

From: Jacob Zimmerman
To: Borchardt, Richard; Collins, Samuel; Johnson, Jon; Sheron, Brian
Date: Fri, Dec 21, 2001 10:05 AM
Subject: Bulletin 2001-01 Status Report

The attached file contains the latest Status Report for Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles" as of this morning, December 21, 2001. Please note that updated information is in red (must be viewed in Word Perfect) and indicated by rev. bars. The most significant changes are associated with the moderate susceptibility plants with spring refueling outages.

Please note - There will not be a status report next week due to the holiday. In addition, starting sometime early in the new year, a new Lead PM will be named. I was selected as John Zwolinski's Technical Assistant in the Division of Licensing Project Management. I will continue to follow the issue and work with the new LPM to assure a smooth transition. Thank you all for your support and attention throughout this process.

If you have any questions or comments, please email or call me. If you would like to be removed from distribution, please let me know.

Hope you all have a happy holiday and joyous new year.

Jake Zimmerman, Lead PM Bulletin 2001-01
(301) 415-2426

CC: Adensam, Elinor; Bajwa, Satwant; Barrett, Richard; Bateman, Bill; Bearden, William; Berkow, Herbert; Black, Suzanne; Blough, A. Randolph; Brockman, Ken; Burkhart, Lawrence; Caldwell, James; Caniano, Roy; Casto, Charles; Chandler, Lawrence; Chokshi, Nilesh; Christensen, Harold; Chung, Jin; Clark, Robert; Clifford, James; Colburn, Timothy; Collins, Daniel; Collins, Elmo; Collins, Jay; Congel, Frank; Cowgill, Curtis; Crlenjak, Richard; Dembek, Stephen; Dyer, Jim; Edison, Gordon; Ellershaw, Lee; Eltawila, Farouk; Goshen, John; Grant, Geoffrey; Grobe, John; Gwynn, Pat; Hackett, Edwin; Harrison, John; Hiser, Allen; Holahan, Gary; Holian, Brian; Holmberg, Melvin; Howell, Art; Jacobson, John; Jaxheimer, Frederick; Lanning, Wayne; Laufer, Richard; Lee, Andrea; Lesser, Mark; Lew, David; Longo, Giovanna; Mallett, Bruce; Marsh, Tad; Marshall, Michael; Mayfield, Michael; McCree, Victor; Mendiola, Anthony; Merschhoff, Ellis; Miller, Hubert J.; Modes, Michael; Monarque, Stephen Raul; Nelson (HQ-OE), David; Olshan, Leonard; Paulk, Chuck; Pickett, Douglas; Raghavan, Lakshminaras; Reckley, William; Reinhart, F. Mark; Reynolds, Steven; Richards, Stuart; Rogge, John; Sands, Stephen; Stang, John; Strosnider, Jack; Wert, Leonard; Wetzel, Beth; Wharton, L. Raynard; Wichman, Keith; Wiggins, James; Young, Mitzi; Zwolinski, John

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STATUS REPORT

RE: UNRESOLVED RESPONSES TO THE BULLETIN 2001-01 FOR HIGH SUSCEPTIBILITY PLANTS AND THOSE PLANTS THAT HAVE EXPERIENCED VHP NOZZLE CRACKING

□ **Davis-Besse**

Licensee Plans/Commitments: The licensee plans to shutdown for their next refueling outage on February 16, 2002 and perform VHP nozzle inspections. The shutdown date of February 16, 2002, was docketed in a letter dated November 30, 2001.

NRC Staff Position: The staff utilized the guidance contained in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," and RG 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants" as the basis for evaluating the licensee's probabilistic safety assessment. The staff recognizes the uncertainties associated with this issue including those associated with the crack initiation and growth models. Based on the available information, the staff believes that the actual initiating event frequency and resultant Δ CDF, ICDP, Δ LERF, and ILERP of a LOCA resulting from a failure of a VHP nozzle due to this cracking mechanism is between the bounding values.

