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VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

10 CFR 50.54(f)

April 1, 2002

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.: 02-168
NL&OS/ETS Rev 3
Docket Nos.: 50-338/339
50-280/281
License Nos.: NPF-4/7
DPR-32/37

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
FIFTEEN DAY RESPONSE TO NRC BULLETIN 2002-01
REACTOR PRESSURE VESSEL HEAD DEGRADATION AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY

On March 18, 2002 the NRC issued NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to 1) the integrity of the reactor coolant pressure boundary including the reactor vessel head, and the extent to which inspections have been undertaken to satisfy applicable regulatory requirements, and 2) the basis for concluding that plants satisfy applicable regulatory requirements related to the structural integrity of the reactor coolant system pressure boundary and that future inspections will ensure continued compliance with the applicable regulatory requirements.

Each of the North Anna and Surry units was shutdown in the Fall of 2001 to perform a bare-metal, "qualified" visual inspection of the reactor vessel head penetrations in accordance with NRC Bulletin 2001-01. Although the focus of the bare-metal visual inspections was the penetrations and the top of the reactor vessel head in the immediate vicinity of each penetration, the surface area between penetrations and the area adjacent to the outer row of penetrations within the ventilation shroud was also observed by the inspectors. Degradation of the reactor vessel head (i.e., wastage of the reactor vessel head base metal) was not observed in the vicinity of the penetrations at North Anna Units 1 and 2 and Surry Units 1 and 2 during the initial bare-metal visual inspections. Additionally, there was no pitting, thinning, or degradation indicative of wastage observed during the re-inspection of three of the units' reactor vessel heads following cleaning (Surry Unit 2 did not require cleaning due to the absence of boric acid residue/deposits) to establish a baseline for future visual inspection activities. Therefore, we conclude that the reactor vessel heads at North Anna and Surry have not experienced observable degradation due to boric acid corrosion.

The most recent reactor vessel head inspection results and repair activities from the Fall of 2001, coupled with the discussion in the attachment to this letter, provide the basis for concluding that North Anna Units 1 and 2 and Surry Units 1 and 2 continue to satisfy the applicable regulatory requirements related to the structural integrity of the reactor coolant system pressure boundary. In addition, Dominion plans to perform bare-metal "qualified" visual inspections of the reactor vessel heads for North Anna Units 1 and 2 and Surry Units 1 and 2 during each future refueling outage until the existing reactor vessel heads are replaced. The inspection scope and method are summarized in the attachment to this letter.

If you have any further questions or require additional information, please contact us.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachment

Commitment made in this letter:

> A qualified bare-metal visual inspection of the reactor vessel head inside the ventilation shroud will be performed during each scheduled refueling outage for North Anna and Surry, until each unit's reactor vessel head is replaced.

cc: U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Suite 23 T85
Atlanta, Georgia 30303-8931

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

Mr. R. A. Musser
NRC Senior Resident Inspector
Surry Power Station

Mr. J. E. Reasor, Jr.
Old Dominion Electric Cooperative
Innsbrook Corporate Center, Suite 300
4201 Dominion Blvd.
Glen Allen, Virginia 23060

SN: 02-168
Docket Nos.: 50-338/339
50-280/281
Subject: Response to NRC Bulletin 2002-01 – 15 Day Response

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President - Nuclear Engineering, of Virginia Electric and Power Company. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 1st day of April, 2002.

My Commission Expires: March 31, 2004.

Maggie McClure
Notary Public

(SEAL)

ATTACHMENT

Fifteen Day Response to NRC Bulletin 2002-01
Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

North Anna Power Station Units 1 and 2
Surry Power Station Units 1 and 2

Virginia Electric and Power Company
(Dominion)

North Anna and Surry Power Stations Units 1 and 2 Fifteen Day Response to NRC Bulletin 2002-01 Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

On March 18, 2002 the NRC issued NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to 1) the integrity of the reactor coolant pressure boundary including the reactor vessel head, and the extent to which inspections have been undertaken to satisfy applicable regulatory requirements, and 2) the basis for concluding that plants satisfy applicable regulatory requirements related to the structural integrity of the reactor coolant system pressure boundary, and that future inspections will ensure continued compliance with the applicable regulatory requirements.

NRC required information

1. *Within 15 days of the date of the Bulletin all PWR addressees are required to provide the following:*

   A. *A summary of the reactor pressure vessel head inspection and maintenance programs that have been implemented at your plant,*

   Response:

   Visual inspections have been performed on each of the four units to address concerns raised by Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," and Generic Letter 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations." These inspections were undertaken in accordance with our Augmented Inspection Program for the four units. The most recent visual inspections conducted under this program were completed for Surry Unit 1 in the Spring of 2000, Surry Unit 2 in the Fall of 2000, North Anna Unit 2 in the Spring of 2001, and North Anna Unit 1 in the Fall of 2001. The inspections were performed by VT-2 qualified personnel during each unit's refueling outage with the vessels depressurized. These inspections placed particular emphasis on identifying any evidence of boric acid accumulation and were conducted above the insulation on the reactor vessel head. Evidence of active leakage was identified at the Number 2 Conoseal canopy seal area during reactor vessel head inspection activities for North Anna Unit 1. The leaking canopy seal was believed to be the source of the boron deposits on the reactor vessel head. The conoseal was repaired prior to returning Unit 1 to service. No evidence of active leakage was identified on the other three units during the Augmented Inspection Program visual inspections.

Active leakage, such as that discovered on North Anna Unit 1 during the above inspections, is addressed by the plant's Corrective Action Program. Corrective actions include the determination and correction of the source of the leakage.

