George Vanderheyden
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Constellation Energy

March 8, 2005

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 2; Docket No. 50-318
Supplemental Data for Request for Relaxation from Interim Inspection Requirements for Reactor Pressure Vessel Head

REFERENCES:

(a) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated January 14, 2005, Request for Relaxation from NRC Revised Order EA-03-009, "Issuance of First Revised NRC Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

(b) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated March 4, 2005, Request for Relaxation from NRC Revised Order EA-03-009, "Issuance of First Revised NRC Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

(c) Letter from Mr. R. William Borchardt (NRC) to Holders of Licenses for Operating Pressurized Water Reactors, dated February 20, 2004, "Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

By letters dated January 14, 2005 and March 4, 2005, (References a and b), Calvert Cliffs Nuclear Power Plant, Inc. submitted a request for relaxation from the inspection requirements of Section IV.C(5)(b)(i) of the First Revised Order EA-03-009 (Reference c). Calvert Cliffs Nuclear Power Plant completed the inspections required by Reference (c) on March 6, 2005. This letter supplements our relaxation request by providing the final results of our ultrasonic testing examination. This letter also replaces the relaxation request of Reference (b) in its entirety with Attachment (4), and affirms our desire for the staff to continue reviewing the relaxation request of Reference (a), in accordance with Section IV(F)(2) of the First Revised Order EA-03-009 (Reference c).

The final reactor pressure vessel head control element drive mechanism penetrations' ultrasonic testing examination results, including specific nozzles for which relaxation is requested, are contained in

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Attachment (1). The stress levels for nozzles that did not receive the expected examination coverage are contained in Attachment (2). The disposition of specific Ultrasonic Test (UT) indications which required further evaluation are contained in Attachment (3).

Please note that this is the last high susceptibility inspection of this reactor vessel head. We continue to plan for reactor vessel head replacement on this Unit in 2007.

Calvert Cliffs Nuclear Power Plant, Inc. requests approval of this relaxation request as soon as reasonably achievable. Calvert Cliffs Unit 2 is currently scheduled to start plant heat-up March 12, 2005.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

GV/MJY/bjd

Attachments:
(1) Calvert Cliffs Unit 2 (Spring 2005) Extent of UT Coverage in RPVH Nozzle Material
(2) Calvert Cliffs Unit 2 (Spring 2005) RV Head Inspection Above the Weld Stress Levels for CEDM Nozzles Without Complete Coverage
(3) Calvert Cliffs Unit 2 (Spring 2005) RV Head Inspection: Disposition of Specific Nozzles Requiring Further Evaluation
(4) Revised Supplemental Request for Relaxation of Order

cc: C. W. Fleming, Esquire
R. V. Guzman, NRC
S. J. Collins, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

CALVERT CLIFFS UNIT 2 (SPRING 2005)

EXTENT OF UT COVERAGE IN RPVH NOZZLE MATERIAL

Calvert Cliffs Nuclear Power Plant, Inc.
March 8, 2005

ATTACHMENT (1)

