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RS-06-063

April 27, 2006

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

Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
<u>NRC Docket Nos. 50-254 and 50-265</u>

Subject: Additional Information Regarding Quad Cities Unit 2 Steam Dryer Inspection, Start-up and Power Ascension Plan

On April 12, 2006, the NRC requested additional information regarding the Quad Cities Nuclear Power Station Unit 2 steam dryer inspections that were performed during the recent refueling outage. Additionally, the NRC requested information regarding the Unit 2 power ascension test procedure that was implemented to assess the effect of the Acoustic Side Branch (ASB) modification. This request for additional information was transmitted to Exelon Generation Company, LLC (EGC) via e-mail from Maitri Banerjee (NRC). The attachments to this letter provide the requested information. Attachment 1 provides the responses to the NRC's requests. Attachments 2 through 9 provide documents referenced in the Attachment 1 responses.

The information provided in Attachments 2, 3, 4, and 8 contains information considered proprietary to General Electric (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 for public disclosure," paragraph (a)(4). An affidavit attesting to the proprietary nature of these documents is included with the requisite information. A non-proprietary version of the information in Attachments 2, 3, 4, and 8 will be provided at a later date.

A total of two (2) CD-ROMs are included with this submission. The CD-ROMs contain the Attachments. The CD-ROMs labeled "QC Dryer/Power Ascension RAI Documents – Not Publicly Available" contains 72 files all in PDF format.

Folder: Attachment 2	Attachment 2 Cover	8,192 bytes	Publicly Available
	EC 360356 Rev 0	20,480 bytes	Publicly Available
	GENE-0000-0052-7988 Rev 2	364,544 bytes	Publicly Available
	GE-NE-0000-0052-9666 Rev 0	10,182,656 bytes	Publicly Available
	GE-NE-0000-0052-9728-P Rev 1	2,777,088 bytes	Not Publicly Available
	GENE-0000-0053-0964 Rev 2	237,568 bytes	Publicly Available
	INR Q2R18 IVVI-06-01 Rev 0	1,597,440 bytes	Publicly Available
	INR Q2R18 IVVI-06-02 Rev 0	839,680 bytes	Publicly Available

