June 30, 2003

MEMORANDUM TO: Eric Duncan, Chief
Branch 5
Division of Reactor Projects

FROM: David Hills, Chief ***/RA/***

Mechanical Engineering Branch
Division of Reactor Safety

SUBJECT: D. C. COOK NUCLEAR POWER PLANT, UNIT 2,
DRS INPUT TO INTEGRATED REPORT 50-315/03-06;
50-316/03-06

Attached is the report input for the D. C. Cook Nuclear Power Plant, Unit 2, Inspection Report 50-315/03-06; 50-316/03-06. This report input documents completion of TI 2515/150 Reactor Pressure Vessel Head and Vessel Head Penetration Nozzles and IP 71111.08 Inservice Inspection Activities for Unit 2. I have reviewed this input and have determined it is ready for distribution to the licensee and dissemination to the public. Additionally, please place A. Hiser of NRR on distribution for this report as required by TI 2515/150.

Attachment: Input to Inspection Report 50-315/03-06;
50-316/03-06

CONTACT: M. Holmberg, DRS
(630) 829-9748

DOCUMENT NAME:C:\ORPCheckout\FileNET\ML031820486.wpd
To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	RIII		RIII	N				
NAME	MHolmberg:aa		DHills					
DATE	06/30/03		06/30/03					

OFFICIAL RECORD COPY

Cover Letter

__X__ No input, no significant findings.

Title Page

Inspector: M. Holmberg, Reactor Inspector

SUMMARY OF FINDINGS

ADAMS boilerplate - Inspectable area: Inservice Inspection Activities.

Modify second paragraph as follows:

The inspection was conducted by an inspector based in the Region III office.

REPORT DETAILS

1. REACTOR SAFETY

1R08 Inservice Inspection Activities (71111.08)

a. Inspection Scope

The inspectors evaluated the implementation of the licensee's inservice inspection program for monitoring degradation of the reactor coolant system boundary and risk significant piping system boundaries, based on review of records and in-process observation of nondestructive examinations.

From May 13 through 15, 2003, inside the Unit 2 containment, the inspectors observed:

- ultrasonic (UT) examination of steam generator (SG) 24 nozzle-to-shell weld (STM-24-MSN) in the Unit 2 Containment;
- UT examination of SG 24 nozzle inner radius (STM-24-MSN-IRS) in the Unit 2 Containment; and
- magnetic particle examination of steam generator 24 nozzle-to-shell weld (STM-24-MSN) in the Unit 2 Containment.

From May 20 through 23, 2003, in an office on the third floor of the on-site service building, the inspectors reviewed repair and replacement records required by the American Society of Mechanical Engineers (ASME) Code for the performance of:

- replacement of a 2 inch diameter loop isolation valve 1-RC-102-L2; and
- removal and reinstallation of a 6 inch diameter section of charging pipe to support repair of charging pump 2-PP-50W.

The records reviewed and activities observed were evaluated for conformance with requirements in the ASME Code, Section III, Section V, Section IX, and Section XI.

The the licensee did not perform activities associated with two inspection items identified in IP 7111108, and therefore, no inspection was performed for these items. Specifically, the licensee had not identified any examinations during the previous outage with recordable indications, and thus no samples were available for review. Additionally, the licensee did not inspect the Unit 2 SGs and thus, no SG related activities could be reviewed.

b. Findings

No findings of significance were identified.

4OA2 Identification and Resolution of Problems

.1 Routine Review of Identification and Resolution of Problems

a. Inspection Scope

From May 14, 2003, through June 4, 2003, in an office on the third floor of the on-site service building, the inspectors performed a review of a sample of inservice inspection related problems that were identified by the licensee and entered into the corrective action program. The inspectors reviewed these corrective action program documents to confirm that the licensee had appropriately described the scope of the problems. Additionally, the inspectors' review included confirmation that the licensee had an appropriate threshold for identifying issues and had implemented effective corrective actions. The inspectors performed these reviews to ensure compliance with 10 CFR Part 50 Appendix B, Criterion XVI, "Corrective Action" requirements. The specific corrective action documents that were reviewed by the inspectors are listed in the attachment to this report.

b. Findings

No findings of significance were identified.

4. OTHER ACTIVITIES

4OA5 Other Activities

.1 Reactor Pressure Vessel Head and Vessel Head Penetration Nozzles (TI 2515/150)

a. Inspection Scope

On August 9, 2002, the NRC issued Bulletin 2002-02, "Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs." The purpose of this Bulleting was to: (1) Advise pressurized water reactor (PWR) licensees that visual examinations, as a primary inspection method for reactor pressure vessel head and

vessel head penetration (VHP) nozzles, may need to be supplemented with additional measures; (2) Advise PWR licensees that inspection methods and frequencies to demonstrate compliance with applicable regulations should be demonstrated as effective and reliable; (3) Request information from all PWR addressees concerning the Reactor Pressure Vessel (RPV) head and VHP nozzle inspection programs; and (4) Require all PWR addressees to provide written responses to this bulletin related to their inspection program plans.

On February 11, 2003, the NRC issued Order EA-03-009 (NRC Accession Number ML030410402). The purpose of this order was to require specific inspections of the RPV head and associated penetration nozzles. The purpose of TI-150 -150, "Reactor Pressure Vessel Head and Vessel Head Penetration Nozzles," Draft Revision 2 was to support the review of licensees' RPV head and VHP nozzle inspection activities required by NRC Order EA-03-009. This NRC review served to confirm that the licensee used procedures, equipment, and personnel that had been demonstrated to be effective in the detection and sizing of primary water stress corrosion cracking (PWSCC) in VHP nozzles and detection of RPV head wastage. Additionally, this NRC review served to promote information gathering to help the NRC identify and shape possible future regulatory positions, generic communications, and rulemaking. For these reasons, the inspectors' documented observations (including minor violations of NRC requirements) and conclusions in response to the questions identified in TI-150 associated with the licensee's RPV head inspection activities.

From May 12 through June 4, 2002, in the on-site vendor trailer (unless otherwise stated), the inspectors performed a review of the licensee's head inspection related activities in response to NRC Order EA-03-009. To evaluate the licensee's efforts in conducting examination and repair of the reactor vessel head and penetration nozzles, the inspectors:

- performed an independent direct visual examination of the head-to-nozzle interface for portions of 8 nozzles inside the Unit 2 containment;
- observed the licensee's remote visual examination of the RPV head for portions of 20 VHP nozzles;
- observed the videotaped dye penetrant (PT) examination of the RPV head vent J-groove weld which was conducted from under the RPV head;
- conducted interviews with the licensee's nondestructive examination personnel performing non-destructive examinations of the RPV head;
- observed acquisition and analysis of UT and eddy current (ET) data recorded from inspections of eight VHP nozzle locations;
- reviewed in an office on the third floor of the on-site service building the head inspection procedures;
- reviewed in an office on the third floor of the on-site service building, the certification records for the nondestructive examination (NDE) personnel performing examinations of the RPV head;
- reviewed in an office on the third floor of the on-site service building the procedures used for identification and resolution of boric acid leakage from systems and components above the RPV head;

- reviewed in an office on the third floor of the on-site service building, the licensee's corrective actions implemented for boric acid leakage identified on components above the RPV head;
- reviewed in the resident inspectors' office on the fourth floor of the on-site service building, the PT examination records for nozzles No. 43, 73, 74, 75, and the RPV head vent location; and
- reviewed in the resident inspectors' office on the fourth floor of the on-site service building, the video records of PT examinations for nozzles No. 73 and No. 75.

The inspectors conducted these observations to confirm that the licensee performed the vessel head examinations in accordance with requirements of NRC Order EA-03-009, using procedures, equipment, and personnel that have been demonstrated to be effective in the detection and sizing of PWSCC in VHP nozzles and detection of RPV head wastage.

From May 12, 2003, through May 23, 2003, in an office on the third floor of the on-site service building, the inspectors reviewed the licensee's VHP nozzle susceptibility ranking calculation documented in design information transmittal (DIT) B-02726-00 to:

- verify that appropriate plant-specific information was used as input;
- confirm the basis for the head temperature used by licensee; and
- determine if previous VHP cracks had been identified, and if so, documented in the susceptibility ranking calculation.

The inspectors conducted these reviews to confirm that the licensee performed the VHP nozzle susceptibility calculation using best estimate values for input parameters in accordance with requirements of NRC Order EA-03-009.

From May 12, 2003, through May 23, 2003, in an office on the third floor of the on-site service building, the inspectors reviewed licensee procedures and interviewed licensee personnel associated with performing examination of components above the vessel head to identify evidence of leakage. Additionally, the inspectors reviewed the corrective action documented for potential leakage from components containing boric acid above the vessel head. The inspectors conducted observations and review of activities discussed above to evaluate the licensee's conformance to the requirements of NRC Order EA-03-009 associated with performing visual examinations to identify boric acid leakage from components above the RPV head.

