Duke Power
A Duke Energy Company

W. R. McCollum, Jr.
Vice President

Duke Power
Oconee Nuclear Site
7800 Rochester Highway
Seneca, SC 29672
(864) 885-3107 OFFICE
(864) 885-3564 FAX

June 7, 2001

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

SUBJECT: Oconee Nuclear Station - Unit 2
Docket No. 50-270
Supplemental Information -
Request to use an Alternative to ASME Boiler and Pressure Vessel Code, Section XI in accordance with 10 CFR 50.55a(a)(3)(ii) (RR 01-08, Supplement 2)

By letter dated May 13, 2001, Duke Energy Corporation (DEC) requested, pursuant to 10 CFR 50.55a(a)(3)(ii), the use of alternatives to portions of the ASME Boiler and Pressure Vessel Code, Section XI, Subsections IWA-4170(d) and IWA-4310, 1992 Edition with no addenda for Oconee Unit 2. By letter dated May 16, 2001, DEC provided additional information concerning the location of flaws at the repair area triple point (RR 01-08, Supplement 1). By letter dated May 22, 2001, DEC provided responses to a NRC request for additional information (RR 01-08, RAI).

During a conference call on May 29, 2001, the NRC requested that certain information proprietary to Framatome ANP (FRA-ANP) provided in the May 13th and May 22nd letters be redesignated as non-proprietary. This submittal provides replacement pages to the above two letters that reflect the redesignation of certain information as discussed in the May 29th conference call. Attachment A to this letter provides replacement pages to the May 13, 2001 submittal and Attachment B provides replacement pages to the May 22, 2001 submittal.

Attachments A and B to this request contain information proprietary to Framatome ANP (FRA-ANP). Brackets enclose the proprietary information "[]" provided in Attachment A. An affidavit from FRA-ANP is included as Attachment C. This

A001

ML011170221

affidavit establishes the basis on which the NRC, pursuant to 10 CFR 2.790 may withhold the information from public disclosure. Attachments D and E provide non-proprietary versions of Attachments A and B, respectively.

Questions regarding this request may be directed to Robert Douglas at (864) 885-3073.

Very truly yours,

William R. McCollum, Jr.
Site Vice President,
Oconee Nuclear Station

Attachments:

A - Replacement Pages for Request for Alternative, Serial Number 01-08 (Proprietary)
B - Replacement Pages for Request for Alternative, Serial Number 01-08 RAI (Proprietary)
C - Affidavit of R.W. Ganthner
D - Replacement Pages for Request for Alternative, Serial Number 01-08 (Non-proprietary)
E - Replacement Pages for Request for Alternative, Serial Number 01-08 RAI (Non-proprietary)

cc w/att:

L. A. Reyes, Regional Administrator
U.S. Nuclear Regulatory Commission, Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, GA 30303

D. E. Labarge, Senior Project Manager (ONS)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop O-8 H12
Washington, D.C. 20555-0001

cc (w/o att):

M. E. Shannon,
NRC Senior Resident Inspector
Oconee Nuclear Station

Mr. Virgil Autrey
Division of Radioactive Waste Management
Bureau of Land and Waste Management
SC Dept. of Health & Environmental Control
2600 Bull St.
Columbia, SC 29201

ATTACHMENT D

DUKE ENERGY CORPORATION
RELIEF REQUEST 01-08, Supplement 2

REPLACEMENT PAGES FOR
REQUEST FOR ALTERNATE 01-08,
DATED May 13, 2001,
ATTACHMENT E
(NON-PROPRIETARY)

Replace the original pages with the replacement pages listed below:

Attachment	Page Number
E	4
E	5
E	6
E	9

[

]

Justification for Alternate to Welding Solidification Anomaly Acceptance Requirements for New Pressure Boundary Weld

Welding solidification is an inherent problem when using high NiCR alloys in the presence of a notch located at the so-called [ ] IWA-4170 mandates that the repair design meets the original construction code or the adopted Section III code. As noted the 1989 ASME Section III code has been adopted for qualification of the described repairs. Subsection NB-5330(b) stipulates that no lack of fusion area be present in the weld. To account for this problem, a flaw evaluation was performed to justify flaws up to 0.1 inch at the root of the weld. This Framatome-ANP calculation, document number 32-5012625-00, "Flaw Eval. Of Weld Anomaly in CRDM Nozz. [ ] Tempbead Weld Repr." (See Attachment B), evaluated the postulated 0.1 inch flaw based on the 1992 Section XI subsection IWB-3612 acceptance criteria based on applied stress intensity factor, and the IWB-3642 limit load acceptance criteria based on applied stress. The evaluation demonstrates that a 0.1 inch weld anomaly is acceptable for an eight-year design life. A fracture toughness margin of 10.6 was shown compared to the required margin of $10^{1/2}$ per IWB-3612, and a limit load margin of 6.99 was shown compared

to the required margin of 3.0 per IWB-3642. The eight-year design life exceeds the time planned for replacement of the Unit 2 RV closure head.

Justification for Alternate to Flaw Removal and Characterization Requirements for J-groove Partial Penetration Weld

A flaw tolerance evaluation was completed to determine the extent to which an assumed radial crack, [

], would grow into the RV closure head low alloy steel. This Framatome-ANP calculation, document number 32-5012649-00, "CRDM Nozzle J-Groove Weld Flaw." (See Attachment C), used the normal and upset loads applicable to the RV head to determine the stress intensity factor that would drive the crack. The yield strength of the SA-533 Grade B, Class 1 Mn-Mo low alloy steel plate was established as 43.8 ksi at 600 degrees F for this evaluation. The RT_{NDT} was conservatively taken as 60 degrees F and a fracture toughness of 250 ksi-in$^{1/2}$ was used as a conservative upper shelf value for evaluation of loads at temperatures above 500 degrees F. At temperatures below 250 degrees F, the fracture toughness of the material was established in accordance with Appendix A, Article A-4000 of Section XI.