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	INR Q2R18 IVVI-06-04 Rev 1	266,240 bytes	Publicly Available
	INR Q2R18 IVVI-06-06 Rev 0	286,720 bytes	Publicly Available
	INR Q2R18 IVVI-06-08 Rev 0	217,088 bytes	Publicly Available
	INR Q2R18 IVVI-06-10 Rev 0	208,896 bytes	Publicly Available
	INR Q2R18 IVVI-06-11 Rev 1	217,088 bytes	Publicly Available
	INR Q2R18 IVVI-06-12 Rev 0	978,944 bytes	Publicly Available
	INR Q2R18 IVVI-06-18 Rev 0	5,689,344 bytes	Publicly Available
	INR Q2R18 IVVI-06-20 Rev 0	1,302,528 bytes	Publicly Available
	INR Q2R18 IVVI-06-21 Rev 0	4,997,120 bytes	Publicly Available
	INR Q2R18 IVVI-06-23 Rev 0	421,888 bytes	Publicly Available
	INR Q2R18 IVVI-06-24 Rev 0	593,920 bytes	Publicly Available
	INR Q2R18 IVVI-06-28 Rev 1	3,633,152 bytes	Publicly Available
	INR Q2R18 IVVI-06-29 Rev 0	925,696 bytes	Publicly Available
	INR Q2R18 IVVI-06-31 Rev 1	2,981,888 bytes	Publicly Available
Folder: Attachment 3	Attachment 3 Cover	8,192 bytes	Publicly Available
	GE-NE-0000-0053-2926-P, Rev. 0	4,067,328 bytes	Not Publicly Available
Folder: Attachment 4	Attachment 4 Cover	8,192 bytes	Publicly Available
	GE-NE-0000-0053-0232-P Rev 1	651,264 bytes	Not Publicly Available
	GE-NE-0000-0053-2456-P Rev 2	1,454,080 bytes	Not Publicly Available
	GE-NE-0000-0053-2910-P Rev 1	2,666,496 bytes	Not Publicly Available
Folder: Attachment 5	Attachment 5 Cover	8,192 bytes	Publicly Available
	DRF Section 0000-0053-3398 Rev 1	118,784 bytes	Publicly Available
Folder: Attachment 6	Attachment 6 Cover	12,288 bytes	Publicly Available
	50.59 Cover Sheet	20,480 bytes	Publicly Available
	50.59 Screening	28,672 bytes	Publicly Available
	Actuator Acceptance Citeria Report - Rev 1	634,880 bytes	Publicly Available
	Actuator Similarity Analysis	172,032 bytes	Publicly Available
	Actuator Test Plan 1	720,896 bytes	Publicly Available
	Actuator Test Plan 2	90,112 bytes	Publicly Available
	Actuator Test Report	2,363,392 bytes	Publicly Available
	Design Considerations Summary	102,400 bytes	Publicly Available
	Picture 1	131,072 bytes	Publicly Available
	Picture 10	131,072 bytes	Publicly Available
	Picture 11	90,112 bytes	Publicly Available
	Picture 12	167,936 bytes	Publicly Available
	Picture 13	77,824 bytes	Publicly Available
	Picture 14	163,840 bytes	Publicly Available
	Picture 15	86,016 bytes	Publicly Available
	Picture 16	126,976 bytes	Publicly Available
	Picture 17	114,688 bytes	Publicly Available
	Picture 18	102,400 bytes	Publicly Available
	Picture 19	122,880 bytes	Publicly Available
	Picture 2	118,784 bytes	Publicly Available
	Picture 20	163,840 bytes	Publicly Available
	Picture 21	122,880 bytes	Publicly Available
	Picture 22	163,840 bytes	Publicly Available
	Picture 23	151,552 bytes	Publicly Available
	Picture 3	90,112 bytes	Publicly Available
	Picture 4	40,960 bytes	Publicly Available
	Picture 5	114,688 bytes	Publicly Available
	Picture 6	102,400 bytes	Publicly Available

	Picture 7	167,936 bytes	Publicly Available
	Picture 8	94,208 bytes	Publicly Available
	Picture 9	155,648 bytes	Publicly Available
	Summary of Vibration Tests	32,768 bytes	Publicly Available
	Work Planning Instructions	49,152 bytes	Publicly Available
Folder: Attachment 7	Attachment 7 Cover	8,192 bytes	Publicly Available
	Attach to MPR Letter 1101-0009-HDG-02	634,880 bytes	Publicly Available
	MPR Calc 1101-0009-HDG-01	266,240 bytes	Publicly Available
	MPR Letter 1101-0009-HDG-01	98,304 bytes	Publicly Available
	MPR Letter 1101-0009-HDG-02	81,920 bytes	Publicly Available
Folder: Attachment 8	Attachment 8	1,310,720 bytes	Not Publicly Available
Folder: Attachment 9	Attachment 9	57,344 bytes	Publicly Available

The other CD-ROM is labeled "QC Dryer/Power Ascension RAI Documents –Publicly Available" and contains 65 files all in PDF format.

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Folder: Attachment 9	Attachment 9	57,344 bytes	Publicly Available

Contact:
Name: David Gullott
Mailing Address 4300 Winfield Road, Warrenville, IL 60555
E-mail Address david.Gullott@exeloncorp.com
Phone Number 630-657-2819

Should you have any questions concerning this letter, please contact Mr. David Gullott at (630) 657-2819.

Respectfully,

Patrick R. Simpson
Manager – Licensing

cc: Regional Administrator Region III
Quad Cities Senior Resident Inspector

Attachment:

1. Response to Request for Additional Information

ATTACHMENT 1

Response to Request for Additional Information

Request 1

Please provide the following information to the NRC staff:

(a) the steam dryer inspection results and analysis, including metallurgical reports;

(b) the steam dryer failure root cause report;

(c) the steam dryer stress analysis report;

(d) licensee's justification for the steam dryer repair, including the extent of the repair, impact of the repair on steam dryer structural characteristics, and evaluation of remaining steam dryer, and

(e) the licensee's description, analysis, and justification for the ERV modification in support of EPU operation, including evaluation of the shaker table test failure?

