CIRCUMFERENTIAL CRACKING OF REACTOR PRESSURE VESSEL
HEAD PENETRATION NOZZLES
(NRC BULLETIN 2001-01)

CORNERSTONE: BARRIER INTEGRITY
INITIATING EVENTS

APPLICABILITY: This temporary instruction (TI) applies to all holders of operating licenses for pressurized-water nuclear power reactors (PWRs), as categorized in Appendix A to this TI.

## 2515/145-01 OBJECTIVE

The objective of this TI is to support the review of licensees' activities in response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," in order to verify licensee's compliance with applicable regulatory requirements. As an ancillary benefit, this TI promotes information gathering to help the NRC staff identify possible future regulatory positions and generic communications.

## 2515/145-02 BACKGROUND

On August 3, 2001, NRC Bulletin 2001-01 was issued in response to recently identified circumferential cracking in control rod drive mechanism (CRDM) nozzles at Oconee Nuclear Station Units 2 and 3 (ONS2 and ONS3), along with axial cracking in the J-groove welds of additional CRDM nozzles at these facilities and Oconee Nuclear Station Unit 1 (ONS1) and Arkansas Nuclear One Unit 1 (ANO1). This phenomenon has raised concerns regarding the potential safety implications of the active degradation mechanism – primary water stress corrosion cracking (PWSCC) – and compliance with applicable regulatory requirements.

The staff addressed cracking of vessel head penetration (VHP) nozzles in Generic Letter (GL) 97-01, "Degradation of Control Rod Drive Mechanism Nozzles and Other Vessel Closure Head Penetrations," dated April 1, 1997. Nevertheless, the recent identification of circumferential cracking calls into question the conclusions in GL 97-01 and the adequacy of industry actions for detecting and managing cracking in VHP nozzles.

Specifically, the findings indicate that circumferential cracks on the outside of the J-groove welds can occur, in contrast to an earlier conclusion that the cracks would be predominantly axial in orientation. This information has caused the staff to reassess its conclusion in GL 97-01 that cracking of VHP nozzles is not an immediate safety concern.

Circumferential cracking of VHP nozzles poses a safety concern if it is permitted to progress to a point at which a loss-of-coolant accident (LOCA) occurs. The potential ejection of a VHP nozzle could result in additional deleterious effects such as potential damage to adjacent rods. Recent experience with VHP nozzle cracking also raises concerns regarding compliance with NRC requirements, for example, plant technical specifications (TSs) do not permit reactor coolant pressure boundary leakage. One function of VHP nozzles is to maintain the integrity of the reactor coolant system pressure boundary. The CRDM nozzles support and guide the control rods and, therefore, are relied upon in shutting down the reactor. Cracking of CRDM nozzles and welds degrades the reactor coolant system boundary, possibly leading to leakage that violates the plant's TSs. NRC Bulletin 2001-01 discusses the safety and regulatory concerns that provide the basis for the bulletin's information request.

In addition, the presence of circumferential cracking at ONS3, where only a small amount of boric acid residue indicated a problem, calls into question the adequacy of current visual examinations to detect either axial or circumferential cracking in VHP nozzles. This is especially significant if existing boric acid deposits on the reactor vessel head mask the identification of new deposits. Also, the presence of insulation or other impediments on the reactor vessel head may preclude an effective visual examination. As a conservative assumption, the NRC staff believes that boric acid deposits that cannot be dismissed as coming from another source should be considered to originate from VHP nozzles, and appropriate corrective actions may be necessary. In addition, the use of special tooling or procedures may be required to ensure that the visual examinations will be effective in detecting the relevant conditions.

The NRC has developed a Web page to keep the public informed of generic activities related to Alloy 600 weld cracking in PWRs. This web-page (*http://www.nrc.gov/NRC/REACTOR/ALLOY-600/index.html*) provides links to information regarding the cracking identified to date, along with documentation of the NRC's interactions with the industry (industry submittals, meeting notices, presentation materials, and meeting summaries). The NRC will continue to update this Web page as new information becomes available.

## 2515/145-03 INSPECTION REQUIREMENTS

### 03.01 General

The following subsections characterize a graduated inspection approach for identified sub-populations of plants. Each of these subsections contains the complete inspection requirements for the plants in the respective sub-population (identified as Bin 1, 2, 3, or 4), as characterized by Appendix A to this TI. The information provided on the NRC's Internal Web site (http://nrr40.nrc.gov/CRDM/index.html) will give inspectors a basic understanding

of NRC Bulletin 2001-01. This WEB site does not stipulate additional inspection requirements beyond those identified in this TI.

