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ComEd

October 5, 1998

JMHLTR: #98-0253

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

Subject: Response to Request for Additional Information
Regarding Core Spray Weld Flaws Evaluation
Dresden Nuclear Power Station, Units 2 and 3
NRC Docket Numbers 50-237 and 50-249

References: L.W. Rossbach (U.S. NRC) letter to
O.D. Kingsley (ComEd), Request for Additional
Information Regarding Evaluation of Core Spray Weld
Flaws at Dresden Nuclear Power Station, Units 2 and 3,
August 5, 1998

The purpose of this letter is to provide Commonwealth Edison (ComEd) Company's response to the Request for Additional Information (RAI) as referenced above. The responses are provided in Attachment A to this letter.

Please direct any questions regarding this matter to Frank Spangenberg, Dresden Regulatory Assurance Manager at (815) 942-2920 extension 3800.

Sincerely,

J. M. Heffley
Site Vice President
Dresden Nuclear Power Station

Attachment

cc: Regional Administrator, NRC Region III
Senior Resident Inspector, Dresden Nuclear Power Station

A001

9810090405 981005
PDR ADOCK 05000237
P PDR

bcc: R. Krich, Vice President Regulatory Services
F. Spangenberg, Regulatory Assurance Manager
C. Peterson, Regulatory Assurance Manager
Tony Fuhs, Nuclear Licensing Administrator
B. Rybak, Director Dresden/Quad Cities Licensing and Compliance
L. Rossbach Project Manager, NRR (Unit 2/3)
N. Reynolds, Winston and Strawn
Office of Nuclear Facility Safety - IDNS
DCD, Licensing, hard copy
DCD, Licensing, electronic copy
Dresden Regulatory Assurance, Chron File
Dresden Regulatory Assurance, Subject File -
Dresden Regulatory Assurance, SALP 16 Regulatory Commitment Book
SVP Numerical File

Attachment A
Request for Additional Information Regarding
Evaluation of Core Spray Weld Flaws at Dresden Units 2 & 3

References:

1) BWRVIP Letter from Mr. Carl Terry to Mr. Brian Sheron dated October 30, 1997
2) ComEd Letter from J. Stephen Perry to U.S. Nuclear Regulatory Commission dated June 5, 1997
3) ComEd Letter from J.M. Heffley to U.S. Nuclear Regulatory Commission dated April 11, 1998
4) ASME B&PV Code Section XI, Appendix C, 1989
5) J.T. Beckham, Jr. to C.E. Carpenter dated July 26, 1996, "BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines (BWRVIP-18)," EPRI TR-106740, July 1996
6) J.T. Beckham, Jr. to C.E. Carpenter dated November 10, 1995,"BWR Vessel and Internals Project Reactor Pressure Vessel and Internals Examination Guidelines (BWRVIP-03)," EPRI Report TR-105696, September, 1995
7) J.T. Beckham, Jr. to C.E. Carpenter dated February 29, 1996, "BWR Vessel and Internals Project Guidelines for Reinspection of BWR Core Shrouds (BWRVIP-07)," EPRI Report TR-105747, February 1996

<u>Dresden Unit 3</u>

(1) In your flaw evaluation report, the flaws in the Loop A upper sparger 80° downcomer shroud pipe to collar weld (1P8a) were determined to be so extensive after crack growth, that the subject weld is assumed not to carry any load. The Staff has concerns regarding the functionability of the core spray loop A because the hidden weld P9, connecting the shroud penetration pipe to the sparger tee box, is not accessible for inspection. Therefore, the structural integrity of weld P9 can not be assured.

(a) Provide a comprehensive discussion on a plant specific basis regarding the susceptibility of the weld P9 (adjacent to weld 1P8a) to IGSCC; and its impact to the structural integrity of weld P9. The discussion should include the effect due to the presence of a crevice condition (annulus between the collar and the pipe) and the grinding of the weld root in accelerating the crack initiation and growth in the subject weld.

