Florida Power
A Progress Energy Company

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50.54(f)

November 19, 2001
3F1101-04

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Crystal River Unit 3 - Information Requested in Item 5 of NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

References:
1. NRC to FPC letter, 3N0801-03, dated August 3, 2001, NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"
2. FPC to NRC letter, 3F0801-06, dated August 30, 2001, Crystal River Unit 3 - Response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

Dear Sir:

Pursuant to 10 CFR 50.54(f), Florida Power Corporation (FPC) is hereby providing the information requested in Item 5 of NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"(Reference 1). Item 5 of the bulletin requests the following:

*(a)* A description of the extent of VHP (Vessel Head Penetration) nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;

*(b)* If cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin.

The Attachment contains the information described above and includes the results of the visual inspection of the Control Rod Drive Mechanism (CRDM) nozzle penetrations performed during the recently completed Refueling Outage 12 (12R), and the corrective actions taken as a result of leakage from a CRDM nozzle found during the visual inspection. This information is being provided within 30 days after breaker closure following restart of Crystal River Unit 3 (CR3) as stated in Reference 2.

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Subsequent to the CR3 bulletin response submittal, an Engineering Evaluation was performed using plant specific as-built CRDM nozzle interference fit data which concluded that through-wall pressure boundary leakage will produce visible boric acid crystal deposits on top of the Reactor Vessel Head (RVH). The visual inspection completed during 12R identified boron crystal deposits as a result of through-wall cracking at CR3's CRDM nozzle #32. Therefore, FPC concludes that although CR3 was committed to performance of an effective visual examination during 12R, the examination meets the intent of the qualified visual examination as described in the NRC Bulletin. The most probable cause of the CRDM nozzle through-wall cracking is primary water stress corrosion cracking. The corrective actions taken by CR3 support the conclusion that safety will be maintained during the planned operating cycle.

This letter establishes no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Sid Powell, Supervisor, Licensing and Regulatory Programs at (352) 563-4883.

Sincerely,

Dale E. Young
Vice President, Crystal River Nuclear Plant

DEY/lvc

Attachment:

Crystal River Unit 3 - Information Requested in Item 5 of NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

xc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector

**STATE OF FLORIDA**

**COUNTY OF CITRUS**

Dale E. Young states that he is the Vice President, Crystal River Nuclear Plant for Progress Energy; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Dale E. Young
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 19 day of Nov., 2001, by Dale E. Young.

Signature of Notary Public
State of Florida

Ellen Deppolder
My Commission DD040101
Expires July 08, 2005

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known X -OR- Produced Identification _____

# ATTACHMENT

## Crystal River Unit 3
## Information Requested in Item 5 of NRC Bulletin 2001-01,
## "Circumferential Cracking of
## Reactor Pressure Vessel Head Penetration Nozzles"

**Crystal River Unit 3**
**Information Requested in Item 5 of**
**NRC Bulletin 2001-01,**
**"Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"**

**REQUESTED ACTION:**

5. Addressees are requested to provide the following information within 30 days after plant restart following the next refueling outage:

   *(a)* a description of the extent of VHP (Vessel Head Penetration) nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;

   *(b)* if cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin.

Additionally, the following commitment was made by Florida Power Corporation (FPC) in response to NRC Bulletin 2001-01 (Reference 1):

> Crystal River Unit 3 (CR3) will provide a report of the results of the visual inspections performed during Refueling Outage 12 (12R), and any corrective actions taken as a result of leakage from a CRDM (Control Rod Drive Mechanism) penetration, within 30 days after breaker closure following restart of the unit after Refueling Outage 12.

**Response:**

On September 29, 2001, CR3 shut down in support of the planned Refueling Outage 12 (12R). CR3 proceeded to implement the planned visual inspection and subsequent repair activities as committed to in the CR3 response to NRC Bulletin 2001-01 (Reference 1).

Following entry into Mode 5 (Cold Shutdown) and removal of the Reactor Vessel Head (RVH) insulation, a bare metal visual inspection of the 69 RVH to CRDM nozzle interfaces was performed. The inspection was performed in accordance with plant procedures SPS VT-N14 Revision 5, "Visual Examination of System Pressure Testing ASME Code Section XI," and SPS VA-N11, Revision 4,"Visual Acceptance of System Pressure Testing ASME Section XI." The inspectors were VT-2 qualified with special qualifications and training related to CRDM nozzle leakage observation. The special qualifications and training used industry operating experience and images of leaking nozzles to sensitize inspectors to the type and quantity of boric acid crystal deposits indicative of CRDM through-wall leaks experienced at Oconee Nuclear Stations and Arkansas Nuclear One.