Based on the additional information provided and FENOC's commitments documented in their November 30, 2001 letter, the staff concludes that sufficient information is available to justify operation of the Davis-Besse facility until February 16, 2002. The staff's decision was documented in a letter dated December 4, 2001, to FENOC, and communicated in a telephone call with Davis-Besse management.

Next Regulatory Action: None planned.

Meetings & Conf. Call Summaries:

11/28/01- The staff hosted a public meeting with FENOC (licensee) representatives as part of its ongoing efforts associated with review of the licensee's Bulletin 2001-01 responses. The licensee provided additional information including its revised probabilistic safety assessment. To address the potential safety concerns and to justify operation beyond December 31, 2001, the licensee also committed to (1) shut down Davis-Besse on February, 16, 2002, for the commencement of the refueling outage, (2) perform the vessel head penetration (VHP) nozzle inspections as recommended in the Bulletin, (3) characterize any cracks that are identified in VHP nozzles (as required by the ASME Code), (4) operate the plant at a lower reactor coolant system hot leg temperature to reduce the vessel head temperature effects on crack initiation and growth, (5) maximize the availability of the plant's redundant critical safety systems until shutdown, and (6) ensure more reliable operator response to the potential consequences of an event by providing enhanced operator training related to SBLOCA. In addition, a meeting will be scheduled with FENOC, prior to their upcoming refueling outage (2/16/02) to discuss their planned inspection and repair activities.

11/30/01- A telephone call was held with Davis-Besse and FirstEnergy management regarding

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the commitments discussed at the November 28, 2001, meeting. During the call, FENOC management committed to provide additional information and docket their commitments. This was provided in their November 30, 2001 letter.

□ **D. C. Cook, Unit 2**

Licensee Plans/Commitments: The licensee plans to shutdown for their next refueling outage on January 19, 2002 and perform VHP nozzle inspections. The shutdown date of January 19, 2002, was docketed in a letter dated November 30, 2001.

NRC Staff Position: Based on its review of information provided by the licensee and results of inspections conducted at other facilities, the staff has concluded that deferral of the inspections at D.C Cook 2 until the next outage, which begins on January 19, 2002, is acceptable.

Next Regulatory Action: None planned.

Meetings & Conf. Call Summaries:

11/20/01- A public meeting was held with the licensee to discuss the licensee's justification for safe operation until January 19, 2002, and their inspections for the next refueling outage.

11/30/01- Conference call was held to discuss the scope of inspections to be conducted in January 2002. The licensee plans to perform the inspections that are recommended in the Bulletin. The licensees' revised inspection scope and method was docketed in a supplemental response letter, dated December 6, 2001.

□ **North Anna, Units 1 and 2**

Licensee Plans/Commitments: The NRC received a supplemental response on November 14, 2001, regarding information to qualify the fall inspections for North Anna and Surry Units.

NRC Staff Position: During an inspection in October 2001, on North Anna, Unit 1, the licensee identified several nozzles with cracking on the inside diameter of the nozzle and penetrant testing (PT) indications on the J-groove welds. The licensee determined that the nozzle cracking did not require repair. A staff review of the PT records concurred with the licensee's conclusions that the indications appeared to be surface indications and not relevant to a cracking mechanism. By letter dated November 14, 2001, the licensee provided the documentation to support a "qualified visual" analysis to demonstrate acceptability of using "design" dimensions of the VHP penetrations and nozzles. The staff is reviewing this information.

North Anna, Unit 2, completed a special outage for nozzle inspections. Results from the visual examination indicated several nozzles that appeared to have boric acid deposits consistent with the findings at the Oconee plants and Crystal River, Unit 3. The licensee identified one of these

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nozzles with a through-wall crack in the J-groove weld (event report #38498). This crack was identified by the licensee due to staff insistence that the licensee destructively confirm the benign nature of PT indications on the J-groove welds dispositioned by the licensee as surface only and not relevant to a cracking mechanism. Repairs are complete on this nozzle and two other suspect nozzles. Ultrasonic examination of the inside diameter of these three nozzles identified no cracking in the nozzle base metal.