Calvert Cliffs Unit 2 (Spring 2005) Extent of UT Coverage in RPVH Nozzle Material							
Pen #	Nozzle Angle	Coverage Above Weld Root on Uphill (in)	Coverage Below Weld Toe on the Downhill Side (in)*	Circumferential Coverage Achieved (Degrees)	Scan Type (Blade Probe / Rotating) Axial Blade: A Circ Blade: C	Examined to End of Nozzle	Leak Path Assessment Possible? (Yes / No)
CEDM 1	0.0	1.70	1.00	360	C	No	Yes
CEDM 2	11.1	>2	0.51	360	C	No	Yes
CEDM 3	11.1	1.91	N/A	360	A/C	Yes	Yes
CEDM 4	11.1	1.50	0.65	360	C	No	Yes
CEDM 5	11.1	>2	0.85	360	C	No	Yes
CEDM 6	12.0	>2	0.70	360	C	No	Yes
CEDM 7	12.0	1.71	0.75	360	C	No	Yes
CEDM 8	12.0	1.20	0.85	360	C	No	Yes
CEDM 9	12.0	>2	0.80	360	C	No	Yes
CEDM 10	22.6	1.92	0.45	360	C	No	Yes
CEDM 11	22.6	1.90	0.60	360	C	No	Yes
CEDM 12	22.6	>2	0.40	360	C	No	Yes
CEDM 13	22.6	>2	0.80	360	C	No	Yes
CEDM 14	24.1	>2	N/A	360	A	Yes	Yes
CEDM 15	24.1	1.90	0.50	360	C	No	Yes
CEDM 16	24.1	>2	0.40	360	C	No	Yes
CEDM 17	24.1	>2	0.45	360	C	No	Yes
CEDM 18	25.5	1.61	N/A	360	A	Yes	Yes
CEDM 19	25.5	1.50	0.70	360	C	No	Yes
CEDM 20	25.5	1.61	0.50	360	C	No	Yes
CEDM 21	25.5	1.80	0.60	360	C	No	Yes
CEDM 22	25.5	1.55	0.40	360	C	No	Yes
CEDM 23	25.5	1.61	0.40	360	C	No	Yes
CEDM 24	25.5	>2	0.40	360	C	No	Yes
CEDM 25	25.5	>2	0.74	360	C	No	Yes
CEDM 26	29.3	1.81	N/A	360	A	Yes	Yes
CEDM 27	29.3	1.75	0.60	360	C	No	Yes
CEDM 28	29.3	>2	0.40	360	C	No	Yes
CEDM 29	29.3	1.80	0.75	360	C	No	Yes
CEDM 30	29.3	>2	0.45	360	C	No	Yes
CEDM 31	29.3	>2	0.35	360	C	No	Yes
CEDM 32	29.3	1.84	0.50	360	C	No	Yes
CEDM 33	29.3	>2	0.75	360	C	No	Yes
CEDM 34	34.9	1.66	0.80	360	C	No	Yes
CEDM 35	34.9	1.48	0.40	360	C	No	Yes
CEDM 36	34.9	1.61	0.85	360	A/C	No	Yes
CEDM 37	34.9	1.79	0.85	360	C	No	Yes
CEDM 38	38.5	1.63	N/A	360	A	Yes	Yes
CEDM 39	38.5	1.30	0.45	360	C	No	Yes
CEDM 40	38.5	1.30	0.40	360	C	No	Yes
CEDM 41	38.5	1.55	0.50	360	C	No	Yes
CEDM 42	38.5	1.75	0.45	360	C	No	Yes
CEDM 43	38.5	1.77	0.70	360	C	No	Yes
CEDM 44	38.5	1.27	0.65	360	C	No	Yes
CEDM 45	38.5	1.40	0.80	360	C	No	Yes

Calvert Cliffs Unit 2 (Spring 2005) Extent of UT Coverage in RPVH Nozzle Material							
Pen #	Nozzle Angle	Coverage Above Weld Root on Uphill (in)	Coverage Below Weld Toe on the Downhill Side (in)*	Circumferential Coverage Achieved (Degrees)	Scan Type (Blade Probe / Rotating) Axial Blade: A Circ Blade: C	Examined to End of Nozzle	Leak Path Assessment Possible? (Yes / No)
CEDM 46	41.8	1.56	N/A	360	A	Yes	Yes
CEDM 47	41.8	1.21	0.40	360	C	No	Yes
CEDM 48	41.8	1.50	0.45	360	C	No	Yes
CEDM 49	41.8	1.44	0.64	360	C	No	Yes
CEDM 50	41.8	1.58	0.60	360	C	No	Yes
CEDM 51	41.8	1.30	0.51	360	C	No	Yes
CEDM 52	41.8	1.60	0.63	360	C	No	Yes
CEDM 53	41.8	1.47	0.60	360	C	No	Yes
CEDM 54	42.5	1.60	0.55	360	C	No	Yes
CEDM 55	42.5	1.67	0.45	360	A/C	No	Yes
CEDM 56	42.5	1.75	0.90	360	C	No	Yes
CEDM 57	42.5	1.60	0.40	360	C	No	Yes
CEDM 58	42.5	1.55	0.55	360	C	No	Yes
CEDM 59	42.5	1.47	0.65	360	C	No	Yes
CEDM 60	42.5	1.25	1.51	360	A	No	Yes
CEDM 61	42.5	1.60	0.50	360	C	No	Yes
CEDM 62	42.5	1.66	0.50	360	C	No	Yes
CEDM 63	42.5	1.36	0.50	360	C	No	Yes
CEDM 64	42.5	1.35	0.50	360	C	No	Yes
CEDM 65	42.5	1.37	0.50	360	C	No	Yes
ICI 66	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 67	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 68	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 69	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 70	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 71	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 72	54.8	>2	N/A	360	Rotating	Yes	Yes
ICI 73	54.8	>2	N/A	360	Rotating	Yes	Yes
Vent-Line	0-11	>2	N/A	360	Rotating/ECT	Yes	N/A

*N/A indicates we made it to the end of the nozzle

ATTACHMENT (2)

