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December 18, 2002

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
Response to NRC Request for Additional Information Regarding ASME Section XI Relief Request to Use Alternative Techniques for Reactor Vessel Head Repair

REFERENCES:

(a) Letter from Mr. C. H. Cruse (CCNPP) to Document Control Desk (NRC), dated February 7, 2002, ASME Section XI Relief Request to Use Alternative Techniques for Reactor Vessel Head Repair

(b) Letter from Ms. D. M. Skay (NRC) to Mr. P. E. Katz (CCNPP), dated November 6, 2002, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 – Request for Additional Information Related to Relief Request (TAC Nos. MB4013 and MB4014)

By letter dated February 7, 2002 (Reference a), Calvert Cliffs Nuclear Power Plant, Inc. submitted an American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) relief request to be used in the event that flaws requiring repair in the reactor vessel closure head penetrations are discovered during inspections. This letter provides Calvert Cliffs Nuclear Power Plant's response to Nuclear Regulatory Commission (NRC) staff's request for additional information transmitted by Reference (b).

NRC Request 1:

A Section III analysis should be performed to demonstrate the structural integrity of the weld repair. In addition, the experience from other licensees who have completed their control element drive mechanism (CEDM) nozzle repairs of a similar nature indicates that a weld anomaly could exist at the root of the CEDM weld repair. As a result, they requested relief from NB-5330(b), which requires that indications characterized as cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length; and proposed, alternatively, a flaw evaluation using a conservatively assumed flaw size to demonstrate the structural integrity of the weld repair with weld anomaly. The NRC requests that the licensee either demonstrate through ultrasonic testing that the repair would not have this weld anomaly or request relief

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from NB-5330(b), and perform a flaw evaluation to assess the impact of this anomaly on the structural integrity of the weld repair.

CCNPP Response:

Calvert Cliffs Nuclear Power Plant has performed a Section III analysis to demonstrate the structural integrity of the weld repair. It was determined that the weld repair design does meet the stress and fatigue requirements of the design code, ASME Code, Section III 1989 Edition, no Addenda. The conservative fatigue analysis performed also determined that the design life of the repair is 40-effective full power years (EFPYs). With respect to a weld anomaly that could exist, we have decided to request a relief from NB-5330(b). Our Code relief request and the justification are provided in Attachment (1).

NRC Request 2:

Identify the specific paragraphs and subparagraphs that you are taking exception to/from the ASME Code for each of your exceptions, and the basis for the exceptions. [This request affects the second Code relief request detailed in Attachment (2) of Reference (a) only.]

CCNPP Response:

The Table in Attachment (2) identifies the specific paragraphs for which exceptions are taken.

NRC Request 3:

How do you intend to address crevice corrosion?

CCNPP Response:

We have performed an evaluation that addresses the effects of corrosion on the exposed low alloy steel surface arising from inner diameter temper bead repair of CEDM nozzles. This evaluation determined that galvanic corrosion, hydrogen embrittlement, stress corrosion cracking, and crevice corrosion are not expected to be a concern for the exposed low alloy steel base metal. Furthermore, the gap between the reactor vessel head and the CEDM nozzle is eventually expected to fill with corrosion products, thus general corrosion will cease. The long-term low alloy steel general corrosion rate and overall release of iron into the Reactor Coolant System is expected to be negligible. Alloy 690 and its weld metals are the best available replacement materials for Alloy 600 and its weld metals in a pressurized water reactor environment. Alloy 690 and its weld metals are not likely to degrade from exposure to typical primary water environments.

NRC Request 4:

Triple point anomaly is the joining of three different materials. Address any implications of triple point anomaly on the primary water stress corrosion cracking (PWSCC) and the non-PWSCC sides of the repair welds.

CCNPP Response:

The triple point anomaly of inner diameter temper bead weld repairs is at point where the low alloy steel reactor vessel head, the Alloy 600 CEDM nozzle, and the Alloy 52 weld bead join. For the non-PWSCC side, we characterized the weld anomaly as a crack like indication with a conservatively estimated length of 0.1 inch. A fracture mechanics evaluation determined that an indication 0.1 inches in length is acceptable for a design life of 25 EFPYs.

For the PWSCC side, we performed an evaluation to estimate the remaining Alloy 600 CEDM nozzles lifetime. This evaluation considered CEDM nozzles in an as-repaired condition, and as-repaired and abrasive water jet machining (AWJM) remediated condition. The results indicate that a non-AWJM condition could exhibit a flaw through 75% of the original wall thickness after 2.2 EFPY. If AWJM is utilized, the estimated time to reach a flaw through 75% of the original wall thickness is 54 EFPYs. Our design instructions require remediation.