Based on fatigue crack growth calculations for the RV closure head low alloy steel, a postulated radial crack [
] in the J-groove partial penetration weld would be acceptable for 70 heat-up and cool-down cycles. The resultant number of heat-up/cool-down cycles bounds the expected number of such cycles during the period of time until the RV closure head is replaced.

The Quality and Safety Provided by the Proposed Alternative

IWA-4170 mandates that the repair meet the provisions of the original design code of record or an adopted Section III code, subject to regulatory acceptance of the adopted Section III code. An analysis of the new pressure boundary weld indicates that the welds meet the stress and fatigue requirements of Section III. The flaw evaluation, assuming a 0.1 inch flaw

at the root of the weld, has shown an acceptable service life of the new weld, until the new RV closure head can be replaced. Acceptable material fracture toughness margins were shown to exceed the requirements of Section XI IWA-3612 and the limit load margins in IWA-3642. The root of the new weld will be examined in accordance with Section III NB-5330 acceptance criteria. The qualified procedure is capable of detecting flaws at the 0.1 inch postulated size. The alternative, along with the cited analyses and examinations will provide an acceptable level of quality and safety when compared to the referenced code requirements.

The requirements of IWA-4310 allow two options for determining the disposition of discovered cracks. The subject cracks are either removed as part of the repair process or left as-is and evaluated per the rules of IWB-3500. The assumptions of IWB-3500 are that the cracks are fully characterized to be able to compare the calculated crack parameters to the acceptable parameters addressed in IWB-3500.

In the alternative being proposed, the postulated crack extent is calculated based on the two inputs of expected crack orientation and the geometry of the weld. Typically, an expected crack orientation is evaluated based on prevalent stresses at the location of interest. In these welds, operating stresses were obtained using finite element analysis of the RV closure head. Since hoop stresses were calculated to be the dominant stress, it is expected that radial type cracks (with respect to the penetration) will occur. Using worst case (maximum) assumptions with the geometry of the as left weld, the postulated crack was assumed to begin at the intersection of the RV closure head inner diameter surface [ ] and propagate into the RV closure head low alloy steel. Based on this weld geometry and the expected orientation, the crack was assumed in the radial direction [ ]. The depth and orientation are worst case assumptions for cracks that may occur in the remaining J-groove partial penetration weld configuration. [ ]

Implementation Schedule

This Request for Alternate is associated with the ongoing repair of the Unit 2 RV head CRDM nozzles. Entry into Mode 2 operation is currently scheduled for May 26, 2001.

References

3. Framatome-ANP document 32-5012625-00, "Flaw Eval. Of Weld Anomaly in CRDM Nozz. [ ] Tempbead Weld Repr." dated 4/30/01 (See Attachment B)

4. Framatome-ANP document 32-5012649-00, "CRDM Nozzle J-Groove Weld Flaw", dated 4/26/01 (See Attachment C).

Originated By: Timothy D. Brown 6-6-01
Melvin L. Arey, Jr. Date

Reviewed By: [signature] for 6-6-01
Leonard J. Azzarello Date

ATTACHMENT E

DUKE ENERGY CORPORATION
RELIEF REQUEST 01-08, Supplement 2

REPLACEMENT PAGES FOR REQUEST FOR ALTERNATE 01-08, RAI, DATED May 13, 2001, ATTACHMENTS C, D, AND E (NON-PROPRIETARY)

Replace the original pages with the replacement pages listed below.

Attachment	Page Number	Attachment	Page Number
C	1	D	21
C	2	D	23
C	5	D	33
D	Cover Page	D	34
D	1	D	37
D	6	D	38
D	7	E	1
D	8	E	4
D	9	E	8
D	10	E	14
D	19	E	18
D	20	E	20

RESPONSES TO RAI
REGARDING THE USE OF AN ALTERNATIVE TO ASME CODE REQUIREMENTS CRDM NOZZLE WELD REPAIR
OCONEE NUCLEAR STATION, UNIT 2
DUKE ENERGY COMPANY

Questions associated with Framatome ANP Report 32-5012625-00, "Flaw Eval. of Weld Anomaly in CRDM Nozz. [ ] Temperbead Weld Repr."

1. NRC Question:

Page 6: Justify the use of an initial flaw size of 0.1 inch in your flaw evaluation. The justification should be based on past and current UT and destructive examination results.

DEC / Framatome ANP Response:

The initial flaw size of 0.1 inch was chosen based on the ability to detect flaws equal to 0.1 inch with qualified UT procedures, and the results of flaw tolerance evaluations that showed that a weld solidification anomaly of 0.1 inch in the new pressure boundary welds was acceptable for the period of time until the Unit 2 RV head is to be replaced. The Unit 2 RV head is scheduled for replacement during refueling outage 2EOC20 (Spring 2004).

Three full size mockups using coupons from the Midland RV head were repaired using the same welding process as the field repair. These mock-ups were UT inspected and metallographically evaluated (four sections per mockup). Weld solidification anomalies were found in the cross sections as expected, and were less than the analyzed maximum allowed of 0.1 inch. UT also detected these indications and determined them to be less than 0.1 inch. In one of the mockups, the maximum size of the weld solidification anomaly was [ ] inch.

A UT mock-up was used to demonstrate the UT capability to detect indications. The mock-up was a CRDM nozzle and RV head portion that was removed from the Midland RV head. The materials of the Midland RV closure head are similar to the Oconee Unit 2 RV closure head. This mock-up was machined and welded using the same processes that are being used for the repair. The mock-up for the UT demonstration

had notches machined in it at depths of [ ] inch, [ ] inch, and [ ] inch into the weld. These notches were used to verify that flaws in this region could be detected and sized.

The subject UT system is calibrated using the calibration standard to a linear time base. The flaw size is determined by subtracting the depth of the top of the flaw from the depth to the weld material - base material interface. UT tends to be conservative (over predict the flaw size) for small flaw sizes.

