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)

August 30, 2001
3F0801-06

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

Subject: Crystal River Unit 3 - Response to 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, 3F0797-03, dated July 29, 1997, Generic Letter 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Penetrations"

Dear Sir:

Pursuant to 10 CFR 50.54(f), Florida Power Corporation (FPC) is hereby providing the information requested in NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles" (Reference 1) for Crystal River Unit 3 (CR3).

Attachment A provides CR3 plant specific information related to the structural integrity of the reactor pressure vessel head penetration (VHP) nozzles. Specifically, the attachment addresses the extent of VHP nozzle leakage and cracking that have been found to date, the inspections and repairs that have been completed to satisfy applicable regulatory requirements, and the basis for concluding that plans for future inspection will ensure compliance with the applicable regulatory requirements.

CR3 has VHP inspections scheduled for the fall 2001 refueling outage (12R). As described in Attachment A, CR3 will perform an effective visual inspection of 100% of the Control Rod Drive Mechanism (CRDM) nozzle penetrations.

CR3 has concluded that an effective visual inspection of the CRDM nozzles can be performed based on the following:

- The control rod drive service structure (CRDSS) allows for direct visual inspection of the top of the Reactor Vessel Head (RVH) through the nine twelve inch diameter access openings
- The access openings allow for multiple views of the CRDMs from various angles,
- A review of CR3 fabrication records establishes similarity to the Oconee (ONS) and Arkansas Nuclear One (ANO 1) nozzle/RVH interference fit which provides assurance that minor leakage can be observed both at the nozzle and in the area surrounding the nozzles,

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- The inspection will be performed by qualified VT-2 personnel trained to identify the characteristic leakage from CRDM nozzles.

If the results of the visual inspection indicate that there are no indications of leakage attributed to CRDM nozzles, no further examinations will be conducted.

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.

CR3 will provide a report of the results of the visual inspection 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. Additionally, the inspection plan and notification requirements provided in Attachment A fulfill the notification requirements in Reference 2.

Although not required by CR3 procedures, this bulletin response has been reviewed and approved by the Plant Nuclear Safety Committee.

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

Dale E. Young
Vice President, Crystal River Nuclear Plant

DEY/lvc

Attachments:

A. Crystal River Unit 3 Response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"
B. List of Regulatory Commitments

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 30th day of August, 2001, by Dale E. Young.

A. MORRIS
Notary Public, State of Florida
My Comm. Exp. Oct. 25, 2003
Comm. No. CC 879691

Signature of Notary Public
State of Florida

LISA A MORRIS

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

LISA A. MORRIS
Notary Public, State of Florida
My Comm. Exp. Oct. 25, 2003
Comm. No. CC 879691

Personally Known X -OR- Produced Identification ______

ATTACHMENT A

Crystal River Unit 3
Response to NRC Bulletin 2001-01
"Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

Crystal River Unit 3 Response to NRC Bulletin 2001-01 "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

Portions of the NRC Bulletin that require response from Crystal River Unit 3 (CR3) are indicated in bold italics font.

Reference to MRP-48 has been made throughout this response. This refers to: *PWR Materials Reliability Program Response to NRC Bulletin 2001-01 (MRP-48),* EPRI, Palo Alto, CA: 2001. 1006284, which has been submitted to the NRC via letter from NEI (Alex Marion) to Dr. Brian W. Sheron (NRC) dated August 21, 2001. (Note that MRP-48 supplements previously submitted report MRP-44, which is referred to in the NRC Bulletin.)

REQUESTED ACTION:

1. ***All addressees are requested to provide the following information:***

   a. ***The plant-specific susceptibility ranking for your plant(s) (including all data used to determine that ranking) using the Primary Water Stress Corrosion Cracking (PWSCC) susceptibility model described in Appendix B to the MRP-44, Part 2, report;***

Response:

CR3 is ranked in the moderate susceptibility category ((5–30) years behind Oconee (ONS) Unit 3 as of March 1, 2001) as defined in NRC Bulletin 2001-01. Using the time-at-temperature ranking model, and CR3 specific input data reported in MRP-48, Table 2-1, CR3 ranks 12 out of 69 pressurized water reactors (PWR's) and last in susceptibility among Babcock & Wilcox (B&W) plants. This evaluation showed (see table below) that it would take CR3 approximately 5.9 Effective Full Power Years (EFPYs) of additional operation to reach the same time-at-temperature susceptibility as ONS Unit 3 at the time that leaking nozzles were discovered in March 2001.

Design and Fabrication					*Operating Time and Temperature*				
NSSS Design	Nozzle Material Supplier	Head Fabricator	Design Diametral Nozzle Interference Fit (mils)	Insulation Type and Config.	EFPY's thru Feb. 2001	Head Temp. Range Over Life (°F)	Current Head Temp. (°F)	EFPY Norm. to 600°F	Remain. EFPYs to Reach ONS 3 from 3/1/01
B&W	#B	BW	0.5 - 1.5	Reflective Horizontal	14.9	601	601	15.6	5.9

#B - B&W Tubular Products

b. ***A description of the Vessel Head Penetrations (VHP) nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;***

Response:

CR3 has a B&W designed reactor vessel closure head with 69 CRDM nozzle penetrations. The nozzles are welded to the Reactor Vessel Head (RVH) (SA-533, Gr. B) using a J-groove partial penetration weld (Alloy 182). The inside diameter of the CRDM nozzles is 2.765 inches with a nominal outside diameter of 4.001 inches. The CRDM nozzles are fabricated of Alloy 600 (SB-167) supplied by B&W Tubular Products. Figure 1 provides a schematic view of the B&W Design CRDM nozzle area. Additional details on materials were provided in BAW-2301, which is the integrated B&W Owners Group (B&WOG) response to Generic Letter (GL) 97-01. The minimum distance between nozzles is 12.15 inches (center-to-center). Note that CR3 has 68 CRDMs (60 control/shim rods and 8 axial power-shaping rods, and 1 CRDM nozzle penetration in the center of the RVH for the reactor head vent/level trending system.) This information is provided in Table 2-3 of MRP-48, below.