NRC Request 5:

Verify the edition of the Code that is being referenced for the Section III repairs and nondestructive examination.

CCNPP Response:

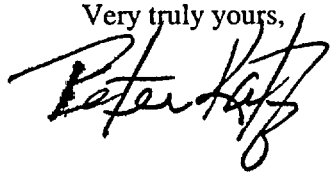
The edition of the ASME Code for design, repair, and nondestructive examination are Section III 1989 Edition, no Addenda, Section XI 1998 Edition, no Addenda, and Section III 1992 Edition, no Addenda, respectively.

SCHEDULE

In accordance with the commitment we made in responses to NRC Bulletins 2001-01, 2002-01, and 2002-02, regarding reactor vessel closure head penetration nozzles, we will be performing reactor pressure vessel head inspections during the next refueling outage currently scheduled to begin in February 2003 for Calvert Cliffs Nuclear Power Plant Unit 2. We request that the NRC review and approve our proposed alternatives for use during this outage.

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

Very truly yours,



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Attachments: (1) Relief Request Regarding NB-5330(b) Requirements to Support Reactor Vessel Closure Head Repair
(2) Specific Paragraphs for Which Exceptions Are Taken Regarding Attachment (2), February 7, 2002, Application

cc: J. Petro, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
D. M. Skay, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

RELIEF REQUEST REGARDING NB-5330(b)

REQUIREMENTS TO SUPPORT

REACTOR VESSEL CLOSURE HEAD REPAIR

ATTACHMENT (1)

RELIEF REQUEST REGARDING NB-5330(b) REQUIREMENTS TO SUPPORT REACTOR VESSEL CLOSURE HEAD REPAIR

Pursuant to 10 CFR 50.55a(a)(3)(i), Calvert Cliffs Nuclear Power Plant, Inc. hereby proposes alternatives to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements. Paragraph 50.55a(a)(3)(i) allows the use of alternatives to the requirements of Paragraph 50.55a(g), that provide an acceptable level of quality and safety, when authorized by the Director of the Office of Nuclear Reactor Regulation.

COMPONENT FOR WHICH RELIEF IS REQUESTED:

Reactor Vessel Closure Head Penetration Repair Welds, ASME Class 1.

CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED:

The 1992 Edition no Addenda of ASME Section III Paragraph NB-5330, "Ultrasonic Acceptance Standards" for Class 1 welds states in part that "Indications characterized as cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length."

PROPOSED ALTERNATIVE:

Perform a fracture mechanics evaluation of a postulated weld anomaly in the CEDM nozzle inside diameter (ID) temper bead repair for Calvert Cliffs Units 1 and 2. This anticipated anomaly has been evaluated in accordance with IWB-3600 of the 1998 Edition, no Addenda of ASME Section XI.

SUPPORTING INFORMATION:

In Attachment (2) of our February 7, 2002, application (Reference 1), we stated, "The ultrasonic acceptance criteria will be in accordance with NB-5330 of the 1992 Edition of ASME Section III." Following the repair of the control element drive mechanism (CEDM) nozzles, it is anticipated that the ultrasonic (UT) examination signal response of the repair weld triple point (intersection of weld material, penetration tube, and vessel head) may result in a UT indication. This UT indication may be from this weld triple point response and may not be distinguishable from a crack or incomplete penetration type flaw response and therefore can only be characterized as unacceptable in accordance with NB-5330(b). This indication may extend from the existing crevice into the weld at angles from 0 to 90 degrees, where 90 degrees is in the through-thickness direction of the nozzle and zero degrees is along the low alloy steel fusion line. Mock-up testing has verified that the anomalies are common and do not exceed 0.1 inch in length. The typical length is closer to 0.05 inches.

We performed a fracture mechanics evaluation of a postulated weld anomaly in the CEDM nozzle ID temper bead weld repair for Calvert Cliffs Units 1 and 2. The postulated anomaly is a 0.1-inch semi-circular flaw extending 360 degrees around the circumference at the weld triple point location. The anomaly is assumed to propagate in each of two directions on the uphill and downhill sides of the nozzle. Flaw acceptance is based on the 1998 ASME Code Section XI criteria for applied stress intensity factor (IWB-3612) and limit load (IWB-3642).

