March 25, 2004

Mr. Christopher M. Crane, President
and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNIT 2 - REQUEST FOR APPROVAL OF FLAW EVALUATION FOR A WELD IN THE REACTOR RECIRCULATION SYSTEM LOOP “B” SUCTION NOZZLE (TAC NO. MC1159)

Dear Mr. Crane:

By letter dated October 29, 2003, Exelon Generation Company, LLC (the licensee) submitted a request for approval of a flaw evaluation for Dresden Nuclear Power Station (DNPS), Unit 2, so that the affected weld could be left “as is” without repair. This flaw evaluation was performed for a weld in the reactor recirculation system loop “B” suction nozzle between the safe end and the pipe elbow. The flaw did not meet the acceptance standards of American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code) Section XI, 1995 Edition with 1996 Addenda, for continued operation without flaw evaluation. In accordance with NRC Generic Letter 88-01, “NRC Position on IGSCC [intergranular stress corrosion cracking] in BWR [boiling water reactor] Austenitic Stainless Steel Piping,” dated January 25, 1988, cracks that do not meet the criteria given in ASME Code Section XI for continued operation require Nuclear Regulatory Commission's (NRC) approval of the flaw evaluation and/or repairs in accordance with subarticles IWB 3640 and IWA 4130 before resumption of operation. In accordance with Generic Letter (GL) 88-01, your flaw evaluation was submitted to the NRC for approval prior to resuming operation from the DNPS Unit 2 refueling outage D2R18.

Based on information provided in your letter dated October 29, 2003, the NRC staff provided verbal approval on October 31, 2003, of your pipe flaw evaluation in accordance with GL 88-01. The staff evaluated the submittal and found your flaw evaluation acceptable such that DNPS Unit 2 can be operated for one fuel cycle without repair of the B-loop reactor recirculation pipe weld. Our safety evaluation is enclosed.

Sincerely,

/RA/

Maitri Banerjee, Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-237

Enclosure: Safety Evaluation

cc w/encl: See next page

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Maitri Banerjee, Project Manager, Section 2
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cc:

Site Vice President - Dresden Nuclear Power Station
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

Dresden Nuclear Power Station Plant Manager
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

Regulatory Assurance Manager - Dresden
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

U.S. Nuclear Regulatory Commission
Dresden Resident Inspectors Office
6500 N. Dresden Road
Morris, IL 60450-9766

Chairman
Grundy County Board
Administration Building
1320 Union Street
Morris, IL 60450

Regional Administrator
U.S. NRC, Region III
801 Warrenville Road
Lisle, IL 60532-4351

Illinois Emergency Management Agency
Division of Disaster Assistance & Preparedness
110 East Adams Street
Springfield, IL 62701-1109

Document Control Desk - Licensing
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Senior Vice President, Nuclear Services
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Vice President of Operations - Mid-West Boiling Water Reactors
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Vice President - Licensing and Regulatory Affairs
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Director - Licensing and Regulatory Affairs
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Associate General Counsel
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Manager Licensing - Dresden, Quad Cities and Clinton
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR APPROVAL OF FLAW EVALUATION FOR A WELD