Response:

ComEd has performed a thorough review of the Dresden Unit 3 fabrication drawings, weld specifications/procedures and Design Specifications to determine susceptibility of the P9 weld due to IGSCC. In addition, industry core spray cracking experience was reviewed and a statistical evaluation was performed. Based on these reviews and the statistical evaluation, it was concluded that the likelihood of significant cracking (i.e., crack length approaching the allowable value) at the P9 weld is very low.

Core Spray Weld Characterization for IGSCC Susceptibility:

To determine the IGSCC susceptibility of the P9 weld, the weld geometries and fabrication details of the core spray piping welds were reviewed to assess the potential for a creviced condition. Tight crevices are likely to promote crack initiation and crack growth, due to the tendency for ionic species to concentrate in the crevice which aggravates IGSCC.

Figure 1 shows a schematic of the annulus core spray piping system at Dresden 3 along with the designations of welds used in the BWRVIP-18 report [Ref. 5]. Based on IGSCC susceptibility and observed frequencies of cracking, the various welds in the system can be divided into three broad categories:

(1) Creviced fillet welds
(2) Welds with a likelihood of lack of fusion leading to potential creviced geometry
(3) Groove or butt welds.

The P2 weld between the T-box and the cover plate falls into weld category 2. The P3 weld between the tee and the horizontal pipe has a complex shape due to the mating of the two cylindrical geometries. Therefore, this weld was also included in category 2. Welds P5, P6 and P7 at the sleeved coupling assembly clearly fall into category 1. The small gap between the two sleeves and the pipe clearly makes these creviced welds.

Although a full penetration weld was specified at P8b, it would have been difficult to make the root pass at the shroud location (as compared with other symmetrical groove welds in the core spray piping) because of the large heat sink and constraint associated with the shroud. It is likely that this weld would have root defects such as lack of fusion associated with it. In addition, because of the configuration, the root was not accessible after welding, so visual inspection of the root would not have been possible. If a weld defect such as lack of fusion occurred, it could create a tight crevice near the heat affected zones in the shroud/collar and which would contribute to increased susceptibility to IGSCC at this particular weld location. Based on the preceding discussion, P8b weld is included in category 2.

Similarly, the P8a weld is a full penetration weld with potential for creviced conditions. The fabrication records show that weld P8a was completed using a Shielded Metal Arc Welding (SMAW) type electrode. This welding process would leave slag at the root and a non-uniform root condition as opposed to the Gas Tungsten Arc Welding (GTAW) process. With regard to geometry, a visual inspection of the root of this weld would not have been possible. In view of these factors, it is judged that an increased potential for IGSCC can not be ruled out at the P8a weld. Thus, P8a welds at Dresden 3 are included in category 2.

The remaining girth welds, including the P4 and P9 welds, fall into category 3. As Figure 2 shows, the geometry of the P9 weld is a typical pipe to pipe butt weld and therefore not different from any other groove welds in the system. The fabrication records show that the P9 weld was completed using the GTAW process, which does not use flux. The fabrication sequence for the P9 weld would allow for inspection of the root pass ID. This process minimizes the potential for a root creviced condition. A review of the drawing and weld procedures indicates the P9 weld was specified to have a crown reinforcement, with no requirements for the weld root or crown to be ground flush. Based on these fabrication requirements, there is no increased susceptibility due to grinding or a root creviced condition. All category 3 welds are GTAW full penetration butt welds.

Due to the geometry of the region between the thermal sleeve collar and the OD of the core spray piping, this region will not act as a crevice location. The gap between the ID of the collar and the OD of the pipe is 0.5 inch and the length of the region is approx. 2.5 inches based on the drawing. This annular region does not meet the crevice definition in the applicable General Electric specification. Thus, it can be concluded that the gap between the ID of the collar and the pipe does not act as a crevice.

To summarize, the welds in the internal core spray piping have been divided into the three categories defined for the purpose of evaluating IGSCC susceptibility of the core spray welds including P9 weld.

Review of Available Industry Core Spray Pipe Cracking Experience

A review of the available core spray inspection data on file with General Electric Nuclear Energy (GENE) was undertaken to assess the relative IGSCC susceptibility of the various welds in the annulus core spray piping system. In-service inspection data from a total of 14 plants were summarized including those from the Quad Cities and Dresden units.

The number of cracked welds in each category of welds can be summarized as the following.