CALVERT CLIFFS UNIT 2 (SPRING 2005)

RV HEAD INSPECTION ABOVE THE WELD STRESS LEVELS

FOR CEDM NOZZLES WITHOUT COMPLETE COVERAGE

Calvert Cliffs Nuclear Power Plant, Inc.
March 8, 2005

ATTACHMENT (2)

CALVERT CLIFFS UNIT 2 (SPRING 2005)
RV HEAD INSPECTION ABOVE THE WELD STRESS LEVELS FOR CEDM NOZZLES WITHOUT COMPLETE COVERAGE

CEDM Number	Nozzle Angle	Minimum Axial Distance Achieved Above Uphill Weld Root (inches)	Stress Level Above the Uphill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)	Minimum Axial Distance Achieved Above Downhill Weld Root for Nozzles with Coverage <2" Above Uphill Weld Root (inches)	Stress Level Above the Downhill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)
1	0.0	1.7	ID: 2.4 OD: -3.6	1.7	ID: 2.4 OD: -3.6
3	11.1	1.91	ID: 2.2 OD: -1.9	2.72	ID: 4.7 OD: 2.4
4	11.1	1.5	ID: 3.8 OD: -5.0	2.31	ID: 2.8 OD: 0.5
7	12.0	1.71	ID: 2.7 OD: -4.3	2.52	ID: 3.8 OD: 2.0
8	12.0	1.2	ID: 5.4 OD: -3.2	2.01	ID: 4.1 OD: -1.4
10	22.6	1.92	ID: 6.0 OD: -3.0	4.27	ID: 10.1 OD: 3.5
11	22.6	1.90	ID: 5.9 OD: -3.3	4.25	ID: 10.1 OD: 3.6
15	24.1	1.90	ID: 5.9 OD: -3.3	4.25	ID: 10.1 OD: 3.6
18	25.5	1.61	ID: 6.2 OD: -6.7	3.96	ID: 9.9 OD: 3.2
19	25.5	1.50	ID: 6.9 OD: -6.6	3.85	ID: 9.7 OD: 2.7
20	25.5	1.61	ID: 6.2 OD: -6.7	3.96	ID: 9.9 OD: 3.2
21	25.5	1.80	ID: 5.5 OD: -4.5	4.15	ID: 10.0 OD: 3.6
22	25.5	1.55	ID: 6.6 OD: -6.6	3.9	ID: 9.8 OD: 2.9
23	25.5	1.61	ID: 6.2 OD: -6.7	3.96	ID: 9.9 OD: 3.2
26	29.3	1.81	ID: 5.5 OD: -4.4	4.16	ID: 10.0 OD: 3.6
27	29.3	1.75	ID: 5.3 OD: -5.1	4.1	ID: 9.9 OD: 3.7
29	29.3	1.80	ID: 5.5 OD: -4.5	4.15	ID: 10.0 OD: 3.6
32	29.3	1.84	ID: 5.7 OD: -4.0	4.19	ID: 10.0 OD: 3.6
34	34.9	1.66	ID: 5.9 OD: -6.2	4.01	ID: 9.9 OD: 3.4
35	34.9	1.48	ID: 7.0 OD: -6.5	3.83	ID: 9.6 OD: 2.7
36	34.9	1.61	ID: 6.2 OD: -6.7	3.96	ID: 9.9 OD: 3.2
37	34.9	1.79	ID: 5.5 OD: -4.6	4.14	ID: 10.0 OD: 3.6

ATTACHMENT (2)

CALVERT CLIFFS UNIT 2 (SPRING 2005)
RV HEAD INSPECTION ABOVE THE WELD STRESS LEVELS FOR CEDM NOZZLES WITHOUT COMPLETE COVERAGE

