June 17, 2004

MEMORANDUM TO: Lakshminaras Raghavan, Chief
Project Directorate Section III-1
Division of Licensing Project Management

FROM: Terence L. Chan, Chief */RA/*
Piping Integrity and NDE Section
Materials and Chemical Engineering Branch
Division of Engineering

SUBJECT: SAFETY EVALUATION FOR POINT BEACH NUCLEAR PLANT UNIT 1, SUPPLEMENTAL ADDITION TO RELIEF REQUEST MR 02-018-2 FOR CRDM REMNANT J-GROOVE WELD REPAIR OVERLAP (TAC NO. MC3221)

By letter dated May 13, 2004, as supplemented by letters dated May 15 and May 20, 2004, Nuclear Management Company (NMC, the licensee), submitted a supplement to its relief request MR 02-018-2 requesting relief from selected American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI requirements related to the reactor pressure vessel control rod drive mechanism (CRDM) J-groove weld repairs that overlap remnant J-groove welds at Point Beach Nuclear Plant Unit 1. This supplement was submitted by the licensee per the staff's September 10, 2003 safety evaluation requiring the licensee to submit a relief request which provides adequate technical justification if the licensee determines repairs to a CRDM result in an Alloy 52 overlap onto remnant J-groove weld(s).

The staff concludes that the alternative requested by the licensee, to operate one cycle with an Alloy 52 weld repair which overlaps the remnant J-groove weld(s), supported by the submitted plant specific analysis, is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for one cycle of operation at Point Beach Nuclear Plant Unit 1. Relief request MR 02-018-01 and the request made in Supplement 3 to the relief request dated May 21, 2004, will be addressed in separate safety evaluations.

Docket No.: 50-266

Attachment: As stated

CONTACT: T.K. Steingass, EMCB/DE
(301) 415-3312

B-48

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPLEMENTAL REPAIR SUBMITTAL
RELIEF REQUEST MR 02-018-2
POINT BEACH NUCLEAR STATION UNIT 1
NUCLEAR MANAGEMENT COMPANY
DOCKET NUMBER 50-266

1.0 INTRODUCTION

By letter dated May 13, 2004, as supplemented by letters dated May 15 and May 20, 2004, Nuclear Management Company (NMC, the licensee), submitted a supplement to relief request MR 02-018-02 requesting relief from selected American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section XI requirements related to the reactor pressure vessel control rod drive mechanism (CRDM) J-groove weld repairs that overlap remnant J-groove weld at Point Beach Nuclear Plant Unit 1 (PBNP). This supplement was submitted by the licensee per the staff's September 10, 2003 safety evaluation condition where the staff granted relief pursuant to 10 CFR 50.55a(g)(6)(i) for instances when the repair weld does not come into contact with the remnant J-groove weld pressure boundary. A separate submittal with additional technical justification was required if the repair weld came into contact and would overlap the remnant J-groove weld.

The supplement to the relief request would authorize the use of the repair methodology approved by the staff's September 10, 2003 safety evaluation to include CRDM weld repairs where Alloy 52 weld metal would overlap the remnant J-groove weld due to the thickness and radius of curvature of the reactor vessel closure head (RVCH). By letter dated September 10, 2003, the staff's granting of relief was for relief request MR 02-018-02 which applied to both PBNP Units 1 and 2 under TAC numbers MB6185 and MB8436. This was based on the licensee's April 10, 2003 letter which expanded the original relief request from Unit 1 to include Unit 2 and that all references and calculations (with the exception of outage dates) be interchanged with a reference to PBNP Unit 2. The licensee's supplemental letters dated May 15 and May 20, 2004, addressed alternatives applicable to relief requests MR 02-018-01 and MR 02-018-02 for both Units 1 and 2. This safety evaluation applies to the requested alternative as it applies to PBNP Unit 1 only for relief request MR 02-018-02. The staff's review of relief request MR 02-018-01 as it applies to Units 1 and 2 will be by separate safety evaluation.

2.0 REGULATORY EVALUATION

Alternatives to requirements may be authorized or relief granted by the NRC pursuant to 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), or 10 CFR 50.55a(g)(6)(i). In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI of items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to Commission approval. Portions of editions and addenda may be used provided that related requirements of the respective editions and

addenda are met. In its supplemental letter dated May 13, 2004, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested a revision to the relief granted by the staff's safety evaluation dated September 24, 2003, as a proposed alternative to the implementation of the requirements of the 1998 Edition of ASME Code Section XI, IWA-3300(b), IWB-3142.4, and IWB-3420 which require characterization of flaw(s) existing in the remnant of the J-groove weld(s) that will remain in service for Point Beach Unit 1 RVCHs if a CRDM nozzle must be partially removed and a new pressure boundary deposited over a portion of the J-groove weld remnant.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements for which Relief is Requested

The licensee requested relief from the requirements of the 1998 Edition of ASME Code Section XI, IWA-3300(b), IWB-3142.4, and IWB-3420. The licensee proposed alternatives to the following ASME Section XI requirements:

Item 1 - IWA-3300(b) requires that flaws shall be characterized in accordance with IWA-3310 through IWA-3390, as applicable.