Weld Category	No. of Welds Inspected[1]	No. Of Welds Cracked
Category 1	168	12
Category 2	196	29
Category 3	252	7

Note 1: Total number of plant welds per category times the number of plants.

It is quite clear from the number of cracked welds in each category that the largest numbers of cracked welds belong to categories 1 and 2. This is expected since the welds in these categories are more susceptible to IGSCC due to the presence of either a crevice in the category 1 welds or a potential crevice in the category 2 welds.

Statistical Evaluation

In order to determine the probability of a crack greater than a specified length in the P9 weld, a subset of the core spray inspection data was reviewed and crack length data was tabulated. Core spray inspection data was obtained from readily available inspection reports for six plants of similar age, including Dresden Unit 3. For conservatism, only welds where cracking had been found were considered as the sample population. There are many core spray piping welds where inspections found zero cracking. In the interest of increasing the sample size, crack data from creviced P5 and P6 welds were also included. Based on this data, the probability that a weld has any cracking is small, typically less than 15%. However, with the zero cracking results omitted, the evaluation uses a conservative cracking probability of 100%.

The first step in evaluating the data was to separate it into appropriate sample populations. Given that the majority of the data was obtained from the P8 weld, the data was evaluated to determine if there was a statistical difference between the population of P8 welds and all other welds.

The two sets of data (P8 and non-P8 welds) were determined to have a significant difference in means with a 95% confidence. Therefore these two sets of sample data were treated as being from different populations. As previously noted, the P9 welds are considered to be different from the P8 welds; therefore, the non-P8 sample data was used to determine the crack length distribution for the P9 welds.

This statistical analysis shows that the data is normally distributed. Analysis of the data determined the mean crack length to be 18.2% of the circumference, with a standard deviation of 10.44%. The critical flaw lengths for the P9 weld, assuming no load carrying capability in the P8a weld, has been determined to be greater than 75% of the pipe circumference. Using these values, the probability of a weld being cracked more than 75% of the circumference was determined to be less than 1×10^{-6}.

Risk Evaluation

ComEd reviewed the risk significance for the probability of the P9 weld developing into a flaw that would challenge structural integrity. A bounding calculation shows that the increase in Core Damage Frequency (CDF) as a result of a total failure of the P9 weld is less that 1% of the baseline CDF which is far below the threshold to be considered risk significant by EPRI. A realistic calculation shows the additional CDF to be several orders of magnitude smaller.

Summary and Conclusion

The purpose of this evaluation was to assess the IGSCC susceptibility of the P9 weld taking into account the environmental conditions in the collar region and the available inspection experience base collected by General Electric. A geometric evaluation of the gap between the ID of the collar and OD of the pipe at P9 indicated that this region is not expected to behave as a crevice. Fabrication records specified a weld crown reinforcement with no requirement to grind the weld root or crown flush. Therefore, the P9 weld is expected to behave similarly, in terms of IGSCC susceptibility, as any groove weld in the core spray piping system. Based on a review of the available industry core spray cracking experience, it was concluded that the likelihood of significant cracking (i.e., crack length approaching the allowable value) at P9 weld is very low. This conclusion was supported by a statistical evaluation of the non-P8 weld cracking data. Conservatively neglecting welds with zero cracking, the statistical evaluation determined the probability of cracking greater than 75% of the circumference to be less than 10^{-6}. Consequently, the increase in CDF as a result of a loss of structural integrity due to the failure of the P8 and P9 from IGSCC, is far below the threshold to be considered risk significant.