With the findings at Unit 2, the staff will address with the licensee the PT findings at Unit 1.

Next Regulatory Action: None planned at this time.

Meetings & Conf. Call Summaries:

10/5/01- Conference call held to discuss the number of VHP penetrations to be inspected at North Anna, Unit 1.

10/24/01- Conference call held to discuss the qualification of the visual exams to be conducted at North Anna, Units 1 and 2.

11/19/01- Drop-in visits were held by the licensee with the Commissioners and the EDO. A general status of the nozzle inspections at the North Anna and the Surry plants was provided by the licensee.

12/6/01- The staff conducted a conference call with the licensee to address questions concerning the qualified visual examinations performed at North Anna and Surry Power Stations. The licensee will provide the staff a response to the request for additional information within 45 days. The conference call and questions will be docketed as part of VEPCO response to the staff. Included in this response will be the Westinghouse analysis of the sample taken from a repaired penetration at North Anna Unit 2.

The licensee restarted Unit 2 and reached full power on December 17, 2001.

Surry, Units 1 and 2

Licensee Plans/Commitments: The NRC received a supplemental response on November 14, 2001, regarding information to qualify the fall inspections for all North Anna and Surry Units.

NRC Staff Position: Staff is reviewing the licensee's supplemental response regarding qualification of visual inspections for these units.

Next Regulatory Action: None planned at this time.

Meetings & Conf. Call Summaries:

10/12/01- Surry agreed to provide a supplement to their Bulletin response addressing qualified

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visual inspection (supplement sent November 14, 2001). Still uncertain as to when Surry, Unit 2, would be inspected.

- 10/31/01- NRC gave verbal relief for Surry, Unit 1, relief requests SR-27 and SR-28 so that repair of cracks could proceed. Relief was based on NRC questions and licensee responses in previous North Anna phone calls (Surry, Unit 1, relief and North Anna, Unit 1, reliefs previously submitted, reviewed and withdrawn) and previous similar reliefs granted for Duane Arnold, Fitzpatrick, and Nine Mile Point.
- 11/6/01- Surry agreed to docket a commitment to provide evidence of weld procedure qualification for P43 to P3 with F43 filler. Also agreed to provide analyses for weld repair and flaw evaluation prior to restart. Also agreed to address crack triplepoint, and to state there will be a PT report documenting J weld crack.
- 12/6/01- The staff conducted a conference call with the licensee to address questions concerning the qualified visual examinations performed at North Anna and Surry Power Stations.

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VHP NOZZLE INSPECTIONS/RESULTS

December 21, 2001

10:00 A.M.

□ **Crystal River, Unit 3**

Inspections completed in October 2001. The licensee identified one leaking CRDM nozzle with a 90° circumferential crack which was subsequently repaired. The staff notes that the licensee did not perform any destructive examination to further characterize the flaw. This is the highest ranked moderate susceptibility plant.

In a phone call on 12/11, the staff questioned the licensee regarding the through-wall flaws identified in nozzle number 32 (note that this nozzle also had two part-through wall circumferential flaws, one 50% through-wall and 91 degrees long above the weld, and the other 75% through-wall and 31 degrees in length below the weld).

Two of the through-wall flaws were essentially axial in extent, extending from the bottom of the nozzle to a location above the J-groove weld. A third flaw had an axial length of 2 inches, and a circumferential extent of 195 degrees. This last flaw had one end below the J-groove weld, and the other end above the J-groove weld. The staff confirmed with the licensee that the through-wall portion of this flaw was located totally below the weld. To aid in describing the location of this last flaw, the licensee will provide the staff with graphics to clearly demonstrate the position of this flaw.

The licensee indicated a plan to replace the head at the next refueling outage, in the fall of 2003.