Item 2 -IWB-3142.4 states in part that a component accepted for continued service based on an analytical evaluation shall be subsequently examined in accordance with IWB-2420(b) and (c).

Item 3 - IWB-3420 states in part that each detected flaw or group of flaws shall be characterized by the rules of IWA-3300 to establish the dimensions of the flaws.

3.1.1 System/Component(s) for which Relief is Requested

The requested relief from the flaw characterization requirements applies to pressure-retaining Alloy 52 repair welds to CRDM nozzles when the repair weld overlaps by direct contact with the remnant J-groove Alloy 82/182 weld in the RVCH.

3.2 Licensee's Proposed Alternative and Bases

Proposed Alternative - Pursuant to the alternative provisions in 10 CFR 50.55a(a)(3)(i), the licensee proposed that the overlap condition(s) be acceptable by analytical evaluation for one cycle of operation then removed from service.

Technical Basis -The licensee stated that the basis in its original relief request remain applicable to this request. In addition the licensee stated that the repairs on the uphill side of the penetrations in the outer ring of the RVCH such as penetration #26, cannot physically be performed without overlapping the new pressure boundary weld onto portions of the remnant J-groove weld due to the high curvature of the RVCH in this area. Westinghouse 2-loop plants have a higher head curvature than most plants due to the reactor vessel diameter being smaller (132 inches).

The licensee conservatively decided to remove several surface indications on the Unit 1 CRDM nozzle #26 J-groove weld by repair of the nozzle rather than to remove the flaws by grinding in order to minimize dose to personnel. The small diameter RVCH resulted in an overlap condition where the new Alloy 52 pressure retaining boundary came into contact with the remnant J-groove weld. The licensee evaluated an alternative which involved separating the overlap condition via grinding. This alternative resulted in an accumulated dose of 15 man-rem due to the high degree of physical contact with irradiated components.

The licensee stated that an analytical evaluation using Alloy 600 crack growth rates as documented in EPRI MRP-55, "Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick-Wall Alloy 600 Material," showed that a worst-case flaw in an Alloy 82/182 weld would take in excess of 1.5 effective full power years (EFPY) to go through the remaining weld ligament of 0.26 inches. Since the actual ligament is 0.5 inches at PBNP, the plant specific calculations demonstrated that the worst case flaw would require over two years to pass through the Alloy 52 heat affected zone ligament using the crack growth rates specific to Alloy 600 material. Finally, in its supplemental letter dated May 15, 2004, the licensee submitted revised calculations which used Alloy 82/182 crack growth rates, which were more conservative when compared to those of the Alloy 600 material. Those results showed that it would take 1.39 EFPY for an assumed 0.100" root defect located at the weld/head interface to propagate through the Alloy 52 weld. Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee stated that the analytical evaluation submitted shows the existing overlap condition provides an acceptable level of quality and safety.

3.3 Evaluation

The Alloy 52 repair weld overlap on the Alloy 82/182 remnant J-groove weld condition noted by the licensee occurs due to the high radius of curvature for a Westinghouse two-loop design of the RVCH. Figure 1 below shows the condition which occurs on the uphill side of outer ring RVCH nozzles:

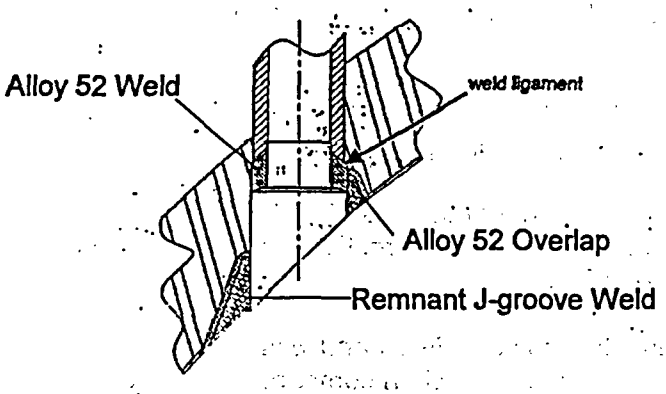

Figure 1

The licensee postulated that the remnant J-groove weld was completely cracked and that a 0.50" ligament of sound metal remained at the Alloy 52 weld overlap. The staff noted that the licensee had applied the Alloy 600 crack growth (MRP-55) rate to determine the amount of time before a postulated flaw in the remnant J-groove weld would grow through the ligament. The staff's conclusion is that using the MRP-55 model for this specific weld overlap configuration is not conservative, and that a more representative model will be gained by using an Alloy 82/182 crack growth rate.