Response 1

The information in response to Request 1(a), (b), (c), and (e) is provided in Attachments 2, 3, 4, and 6, respectively.

With respect to Request 1(d), the root cause analysis has concluded that observed dryer structural damages are due to impact and plastic deformation of the skirt base ring and skirt plate during installation of the dryer. Additionally, the existence of persistent cyclic flow induced vibration (FIV) loads throughout the reactor vessel region that act on the entire dryer including the skirt was also identified as a root cause. The severe deformation at the 140° location is considered to be the primary cause for the fatigue failure. It introduced significant plastic strains into the materials that reduced the material's resistance to fatigue initiation. Thus the repair strategy is to restore the dryer to its original undeformed design configuration.

The repairs will restore the structural characteristics of the steam dryer to its original design configuration. Therefore, a re-evaluation of the remaining steam dryer is not required. This is because the repairs have restored the dryer to its original undeformed design configuration. This is due to the installation techniques used such as a single groove weld with varied weld bead sequence around the panel to minimize unequal shrinkage and the fact that no jacking setup was necessary for fit up, thus minimizing any fit up stress. Therefore the fabrication and weld residual stresses are expected to be no different than in the original design.

A description of the extent of the repairs is contained in Attachment 5.

Request 2

Please provide the following information to the NRC:

> **MSL strain gage and accelerometer data, and walkdown information, during the power ascension.**

The NRC staff would like to have sufficient time to review the data to determine if any safety concerns exist with continued power ascension.

Response 2

In Reference 1, Exelon Generation Company, LLC (EGC) outlined the operational plans for Quad Cities Nuclear Power Station (QCNPS) Unit 2 following start-up from the spring 2006 refueling outage. EGC implemented the start-up test program described during the March 16, 2006 meeting between EGC and the NRC. This start-up test plan included collecting data during operation at extended power uprate (EPU) power levels. Following the EPU data collection effort, QCNPS Unit 2 was returned to a pre-EPU power level.

As discussed during an April 13, 2006, conference call between the NRC (Banerjee, Scarbrough, et al.) and EGC, the NRC agreed that in light of EGC's plans, as subsequently documented in Reference 1, that EGC could provide the main steamline (MSL) strain gage data, accelerometer data, and walkdown information acquired during the Unit 2 power ascension testing following the return of QCNPS Unit 2 to pre-EPU power levels. Subsequently, EGC shared the requested information during a conference call with the NRC on April 25, 2006.

Request 3

In the Quad Cities Unit 2 Power Ascension Test Procedure TIC-1402, what is the power ascension intervals for Test Condition steps and hold times above OLTP (TC 12 to 18)?

Response 3

In the QCNPS Unit 2 Power Ascension Test Procedure TIC-1463, the power ascension intervals for Test Conditions 12 through 18 are as follows:

	Approx. Initial MWe	delta MWe	delta MWt	% Power Chg
to TC 12 from TC 11	800	25	65	2.2
to TC 13 from TC 12	825	25	64	2.2
to TC 14 from TC 13	850	25	64	2.2
to TC 15 from TC 14	875	25	65	2.2
to TC 16 from TC 15	900	12	31	1.0
to TC 17 from TC 16	912	9	23	0.8
to TC 18 from TC 17	921	9	23	0.8

The power increases are approximately 1 hour apart. The power increase is performed in a 15-minute period with a 45-minute hold before the next power increase.

Note: Prior to Unit 2 start-up, TIC-1402 was revised and renumbered to TIC-1463, Revision 0.

Request 4

Provide the basis for the vibration acceptance criteria for Levels 1 and 2 in Attachment 9.2 of TIC-1402.