Figure 1 Typical Core Spray Piping Layout with BWRVIP Weld Designations

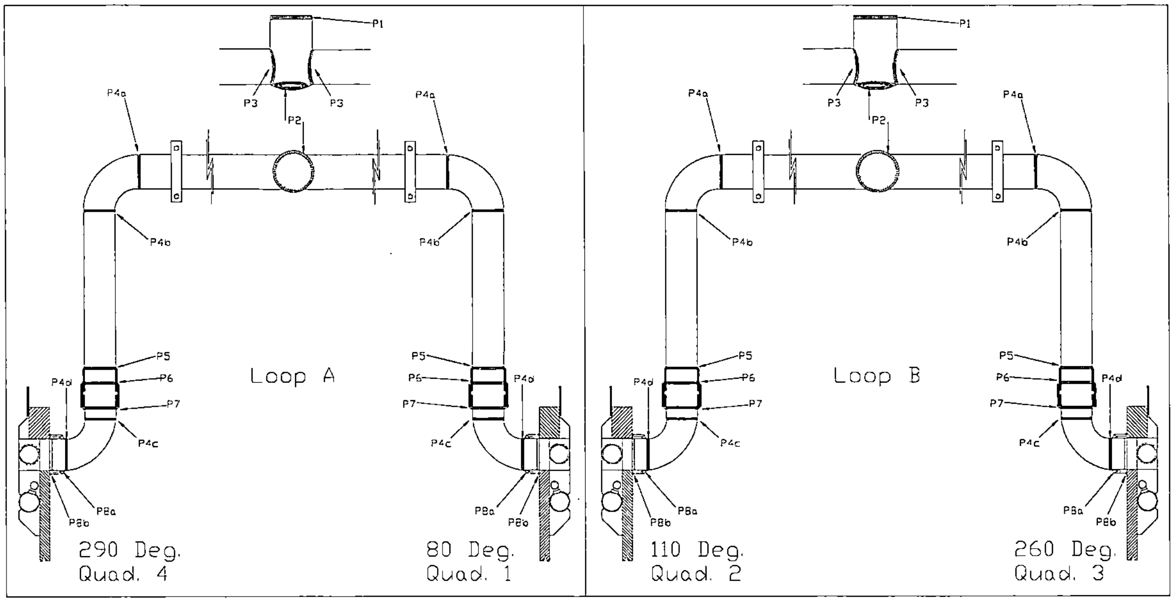
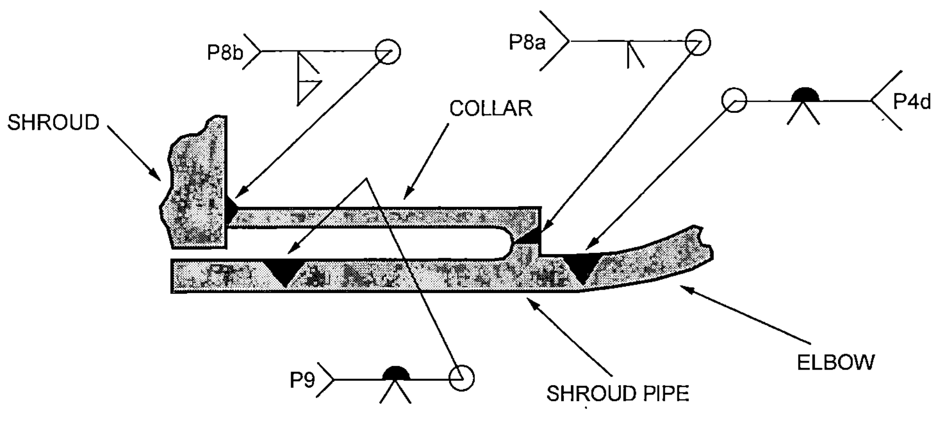


Figure 2 Schematic of the Core Spray Pipe Attachment to the Shroud



(b) Discuss the safety consequences including its impact to the peak cladding temperature (PCT) for the most bounding case of LOCA, when both weld P9 and its adjacent weld 1P8a are assumed to be completely failed due to extensive through-wall cracking.

Response:

ComEd contracted GENE to calculate the maximum displacement of the core spray piping, given failures of P9 and P8a welds, and to determine the resultant leakage.