NSSS Design	Head Map Figure In MRP-44, Part 2	Minimum Distance Between CRDM Nozzles (in)	CRDM Nozzles		
			Number	OD (in)	ID (in)
B&W	A-8a	12.15	69	4.001	2.765

c. ***A description of the Reactor Pressure Vessel (RPV) head insulation type and configuration;***

Response:

The RVH (inside of the upper support structure skirt) is insulated using reflective metal insulation (Mirror® insulation), which is mounted in a horizontal configuration on steel angle supports. There is a specified minimum 2-inch gap between the RVH (highest point of the arc) and the bottom of the insulation. The outside diameters of the RVH and support structure skirt are enclosed in reflective metal insulation that is removed during refueling to provide access to the inspection openings. The insulation configuration (inside of the upper support structure skirt) is typical of the B&W design, as shown in Figure 2. Note that CR3 does not have reactor vessel thermocouple penetrations.

d. ***A description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past 4 years, and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;***

Response:

The configuration of the reactor head and Control Rod Drive Service Structure (CRDSS) provides two type of openings that can be used for leakage inspection (see Figure 2). There are nine twelve-inch diameter round inspection ports located around the perimeter of the CRDSS that allow for direct visual inspection of the top of the RVH. The inspection ports have doors that are normally bolted in the closed position and are normally covered in mirror insulation. There are also small diameter (approximately 4 5/8(W) x 7(H) inches) holes around the perimeter of the CRDSS called "mouse holes". The mouse holes were cut or ground out of the cylindrical section of the lower CRDSS skirt after the skirt was welded to the reactor closure head.

Visual inspections have been performed at CR3 in accordance with the plant response to GL 97-01, which indicated that inspections of the RVH would be conducted in accordance with the GL 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants" program. GL 88-05 identified to the industry that when borated systems leak, the boron could cause degradation that also needs to be evaluated.

During refueling outage 10R (February 1996), CR3 performed a 100% bare metal detailed inspection (i.e., through the access ports). Boron was noted on the RVH attributed to leaking CRDM flanges. CR3 also performed various cleaning activities of the RVH through the access ports. Note that CR3 had an extended shutdown from September 1996 through February 1998.

During refueling outage 11R (October 1999), CR3 performed a visual inspection for evidence of leakage at the mouse holes with no leakage observed. Recent experience from ONS and ANO 1 indicate that the expected leakage resulting from a through-wall leak of a CRDM nozzle would yield very small quantities of boric acid residue which would not typically be visible from the mouse holes without additional inspection equipment.

e. ***A description of the configuration of the missile shield, the Control Rod Drive Mechanism (CRDM) housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.***

Response:

The missile shield is comprised of three individual reinforced concrete blocks spanning the refueling canal (see Figure 3). Each of the blocks is approximately 8 feet wide by 29 feet long by 1½ feet thick. The blocks are mounted on a reinforced concrete flange that is integral with the "D-ring" walls. The missile shields are through-bolted to the flange using 1¾-inch diameter (A-307, Gr. A) studs and appropriate washers and nuts. The missile shields are located directly over the reactor vessel.

The CRDM assembly consists of the motor tube, stator, position indicating tube, and associated power and instrumentation cabling. The motor tube is approximately 210 inches long with a flanged connection at the bottom and a vent connection at the top. The flanged end bolts to the RVH nozzle flange with eight bolts. The RVH nozzle is welded to the inside of the head with a partial penetration weld. The top end of the CRDM is restrained in the horizontal direction by the seismic/stabilizer plate. The plate is bolted to structural steel channels that span across the service structure top frame. The CRDM is free to thermally expand vertically. All of the CRDMs are located inside the service structure support cylindrical shell. The stator and position indicating tube is a non-integral attachment to the motor tube. Service Water (SW) cooling is provided to each stator through a piping system attached to the service structure support.

As stated previously, the CRDM nozzle connection in the center of the RVH is used for the reactor head vent and level trending system. The connection is mounted to the CRDM nozzle by a flanged connection similar to the CRDM motor tube flange. In place of the CRDM motor tube, the RVH vent connection uses a fabricated standpipe (approximately 17 feet 10 inches long). The standpipe is fabricated from 4-inch schedule 160 stainless steel pipe (SA-182, Gr. 304) approximately 15 feet 6 inches long, which is reduced down to a ½ inch diameter pipe. There is a dual (series) valve arrangement leading to a flanged connection. The flange mates with a tee that reduces into the ½ inch diameter tubing (.065 inch wall). There is a vent valve connection at the top of the standpipe. The standpipe is insulated from the CRDM nozzle flange taper up approximately 72 inches. The RVH vent/level trending line is supported using a modified CRDM motor tube seismic/stabilizer plate mounted on the service structure. An additional support is provided to restrain lateral movement above the floor of the service structure below the vent valve. The ½ inch tubing is supported in a tray arrangement and clamped to the CRDSS handrail. The end of the tubing is attached to a flange connection, which allows removal during refueling operations.

The envelope between the top of the reactor vessel head (approximate elevation 141 feet) and the bottom of the missile shield (approximate elevation 179 feet) is occupied by the CRDMs and attendant equipment (motor tubes, stators, position indicators, thermocouples, stator cooling water (SW), drive power and instrumentation cables). The reactor head vent standpipe and associated tubing is also located in this area. This equipment is housed within the CRDSS or on top of the CRDSS. Twelve CRDM cooling fans and power cabling are mounted around the outside perimeter of the service structure. The CRDM and RVH vent seismic tie plates are located on the CRDSS (approximate elevation 159 feet). The cabling for the CRDMs is routed through the service structure below the service structure floor to the sides of the refueling canal (approximate elevation 160 feet). The piping headers and branch connections for the SW cooling to/from the CRDM stators are likewise mounted below the service structure floor and routed to the sides of the refueling canal.

Component/Structure	Approximate Elevation (ft)
Bottom of Missile Shields	179
CRDM Seismic Tie Plates	159
CRDM Flanges	143
Top of RV Head	141
Reactor Vessel Flange	135

4. ***If the susceptibility ranking for your plant is greater than 5 EFPY and less than 30 EFPY of ONS3, addressees are requested to provide the following information:***

   a. ***Your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;***

Response:

During the next refueling outage in October 2001 (12R), CR3 will perform an effective visual inspection of 100% of the CRDM nozzle penetrations. The configuration of the CR3 RVH insulation (as described above), and the nine twelve inch diameter access openings in the CRDSS allow for an effective bare metal visual inspection of all 69 of the CRDM nozzles. The initial visual inspection will be performed when the plant is in Mode 5.