IN THE REACTOR RECIRCULATION SYSTEM LOOP "B" SUCTION LINE

EXELON GENERATING COMPANY (EXELON), LLC

DRESDEN NUCLEAR POWER STATION UNIT 2

DOCKET NO. 50-237

1.0 INTRODUCTION

On October 22, 2003, during the Dresden Nuclear Power Station (DNPS) Unit 2, refueling outage D2R18, the licensee identified, using an automated ultrasonic testing (UT) technique, four separate planar flaws in the reactor recirculation (RR) system. The inspections were conducted in accordance with Generic Letter (GL) 88-01, "NRC Position on IGSCC [intergranular stress corrosion cracking] in BWR [boiling water reactor] Austenitic Stainless Steel Piping," and Boiling Water Reactor Vessel and Internals Project (BWRVIP) Report 75, "Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules," as modified by the associated Nuclear Regulatory Commission (NRC) Safety Evaluation dated May 14, 2002. The UT examination used Performance Demonstration Initiative qualified personnel, equipment, and procedures. Specifically, four flaws were found in one category "D" weld which was identified as 2/1/0202B-28/PS2/201-1. The weld is located in the 28-inch diameter "B" RR loop suction nozzle between the safe end and pipe elbow. The safe end is constructed of furnace sensitized SA376-TP316 material, with a measured pipe wall thickness of 1.34 inches. The flaws are located on the safe end side of the weld, with no axial indication. The through-wall depth, measured from the inside diameter, of each flaw does not exceed 0.24 inches. The lengths of the four flaws are 1.728 inches, 2.788 inches, 3.614 inches, and 17.075 inches. Following the discovery of the flaws in the weld, the inspection scope was expanded in accordance with GL 88-01 and BWRVIP Report 75 (as modified by the NRC Safety Evaluation dated May 14, 2002) by adding eight additional category "D" welds in the RR system. No other flaws were identified within the expanded weld inspection population nor within the remaining seven welds of the original population. The last examination of this weld was performed in October 1999, using manual UT, and no recordable indications were identified at that time.

The licensee with the assistance of its contractor General Electric (GE) performed an evaluation of the flaws. The evaluation was performed using the methodology and acceptance criteria specified in American Society of Mechanical Engineers (ASME) Code, Section XI, 1995 Edition with 1996 Addenda, subarticle IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping," and the guidance of NUREG-0313, Revision 2, "Technical Report on Material Selection and Process Guidelines for BWR Coolant Pressure Boundary Piping, January 1988."

ENCLOSURE

The flaw evaluation considered a conservative flaw size, expected growth rates assuming both hydrogen and normal water chemistry, and plant chemistry parameters, and demonstrated that the flawed weld is acceptable "as is" for more than one operating cycle because the acceptance criteria of subarticle IWB-3640 are met.

By letter dated October 29, 2003, Exelon Generating Company, LLC (the licensee), requested that the NRC review and approve the pipe flaw evaluation for weld 21/0202B-28/PS2/201-1 so that the weld is left "as is" without repair. The weld will be reclassified from category "D" to category "F" and will be inspected each refueling outage.

2.0 REGULATORY EVALUATION

ASME Code Section XI, IWB-3514.3 specifies the acceptance standards for flaws identified in the DNPS Unit 2 reactor recirculation nozzle weld. NRC Generic Letter 88-01 specified that cracks that do not meet the acceptance standards for continued operation without evaluation given in ASME Code Section XI, NRC approval of flaw evaluations and/or repairs in accordance with IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping," and IWA-4130, "Repair Program," is required before resumption of operation. In this evaluation, only IWB-3640 applies. IWB-3640 further requires that the flaw will be evaluated by analytical procedures such as those described in Appendix C. Complete information on IWB-3640, IWA-4130, and Appendix C can be found in Section XI of the ASME Boiler and Pressure Vessel Code. Appendix C, which also contains the acceptance criteria, is the underlying basis for the licensee's limit load analysis methodology for this flaw evaluation.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Evaluation

The licensee's evaluation of the flaws provided in their application dated October 29, 2003, was contained in a General Electric (GE) report GE-NE-0000-0022-6311-01, "Fracture Mechanics Evaluation of the Indication in the Recirculation Line at the Safe-End of Elbow 2/1/0202B-28/PS2/201-1 Weld," dated October 2003. This GE report is copyrighted, and by letter dated February 11, 2004, GE has granted the NRC limited right to insert, reproduce and distribute information from this copyrighted report, provided it continues to bear the copyright notice. The following paragraphs, marked "as stated" are taken from this GE report. Therefore, for all other potential use outside that stated in the February 11, 2004 GE letter, the following copyright notice applies to information contained herein that are marked "as stated."

3.1.1 Design Inputs (as stated):

The Design Input Request (DIR) responses from Exelon (Reference 7) states that the [reactor pressure vessel] RPV Nozzle Safe-end is SA-376 TP 316 stainless steel (furnace sensitized) with an outside diameter of 28.375 inches with a wall thickness of 1.34 inches. The Design Stress Intensity (Sm) for the material at 550°F is 17600 psi (Reference 1). The RPV pressure used in the fracture mechanics evaluation is taken from the "Reactor Vessel — Power Uprate — Design Specification" (Reference 6).