From June 2, 2003, through June 4, 2003, in the resident inspectors' office on the fourth floor of the on-site service building, the inspectors performed a review of:

- the flaw evaluations for VHP nozzles No. 59 and No. 64; and
- the repair records (including post repair NDE records) for VHP nozzles No. 74 and No. 43.

The inspectors conducted these reviews to confirm that the licensee met the ASME Code Sections III, IX, XI, and V requirements for Code repairs and NDE. In addition, the inspectors confirmed that for the flaw evaluations of VHP nozzles No. 59 and

No. 64, the licensee applied crack growth rates consistent with NRC accepted flaw growth rates for PWSCC.

b. Observations

Summary

The licensee did not identify any leaking VHP nozzles. The licensee identified shallow crack indications located at the inside surface of VHP nozzles No. 43, 59, 64 and 74, which did not penetrate the nozzle wall. The licensee performed a repair on VHP nozzles No. 43 and No. 74 by removing a small amount of metal from the inside surface which contained the crack indications. For VHP nozzles No. 59 and No. 64, the licensee performed a flaw evaluation to accept these nozzles for continued service.

During the head visual examination, the licensee identified a number of VHP nozzle locations which were categorized as indeterminate because of the quantity/quality of deposits in the head-to-nozzle region. At the conclusion of the inspection, the licensee implemented vacuum cleaning methods and reinspections to attempt to resolve the nozzles with indeterminate visual examinations.

Evaluation of Inspection Requirements

In accordance with requirements of TI-150, the inspectors evaluated and answered the following questions:

1. For each of the examination methods used during the outage, was the examination performed by qualified and knowledgeable personnel? (Briefly describe the personnel training/qualification process used by the licensee for this activity.)

1.1. Upper Head Bare Metal Remote Visual Examination

Yes. The licensee conducted a remote visual examination of the top surface of the RPV head with knowledgeable staff members certified to Level II as VT-2 examiners in accordance with programs meeting the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A. Additionally, the licensee inspection staff had been trained on Electric Power Research Institute (EPRI) Report TR 1006296, “Visual Examination For Leakage Of PWR Reactor Head Penetrations,” Revision 2, issued in March of 2003. The inspectors reviewed this document that contained an extensive number of color pictures of VHP nozzle leakage which had been identified during head visual inspections at US PWR sites through the end of 2002. This report also contained pictures of leakage on the vessel heads at several plants from conoseal or other leakage sources above the head.

1.2. Under Head Volumetric and Surface Examinations

Yes. The licensee's vendor conducted the under head UT and ET examinations using personnel who were qualified in accordance with programs meeting the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A or CP-189. The personnel typically had extensive experience with the UT and ET techniques which were being used.

The inspectors identified an isolated training weakness in a licensee vendor UT data analyst knowledge level associated with the UT leakage path signature. The inspectors questioned a night shift vendor UT analyst responsible for analyzing UT data on the VHP nozzles. This analyst did not appear to be knowledgeable on the physical phenomena responsible for the leakage path signature in the UT data (e.g. that the loss of RPV head material causes a loss in the VHP nozzle-to-head interference fit, creating an air gap that is responsible for the change in UT backwall signal amplitude). This analyst incorrectly stated that the leak path UT signature was caused by the loss of metal (Inconel) from the VHP nozzle, instead of loss of RPV head material (carbon steel). The inspectors interviewed other vendor analysts including the lead analyst and did not see a common weakness in understanding the physical representation of the leakage path UT signature. Therefore, the inspectors concluded that this example represented an isolated case of lack of effective training. The licensee's vendor rereviewed the UT data completed by this analyst to confirm that no leakage paths had been misinterpreted.

1.3 Under Head PT Examinations

Yes. The licensee's vendor conducted the under head PT examinations using personnel which were qualified for PT in accordance with programs meeting the requirements of the American Society for Nondestructive Testing Recommended Practice SNT-TC-1A. The licensee's staff performing PT examinations had extensive experience with the manual solvent removable PT technique used.

2. For each of the examination methods used during the outage, was the examination performed in accordance with demonstrated procedures?

2.1 Upper Head Bare Metal Remote Visual Examination

Yes. The licensee performed a demonstrated remote visual examination of the vessel head and penetration nozzles using three cameras mounted to a robotic crawler in accordance with procedure MRS-SSP-1483-AMP "Rx Vessel Head Penetration Remote Visual Inspections For D. C. Cook, Unit 2." The licensee demonstrated the capability of the remote camera system to resolve color and 0.158 inch high lower case alpha numeric characters from 12 inches. However, the inspectors noted that this visual demonstration standard was less restrictive than an existing boric acid inspection procedure 12 QHP-5050-NDE-027, "Visual Examination For Boric Acid And Condition Of Component Surfaces" which required resolution of smaller characters at greater distances. The licensee

used this 12 inch distance as the maximum distance allowed for the examination of the nozzle interface area and similarly established a minimum distance for resolution of these alphanumeric characters.

The inspectors reviewed the videotape of the licensee's demonstration of color acuity and visual resolution and noted that it was consistent with the procedure requirements. The inspectors performed a direct visual inspection for portions of eight head penetration nozzles viewable at the 200 degree head azimuth location through removed insulation at this location. Based on this examination, the inspectors noted that the remote picture quality appeared to provide superior inspection to that available based on a direct visual examination conducted from the access doors in the service structure. Overall, the inspectors considered that the quality of the remote visual examination was excellent based on the ability to resolve very small debris at the VHP nozzle-to-head interfaces.

2.2 Under Head Volumetric and Surface Examinations

The inspectors identified that none of the NDE procedures used to acquire or analyze NDE data for examinations of penetration nozzles below the vessel head contained or referenced acceptance criteria for any flaws identified. Each procedure contained appropriate recording criteria for determining and recording flaw sizes, but did not include identification of the root mean square sizing accuracy which had been documented during demonstration of the UT & ET techniques. The licensee stated that any flaws identified would be entered into the corrective action system and evaluated with appropriate criteria on a case-by-case basis.

The licensee was required to perform an assessment of leakage through the J-weld into the interference zone when performing UT examination of the nozzles in accordance with NRC Order EA-03-009. The licensee committed to perform this assessment in a letter dated March 26, 2003, which requested relaxation from some of the Order requirements. Specifically, the licensee stated that visual examination results in conjunction with evaluating the ultrasonic examination results would be used in their assessment to determine if leakage was occurring into the interference fit zone. The inspectors identified that the licensee's UT analysis guidelines WDI-UT-013, "CRDM/ICI UT Analysis Guidelines," Revision 2, did not clearly define what to consider a leakage path in the interference fit zone. On May 15, 2003, the inspectors observations prompted the licensee to issue Field Change Notice No. 3 to procedure WDI-UT-013, which provided pictorial C-scan backwall displays and additional instructions for analysts to use for identification of a leakage path UT signature in the interference fit zone. The licensee's vendor then re-reviewed all UT data acquired to this point to ensure that a leakage path would be adequately identified and evaluated.

2.2.a Penetration Nozzles 10 Through 78

Yes. For the VHP nozzles with thermal sleeves, the licensee used a blade probe with UT transducers and ET coils in accordance with demonstrated procedures WDI-UT-010, "IntraSpect Ultrasonic Procedure For Inspection Of Rx Vessel Head Penetrations/Time Of Flight Ultrasonic, Longitudinal Wave & Shear Wave," and WDI-ET-003, "IntraSpect Eddy Current Imaging Procedure For Inspection Of Reactor Vessel Head Penetrations." The vendor used a PCS 23.5 type UT probe which contained transducers set up for time-of-flight-tip-diffraction (TOFT) and a X-wound ET coil. The licensee's vendor provided a copy of the EPRI Materials Reliability Project Report Updated December 11, 2002, in which they had performed a demonstration of their PCS 24 probe. The licensee vendor stated that they had actually used a PCS 23.5 probe during this demonstration which was performed on a mockup CRDM penetration nozzle with simulated cracks and electric discharge machined notches of known dimensions. In this demonstration, the licensee's vendor was not completely successful in identification of flaws less than 10 percent through-wall from the outside surface. The vendor had also performed an internal demonstration (reference internal Wesdyne Leakage Detection Report, dated March of 2003) of the capability of the PCS 23.5 TOFT transducers to detect a simulated leakage path in the nozzle interference fit zone on a vendor mockup CRDM nozzle. This mockup contained a shrink fit steel collar with two axial notches and two holes which simulated the loss of interference fit observed during UT of head penetration nozzles with J-groove weld leakage and RPV head wastage.