CEDM Number	Nozzle Angle	Minimum Axial Distance Achieved Above Uphill Weld Root (inches)	Stress Level Above the Uphill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)	Minimum Axial Distance Achieved Above Downhill Weld Root for Nozzles with Coverage <2" Above Uphill Weld Root (inches)	Stress Level Above the Downhill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)
38	38.5	1.63	ID: 9.9 OD: -7.7	5.47	ID: 15.7 OD: 1.6
39	38.5	1.30	ID: 10.6 OD: -10.4	5.14	ID: 16.2 OD: 2.0
40	38.5	1.30	ID: 10.6 OD: -10.4	5.14	ID: 16.2 OD: 2.0
41	38.5	1.55	ID: 10.1 OD: -8.4	5.39	ID: 15.8 OD: 1.7
42	38.5	1.75	ID: 9.7 OD: -6.7	5.59	ID: 15.5 OD: 1.4
43	38.5	1.77	ID: 9.7 OD: -6.6	5.61	ID: 15.4 OD: 1.4
44	38.5	1.27	ID: 10.7 OD: -10.6	5.11	ID: 16.2 OD: 2.0
45	38.5	1.40	ID: 10.4 OD: -9.6	5.24	ID: 16.0 OD: 1.8
46	41.8	1.56	ID: 10.0 OD: -8.3	5.40	ID: 15.8 OD: 1.6
47	41.8	1.21	ID: 10.1 OD: -11.1	5.05	ID: 16.3 OD: 2.1
48	41.8	1.50	ID: 10.2 OD: -8.8	5.34	ID: 15.9 OD: 1.7
49	41.8	1.44	ID: 10.3 OD: -9.3	5.28	ID: 16.0 OD: 1.8
50	41.8	1.58	ID: 10.0 OD: -8.1	5.42	ID: 15.7 OD: 1.6
51	41.8	1.30	ID: 10.6 OD: -10.4	5.14	ID: 16.2 OD: 2.0
52	41.8	1.60	ID: 10.0 OD: -8.0	5.44	ID: 15.7 OD: 1.6
53	41.8	1.47	ID: 10.3 OD: -9.0	5.31	ID: 15.9 OD: 1.8
54	42.5	1.60	ID: 10.0 OD: -8.0	5.44	ID: 15.7 OD: 1.6
55	42.5	1.67	ID: 9.9 OD: -7.4	5.51	ID: 15.6 OD: 1.5
56	42.5	1.75	ID: 9.7 OD: -6.7	5.59	ID: 15.5 OD: 1.4
57	42.5	1.60	ID: 10.0 OD: -8.0	5.44	ID: 15.7 OD: 1.6
58	42.5	1.55	ID: 10.1 OD: -8.4	5.39	ID: 15.8 OD: 1.7
59	42.5	1.47	ID: 10.3 OD: -9.0	5.31	ID: 15.9 OD: 1.8

ATTACHMENT (2)

CALVERT CLIFFS UNIT 2 (SPRING 2005)
RV HEAD INSPECTION ABOVE THE WELD STRESS LEVELS FOR CEDM NOZZLES WITHOUT COMPLETE COVERAGE

CEDM Number	Nozzle Angle	Minimum Axial Distance Achieved Above Uphill Weld Root (inches)	Stress Level Above the Uphill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)	Minimum Axial Distance Achieved Above Downhill Weld Root for Nozzles with Coverage <2" Above Uphill Weld Root (inches)	Stress Level Above the Downhill Weld Root at the Axial Distance for Nozzles Without Complete Coverage (ksi)
60	42.5	1.25	ID: 10.7 OD: -10.8	5.09	ID: 16.3 OD: 2.0
61	42.5	1.60	ID: 10.0 OD: -8.0	5.44	ID: 15.7 OD: 1.6
62	42.5	1.66	ID: 9.9 OD: -7.5	5.50	ID: 15.6 OD: 1.5
63	42.5	1.36	ID: 10.5 OD: -9.9	5.20	ID: 16.1 OD: 1.9
64	42.5	1.35	ID: 10.5 OD: -10.0	5.19	ID: 16.1 OD: 1.9
65	42.5	1.37	ID: 10.5 OD: -9.8	5.21	ID: 16.1 OD: 1.9

ATTACHMENT (3)

CALVERT CLIFFS UNIT 2 (SPRING 2005)

RV HEAD INSPECTION: DISPOSITION OF SPECIFIC NOZZLES REQUIRING FURTHER EVALUATION

Calvert Cliffs Unit 2 (Spring 2005) RV Head Inspection: Disposition of Specific Nozzles Requiring Further Evaluation

CEDM No.	Indication Location	Angular Position[1] (deg)	Orientation	Length	Depth	PT Results	Excavation	PT After Excavation
8	Nozzle base material @ OD and intersection of weld toe	271	Axial	0.45"	0.065"	No Indications	No	N/A
12	Nozzle base material @ OD and intersection of weld toe	234	Axial	0.35"	0.068"	No Indications	No	N/A
25	Nozzle base material @ OD and intersection of weld toe	265	Axial	0.35"	0.096"	3/16" Rounded Indication	YES	No Indications
30	Nozzle base material @ OD and intersection of weld toe	19	Axial	0.30"	0.073"	1/8" Rounded Indication	YES	No Indications
32	Nozzle base material @ OD and intersection of weld toe	291	Axial	0.40"	0.089"	1/16" Rounded Indication	YES	No Indications
41	Nozzle base material @ OD ~1/4" below weld toe	179	Axial	0.45"	0.107"	No Indications	No	N/A
42	Nozzle base material @ OD and intersection of weld toe	337	Axial	0.45"	0.077"	No Indications	No	N/A
44	Nozzle base material @ OD and intersection of weld toe	67	Axial	0.40"	0.055"	No Indications	No	N/A
58	Nozzle base material @ OD and intersection of weld toe	152	Axial	0.40"	0.064"	No Indications	No	N/A

[1] Clockwise looking down – 0 Degrees is downhill side.