In its supplemental letter dated May 15, 2004, in response to the staff's request for additional information, the licensee provided an analytical evaluation of the same configuration using the crack growth rate for Alloy 82/182 as the basis for the model in determining the amount of time involved for the postulated flaw to grow through the Alloy 52 ligament. The staff concludes that the use of the Alloy 82/182 crack growth rate is a more conservative representation for Alloy 52 since published information indicates that the crack growth rates are 5 - 6 times higher in Alloy 82 welds than in Alloy 600 nozzle materials. Secondly, since Alloy 52 and Alloy 82 are both coarse-grained austenitic welds, the 82/182 crack growth rate model is more representative than when compared to the rolled, annealed Alloy 600 material crack growth model. The subject calculation package, "Point Beach Unit 1 CRDM Top Head Analysis, PBCH-09Q-302," used the following assumptions:

1. Stress intensity factors at the interface of the new, Alloy 52 repair weld and the original Alloy 82/182 J-groove weld were computed assuming the entire original J-groove weld to be cracked.

2. The use of a crack growth law recommended by a panel of industry experts for Alloy 82/182 weld metals to calculate the time for the Alloy 52 diluted zone to crack through its full segment (proprietary information submitted by supplemental letter dated May 25, 2004).

3. The PWSCC crack growth correlation was adjusted to the Point Beach head operating temperature of 592°F due to the lower operating temperature.

4. The calculation assumed a 0.100" weld root defect was present in the triple point area of Alloy 52 and the RVCH ferritic material thereby using the remaining 0.400" ligament for the postulated flaw to grow through.

5. The calculations assumed that the postulated flaw grew axially/radially since the applied plus residual stresses in the hoop direction are greater than those in the radial direction by a factor of two to four.

6. Fatigue crack growth was considered and was estimated at approximately 0.0002" and therefore considered negligible when compared to PWSCC propagation.

The staff notes that published data verifies the appropriateness of the licensee's assumption that a 0.100" root defect may exist at the weld triple point of the Alloy 82, Alloy 600 and ferritic material of the RPV head. The results of the analysis indicated that assuming a 0.100" root defect contacts the fully cracked remnant, the time required for the assumed flaw to propagate through the remaining ligament would be 1.39 EFPY of operation. This is nearly the remaining amount of time the licensee will operate before retiring the RVCH from service since the

licensee intends to replace the Point Beach Unit 1 head after 1.5 EFPY of operation. Based on the conservative assumptions in the licensee's revised calculations, the staff concludes that it would take in excess of 1.5 EFPY for a flaw to propagate through the J-groove weld with an overlap condition, and is therefore acceptable.

When considering the conclusions in the staff's safety evaluation dated September 10, 2003, compliance with the ASME Code requirements therein were predicated on the fact that a new Alloy 52 pressure retaining boundary was not coming into contact with the remnant, assumed cracked, J-groove weld. On that assumption, the staff concluded that successive inspections in accordance with ASME Code Section XI, IWB-3142 were not necessary. Under this configuration, since the licensee will be removing the head from service after one operating cycle (1.5 EFPY), the same successive inspections required by IWB-3142.4 do not apply and the alternative to remove the RVCH from service after one cycle of operation is therefore, acceptable to the staff. Secondly, since the morphology and weld structure is the same for the non-overlap condition and the Alloy 52/82 overlap condition, the conclusions in the previous safety evaluation regarding impracticality of characterizing defects in the remnant J-groove weld still apply. The staff concludes that the previously granted relief from the requirements of IWA-3300 and IWB-3640, remain in effect for this repair situation.

In its supplemental letter dated May 20, 2004, the licensee provided additional information supporting its dose estimate of 15 man-rem to separate the welds. The work involved with this evolution was listed as:

1. Set up ladders and support equipment
2. Install template
3. Layout the grind location
4. Inspect
5. Grind, etch and measure - estimated 12 people to grind
6. Quality Control measurement
7. Swab nozzle to clean
8. Clean the nozzle(s) ground area for liquid penetrant examination
9. Perform liquid penetrant examination - requires four entries under head

Based on the information provided by the licensee indicating that removal of the overlap condition will result in 15 man-rem of dose, the licensee has sufficiently justified the hardship involved with removing the overlap condition by grinding. The conservative assumptions in the revised calculations indicate that an actual flaw would require more than 1.39 EFPY to grow through the J-groove weld. Based on the analytical information provided by the licensee, the short time of operation (1.5 EFPY) prior to removal of the RCVH from service, and the staff conclusion that no safety concern exists for this configuration due to its short operating time, the staff finds the alternative provides an acceptable level of quality and safety.

4.0 CONCLUSION

The staff has reviewed the licensee's submittal and determined that in accordance with 10 CFR 50.55a(a)(3)(i), the proposed alternative to overlap a remnant J-groove weld with Alloy 52 and operate 1.5 EFPY before retiring the RVCH from service, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the licensee's proposed alternative for 1.5 EFPY of operation as a supplement to relief request MR 02-018-02 which granted relief by the staff by safety evaluation dated September 10, 2003 for Point Beach Unit 1.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.