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April 9, 2003

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
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)

REFERENCES:

(a) Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated February 18, 2003, Response to Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors

(b) Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated March 13, 2003, Response to Request for Additional Information Regarding Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC Nos. MB7752 and MB7753)

(c) Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated April 4, 2003, Response to Request for Additional Information Regarding Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC Nos. MB7752 and MB7753)

(d) Letter from Mr. S. J. Collins (NRC) to Holders of Licenses for Operating Pressurized Water Reactors, dated February 11, 2003, Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors (EA-03-009)

By letter dated February 18, 2003 (Reference a) and supplemented by letters dated March 13, 2003 and April 4, 2003 (References b and c), Calvert Cliffs Nuclear Power Plant, Inc. submitted a request for relaxation from the inspection requirements of Section IV.C(1)(b)(i) of Order EA-03-009 (Reference d). Calvert Cliffs Nuclear Power Plant completed the inspections required by Reference (d) on April 8, 2003. This letter supplements our relaxation request by providing the final results of our ultrasonic testing examination and a response to Nuclear Regulatory Commission Staff's April 8, 2003, verbal request for additional information. This letter also requests additional relaxation from the Order due to instrument limitations encountered during the inspection.

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Our response to the Staff's request for additional information and the final Reactor Pressure Vessel Head control element drive mechanism penetrations' ultrasonic testing examination results, including the specific nozzles for which relaxation is requested by Reference (a), are contained in Attachment (1). The additional relaxation request is contained in Attachment (2).

Calvert Cliffs Nuclear Power Plant, Inc. requests approval of the relaxation requests by April 18, 2003, the current scheduled date for Calvert Cliffs Unit 2 startup.

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

Very truly yours,

Peter E. Katz

PEK/JKK/bjd

Attachments: (1) Response to Request for Additional Information and Reactor Pressure Vessel Head UT Examination Results
(2) Additional Relaxation Request

cc: J. Petro, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
G. S. Vissing, NRC
H. J. Miller, NRC
Resident Inspector, NRC
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ATTACHMENT (1)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION AND REACTOR PRESSURE VESSEL HEAD UT EXAMINATION RESULTS

ATTACHMENT (1)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION AND REACTOR PRESSURE VESSEL HEAD UT EXAMINATION RESULTS

NRC Request:

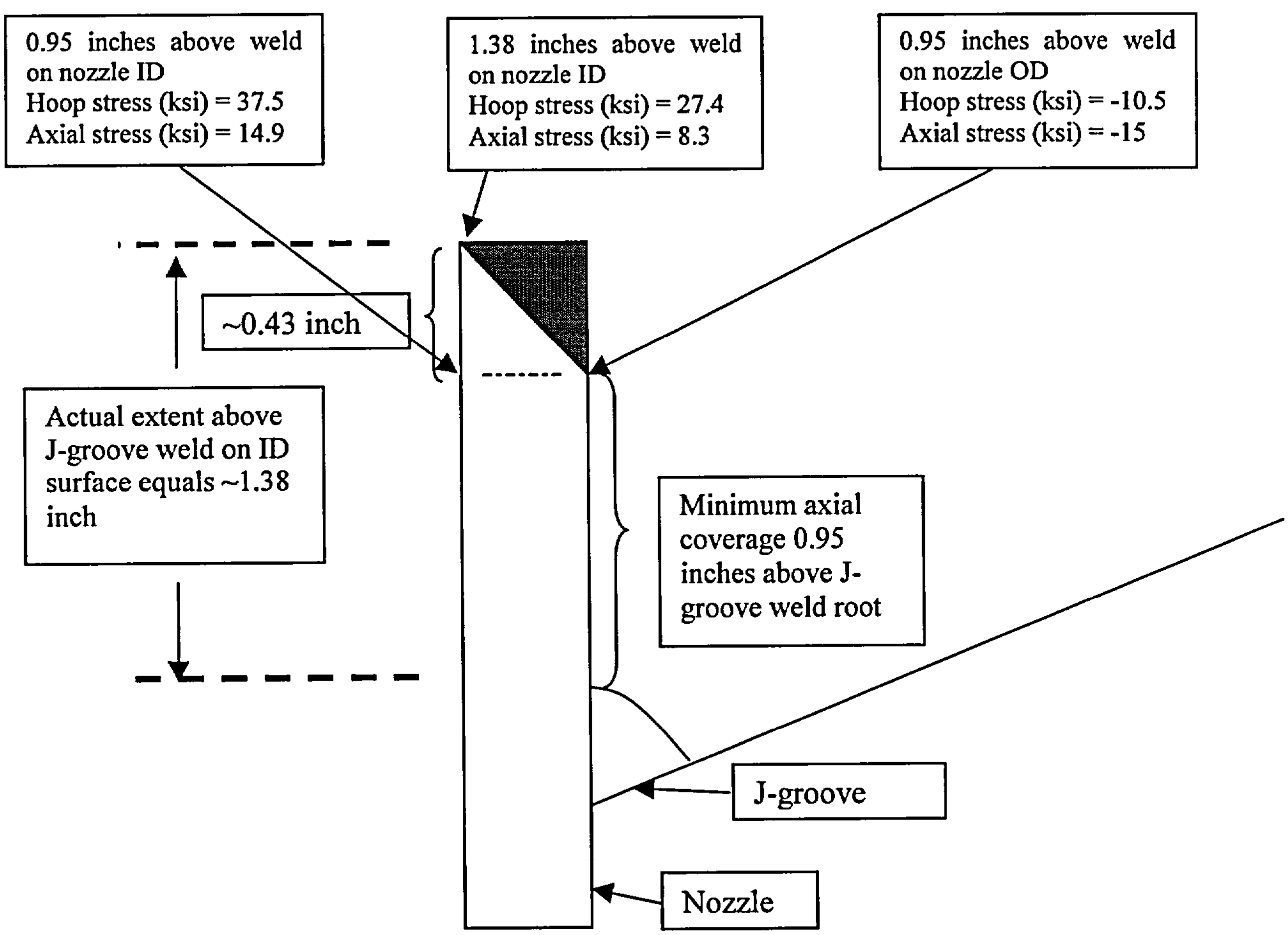
Provide the bounding hoop and axial stresses present at the location of lowest coverage above the J-groove weld.

