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A Progress Energy Company

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United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

REQUEST FOR RELIEF NO. 33 REGARDING EXAMINATION
OF CONTROL ROD DRIVE MECHANISM HOUSING SEAL WELD

Ladies and Gentlemen:

In accordance with 10 CFR 50.55a(3)(ii), H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, requests relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, 1986 Edition with no Addenda, Paragraph IWA-4120, which require liquid penetrant examination of CRDM weld repairs.

In this regard, please find attached the supporting details and technical information associated with HBRSEP, Unit No. 2, Relief Request No. 33.

ASME B&PV Code, Section XI, Paragraph IWA-4120 of the Code requires that repairs be performed in accordance with the owner's original construction code of the component or system, or later editions and addenda of the construction code. The HBRSEP, Unit No. 2 CRDMs were designed and fabricated as ASME B&PV Code, Section III, 1965 Edition, Class A components. The repair of the CRDM will be a weld overlay technique as performed by Welding Services Incorporated, of Atlanta, Ga.

During Refueling Outage (RO) 20 activities to detension the vessel studs, boric acid crystals were found on the surface of the Reactor Vessel Head, insulation and CRDM housings. The boric acid crystals were determined to be coming from the CRDM housing lower canopy seal weld of CRDM Number 68 at location B-10. Two leaks were identified on the B-10 CRDM, but the actual flaws were not visually discernable. Staining from the reactor coolant was evident, identifying the location of the leaks. The seal welds are required to be repaired prior to completion of RO-20. The weld overlay is considered a repair in accordance with ASME B&PV Code, Section XI, Paragraph IWA-4000, because the weld is performed on an appurtenance to a pressure retaining component.

Robinson Nuclear Plant
3581 West Entrance Road
Hartsville, SC 29550

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An alternative examination is proposed in the attached Relief Request No. 33. Relief is requested from code requirements on the basis that the Code examination would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

HBRSEP, Unit No. 2, is currently in the Third Ten-Year Inservice Inspection (ISI) Interval, which began on February 19, 1992.

The requested relief, if approved, will be implemented during the HBRSEP, Unit No. 2, Third Ten-Year ISI Interval and is needed in RO-20, which is in progress. Approval of this relief is requested on or before April 21, 2001, at 2200 EDT, to permit effective completion of this repair during RO-20.

Similar relief requests have been granted to Carolina Power & Light Company's Shearon Harris Nuclear Power Plant by letter dated November 6, 1998, Northern States Power's Prairie Island Nuclear Generating Plant, by letter dated January 22, 1999, Tennessee Valley Authority's (TVA) Watts Bar Nuclear Plant by letter dated August 25, 1999, and TVA's Sequoyah Nuclear Plant by letter dated September 12, 2000.

If you have any questions concerning this matter, please contact me or Mr. H. K. Chernoff.

Sincerely,

Timothy P. Cleary

Timothy P. Cleary
Plant General Manager

ALG/alg

Attachment

c: L. A. Reyes, USNRC, Region II
R. Subbaratnam, NRC, NRR
NRC Resident Inspector, HBRSEP

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

REQUEST FOR RELIEF NO. 33 REGARDING EXAMINATION OF CONTROL ROD DRIVE MECHANISM HOUSING SEAL WELD

Components for Which Relief is Requested

The component applicable to this relief request is the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, Reactor Pressure Vessel (RPV) Control Rod Drive Mechanism (CRDM) number 68. The CRDM is in location B-10 on a peripheral row of CRDM and other penetrations. The CRDMs are located on the vessel head inside the cooling shroud. The CRDMs are used for withdrawal and insertion of the rod cluster control assemblies into the reactor core and provide stationary support. The CRDM housing and Reactor Vessel Head adapters are the pressure retaining parts of the drive mechanism. The threaded connection between these two components carries the structural loads and is considered the pressure boundary. Leakage from the threaded connection is prevented by a seal weld on the mechanical attachment of the CRDM housing to the Reactor Vessel Head adapter.

Code Examination Requirements

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, 1986 Edition with no Addenda, Paragraph IWA-4120(a) requires that repairs to pressure retaining components and their supports, including appurtenances and subassemblies or parts of a component be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system, or later editions and addenda of the construction code. The CRDMs were designed and fabricated in accordance with ASME B&PV Code, 1965 Edition, Section III as a Class A component. The repair of the CRDM will be performed using Code Case N-504-1, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1," as guidance except as noted below. Code Case N-504-1 has been accepted by the NRC in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 12, May 1999. Code Case N-504-1, paragraph (c) requires that prior to the deposition of weld reinforcement, the surface to be repaired shall be examined by the liquid penetrant method. Paragraph (d) requires that if preparation of one or more layers of weld overlay is required, the area to be deposited shall be examined by the liquid penetrant method. Paragraph (i) requires that pre-service examination of the repair be performed in accordance with IWB-2200, which requires a liquid penetrant examination of the completed weld repair is required.