The inspectors identified that the licensee had changed the UT equipment from the demonstrated equipment configuration. Specifically, the vendor changed the PCS 23.5 probe configuration to a two channel system with a high pass filter that affected both channels. This differed from the demonstrated singe channel configuration without a high pass filter used on the EPRI demonstration mockup. The vendor had implemented this change to be able to use a single probe to perform both the inspection for flaws and monitoring of the UT backwall signal for indications of J-weld leakage. The vendor added the high pass filter to reduce unwanted low frequency energy from the preamplifier. The licensee's vendor documented the equivalency of the revised PCS 23.5 blade probe configuration in internal technical reports (WDI-TJ-008-03, "Sysem Setup Testing Of Blade Probe For Multiple Inspection Sensitivities," Revision 0 and WDI-TJ-007-03, "Installation of High Pass Filter To Improve Blade Probe Inspections," Revision 0). In these reports, the licensee's vendor concluded, that with the filter in the system and operating in a two-channel mode a valid calibration was achieved, the signal-to-noise ratio was improved, and the frequency response was virtually identical compared to the system without a filter operating in a single channel mode. However, the inspectors noted that the vendors' equivalency evaluation only compared signal-to-noise ratio for the channel associated with crack detection in the nozzle base material and not that used for leakage path detection. Therefore, the inspector requested the licensee provide a technical basis to confirm that the equipment change did not affect the

demonstrated qualification for the IntraSpect channel used to identify a leakage path.

On May 17, 2003, the licensee's vendor performed a demonstration on their internal CRDM leakage path mockup to confirm the ability of the PCS 23.5 dual channel probe with a high pass filter. The results of this demonstration and the vendor's conclusions were documented in WesDyne report WDI-TJ-008-03, "System Setup Testing Of Blade Probe For Multiple Inspection Sensitivities," Revision 1. The vendor documented that the high pass filter caused a 4dB drop in sensitivity which was recovered with some increase in over all noise level. The vendor also concluded that "The signal response from the grooves in the shrink fit sample are comparable with or without the high pass filter in line." The inspectors compared the PCS 23.5 probe C-scan data plots with, and without, the filter and noted that there was some degradation in resolution of the grooves and holes in the mockup. The inspectors noted that the smaller hole could not be identified and the narrow groove was more difficult to resolve with the high pass filter in the circuit. On May 21, 2003, the inspectors and NRC staff from the Office of Nuclear Reactor Regulation held a conference call with the licensee and vendor staff to discuss the sensitivity limitations of this UT system and whether these limitation impacted adequacy of the UT inspection. As a result of this discussion, no concerns were identified.

For the 18 penetration nozzles without thermal sleeves, the licensee's vendor used the 7010 open housing scanner with UT and ET probes in accordance with WDI-UT-010, "IntraSpect Ultrasonic Procedure For Inspection Of Rx Vessel Head Penetrations/Time Of Flight Ultrasonic, Longitudinal Wave & Shear Wave," and WDI-ET-003, "IntraSpect Eddy Current Imaging Procedure For Inspection Of Reactor Vessel Head Penetrations." The vendor's 7010 open housing scanner contained similar transducers to the PCS 23.5 blade probe supplemented with a 0 degree UT transducer used to identify the leakage path signature. The licensee's vendor provided a copy of the EPRI Materials Reliability Project Report updated December 11, 2002, which documented a demonstration of the vendor's 7010 open housing scanner. The inspectors noted that in this demonstration the vendor did not identify all flaws less than 10 percent through wall. The inspectors noted that the demonstration which had been performed using the 0 degree transducer appeared to provide better resolution of simulated leakage paths than that demonstrated by the PCS 23.5 blade probe with TOFT transducers.

The licensee's vendor performed UT analysis of data acquired in accordance with WDI-UT-013 "CRDM/ICI UT Analysis Guidelines." The licensee's vendor performed ET analysis of data acquired in accordance with WDI-ET-004, "IntraSpect Eddy Current Analysis Guidelines Inspection Of Reactor Vessel Head Penetrations."

2.2.b Penetration Nozzles 1 Through 9

Yes. For the examination of the center penetration nozzles (no. 1-9), the licensee performed an ET with a cross-wound ET coil of the outer surface of the J-weld and nozzle surface using the "Grooveman" scanner probe in accordance with demonstrated procedure WDI-ET-002 "IntraSpect Eddy Current Inspection Of J-Groove Welds in Vessel Head Penetrations." The vendor provided EPRI Materials Reliability Project Report Updated December 11, 2002 and WDI-TJ-002-02, "Technical Justification For Eddy Current Of J-Groove Welds," which documented a demonstration of this ET probe on a J-weld mockup and provided technical basis for the equipment used.

Yes. The licensee's vendor used an ET gap scanner with dual pancake ET coils for examination of the inside surfaces of the center penetration nozzles (no. 1-9) in accordance with demonstrated procedure WDI-ET-008, "IntraSpect Eddy Current Imaging Procedure For Inspection Of Rx Vessel Head Penetrations With Gap Scanner." The licensee's vendor selected this method over UT techniques due to the potential for interference with thermal sleeve centering tabs. The ET probe had a narrower cross-section and was less susceptible to damage than the UT blade probe. The vendor initially provided EPRI TR-106260, "Demonstrations Of Inspection Technology For Alloy 600 CRDM Head Penetrations," dated October 1996, as the basis for demonstration of this technique. However, this document did not contain any specific descriptions of the ET equipment used, and the vendor subsequently confirmed that the equipment used in this demonstration was not the same as that used on-site.

The inspectors' questions prompted the licensee's vendor to retrieve data and document a more recent demonstration of this equipment. Specifically, the vendor provided a Letter from P. Lara (EPRI) to R. Hall (licensee), dated May 23, 2003, which documented the use of draft revision 0 to procedures WDI-ET-003 and WDI-ET-008 during a mockup demonstration at the vendor facility. The vendor had completed and documented data analysis for this demonstration on May 22, 2003. In the May 23, 2003 letter, the EPRI representative confirmed, that the licensee's vendor had successfully detected all the inside diameter initiated flaws in the EPRI 97-01 mock-up "A." The inspectors noted that this letter did not identify the equipment used on the mockup and requested additional documentation. The licensee provided a letter from B. Rassler (EPRI) to R. Hall (licensee), dated June 4, 2003, which confirmed that the vendor had used the same probes equipment and setup during this mockup demonstration as used on-site.

The inspectors identified that WDI-ET-008 allowed the use of a cross-wound ET coil or dual pancake ET coils without any reference to coil size and spacing. Because the procedure lacked these details, the licensee could have used ET equipment which was not consistent with that demonstrated to be affective at identification of cracks. Title 10 CFR Part 50 Appendix B, Criterion V, required in part, that activities affecting quality shall be prescribed by documented

instructions appropriate to the circumstances. Contrary to these requirements, in procedure WDI-ET-008, Revision 1, Change 1, the licensee failed to provide instructions appropriate to the circumstances. In this case, failure to have instructions in the procedure "appropriate to the circumstances" that ensured that the technique/equipment used was qualified/demonstrated is a violation of 10 CFR Part 50, Appendix B, Criterion V. The licensee issued Field Change Notice No. 2 to WDI-ET-008 to include coil size and spacing data, which corrected this issue and the licensee entered this issue into the corrective actions system (Esat 03143035 and 03143034). Because the licensee had used appropriately qualified equipment, and took appropriate corrective actions for the lack of specific documentation, the inspectors considered this violation of minor significance.

The licensee's vendor performed ET analysis of data acquired in accordance with WDI-ET-004, "IntraSpect Eddy Current Analysis Guidelines Inspection Of Reactor Vessel Head Penetrations."

2.2.c Head Vent Nozzle

No. The inspectors identified that for the examination technique used on the head vent nozzle J-weld, the licensee did not have a documented demonstration to support the examination equipment used. For the examination of the head vent nozzle J-weld the licensee vendor used an ET array probe in accordance with procedure WDI-STD-101, "RVHI Vent Tube J-Weld Eddy Current Examination." The licensee's vendor did not have a documented demonstration for the ET equipment used to identify cracking in the J-weld region of the head vent nozzle. The vendor probe contained an array of +Point ET coils and was manually rotated to scan the inner surface of the vessel head at the J-weld for the vessel head vent. For this technique, the licensee's vendor considered the technique qualified based upon ability to see axial and circumferential notches in a calibration standard. Additionally, the licensee vendor stated that they were relying on this being a similar technique to those used to identify PWSCC cracking in SG tubes. However, the licensee's vendor did not have a documented basis to confirm that the this ET technique used was capable of detecting PWSCC cracking in VHP nozzles or J-welds.