3.1.2 Flaw Description (as stated):

Reference 2 provides details of the UT examination of the 2/1/0202B-28/PS2/201-1 weld. The Automated Phased Array Ultrasonic Inspection showed a total of four (4) circumferential flaw indications on the inside surface of the Safe-End on the upstream side of the weld.

Table 1 shows the flaw locations relative to Top Dead Center, the reference point, the flaw lengths, and flaw locations relative to each other. Figure 1 is a Schematic that graphically shows the information for the observed indications [*Figure 1 is not included in this SER*].

TABLE 1-OBSERVED FLAWS, LOCATION, AND LENGTHS

Flaw Number	Flaw Start from TDC (inches)	Flaw Stop from TDC (inches)	Flaw Length*	Relative Distance Between Flaws in (+) direction (Inches)
1	+15.149	+16.877	1.728	0.823
2	+17.700	+20.488	2.788	6.634
3	+27.122	+30.736	3.614	34.303
4	+65.039	+82.114	17.075	22.178

* Flaw length dimensions are relative to the outside of the pipe.

The sum (simple addition) of the flaw lengths is 25.2 inches. Therefore approximately 28.3% of the total circumference is flawed. The Examination Summary Sheet (Reference 2) states that a shear wave, 45°RL and 60°RL were used to size the crack tip depth. The maximum thru-wall depth of 0.24 inch (approximately 18.0% of thru-wall thickness) was calculated/reported for indications 1 thru 4 and used for the fracture mechanics evaluation.

The indications exceed the acceptance standards of IWB-3514.3 and must be evaluated using the procedures outlined in IWB-3600, Section XI, ASME Code. This report describes the methods and results of the evaluation.

3.1.3 Flaw Geometry Used for Calculation (as stated):

The analyzed flaw geometry is based on the “Multiple and Complex Crack Characterizations (Case 3)” recommendations provided in NUREG-0313 Rev. 2 (Reference 4). The flaw geometry is one (1) fully circumferential flaw with a uniform depth equal to the maximum thru-wall depth determined in the UT examination (0.24 inch). Figure 2 is a Schematic that graphically shows the assumed/analyzed flaw [*Figure 2 is not included in this SER*].

3.1.4 Crack Growth Mitigation Assessment (as stated):

Dresden Unit 2 has been operating under Hydrogen Water Chemistry (HWC) since 1983. NobleChem™ was implemented during the Fall outage in 1999. Hydrogen availability during the last two (2) year was greater than 90% at temperatures above 200°F. Barring major transients, it is expected that the hydrogen availability will be at least 90% during the coming cycle with an availability goal of greater than 98%.

The historical and expected water chemistry parameters for Dresden Unit 2 are compared to the EPRI BWR Water Chemistry Guidelines (Reference 3) in the evaluation titled “Dresden Unit 2 Water Chemistry Data from Cycle 18 and Expected Water Chemistry Data from Cycles 19 and 20 Comparison to the EPRI BWR Water Chemistry Guidelines”, included in this report as Appendix B [*Appendix B not included in this SER*].

With the reapplication of NobleChem™ at EOC 18, it is currently expected that the Cycle 18 chemistry can be routinely achieved, barring major transients. Provided the reactor water chemistry at Dresden-2 can be maintained in Cycles 19 and 20 at comparable values to those in Cycle 18, the Hydrogen Water Chemistry & Noble Chemistry (HWC/NobleChem™) crack growth rate values from BWRVIP-14 (Reference 5) are valid and can be utilized. For the purposes of this evaluation, a 90% capacity factor for HWC/NobleChem™ and a conservative factor of improvement (FOI) of 2 for crack growth was used.

3.1.5 Structural Margin Assessment (as stated):

The limit load method used in the analysis is consistent with the procedures outlined in Appendix C of Section XI of the ASME Code [1]. A brief description of the method is provided next.