Code Case N-504-1 examinations include cleaning, application of penetrant, cleaning of penetrant, application of developer, visually examining the surfaces, and cleaning the surface again. Three separate examinations may be required as follows:

1) An initial examination of the surface prior to welding;

2) An examination of the weld passes used to seal the indications; and,

3) The final overlay surface examination.

In addition, exceptions to Code Case N-504-1, Paragraphs (b), (e), and (f) are taken and are described in the proposed alternative below.

Requested Relief

HBRSEP, Unit No. 2, requests relief from ASME B&PV Code, Section XI, 1986 Edition with no Addenda, Paragraph IWA-4120, and proposes to perform a weld repair using Code Case N-504-1, as guidance. An alternative visual (VT-1) examination technique is proposed using a camera to facilitate observation of weld flaws in lieu of Code Case N-504-1, Paragraphs (c), (d), and (i) for pre-weld and post-weld examinations for the CRDM weld repair.

This relief is requested for and will be implemented in the Third Ten-Year Inservice Inspection (ISI) Interval, which began on February 19, 1992.

Basis for Requested Relief

HBRSEP, Unit No. 2, requests relief in accordance with 10 CFR 50.55a(a)(3)(ii) from the required surface examination on the basis that compliance with the Code would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

During Refueling Outage (RO) 20 activities to detension the vessel studs, boric acid crystals were found on the surface of the Reactor Vessel Head, insulation and CRDM housings. The boric acid crystals were determined to be coming from the CRDM housing lower canopy seal weld of CRDM Number 68 at location B-10. Two leaks were identified on the CRDM, but the actual flaws were not visually discernable. Staining from the reactor coolant was evident, identifying the location of the leaks. Industry experience of failure analyses performed on leaking canopy seal welds removed from service at other plants have attributed the majority of cases to transgranular stress corrosion cracking. The size of the opening where leakage occurs has been extremely small, normally only a few thousandths of an inch in size. The crack orientations vary, but often radiate outward such that a pinhole appears on the surface, as opposed to a long crack. The stress corrosion cracking results from exposure of a susceptible material (i.e., Type 308 stainless steel) to residual stress, which is often concentrated by weld discontinuities, and to a corrosive environment, such as water trapped in the cavity behind the seal weld which was mixed with the air initially in the cavity, resulting in a higher oxygen content than is in the bulk primary coolant.

The two leaks are in a single CRDM seal weld, located in a peripheral row of CRDMs. The larger leak is facing toward the center of the RV head, while the smaller leak faces outward. It is possible to perform the code case required liquid penetrant inspections, but significantly higher occupational dose will be incurred.

The seal welds are required to be repaired prior to completion of RO-20. As allowed by the guidance of Code Case N-504-1, the flaws will not be removed, but an analysis of the repaired weldment has been performed using Code Case N-504-1, Paragraph (g) as guidance to assure the remaining flaw will not propagate unacceptably. The analysis shows that the visual method is capable of detecting flaws sufficiently below the critical flaw size to assure a sufficient safety margin of 3.0. The canopy seal weld is not a structural weld, nor a pressure retaining weld, but provides a seal to prevent reactor coolant leakage. The weld buildup is considered a repair in accordance with ASME B&PV Code, Section XI, Paragraph IWA-4000, because the weld is performed on an appurtenance to a pressure retaining component. Figure 1 shows a section view of the weld repair.

Proposed Alternative Examinations

The alternative technique is a weld overlay with a visual (VT-1) examination in accordance with ASME B&PV, Code, Section XI, Paragraph IWA-2211. The VT-1 examination will use a video camera with approximately 8X magnification, within several inches of the leaking weld, which is mounted to view the weld. The weld repair uses a Gas Tungsten Arc Welding (GTAW) process controlled remotely. Alloy 52 nickel-based overlay material was selected for the repair rather than austenitic stainless steel as required by Code Case N-504-1, Paragraph (b). Alloy 52 was selected because of this alloy's resistance to stress corrosion cracking. Consequently, the ferrite requirements of Code Case N-504-1, Paragraph (e) do not apply.

The repair method was chosen to reduce radiation exposure to workers. The alternate repair methods considered were: 1) a mechanical clamp, and 2) a repair involving excavation of the flaws and restoration to the original configuration. The mechanical clamp requires future bolt torquing and inspections and reduces the space available for repairing adjacent CRDMs. The clamp method would not require inspections of the flaws or of the repair. The traditional repair method requires manual excavation of the flaws, manual repair welding, and has a higher risk of failure due to the difficulty of making a quality weld on the canopy accompanied by the required back-purging and cleaning. This repair also requires surface examinations, and would incur higher dose.

In lieu of Code Case N-504-1 paragraph (f) design requirements, the ASME B&PV Code, 1986 Edition, No addenda, Section III design requirements for canopy seal welds will be applied to the repair. The threaded connection between the CRDM latch housing and the adapter will resist bending moments or secondary stresses applied to the connection, and the canopy seal weld will not be required to resist such loadings. The canopy seal weld design requirements specified in Paragraph NB-3227.7 of Section III, "Requirements for Specially Designed Welded

Seals" are used to determine if the overlay design will withstand the operating pressure applied at operating temperatures.