10 CFR Part 50, Appendix B, Criterion V, required, in part, that activities affecting quality shall be prescribed by documented instructions appropriate to the circumstances. Contrary to these requirements, in procedure WDI-STD-101, "RVHI Vent Tube J-Weld Eddy Current Examination," Revision 0, the licensee failed to provide instructions appropriate to the circumstances. In this case failure to have instructions in the procedure "appropriate to the circumstances" to ensure that the technique/equipement used was qualified/demonstrated is a violation of Appendix B Criterion V. The licensee entered this issue into the corrective action system in Esat 03143036 and reported that they would not rely on the data obtained from this examination. Because the licensee did not rely on this examination data and no cracking was found in the J-welds during follow up PT examinations, the inspectors considered the violation of minor significance.

Because the ET array probe had not been specifically demonstrated by the vendor, the licensee elected to perform a solvent removable manual PT examination of the J-groove weld on the head vend nozzle in accordance with procedure 12-QHP-5050-NDE-001, "Liquid Penetrant Examinations For Nuclear And Non-Nuclear Welds And Components." This procedure met the ASME Code requirements of the 1989 Edition of Section V and XI and applied the flaw acceptance criteria from the 1983 Edition, Summer 1984 Addenda of Section III.

Yes. For the examination of the internal surfaces of the head vent nozzle J-weld, the licensee was relying on the vendors X-wound ET coil examination in accordance with demonstrated procedure WDI-UT-011, "IntraSpect NDE Procedure For Inspection Of Reactor Vessel Head Vent Tubes." The licensee's vendor provided WDI-TJ-002-02, "Technical Justification For Eddy Current Of J-Groove Welds," as the demonstrated technical basis for this examination technique. In this document, the vendor documented the results of an internal demonstration on PWSCC cracks in VHP nozzle samples removed from the Oconee plant. In addition, the vendor demonstrated the equipment on a mockup that contained electric discharge machined notches and simulated cracks made by applying cold isostatic pressure to notches. The licensee used a X-wound ET coil at the same frequency and size to that used on the mockups, except that the on-site equipment did not include the TC 5700 Data Acquisition System. The licensee's vendor documented a comparisons of the display on the mockup flaws from the TC 5700 Data Acquisition System and the IntraSpect Data Acquisition System (used on-site) and concluded that there was no effect on the data acquired.

2.2.d Penetration Nozzle No. 73

Yes. For the PT examination of the outer surface of portions of nozzle No. 73, the licensee used a Code procedure.

In response to Order EA-03-009 and associated relaxation requests, the licensee had committed to inspect the nozzles to a distance below the J-weld which was supported by calculations. However, the licensee could not obtain the minimum of 0.5 inch (reference CR 03143045, and EVAL-MD-02-RCS-024) below the J-weld using ET or UT techniques on nozzle No. 73 because of the short distance from the J-weld to the threads. To supplement the UT and ET examination of this nozzle, the licensee performed a PT examination of the outside surface of this nozzle which included the threads and ½ inch above the threads. For this examination the licensee performed a solvent removable manual PT examination in accordance with procedure 12-QHP-5050-NDE-001, "Liquid Penetrant Examinations For Nuclear And Non-Nuclear Welds And Components." This procedure met the ASME Code requirements of the 1989 Edition of Section V and XI and applied the flaw acceptance criteria from the 1983 Edition, Summer 1984 Addenda of Section III.

2.2.e Penetration Nozzle No. 75

Yes. For the J-weld on nozzle No. 75, the licensee used a Code PT procedure to supplement the UT and ET examination of this nozzle. The licensee performed a PT examination of the J-weld including the outside surfaces of the nozzle. For this examination the licensee performed a solvent removable manual PT examination in accordance with procedure 12-QHP-5050-NDE-001, "Liquid Penetrant Examinations For Nuclear And Non-Nuclear Welds And Components." This procedure met the ASME Code requirements of the 1989 Edition of Section V and XI and applied the flaw acceptance criteria from the 1983 Edition, Summer 1984 Addenda of Section III.

2.2.f Penetration Nozzles No. 43 and No. 74

Yes. For the PT examination of the repaired areas on the inside surface of nozzles No. 43 and No. 74, the licensee used a PT tool that delivered PT chemicals remotely in accordance with MRS-SSP-1484-AMP, "Reactor Vessel Head Penetration Repair Scenarios For D.C. Cook Unit 2." The licensee performed the actual PT examination in accordance with procedure GQP 9.4, "Remote Flourescent Post-Emulsifiable Dye Penetrant Exam and Acceptance." The licensee's procedure referenced applicable acceptance requirements of the ASME Code, Section III, 1989 Edition. Because the licensee was performing this PT examination using remote tooling, which was not recognized by the ASME Code, the inspectors noted deviations from Code requirements. For example, the licensee added a step to allow not performing the Code required five minute wait to allow the eyes of the examination personnel to adjust to lighting conditions, because the procedure was done using a remote camera system. The procedure also allowed up to 60 minutes for final interpretation of indications vice the Code required maximum of 30 minutes. The Authorized Nuclear Inservice Inspector had observed the remote PT procedure demonstration and had approved it as a "newly developed technique" in accordance with IWA-2240 of Section XI of the ASME Code. The licensee had also performed ET of the repaired areas in accordance with procedure WDI-ET-008, "IntraSpect Eddy Current Imaging Procedure For Inspection of Rx Vessel Head Penetrations With Gap Scanner." This was the same ET equipment and technique which the licensee's vendor had used to identify the cracks in these nozzles and the licensee used this method after metal removal to confirm that the crack indications had been removed.

3. For each of the examination methods used during the outage, was the examination able to identify, disposition, and resolve deficiencies and capable of identifying the PWSCC and/or RPV head corrosion phenomena described in the bulletin?

3.1 Upper Head Bare Metal Remote Visual Examination

Unknown. At the conclusion of this inspection, the licensee was not able to identify, disposition, and resolve deficiencies and identify PWSCC at each VHP

nozzle based on the visual examination. The licensee's examinations identified 17 nozzle locations (based on draft visual examination records dated May 21, 2003) which were considered indeterminate because of the presence of debris or boric acid deposits. This result precluded the licensee from confirming the absence of PWSCC based upon the visual examination. For these and other indeterminate nozzle locations the licensee was relying on the under head ET and UT examinations to confirm the absence of PWSCC cracking induced leakage.

3.2 Under Head Volumetric and Surface Examinations

Yes. The licensee had successfully identified four VHP nozzles (No. 43, 59, 64, and 74) with indications of shallow surface (craze) cracking at the inside nozzle surface using ET examinations. Additionally, the UT techniques used were successful at detecting simulated PWSCC in mockup tests. Therefore, the inspectors concluded that the under head UT and ET examinations were capable of detecting PWSCC.

Yes. The licensee's UT techniques were capable of detecting notches and holes in a vendor calibration standard that simulated a loss of RPV head materials. Therefore, the inspectors concluded that the licensee would have likely detected degradation induced in the RPV head in the interference zone, caused by RCS leakage through the nozzle cracks.

Yes. Other licensee's have been successful at detecting PWSCC in the J-weld region using Code PT examinations. Therefore, the inspectors concluded that the Code PT examinations completed under the head were capable of identifying PWSCC cracking.

4. What was the physical condition of the reactor head (debris, insulation, dirt, boron from other sources, physical layout, viewing obstructions)?

4.1 Top of Vessel Head Visual Examinations

The reactor head insulation consisted of reflective metal insulation panels which were installed on a support structure over the top of the reactor head. The remote camera visual inspection was conducted under the insulation support structure and the as-found head condition was generally clean (free of debris, insulation, dirt). The uphill side of the annulus gap on several penetrations contained loose debris, which generally did not hinder the licensee's evaluation of the penetration. Additionally, the licensee robotic crawler had a pressurized air source which the vendor used to blow loose debris out of the nozzle-to-head interface. Some quadrants of penetrations near insulation support structures were obstructed from the crawler mounted camera and the licensee used a fiber optic scope mounted to the crawler to view these areas. The licensee reported a 100 percent visual examination of the VHP nozzle-to-head interface was achieved for all 78 head penetrations and the head vent location. However, the licensee identified several nozzle locations which were considered indeterminate

based on the presence of debris or boric acid deposits at the interface. The licensee also removed a brick of asbestos insulation material wrapped in fiberglass cloth from the top of the vessel head under the insulation support structure.