The results of the visual inspection indicated that there was one nozzle (#32) with a potential through-wall crack based on boric acid crystal accumulation. As a result of the visual inspection, the CRDM mounted on nozzle #32 was removed to support an Ultrasonic Examination (UT) of the CRDM nozzle base material. The UT probes were deployed using the Babcock & Wilcox Owners Group (B&WOG) Top-down tooling.

The results of the UT examination of CRDM nozzle #32 are provided in the table below.

Table 1

| Crystal River Unit 3 CRDM Nozzle #32 (F12)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Flaw # | Axial Location[1] | | | Circ. Location[2] | | | Remaining Ligament (From ID Surface) | Surface (ID/OD) |
| | Min. (in.) | Max. (in.) | Length (in.) | Min. (Deg) | Max. (Deg) | Extent (Deg) | | |
| 1 | 36.51 | | | 347.0 | 17.82 | 30.82 | 0.15 in. | OD |
| 2 | 35.24 | 37.27 | 2.03 | -132.25 | 63.14 | 195.39 | Through-wall | OD |
| 3 | 36.21 | 39.65 | 3.44 | 114.14 | | | Through-wall | OD |
| 4 | 36.41 | 39.65 | 3.24 | 170.18 | | | Through-wall | OD |
| 5 | 36.27 | | | 102.65 | 193.88 | 91.23 | 0.33 in. | OD |

Notes:
* - Core position provided for convenience
1 - End of Nozzle @ 39.65 inches (Top of Nozzle Flange is Zero)
2 - Downhill Side of Nozzle @ 154.92 degrees
OD=Outside Diameter, ID=Inside Diameter

As indicated in the Table, the UT data indicated the presence of five recordable indications including two (2) axially oriented cracks (flaw 3 and 4) that were through-wall, and extended from the bottom of the nozzle through and above the J-groove weld. These cracks originated at the weld-to-nozzle interface, propagated downward to the end of the nozzle, and upward through the weld into the annular space between the nozzle and the head. These two axial cracks were the source of leakage. These two cracks were then joined circumferentially (flaw 5) on the OD of the nozzle above the weld. The circumferential crack (flaw 5) above the weld extended about 90 degrees and was approximately 50% through-wall. The UT identified one circumferential crack (flaw 1) below the weld. Flaw 1 extended for about 30 degrees and was within 0.15 inch of the ID (approximately 75% through-wall). Flaw 2 extended for about 195 degrees and was through-wall. Note that flaw 2 had both axial and circumferential characteristics, extending from below the weld, through the weld and above the weld. The largest portion of the flaw was below the weld (approx. 130 degrees). All five cracks were OD initiated. No dye penetrant test (PT) of the J-groove weld was required since through-wall cracking of the nozzle base material was confirmed.

As provided in the CR3 response to NRC Bulletin 2001-01 (See Table 2), since through-wall cracking of CRDM nozzle #32 was confirmed by UT, an extent of condition of the cracking was performed using UT on eight (8) nozzles where CRDM's were removed to facilitate nozzle #32 repair or removed for CRDM replacement (See Figure 1). The nozzles inspected were #8 (L8), #21 (G5), #40 (G13), #52 (E13), #54 (O11), #58 (B8), #63 (B10), and #64 (F14). The results of the additional UT's indicated that there was no cracking in the eight CRDM nozzles inspected.

The eight locations selected provide for reasonable assurance of bounding the extent of condition based on the following:

1) All nozzles on the CR3 head are the same material type, heat, and batch number (M1228-3).

2) Three nozzles (#40, #52 and #64) are located adjacent to the affected nozzle (#32). This will determine if there is a local phenomena affect. Two of these three nozzles (#52, #64) are also located on the peripheral row that has a greater residual stress component.

3) There are two other nozzles (#54, #63) located on a peripheral row and one nozzle (#58) in the same row, which would sample nozzles in different quadrants.

4) One nozzle (#8) is located within one row of the center and the final nozzle location (#21) is located in the third row from the center. These locations would sample different residual stress levels, different quadrant locations, different radial location, and therefore different stress components.

5) Total number of expanded inspection locations is greater than 10% of the remaining nozzles; eight (8) out of sixty-eight nozzles (68).