ATTACHMENT (4)

REVISED SUPPLEMENTAL REQUEST

FOR RELAXATION OF ORDER

RELAXATION REQUEST:

Pursuant to the procedure specified in Section IV.F (2) of Nuclear Regulatory Commission (NRC) Revised Order EA-03-009 (Reference 1), Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP) hereby submits a supplemental request for relaxation from certain inspection requirements of the Revised Order. Specifically, the relaxation request involves a requirement in Section IV.C(5)(b)(i) of the Revised Order as described below. The relaxation requested in this letter is identical to the relaxation requested in Reference (1). The information used to justify this supplement to our original request (Reference 5) is a reprise of the justifications used for relaxation of below-the-weld requirements on Unit 1 in 2004 (Reference 2, 3, and 4).

A. Order Requirement from Which Relaxation is Requested:

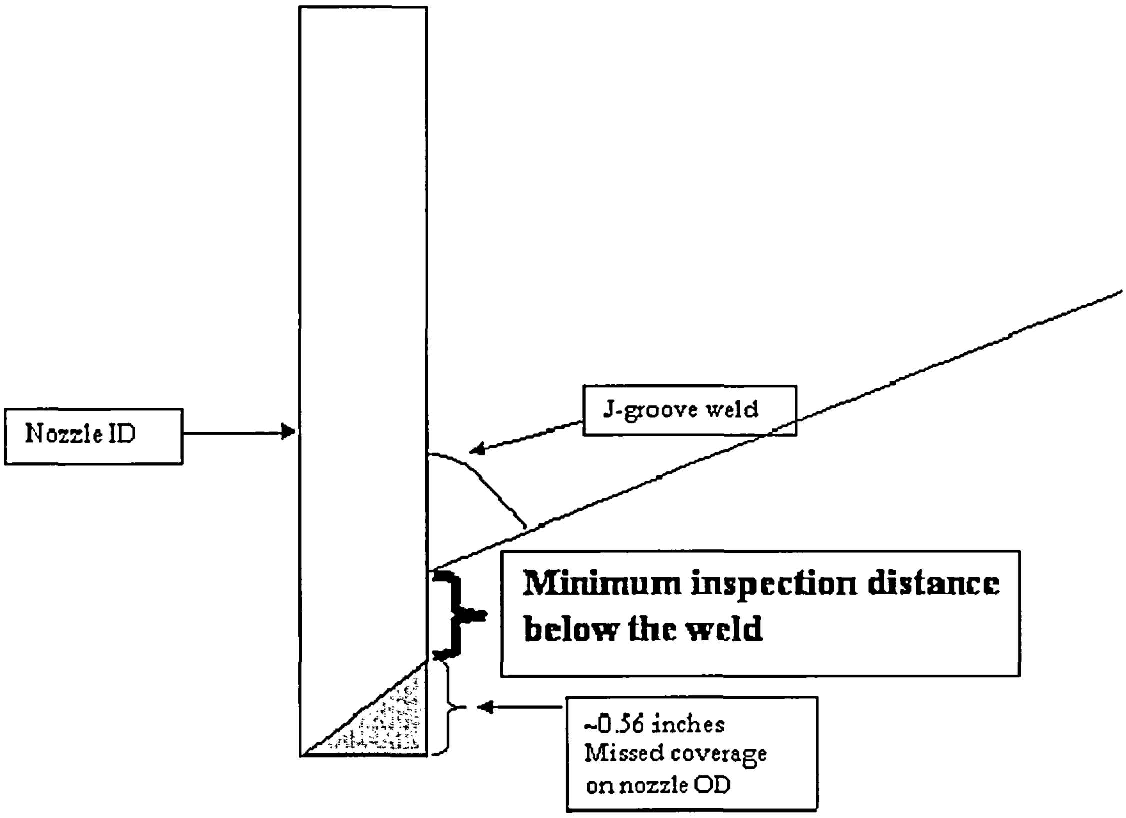
We request relaxation from the requirement in Section IV.C(5)(b)(i) of the Order for ultrasonic testing of each reactor pressure vessel head penetration nozzle (i.e., nozzle base material) to the bottom of the nozzle, specifically, missed examination coverage near the bottom end of the control element drive mechanism (CEDM) nozzles due to instrument limitation. Reference (5) noted our expectation for examination results consistent with those obtained during the 2004 Unit 1 inspection, due to the use of an identical axial ultrasonic test (UT) probe design. Initial results on Unit 2 this year, using the axial UT probes, have resulted in a decision to switch to circumferential probes to ensure adequate inspection coverage of the most critical weld areas. Our results are more consistent with those obtained during the 2003 Unit 2 inspection (Reference 6) because of this change. (Note: This relaxation request applies only to CEDM nozzles. The in-core instrumentation nozzles and vent line were inspected using a rotating probe that does not have the limitations described for the blade probe.)