All of the calibration holes were detected with each transducer with very good signal to noise ratios. Additionally, the notches in the mock-up could be detected and depth sized using tip diffraction techniques. Based on these results the procedure was qualified to detect flaws less than 0.1 inch in depth. The UT mock-up showed that the UT procedure met all requirements of the ASME Code Section III, 1989 Edition

The UT technique described was qualified and demonstrated to the ANII. Using these techniques, it is industry standard (Section XI (Reference 1)) that UT uncertainty is not added into the results.

2. **NRC Question:**

Page 19: Has the stress intensity factor (SIF) solution of Buchalet and Bamford been approved by the NRC? If not, provide validation by comparing the results relevant to the current application from using the proposed solution and a solution from a different source.

No response required per May 17, 2001 phone call with NRC.

3. **NRC Question:**

Page 20: It is not obvious from Figure 2 that cracking along Path 2 can be represented by the SIF solution of a semi-elliptical surface crack in a flat plate subjected to radial stresses. Please clarify.

DEC / Framatome ANP Response:

The flat plate model can be visualized as a horizontal disk, with a hole at the inside surface of the new weld,

material during the welding process and the subsequent cooldown to ambient temperature, a pre-service hydro test, and operation at steady state conditions. After the steady state loads were removed, and the structure was again at ambient conditions, the [ ] portion of the CRDM nozzle was [ ] the model [ ] the temper bead weld. The remaining stresses are the residual stresses corresponding to an unflawed structure.

Although the residual hoop stress predicted by the model in the weld region is high, up to about [ ] psi, the stress decreases to [ ] at the butter-to-head interface (at the postulated crack tip), and is compressive in the head. These stresses would be relieved as the crack propagates through the weld, and a crack at the butter-to-head interface would experience only compressive stress ahead of the crack.

2. **NRC Question:**

Page 8: You used the ratio between the safety factor of 3.16 from IWB-3612 and the safety factor of 1.25 from Appendix K to justify the use of 250 ksi√in instead of 200 ksi√in in your flaw evaluation. The staff considers it inappropriate because what we are dealing with now is detected flaws, not postulated flaws as in the case for Appendix K. Therefore, the safety factors associated with detected flaws should be used. ASME Code uses about the same safety factors for flaw evaluations based on LEFM, EPFM, and limit load approach. Revise your analysis using 200 ksi√in for all cases in your flaw evaluation.

DEC / Framatome ANP Response:

The subject document was revised to use 200 ksi√in for the fracture toughness and to more accurately reflect the actual repair configuration. Previously, a maximum crack size was postulated in the J-groove weld at the outermost CRDM nozzle penetration in the head (nozzle No. 69). At this location, the depth of the J-groove and the assumed flaw size is [ ] inch. The outermost nozzle that was repaired in Unit 2 is nozzle No. 30. At this location, the penetration angle between the nozzle and head is less than at nozzle No. 69, and the depth of the J-groove and the flaw size assumed for the revised analysis is 1.455 inch.

ATTACHMENT B

DUKE ENERGY CORPORATION
RELIEF REQUEST 01-08, Supplement 2

Framatome-ANP document 32-5012625-00, "Flaw Eval. of Weld Anomaly in CRDM Nozz. [ ] Temperbead Weld Repr.", dated 4/30/01

(PROPRIETARY)

FRAMATOME ANP

CALCULATION SUMMARY SHEET (CSS)

Document Identifier 32 - 5012625 - 00

Title FLAW EVAL. OF WELD ANOMALY IN CRDM NOZZ.[ ]TEMPBEAD WELD REPR.

PREPARED BY:

NAME A.D. NANA

SIGNATURE [signature]

TITLE PRINCIPAL ENGR. DATE 4/30/01

COST CENTER 41026 REF. PAGE(S) 39

REVIEWED BY:

METHOD: ☒ DETAILED CHECK ☒ INDEPENDENT CALCULATION

NAME D.E. KILLIAN

SIGNATURE [signature]

TITLE PRINCIPAL ENGR. DATE 4/30/01

TM STATEMENT: REVIEWER INDEPENDENCE JFS for ADM

PURPOSE AND SUMMARY OF RESULTS:

The purpose of this analysis is to perform a fracture mechanics evaluation of the weld anomaly in the CRDM Nozzle temperbead weld repair design. The postulated anomaly is assumed to be a 0.1 inch semi-circular flaw that is 360 degrees around the circumference at the "triple point" location where there is a confluence of three different materials. The materials are Alloy 600, Alloy 52/152 weld metal and low alloy steel plate material. Two different potential flaw propagation paths are considered in the evaluation. The analysis includes prediction of fatigue crack growth in air environment since the anomaly is embedded near the base of the OD of the[ ]CRDM tube. Flaw acceptance is based on the 1992 ASME Code Section XI criterion for the applied stress intensity factor (IWB-3612) as well as by limit load analysis per the Section XI acceptance criterion based on applied stress (IWB-3642).

The results of the analysis demonstrate that the 0.1 inch weld anomaly is acceptable for an eight year design life of the CRDM ID temper bead weld repair. Significant fracture toughness margins (FTM) have been demonstrated for both of the flaw propagation paths considered in the analysis. The minimum FTM has been shown to be [ ], compared to the required margin of $\sqrt{10}$ per IWB-3612. The fatigue crack growth is minimal. The maximum final flaw size is[ ]inches. The limit load analysis showed a limit load margin of [ ]compared to the required margin of 3.0 per IWB-3642.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

☐ YES ☒ NO

3.0 WELD ANOMALY

The anomaly is located in the triple point region as shown in Figure 1 below.

[ ]

Figure 1. Weld Anomaly in Temper Bead Weld Repair *(Excerpted from Ref. 1).*

The region is called "triple point" since three materials intersect at this point. The materials are:
a) [ ]
b) [ ]
c) [ ]

* Per Reference 7, Specification 5.14, Par. A7.4.3, "Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS Number N06690)." This UNS number is associated with Alloy 690 material.

3.1 Postulated Flaw

The anomaly is assumed to be semi-circular in shape with an initial size of 0.1 inches as noted in the sketch above. These anomalies can be present, at the triple point location, around the

full circumferential extent. They can be oriented such that there are two possible flaw propagation paths that must be considered, as illustrated in Figure 2, and discussed below.