03.02 Plants With Identified PWSCC (Bin 1)

NRC Bulletin 2001-01 states that it may be appropriate for plants identified in Bin 1 of Appendix A to perform a 100% volumetric examination by the end of 2001. Otherwise, the plant's response to the bulletin should provide justification for their chosen course of action. If a licensee chooses a course of action other than 100% volumetric examination, the inspectors will coordinate with their respective region and the NRC's Office of Nuclear Reactor Regulation (NRR), Division of Engineering (DE), Materials and Chemical Engineering Branch (EMCB) to determine which section(s) of this TI to use in performing an inspection that will verify whether the licensee's course of action meets the intent of NRC Bulletin 2001-01.

For plants in Bin 1, two distinct aspects of this TI are: (1) inspecting the licensee's examination activities associated with the phenomenon described in the bulletin, and (2) gathering additional information to help the staff identify future regulatory positions and possible generic communications. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability, and provide the assigned inspectors the critical performance parameter to aid them in inspecting the examination activities. If a 100% volumetric examination is performed, the inspection will consist of the following steps:

a. Inservice Inspection (ISI) specialist inspectors will follow Inspection Procedure (IP) 71111.08, "Inservice Inspection Activities," using a sample of VHP nozzles to assess the licensee's qualified volumetric examination. The inspection of the licensee's reactor VHP nozzle examination may be considered part of the sample required by IP 71111.08.

b. Inspectors will review the "qualified" 100% volumetric examination, including the licensee's demonstration that the cracking of concern can be effectively identified and characterized by whatever method the licensee has adopted. The inspectors will coordinate with their respective region and the NRR/DE/EMCB point of contact and perform the following:

    1. Review the licensee's chosen examination method for its ability to reliably detect cracking on the outside diameter (OD) of the VHP nozzle. This portion of the inspection includes reviewing demonstrations and training provided to licensee/contractor personnel.

    2. Assess the licensee's implementation of the chosen method to detect cracking on the OD of the VHP nozzle.

c. If an inspection opportunity is available, inspectors will observe, assess, and report the condition of the reactor vessel head, and also assess and report on the licensee's capability to detect small amounts of boron, as described in NRC Bulletin 2001-01. If an opportunity to observe the reactor vessel head does not become available, inspectors will briefly describe the circumstances (i.e., is this a

routine outage condition that does not permit viewing the reactor vessel head) and what they could observe.

d. Inspectors will report anomalies, deficiencies, and discrepancies identified with the reactor coolant system (RCS) structures or the examination process, when such problems are judged to be significant enough to potentially impede the examination process, as described in the Web-based familiarization.

03.03 High-Susceptibility Plants (Bin 2)

NRC Bulletin 2001-01 states that it may be appropriate for plants identified as Bin 2 in Appendix A to perform a "qualified" visual examination by the end of 2001. If that is not possible, the bulletin states that a 100% volumetric examination may be appropriate. Otherwise, the plant's response to the bulletin should provide justification for their chosen course of action. A "qualified" visual examination has two essential elements, as described in the bulletin. The first element is a demonstration by the licensee (through research, empirical data, or analysis) that a leak flow-path will exist if VHP nozzle cracking goes "through-wall," resulting in leakage or leakage deposits available on the vessel head for detection. The second element of a "qualified" visual examination is the effectiveness of the examination should not be compromised by the presence of insulation, existing deposits on the reactor vessel head, or other factors that could interfere with the detection of leakage. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability, and provide the assigned inspectors the critical performance parameters to aid them in inspecting the examination activities. If a 100% volumetric examination is performed, inspectors will use Section 03.01 of this TI to conduct the inspection. If a "qualified" visual examination is to be performed, the inspection will consist of the following activities:

a. The assigned inspector (with assistance from a regional ISI specialist inspector, as required) will interview personnel, and observe and assess the effectiveness of a sample of the visual examination of the VHP nozzles.

b. Inspectors will observe, assess, and report the condition of the reactor vessel head, and also assess and report on the licensee's capability to detect small amounts of boron, as described in NRC Bulletin 2001-01.

c. Inspectors will report anomalies, deficiencies, and discrepancies identified with the associated structures or the examination process when such problems are judged to be significant enough to potentially impede the examination process in accordance with the reporting instructions of this TI.