B. Specific Penetration Nozzles For Which Relaxation Is Requested:

This relaxation request applies to all CCNPP Unit 2 CEDM penetrations 1 through 65, except nozzles 3, 14, 18, 26, 38, and 46, each of which were successfully scanned for the full length below the nozzle with an axial probe. For the remaining CEDM nozzles, the un-interrogated area at the bottom end of the nozzles is due to the configuration of the ultrasonic transducers in the circumferential probes that are used to examine the nozzles. These probes have separate transducers for sending and receiving the ultrasonic signal. The transducers are arranged one above the other nominally 0.86-inch apart. With this configuration, the lower transducer will not contact the inside wall on the nozzle until the upper transducer is inserted greater than approximately 0.86-inch into the nozzle. Since the scanning process requires that both transducers be in contact with the surface, the probe cannot scan the outer portion of the bottom of the nozzle. Based on the geometry involved in the transducer location and nozzle configuration, the portion that cannot be scanned is the portion extending from the bottom of the nozzle upward for a distance of approximately 0.56-inch. The value is half the distance between the two transducers plus a 1/8-inch radius at the bottom corner of the nozzle. The actual volume of unobtainable coverage is triangular in cross-section. The inside diameter of the nozzle receives relatively complete coverage (with a lateral wave), while the UT angle defines a triangle hypotenuse extending from the nozzle inside diameter lower end, to a spot on the nozzle outside diameter, located approximately 0.56-inch above the bottom of the nozzle. The other legs of the triangle are the lower portion of the nozzle outside diameter and the bottom surface of the nozzle. Figure 1 illustrates the un-interrogated area.

FIGURE 1

Circumferential Probe Inspection Coverage



C. **Justification for Relaxation Request:**

Compliance with the requirements specified in the Order would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Examination of the bottom of the nozzle could be accomplished by surface examination. However, this alternative has prohibitive worker dose implications without a commensurate increase in quality or safety. Removal of thermal guide sleeves to provide access for a rotating probe has similar dose implications that present hardship with no commensurate increase in safety or quality as described in our January 14, 2005 submittal (Reference 5).

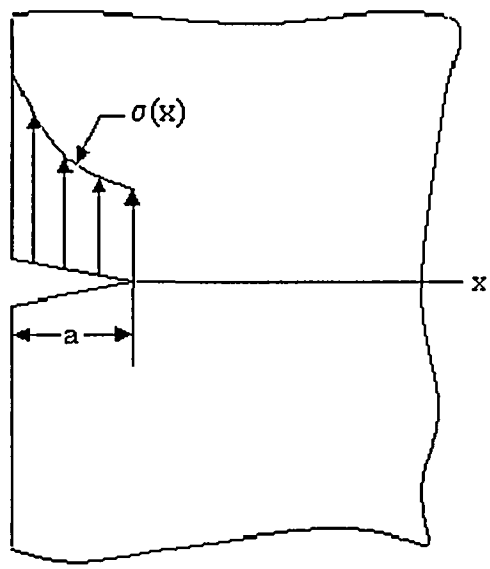
The UT coverage area achieved provides an acceptable level of quality and safety because the un-interrogated area involves a portion of the nozzle at the very bottom, below the J-groove weld. Below the J-groove weld, the nozzle is essentially an open-ended tube and the nozzle wall in this portion is not part of the Reactor Coolant System pressure boundary. To determine the significance of an axial flaw that is contained in the non-pressure boundary nozzle material in the un-interrogated region of the nozzle, plant specific flaw growth analyses were performed. The analysis methodology for the flaw tolerance approach is in Reference (3) and is summarized as follows.