The inspectors will look for leakage and/or evidence of leakage such as accumulation of boric acid. The visual inspection that will be performed will be effective in identifying CRDM nozzle leakage and will not be compromised due to pre-existing deposits of boric acid. Effectiveness of the visual inspection is ensured through training and qualification of the inspectors, as well as applications of lessons learned from the recent ANO 1 and ONS inspections. The inspectors will be VT-2 qualified and will be trained to look for the small amounts of boric acid accumulation as observed at ONS and ANO 1. Specialized training using photos, videos and other available information from recent visual inspections at ONS and ANO 1 will enhance inspectors sensitivity to minor leakage evidence both at the nozzle and in the area surrounding the nozzles. The photos and video data of observed leakage from both ONS and ANO 1 define the unique characteristics of nozzle leakage which will be useful in identifying leakage at CR3.

The capability to view the CRDM nozzles with minimum obstructions is enhanced through the access openings described above. The access openings around the perimeter of the service structure allow for views of the CRDMs from multiple angles allowing visual inspection of all sides of the nozzles.

The acceptance criteria for the visual inspection will be the absence of boric acid crystal deposits at the CRDM nozzle to RVH interface/adjacent area or boric acid crystal deposits adjacent to the CRDM nozzle determined to be from another source other than CRDM nozzle leakage. The boric acid accumulation around the CRDM nozzle should exhibit visual characteristics similar to the accumulations observed at ONS and ANO 1 during recent visual inspections that can be distinguished from CRDM flange leakage.

Questionable penetrations will be conservatively identified as potentially leaking nozzles. Each identified potentially leaking nozzle will be independently confirmed as leaking by inspection using UT and if necessary PT examination prior to the initiation of repair activities. Confirmed leaks will be characterized to determine the extent and severity of cracking.

The reactor head condition will be evaluated for cleanliness and appropriate measures will be taken during 12 R to assure the effectiveness of future visual inspections.

b. ***Your basis for concluding that the inspections identified in 4.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:***

(1) If your future inspection plans do not include a *qualified visual examination at the next scheduled refueling outage, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.

(2) The corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.

* During a public meeting with the Nuclear Energy Institute on August 15, 2001, the NRC clarified that the appropriate terminology for the visual inspections performed for the plants in the moderate category (5-30 EFPY) is "effective" visual inspection and not "qualified" visual inspection

Response:

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 in October 2001 (12R). If there are no indications of leakage attributed to CRDM nozzles, no further examinations will be conducted.

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.

CR3 has determined that the B&WOG Top-down Ultrasonic Inspection tool is best suited for performance of the inspections described above. The tool has been developed for situations when the CRDM is removed or is capable of being removed from the nozzle. This allows for access to the inside diameter (ID) of the CRDM nozzle. The top-down tool is placed on the CRDM nozzle flange from on top of the CRDSS and shielded work platform and is operated (data gathered) remotely.

During 12R, CR3 is planning to have a limited number of CRDMs removed for CRDM replacement. In addition to the drives removed for replacement, the repair activities require removal of at least one adjacent CRDM to allow for access for the repair tooling. CR3 has estimated that for each CRDM removed for replacement it would take approximately 16 hours for removal of the CRDM. It would take an additional 16 hours for each replacement of the CRDM. Additionally, the dose associated with these activities is on the order of 1.25 Rem per CRDM, based on the estimated dose rates for CRDM replacement activities. Using the top-down tool, the projected outage impact of inspecting 100% of the CRDM nozzles is about thirty-three days. ONS has used the top-down tool for both extent of condition evaluations and for characterizing flaws indicated as a result of the bare head visual inspection with satisfactory results.

CR3 will repair any CRDM nozzle(s) that have been identified and confirmed as containing through-wall leakage or indications evaluated to be structurally significant. The repair will consist of a repair technique similar to the repairs conducted at ONS 2 in April 2001. An ambient temperature temper bead repair will be performed by Framatome using tooling, processes and techniques similar to what was employed at ONS 2. Note that ONS performed a temper bead repair using pre/post weld heating. The repair removes a portion of the leaking CRDM nozzle, establishes a new pressure boundary by welding, and conditions the nozzle and weld using abrasive water jet techniques to establish a compressive stress on the surface of these areas. The compressive stress provides resistance to PWSCC within the conditioned area. This repair technique provides substantial reduction in personnel exposure over the manual techniques employed at ONS 1 and ONS 3.

CR3 is similar in design to ONS and ANO 1, which have demonstrated an ability to identify leaking CRDM nozzles by visual inspection for boric acid crystal deposits. CR3 fabrication records were reviewed to determine how CRDM bores were machined and how CRDM nozzles were installed. CRDM nozzles were installed in the Reactor Vessel (RV) closure head with a designed 0.0005-inch to 0.0015-inch of diametral interference.

The values for the CR3 Reactor Pressure Vessel (RPV) head using as-built data are calculated to range from a maximum interference fit of 0.0017-inch to a gap of 0.0009-inch. Figure 4, provides a graphical representation of distribution of the dimensional plant specific data.

In 1993, the B&WOG performed a safety evaluation for CRDM nozzle cracking. In this evaluation, a 3-dimensional finite element model of all major components of a hillside CRDM nozzle-to-head welded structure was constructed. The B&WOG calculation includes the maximum 0.010-inch diametric counterbore at the top and bottom locations (typical for most B&WOG plant designs), which tends to increase the stresses in the nozzle and is bounding for CR3. During operation, an interference fit is calculated to release and to become a gap due to temperature and pressure dilation, which provides a leak path for a through-wall crack that allows detection by visual inspection. The B&WOG calculation assumes a nominal 0.0010-inch interference fit, which will open to a maximum gap of 0.0033-inch during operation.

As noted earlier, leakage from this gap has been demonstrated at both ONS and ANO 1, for which interference fits of up to 0.0014-inch have been calculated from the final quality assurance (QA) inspection data. The largest interference fit at CR3 occurs on nozzle number 30, and has been calculated at 0.0017-inch at the top. This same nozzle also has an interference fit of 0.0014-inch at the bottom. Thus, the calculated 0.0033-inch gap during operation would be somewhat less for CR3, assuming 0.0017-inch interference fit (instead of the nominal 0.0010-inch). This gap would still be expected to provide a leak path to the top of the RPV head in the event of a cracked CRDM nozzle or J-groove weld.

Adequate access for visual inspections through the nine openings around the CRDSS, the similarity to the ONS and ANO 1 nozzle/RVH interference fit, and use of qualified VT-2 personnel trained to identify characteristic leakage from CRDM nozzles, provide assurance that CR3 can perform an effective visual inspection of the CRDM nozzles.