CCNPP Response:

The requested information is provided on Figure 1 below. The bounding value is located on Nozzle 43 which had coverage to 0.95 inches above the root of the J-groove weld. Nozzle 43 has a 38.5 degree angle with the head. Calculated stresses are reported for a 42.5 degree nozzle, which bounds a 38.5 degree nozzle. Stresses are provided at three locations: on the outside diameter (OD) at the elevation of highest coverage, on the inside diameter (ID) at the same elevation, and on the ID at the elevation of highest coverage. Coverage elevations above the J-groove weld have been reported for coverage on the OD. In all cases coverage on the ID is higher. This is due to the configuration of the transducers in the blade probe and is analogous to the situation at the bottom of the nozzle (see Figure 1 in Attachment 2). Further discussion on the configuration of the transducers in the blade is contained in Attachment (2).

FIGURE 1

Bounding hoop and axial stresses at elevation of minimum coverage extent above the root of the J-groove weld occurs on Nozzle 43



Calvert Cliffs Nuclear Power Plant -- Unit 2
Ultrasonic Testing Data Coverage Matrix for Control Element Drive Mechanism Nozzles

CEDM		Extent of UT Coverage in RVHP Nozzle Material					Leak Path Assessment Determination Possible?	UT Indications/ Leakage Path Indications (Yes/No)
Pen #	Approximate Angle Between Nozzle and Head (Degrees)	Min ** Distance Above Weld Root	Coverage Above Weld Root (Theta)	Coverage @ Weld Root (Theta)	Weld Region Coverage (Theta)	Below Weld Coverage (Theta)		
1	0.000	**2.0***	360	360	360	360	Yes	No
2	11.143	1.6	360	360	360	360	Yes	No
3	11.143	1.55	360	360	360	360	Yes	No
4	11.143	1.85	360	360	360	360	Yes	No
5	11.143	1.65	360	360	360	360	Yes	No
6	11.976	**2.11***	360	360	360	360	Yes	No
7	11.976	1.40	360	360	360	360	Yes	No
8	11.976	1.83	360	360	360	360	Yes	No
9	11.976	1.4	360	360	360	360	Yes	No
10	22.620	1.40	360	360	360	360	Yes	No
11	22.620	1.9	360	360	360	360	Yes	No
12	22.620	1.7	360	360	360	360	Yes	No
13	22.620	1.45	360	360	360	360	Yes	No
14	24.083	1.95	360	360	360	360	Yes	No
15	24.083	1.70	360	360	360	360	Yes	No
16	24.083	1.8	360	360	360	360	Yes	No
17	24.083	**2.12***	360	360	360	360	Yes	No
18	25.514	1.45	360	360	360	360	Yes	No
19	25.514	1.45	360	360	360	360	Yes	No
20	25.514	1.45	360	360	360	360	Yes	No
21	25.514	1.55	360	360	360	360	Yes	No
22	25.514	1.65	360	360	360	360	Yes	No
23	25.514	1.45	360	360	360	360	Yes	No
24	25.514	1.7	360	360	360	360	Yes	No
25	25.514	1.65	360	360	360	360	Yes	No
26	29.275	1.55	360	360	360	360	Yes	No
27	29.275	1.46	360	360	360	360	Yes	No
28	29.275	1.82	360	360	360	360	Yes	No
29	29.275	1.82	360	360	360	360	Yes	No
30	29.275	1.75	360	360	360	360	Yes	No
31	29.275	1.20	360	360	360	360	Yes	No
32	29.275	1.5	360	360	360	360	Yes	No
33	29.275	1.24	360	360	360	360	Yes	No
34	34.875	1.43	360	360	360	360	Yes	No
35	34.875	1.3	360	360	360	360	Yes	No
36	34.875	1.45	360	360	360	360	Yes	No
37	34.875	1.85	360	360	360	360	Yes	No
38	38.501	1.30	360	360	360	360	Yes	No