Response 4

The Acoustic Side Branch (ASB) modification will be demonstrated to be successful by lower vibration measurements and no new frequency peaks. The overall Level 1 criterion is developed by comparing vibration data gathered at the current Test Condition to vibration data gathered at the same locations during the startup in May 2005. The current readings will be compared to an envelope value of the Unit 1 and Unit 2 data gathered at pre-ASB full EPU power level. This value was chosen as a benchmark that would assure safe operation for the period of time required to gather the data and therefore was classified as a Level 1 criterion.

The Level 2 criteria, which would be the vibration levels at which long-term operation would be allowed, for the electromatic relief valve (ERV) flange locations were chosen based on comparison of the current vibration levels to an envelope value of the Unit 1 and Unit 2 vibration levels that are the pre-ASB 2511 MWt original licensed thermal power (OLTP) measurements. An allowance of plus 25% of the difference between pre-ASB 2511 MWt (OLTP) measurements and the pre-ASB full EPU measurements may be added. This was chosen because past operation at OLTP has demonstrated that there is significant margin with equipment performance at OLTP vibration levels. The Level 2 Acceptance Criteria for the 3A Target Rock valve, the B main steam isolation valve, and High Pressure Coolant Injection motor operated valve 2-2301-4 are based on 85% of the previously observed pre-ASB full EPU vibration. This criterion was determined to be acceptable based on the relative robustness of the components, their previous vibration history, and recent inspections that determined no damage had occurred as a result of the vibration. Generally, EGC has concluded that if the ASBs are able to lower the vibration levels to a level consistent with the levels measured at OLTP, then the modification will be considered successful.

The comparisons described above will compare the time domain overall g root mean square (rms) vibration level obtained at the Test Condition to the g rms level obtained at the pre-ASB conditions. For the frequency domain, spectra comparisons for the ERV and Target Rock inlet flanges will be compared to the historical measurements. The criteria will be no new peaks greater than the historical pre-ASB measurements (either full EPU power measurements for Level 1 and OLTP measurements for Level 2). New peaks are defined to be those peaks that are greater than 20% of the maximum amplitude of the dominant peak in the spectra on pre-ASB measurements. This was chosen so that peaks within the noise floor would not be flagged as exceeding the acceptance criteria.

In addition to the criteria described above, additional acceptance criteria were developed for the new accelerometers connected to the ASBs and for accelerometers monitoring the new ERV actuators and pilot valves. These criteria were developed based upon shaker table testing for the ASBs and the new ERV actuators. The criteria for the ASBs are discussed fully in MPR letter 1101-0009-HDG-01 dated April 13, 2006, and MPR calculation 1101-0009-HDG-01. The criteria for the new ERV actuators are discussed fully in MPR letter 1101-0009-HDG-02 dated April 13, 2006, and its attachment. These documents are provided in Attachment 7. Vibration levels of other components not previously monitored are being recorded for further analysis with no established acceptance criteria.

Request 5

Provide the basis for the MSL strain gage data acceptance criteria for Levels 1 and 2 in Attachment 9.3 of TIC-1402.

Response 5

The purpose of the MSL strain gage data was to qualify the new steam dryer. The ASB modification will be demonstrated to be successful by lower MSL strain gage measurements and no new frequency peaks. This will demonstrate that the loads on the dryer are lower than the levels observed at EPU operation. The overall Level 1 criteria is that data from the same locations previously gathered during the startup in May 2005 will be compared to the measured strain gage readings at the current Test Condition. The comparison of the current readings will be to an envelope of the Unit 1 and Unit 2 data gathered at pre-ASB full EPU power level. This value was chosen as a benchmark that would assure safe operation for the period of time to gather the data and therefore was classified as Level 1 criteria. The overall Level 2 criteria, which would be the strain gage readings at which long-term operation would be allowed, was chosen to be a comparison of the current strain gage readings to an envelope of the Unit 1 and Unit 2 pre-ASB 2511 MWt (OLTP) measurements plus 25% of the difference between pre-ASB 2511 MWt (OLTP) measurements and the pre-ASB full EPU measurements. This was chosen because the loading as a function of power (steam flow) was observed to increase significantly between OLTP and full EPU power. EGC has concluded that if the ASBs are able to lower the dryer loading to a level consistent with the levels measured at OLTP, then the modification will be considered successful.