The following paragraphs provide the basis for concluding that CR3 plans for future inspections will continue to assure that regulatory requirements are met:

DESCRIPTION OF REGULATORY REQUIREMENTS

The general design criteria (GDC) as stated in the bulletin, for nuclear power plants (Appendix A to 10 CFR 50), came into effect after the licensing of CR3. CR3 has been designed and constructed taking into consideration the proposed 10 CFR 50.34 Appendix A, "General Design Criteria for Nuclear Power Plant Construction Permits," as published in the Federal Register (32FR10213) on July 11, 1967, and which are applicable to this unit. The GDC in 10 CFR 50, Appendix A and the corresponding CR3 criteria are provided for comparison.

10 CFR 50, Appendix A
Criterion 14 – Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

Corresponding CR-3 Criterion 9 – Reactor Coolant Pressure Boundary (Category A)

The reactor coolant pressure boundary shall be designed and constructed so as to have an exceedingly low probability of gross rupture or significant leakage throughout its design lifetime.

Discussion

The Reactor Coolant (RC) system pressure boundary at CR3 meets the criterion through the following:

a. Material selection, design, fabrication, inspection, testing, and certification in accordance with ASME and USA Standards (USAS) codes.
b. Manufacture and construction in accordance with approved procedures.
c. Inspection in accordance with ASME and USAS code requirements plus additional requirements imposed by the manufacturer.
d. System analysis to account for cyclic effects of thermal transients, mechanical shock, seismic loadings, and vibration loadings.
e. Selection of reactor vessel material properties to give due consideration to neutron flux effects and the resultant increase of the Nil-Ductility Transition Temperature (NDTT).
f. Quality Assurance program described in Sections 1.6 and 1.7 of the CR3 FSAR.
g. Advances in the field of fracture mechanics have been used to analytically demonstrate that large bore pipe, such as that used in the reactor coolant loop, will not rupture catastrophically.

The original materials and methods of construction are not changed or altered as a result of the potential for CRDM nozzle cracking. The CRDM nozzle materials are flaw tolerant and will exhibit degradation through small leakages visible on the RVH and not through sudden rupture or catastrophic failure. The small amount of observed leakage from the CRDM nozzles at ONS and ANO 1 demonstrate that leakage from RVH penetration cracks can be detected before they lead to gross failure or result in significant leakage. Therefore, CR3 concludes that the GDC continues to be met.

10 CFR 50, Appendix A
Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing, and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient stresses, and (4) size of flaws.

Corresponding CR3 Criterion 34 – Reactor Coolant Pressure Boundary Rapid Propagation Failure Prevention (Category A)

The reactor coolant pressure boundary shall be designed to minimize the probability of rapidly propagating type failures. Consideration shall be given (a) to the notch-toughness properties of materials extending to the upper shelf of the Charpy transition curve, (b) to the state of stress of materials under static and transient loadings, (c) to the quality control specified for materials and component fabrication to limit flaw sizes, and (d) to the provisions for control over service temperature and irradiation effects which may require operational restrictions.

<u>**Discussion**</u>

The reactor coolant pressure boundary design meets this criterion by the following:

a. Development of reactor vessel plate material properties opposite the core to a specified Charpy-V-notch test result of 30 ft/lb or greater at a nominal low NDTT.
b. Determination of the fatigue usage factor resulting from expected static and transient loading during detailed design and stress analysis.
c. Quality Control procedures including permanent identification of materials and non-destructive testing.
d. Operating restrictions to prevent failure towards the end of design vessel life resulting from increase in the NDTT due to neutron irradiation, as predicted by a material irradiation surveillance program (CR3 FSAR Section 4.4.5).

10 CFR 50, Appendix A
Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leaktight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel.

Corresponding CR3 Criterion 36 – Reactor Coolant Pressure Boundary Surveillance (Category A)

Reactor coolant pressure boundary components shall have provisions for inspection, testing, and surveillance by appropriate means to assess the structural and leaktight integrity of the boundary components during their service lifetime. For the reactor vessel, a material surveillance program conforming to ASTM-E-185-66 shall be provided.

Discussion

The reactor coolant pressure boundary components at CR3 meet this criterion. Access is provided for non-destructive examination during plant shutdown. A reactor pressure vessel material surveillance program conforming to this criterion has been established as described in CR3 FSAR Section 4.4.5. The present reactor vessel surveillance program is described in B&WOG Topical Report BAW-1543.

As described above, the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 were satisfied during the initial licensing review of CR3, and continue to be satisfied during operation, even in the presence of the potential for PWSCC of the CRDM nozzle penetrations of the RVH. In part, the selection of Alloy 600 materials provide excellent corrosion resistance and extremely high fracture toughness of the reactor coolant pressure boundary. CR3, in the original design of the CRDSS, had the capability to perform required ASME Code visual examinations. The CR3 CRDSS has been modified to provide additional access to the bare metal interface of the CRDM nozzle and the RVH to improve inspector capabilities during ASME Code required visual examinations.

10CFR50.55a Codes and Standards

ASME Class I components (which include VHP nozzles) must meet the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Table IWB-2500-1 of Section XI provides examination requirements for VHP nozzles and references IWB-3522 for acceptance standards.

Discussion

CR3 has performed inspections of the RVH during previous refueling outages using both direct observation and indirect observation for leakage. The direct inspection is conducted through the access openings in the CRDSS and is a bare metal inspection. The indirect inspection is performed through the observation of evidence of leakage; i.e., signs of boric acid accumulation. These visual inspections meet the requirements of Section XI Table IWB-2500-1 and IWB-3522. The visual inspections also meet the requirements of NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants." Compliance with the requirements of Section XI is implemented through the CR3 Inservice Inspection Program. If the VT-2 examinations detect the conditions described in IWB-3522.1, as not meeting the acceptance of IWB-3142, then the corrective actions required would be performed in accordance with IWA-5250 (Corrective Measures) and the CR3 Corrective Action Program. During 12R, CRDM nozzles identified and confirmed, as leaking from the visual inspections of the RVH will be repaired prior to unit restart from the refueling outage.

CR3 Improved Technical Specifications (ITS)

CR3 ITS 3.4.12 "RCS Operational LEAKAGE", LCO 3.4.12a states "RCS operational LEAKAGE shall be limited to: No pressure boundary LEAKAGE".

Discussion

Identification of RCS pressure boundary (RCPB) leakage would require the plant to shutdown. With the plant in the shutdown condition, leakage should reduce due to the lower pressure since stresses on the RCS are lower, and further degradation of the RCPB is less likely. Monitoring of the plant leakages (identified and unidentified) provides assurance that pressure boundary leakage can be distinguished from unidentified leakage. When the unidentified plant leakage approaches the plant administrative limits, appropriate actions will be taken to identify leakage sources to ensure that continued degradation of the RCPB does not continue.