Path 1:

Flaw propagation path 1 runs across the CRDM tube wall thickness from the OD of the tube to the ID of the tube. This is the shortest path through the component wall thickness and is made of the new Alloy 690 material. However, Alloy 600 tube material properties or equivalent will be considered so as to ensure that another potential path through the HAZ between the new repair weld and the Alloy 600 tube material is bounded.

Path 2:

Flaw propagation path 2 runs down the new repair weld near the weld-penetration interface. At this region, the flaw may propagate through the new Alloy 690 material or the low alloy steel RV head material. For both these paths, the most susceptible material to fatigue crack growth will be considered in the evaluation.

4.0 MATERIAL PROPERTIES

The region of interest for the present flaw evaluation is near the triple point location. As stated in Section 3.0, at this location three different materials intersect. [ ]

A typical CRDM nozzle of the B&W 177 FA plant (Ref. 4) is made from Alloy 600 material to ASME specification SB-167 for tubular products (Ref. 5). The new weld material, as noted in Section 3.0, is made of Alloy 690 material. The RV head (closure head center disk) is made of SA-533, Grade B modified (equivalent to Class 1) material per References 5 and 6.

4.1 Yield Strength

Values of yield strength, S_y, are obtained from the 1989 Edition of the ASME Code (Ref. 9), as listed below.

SA-533, Grade B, Class 1 Low Alloy Steel Plate Material (RV Head)

Room temperature	50.0 ksi
Operating temperature of 600 °F	43.8 ksi

SB-163 Material N06690 (used for Alloy 690 Materials or 52/152 Weld Metal)

Room temperature	40.0 ksi
Operating temperature of 600 °F	31.1 ksi

SB-167 Material N06600 (used for Alloy 600 Materials or 82/182 Weld Metal)

Room temperature	35.0 ksi
Operating temperature of 600 °F	27.9 ksi

4.2 Fracture Toughness

4.2.1. For Low Alloy Steel RV Head Material

The fracture toughness curves for SA-533 Grade B class 1 material are illustrated in Figure A-4200-1 of Ref. 3. At an operating temperature of 600 F, the maximum upper shelf fracture toughness value for this material is above 200 ksi√in. However, an upper bound cut-off value of 200 ksi√in as shown in the above referenced figure will be conservatively used in the analysis.

4.2.2. For Alloy 600 and Alloy 690 materials

In Table 7 of Reference 12, Mills provides fracture toughness data for unirradiated Alloy 600

material at 24 °C (75 °F) and 427 °C (800 °F) in the form of crack initiation values for the J-integral, J_c. Using linear interpolation and the LEFM plane strain relationship between J_c and fracture toughness, K_{Jc},

$$K_{Jc} = \sqrt{\frac{J_c E}{1-\nu^2}},$$

the fracture toughness at an operating temperature of 600 °F is derived as follows:

Note: $\nu = 0.3$
$1 \text{ kN/m} = 1 \text{ kN/m} \div 4.448 \text{ N/lb} \times 0.0254 \text{ m/in} = 0.00571 \text{ kip/in}$

Temp. (F)	Mills [12] J_c (kN/m)	J_c (kip/in)	Code [9] E (ksi)	K_{Jc} (ksi√in)
75	382	2.18	31000	273
600	522	2.98	28700	307
800	575	3.28	27600	316

Since brittle fracture is not a credible failure mechanism for ductile materials like Alloy 600 or Alloy 690, these fracture toughness measures, provided for information only, are not considered in the present flaw evaluations. However it should be noted that the fracture toughness measures of these ductile materials is significantly greater than the fracture toughness measure of the low alloy RV head material reported in Section 4.2.1.

4.3 Fatigue Crack Growth

Flaw growth due to fatigue is characterized by

$$\frac{da}{dN} = C_o(\Delta K_I)^n ,$$

where C_o and n are constants that depend on the material and environmental conditions, ΔK_I is the range of applied stress intensity factor in terms of ksi√in, and da/dN is the incremental flaw growth in terms of inches/cycle. For the embedded weld anomaly considered in the present analysis, it is appropriate to use crack growth rates for an air environment. Fatigue crack growth is also dependent on the ratio of the minimum to the maximum stress intensity factor; i.e.,

$$R = (K_I)_{min} / (K_I)_{max}$$

SA-533, Grade B, Class 1 Low Alloy Steel Plate Material (RV Head)

From Article A-4300 of Section XI (Ref. 3), the fatigue crack growth constants for subsurface flaws in an air environment are:

$$n = 3.07$$

$$C_o = 1.99 \times 10^{-10}\, S$$

where $S = 25.72\,(2.88 - R)^{-3.07}$ and $0 \le R < 1$.

Alloy 600, Alloy 690 or 52/152 Weld Metal

Fatigue crack growth rates for austenitic stainless steels are used to conservatively predict flaw growth in the new Alloy 52/152 repair weld. Using crack growth rates from Article C-3210 of Section XI (Ref. 3) for austenitic stainless steels in an air environment,

$$n = 3.3$$

$$C_o = C \times S$$

where $C = 10^{[-10.009 + 8.12E\text{-}4 \times T - 1.13E\text{-}6 \times T^2 + 1.02E\text{-}9 \times T^3]}$