We postulated through-wall axial flaws extending from the bottom of the nozzle towards the weld to determine the maximum-length-flaws that would not grow to the bottom of the weld in a single two-year inspection interval. We performed analyses for all four penetration angles.

The analyses were performed as follows:

Single Edge Crack Model for Axial Flaws

The crack is modeled as a continuous surface crack of length *a* in a semi-infinite body, subjected to an arbitrary stress profile.



Stress intensity factors are determined at the crack tip using the solution,

$$K_I = 1.12\sqrt{\pi a}\left[(A_0 + A_p) + A_1\left(\frac{2a}{\pi}\right) + A_2\left(\frac{a^2}{2}\right) + A_3\left(\frac{4a^3}{3\pi}\right)\right],$$

where the average through-wall hoop stresses in the uncracked nozzle are represented by the third-order polynomial,

$$\sigma = A_0 + A_1x + A_2x^2 + A_3x^3,$$

and x = distance from the bottom of the nozzle
A_0, A_1, A_2, and A_3 = third-order stress coefficients
A_p = crack face pressure

Finite element analyses specific to Calvert Cliffs were performed to determine the operating stresses in the CEDM nozzles. Results from this finite element model (FEM) were used to define the loading (described in References 2, 3, 4, and 7). The FEM was performed for the 42 ksi yield strength material used to fabricate the CEDM penetrations in Calvert Cliffs Unit 1. The residual stresses at the nozzle surface scale with the yield strength, therefore, the tabulated stresses would all be proportionally slightly lower for Calvert Cliffs Unit 2 CEDM penetrations, which have a yield strength of 37.5 ksi. As a result, the FEM analysis is bounding for Calvert Cliffs Unit 2.

Crack Growth Rates:

a) Primary Water Stress Corrosion Cracking

Basis: MRP-55 crack growth rate for Alloy 600 material as expressed in NRC flaw evaluation guidelines, referenced to a temperature of 325°C using an activation energy of 31,000 calories/mole.

$$da/dt = C_0(2.67\times10^{-12})(K_I - 9)^{1.16} \text{ m/sec}$$

where K_I is the applied stress intensity factor in MPa√m, and

$$C_o = e^{-\frac{Q}{R}\left(\frac{1}{T}-\frac{1}{Tref}\right)}$$

where Q = 130 kJ/mole = 31,000 calories/mole
R = 8.314×10^{-3} kJ/mole-°K = 1.987 calories/mole-°K

And T = Operating temperature in degrees Kelvin
T_{ref} = Reference temperature in degrees Kelvin

At an operating temperature of 594°F, the temperature correction term is

$$C_0 = 0.566$$

b) Fatigue Crack Growth

Basis: Crack growth rate for Alloy 600 material in a pressurized water reactor water environment as expressed in NRC flaw evaluation guidelines.

$$\frac{da}{dN} = CS_R S_{ENV}(\Delta K)^n$$

where ΔK is the stress intensity factor range in terms of MPa√m and da/dN is the crack growth rate in terms of m/cycle

$$C = 4.835x10^{-14} + 1.622x10^{-16}T - 1.490x10^{-18}T^2 + 4.355x10^{-21}T^3$$

$$S_R = [1 - 0.82R]^{-2.2}$$

$$S_{ENV} = 1 + A[CS_R\Delta K^n]^{m-1}T_R^{1-m}$$

A = $4.4x10^{-7}$
M = 0.33
N = 4.1
T = degrees C
R = K_{min} / K_{max}
T_R = rise time, set at 30 sec.

Table 1 and Figure 2 represent the minimum area that must be inspected to satisfy the flaw tolerance evaluation. As indicated in previous Requests for Additional Information (References 3 and 4), the crack growth analysis and acceptance criteria conform to NRC provided guidelines.