Additionally, monitoring and various leakage detection systems are available that provide diverse methods of detection to the plant operator to ensure appropriate corrective actions are taken in accordance with ITS. Visual inspections conducted during refueling outages provide the opportunity to access areas/components within the plant that are normally not accessible during plant operations. Performance of an effective visual inspection during the refueling outage will ensure the discovery of any potential CRDM nozzle leakage prior to return to service. All suspect leaking nozzles will be fully investigated and repaired to meet all applicable code and regulatory requirements. All repairs will be completed prior to return to service.

10 CFR 50, Appendix B "Quality Assurance Requirements"

Criterion IX - Control of Special Processes

Measures shall be established to assure that special processes, including welding, heat-treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria and other special requirements.

Discussion

Activities related to inspection and repair of the CRDM nozzles will be controlled as required by the Florida Power Quality Assurance Program for CR3. Personnel, processes and procedures will be used as required. The visual inspections of the CRDM nozzle RVH interface will be conducted by qualified inspectors using approved procedures. The inspectors will be specifically qualified for CRDM nozzle leakage observations. Additional processes and procedures required for nondestructive examination (NDE) and other repair activities such as machining and welding will be controlled in accordance with the QA program.

Criterion V – Instructions, Procedures, and Drawings

Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

Discussion

Activities for visual inspection, NDE and repair of CRDM nozzles are performed in accordance with the Florida Power QA Program for CR3. The procedures, instructions and drawings are subject to preparation, review and approval requirements imposed through the QA Program. The QA Program meets the requirements of Appendix B.

Criterion XVI – Corrective Actions

Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective actions taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to the appropriate levels of management.

Discussion

The identification and confirmation of a leaking CRDM nozzle requires that the issue be appropriately identified and entered into the CR3 Corrective Action Program (CAP) in a timely manner. In the case of a significant adverse condition, the CAP requires determination of the cause of the failure and assignment of appropriate corrective actions to preclude recurrence. The CAP implemented at CR3 meets the requirements of Appendix B, Criterion XVI.

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 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.

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.