03.04 Moderate-Susceptible Plants (Bin 3)

NRC Bulletin 2001-01 states that it may be appropriate for plants identified as Bin 3 in Appendix A to perform an effective visual examination. Otherwise, the plant's response to the bulletin should provide justification for their chosen course of action. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability, and provide the assigned inspectors the critical performance parameters to aid them in inspecting the

examination activities. If a visual examination of the reactor vessel head is performed, the inspection will consist of the following activities:

a. The assigned inspector will interview personnel, and observe and assess the effectiveness of a sample of the visual examination of the VHP nozzles.

b. Inspectors will observe, assess, and report the condition of the reactor vessel head, and also assess and report on the licensee's capability to detect small amounts of boron, as described in NRC Bulletin 2001-01.

c. Inspectors will report anomalies, deficiencies, and discrepancies identified with the associated structures or the examination process when such problems are judged to be significant enough to potentially impede the examination process. Reports shall be made in accordance with the reporting instructions of this TI.

03.05 Low-Susceptibility Plants (Bin 4)

NRC Bulletin 2001-01 states that plants identified as Bin 4 in Appendix A are considered to have a low susceptibility to PWSCC, given a susceptibility ranking of more than 30 effective full power years (EFPYs) from the ONS3 condition. If the licensee conducts a reactor vessel head examination, the assigned inspector should perform the following verification process:

a. Observe, assess, and report the condition of the reactor vessel head, and also assess and report on the licensee's capability to detect small amounts of boron, as described in NRC Bulletin 2001-01.

b. Report anomalies, deficiencies, and discrepancies identified with the associated structures or the examination process when such problems are judged to be significant enough to potentially impede the examination process in accordance with the reporting instructions of this TI.

2515/145-04 GUIDANCE

04.01 General

The inspectors should be cognizant of extenuating circumstances at their respective plant(s), such as the operational history, physical layout and material condition of the reactor vessel head, and any identified VHP nozzle leakage or other Alloy-600 PWSCC indications that would suggest a need for more aggressive licensee inspection practices. In addition, since inspection and repair activities can potentially result in large collective occupational doses, licensees should ensure that all activities related to the inspection of VHP nozzles and the repair of identified degradation are planned and implemented to keep personnel exposures as low as reasonably achievable (ALARA), consistent with the NRC Part 20, ALARA requirements.

04.02 Plants With Identified PWSCC (Bin 1)

For plants that have already identified PWSCC in the CRDM nozzles (for example, by detecting boric acid deposits), the cracking of VHP nozzles is likely to continue to occur as the facilities continue to operate. Therefore, a qualified 100% volumetric examination of *every* VHP (with a demonstrated capability to reliably detect cracking of the associated portion of the reactor coolant pressure boundary) may be appropriate to provide evidence of the structural integrity of the VHP nozzles. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability, and provide the assigned inspectors the critical performance parameters to aid them in inspecting the examination activities. If a licensee chooses a course of action other than 100% volumetric examination, the inspectors will coordinate with their respective region and NRR/DE/EMCB to determine which sections of this TI to use in performing an inspection that will verify whether the licensee's course of action meets the intent of NRC Bulletin 2001-01.

a. Inspectors will use IP 71111.08 to inspect the ISI-related aspects of the licensee's activities. The inspector's VHP nozzle sample should consist of nozzles at different points evenly distributed around the reactor vessel head.

b. A "qualified" volumetric examination includes a demonstration by the licensee that the cracking of concern can be effectively identified and characterized. NRR/DE/EMCB will verify the analysis/methodology used by the licensee, and pass on to the inspectors the critical performance concerns. For the onsite inspection, the inspector should perform the following activities:

    1. Interview examination personnel and/or analysts to assess their knowledge of the licensee's activities. Additionally, assess whether licensee's training and/or the qualification processes adequately prepared assigned staff to perform the licensee's examination.

    2. Review the examination procedures to determine whether they provide adequate guidance and examination criteria to implement the licensee's examination plan submitted to NRR/DE/EMCB. The procedures should meet the following minimum criteria:

        (a) Ensure that a complete reactor vessel head examination is planned and successfully implemented. A complete examination means that all penetration nozzles are examined 360° around the circumference of the nozzle. A VHP nozzle location indexing plan that ensures all nozzles are examined may be established. If so, it should be reviewed for completeness.