The results of the analysis demonstrate that a 0.1-inch weld anomaly is acceptable for at least 25 years of operation following a CEDM nozzle ID temper bead weld repair. Significant design margins have been demonstrated for all flaw propagation paths considered in the analysis. The minimum fracture toughness margin has been shown to be 13.1, compared to the required margin of 3.16 for normal operation conditions per Section XI, IWB-3612. Fatigue crack growth is minimal along each flaw propagation path, with the maximum flaw size being only 0.113 inch. A limit load analysis was also performed

considering the ductile Alloy 600/690 materials. This analysis showed a limit load margin of 5.03 for normal operating conditions, compared to the required margin of 3.0 per Section XI, IWB-3642.

CONCLUSION:

By characterizing the anticipated anomaly as a crack like indication with a conservatively estimated length of 0.1 inch, we were able to show the weld anomaly is acceptable for the design life of the CEDM nozzle ID temper bead weld repair. Therefore, the proposed alternative provides an acceptable level of quality and safety.

SAFETY COMMITTEE REVIEW

The proposed relief request has been reviewed by our Plant Operations and Safety Review Committee, and they have concluded that the proposed alternatives provide an acceptable level of quality and safety.

REFERENCE:

(1) Letter from Mr. C. H. Cruse (CCNPP) to Document Control Desk (NRC), dated February 7, 2002, ASME Section XI Relief Request to Use Alternative Techniques for Reactor Vessel Head Repair

ATTACHMENT (2)

SPECIFIC PARAGRAPHS FOR WHICH EXCEPTIONS ARE TAKEN REGARDING ATTACHMENT 2, FEBRUARY 7, 2002 APPLICATION

ATTACHMENT (2)

SPECIFIC PARAGRAPHS FOR WHICH EXCEPTIONS ARE TAKEN REGARDING ATTACHMENT 2, FEBRUARY 7, 2002 APPLICATION

Welding and associated nondestructive examination will be performed in accordance with IWA-4610 and IWA-4630 modified as indicated below. Only those portions of Section XI for which relief is requested or which are necessary for place keeping are listed. The modifications are consistent with the technical requirements of Code Case N-638, and the basis for other exceptions are contained in our February 7, 2002 submittal. (See Reference 1, Attachment 2)

1998 Section XI	Exceptions/Clarifications
IWA-4600 ALTERNATIVE WELDING METHODS	
(b) When post-weld heat treatment is not to be performed, the following provisions may be used. (1) The welding methods of IWA-4620, IWA-4630, or IWA-4640 may be used in lieu of the welding and nondestructive examination requirements of the Construction Code or Section III, provided the requirements of IWA-4610 are met.	The welding methods of IWA-4610 and IWA-4630 as modified herein will be used.
IWA-4610 GENERAL REQUIREMENTS FOR ALL MATERIALS	
(a) The area to be welded plus a band around the area of at least 1-1/2 times the component thickness or 5 inches (127 mm), whichever is less, shall be preheated and maintained at a minimum temperature of 350°F (177°C) for the shielded metal arc welding process and 300°F (149°C) for the gas tungsten arc welding process during welding. The maximum interpass temperature shall be 450°F (232°C). Thermocouples and recording instruments shall be used to monitor the process temperatures. Their attachment and removal shall be in accordance with Section III.	Prior to welding, the area to be welded and a band around the area of at least 1-1/2 times the component thickness (or 5 inches, whichever is less) will be at least 50°F. Preheat temperature will be monitored using either thermocouple(s) or contact pyrometer(s) placed at a readily accessible location(s) on the closure head exterior surface and will probably be outside the 5 inch band and recorder(s) will not be required to be used. Interpass temperature will not be measured nor recorded.
IWA-4630 DISSIMILAR MATERIALS	
IWA-4631 General Requirements	
(b) Repair/replacement activities in accordance with this paragraph are limited to those along the fusion line of a nonferritic weld to ferritic base material where 1/8 inch (3.2 mm) or less of nonferritic weld deposit exists above the original fusion line after defect removal. If the defect penetrates into the ferritic base material, welding of the base material may be performed in accordance with IWA-4633 provided the depth of the weld in the base material does not exceed 3/8 in. The repair/replacement activity performed on a completed joint shall not exceed one-half the joint thickness. The surface of the completed weld shall not exceed 100 sq. in. (64,500 mm^2).	Weld will not be along a fusion line but will join nonferritic to ferritic base material in intimate contact. The weld will not exceed ½ the ferritic base metal thickness.