The GTAW overlay weld repair method results in lower radiation exposure because the equipment is remotely operated after setup. The visual examination system eliminates the need for an inspector to place himself within 2 feet of the CRDM for a cumulative period of approximately 2 hours during the three phases of required surface examinations.

The 8X visual examination method permits separate examinations to be performed on the weld passes, consisting of an examination of the surface before and after welding, and an examination while the weld deposit is being applied. Potential flaws resulting from contamination of the weld deposit, burn-through, or blow back can be seen as soon as they occur, and welding can be stopped to permit correction of the problems immediately. After each bead is applied in one direction, the machine is rotated back in the other direction permitting visual examination of the entire bead, including overlaps. No additional radiation exposure other than that required to set up the welding equipment is required.

Code Case N-504-1, Paragraph (h) requires pressure testing in accordance with ASME B&PV Code, Section XI, Paragraph IWA-5000. Because the canopy seal weld is not a pressure retaining component, a system leakage, inservice, or functional test will be performed as stated in the Code case.

The general dose rate averages approximately 700 mRem/hr at the CRDMs. Work techniques to reduce occupational dose As Low As Reasonably Achievable (ALARA) will be employed as necessary. Installation of temporary shielding is not feasible, as it would interfere with the required inspections.

Based upon an estimated total time of two hours to perform the liquid penetrant examinations, the occupational exposure from the required Code Case examinations will add approximately 1.4 person-Rem to the total repair dose.

Due to the overlapping nature of the weld surfaces, there is the potential for false positive indications using a liquid penetrant examination. If the examination results in false positive indications, additional dose will be incurred for additional examinations as needed to clean and repair the indications. This could result in an additional occupational dose of approximately 975-1000 mRem.

The remotely operated VT-1 alternative examination technique avoids placing workers in close proximity to the CRDMs for extended periods to perform the examinations.

Implementation Schedule

This relief is requested for and will be implemented in the HBRSEP, Unit No. 2, Third Ten-Year ISI Interval, which began on February 19, 1992.

The requested relief, if approved, will be implemented during the HBRSEP, Unit No. 2, Third Ten-Year ISI Interval and is needed in RO-20, which is in progress. Approval of this relief is requested on or before April 21, 2001, at 2200 EDT to permit effective completion of this repair during RO-20.

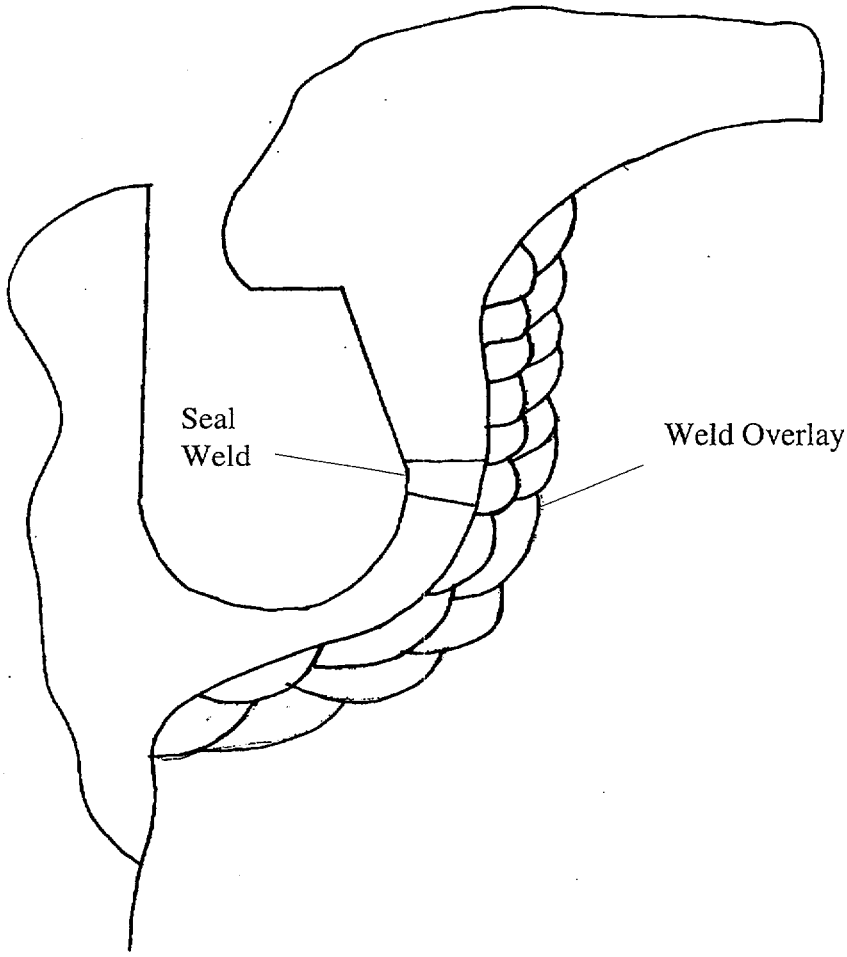

FIGURE 1
SECTION VIEW OF WELD REPAIR