For the 80° downcomer (figure 1), with both the P8a and P9 welds severed, the resulting leakage for a bounding case LOCA is as follows:

- 4500 gpm Pump Flow Case, Total Leakage Outside the Shroud Equaled 1140 gpm
- 5650 gpm Pump Flow Case, Total Leakage Outside the Shroud Equaled 1580 gpm

The leakage from a postulated failure of P9 and P8a welds during a bounding design basis LOCA was analyzed by Siemens Power Corporation to assess the impact to peak cladding temperature (PCT). The limiting single failure for LOCA is the single failure of the LPCI injection valve (SF-LPCI). The other potentially limiting single failure is the failure of a diesel generator (SF-DG). For SF-LPCI, the low pressure ECCS available are 2 core spray pumps. For SF-DG, the ECCS available are 2 LPCI and 1 core spray pump. The additional core spray leakage resulting from a postulated failure of P8a and P9 welds will impact both the SF-LPCI results and the SF-DG results. Siemens Power Corporation calculations determined that SF-LPCI is still limiting. Considering this additional leakage from the postulated severed welds, the calculated PCT still meets the 10CFR50.46 acceptance criteria.

(c) Discuss the industry-wide effort in developing the techniques to inspect P9 welds and the feasibility of inspecting P9 welds during the upcoming refueling outage.

Response:

At the present two vendors, GE and FTI, are attempting to demonstrate P9 weld ultrasonic inspection techniques in accordance with Reactor Pressure Vessel and Internals Examination Guidelines (BWRVIP-03), Reference 6. Both vendor techniques have issues regarding the metal path through the collar, annulus and sleeve.

Since a technique to inspect the P9 weld has not been demonstrated prior to the outage scope freeze date (May 9, 1998), ComEd does not plan to perform an inspection of the P9 weld during D3R15.

(d) **In the staff's safety evaluation of BWRVIP-18, "BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines," which was issued on June 8, 1998, the Staff requires that the inspection of P9 welds should be performed when extensive cracking of the corresponding P8a welds was found. What is your plan to meet that requirement?**

Response:

ComEd is an active participant with the BWRVIP and will continue to follow the progress of the resolution of this issue with the NRC. It is ComEd's understanding that the BWRVIP has agreed with the NRC to implement BWRVIP document requirements when the NRC Staff approves the document as submitted by the BWRVIP (Ref. 1).

For BWRVIP documents, which receives conditional approval from the NRC, the BWRVIP has agreed to resolve the NRC comments and resubmit a revised document prior to implementation

On August 25, 1998, the BWRVIP Core Spray Focus Group held a meeting to discuss the additional requirements in the NRC Safety Evaluation of BWRVIP-18. On the issue of P9 inspections, it was the consensus opinion of the BWRVIP Core Spray Focus Group that present NDE techniques have not been demonstrated and therefore it is not reasonable to impose an inspection requirement that can not be accomplished. The results of this Core Spray Focus Group meeting will be reflected in a revision to BWRVIP-18, which will be resubmitted to the NRC.

ComEd is committed to comply with the BWRVIP-18 document currently issued. As the BWRVIP works out resolution of the NRC additional requirements found in the June 8, 1998 Safety Evaluation, ComEd will comply with the updated BWRVIP-18 document.

(e) **Discuss your contingent repair/replacement plan in the event that the structural integrity of weld 1P8a or its adjacent weld P9 can not be assured?**

Response:

As stated in the Desden flaw evaluation, ComEd has evaluated the structural requirements for the P9 weld for a minimum of two 24 month fuel cycles (Ref. 2). With the additional information provided in this response, ComEd's does not intend to incorporate a repair/replacement plan for the upcoming Dresden D3R15 outage. In the event that our future inspection indicate a repair or replacement is required, ComEd is considering two options.

First, ComEd is working with GENE to develop a clamp that attaches to the elbow section of the downcomer which would limit the deflection of the downcomer during a bounding case LOCA so that the leakage would be minimized. This option will be pursued as a potential short term repair.

Second, ComEd has purchased the Core Spray Sectional Replacement (CSSR) required to replace four core spray line lower elbow assemblies. The CSSR replaces the core spray piping and welds from the shroud to above the sleeve coupling assembly. All design basis calculations for the installation of this modification are complete. This option will be considered for long term repairs once the installation tooling has been demonstrated.

(2) In the staff's safety evaluation of BWRVIP-18 which was issued on June 8, 1998, the Staff required that the inspection uncertainties in measuring the flaw length by UT or VT should be considered in flaw evaluations by incorporating the inspection uncertainties in the crack growth calculations and discuss the results of load margin factors.