ATTACHMENT (2)

SPECIFIC PARAGRAPHS FOR WHICH EXCEPTIONS ARE TAKEN REGARDING ATTACHMENT 2, FEBRUARY 7, 2002 APPLICATION

1998 Section XI	Exceptions/Clarifications
IWA-4632(b) Welding Procedure Qualification	Subsequent to our submittal in February 2002 an additional procedure qualification record (PQR) of a test assembly was performed. This PQR utilized P-No. 43 and P-No. 3 Group 3 base materials welded with Alloy 52 filler. The Charpy v-notch tests on the ferritic steel heat affected zone required a +5°F RT_{NDT} shift, as permitted by ASME III NB-4335.2, be used on the ferritic steel base material on which welding is performed. This PQR will be referenced in future reactor vessel closure head (RVCH) inside diameter temper bead penetration work that is performed at Calvert Cliffs. Calvert Cliffs will evaluate the impact of the +5°F RT_{NDT} adjustment temperature on the RVCH against the fracture toughness requirements of 10 CFR Part 50, Appendix G and existing Technical Specification pressure-temperature limits for the RVCH and Reactor Coolant System. However, it is expected that this minor degradation will have no effect on the safe operation of the RVCH or Technical Specification pressure-temperature limits.
IWA-4633 Welding Procedure	
IWA-4633.2 Gas Tungsten-Arc Welding	
(a) The weld shall be made using A-No. 8 weld metal (QW-442) for P-No. 8 to P-No. 1 or P-No. 3 weld joints or F-No. 43 weld metal (QW-432) for either P-No. 8 or P-No. 43 to P-No. 1 or P-No. 3 weld joints.	Dissimilar metal welds will be made using F-No. 43 weld metal (QW-432) for P-No. 43 to P-No. 3 weld joints. ERNiCrFe-7 filler metal is considered F-No. 43 in Code Case 2142-1.
(c) The cavity shall be buttered with the first six layers of weld metal as shown in Figure IWA-4633.2-1, Steps 1 through 3, with the weld heat input for each layer controlled to within ±10% of that used in the procedure qualification test. Subsequent layers shall be deposited with a heat input equal to or less than that used for layers beyond the sixth in the procedure qualification (see Figure IWA-4633.2-1, Step 4). The completed weld shall have at least one layer of weld reinforcement deposited and then this reinforcement shall be removed by mechanical means, making the finished surface of the weld substantially flush with the surface surrounding the weld.	Consistent with Code Case N-638, "six" and "sixth" will be "three" and "third". Consistent with Code Case N-638 the reinforcement is not required for dissimilar metal welding.

ATTACHMENT (2)

SPECIFIC PARAGRAPHS FOR WHICH EXCEPTIONS ARE TAKEN REGARDING ATTACHMENT 2, FEBRUARY 7, 2002 APPLICATION

1998 Section XI	Exceptions/Clarifications
(d) After at least 3/16 inch (4.8 mm) of weld metal has been deposited, the weld area shall be maintained at a minimum temperature of 300°F (149°C) for a minimum of 2 hour in P-No. 1 materials. For P-No. 3 materials, the minimum holding time shall be 4 hour.	This post-weld hydrogen bakeout will not be performed. During all welding, particular care will be given to ensure that the weld repair is free of all potential sources of hydrogen. The surfaces to be welded, filler metal, and shielding gas shall be suitably controlled.
(e) Subsequent to the above heat treatment, the balance of the welding may be performed at maximum interpass temperature of 350°F (177°C).	The maximum interpass temperature will be 350°F, verified by calculation rather than thermocouple measurement, even though the applicable PQR(s) were performed with less than the 150°F maximum interpass temperature during qualification.
IWA-4634 Examination	
The weld as well as the preheated band shall be examined by the liquid penetrant method after the completed weld has been at ambient temperature for at least 48 hours. The weld shall be volumetrically examined.	The final weld will be examined using the liquid penetrant and ultrasonic examination methods. The band around the area defined in paragraph IWA-4610(a) cannot be examined due to the physical configuration of the partial penetration weld. Liquid penetrant (PT) examination coverage will include the final weld surface and base metal at least ½ inch around the nozzle. Ultrasonic examination (UT) will include the base metal ½ inch above the weld and the weld surface.

REFERENCE:

(1) Letter from Mr. C. H. Cruse (CCNPP) to Document Control Desk (NRC), dated February 7, 2002, ASME Section XI Relief Request to Use Alternative Techniques for Reactor Vessel Head Repair