Request 6

Provide the scope and objectives of the walkdowns that are planned at specific Test Condition steps.

Response 6

QCNPS has considerable experience with the plant operating at EPU power levels. Unit 1 has operated for 444 days at a thermal power level greater than 2800 MWt. Unit 2 has operated for 755 days at a thermal power level greater than 2800 MWt. Previous walkdowns and the length of time operated at EPU demonstrate that there are no significant issues with the balance of the plant operating at EPU. However, during this startup testing, walkdowns and handheld vibration readings will be taken on small bore Feedwater piping in the reactor feed pump room and at the Feedwater Regulating Valves. These measurements will be compared to the acceptance criteria of NES-MS-03.04, "Small Bore Piping Design for High cycle Fatigue." These measurements will be recorded at OLTP and at the maximum power level achieved. In addition, vibration checks will be performed at the 2202-5 Instrument Rack on the pressure controllers mounted on the rack, and the process sensing lines connecting to the pressure controllers for the ERVs. These local vibration measurements will be compared with readings taken at OLTP to measurements recorded at the maximum power level achieved.

Request 7

Provide the basis and justification for remaining at the EPU power level while resolving the uncertainties surrounding the structural capability of the steam dryer and ERVs under EPU conditions.

Response 7

As discussed in an April 13, 2006 conference call between the NRC and EGC and subsequently described in Reference 1, following the QCNPS Unit 2 start-up and power ascension testing, Unit 2 will be returned to a pre-EPU power level.

Request 8

Provide the extent of and the justification for leaving the small cracks in service during operation, especially at EPU.

Response 8

EGC has determined that a subset of the Unit 2 steam dryer cracks identified during the spring 2006 refueling outage do not require a repair and are acceptable for service for at least the next operating cycle. These cracks are planned to be visually examined during the next Unit 2 refuel outage in accordance with BWRVIP-139. The cracks in this category are documented in the following Indication Notification Reports (INRs):

- Q2R18-IVVI-06-04, Revision 1, Steam Dryer Bank E ID
- Q2R18-IVVI-06-06, Revision 0, Steam Dryer ID Weld SD-BF-V06-2H-ID
- Q2R18-IVVI-06-08, Revision 0, Steam Dryer Weld SD-BD-V06-2H-ID
- Q2R18-IVVI-06-10, Revision 0, Steam Dryer Weld SD-BB-V04-2H-ID

The INRs listed above and the associated GE report (GE-NE-0000-0052-7988, Revision 2) that evaluates these cracks as being acceptable for service for the next operating cycle are provided in Attachment 2. EGC has reviewed this GE analysis and report and concurs with the conclusion that the cracks do not require repair and are acceptable for service for at least the next operating cycle.

Request 9

For the large dryer crack in the skirt base metal at 135-degree location, provide the following information and documentation supporting your responses.

(a) What may be the magnitude of plastic strains and residual stresses introduced by the reported installation difficulty?
(b) What may be the corresponding reduction in the fatigue stress limits?
(c) What may be the stresses acting at the crack location?
(d) What is the stress intensity at the crack tip?

Response 9

The response to Requests 9(a), (c), and (d) are provided in Attachment 8. The response to Request 9(b) is provided in Attachment 9.

Request 10

In the stress analysis submitted by Exelon in August 2005 (Report # GENE-0000-0043-5391-01-P), the maximum stress intensity in the skirt was high (24,285 psi) when 2% damping was assumed. Then damping in the skirt was increased to 4% and the corresponding maximum stress intensity was reduced to about 9,000 psi. Explain whether the damping in the skirt could be lower than 4% and what may be the role of resulting higher stresses in causing the large dryer crack?

Response 10

The requested information is provided in Attachment 8.

Request 11

Explain why some small fatigue cracks in several vane assemblies are not repaired. Did initial installation introduce any residual stress at the crack locations? What may be the magnitude of this stress? What may be the driving force for these cracks? How does this driving force compare with the one acting on the large crack at 135-degree location? How much these small cracks may grow during the next fuel cycle?