$S = 1.0$ for $R \le 0$

$= 1.0 + 1.8R$ for $0 < R \le 0.79$

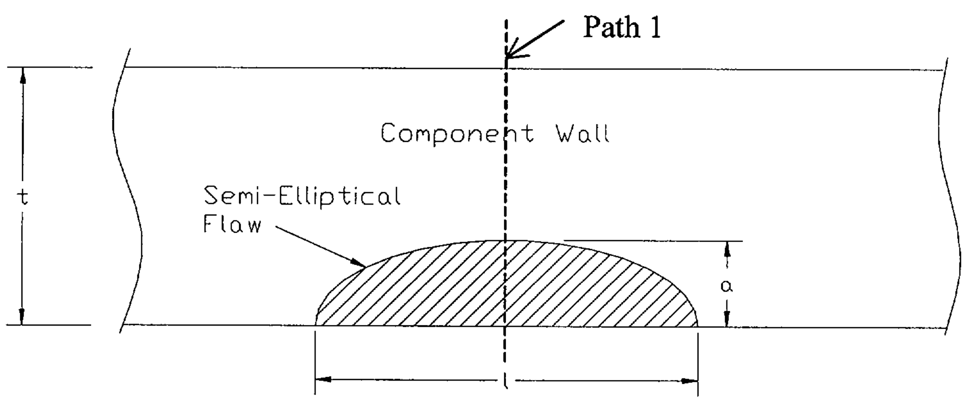
$= -43.35 + 57.97R$ for $0.79 < R < 1.0$

6.0 FRACTURE MECHANICS METHODOLOGY

This section presents several aspects of linear elastic fracture mechanics (LEFM) and limit load analysis (to address the ductile Alloy 600 and Alloy 690 materials) that form the basis of the present flaw evaluations. As discussed in Section 3.1, the flaw evaluations are performed for flaw propagation paths 1 and 2.

Path 1 represents a section across the new Alloy 52 weld metal which is equivalent to the thickness of the CRDM tube wall. Since the weld anomaly is located at the base of the OD of the CRDM tube and is assumed to be all the way around the circumference, a stress intensity factor (SIF) solution for a 360 degree circumferential crack on the OD of a circular tube is deemed appropriate. Therefore, the SIF solution of Buchalet and Bamford (Reference 13) is used in the analysis. However, this solution is applicable for a 360-degree part-through ID flaw. To develop an SIF solution for a 360 degree part-through OD flaw, an F function is determined based on SIF solutions of Kumar (References 14 and 15). The appropriate F function for an internal as well as an external circumferential flaw in a cylinder subjected to remote tension are determined first. The ratio of the F functions of the external flaw to the internal flaw is considered to be the appropriate multiplication factor for the Buchalet and Bamford SIF solution, to extend its application to an external crack. The materials to be considered for this path are the Alloy 600 tube material or the Alloy 52 weld metal. The fatigue crack growth rate properties for austenitic stainless steel as given in Appendix C of Reference 3 will be conservatively used in the analysis. A limit load analysis for an external circumferential flaw in a cylinder subjected to remote tension per Reference 15 is also performed to demonstrate the margins against the applied loads on the CRDM tube.

An axially oriented semi-circular OD surface flaw is also considered in the evaluation, as illustrated by the schematic below.



where, a = initial flaw depth = 0.1 inch

$l = 2c$ = flaw length = [ ] inch

t = wall thickness = [ ] inches

An axial flaw is considered since the stresses in the CRDM penetration region are primarily due to pressure and therefore the hoop stresses are more significant. The SIF solution by Raju &

Newman (Reference 17) for an external surface crack in a cylindrical vessel is used in the evaluation. The fatigue flaw growth analysis for the axial crack is also performed using the austenitic stainless steel properties.

Path 2 represents the interface section between the new repair weld and the RV head material. The potential for tearing at this interface section is likely if the radial stresses are significant along this section. For this assessment, an SIF solution of a semi-elliptical surface crack in a flat plate (Reference 11, Table 12.23) subjected to radial stresses will be used. A crack growth analysis will subsequently be performed considering propagation through the Alloy 52 weld metal or the low alloy carbon steel material.

Irwin plasticity correction is also considered in the SIF solutions discussed above. The plastic zone correction is discussed in detail in Section 2.8.1 of Reference 11. The effective crack length is defined as the sum of the actual crack size and a plastic zone correction:

$$a_e = a + r_y$$

where r_y for plane strain condition (applicable for this analysis) is given by:

$$r_y = \frac{1}{6\pi}\left(\frac{K_I}{\sigma_{YS}}\right)^2$$

7.0 ANALYTICAL CONSIDERATIONS

For low alloy steel materials such as the RV head material, the evaluation will be performed to the IWB-3612 acceptance criteria of Section XI of the Code (Reference 3). The following considerations are made to address the flaw acceptance criteria for highly ductile materials such as Alloy 600 and Alloy 690 or Alloy 52 weld metal materials. The assumed initial flaw size to thickness ratio in this analysis is 20% or less. Fatigue crack growth under normal operating loads is minimal for Alloy 600 or Alloy 690 materials in an air environment. The only acceptance criterion on flaw size is the industry developed 75% through-wall limit on depth (Reference 8):

$$\frac{a}{t} \leq 0.75$$

For shallow cracks considered in the present analysis, this criterion is easily met. Another acceptance criteria for ductile materials is demonstration of sufficient limit load margin. The required safety margin, based on load, per IWB-3642 of Reference 3 is a factor of 3 for normal operating (including upset and test) conditions and a factor of 1.5 for emergency and faulted conditions.

In addition, the applied SIF are determined and compared against the equivalent fracture toughness measure (K_{Jc}), to demonstrate sufficient safety margin. As noted in the assumption section, considering fatigue crack growth, the final flaw size of the anomaly is not to exceed [ ] inches.