Consider a fully circumferential crack of length, $l = 2\pi R$ and constant depth, d. In order to determine the flaw parameters at which limit load is achieved, it is necessary to apply the equations of equilibrium assuming that the cracked section behaves like a plastic hinge. For this condition, the assumed stress state at the cracked section is as shown in Figure 4, where the maximum stress is the flow stress of the material, σ_f [*Figure 4 is not included in this SER*]. Equilibrium of longitudinal forces and moments about the original neutral axis gives the following equations:

$$\beta = \pi \cdot \frac{1 - \frac{d}{t} - \frac{Pm}{3 \cdot Sm}}{2 - \frac{d}{t}} \qquad (1)$$

$$Pb' = \left(\frac{2 \cdot 3 \cdot Sm}{\pi} \right) \cdot \left(2 - \frac{d}{t} \right) \cdot \sin(\beta) \qquad (2)$$

Where,
t = pipe thickness in inches
d = the flaw depth in inches
β= angle that defines the location of the neutral axis in radians
P_m= Primary membrane stress in psi
P_b' = Failure bending stress in psi

The safety factor, SF, is then incorporated as follows:

$$Pb' = z \cdot SF \cdot \left(Pm + Pb + \frac{Pe}{SF} \right) - Pm \qquad (3)$$

P_m and P_b are the primary membrane and bending stresses, respectively. P_e is the secondary stress and includes stresses from all displacement-controlled loadings such as thermal expansion and dynamic anchor motion. P_e is applicable for flux welds only. All three quantities are calculated from the analysis of applied loading. The safety factor is 2.77 for normal/upset conditions and 1.39 for emergency/faulted conditions. The Z factor is discussed next.

<u>Z Factor</u>

The test data considered by the ASME Code in developing the flaw evaluation procedure (Appendix C, Section XI) indicated that the welds produced by a process that did not use a flux had fracture toughness as good or better than the base metal. However, flux welds had lower toughness. To account for the reduced toughness of the flux welds (as compared to non-flux welds) the Section XI procedures prescribe a penalty factor, called a 'Z' factor. Examples of flux welds are submerged arc welds (SAW) and shielded metal arc welds (SMAW). Gas metal arc welds (GMAW) and gas tungsten-arc welds (GTAW) are examples of non-flux welds. Figure IWB-3641-1 of Reference 1 may be used to define the weld-base metal interface. The expressions for the value of the Z factor in Appendix C of Section XI are given as follows:

Z = 1.15[1+0.013(OD-4)] for SMAW (4)
= 1.30[1+0.010(OD-4)] for SAW

where OD is the nominal outside pipe diameter in inches. The weld was conservatively evaluated as a SAW weld (Reference 10). Therefore, the Z factor in the evaluation was calculated using the expression for SAW. For a 28 inch pipe, the Z factor equals 1.62.

3.1.6 Flaw Evaluation Assessment (as stated):

Section XI of the ASME Boiler & Pressure Vessel Code (Reference 1) requires that flaw evaluations consider all relevant methods of crack growth and provides recommendations regarding both Fatigue Crack Growth (FCG) and Intergrannular Stress Corrosion Cracking Crack growth (IGSCC).

FCG is typically negligible compared to IGSCC growth. The only stress cycles acting on the recirculation system that influence FCG are the startup shutdown cycles and seismic events. In the fracture mechanics evaluation GE considered; twenty (20) startup/shutdown cycles and ten (10) seismic events with ten (10) load cycles each, two (2) cycles of operation. The FCG calculated was less than 0.0017 inch at the end of two (2) operating cycle, two (2) years in length each. Therefore, the incremental FCG contribution to length for one (1) cycle, two (2) years, is negligible (less than 0.001 inch crack depth).

IGSCC Crack growth evaluations were performed using three different approaches and the structural margin assessment for these cases are provided in the next section.