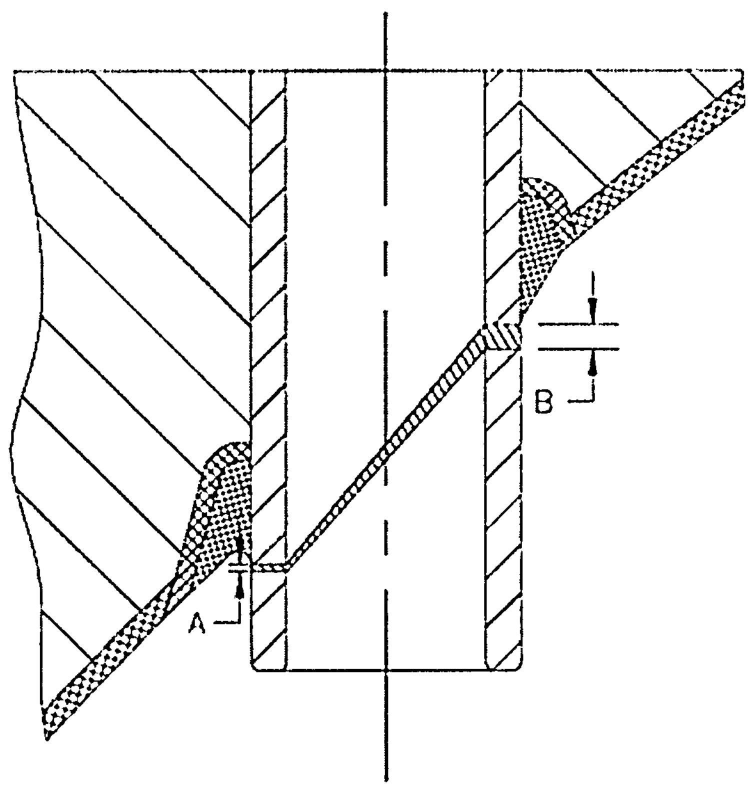
Table 1

Maximum Growth of Bounding Axial Through-Wall Flaws Below the Weld
(Bounding for all Weld Lengths)

Location	Downhill Side (A)	Uphill Side (B)
0° Nozzle	0.324"	0.324"
11° Nozzle	0.179"	0.386"
29° Nozzle	0.191"	0.361"
43° Nozzle	0.200"	0.360"

See Figure 2 below for location of the downhill and uphill sides identified in Table 1 above.

FIGURE 2



We performed UT inspection on each CEDM nozzle to the maximum achievable axial distance below the toe of the weld. The minimum inspection distance below the toe of the J-groove weld on any CEDM nozzle was 0.35 inches on CEDM 31 on the downhill side. This is a 29 degree nozzle, which according to the flaw tolerance evaluation must be inspected a minimum of 0.191 inches at this location. The minimum inspection distance achieved on every nozzle exceeded the minimum distances defined by the flaw tolerance approach as tabulated in Table 1.

Calvert Cliffs Nuclear Power Plant acknowledges that the crack-growth methodology used in this letter, while consistent with MRP-55, has not been formally approved by NRC. Further, if the NRC staff finds that the crack-growth formula in industry report MRP-55 is unacceptable, CCNPP shall revise its analysis that justifies relaxation of the First Revised Order dated February 20, 2004, within 30 days after the NRC informs us of an NRC-approved crack growth formula. If our revised analysis shows that the crack growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation can be rescinded and CCNPP shall, within 72 hours, submit to the NRC written justification for continued operation. If the revised analysis shows that the crack growth acceptance criteria are exceeded during the subsequent operating cycle, CCNPP shall, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, CCNPP shall, within 30 days submit a letter to the NRC confirming that its analyses have been revised. Any future crack growth analyses performed for this and future cycles for reactor pressure vessel head penetrations must be based on an acceptable crack growth rate formula.

CONCLUSION:

As described above, compliance with the Order requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, in accordance with the provisions of Section IV.F(2) of the Order, we request relaxation of the requirement described in Section IV.C(5)(b)(i).

REFERENCES:

(1) Letter from R. W. Borchardt (NRC) to Holders of Licenses for Operating Pressurized Water Reactors, dated February 20, 2004, "Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

(2) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated January 30, 2004, Request for Relaxation from NRC Order EA-03-009, "Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

(3) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated April 13, 2004, "Response to Request for Additional Information Regarding Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC No. MC1921)"

(4) Letter from G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated April 27, 2004, "Supplemental Data for Request for Relaxation from Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC No. MC1921)"

(5) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated January 14, 2005, Request for Relaxation from NRC Revised Order EA-03-009, "Issuance of First Revised NRC Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors"

(6) Letter from P. E. Katz (CCNPP) to Document Control Desk (NRC), dated June 3, 2003,"60 Days After Restart Report – NRC Order EA-03-009, Interim Inspection Requirement for Reactor Pressure Vessel Heads at Pressurized Water Reactors (TAC No. MB7753)

(7) Letter from P. E. Katz (CCNPP) to Document Control Desk (NRC), dated April 9, 2003, "Supplemental Data for Request for Relaxation from Certain Inspection Requirements in NRC Order (EA-03-009) for Reactor Pressure Vessel Head Penetration Nozzles (TAC Nos. MB7752 and MB7753)"