Response:

ComEd's position concerning the additional requirement found in the NRC's Safety Evaluation can be found in RAI Response 1d. In addition, the information below is the BWRVIP and ComEd's position concerning measurement uncertainty.

The BWRVIP has and is continuing to demonstrate and document the measurement uncertainties associated with each of the BWRVIP recommended inspection techniques. It is not the intent of the BWRVIP that this information be used as additional dimensions to be added to the observed flaw sizes when performing flaw evaluations. The purpose of the BWRVIP activity is to ensure that the uncertainties are relatively small and are appropriately accounted for in the margins that exist in the flaw evaluation procedures (code margins, crack growth rates, etc.). This is consistent with ASME Section XI and other industry codes that provide for evaluation of flaws detected and measured with NDE techniques. The BWRVIP and the EPRI NDE Center have worked together to develop the qualification process and have confirmed that the uncertainties are small and do not warrant any unique recognition in the analytical evaluation process.

ComEd utilized an automated UT inspection technique for Dresden's D3R14 refueling outage. This technique inherently demonstrates insignificant position uncertainty. Therefore, based on the above, there is no change to the measured flaw lengths due to uncertainties and, consequently, there is no impact on load margin factors.

(3) The Staff notes that, for the five cracked welds, both VT and UT were performed. Describe the crack indications that were observed by visual examinations and compared to that reported by UT.

Response:

The inspection of Dresden's Core Spray piping during D3R13 was a visual examination of all welds on the spargers and downcomer piping. The visual technique used at that time required a 1-mil wire resolution with no cleaning stipulations.

The method employed during D3R14 was a fully automated, computer controlled, multi-axis ultrasonic scanning head, i.e., the General Electric CSI-2000 system. This examination was fully qualified for P4c welds. The P8a welds, for which the UT inspection technique was not demonstrated per BWRVIP-03, were brushed clean and visually inspected using an enhanced visual inspection (EVT-1) with a one-half mil wire resolution to the extent possible.

The following table summarizes the Dresden Unit 3 data in the same fashion that it is presented in the Dresden Unit 2 Flaw Evaluation Report.

<u>D3R13 and D3R14 IVVI Core Spray Inspection Results</u>

Indication Locations	D3R13 VT Results 1 Mil Resolution	D3R14 Automated UT Results 100% Coverage	D3R14 EVT-1 Result (Cleaned) ½ Mil Resolution
2P4c, 110° Downcomer to Lower Elbow Upper Weld	6″ Cleaned for Sizing	4.6″	N/A
4P4c, 290° Downcomer to Lower Elbow Upper Weld	4″ Cleaned for Sizing	4.5″	N/A
1P8a, 80° Thermal Sleeve Collar	NRI No Cleaning	14.3″ total made up of 3 non-continuous flaws with short ligaments between flaws	10" total Made up of two non-continuous flaws

2P8a, 110° Thermal · Sleeve Collar	NRI No Cleaning	5.7″	4" made up of 3 non-continuous flaws
3P8a, 260° Thermal Sleeve Collar	NRI No Cleaning	8.3″	6.5"

Comparison of the VT and UT reported results is included in the response to the following question.

(4) **For the two cracked lower elbow welds (P4C), cracking was originally found during the previous refueling outage (D3R13) and were re-inspected during the following refueling outage D3R14. Discuss the inspection techniques used in each refueling outage and estimate the crack growth rate based on the flaw sizes measured at the two refueling outages.**

Response:

The inspection of Dresden's Core Spray piping during D3R13 was a visual examination of all welds on the spargers and downcomer piping. The visual technique used at that time required a 1-mil wire resolution with no cleaning stipulations. At that time the BWRVIP I & E Guidelines for Core Spray piping had not been published. The method employed during D3R14 was a fully automated, computer controlled, multi-axis ultrasonic scanning head, i.e., the General Electric CSI-2000 system. This examination was fully qualified for P4c welds. The inspection results were:

- Weld 2P4c, the 110° down-comer pipe to lower elbow upper weld, had a flaw measured at 4.6 ″ in length or 80° of it's circumference during D3R14. It had been previously sized at 6 ″ during D3R13.