□ **North Anna, Unit 1**

Inspections completed in October 2001. The licensee identified eight shallow axial cracks below the J-groove weld and penetrant testing (PT) indications on the J-groove welds. The licensee did not perform any repairs because these cracks were not part of the reactor coolant pressure boundary. A staff review of the PT records concurred with the licensee's conclusions that the indications appeared to be surface indications and not relevant to a cracking mechanism.

□ **North Anna, Unit 2**

North Anna, Unit 2, found a through-wall leak in a CRDM nozzle (event report issued). As of December 6, 2001, the licensee has completed repairs of the leaking CRDM nozzle and two other suspect nozzles. VEPCO reinstalled the thermal sleeves on these nozzles. Ultrasonic examination of the inside diameter of these three nozzles identified no cracking in the nozzle base metal. A preliminary analysis conducted by Westinghouse of a sample taken from one of the repaired penetrations showed fabrication defects including hot cracking and lack of fusion. Most of this cracking occurred at the weld to butter layer.

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The licensee restarted the unit and reached full power on December 17, 2001.

Surry, Unit 1

The licensee completed repairs of six penetrations during their fall refueling outage. The unit went online on 12/08 and reached full power on 12/12. The staff continues to review the Bulletin response and the weld repair relief requests.

Surry, Unit 2

The licensee shutdown Unit 2 on November 19, 2001 to conduct the recommended inspections. A bare-head visual inspection was conducted over the weekend of November 24, 2001. No indications of VHP nozzle cracking and leakage were evident. In addition, there were no indications that would lead the licensee to perform NDE of any VHP nozzles. Surry, Unit 2 restarted on 12/1 and is now at full power.

TMI-1

Following shutdown for a scheduled refueling outage in October 2001, TMI-1 performed visual inspections of the reactor vessel CRDM nozzles as recommended in NRC Bulletin 2001-01. The inspections revealed axially-oriented flaw indications in eight CRDM nozzles, six nozzles were found to have cracks within the pressure boundary (five nozzles had through-wall cracks and one did not), the other two nozzles had cracks that were outside the pressure boundary. The licensee completed Code repairs on all six of the CRDM nozzles that had flaws within the pressure boundary. Additionally, the licensee performed visual inspections of the eight thermocouple (T/C) nozzles and found evidence of leakage on all of them. Two of the leaking T/C nozzles were replaced and the remaining six were plugged in accordance with Code requirements or as allowed by an NRC-approved relief request. These corrective actions are complete.

The staff is interested in information regarding the licensee's flaw evaluation with regard to the 2 axial (below-the-weld) flaw indications that were not repaired. Items of interest are the assumed crack growth rate and the subsequent time it takes the axial flaws to propagate into the weld. The staff will engage the licensee in the near future regarding this issue.

Oconee, Unit 3

The licensee initially identified cracking in February of 2001 (nine leaking CRDMs, three circumferential cracks) during a maintenance outage. On November 12, 2001, after only seven months of operation following its previous inspection and during its regularly scheduled refueling outage Oconee, Unit 3, identified indications of leakage evidenced by boric acid buildup around four CRDM nozzles.

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The CRDM nozzle repair and inspection activities were completed, and the reactor vessel head was reinstalled on December 6, 2001. Entry into Mode 1 for this cycle is expected to occur during the evening of December 13. Ocone identified 5 leaking nozzles and repaired 7 nozzles. In addition, the licensee inspected 43 nozzles which have not been previously inspected. This inspection was intended to detect circumferential indications 1-inch above and below the J-groove weld; the inspection was not capable of detecting axial cracks. The inspection found no circumferential indications. However, seven of the 43 nozzles were not 100% inspected. The inspection coverage on these 7 nozzles ranged from 75% to 99%. The licensee has concluded, using the NRC crack growth methodology, that even if a circumferential cracks existed in the uninspected areas of these 7 nozzles, these cracks would not grow to the extent that they would present a safety concern prior to the next planned outage in 18 months. The licensee has also concluded that Ocone 3 will be restarting with no known leakage and this is in compliance with applicable technical specification requirements.