The licensee performed a systematic inspection and documented the visual examination results of each of four quadrants on each VHP nozzle-to-vessel interface. No indications of head leakage were recorded. The licensee's remote examination noted several penetrations with white stains running down the penetration nozzle into the interface area. The licensee's remote visual examination also identified a rust contrail which appeared to originate at nozzle No. 17 (CR 03137028). The inspectors performed a direct visual examination of penetration nozzle No. 17 and noted that the rust contrail originated from the VHP nozzle- to-head interface. The inspectors did not observe any white deposits (boric acid) which have been the typical indicator of coolant leakage. The inspectors also reviewed the UT examination results for VHP nozzle No. 17 and noted that no leakage path or cracking was identified.

4.2 Under Vessel Head Ultrasonic and Eddy Current Examinations

The surface of the inner bore of the CRDM penetrations was sufficiently smooth, such that the quality of the UT and ET examinations was not affected. An exception to this, was the surface condition of the weld repair area for nozzle No. 75. The licensee had identified PWSCC and performed an embedded flaw repair at the inside surface of VHP nozzle No. 75, during a prior Unit 2 outage (1994). The surface condition of the nozzle at this location precluded a meaningful UT examination of the embedded flaw below the repair weld. The licensee's vendor compared prior ET results from the past ET examination and concluded that the repair area had not changed in size.

4.3 Under Vessel PT Examinations

The licensee did not identify any surface conditions which precluded obtaining acceptable PT examinations for the nozzle and weld surfaces examined except at nozzle No. 75 J-weld. On May 23, 2003, during this PT examination, the licensee identified a "broad area of pigmentation" on the J-weld of nozzle No. 75 that could have masked relevant indications and was caused by incomplete cleaning of the penetrant material prior to application of the developer. The licensee reperformed this examination on May 31, 2003, and achieved a successful Code PT examination.

5. Could small boron deposits, as described in Bulletin 2001-01, be identified and characterized?

Unknown. At the conclusion of the inspection, the licensee was not able to resolve small boron deposits at each head penetration based on the remote visual examination. The licensee personnel had access to each of the head penetrations (78 total) and head vent nozzle to perform the remote visual

examination. However, the licensee's examinations noted 17 nozzle locations (based on draft visual examination records as of May 21, 2003) which were considered indeterminate based on the identification of debris or boric acid deposits. For example, at the head vent nozzle penetration, the licensee identified an aspirin size deposit of boric acid which appeared to be wedged at the interface. This deposit did not appear to be consistent with the leaks from plants with confirmed nozzle cracking documented in EPRI Report TR 1006296, "Visual Examination For Leakage Of PWR Reactor Head Penetrations." However, the licensee could not attribute this deposit of boric acid to rundown from a leakage source above the head, so the licensee inspector considered the nozzle examination as indeterminate. At VHP nozzle No. 47, the licensee identified a boric acid deposit that filled in the interface area. Although this type of boric acid deposit was not characteristic of plants that have confirmed nozzle leakage, the licensee's examiner considered the nozzle indeterminate because of the potential masking effects of this deposit. For these and other indeterminate nozzle locations, the licensee was relying on the under head ET and UT examinations to confirm the absence of coolant leakage caused by PWSCC. At the conclusion of this inspection, the licensee had performed vacuum cleaning of the debris at the interface regions and was reinspecting the indeterminate nozzle locations.

6. What material deficiencies (i.e., cracks, corrosion, etc) were identified that require repair?

On May 15, 2003, the licensee contractor identified axial crack indications on the inside diameter surface of VHP nozzle No. 74 during the Unit 2 reactor head inspection. The licensee determined that the VHP nozzle No. 74 crack(s) were a maximum of 0.117 inches deep based on UT results and had a maximum length of 2.6 inches based on ET data. This area of surface cracks had been identified during the previous Unit 2 head examination and found to be acceptable for service. Further, the licensee concluded that the crack indications had not changed appreciably in size based upon comparison with previous inspection results.

The licensee stated that a vendor evaluated the crack indications in penetration No. 74 using a flaw growth formula derived from EPRI MRP-55, "Materials Reliability Program Crack Growth Rates For Evaluating Primary Water Stress Corrosion Cracking (PWSCC) Of Thick-Wall Alloy 600 Materials," Revision 1. The inspectors confirmed that the flaw growth rate specified in MRP-55 was consistent with that accepted by the NRC in the April 11, 2003, letter from R. Barrett (NRC) to A. Marion (Nuclear Energy Institute). Based upon this evaluation, the licensee determined that penetration 74 would not to be serviceable for a full cycle of plant operation. Specifically, the licensee determined that this cluster of cracks could grow to 75 percent through wall (the maximum allowable) in 1.05 effective full power years (EFPY). Because cycle 14 was 1.33 EFPY, the licensee could not return the reactor head to service for a full cycle of operation with these cracks in place and initiated repairs to penetration 74.

The licensee also identified shallow crack indications in VHP nozzles No. 43, 59, and 64, which did not require repair based upon the licensee's calculations of maximum expected flaw growth. For these nozzles, the ET indications identified were typically axial and located at or below the J-weld at the inside diameter surface except for penetration 64 cracking which was slightly above the J-weld.

The licensee recorded the following dimensions for these indications.

Penetration No.	ET Indication No	L1 & L2	Angle 1 & Angle2	Disposition
43	1	5.06 & 5.62	156 & NA	group of multiple axial indications.
	2	4.98 & 5.74	165 & NA	
	3	5.180 & 5.9	174 & NA	
	4	4.98 & 5.66	180 & NA	
59	1	6.44 & 6.64	176.5 & 176.5	single axial indication (SAI)
	2	4.52 & 4.88	155.5 & 155.5	SAI
	3	4.32 & 4.88	166 & 166	SAI
	4	4.44 & 4.84	178 & 178	SAI
	5	4.52 & 4.96	2.5 & 2.5	SAI
64	1	6.32 & 6.6	162 & 162	SAI
	2	6.36 & 6.52	179 & 179	SAI
	3	5.72 & 5.88	171 & 171	SAI
	4	5.56 & 5.64	182 & 182	SAI
	5	4.56 & 4.72	160 & 160	SAI
	6	4.44 & 4.88	181 & 181	SAI
	7	4.48 & 4.92	346 & 346	SAI
	8	4.8 & 5	350 & 350	SAI
74	1	5.8 & 8.7	167 & 203	cluster of multiple axial indications

Note. The axial length (in inches) of the indications is L1-L2, and the circumferential extent is Angle 1-Angle 2 (in degrees).

The licensee implemented repairs to VHP nozzle No. 74 by excavating the cracks and associated base metal (nominal 0.625 inch thick wall thickness) using an electric discharge machining tool. The licensee also elected to perform the same repair to VHP nozzle No. 43 which had a larger cluster of flaws, even though the licensee's vendor had indicated that this flaw would remain within an acceptable size for a full cycle of operation. The licensee performed metal removal on VHP nozzles No. 43 and No. 74 in accordance with procedure MRS-SSP-1484-AMP, "Reactor Vessel Head Penetration Repair Scenarios For D.C. Cook Unit 2." The licensee removed 0.127 inch and 0.129 inch of metal from the inside surface of nozzles No. 43 and No. 74 respectively.

The licensee provided WCAP-14563, "Determination Of Maximum Excavation Depth On Reactor Head Penetrations For D.C. Cook Units 1 & 2," as the basis for the maximum allowable amount of metal removed for the nozzle repairs. In this document, the licensee vendor performed stress and fatigue analysis at the vessel head penetration for inside surface excavations up to 0.315 inch depth. The inspectors identified that the licensee had not subtracted appropriate measurement uncertainties (0.015 inch) and metal removed during honing (0.012 inch) from the maximum allowable (0.315 inch) amount of metal which could have been removed under procedure MRS-SSP-1484-AMP. Because the actual amount of metal removed including measurement uncertainty and honing was within the bounds of the stress analysis, there was no impact on the integrity of the repaired VHP nozzles. The inspectors also confirmed that the licensee had applied acceptance criteria consistent with the installation Code identified in the licensee's repair plan (e.g., Section III, of the 1989 Edition of the ASME Code) for the PT examination of the repaired areas of VHP nozzles No. 43 and No. 74.

7. What, if any, impediments to effective examinations, for each of the applied methods, were identified (e.g., centering rings, insulation thermal sleeves, instrumentation, nozzle distortion)?