- Weld 4P4c, the 290° down-comer pipe to lower elbow upper weld, also had a flaw that was measured at 4.5 ″ in length or 78° of the circumference during D3R14. It had been previously sized at 4 ″ during D3R13.

Based on the significant difference in inspection techniques that exist between D3R13 (VT with 1 mil resolution) and D3R14 (automated UT), no meaningful crack growth rate extrapolations can be made.

<u>**Dresden Unit 2**</u>

(5) **In the staff's safety evaluation of BWRVIP-18 which was issued on June 8, 1998, the Staff does not agree with the BWRVIP provided guidelines regarding the flaw evaluation of the inaccessible region by assuming that**

"2X" percent of the inaccessible region should be assumed to be completely cracked for flaw evaluation. Therefore, the licensee should perform an additional flaw evaluation of the (loop B) 110° shroud penetration thermal sleeve collar weld (2P8a) by assuming the inaccessible region to be completely cracked, and discuss the results of load margin factors (safety factors).

Response:

ComEd's position concerning the additional requirement found in the NRC's Safety Evaluation can be found in RAI Response 1d. In addition the information below is the BWRVIP and ComEd's position concerning inaccessible regions.

It is the consensus opinion of the BWRVIP Core Spray Focus Group that "2X" percent of the inaccessible region conservatively bounds the statistical methodology applied in Appendix C of the BWRVIP-07 Report, (Ref. 7). Section 5.1.4 of BWRVIP-18 states that as an alternative to "2X," a statistical approach similar to that in BWRVIP-07 can be used to determine the amount of cracking in uninspected areas. The "2X" approach is more conservative than the BWRVIP-07 statistical approach (which has a 95% confidence) as demonstrated by the following example.

For example, assume that 50% of a weld is inspected. If the cracking on the accessible side is 50% of the amount inspected, then the assumption of "2X" percent cracked in the uninspected portion of the weld would result in 100% of the remaining weld length being assumed cracked. If the statistical approach in BWRVIP-07 were used, this would result in 65% of the uninspected weld length being assumed cracked.

If ComEd were to apply the BWRVIP-07 approach to the Dresden Unit 2 110° P8a weld only 0.81" would have been assumed to be flawed as compared to 1.6" used for the flaw evaluation.

Thus the "2X" term bounds the statistical approach in BWRVIP-07. BWRVIP proposes to only use the "2X" term for determining the amount of cracking in inaccessible areas.

<u>**Dresden Units 2 and 3**</u>

(6) For the Tables reporting the results of flaw evaluation or stress values, identify the bounding conditions (normal/upset or emergency/faulted conditions) for each reported evaluation.

Response:

The tables below for Dresden Unit 3 and Dresden Unit 2 identify the bounding condition (Normal/Upset or Emergency/Faulted) for each of the reported evaluations.

DRESDEN 3

Flaw Location	Design Basis (1)		Beyond Design Basis	
	P_m (psi)	P_b (psi)	P_m (psi)	P_b (psi)
Loop B 110° Collar	10(1) NU	108 NU	21(1) BDB	270 BDB
	21(2) EF		21(2) BDB	
Loop B 110° Elbow	0(1) EF	690 EF	25(1) BDB	901 BDB
	415(2) EF		439(2) BDB	
Loop B 260° Collar	10(1) NU	108 NU	21(1) BDB	270 BDB
	21(2) EF		21(2) BDB	
Loop B 290° Elbow	0(1) EF	698 EF	28(1) BDB	876 BDB
	415(1) EF		443(2) BDB	

Normal/Upset = NU
Emergency Faulted = EF
Beyond Design Basis = BDB

Notes:

1. The applied bending stress (P_{AB}) as defined in Eq. 7-2 (Ref. 4), is based on the bounding load combination for the design basis and beyond design basis load combinations.
2. This maximum primary membrane stress from the design basis and beyond design basis load combinations was conservatively used to calculate the allowable bending stress (P_B) as defined in Eq. 7-1 (Ref. 4)