        (b) Require adequate documentation of work, such that the examination scope, process, criteria, and results are complete and clearly described.

        (c) Provide inspection standards and acceptance criteria that are clear and on which personnel have been trained.

    3. Determine whether the examination procedures were properly performed.

c. If an inspection opportunity is available, inspectors will assess the condition of the reactor vessel head through either direct observations or video inspections. In particular, inspectors should look for and document items on the reactor vessel head, such as debris, insulation, dirt, boron from other sources, physical layout, and viewing obstructions. Additionally, inspectors should assess the licensee's ability to distinguish small boron deposits on the head, because this is an important aspect of NRC Bulletin 2001-01. These observations and assessments will give the agency an independent look at the condition of the reactor vessel head and the effectiveness of the examinations, and will provide baseline data for possible future licensing actions or generic communications. In addition, the information provided on the internal web will provide some guidance for qualitative assessment. If an opportunity to observe the reactor vessel head does not become available, inspectors will briefly describe the circumstances (i.e., is this a routine outage condition that does not permit viewing the reactor vessel head) and what they could observe.

d. Inspectors will identify any anomalies, deficiencies, and discrepancies associated with the RCS structures or the examination process including those identified by the licensee and then verify they are placed in the licensee's corrective action process. In accordance with the bulletin, the licensee will provide information concerning any identified VHP nozzle leakage and for cracking detected in the plant. The inspectors will report lower-level issues concerning data collection and analysis, as well as any issues that are deemed to be significant to the phenomenon described in the bulletin. These items should be reported in accordance with the reporting instructions of this TI.

04.03 High-Susceptibility Plants (Bin 2)

Plants are considered to have a high susceptibility to PWSCC, given a susceptibility ranking of less than 5 EFPYs from the ONS3 condition. The possibility of VHP nozzle cracking at one of these facilities indicates the need to use a qualified visual examination of 100% of the VHP nozzles. A "qualified" visual examination has two essential elements, as described in the bulletin. One element is a plant specific demonstration that any VHP nozzle exhibiting through-wall cracking will provide sufficient leakage to the reactor vessel head surface (given the as-built configuration of the VHPs). A second characteristic is that the examination is capable of detecting and discriminating small amounts of boric acid deposits from VHP nozzle leaks, such as were identified at ONS2 and ONS3, and the effectiveness of the qualified visual examination should not be compromised by the presence of insulation, existing deposits on the reactor vessel head, or other factors that could interfere with the detection of leakage. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability with regard to the "qualification" aspects of the submittals, and provide the assigned inspectors the critical performance parameters to aid them in inspecting the examination activities. If the licensee chooses not to conduct a qualified visual examination, a qualified volumetric examination of 100% of the VHP nozzles (with a demonstrated capability to reliably detect cracking of the associated portion of the reactor vessel pressure boundary) may be appropriate to provide evidence of the structural integrity of the VHP nozzles. For onsite inspections, the inspector should perform the following verification activities:

a. Observe a sample of the visual examination of the VHP nozzles. The sample should consist of VHP nozzles at different points evenly distributed around the reactor vessel head curvature. The sample should also allow for assessment of the physical difficulties in conducting the examination. Assess the effectiveness of the visual examination and ensure that it can reliably detect and accurately characterize any leakage from cracking in VHP nozzles, and that it is not compromised by the presence of insulation, pre-existing deposits on the reactor vessel head, or other factors that could interfere with the detection of leakage. The inspection plan should include the following activities:

1. Interview examination personnel and/or analysts to assess their knowledge of the licensee's activities. Additionally, assess whether licensee's training and/or the qualification processes adequately prepared assigned staff to perform the licensee's examination.

2. Review examination procedures to determine whether they provide adequate guidance and examination criteria to implement the licensee's examination plan submitted to NRR/DE/EMCB. The procedures should meet the following minimum criteria:

   (a) Ensure that a complete reactor vessel head examination is planned and successfully implemented. A complete examination means that all penetration nozzles are examined 360$^{o}$ around the circumference of the nozzle. A VHP nozzle location indexing plan may be established to ensure that the examination accounts for all nozzles. If so, it should be reviewed for completeness.