Table 3. FCG Evaluation of Continuous External Circumferential Flaw along Path 1

INPUT DATA

Pipe Geometry:	Outside diameter,	Do =	[ ]	in.
	Inside diameter,	Di =	[ ]	in.
	Mean radius,	R =	[ ]	in.
	Thickness,	t =	[ ]	in.
		Ri/t =	[ ]	
Flaw Size:	Flaw depth,	a =	0.1000	in.
		a/t =	[ ]	
Material Strength:	Yield strength,	y.s. =	27.9000	ksi

Table 6. FCG Evaluation of Semi-Elliptical Surface Crack along Path 2

INPUT DATA

Crack Geometry:	Thickness of section,	t =	[ ]	in.
	Half Width of section,	W =	[ ]	in.
	OD of CRDM,	Do =	[ ]	in.
Flaw Size:	Flaw depth,	a =	0.1000	in.
		a/t =	[ ]	
Environment:	Temperature,	T =	600	F
Material Strength:	Yield Strength,	y.s. =	27.9	ksi

Table 6 (cont'd). FCG Evaluation of Semi-Elliptical Surface Crack along Path 2

STRESS INTENSITY FACTOR FOR SEMI-ELLIPTICAL SURFACE CRACK

Basis: Anderson T.L., "Fracture Mechanics: Fundamentals and Applications, Table 12.23
Semi-elliptical surface crack in a flat plate

$KI = \sqrt{(\pi a/Q)} * (G_0 A_0 + G_1 A_1 a + G_2 A_2 a^2 + G_3 A_3 a^3) f_w$

where, per Table 12.23,
a/c = 1.0, a/t <=0.2, and $2\phi/\pi = 1$

Go = 1.021
G_1 = 0.717
G_2 = 0.589
G_3 = 0.513
and **Q =** 2.464 (1 + 1.464*(a/c)^1.65)
c = a = 0.1 in.
f_w = [ ] = [sec((π*c)/(2*W)*sqrt(a/t))]^0.5

and the through-wall stress distribution is described by the third order polynomial,

$S(x) = A_0 + A_1x + A_2x^2 + A_3x^3$.

Applicablility: Ri/t = 10
a/t ≤ 0.8

Through-Wall Stresses for Crack Growth:

Wall Position x (in.)	Normal/Upset Loading Conditions NU1 (ksi)	NU2 (ksi)
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]

Note: x is measured from the flawed surface.

Stress Coefficients:

Stress Coeff.	Normal/Upset Loading Conditions NU1 (ksi)	NU2 (ksi)
A_0	[ ]	[ ]
A_1	[ ]	[ ]
A_2	[ ]	[ ]
A_3	[ ]	[ ]

9.0 SUMMARY OF RESULTS

9.1 Flaw Propagation Path 1

a) FCG analysis of continuous external circumferential flaw

Maximum axial uphill stresses are considered in analysis
Initial flaw size, a_i = 0.1 inches
Final flaw size, a_f = [ ] inches < [ ] inches
Stress Intensity Factor at final flaw size, $K_I(a_{ef})$ = [ ] ksi√in
Fracture Toughness at [ ] F (Reactor Trip) > 200 ksi√in
as demonstrated by K_{Jc} calculations in Section 4.2 for ductile materials
Conservatively use K_{Ia} = 200 ksi√in
Fracture Toughness Margin, K_I / K_{Ia} = [ ] > √10

b) Limit load analysis for continuous external circumferential flaw

Maximum emergency and faulted condition applied load on CRDM tube,
P(appl) = [ ] lbs
Limit load, P_O = [ ] lbs
Limit Load Margin, P_O / P(appl) = [ ]

c) FCG analysis of external axial flaw

Conservatively used maximum hoop membrane stress of 46 ksi in analysis
Initial flaw size, a_i = 0.1 inches
Final flaw size, a_f = [ ] inches < [ ] inches
Stress Intensity Factor at final flaw size, $K_I(a_{ef})$ = [ ] ksi√in
Fracture Toughness, conservatively use K_{Ia} = 200 ksi√in
Fracture Toughness Margin, K_I / K_{Ia} = [ ] > √10

9.2 Flaw Propagation Path 2

FCG analysis of semi-elliptical surface crack

Maximum radial stresses at uphill location are considered in analysis
Initial flaw size, a_i = 0.1 inches
Final flaw size, a_f = [ ] inches < [ ] inches
Stress Intensity Factor at final flaw size, $K_I(a_{ef})$ = [ ] ksi√in
Fracture Toughness at [ ] F (Reactor Trip) = 200 ksi√in (for low alloy steel)
Fracture Toughness Margin, K_I / K_{Ia} = [ ] > √10

10.0 CONCLUSION

The results of the analysis demonstrate that the 0.10 inch weld anomaly is acceptable for an eight year design life of the CRDM [ ] temper bead weld repair. Significant fracture toughness margins (FTM) have been demonstrated for both of the flaw propagation paths considered in the analysis. The minimum FTM for flaw propagation paths 1 and 2 have been shown to be [ ] and [ ], respectively, compared to the required margin of $\sqrt{10}$ per Section XI, IWB-3612 (Ref. 3). The fatigue crack growth is minimal. The maximum final flaw size is [ ] inches (considering both of the flaw propagation paths). In addition, a limit load analysis was performed considering the ductile Alloy 600/Alloy 690 materials along flaw propagation path 1. The analysis showed a limit load margin of [ ] compared to the required margin of 3.0 per Section XI, IWB-3642 of Reference 3.

FRAMATOME ANP

CALCULATION SUMMARY SHEET (CSS)

Document Identifier 32 - 5012649 - 00

Title CRDM NOZZLE J-GROOVE WELD FLAW

PREPARED BY:				REVIEWED BY:			
NAME	D.E. KILLIAN			NAME	K.K. YOON		
SIGNATURE	[signature]			SIGNATURE	[signature]		
TITLE	PRIN. ENGR.	DATE	4/26/01	TITLE	TECH. CONSULT.	DATE	4/26/01
COST CENTER	41026	REF. PAGE(S)	21	TM STATEMENT: REVIEWER INDEPENDENCE	DRC for ADM		

PURPOSE AND SUMMARY OF RESULTS:

The purpose of the present analysis is to determine from a fracture mechanics viewpoint the suitability of leaving degraded J-groove weld material in the vessel following the repair of a CRDM nozzle by the [ ] temper bead weld option. It is postulated that a small flaw in the head would combine with a large stress corrosion crack in the weld to form a radial corner flaw that would propagate into the low alloy steel head by fatigue crack growth under cyclic loading conditions associated with heatup and cooldown.