1. *Bounding crack growth rates for normal water chemistry (NWC) based on the recommendations in NUREG-0313 Rev. 2 (Reference 4,)*

Figure 3, of this report, from Reference 4 shows the typical stress intensity factors for different pipe sizes and typical weld residual stress patterns. The stresses calculated for this weld are below the 7500 psi considered in Figure 3, however the applied stress intensity distribution shown in Reference 4 was conservatively used. For a 28 inch diameter pipe the maximum K value is 21 ksi-√in over the relevant range of allowable crack depths (based on ASME Section XI, IWB-3600 evaluation methods). The associated crack growth rate (CGR) corresponding to NUREG-0313 Rev.2 (Reference 4) is:

$CGR = 3.59 \times 10^{-8} K^{2.161}$ in/hour, where K is the applied stress intensity factor in ksi-√in.

Using a K value of 21 ksi-√in, the corresponding CGR is 2.58×10^{-05} in/hour. This takes no credit for HWC/NobleChem™ operation. Additionally, no credit is taken for the predicted decrease in total stress intensity as the flaw grows deeper into the pipe thickness. Considering these two items, this method is extremely conservative. GE assumed one (1) operating cycle, with a capacity factor of 100%, for a two (2) year cycle thus 17532 hours of hot operation, resulting in an incremental crack growth of 0.453 inch. This growth results in a maximum depth of 0.24 + 0.001 + 0.453 = 0.694 inch at the end of one (1) operating cycle two (2) years in length. Using the crack growth rate discussed above, 25092 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C (Reference 1) analysis methodology. This corresponds to approximately 1.43 cycles of operation based on a two (2) year cycle.

The results of this evaluation demonstrate that adequate structural margin can be demonstrated for operation of Dresden Unit 2 considering the flaw described in this report and the NWC crack growth method described in NUREG 0313, Rev. 2 (Reference 4), for one (1) cycle of operation on a two (2) year fuel cycle.

2. *Plateau crack growth rates based on NRC SER for BWRVIP-14 (Reference 5,)*

In the SER for BWRVIP-14, the NRC approved a plateau CGR of 2.2×10^{-5} in/hr for the shroud with NWC conditions. Although this was primarily intended for BWR internals, it is conservative to use this for the recirculation piping since the environment is less oxidizing than that for the internals. Additionally, this CGR is only applicable to items with fluences less than 5.0×10^{20} n/cm^2.

The CGR of 2.2×10^{-5} in/hr for the recirculation piping with NWC conditions has been previously approved by the NRC in the Quad Cities Unit 2 Flaw Evaluation SER (Ref 9). For the fracture mechanics evaluation a CGR of 2.2×10^{-5} in/hour for NWC conditions was used. The fluence limitation, mentioned above, is readily met by the low fluence condition at the recirculation pipe weld. This crack growth rate does not take credit for HWC/NobleChem™. Assuming 17532 hours of hot operation for each cycle, the incremental crack growth is 0.386 inch. This growth results in a maximum depth of 0.24 + 0.001 + 0.386 = 0.627 inch at the end of one (1) operating cycle two (2) years in length. Using the crack growth rate discussed above, 29470 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C (Reference 1) analysis methodology. This corresponds to approximately 1.68 cycles of operation.

The results of this evaluation demonstrate that adequate structural margin can be demonstrated for operation of Dresden Unit 2 considering the flaw described in this report and the NWC crack growth rate described in BWRVIP-14 (Reference 5), and reviewed and approved for use in recirculation piping in the fore mentioned SER (Reference 9), for one (1) cycle of operation on a two (2) year fuel cycle.

3. *Plateau crack growth rates taking credit for HWC/NobleChem™*

This approach takes credit for the HWC/NobleChem™ operation during the next cycle. As discussed earlier, assuming a conservative FOI of 2, and the BWRVIP-14 (Reference 5) plateau CGR of 2.2×10^{-5} in/hour for NWC, the CGR for HWC/NobleChem™ is 1.1×10^{-5} in/hour. The CGR of 2.2×10^{-5} in/hour for NWC, the CGR for HWC/NobleChem™ is 1.1×10^{-5} in/hour and FOI of 2 require that ECP values of less than -230 mV and a HWC operation at greater than 80%. The location of the crack also has to have a lower oxidizing environment than the monitored location. Consistent with the plant chemistry discussion provided in Appendix B, of this report, GE assumes a conservative value of 90% for HWC availability and that the average ECP value is less than -230 mV is maintained [*Appendix B is not included in this SER*]. A lower oxidizing environment than the monitored location is met by virtue of the location of the crack. The effective CGR for the next cycle is given by:

Effective CGR = $(0.1 \times 2.2 + 0.9 \times 1.1) \times 10^{-5}$ in/hour or 1.21×10^{-5} in/hour.

