as well supported as when all applications aspire for a comparable level of realism.

Table 10A. Comparison of Risk Impact Results for Quad Cities Unit 1

Quad Cities 1 Risk Impact Report *						
System	**CDF**			**LERF**		
	Conservative Delta CDF for All Welds	**Conservative Delta CDF Excluding Low Risk Welds**	**Realistic Delta CDF using Markov Model**	**Conservative Delta LERF for All Welds**	**Conservative Delta LERF Excluding Low Risk Welds**	**Realistic Delta LERF using Markov Model**
CRD	1.29E-10	0.00E+00	7.29E-11	4.30E-11	0.00E+00	2.43E-11
ECCS	-4.06E-09	-4.05E-09	-3.49E-09	-2.43E-09	-2.43E-09	-2.12E-09
FW	1.16E-08	1.14E-08	4.94E-09	2.96E-09	2.78E-09	1.31E-09
HPCI	-1.19E-10	-1.21E-10	-9.36E-11	-2.24E-11	-2.43E-11	-9.36E-11
MS	2.56E-09	2.21E-09	1.55E-09	6.47E-10	4.42E-10	3.87E-10
RCS	3.89E-09	2.40E-09	2.19E-09	2.33E-09	1.40E-09	1.31E-09
RWCU	1.86E-09	1.72E-09	1.05E-09	1.81E-09	1.72E-09	1.03E-09
SBLC	1.28E-11	0.00E+00	7.25E-12	1.09E-11	0.00E+00	6.14E-12
Total	1.59E-08	1.36E-08	6.23E-09	5.35E-09	3.89E-09	1.85E-09

* Positive values indicate a risk increase while negative values denote a risk decrease

Table 10B. Comparison of Risk Impact Results for Quad Cities Unit 2

Quad Cities 2 Risk Impact Report *						
	CDF			LERF		
System	Conservative Delta CDF for All Welds	Conservative Delta CDF Excluding Low Risk Welds	Realistic Delta CDF using Markov Model	Conservative Delta LERF for All Welds	Conservative Delta LERF Excluding Low Risk Welds	Realistic Delta LERF using Markov Model
CRD	1.29E-10	0.00E+00	7.29E-11	4.30E-11	0.00E+00	2.43E-11
ECCS	-5.04E-09	-1.59E-09	-4.09E-09	-3.11E-09	-1.01E-09	-2.54E-09
FW	9.60E-09	9.34E-09	3.80E-09	2.50E-09	2.30E-09	1.06E-09
HPCI	-7.18E-11	-7.49E-11	-4.57E-11	-1.23E-11	-1.50E-11	-7.96E-12
MS	3.55E-09	3.28E-09	2.18E-09	8.31E-10	6.56E-10	5.05E-10
RCS	3.86E-09	1.46E-09	2.17E-09	2.30E-09	8.39E-10	1.29E-09
RWCU	2.68E-09	2.58E-09	1.51E-09	2.64E-09	2.58E-09	1.50E-09
SBLC	1.28E-11	0.00E+00	7.25E-12	1.09E-11	0.00E+00	6.14E-12
Total	1.47E-08	1.50E-08	5.60E-09	5.20E-09	5.35E-09	1.84E-09

* Positive values indicate a risk increase while negative values denote a risk decrease

Reference: Letter from T. J. Tulon (Exelon Generation Company, LLC) to U.S. NRC, "Response to Request for Additional Information Concerning Risk Informed Inservice Inspection Program Alternative to the ASME Boiler and Pressure Vessel Code Section XI Requirements for Class 1 and 2 Piping Welds," dated August 10, 2001