Based on an evaluation of fatigue crack growth into the low alloy steel head, a postulated [ ] radial crack in the Alloy 182 J-groove weld would be acceptable from a fracture mechanics viewpoint for 70 heatup and cooldown cycles.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

☐ YES ☒ NO

1.0 Introduction

Following the discovery of leaking Alloy 600 control rod drive mechanism (CRDM) nozzles at ONS-1 (December 2000), ONS-3 (February 2001), and ANO-1 (March 2001), [ ] temper bead weld repair option has been proposed that includes [ ] welding the remaining portion to the low alloy steel reactor vessel head above the original Alloy 182 J-groove attachment weld, as shown in Figure 1. This repair procedure is more fully described by the design drawing [1] and the technical requirements document [2]. Except for a small ($^{1}/_{8}$" - $^{1}/_{4}$") [ ], the original J-groove weld will [ ]. Since it has been determined that cracking in the J-groove weld will most likely accompany a leaking CRDM nozzle, it must be assumed that the "as-left" condition of the remaining J-groove weld includes degraded or cracked weld material. The extent of this cracking has varied from minimal, at ANO-1 where a 0.200" axial crack extended along the outside surface of the nozzle adjacent to the weld, to significant, at ONS-1 where a radial crack extended virtually through the entire J-groove weld and Alloy 182 butter material. The purpose of the present analysis is to determine from a fracture mechanics viewpoint the suitability of leaving degraded J-groove weld material in the vessel following the repair of a CRDM nozzle by the [ ] temper bead weld procedure.

Since the hoop stresses in the J-grove weld are generally about two times the axial stress at the same location [3], the preferential direction for cracking would be axial, or radial relative to the nozzle. It is postulated that a radial crack in the Alloy 182 weld metal would propagate by primary water stress corrosion cracking, through the weld and butter, to the interface with the low alloy steel head. It is fully expected that such a crack would then blunt and arrest at the butter-to-head interface [4]. On the uphill side of the nozzle, where the hoop stresses are highest [3] and the area of the J-groove weld is the largest [1], a radial crack depth extending from the corner of the weld to the low alloy steel head would be very deep, about [ ]". Ductile crack growth through the Alloy 182 material would tend to relieve the residual stresses in the weld as the crack grew to its final size and blunted. Although residual stresses in the head material are low [3], it is assumed that a small flaw could initiate in the low alloy steel material and grow by fatigue. For the present analysis of the remaining J-groove weld, it is postulated that a small flaw in the head would combine with the stress corrosion crack in the weld to form a large radial corner flaw that would propagate into the low alloy steel head by fatigue crack growth under cyclic loading conditions associated with heatup and cooldown.

3.0 Material Properties

The material used for the center portion of the reactor vessel head (closure head center disc) is a modified SA-533, Grade B, Class 1 Mn-Mo low alloy steel plate [5, 7].

Yield Strength

From the ASME Code, Section III, Appendix I [8], the minimum yield strength for the head material is 43.8 ksi at 600 °F. This is used as a conservative lower bound for yield strengths at operating temperatures less than 600 °F.

Reference Nil-Ductility Temperature

The RT_{NDT} of the SA-533, Grade B low alloy reactor vessel head material is conservatively taken as 60 °F [9].

Fracture Toughness

The lower bound K_{Ia} curve of Section XI, Appendix A, Figure A-4200-1 [10], which can be expressed as

$$K_{Ia} = 26.8 + 1.233 \exp\left[0.0145\,(T - RT_{NDT} + 160)\right], \qquad [11]$$

represents the fracture toughness for crack arrest, where T is the crack tip temperature and RT_{NDT} is the reference nil-ductility temperature of the material. K_{Ia} is in ksi$\sqrt{\text{in}}$, and T and RT_{NDT} are in °F. Use of the crack arrest K_{Ia} curve has implications regarding how residual stresses are treated in the analysis. The [ ] corner crack postulated for the present analysis is about ¼ of the thickness of the reactor vessel head (from Reference 12, the thickness of the head is [ ]). Residual stresses would be relieved by such a deep crack, and therefore need not be considered, especially when using the crack arrest fracture toughness. Residual stresses would need to be considered only if the higher K_{Ic} crack initiation fracture toughness were used to evaluate the applied stress intensity factor (although not permitted by Article IWB-3612 [10] for normal and upset conditions).

No upper-shelf fracture toughness is defined in Appendix A to Section XI. Indeed, the temperature range on the K_{Ia} fracture toughness curve of Figure A-4200-1 indicates that the available fracture toughness need only be assured for temperatures below T - RT_{NDT} of about 180 °F, or temperatures less than about 240 °F for the reactor vessel head material. At this temperature, K_{Ia} is 200 ksi$\sqrt{\text{in}}$, which is often used as an implicit value for upper-shelf fracture toughness. Appendix K [10] contains explicit guidelines for evaluating the reactor vessel for temperatures in the upper-shelf range ($T \gg 240$ °F). The Appendix K evaluation procedure specifies a safety factor of 1.25, well below the value of 3.16 required by Article IWB-3612. It therefore seems reasonable to use a fracture toughness higher than 200 ksi$\sqrt{\text{in}}$ for temperatures in the upper-shelf range. Although an equivalent fracture toughness of 3.16/1.25 times 200 ksi$\sqrt{\text{in}}$ might be considered, 250 ksi$\sqrt{\text{in}}$ will be conservatively used as the upper-shelf fracture toughness at the higher temperatures considered in the present analysis ($T > 500$ °F).

Table 2. Evaluation of CRDM Nozzle Corner Crack for Controlling Reactor Trip Condition

INPUT DATA

Initial Flaw Size:	Depth,	a =	[ ]	in.
Material Data:	Yield strength,	S_y =	43.8	ksi
Fracture Toughness:	Temperature,	T =	[ ]	F
	Reference temp.,	RTndt =	60	F
	Upper shelf tough.	=	250	ksi√in

Kla = 26.8 + 1.233 exp [0.0145 (T - RTndt + 160)]

Kla is limited to the upper shelf toughness.