Schematic View of B&W Design CRDM Nozzle Area

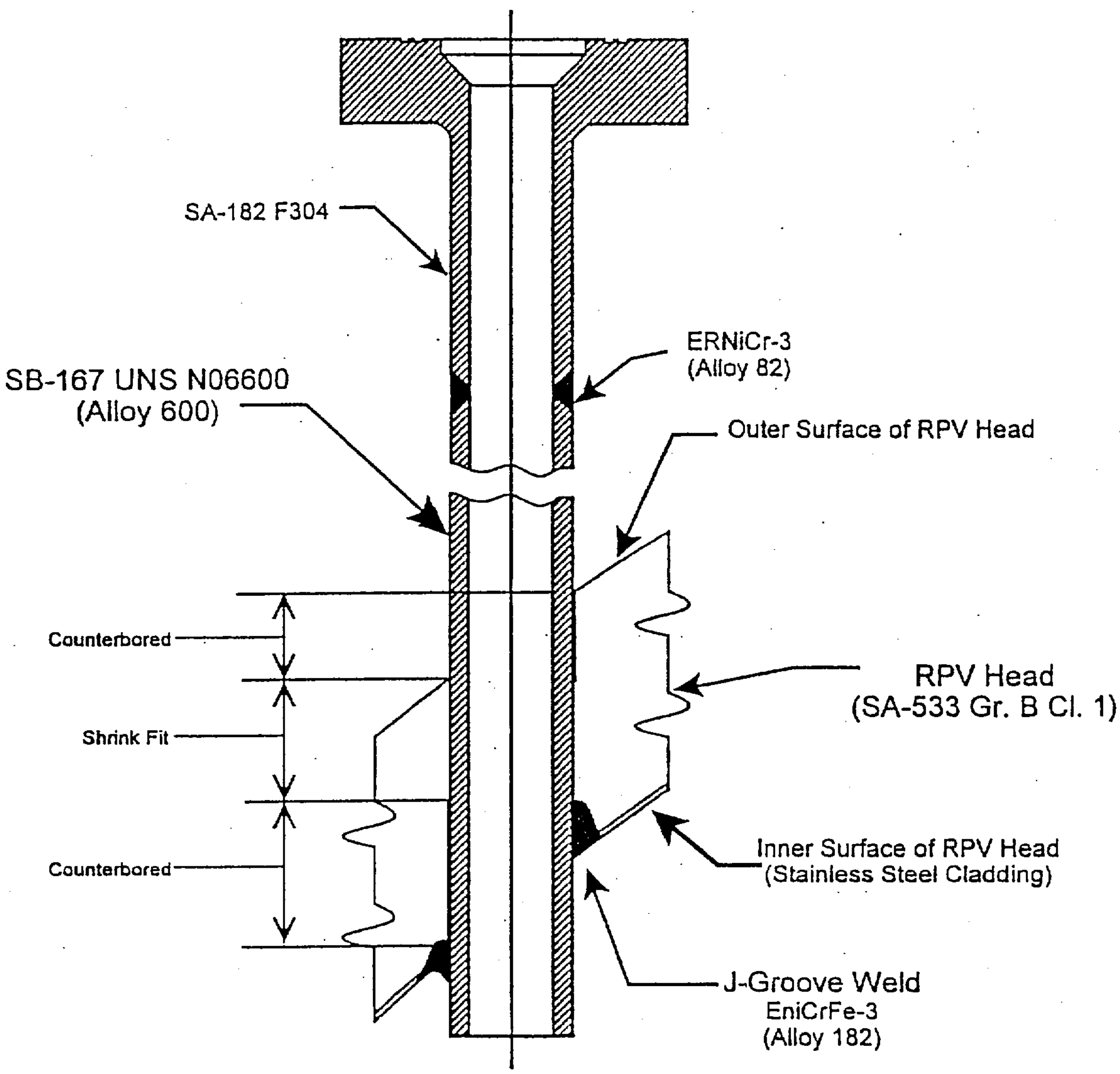

Figure 1

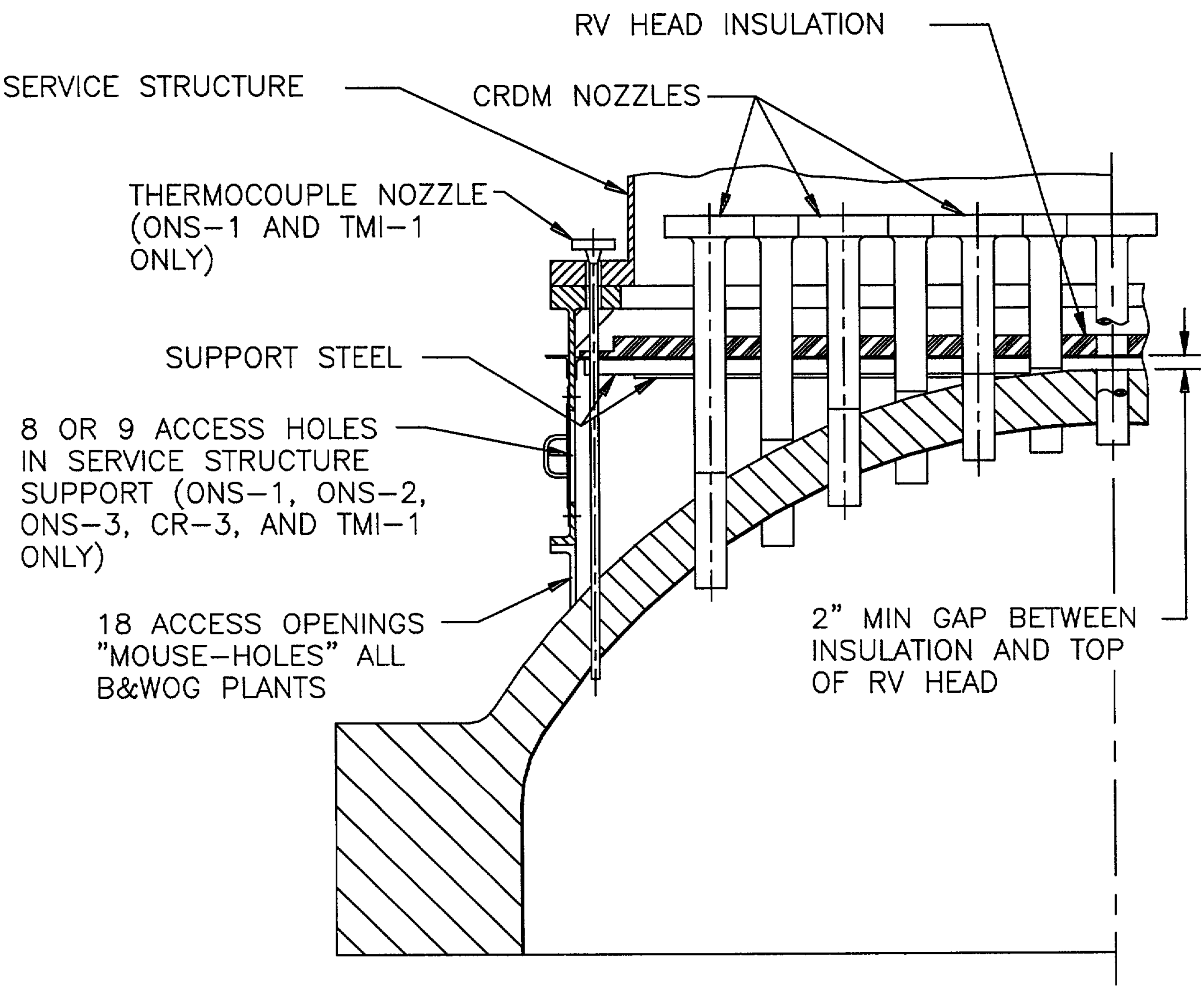

Figure 2.
Side View Schematic of B&W-Design Reactor Vessel Head, CRDM Nozzles, Thermocouple Nozzles, and Insulation

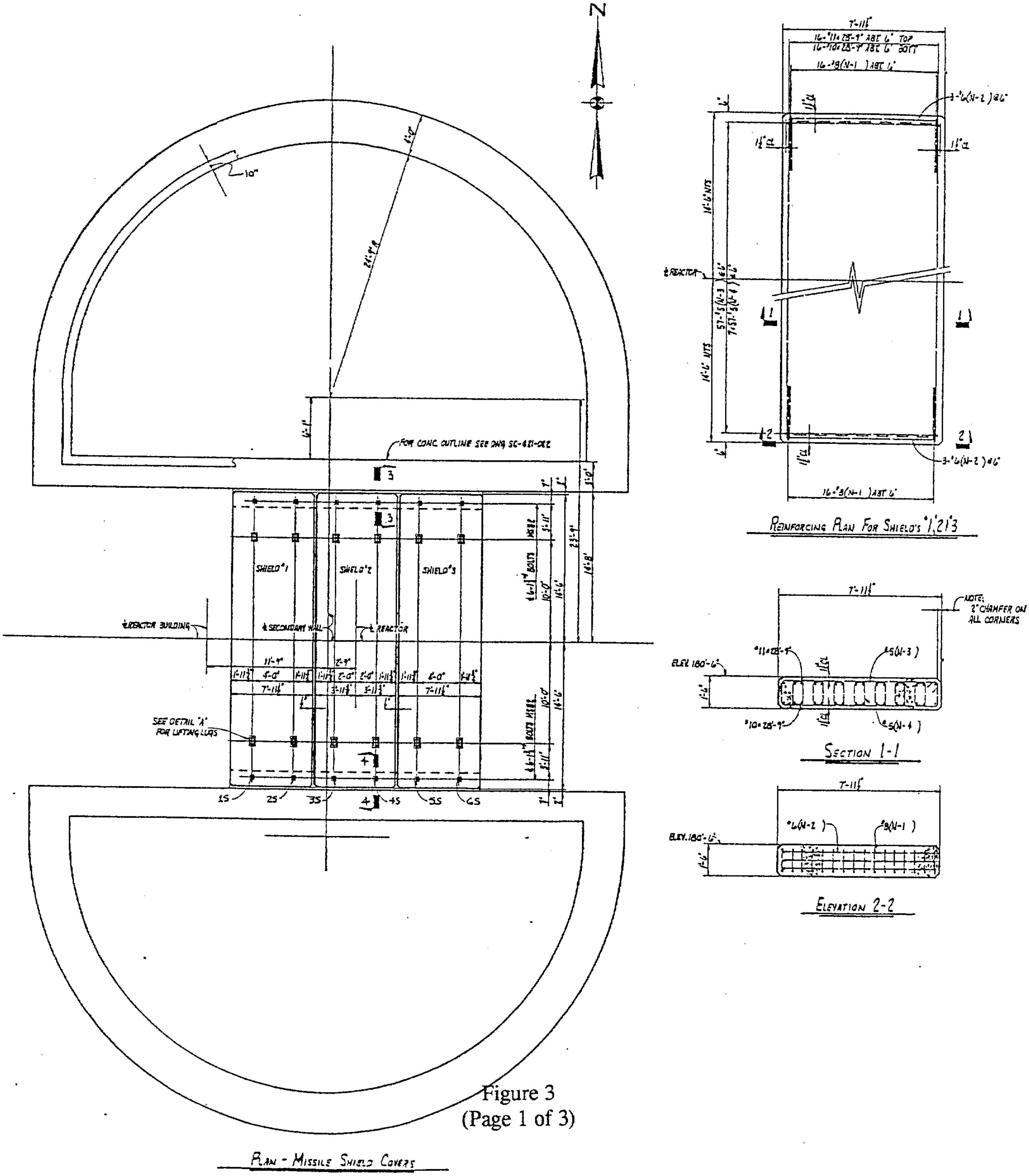

Figure 3
(Page 1 of 3)