   (b) Require adequate documentation of work, such that the examination scope, process, criteria, and results are complete and clearly described.

   (c) Provide inspection standards and acceptance criteria that are clear and on which personnel have been trained.

3. Conduct a performance-based inspection to verify that the licensee properly performed the procedure. Pay particular attention to ensure that the visual clarity of the examination process was adequate and that old boron deposits, debris, and insulation were effectively identified and categorized.

b. Observe and assess the condition of the reactor vessel head through either direct observations or video inspections. Look for and document items affecting the reactor vessel head, such as debris, insulation, dirt, boron from other sources, physical layout, and viewing obstructions. Additionally, assess the licensee's ability to distinguish small boron deposits on the head, as described in NRC Bulletin 2001-01. These observations and assessments will give the agency an independent look at the condition of the reactor vessel head and the effectiveness of the examinations, and will provide baseline data for possible future licensing actions or generic communications. In addition, the information contained on the internal web will provide some guidance for qualitative assessment.

c. Inspectors will identify any anomalies, deficiencies, and discrepancies associated with the RCS structures or the examination process including those identified by the licensee and then verify they are placed in the licensee's corrective action process. In accordance with the bulletin, the licensee will provide information concerning any identified VHP nozzle leakage and for cracking detected in the plant. The inspectors will report lower-level issues concerning data collection and analysis, as well as any issues that are deemed to be significant to the phenomenon described in the bulletin. These items should be reported in accordance with the reporting instructions of this TI.

04.04 Moderate-Susceptible Plants (Bin 3)

Plants are considered to have a moderate susceptibility to PWSCC, given a susceptibility ranking of more than 5 EFPYs, but less than 30 EFPYs from the ONS3 condition. An effective visual examination of 100% of the VHP nozzles may be sufficient to provide reasonable confidence that PWSCC degradation would be identified before it poses an undue risk, provided that the examination is capable of detecting and discriminating small amounts of boric acid deposits from VHP nozzle leaks, such as were identified at ONS2 and ONS3. NRR/DE/EMCB will receive the licensee's examination plan, review it for acceptability, and provide the assigned inspectors the critical performance parameters to aid them in inspecting the examination activities. The inspector should perform the following verification activities:

a. Observe a sample of the visual examination of the VHP nozzles. The sample should consist of VHP nozzles at different points evenly distributed around the reactor vessel head curvature. The sample should also allow for assessment of the physical difficulties in conducting the examination. Assess the effectiveness of the visual examination and ensure that it can reliably detect and accurately characterize any leakage from cracking in VHP nozzles is not compromised by the presence of insulation, preexisting deposits on the reactor vessel head, or other factors that could interfere with the detection of leakage. The inspection plan should include the following activities:

    1. Interview examination personnel and/or analysts to assess their knowledge of the licensee's activities. Additionally, assess whether licensee's training and/or the qualification processes adequately prepared assigned staff to perform the licensee's examination.

    2. Review examination procedures to determine whether they provide adequate guidance and examination criteria to implement the licensee's examination plan submitted to NRR/DE/EMCB. The procedures should meet the following minimum criteria:

        (a) Ensure that a complete reactor vessel head examination is planned and successfully implemented. A complete examination means that all penetration nozzles are examined 360$^{o}$ around the circumference of the nozzle. A VHP nozzle location indexing plan may be established to ensure that the examination accounts for all nozzles. If so, it should be reviewed for completeness.

(b) Require adequate documentation of work, such that the examination scope, process, criteria, and results are complete and clearly described.

(c) Provide inspection standards and acceptance criteria that are clear and on which personnel have been trained.

3. Conduct a performance-based inspection to verify that the licensee properly performed the procedure. Pay particular attention to ensure that the visual clarity of the examination process was adequate and that old boron deposits, debris, and insulation were effectively identified and categorized.

b. Observe and assess the condition of the reactor vessel head through either direct observations or video inspections. Look for and document items affecting the reactor vessel head, such as debris, insulation, dirt, boron from other sources, physical layout, and viewing obstructions. Additionally, assess the licensee's ability to distinguish small boron deposits on the head, as described in NRC Bulletin 2001-01. These observations and assessments will give the agency an independent look at the condition of the reactor vessel head and the effectiveness of the examinations, and will provide baseline data for possible future licensing actions or generic communications. In addition, the information contained on the internal web will provide guidance for qualitative assessment.

c. Inspectors will identify any anomalies, deficiencies, and discrepancies associated with the RCS structures or the examination process including those identified by the licensee and then verify they are placed in the licensee's corrective action process. In accordance with the bulletin, the licensee will provide information concerning any identified VHP nozzle leakage and for cracking detected in the plant. The inspectors will report lower-level issues concerning data collection and analysis, as well as any issues that are deemed to be significant to the phenomenon described in the bulletin. These items should be reported in accordance with the reporting instructions of this TI.