Calvert Cliffs Nuclear Power Plant -- Unit 2
Ultrasonic Testing Data Coverage Matrix for Control Element Drive Mechanism Nozzles

CEDM		Extent of UT Coverage in RVHP Nozzle Material					Leak Path Assessment Determination Possible?	UT Indications/ Leakage Path Indications (Yes/No)
Pen #	Approximate Angle Between Nozzle and Head (Degrees)	Min ** Distance Above Weld Root	Coverage Above Weld Root (Theta)	Coverage @ Weld Root (Theta)	Weld Region Coverage (Theta)	Below Weld Coverage (Theta)		
39	38.501	1.39	360	360	360	360	Yes	No
40	38.501	1.37	360	360	360	360	Yes	No
41	38.501	1.2	360	360	360	360	Yes	No
42	38.501	1.2	360	360	360	360	Yes	No
43	38.501	0.95	360	360	360	360	Yes	No
44	38.501	1.05	360	360	360	360	Yes	No
45	38.501	1.4	360	360	360	360	Yes	No
46	41.795	1.3	360	360	360	360	Yes	No
47	41.795	1.15	360	360	360	360	Yes	No
48	41.795	1.50	360	360	360	360	Yes	No
49	41.795	1.15	360	360	360	360	Yes	No
50	41.795	1.2	360	360	360	360	Yes	No
51	41.795	1.0	360	360	360	360	Yes	No
52	41.795	1.3	360	360	360	360	Yes	No
53	41.795	1.2	360	360	360	360	Yes	No
54	42.510	1.2	360	360	360	360	Yes	No
55	42.510	1.55	360	360	360	360	Yes	No
56	42.510	1.80	360	360	360	360	Yes	No
57	42.510	1.2	360	360	360	360	Yes	No
58	42.510	1.25	360	360	360	360	Yes	No
59	42.510	1.55	360	360	360	360	Yes	No
60	42.510	1.2	360	360	360	360	Yes	No
61	42.510	1.0	360	360	360	360	Yes	No
62	42.510	1.25	360	360	360	360	Yes	No
63	42.510	1.25	360	360	360	360	Yes	No
64	42.510	1.35	360	360	360	360	Yes	No
65	42.510	1.50	360	360	360	360	Yes	No

* Relaxation from the Order requirement to inspect 2 inches above the J-groove weld is requested for all CEDM nozzles except for Nozzles 1, 6, and 17.

** Coverage is for nozzle outside diameter. Nozzle inside diameter coverage is 0.43 inches greater for all penetrations.

ATTACHMENT (2)

ADDITIONAL RELAXATION REQUEST

RELAXATION REQUEST:

In accordance with Section IV.F(2) of Reference (1), Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP) hereby submits a request for relaxation.

ORDER REQUIREMENT FROM WHICH RELAXATION IS REQUESTED:

Section IV.C(1)(b)(i) -- Ultrasonic testing (UT) of each Reactor Pressure Vessel (RPV) head penetration nozzle (i.e., nozzle base material) from two inches above the J-groove weld to the bottom of the nozzle. The request for relaxation from the Order requirement for two inches above the weld for control element drive mechanism (CEDM) penetration was the subject of our original relaxation request (References 2, 3, and 4). This relaxation request is for missed examination coverage near the bottom end of the CEDM nozzles due to instrument limitation. (Note: This relaxation request applies only to CEDM nozzles. The incore instrumentation nozzles and vent line were inspected using a rotating probe that did not have the limitations described for the blade probe.)