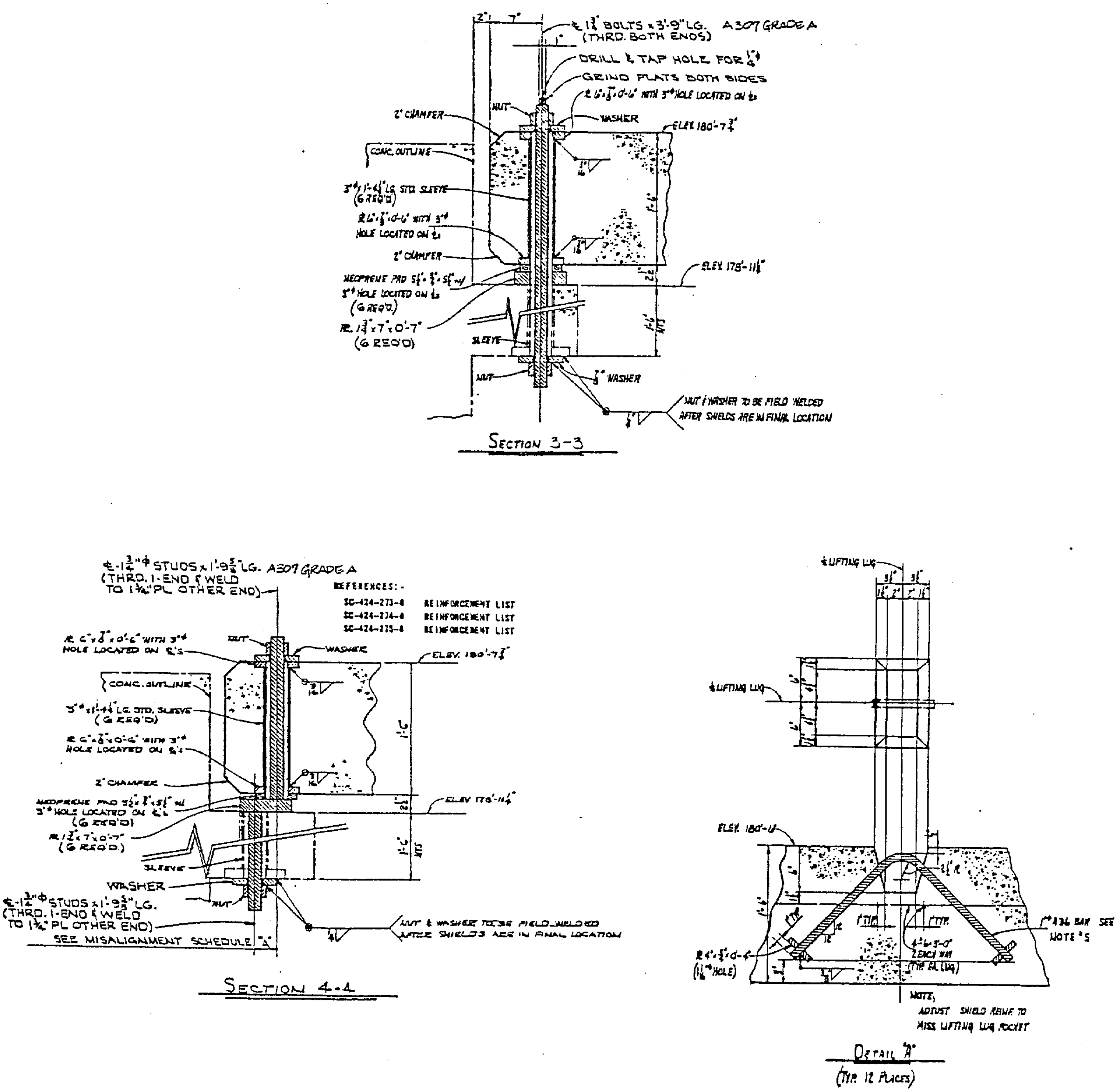

Figure 3
(Page 2 of 3)