DRESDEN 2

Flaw Location	Design Basis [1]		Beyond Design Basis	
	P_m (psi)	P_b (psi)	P_m (psi)	P_b (psi)
Loop B 260° Elbow (Upstream Weld)	455[1] NU	236 NU	374[1] BDB	872 BDB
	455[2] NU		479[2] BDB	
Loop B 260° Elbow (Downstream Weld)	375[1] NU	312 NU	74[1] BDB	1207 BDB
	375[2] NU		417[2] BDB	
Loop B 110° Collar	13[1] NU	108 NU	36[1] BDB	311 BDB
	23[2] EF		36[2] BDB	
Loop B 260° Collar	13[1] NU	108 NU	36[1] BDB	311 BDB
	23[2] EF		36[2] BDB	
Loop A 290° Collar	13[1] NU	95 NU	37[1] BDB	289 BDB
	22[2] EF		37[2] BDB	

Normal/Upset = NU
Emergency Faulted = EF
Beyond Design Basis = BDB

Notes:
1. The applied bending stress (P_{AB}) as defined in Eq. 7-2 (Ref. 4), is based on the bounding load combination for the design basis and beyond design basis load combinations.
2. This maximum primary membrane stress from the design basis and beyond design basis load combinations was conservatively used to calculate the allowable bending stress (P_B) as defined in Eq. 7-1 (Ref. 4)

DRESDEN 2

Flaw Location		Design Basis [1]		Beyond Design Basis	
		P_m (psi)	P_b (psi)	P_m (psi)	P_b (psi)
Loop A 80° Sleeve Assembly	Primary	102[1] EF	270 EF	470[1] BDB	356 BDB
		445[2] EF		470[2] BDB	
	Secondary	137 EF	7156 EF	290 BDB	11599 BDB

Normal/Upset = NU
Emergency Faulted = EF
Beyond Design Basis = BDB

Notes:

1. The applied bending stress (P_{AB}) as defined in Eq. 7-3 (Ref. 4), is based on the bounding load combination for the design basis and beyond design basis load combinations.
2. This maximum primary membrane stress from the design basis and beyond design basis load combinations was conservatively used to calculate the allowable bending stress (P_B) as defined in Eq. 7-1 (Ref. 4)

(7) Provide the information on reactor water chemistry (conductivity, chloride, sulfate, and oxygen content) for the last three operating cycles.

Response:

The Dresden Chemistry Program has been established to maintain the best achievable chemical control with regard to protection of plant components. Together with correct operating practices, BWR water chemistry increases plant availability by reducing inter-granular stress corrosion in primary system piping and the reactor internals components. This program is based on ComEd Nuclear Operations Directive NOD CY.02, "BWR Water Chemistry Control Program." This NOD is adopted from the Electric Power Research Institute's (EPRI) Document TR-103515-R1. Dresden, Quad-Cities and LaSalle County Stations adhere to this program.

Dresden 2 has been operating with Hydrogen Water Chemistry since 1983 and Zinc Injection since December 1996. Dresden 3 will begin utilizing Hydrogen Water Chemistry in the fourth quarter of 1998 and has commenced Zinc Injection in August of 1998. The following table presents the last three fuel cycle average chemistry values and their limits for the four requested parameters.

	Conductivity	Chloride	Sulfate	Dissolved O_2
	microS/cm	ppb	ppb	ppb
Dresden 2				
Cycle 13	0.071	0.53	1.42	18.0
Cycle 14	0.072	0.30	2.49	30.0
Cycle 15	0.072	0.30	2.33	15.3
Dresden 3				
Cycle 12	0.072	0.35	0.80	N/A
Cycle 13	0.073	0.33	1.41	210
Cycle 14	0.078	0.30	1.93	212
NOD Goal	0.10	<2.0	<2.0	N/A
NOD/EPRI Limit	<0.3	<5.0	<5.0	N/A

(8) Provide a brief discussion of the methodologies used in your flaw evaluation including load calculations and combinations, piping modeling and stress analysis, and crack growth calculations that deviate from the guidelines provided in BWRVIP-18.

Response:

The flaw evaluation methodologies including pipe modeling, load calculations/ combinations, stress analysis and crack growth calculations meet the BWRVIP-18 Guidelines. Therefore, there are no deviations from BWRVIP-18 guidelines.