For examinations of penetration nozzles which were observed by the inspectors, the licensee was able to get coverage consistent with licensee commitments to the NRC Order EA-03-009, except for a small area at the bottom end of the nozzle. The licensee could not examine a short segment at the bottom of the CRDM nozzles due to a threaded configuration on the outside of the penetration nozzles which served to connect to guide funnels at some locations. This area of limited NDE coverage was approximately 0.75 inches in length at the end of the penetration nozzle. The licensee had submitted by letter dated March 26, 2003, a request for relaxation request to Order EA-03-009 requirements, to address this limitation in the extent of NDE. This licensee relaxation request was still under review at the conclusion of this inspection. The inspectors noted that each of the 78 head penetration nozzles contained this threaded region at the end of the nozzle. For penetrations 1-9, the licensee could only the perform ET scan on the outside surface of the penetration nozzle to within an estimated 3-4 millimeters above the threaded area. Additionally, a chamfer edge of 0.23 inch vertical height on the inside surface at the bottom of each of the nozzles precluded UT or ET examination coverage below this point.

8. What was the basis for the temperatures used in the susceptibility ranking calculation, were they plant-specific measurements, generic calculations, (e.g., thermal hydraulic modeling), etc.?

NRC Order EA-03-009 required licensee's to calculate the susceptibility category of each reactor head to PWSCC-related degradation. The susceptibility category in total effective degradation years (EDY) establishes the basis for the licensee to perform appropriate head inspections during each refueling outage. The licensee documented calculation of the Unit 2 RPV head EDY in DIT B-02726-00 using a formula consistent with Order EA-03-009 and determined that as of April 25, 2003, the Unit 2 RPV head had 14.56 EDY. This value placed the Unit 2 RPV head in the high susceptibility category. NRC Order EA-03-009 also required the licensee to have used best estimate values in determining the susceptibility category for the vessel head. The inspectors were able to confirm, based on verbal discussions with cognizant licensee and vendor personnel, that plant specific information had been used in the determination of vessel head temperatures used in the susceptibility ranking calculation for the Unit 2 RPV head.

In DIT B-02726-00, the licensee referenced the source document for the Unit 2 vessel head operating temperature as MRP 48, "PWR Materials Reliability Program Response to NRC Bulletin 2001-01," dated August of 2001. However, MRP 48 did not contain any reference to be able to confirm the source of the head temperatures identified for Unit 2. The licensee staff stated that they believed that the head temperatures were derived by a vendor using plant specific information and a vendor proprietary THRIVE computer program. The licensee provided a vendor document WIN 284-6397, "Upper Head Temperatures for Westinghouse Plants Based on Plant Operating Data Survey," dated November 4, 1992. This document was consistent with the MRP-48 values used for Unit 2 head temperatures (e.g., 595.5 degrees Fahrenheit for the first 3 operating cycles and 600.7 degrees Fahrenheit for the next five operating cycles). However, this vendor document did not identify if plant specific information was used to determine the vessel head temperature for each cycle. Based on subsequent verbal confirmation from the licensee's vendor, the inspectors concluded that applicable plant specific information had been used in determination of the vessel head temperatures. Specifically, the vendor had used values of RCS cold leg temperature and thermal power level documented in the 1992 vendor internal memorandum, to derive a representative bulk fluid head temperature.

In review of the EDY calculation, the inspectors identified a minor error in addition of the EFPY value used in this calculation. The inspectors determined that the EFPY value should have been 11.50 years instead of 11.52 years for cycles 4 through 13 based on the input values documented in DIT S-00705-03. This minor calculation error was in the conservative direction and did not affect the EDY output or classification of the Unit 2 head in the high susceptibility category. In addition to the EDY, an acceptable vessel susceptibility evaluation must consider past experience with nozzle cracking. The inspectors identified

that the calculation did not contain or reference the fact that Unit 2 had known penetration cracking which would place it in the high susceptibility category irrespective of the calculated EDY results.

10 CFR Part 50, Appendix B, Criterion V, requires, in part, that activities affecting quality shall be prescribed by documented instructions appropriate to the circumstances. Contrary to this requirement, the licensee failed to have documented instructions in DIT B-02726-00 appropriate to the circumstances. Specifically, the licensee had not documented the root source of the vessel head temperature (or the plant specific input values used to derive parameter) as input to the EDY calculation, had a minor math error and had not referenced or documented PWSCC cracking which had been previously identified in Unit 2 nozzles No. 74 and No. 75. Failure to provide documented instructions appropriate to circumstances in DIT B-02726-00 is an example of a minor violation of Criterion V. Because the licensee's calculated value resulted in the high susceptibility category and the licensee had implemented inspections consistent with the NRC Order EA-03-009 for this category, the inspectors considered this violation of minor significance. The licensee documented this minor violation in the corrective action program in CR 03148059.

9. During non-visual examinations, was the disposition of indications consistent with the guidance provided in Appendix D of this TI? If not, was a more restrictive flaw evaluation guidance used?.

Yes. The licensee's vendor performed a flaw growth evaluation for flaws in nozzles No. 59 and No. 64 as documented in letter AEP-03-48, "Sensitivity Study Information For Unit 2 Relaxation Request," from R. Rice (Westinghouse) to C. Bakken (licensee) dated June 2, 2003. The licensee performed an owners acceptance review of this letter dated June 2, 2003. In this letter the licensee's vendor determined that the flaws in these VHP nozzles would remain within service limits acceptable to the NRC for a minimum of 1.79 years. The inspectors reviewed this evaluation and portions of the vendors source calculation LTR-PAFM-03, "Supporting Calculation Information For D. C. Cook Unit 2 Flaw Growth Sensitivity Study," and confirmed that, the licensee applied a flaw growth rate and calculation methodology consistent with that accepted by the NRC. Specifically, the inspectors confirmed that the licensee applied a crack growth formula consistent with that accepted by the NRC in a letter dated April 11, 2003, from R. Barret (NRC) to A. Marion (Nuclear Energy Institute). However, the inspectors identified that the licensee had used flaw dimensions (without allowance for NDE sizing errors) that were not consistent with that measured by ET and documented in the examination reports for these nozzles. The licensee flaw evaluation had used flaw depths of 0.05 and 0.1 inch and a bounding flaw length of 0.6 inch. However, the inspectors identified that existing ET examination reports for penetration 59 had recorded flaws up to 1.2 inches in length. The licensee reanalyzed the recorded ET data for penetrations 59 and 64 and confirmed that the crack indiction sizes used in the flaw evaluation bounded the actual crack sizes in nozzles No. 59 and No. 64.

10 CFR Part 50, Appendix B, Criterion III, requires, in part that measures shall be provided for verifying or checking the adequacy of the design. Contrary to this requirement, the licensee failed to conduct adequate checking of design inputs (flaw sizes) used in the "Sensitivity Study Information For Unit 2 Relaxation Request," from R. Rice (Westinghouse) to C. Bakken (licensee) dated June 2, 2003. Specifically, the licensee had used flaw sizes which were not consistent and confirmed by documented ET examination records. Failure to conduct adequate reviews in the owner review and acceptance of "Sensitivity Study Information For Unit 2 Relaxation Request," is an example of a minor violation of 10 CFR Part 50, Appendix B, Criterion III. Because the licensee's re-evaluation of ET data confirmed that bounding flaw sizes had been used in this flaw evaluation, there was no impact on component operability. Therefore, the inspectors considered this violation of minor significance. The licensee documented this issue in the corrective action system in CR 03155017.

10. Did procedures exist to identify potential boric acid leaks from pressure-retaining components above the RPV head?

Yes. The licensee performed inspections of components within containment to identify leakage which included the area above the RPV head. This inspection was conducted by Operations and Maintenance Department personnel with the plant in a hot shutdown condition in accordance with procedure 02-0HP-4030-001-002, "Containment Inspection Tours," and PMP-5030-001-001, "Boric Acid Corrosion of Ferritic Steel Components and Material." The licensee also performed inspections to identify boric acid leakage (including areas above the RPV head) during performance of the Code pressure test 12-QHP-5070-NDE-001, "Visual VT-2 Examination: RCS System Leakage Test." These procedures provided for detection and disposition of boric acid on components. In general, boric acid deposits were binned into two categories "Active Wet Leakage" and "Inactive/Minor Dry Residue." The first category required evaluation and the second category generally required only cleaning or was accepted as is. Procedure 12-QHP-5070-NDE-001, provided further guidance for boric acid deposits on insulation. Specifically, this procedure stated "IF, evidence of leakage is observed, THEN remove the insulation to determine the source of leakage."

The inspectors interviewed licensee staff who were involved in the most recent performance of containment area inspections to detect leakage including the area above the Unit 2 vessel head. The inspectors noted that licensee staff understood the procedure requirements and appeared to be adequately trained to identify boric acid leakage.

11. Did the licensee perform appropriate follow-on examinations for boric acid leaks from pressure retaining components above the RPV head?