04.05 Low-Susceptibility Plants (Bin 4)

Plants are considered to have a low susceptibility to PWSCC, given a susceptibility ranking of more than 30 EFPYs from the ONS3 condition. The anticipated low likelihood of PWSCC degradation at these facilities indicates that enhanced examination beyond the present requirements is not currently necessary because enhanced examination is not likely to yield additional evidence of the propensity for PWSCC in VHP nozzles. However, if the licensee inspects the reactor vessel head, the inspector should perform the following verification activities:

a. Observe a sample of the VHP nozzle examinations. The sample should consist of VHP nozzles at different points evenly distributed around the reactor vessel head curvature. The sample should also allow for assessment of the physical difficulties in conducting the examination. Assess the condition of the reactor vessel head through either direct observations or video inspections. Look for and

document items affecting the reactor vessel head such as debris, insulation, dirt, boron from other sources, physical layout, and viewing obstructions. Additionally, assess the licensee's ability to distinguish small boron deposits on the reactor vessel head, as described in NRC Bulletin 2001-01. Pay particular attention to ensure that the visual clarity of the examination process was adequate and that old boron deposits, debris, and insulation were effectively identified and categorized. Observe the extent to which head insulation inhibits effective visual inspection of the nozzles. These observations and assessments will give the agency an independent look at the condition of the reactor vessel head and the effectiveness of the examinations, and will provide baseline data for possible future licensing actions or generic communications. In addition, the web-based familiarization information will provide guidance for qualitative assessment.

b. Report anomalies, deficiencies, and discrepancies identified with the RCS structures or the examination process, in accordance with the reporting instructions of this TI. In addition, report issues concerning data collection and analysis, as well as any issues that are deemed to be significant to the phenomenon described in the bulletin.

## 2515/145-05 REPORTING REQUIREMENTS

Document inspection results in a resident inspectors' routine inspection report, and send a copy of the applicable sections to NRR/DE/EMCB, Attention: Allen Hiser, or e-mail to ALH1@NRC.GOV. Mr. Hiser can also be reached by telephone at (301) 415-1034.

One purpose of this TI is to support NRR/DE/EMCB by inspecting and reporting on the licensees' performance of reactor VHP nozzle examinations. Specifically, the inspectors should provide a qualitative assessment of equipment condition and the effectiveness of the licensees' examinations. At a minimum, the inspectors should be able to briefly answer the following questions (with a description of inspection scope and results) in IMC 0610*, Section 4OA5, "Other," of the next integrated inspection report.

a. Was the examination:

   1. Performed by qualified and knowledgeable personnel? (Briefly describe the personnel training/qualification process used by the licensee for this activity.)

   2. Performed in accordance with approved and adequate procedures?

   3. Adequately able to identify, disposition, and resolve deficiencies?

   4. Capable of identifying the PWSCC phenomenon described in the bulletin?

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

c. Could small boron deposits, as described in the bulletin, be identified and characterized?

d. What materiel deficiencies (associated with the concerns identified in the bulletin) were identified that required repair?

e. What, if any, significant items that could impede effective examinations and/or ALARA issues were encountered.

## 2515/145-06 COMPLETION SCHEDULE

This TI should be completed by the end of the next scheduled unit refueling outage.

## 2515/145-07 EXPIRATION

This TI will expire 2 years from the date of issuance. Before that date, each PWR unit identified in Appendix A should have this TI performed once, during an outage.

## 2515/145-08 CONTACT

For questions regarding the performance of this TI and emergent issues, contact Allen Hiser at (301) 415-1034 or ALH1@NRC.GOV or Jacob Zimmerman at (301) 415-2426 or JIZ@NRC.GOV.