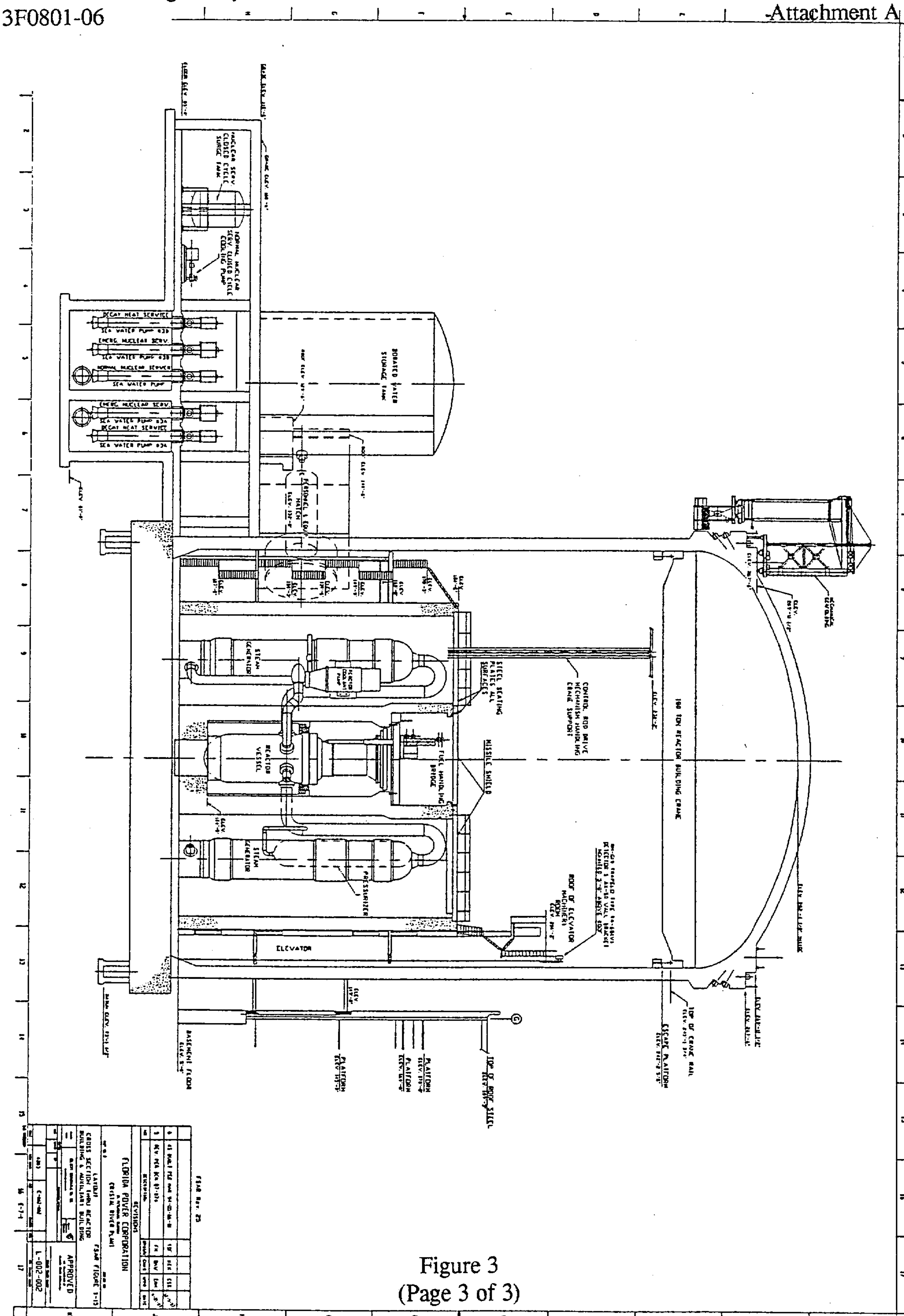

Figure 3
(Page 3 of 3)

Distribution of Dimensional Fits in CR-3 RV Head

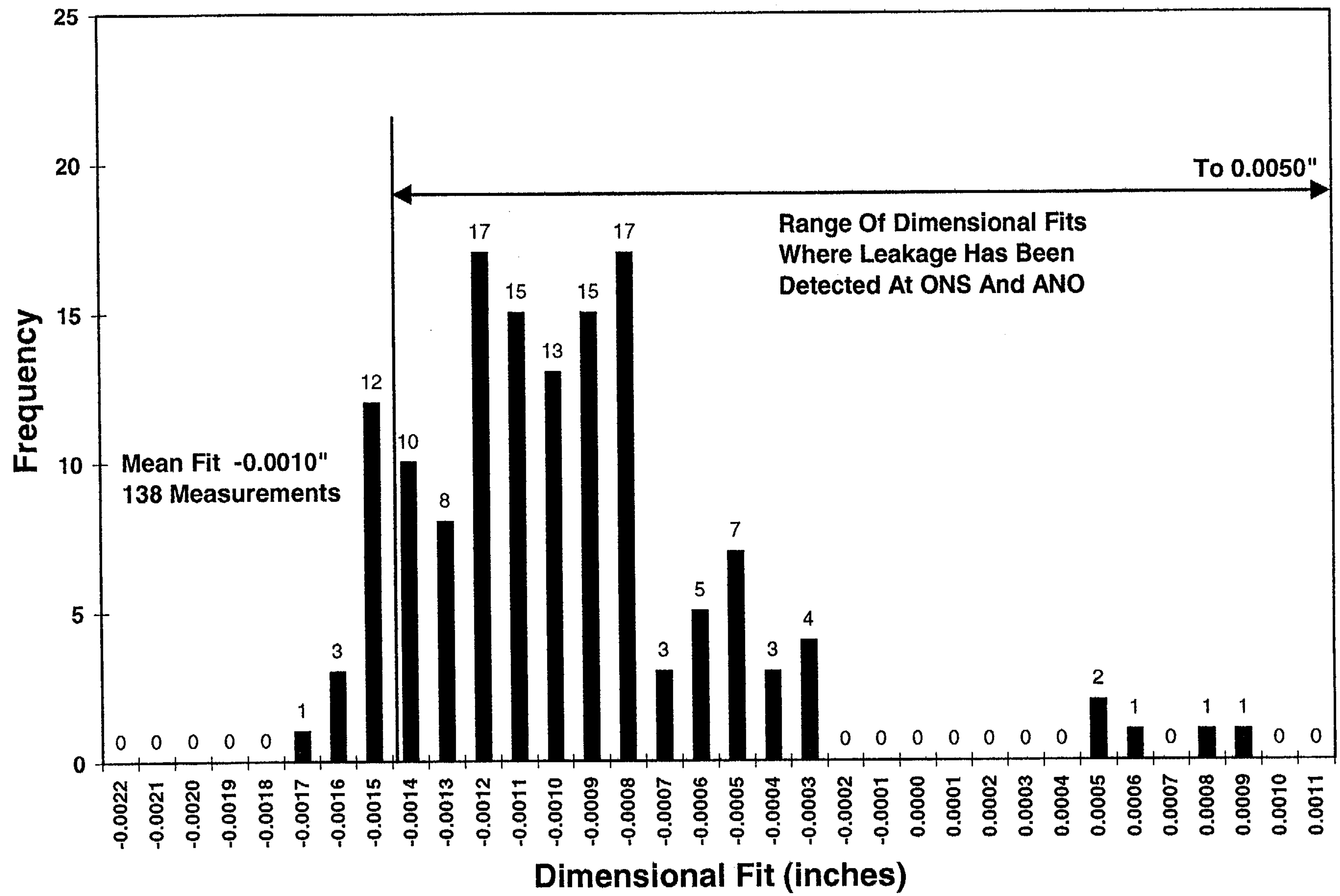

Figure 4
Distribution of Dimensional Fits in CR-3 RV Head

List of Regulatory Commitments

The following table identifies those actions committed to by Florida Power Corporation in this document. Any other actions discussed in the submittal represent intended or planned actions by Florida Power Corporation. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Supervisor, Licensing and Regulatory Programs, of any questions regarding this document or any associated regulatory commitments.

ID Number	Commitment	Commitment Date
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.
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.
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.
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.