Yes. The inspectors reviewed licensee corrective actions taken for dry boric acid deposits which the licensee identified during system leakage tests and documented in their corrective action system. In January 26, 2003, at the packing

area of valve 2-RC-121 (CR 03026011) and on May 9, 2000, for the No. 4 CETNA seal leak (CR P-00-06663), the licensee identified boric acid deposits. The leakage at these components was limited and the licensee did not identify any boric acid deposits which contacted the vessel head or insulation. For these indications of leakage, the licensee cleaned up the boric acid deposits and corrected the source of the leakage. In CR 03026011, the licensee incorrectly stated that valve 2-RC-121 did not have a history of packing leakage. The inspectors identified that on February 24, 2002, during 12-QHP-5070.NDE.001, "Visual VT-2 Examination: RCS System Leakage Test," the licensee had documented a leak at the No. 4 CETNA seal (with dry boric acid residue) and on 2-RC-121 packing (active wet leak). For each of these areas the licensee had documented the leakage as being corrected. However, for the No. 4 CETNA seal, the licensee had referenced ESAT 02055022, which did not identify this seal area as leaking. To confirm that the licensee had taken appropriate actions, the inspectors performed a walkdown of the 2-RC-121 and No. 4 CETNA seal area and confirmed the absence of boric acid deposits in these areas.

c. Findings

No findings of significance were identified.

4OA6 Meetings

.2 Interim Exit Meeting

Interim exit was conducted for:

- Temporary Instruction 2515/150 and inservice inspection (IP 7111108) with Mr. C. Bakken on May 23, 2003 and June 4, 2003.

KEY POINTS OF CONTACT

Licensee
A. Bakken, Senior Vice President, Nuclear Generation
G. Borlodon, Manager, Maintenance, Engineering and Programs
M. Finissi, Plant Manager
D. Garner, Reactor Vessel Head Technical Lead
R. Hall, Inservice Inspection Program
C. Lane, Inservice Inspection Supervisor
R. Meister, Regulatory Affairs
T. Noonan, Performance Assurance
J. Pollock, Site Vice President
M. Scarpello, Supervisor Regulatory Affairs
C. Vanderniet, Reactor Vessel Head Project Manager

LIST OF DOCUMENTS REVIEWED

1R08 Inservice Inspection Activities

Audit

Performance Assurance Department Audit Report dated November 8, 1999

Condition Reports

01241027; 1RC-102-L2 Has A Buildup Of Boric Acid Indicating A Packing Leak Or Bonnet Leak; dated August 29, 2001

02023050; Unit 2 Third Period Second Interval Exam Code Relief Requests Had Not Been Submitted As Required By 10 CFR50.55a; dated January 23, 2001

02141047; During U1C18 Steam Generator Eddy Current Inspections 4 Tubes Were Identified With Abnormal Eddy Current Signals; dated May 21, 2002

02035046; During The 2002 NRC ISI Inpsection, The NRC Inspector Raised The Following Questions On The Possible Inaccurate Application Of Weld Acceptance Criteria; dated February 4, 2002

02035044; The NRC Inspector Has Raised The Following Questions During The 2002 ISI Inspection; dated February 4, 2002

02207026; Tracking eSat To Follow Review Of Abnormal Steam Generator Eddy Current Signals Noted During U1C18 Steam Generator Inspection; dated July 26, 2002

02174018; Unit 1 Steam Generator Contaminates Increased Following The Middle Hotwell Pump Start; dated June 23, 2002

Corrective Action Process Reports Issued As a Result of Inspection Activities

3135023; Historic Failure To Identify Source Of Leakage When Boric Acid And Corrosion Were Found On The Bottom Of Unit 2 Reactor Vessel During The Bottom Head Inspection; dated May 14, 2002

Code Replacement/Repair Activities

Job Order 0124102706; 1-RC-102-L2 Replace Valve EE-2002-0340; dated May 19, 2002

Job Order R005877514; 2-PP-50W Remove/Install Piping To Support Repairs; dated January 31, 2002

Nondestructive Examination Reports

Radiographic record for 6 inch diameter charging pipe-to-nozzle weld 2CS81OW-1R3; ated February 8, 2002

325500; Valve To Elbow Weld 2-SI-42-01S Dye Penetrant Examination Report; dated May 8, 2003

325500; Valve To Elbow Weld 2-SI-42-01S Ultrasonic Examination Report; dated May 8, 2003

325520; Pipe To Valve Weld 2-SI-42-03F Dye Penetrant Examination Report; dated May 9, 2003

325520; Pipe To Valve Weld 2-SI-42-03F Ultrasonic Examination Report; dated May 9, 2003

329100; Pipe To Elbow Weld 2-SI-72-11S Dye Penetrant Examination Report; dated May 8, 2003

329100; Pipe To Elbow Weld 2-SI-72-11S Ultrasonic Examination Report; dated May 8, 2003

001800; Rx Vessel To Flange Weld 2-RPV-A; Ultrasonic Examination Report dated May 12, 2003

Procedures

54-ISI-130-38; Ultrasonic Examination Of Ferritic Vessel Welds Greater Than 2.0 Inches In Thickness; Revision 38

54-ISI-132-01; Ultrasonic Examination Of Vessel Inner Radii;

54-ISI-124-02; Ultrasonic Examination Of Ferritic Piping Welds And Vessel Welds Two Inches Or Less In Thickness; Revision 2

54-ISI-835-04; Procedure For The Ultrasonic Examination Of Ferritic Piping Welds; Revision 4

54-ISI-836-04;Procedure For The Ultrasonic Examination Of Austenitic Piping Welds; Revision 4

54-ISI-837-03;Procedure For The Ultrasonic Through-Wall Sizing In Pipe Welds; Revision 3

54-ISI-240-40; Visible Solvent Removable Liquid Penetrant Examination Procedure: Revision 40

54-ISI-270-39; Wed Or Dry Magnetic Particle Examination Procedure; Revision 39.

Miscellaneous Documents

Weld Procedure Specification 8.1TS; dated May 13, 2002

Procedure Qualification Record 136; dated February 10, 1976

Procedure Qualification Record 219; dated January 16, 1990

Procedure Qualification Record 256; dated August 7, 1989

Procedure Qualification Record 258; dated August 7, 1989

Weld Procedure Specification 1.2TS; dated March 10, 2000

Procedure Qualification Record 136; dated February 10, 1976

Procedure Qualification Record 234; dated March 29, 1989

Procedure Qualification Record 235; dated March 30, 1989

Procedure Qualification Record 255; dated August 8, 1989

TI 2515/150 Reactor Pressure Vessel Head and Vessel Head Penetration Nozzles

Corrective Action Documents

CR 03026011; 2-RC-121-Dry Boric Acid From An Old Packing Leak; dated January 26, 2003

CR 03138024; Craze Cracking Has Been Discovered On Penetrations 43, 59 And 64; dated May 18, 2003

CR 031370448; Cracks Found On The Inside Diameter Of Penetration 74 During The Unit 2 Reactor Head Inspection Have Been Evaluated As Not Serviceable For The Next Cycle; dated May 15, 2003

CR P-00-06663; CETNA Seal #4 Leaking RCS From Swagelock Fittings; dated May 9, 2000

eSAT-02055022; Numerous Components Have Accumulated Boric Acid; dated February 24, 2002

eSAT-03137028; Rust Staining Was Noted At Penetration Annular Area And Trailing Down The Head Surface; dated May 17, 2003

CR 03143045; Unit 2 RPV Penetration # 73 Has An Area Below The Weld That Cannot Be Inspected By TOFD UT Or ET; dated May 22, 2003

Corrective Action Process Reports Issued As a Result of Inspection Activities

CR 03148059; Three Documentation Issues Related To Determination Of The Susceptibility Category Of The Unit 2 Reactor Vessel Head Were Identified; dated May 28, 2003

eSAT-03143034; Specific Dimensions Related To Tooling And Probes For The Westinghouse Eddy Current Gap Scanner; dated May 22, 2003

eSAT-03143035; Formal Documentation Describing The Westinghouse Eddy Current Gap Scanner Detection Capabilities Was Not Available; dated May 22, 2003

eSAT-03143036; Formal Documentation Describing The Westinghouse Eddy Current Array Detection Capabilities Was Not Available; dated May 22, 2003

CR 3143038; Reference To The Plant Specific Head Temperature Is Not Documented In The MRP Guidance; dated May 22, 2003

Design Information Transmittals

DIT B-02726-00; Unit 1 & 2 Effective Degradation Years; dated May 14, 2003

DIT S-00700705-03; Unit 1And Unit 2 Burnup Data; dated April 29, 2003

Drawings

6D30089; RV Head Penetration CRDM Calibration Standard CRDM Calibration Standard Details; Revision 0