SPECIFIC PENETRATION NOZZLES FOR WHICH RELAXATION IS REQUESTED:

This relaxation request applies to all Calvert Cliffs Nuclear Power Plant Unit 2 CEDM penetrations 1 through 65. The un-interrogated area at the bottom end of the CEDM nozzles is due to the configuration of the ultrasonic transducers in the probes used to examine the nozzles. These probes have separate transducers for sending and receiving the ultrasonic signal. The probes, used for detection of the most significant type of cracks, circumferential cracks, have the two transducers arranged one above the other. The transducers used in the CE-type circumferential blade probe are located 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 a small 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.

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. Use of an additional, different type of probe would not provide information that is significant to preventing leakage or degradation of the reactor coolant system pressure boundary. Examination of the bottom of the nozzle could be accomplished by surface examination. However, this presents a significant hardship since our inspection vendor does not currently have the capability of performing eddy current examination for this application. The other alternative, dye penetrant examination, 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 presents hardship with no commensurate increase in safety or quality.

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, a flaw tolerance approach was used. A flaw evaluation was performed postulating an axial flaw at the bottom of the nozzle. A through-wall flaw could grow approximately 0.376 inches vertically during an additional two years of operation. The distance below the weld scanned with UT techniques exceeded 0.4 inches for all CEDM nozzles, with no noticeable indications. Therefore, any crack below this region could not grow into the weld during the next two years of operations.

We conclude that our inspection results and analysis prove that no flaw can exist in the bottom portion of the nozzle that could grow to the weld during an additional cycle of operation. Therefore, there is no possibility of leakage from an undiscovered flaw in the region for which relaxation is sought.

The fracture mechanics evaluation was performed for nozzle material having 37.5 ksi yield strength, which is the yield strength for the two heats of material used to fabricate the Calvert Cliffs Unit 2 CEDMs. The residual and operating stresses used in the fracture mechanics analysis were calculated in a finite element model (FEM) of Calvert Cliffs CEDMs. The FEM assumed material yield strength of 42 ksi, which is bounding for both Calvert Cliffs Units. Since Unit 2 has lower yield strength material, the actual stresses will be slightly lower in Unit 2 as indicated in Reference (4). Lower applied stresses would result in lower crack growth rates. The stress distributions for the material below the weld was provided in Reference (3). The maximum hoop stress in the bottom portion of the nozzle (lowest 0.56 inch) is 25.5 ksi. This maximum hoop stress was used for the bounding evaluation of the hypothetical through-wall crack growth.

Flaw growth due to primary water stress corrosion cracking was assessed using the Materials Reliability Program (MRP) 75^{th} percentile level curve (Reference 5). The MRP model provides a reference crack growth rate at 325°C and uses an activation energy of 31,000 calories/mole to account for differences in operating temperature. We note that the Staff is still reviewing the crack growth rates provided in MRP-55. Should the Staff find the crack growth rate formula described in MRP-55 to be unacceptable, CCNPP would revise our analysis that justifies no examination of the bottom 0.56 inches of the nozzles.

The safety issues that are addressed by the inspections mandated by the Order are degradation (corrosion) of the low-alloy steel RPV head and ejection of the vessel head penetration nozzle due to circumferential cracking of the nozzle above the J-groove weld. The following three items provide reasonable assurance that these safety issues are addressed:

1. The bare-metal visual examination of CCNPP Unit 2 demonstrated the integrity of the RPV head and the absence of ongoing degradation of the head.
2. The analysis described above demonstrates that no flaw located in the bottom portion of the nozzle would propagate to a level adjacent to the weld within a two-year operating period.
3. The UT examination of 65 CEDM nozzles, 8 incore instrumentation nozzles, and 1 vent line in accordance with Section IV, Paragraph C.(1)(b)(i) of the Order (subject to relaxation of the requirement for examination of the very top and very bottom of the required inspection areas) reasonably demonstrates that the RPV head penetration nozzles are intact throughout the region of inspection. These examinations provide reasonable assurance that no circumferential cracking of the nozzles above the J-groove weld is present and no through-wall leakage or degradation of the RPV head should occur.

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(1)(b)(i).

REFERENCES

1. Letter from Mr. S. J. Collins (NRC) to Holders of Licenses for Operating Pressurized Water Reactors, dated February 11, 2003, Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors (EA-03-009)

2. Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated February 18, 2003, Response to Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors

3. Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated March 13, 2003, Response to Request for Additional Information Regarding Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC Nos. MB7752 and MB7753)

4. Letter from Mr. P. E. Katz (CCNPP) to Document Control Desk (NRC), dated April 4, 2003, Response to Request for Additional Information Regarding Interim Inspection Requirements for Reactor Pressure Vessel Head (TAC Nos. MB7752 and MB7753)

5. Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick-Wall Alloy 600 Material (MRP-55) Revision 1, EPRI Report, November 2002

FIGURE 1

Illustration of the Un-interrogated Area at the Bottom of the CEDM Nozzles