The licensee plans to replace the head at the next refueling outage, scheduled for spring 2003.

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MODERATE SUSCEPTIBILITY PLANT INSPECTION PLANS/ RESULTS

December 21, 2001

10:00 A.M.

The following plants have performed the recommended inspections as defined in Bulletin 2001-01 this fall and found no indications of leakage. All of these plants are ranked as moderately susceptible to primary water stress corrosion cracking. The licensee for these plants performed 100% bare metal visual inspections.

Beaver Valley, Unit 1
Farley, Unit 1
Kewaunee
Turkey Point, Unit 3
St. Lucie, Unit 2

No other moderate plants are scheduled for outages before 12/31/01.

The following moderate susceptibility plants are scheduled for refueling outages in spring 2002:

ANO, Unit 2* (April 2002)
Beaver Valley, Unit 2* (February 2002)
Calvert Cliffs, Unit 1* (February 2002)
Diablo Canyon, Unit 1* (May 2002)
Fort Calhoun* (May 2002)
Ginna (March 2002) - Licensee needs to supplement the Bulletin response

Meetings & Conference Calls

12/12/01 - A public meeting was held with representatives from Rochester Gas and Electric Corporation (RG&E). RG&E presented their technical evaluation regarding the potential for CRDM cracking to occur at Ginna and, thereby, justify why no inspection of the reactor vessel head would be necessary during the next scheduled refueling outage.

RG&E staff indicated that it was confident that there is no safety issues associated with their plans to not inspect the reactor vessel head for circumferential cracking during the next refueling outage which is scheduled for March of 2002. This decision was based on the results of (1) the previous eddy current testing performed in 1999, (2) the crack growth rate analysis developed by Structural Integrity Associates, and (3) the fact that Ginna reactor vessel head temperatures are significantly lower than plants which have seen cracking. The 1999 eddy current test indicated no through-wall cracks, and the crack growth rate analysis using linear elastic fracture mechanics indicated that for the most limiting case (180 degree flaw) the time to grow to the allowable flaw size of 300 degrees is greater than the operating time from the 1999 inspection until the Fall of 2003 outage when RG&E plans to replace the reactor vessel head. The licensee also indicated that by providing enhanced operator training related to medium break loss of coolant accident, the probabilistic safety assessment results indicated that the

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conditional core damage probability is equal to 2.252E-03.

RG&E plans to submit a revised bulletin response by December 31, 2001.

Millstone, Unit 2 (February 2002) - Licensee needs to supplement the Bulletin response
Meetings & Conf. Call Summaries:

12/10/01 - A telephone call was held with Dominion Nuclear Connecticut (DNC) representatives to discuss their supplemental response to the Bulletin which they committed to provide by 12/31/01. They reiterated that they are ranked 29th in susceptibility out of 69 operating PWRs and that they are 14.3 EFPY from Oconee 3. They concluded that a visual inspection is not viable because of the contoured insulation, presence of asbestos, restricted access, as well as ALARA concerns.

Though their initial Bulletin response said that "DNC is not currently planning to perform additional inspections during the upcoming Millstone Unit No. 2 refueling outage," DNC said that they intend to perform UT from the nozzle ID (no thermal sleeve problems) to look for axial and circumferential flaws initiating on the ID or OD of the nozzle. The planned vendor (Framatome) has been developing a low frequency UT technique that they believe may be sufficient to qualify for examination of the J-groove weld metal for surface-breaking flaws. Concerns cited by the licensee are: the ability to qualify the UT method in time (tentatively scheduled for mid to late January in Lynchburg), possible problems with equipment reliability, and a reluctance by the licensee to extend the outage beyond the time period allocated.

The staff informed the licensee that their plans appear to be focused in the proper direction, and the ability to interrogate the weld metal would result in a thorough examination (the licensee cited ALARA as the basis for not performing PT of the J-groove welds). However, the licensee's possible lack of commitment to inspect 100% of the VHP nozzles, and the need for contingency plans should problems develop, are important considerations during the upcoming review of the licensee's supplemental response.