## 2515/145-09 STATISTICAL DATA REPORTING

All direct inspection effort expended in connection with this TI is to be charged to 2515/145 for reporting by the Regulatory Information Tracking System (RITS) with an IPE code of SI.

## 2515/145-10 ORIGINATING ORGANIZATION INFORMATION

### 10.01 Organizational Responsibility

This TI was initiated by NRR/DE/EMCB.

### 10.02 Resource Estimate

The direct inspection effort to be expended in connection with this TI is estimated to be as follows:

a. 100% volumetric examination (Bin 1 plants): 100 man-hours/unit inspection.

b. Qualified visual examination (Bin 2 plants): 60 man-hours/unit inspection.

c. Effective visual examination (Bin 3 plants): 40 man-hours/unit inspection.

d. Reactor vessel head observations (Bin 4 plants): 20 man-hours/unit inspection.

10.03 Other

IP 71111.08 can be satisfied by performing this TI, provided that a volumetric inspection is performed.

10.04 Training

No formal training is proposed for the performance of this TI. Web-based information will be provided to inspectors via the NRC internal Web site (http://nrr40.nrc.gov/CRDM/index.html) for their insight and also for their preparation for this inspection. This information will include a general description of the problem, an explanation of NRC Bulletin 2001-01, a walk through of the proposed TI, pictures of what inspectors should look for, an explanation of inspection criteria, and a discussion of how the information is to be used.

END

Appendix A Susceptibility Sub-population Bins

Appendix A

SUSCEPTIBILITY SUB-POPULATION BINS

- **Bin 1** includes the sub-population of the following plants that have already identified PWSCC in the CRDM nozzles:

  – Oconee Nuclear Station Units 1, 2, and 3
  – Arkansas Nuclear One Unit 1
  – Donald C. Cook Unit 2

- **Bin 2** includes the sub-population of plants that are considered to have a high susceptibility to PWSCC, given a susceptibility ranking of less than 5 EFPYs from the ONS3 condition.

  – Davis-Besse Nuclear Power Station
  – North Anna Power Station Units 1 and 2
  – Robinson Steam Electrical Plant Unit 2
  – Surry Power Station Unit 1 and 2
  – Three Mile Island

- **Bin 3** includes the sub-population of plants that are considered to have a moderate susceptibility to PWSCC given a susceptibility ranking of more than 5 but less than 30 EFPYs from the ONS3 condition.

  – Arkansas Nuclear One Unit 2
  – Beaver Valley Power Station Units 1 and 2
  – Calvert Cliffs Nuclear Power Plant Units 1 and 2
  – Crystal River Nuclear Power Generating Station Unit 3
  – Diablo Canyon Nuclear Power Plant Units 1 and 2
  – Joseph M. Farley Nuclear Power Plant Units 1 and 2
  – Fort Calhoun Station
  – Indian Point Station Units 2 and 3
  – Kewaunee Nuclear Power Plant
  – Millstone Nuclear Power Station Unit 2
  – Palo Verde Nuclear Generating Station Units 1, 2, and 3
  – Point Beach Nuclear Plant Units 1 and 2
  – Prairie Island Nuclear Generating Plant Units 1 and 2
  – R. E. Ginna Nuclear Power Plant
  – Salem Nuclear Generating Station Units 1 and 2
  – San Onofre Nuclear Generating Station Units 2 and 3
  – St. Lucie Plant Units 1 and 2
  – Turkey Point Station Units 3 and 4
  – Waterford Generating Station Unit 3

- **Bin 4** includes the sub-population of plants that are considered to have a low susceptibility to PWSCC, given a susceptibility ranking of more than 30 EFPYs from the ONS3 condition.

- Braidwood Station Units 1 and 2
- Byron Station Units 1 and 2
- Callaway Plant
- Catawba Nuclear Station Units 1 and 2
- Comanche Peak Units 1 and 2
- Donald C. Cook Plant Unit 1
- McGuire Nuclear Station Units 1 and 2
- Millstone Nuclear Power Station Unit 3
- Palisades Nuclear Power Plant
- Seabrook Nuclear Power Station
- Shearon Harris Nuclear Power Plant
- South Texas Project Units 1 and 2
- V. C. Summer Nuclear Station
- Vogtle Electric Generating Station Units 1 and 2
- Watts Bar Nuclear Plant Unit 1
- Wolf Creek Generating Station

END