CBI 19; 173" Instrumentation Tube Final Machining Details; Revision 9

CBI 21; Instrumentation Tube Installation Details 173" PWR; Revision 10

CBI 23; Location Of Instrumentation Tubes In Bottom Head 173" PWR; Revision 2

CBI 38; 173" PWR Top Head Assembly; Revision 4

CBI 40; CRD Housing Installation Detail 173" PWR; Revision 12

CBI 41; 173" PWR Control Rod Drive Mechanism Housings Final Machining Details; Revision 13

CBI 52; 173" Location Of Control Rod Drive Mechanism Housings In Top Head ~ (Outside View); Revision 6

Miscellaneous Documents

MRP-48; PWR Materials Reliability Program Response To NRC Bulletin 2001-001; dated August 2001

Westinghouse WIN 284-6397; Upper Head Temperatures For Westinghouse Plants Based On Plant Operating Data Survey; dated November 4, 1992

Order EA-03-009; Issuance Of Order Establishing Interim Inspection Requirements For Pressure Vessel Heads At Pressurized Water Reactors; dated February 11, 2003

AEP Letter NRC 3054-03; Donald C. Cook Nuclear Plant Units 1And 2 Answer To Nuclear Regulatory Commission Order Establishing Interim Inspection Requirements For Reactor Pressure Vessel Heads At Pressurized Water Reactors; dated March 3, 2003

AEP Letter NRC 3054-04; Donald C. Cook Nuclear Plant Units 1 And 2 Request For Relaxation From Nuclear Regulatory Commission Order Establishing Interim Inspection Requirements For Reactor Pressure Vessel Heads At Pressurized Water Reactors; dated March 26, 2003

AEP Letter NRC 3054-06; Donald C. Cook Nuclear Plant Units 1And 2 Response To Request For Additional Information Regarding Relaxation Of Reactor Pressure Vessel Head Penetration Inspection Requirements In Nuclear Regulatory Commission Order; dated May 13, 2003

NRC Letter (package ML030980327); Flaw Evaluation Guidelines; Dated April 11, 2003.
Job Order R0073019; Perform Full Pressure Temperature Walkdown; dated June 17, 2000

Job Order R0204062; Perform Full Pressure Temperature Walkdown; dated February 24, 2002

Job Order 02294028; 2-OME-1 Repair Rx Vessel Head Penetration 74 & 43; dated May 31, 2003

Letter from P. Lara (EPRI) to R. Hall (AEP); dated May 23, 2003

WCAP-14563; Determination Of Maximum Excavation Depth On Reactor Head Penetrations For D.C. Cook Units 1 &2; Revision 0

PCI Project Instruction PI-900073-12; RVHP EDM Defect Removal Tool For Nozzle Inside Diameter Operation; Revision 1

Letter AEP-03-48; Sensitivity Study Information For Unit 2 Relaxation Request, from R. Rice (Westinghouse) to C. Bakken (AEP); dated June 2, 2003

AEP Letter; Best Estimate Hot Leg Temperature For Donald C. Cook Plant Unit 1 and Unit 2; dated July 1, 1997

AEP Letter; Best Estimate Hot Leg Temperature For Donald C. Cook, Unit 2; dated July 21, 1994

EPRI Letter from B. Rassler (EPRI) to R. Hall (AEP); Dated June 4, 2003.
Wesdyne International; Blade And Open Housing UT Essential Variables; dated September 2002

Wesdyne Report; Leak Path Detection; March 2003.
WDI-TJ-008-03;Sysem Setup Testing Of Blade Probe For Multiple Inspection Sensitivities; Revision 0 and Revision 1

WDI-TJ-002-02; Technical Justification For Eddy Current Of J-Groove Welds; Revision 0

EPRI Materials Reliability Project Report; Dated December 11, 2002.
WDI-TJ-007-03; Installation of High Pass Filter To Improve Blade Probe Inspections; Revision 0

WDI-TJ-013-02; MRP Inspection Demonstration Program; dated December 2, 2002

Nondestructive Examination Reports

Liquid Penetrant Examination Report; Rx Hd Vent Under Vessel J-Weld And ID Chamfer (JO 02294028-06); dated May 21, 2003

Liquid Penetrant Examination Report (JO 02294028-06); RX Head Penetration # 73 Threaded End And ½" Above; dated May 30, 2003

Liquid Penetrant Examination Report (JO 02294028-06); RX Head Penetration # 75 J-Weld And Penetration, dated May 24, 2003

Liquid Penetrant Examination Report (JO 02294028-06); RX Head Penetration # 75 J-Weld Re-examination area, ated May 31, 2003

DCC-002; Report of Non-Destructive Examination Liquid Penetrant, Penetration #74 ID, dated June 2, 2003

DCC-001; Report of Non-Destructive Examination Liquid Penetrant, Penetration #43 ID, dated June 2, 2003

Eddy Current Report Sheet; Penetration No. 74; dated May 15, 2003

Eddy Current Report Sheet; Penetration No. 43; dated May 18, 2003

Eddy Current Report Sheet; Penetration No. 59; dated May 18, 2003

Eddy Current Report Sheet; Penetration No. 64; dated May 18, 2003

Eddy Current Report Sheet; Penetration No. 59; dated June 4, 2003

Eddy Current Report Sheet; Penetration No. 64; Dated June 4, 2003

Eddy Current Report Sheet; Penetration No. 43; dated June 2, 2003

Eddy Current Report Sheet; Penetration No. 74; dated June 2, 2003

Eddy Current Report Sheet; Penetration No. 74; dated May 2, 2003

Ultrasonic Report Sheet; Penetration No. 74; dated May 15, 2003

Draft Visual Examination Records MRS-SSP-1483-AMP, Appendix D; dated May 14, 2003 through May 16, 200.

Procedures

02-0HP-4030-001-002; Containment Inspection Tours; Revision 14

PMP-5030-001-001; Boric Acid Corrosion of Ferritic Steel Components and Material, Revision 5

12-QHP-5070-NDE-001; Visual VT-2 Examination: RCS System Leakage Test; Revision 2a

12-QHP-5050-NDE-027; Visual Examination For Boric Acid And Condition Of Component Surfaces; Revsion 0

GQP 9.4; Remote Flourescent Post-Emulsifiable Dye Penetrant Exam and Acceptance; Revision 2, Change 0

MRS-SSP-1483-AMP; Rx Vessel Head Penetration Remote Visual Inspections For D. C. Cook Unit 2; Revision 1, Change 0

WDI-ET-002; IntraSpect Eddy Current Inspection Of J-Groove Welds in Vessel Head Penetrations; Revision 2, Field Change Notice 2

WDI-UT-010; IntraSpect Ultrasonic Procedure For Inspection Of Rx Vessel Head Penetrations/Time Of Flight Ultrasonic, Longitudinal Wave & Shear Wave; Revision 4, Field Change Notice 5

WDI-UT-011; IntraSpect NDE Procedure For Inspection Of Reactor Vessel Head Vent Tubes," Revision 2; Field Change Notice 2

WDI-UT-013; CRDM/ICI UT Analysis Guidelines; Revision 2, Field Change Notice 3

WDI-ET-004; IntraSpect Eddy Current Analysis Guidelines Inspection Of Reactor Vessel Head Penetratios; Revision 2, Change 1

WDI-ET-003; IntraSpect Eddy Current Imaging Procedure For Inspection Of Reactor Vessel Head Penetrations; Revision 4, Change1

WDI-ET-008; IntraSpect Eddy Current Imaging Procedure For Inspection Of Rx Vessel Head Penetrations With Gap Scanner; Revision 1, Field Change Notice 1 and Field Change Notice 2

WDI-STD-101; RVHI Vent Tube J-Weld Eddy Current Examination; Revision 0, Change 0

MRS-SSP-1484-AMP; Reactor Vessel Head Penetration Repair Scenarios For D.C. Cook Unit 2; Revision 0, Field Change Notice 1

LIST OF ACRONYMS USED

ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CRDM	Control Rod Drive Mechanizm
DIT	Design Information Transmittal
DRP	Division of Reactor Projects
EDY	Effective Degradation Years
EFPY	Effective Full Power Years
EPRI	Electric Power Research Institute
ET	Eddy Current
MS	Mitigating System
NDE	Nondestructive Examination
No.	Number
OPR	Operability Recommendation
PT	Dye Penetrant
PWR	Pressurized Water Reactor
PWSCC	Primary Water Stress Corrosion Cracking
RCS	Reactor Coolant System
RPV	Reactor Pressure Vessel
SAI	Single Axial Indication
SG	Steam Generator
TI	Temporary Instruction
TOFT	Time-Of-Flight-Tip-Diffraction
TS	Technical Specification
UT	Ultrasonic
VHP	Vessel Head Penetration