12/12/01- The staff hosted a drop-in visit from DNC management to facilitate a general exchange of information regarding vessel head penetration (VHP) nozzle inspections. DNC is concerned that the technology that Millstone 2 would have to employ during their February outage is still being developed and has not yet been demonstrated or qualified. They are highly dependent on their vendor, and they are concerned that difficulties encountered during the inspections may lead to extending the outage.

The staff encouraged the licensee to broaden their view of potential success paths to include risk informed arguments possibly coupled with compensatory measures to further reduce any significant risk components.

The licensee stated that they will provide their supplemental response by January 31,

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2001.

Palo Verde, Unit 2 (March 2002) - Licensee needs to supplement the Bulletin response.

Meetings & Conference Calls

12/13/01 - The staff conducted a follow-up telephone conference with Arizona Public Service Company (APS) to obtain clarification on their revised response to Bulletin 2001-01, dated December 6, 2001. APS stated in the revised response that they have modified their inspection schedule for Unit 2 from 2005 to spring 2002 and that a finalized inspection schedule for Units 1 and 3 will be based on Unit 2 inspection results. During the telephone call APS specified that they planned to perform eddy current testing of the wetted surfaces of all 97 CEDM nozzles and the head vent nozzles, including the inside diameter (ID) surface, the outside diameter (OD) surface below the J-groove weld, and the J-groove welds. APS plans to follow-up with ultrasonic examination to characterize any defects detected by eddy current testing, and will use ultrasonic examination to detect circumferential flaws on the OD surface above the J-groove weld for any nozzle exhibiting through-wall cracking. APS explained that they were not prepared to commit to a specific technique to be used, but acknowledged that their goal is to address both the safety concern (e.g., a circumferential flaw above the weld) and the compliance concern (e.g., through-wall leakage). The staff requested that APS revise their response to reflect information discussed on the telephone call regarding the specifics of the planned inspections. APS is planning to revise their response by mid-January 2002.

12/14/01 - APS requested a follow-up call to clarify what was discussed on the 12/13/01 call. The licensee again summarized their scope and method of inspection for the 97 CEDM nozzles and head vent nozzle. The licensee also inquired as to whether or not the NRC was imposing requirements in addition to the recommendations of the Bulletin with regard to detection of circumferential flaws above the J-groove weld. The staff reiterated its expectation that licensee's employ an examination technique that is capable of detecting circumferential flaws on the OD surface above the J-groove weld for any nozzle exhibiting through-wall cracking. This has been a consistent staff approach with all licensees who have detected through-wall leakage.

Point Beach, Unit 2 (April 2002) - Licensee needs to supplement the Bulletin response

Meetings & Conference Calls

12/18/01 - The staff conducted a telephone call with the licensee for Point Beach Units 1 & 2 licensee to discuss their VHP inspection plans during the spring 2002 refueling outage of Unit 2. The licensee proposed to remove a layered insulation package from the reactor vessel head, perform visual inspections and repair as necessary at its next outage. However, for those locations in which the visual exam becomes indeterminate due to the disturbance of deposits when removing the insulation or the presence of masking materials that would result in an inconclusive visual examination, the licensee proposed to re-start, operate another 6-8 months, and then come down for a mid-cycle outage to perform a visual inspection (through visual inspection ports in a newly installed insulation package.)

The staff informed the licensee that the expectations stated in Bulletin 2001-01 are to disposition every nozzle at the next outage. Point Beach's proposal does not commit to

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this expectation. The licensee continues to explore their options with various contractors and will submit a supplemental response to Bulletin 2001-01 in the next couple of weeks.

Prairie Island , Unit 2* (January 2002)
Salem, Unit 2* (April 2002)
San Onofre, Unit 2* (May 2002)
Turkey Point, Unit 4* (March 2002)
Waterford 3* (March 2002)

- * This plant has committed to perform an inspection consistent with the discussion in Bulletin 2001-01 (an effective visual examination or better).

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