Using this CGR and Assuming 17532 hours of hot operation for the next cycle, the incremental growth crack depth is 0.212 inch. This results in a maximum depth of 0.24 + 0.001 + 0.212 = 0.453 in. Using the crack growth rate discussed above, 53487 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C (Reference 1) analysis methodology. This corresponds to approximately 3.05 cycles of operation.

The results of this evaluation demonstrate that adequate structural margin can be demonstrated for operation of Dresden Unit 2 considering the flaw described in this report and the HWC/NobleChem™ crack growth rate described in BWRVIP-14 (Reference 5), and reviewed and approved for use in recirculation piping in the fore mentioned SER (Reference 9), for at least one (1) cycle of operation on a two (2) year fuel cycle.

3.1.7 Conclusion (as stated):

The evaluation presented is based on several conservative assumptions concerning crack growth and follows the procedures of the Appendix C, Section XI, ASME Code - 1995 Edition, including the 1996 addendum (Reference 1), NUREG-0313 Rev. 2 (Reference 4), and BWRVIP-14 (Reference 5) criteria. Table 2 provides a summary of the calculated Flaw depth after 1 cycle of operation for all chemistry assumptions/situations [*Table 2 is not included in this SER*]. The results of the evaluation for normal water chemistry (NWC) confirm that the required ASME Code structural factors are maintained beyond the next (1) operating cycle, two (2) years in length. The results of the evaluation for Hydrogen Water Chemistry with Noble Chemistry (HWC/NobleChem™) confirm that the required ASME Code structural factors are maintained beyond the next three (3) operating cycles, each two (2) years in length. In both chemistry situations (NWC & HWC/NobleChem™), it is shown that adequate structural margins are maintained considering at least one (1) additional cycle of operation, two (2) years in length. Therefore continued operation 'as is' for at least one (1) additional operating cycle, two (2) years in length is justified and all required structural margins are maintained.

3.2 Staff Evaluation

Results of the staff's review of the licensee's pipe flaw evaluation report indicate the following:

The pipe flaw evaluation report followed the guidance provided in NUREG-0313, Revision 2 and used the methodology and acceptance criteria specified in ASME Code, Section XI, 1995 Edition with 1996 Addenda, subarticle IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping." This is acceptable because the flaw evaluation process followed NRC approved procedures, methodology and acceptance criteria.

The flaw evaluation report considered a conservative flaw size - that is the assumed flaw size in the calculations used full pipe circumference flaw size instead of 25.2 inches flaw size (approximately 28.3% of the total pipe circumference) as determined by the UT examination. This is consistent with the crack characterization recommendations provided in Case 3 of NUREG-0313, Revision 2. Therefore, the flaw size and flaw characterization methods used in the licensee's pipe flaw evaluation are acceptable.

The limit load method used in the licensee's structural margin analysis is consistent with the procedures outlined in Appendix C of Section XI of the ASME Code. The analysis used conservative safety factors of 2.77 for normal and upset conditions and 1.39 for emergency and faulted conditions. The weld was also conservatively evaluated as a SAW weld and used a Z factor of 1.62. This is acceptable because the structural margin analysis used in the licensee's pipe flaw evaluation followed the procedures outlined in Appendix C of Section XI of the ASME Code, which are acceptable to the NRC.

The licensee provided a flaw evaluation assessment in its pipe flaw evaluation report which followed the procedures included in Section XI of the ASME Code. The Code requires that flaw evaluations consider all relevant methods of crack growth and provides recommendations regarding both FCG and IGSCC.

For FCG the licensee considered twenty startup/shutdown cycles and ten seismic events with ten load cycles each, in two cycles of operation. The FCG calculated was less than 0.0017 inch at the end of two operating cycle, two years in length each. Therefore, the FCG contribution to length for one cycle, two years, is negligible (less than 0.001 inch crack depth).