Arrest toughness, Kla = 250 ksi√in

Applied Loads:

	Loading Conditions	
	RT2*	SD**
Radial Position x	Pressure, p (ksi)	
	[ ]	[ ]
	Hoop Stress	
(in.)	(ksi)	(ksi)
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]

* Reactor Trip at 10.125 hours
** Shutdown

Table 3. Evaluation of CRDM Nozzle Corner Crack for Various Conditions at Final Flaw Size

INPUT DATA

Final Flaw Size: Depth, a = [ ] in.

Material Data: Yield strength, S_y = 43.8 ksi

Fracture Toughness:

		Loading Condition RT1*	Loading Condition CD**	
Temperature,	T =	[ ]	[ ]	F
Reference temp.,	RTndt =	60	60	F
Upper shelf tough.	=	250	200	ksi√in

Kla = 26.8 + 1.233 exp [0.0145 (T - RTndt + 160)]

Kla is limited to the upper shelf toughness.

		RT1*	CD**	
Arrest toughness,	Kla =	250	200	ksi√in

Applied Loads:

Radial Position x	Loading Conditions RT1*	Loading Conditions CD**
	Pressure, p (ksi)	
	[ ]	[ ]
	Hoop Stress	
(in.)	(ksi)	(ksi)
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]

* Reactor Trip at 10.003 hours
** Cooldown at 12.939 hours

7.0 Summary of Results

A fracture mechanics analysis has been performed to evaluate a postulated large radial crack in the J-groove weld (and butter) used to attach the CRDM nozzle to the reactor vessel head. Results of this analysis are summarized below.

Reactor Trip at 10.125 Hours

Temperature,	T = [ ] °F
Initial flaw size,	a_i = [ ] in.
Final flaw size,	a_f = [ ] in.
Stress intensity factor at final flaw size,	K_I = [ ] ksi$\sqrt{in}$
Fracture toughness at [ ] °F,	K_{Ia} = 250.0 ksi$\sqrt{in}$
Safety margin:	KI / K_{Ia} = [ ] > $\sqrt{10}$

Reactor Trip at 10.003 Hours

Temperature,	T = [ ] °F
Final flaw size,	a_f = [ ] in.
Stress intensity factor at final flaw size,	K_I = [ ] ksi$\sqrt{in}$
Fracture toughness at [ ] °F,	K_{Ia} = 250.0 ksi$\sqrt{in}$
Safety margin:	KI / K_{Ia} = [ ] > $\sqrt{10}$

Cooldown at 12.939 Hours (Initiation of Decay Heat)

Temperature,	T = [ ] °F
Final flaw size,	a_f = [ ] in.
Stress intensity factor at final flaw size,	K_I = [ ] ksi$\sqrt{in}$
Fracture toughness at [ ] °F,	K_{Ia} = 200.0 ksi$\sqrt{in}$
Safety margin:	KI / K_{Ia} = [ ] > $\sqrt{10}$

Conclusion

Based on an evaluation of fatigue crack growth into the low alloy steel head, the above results demonstrate that a postulated radial crack in the Alloy 182 J-groove weld would be acceptable from a fracture mechanics viewpoint for 70 heatup and cooldown cycles.

ATTACHMENT C

DUKE ENERGY CORPORATION
RELIEF REQUEST 01-08, Supplement 2

AFFIDAVIT OF

R. W. Ganthner

AFFIDAVIT OF RAYMOND W. GANTHNER

A. My name is Raymond W. Ganthner. I am Vice-President of Engineering & Licensing for Framatome ANP, Inc. (FRA-ANP), and as such, I am authorized to execute this Affidavit.

B. I am familiar with the criteria applied by FRA-ANP to determine whether certain information of FRA-ANP is proprietary and I am familiar with the procedures established within FRA-ANP to ensure the proper application of these criteria.

C. In determining whether an FRA-ANP document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by me to assure that the regulatory requirements of 10 CFR Section 2.790 are met.

D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:

(i) The information has been held in confidence by FRA-ANP. Copies of the document are clearly identified as proprietary. In addition, whenever FRA-ANP transmits the information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the substance of the following provision is included in all agreements entered into by FRA-ANP, and an equivalent version of the proprietary provision is included in all of FRA-ANP's proposals:

"Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.

Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser shall prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

(ii) The following criteria are customarily applied by FRA-ANP in a rational decision process to determine whether the information should be classified as proprietary. Information may be classified as proprietary if one or more of the following criteria are met:

a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of FRA-ANP, its customers or suppliers.

b. The information reveals data or material concerning FRA-ANP research or development plans or programs of present or potential competitive advantage to FRA-ANP.

c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to FRA-ANP.

e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to FRA-ANP.

f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is attached hereto and made a part hereof, has been evaluated in accordance with normal FRA-ANP procedures with respect to classification and has been found to contain information which falls within one or more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

(iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.

(iv) The information is not available in the open literature and to the best of our knowledge is not known by General Electric, Westinghouse-CE, or other current or potential domestic or foreign competitors of FRA-ANP.

(v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of FRA-ANP, taking into account the value of the information to FRA-ANP; the amount of effort or money expended by FRA-ANP developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".

E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by FRA-ANP because it contains information which falls within one or more of the criteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by FRA-ANP. This report

AFFIDAVIT OF RAYMOND W. GANTHNER (Cont'd.)

comprises information utilized by FRA-ANP in its business which affords FRA-ANP an opportunity to obtain a competitive advantage over those who may wish to know or use the information contained in the document(s).

RWGanthner

RAYMOND W. GANTHNER

State of Virginia)
) SS. Lynchburg
City of Lynchburg)

Raymond W. Ganthner, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

RWGanthner

RAYMOND W. GANTHNER

Subscribed and sworn before me
this 1st day of June 2001.

Brenda C. Maddox
Notary Public in and for the City
of Lynchburg, State of Virginia.
I was commissioned a Notary
public as Brenda C. Cardona.
My Commission Expires July 31, 2003

Exhibits A & B

Exhibit A

Request for Alternate No. 01-08 Supplement 2, Duke Energy Corporation Oconee Nuclear Station, Unit 2

Exhibit B

The above listed document contains information, which is considered Proprietary in accordance with Criteria b,c,d,e and f of the affidavit.