The UT results from the extent of condition support the effectiveness of the visual inspection and the fact that accumulation of boric acid crystals did not impact the ability to discriminate between active CRDM nozzle leakage and other sources of leakage. The initial visual inspection and UT performed for extent of condition were in keeping with the commitment provided in the CR3 response to NRC Bulletin 2001-01 (See Table 2).

Furthermore, subsequent to the CR3 bulletin response submittal, an Engineering Evaluation was performed using plant specific as-built CRDM nozzle interference fit data which concluded that through-wall pressure boundary leakage will produce visible boric acid crystal deposits on top of the Reactor Vessel Head (RVH). The visual inspection completed during 12R identified boron crystal deposits as a result of through-wall cracking at CR3's CRDM nozzle #32. Therefore, FPC concludes that although CR3 was committed to performance of an effective visual examination during 12R, the examination meets the intent of the qualified visual examination as described in the NRC Bulletin.

Nozzle #32 was repaired using the ambient temperature temper bead repair technique as described in CR3 Relief Requests 01-0002-RR and 01-0003-RR, Reference 2. The final (new) weld was examined using PT and UT. No recordable indications were found. An in-service leakage test, as outlined in 01-0002-RR, was performed in accordance with plant procedures. The plant conditions were nominal operating pressure and temperature. No evidence of leakage was noted following a

four-hour hold. Operability of the CRDM was confirmed during plant start-up in accordance with existing plant procedures. No problems with the CRDM were noted.

**Conclusion:**

The visual inspection completed during Refueling Outage 12 meets the intent of a qualified visual inspection as defined in NRC Bulletin 2001-01. The most probable cause of the CRDM nozzle through-wall cracking is primary water stress corrosion cracking. The corrective actions taken by CR3 support the conclusion that safety will be maintained during the planned operating cycle.

All commitments made in the CR3 response to NRC Bulletin 2001-01 have been satisfied with the submittal of this report.

**References:**

1. FPC to NRC letter, 3F0801-06, dated August 30, 2001, Crystal River Unit 3 – Response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

2. FPC to NRC letter, 3F0901-04, dated September 11, 2001, Crystal River Unit 3 – Third Ten-Year Interval, Inservice Inspection Program, Relief Requests 01-0002-RR, Revision 0, and 01-0003-RR, Revision 0

**Table 2**
**CR3 Response to NRC Bulletin 2001-01 Commitments Summary**

| ID Number | Commitment | Commitment Date | 12R Results |
|---|---|---|---|
| 3F0801-06-01 | CR3 will perform an effective bare metal visual inspection of all 69 CRDM nozzles through the access openings around the perimeter of the service structure during the next scheduled refueling outage 12R, October 2001. | During Refuel Outage 12, fall 2001. | Performed an effective visual inspection of all 69 RVH penetrations. One nozzle (#32) identified as having a potential through-wall crack. |
| 3F0801-06-02 | For any CRDM nozzle identified as a potentially leaking nozzle through visual inspection, CR3 will confirm the existence of a flaw, locate and characterize the flaw by performing a top-down UT, and if necessary, PT on the affected nozzle(s). If the characterizations indicate cracking in the J-groove weld or nozzle material above the weld, CR3 will perform additional volumetric inspections of any open CRDM nozzle; i.e., the CRDMs that are removed from the RVH to facilitate nozzle repair or CRDM replacement. If the expanded inspection of the open nozzles identifies indications in the J-groove weld or nozzle material above the weld, the CR3 Corrective Action Program will be used to determine any additional inspection scope expansion and/or repairs. | During Refuel Outage 12, fall 2001. | Nozzle #32 was UT examined. UT confirmed through-wall cracks. No PT was required.<br>Eight CRDMs were removed to facilitate nozzle #32 repair or CRDM replacement.<br>These eight nozzles were UT examined.<br>No additional reportable indications identified.<br>No further expansion of scope required. |
| 3F0801-06-03 | CR3 will repair any CRDM leaking nozzle(s) that have been identified and confirmed as containing through-wall leakage or indications evaluated to be structurally significant. | During Refuel Outage 12, fall 2001. | Nozzle #32 was repaired using the ambient temperature temper bead repair. |
| 3F0801-06-04 | CR3 will provide a report of the results of the visual inspections performed during 12R, and any corrective actions taken as a result of leakage from a CRDM penetration, within 30 days after breaker closure following restart of the unit after Refueling Outage 12. | 30 days after breaker closure following restart of the unit after Refueling Outage 12. | This document provides the 30-day report. Breakers were closed 10/26/01. |

FIGURE 1

**Reactor Vessel Closure Head Map**