Response 11

Cracking was detected in several vane bank locations. These cracks were documented in the following INRs:

1. INR Q2R18-IVVI-06-06, Steam Dryer ID Weld SD-BF-V06-2H-ID
2. INR Q2R18-IVVI-06-08, Steam Dryer Weld SD-BD-V06-2H-ID
3. INR Q2R18-IVVI-06-10, Steam Dryer Weld SD-BB-V04-2H-ID
4. INR Q2R18-IVVI-06-04, Rev. 1, Steam Dryer Bank E ID
5. INR Q2R18-IVVI-06-11, Rev. 1, Steam Dryer Internal Debris

The justifications for leaving the small cracks in service without repair are contained in two reports. Dispositions of the cracking detailed in INR Q2R18-IVVI-06-06, INR Q2R18-IVVI-06-04 (outer vane element material), INR Q2R18-IVVI-06-08, INR Q2R18-IVVI-06-10 and INR Q2R18-IVVI-06-11, are contained in GENE 0000-0052-7988, Revision 2. Disposition of vane bank end plate cracking detailed in INR Q2R18-IVVI-06-04 is presented in GENE 0000-0052-9728-P, Revision 1. These INRs and GE reports are provided in Attachment 2.

The remaining questions are responded to below:

(a) Did initial installation introduce any residual stress at the crack locations? What may be the magnitude of this stress?

As with all welds, the fabrication process will introduce weld residual stresses. Specifically, fit-up can play an important role in determining the location where they are present. The magnitude of these residual stresses can vary but is generally expected to reach the yield strength of the stainless steel.

(b) What may be the driving force for these cracks?

The driving forces are the fluctuating loads during normal operation. The details of the loading are given in GENE 0000-0052-7988, Revision 2, and GENE 0000-0052-9728-P, Revision 1.

(c) How does this driving force compare with the one acting on the large crack at 135-degree location?

The applicable fluctuating loads and applied displacements in these regions would be smaller than that applied to the skirt cracking. For these cracking locations, as the cracking grew across the vane bank component, the stress conditions for continued crack growth would decrease since the cracking is most likely driven by imposed displacements.

(d) How much these small cracks may grow during the next fuel cycle?

These cracks would not be expected to grow significantly in the upcoming cycle. GENE 0000-0052-7988, Revision 2, and GENE 0000-0052-9728-P, Revision 1, provide a full discussion of these cracked locations including the cracking behavior and future actions.

<u>Request 12</u>

Are the MSL strain gage data at 2957 MWt available? How does this data compare with the corresponding data at 2,885 MWt and at pre-EPU condition? Provide similar comparison for RPV level sensor data.

<u>Response 12</u>

As was discussed during the April 13, 2006, conference call between EGC and the NRC, QCNPS Unit 2 has not operated at 2957 MWt since replacement of the steam dryer. Therefore, the requested data and comparison is not available.

Request 13

What may be the magnitude of the weld residual stresses at the repaired crack location? What may be the effect of these residual stresses on the fatigue stress limits? Explain why the repaired crack location may not be susceptible to fatigue cracking?

Response 13

The repair involved removing a panel of skirt and base ring material the full width between the vertical drain channels. As such, all of the damaged material (cold worked) was removed. The replacement base ring and skirt panel are standard fully annealed low carbon stainless steel attached with full penetration welds that restore the full thickness to the structure. The replacement base ring segment was manually fit into position and tack welded, followed by completion of full penetration, single-sided groove welds at either end of the ring segment. This was essentially the same as the original installation of the ring. The replacement skirt plate was then manually positioned (no jacking) and tacked in place. Full penetration groove welds were completed in a sequence and direction designed to minimize residual stresses and distortion. Because a relatively large panel was replaced, the restraint is considered to be normal for this type of welded structure and effectively no different from the original fabrication welds. The welds to replace the panel section were performed underwater, which tends to minimize weld residual stresses because of the small weld pool size and rapid quenching characteristic of underwater welds. However, the fatigue evaluation of the repair did not take any credit for these probable reduced residual stresses.