The licensee performed IGSCC crack growth evaluations using three different approaches. The evaluations for these three cases determined the following:

- Bounding crack growth for normal water chemistry based on the recommendations provided in NUREG-0313, Revision 2 was calculated to be 0.694 inch at the end of one operating cycle two years in length. Using crack growth of 0.694 inch, 25092 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C analysis methodology. This corresponds to approximately 1.43 cycles of operation based on a two year cycle.

- Bounding crack growth for normal water chemistry based on NRC SER for BWRVIP-14 was calculated to be 0.627 inch at the end of one operating cycle two years in length. Using crack growth of 0.627 inch, 29470 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C analysis methodology. This corresponds to approximately 1.68 cycles of operation.

- Bounding crack growth taking credit for HWC was calculated to be 0.453 inches. Using crack growth of 0.453 inches, 53487 hours of operation can be justified before the considered indication reaches the limiting depth determined using the ASME Section XI, Appendix C analysis methodology. This corresponds to approximately 3.05 cycles of operation. The DNPS Unit 2 has been operating under HWC since 1983. HWC provides an effective counter measure for reducing IGSCC in BWR piping. The expected crack growth rates used in the licensee's pipe flaw evaluation used a conservative 90 percent capacity value for the HWC model.

The results obtained for crack growth rates for the above mentioned three cases that were used in the licensee's pipe flaw evaluation demonstrate that adequate structural margin exist and that the DNPS Unit 2 can operate safely with flawed piping for one cycle consisting of two years in length. The staff, therefore, concludes that the licensee has demonstrated that the required

ASME Code structural factors will be maintained beyond the next operating cycle of two years in length. This is based on the fact that the licensee's flaw evaluation meets the requirements of ASME Code, Section XI, 1995 Edition with 1996 Addenda.

4.0 CONCLUSION

Based upon its review of the licensee's evaluation, the staff concludes that the licensee's flaw evaluation meets the rules in Section XI of the ASME Code. Since the calculated hours of operation to reach the allowable flaw depth are greater than the hours of operation for one fuel cycle, and the safety factors associated with the detected crack are greater than those specified in the ASME Code, the staff concludes that DNPS Unit 2 can be operated for one fuel cycle without repair of the B-loop reactor recirculation pipe weld.

5.0 REFERENCES

1. American Society of Mechanical Engineers,
   - Boiler & Pressure Vessel Code, Section III (1965)—Nuclear Vessels
   - Section XI, ASME Code 1995 Edition, including the 1996 addendum.

2. GE Nuclear Energy, "2R18-052 Examination Report — Examination Summary Sheet for 2/I/0202B-28/PS2/201-I," GE Nuclear Energy, San Jose, CA, October 2003.

3. EPRI, "BWR Water Chemistry Guidelines—2000 Revision," EPRI, Palo Alto, California, February 2000, (EPRI Document No. TR-103515-R2).

4. U.S. Nuclear Regulatory Commission, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," US Nuclear Regulatory Commission Office of Nuclear Reactor Regulation, (NUREG-0313 Rev.2) January 1988.

5. BWRVIPS
   - BWR Vessel and Internal Projects: Evaluation of Crack Growth in BWR Stainless Steel RPV Internals (BWRVIP-14), EPRI, Palo Alto, CA (EPRI TR-105873), March 1996.
   - BWR Vessel and Internal Projects: Evaluation of Crack Growth in BWR Stainless Steel RPV Internals (BWRVIP-14-A), EPRI, Palo Alto, CA (EPRI XXXXXXX), DRAFT August 2003.

6. GE Nuclear Energy, "Reactor Vessel — Power Uprate — Design Specification," GE Nuclear Energy, San Jose, CA (26A5587, Rev. 0).

7. GE Nuclear Energy, "Design Input Request (DIR) - Dresden 2 Recirculation Line Flaw Evaluation," GE Nuclear Energy, San Jose, CA (Contained in DRF# 0000-0022-6311), October 2003.

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Principal Contributor: G. Georgiev, EMCB/DE/NRR

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