Residual stresses specific to this repair were not determined. This is because the weld configuration used conventional V-groove welds with normal manual fit-up. It was therefore considered that these welds were bounded by the ASME assumed worst-case residual stress attributable to standard fabrication practice. Weld residual stresses present in the replacement welds were therefore adequately considered by using the most conservative ASME fatigue curve, Curve C (ASME Appendix I, Figure I-9.2.2). Incorporated in this curve is an assumed maximum residual stress of 44,000 psi (Reference 2).

Based on the stress analysis of the entire skirt, the highest calculated stress in the skirt met the design limits with respect to Curve C. This value, if assumed to be applied at the location of the repair welds, would also be acceptable. In reality, the base ring welds, the vertical skirt panel welds, and much of the horizontal skirt panel weld have been analyzed and have been shown to have stresses that are much less than this maximum value, including the use of a stress concentration factor for single-sided, full penetration groove welds of 1.4.

In summary, there is adequate basis to use the 13,600 psi limit of Curve C in the fatigue analysis of the repair welds. The repair welds have stresses well below this design limit substantiating that their fatigue resistance is adequate.

Request 14

Address how the magnitude of residual stresses created as a result of highly constrained weld repair is determined. How do these residual stresses affect the fatigue life for the material?

Response 14

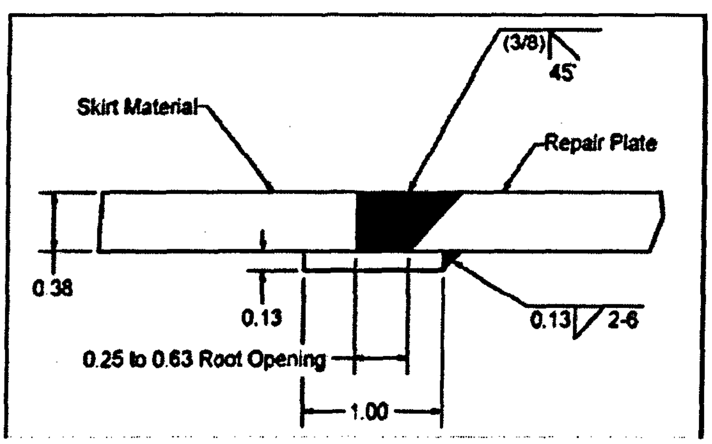
See Response 13.

Request 15

Discuss the potential for loose parts resulting from the failure of the backing bar.

Response 15

Repairs to the QCNPS Unit 2 steam dryer skirt and skirt base ring were made with full penetration welds. In consideration of diver safety and dose these welds were made from the outside of the dryer skirt. To provide for underwater welding from one side only it was necessary to use a backing strip at the weld root. The backing strip was not removed after welding. The backing strip has a 1-inch wide by 0.13-inch thick cross-section. The below figure shows a cross-section view through the completed skirt repair weld. A cross-section through the base ring would be similar except that the base ring and base ring materials are 1-inch thick. In the completed weld, the backing strip surface exposed to the root opening is fused and becomes part of the weld. Prior to welding of the joint, one edge of the backing strip is attached to the back side of the repair plate using a stitch weld technique (0.13 inch fillet welds, 2 inches in length, with a 6 inch pitch). The backing strip material used is compatible with the base metals. Also, a qualified welding procedure and qualified welders were used. Separate backing ring welds have been used in constructing many of the operating plant BWR steam dryers.



Based on an acceptable weld joint configuration; a continuous backing strip being used; the backing strip being compatible with the base metals; the use of a qualified welding procedure and qualified welders; and previous operating plant experience it is extremely unlikely that these repair weld backing strips will ever come loose.

References

1. Letter from Keith R. Jury (Exelon Generation Company, LLC) to U. S. NRC, "Quad Cities Nuclear Power Station Operational Plan Commitments," dated April 14, 2006
2. Manjoine, M.J. and Tome, R.E., "Proposed Design Criteria for High Cycle Fatigue of Austenitic Stainless Steels," International Conference on Advances in Life Prediction Methods, ASME, 1983, pp. 51-57