In the Fall of 2001, in response to NRC Bulletin 2001-01, bare-metal, "qualified" visual inspections were conducted on each of the four units. Although the focus of the bare-metal visual inspections was the penetrations and the reactor vessel head in the immediate vicinity of each penetration, the surface area between each penetration and the area adjacent to the outer row of penetrations within the ventilation shroud was also observed by the inspectors. Degradation (i.e., wastage of the reactor vessel head base metal) was not observed on the reactor vessel heads, including the area around the penetrations that required repair or evaluation after boric acid residue/deposits were removed, during the initial bare-metal visual inspections performed at North Anna and Surry. Additionally, the re-inspection of three of the units' reactor vessel heads following cleaning to establish a baseline for future visual inspection activities confirmed that there was no pitting, thinning, or degradation indicative of wastage. Surry Unit 2 was not re-inspected because of its clean as-found condition. The results of these inspections are documented in our letters Serial No. 01-490C for Surry Units 1 and 2 and Serial No. 01-490A and 01-490E for North Anna Units 1 and 2, respectively.

In response to information that has recently become available relative to reactor vessel head degradation at Davis-Besse, we have again reviewed the videotapes made of the Fall 2001 North Anna and Surry bare-metal inspections with particular emphasis on conditions that could indicate wastage. The latest examination of the videotapes, which involved review of both the as-found conditions (North Anna Units 1 and 2 and Surry Units 1 and 2) and as-left conditions (North Anna Units 1 and 2 and Surry Unit 1), confirmed no evidence of any reactor vessel head corrosion or wastage.

B. *An evaluation of the ability of your inspection and maintenance programs to identify degradation of the reactor pressure vessel head including, thinning, pitting, or other forms of degradation such as the degradation of the reactor pressure vessel head observed at Davis-Besse,*

Response:

Information currently available suggests that the reactor vessel head wastage found at the Davis-Besse plant resulted from corrosion and/or erosion from leaks in two of the reactor vessel head penetrations, from accumulations of boric acid from other leakage sources, such as CRDM flange leaks, or a combination of both. In any case, the process responsible resulted in significant accumulation of boric acid and corrosion products on the reactor vessel head at the site of the wastage in addition to the corrosion cavity in the reactor vessel head. The visual examination techniques used for the North Anna and Surry bare-metal inspections would have easily detected even minor accumulations of boric acid residue/corrosion products on the reactor vessel head and any sign of active corrosion of the pressure boundary. Even if the corrosion/erosion process were to initially proceed from near the root of the J-groove weld instead of from the top of the reactor vessel head, the process would leave observable boric acid residue and corrosion debris (rust) on the reactor vessel head at the reactor vessel head-to-penetration interface. We have previously documented that any flaw breaching the pressure boundary of the reactor vessel head penetration tubes would produce visible evidence of leakage (i.e., boric acid deposits) on top of the reactor vessel head via the gap between the tube and the bore in the reactor vessel head at operating temperature and pressure. The basis for our reactor vessel head-penetration interference fit analysis to verify that this gap exists was provided in letters Serial No. 01-490B and 01-490D, dated November 14, 2001 and January 23, 2002, respectively.

C. *A description of any conditions identified (chemical deposits, head degradation) through the inspection and maintenance programs described in 1.A that could have led to degradation and the corrective actions taken to address such conditions,*

Response:

The bare-metal inspection, in conjunction with the follow-up under-the-head NDE activities performed at Surry Unit 1 in the Fall of 2001, found six reactor vessel head penetrations with evidence of probable Primary Water Stress Corrosion Cracking (PWSCC) requiring repair. Three of those penetrations were judged to be leaking. Repairs to the six penetrations were performed using a technique that removed the lower portion of each penetration and established a new pressure boundary weld approximately one-half to two-thirds of the reactor vessel head thickness above the J-groove weld. No wastage or degradation of the low alloy steel reactor vessel head base metal was identified either by visual or liquid penetrant examination in the area exposed when the lower portion of the penetration was removed. Subsequent to the repair activities, the reactor vessel head was cleaned in the area surrounding the penetrations to remove accumulated debris and deposits and was re-inspected as discussed earlier. No evidence of wastage at the penetrations-to-reactor vessel head interfaces at the outside surface of the reactor vessel head was identified at that time or in subsequent reviews of the inspection videotapes to specifically look for reactor vessel head degradation.

The bare-metal inspection, in conjunction with the follow-up under-the-head NDE activities performed at North Anna Unit 2 in the Fall of 2001, found three reactor vessel head penetrations with evidence of probable PWSCC requiring repair.

One of those penetrations was judged to be leaking. The boric acid debris associated with these penetrations was less significant than that associated with the suspected leaks at Surry Unit 1. Repairs to the three penetrations were performed using a technique that embedded the flaws detected by NDE techniques. This technique sealed potential leakage paths from further exposure to reactor coolant, thereby eliminating this source of corrosion. Subsequent to the repair activities, the reactor vessel head was cleaned to remove accumulated debris and deposits and was re-inspected as discussed above. No evidence of wastage at the penetrations-to-reactor vessel head interfaces on the outside surface of the reactor vessel head was noted at that time or in subsequent reviews of the inspection videotapes, which were conducted to specifically look for reactor vessel head degradation. Given the minor amount of boric acid accumulation around the penetrations on North Anna Unit 2, coupled with evidence from the Surry Unit 1 reactor vessel head inspections we have concluded that there is no likelihood of any degradation or wastage of the reactor vessel head below the outside surface along the interface between the reactor vessel head and penetration tubes.

In the case of North Anna Unit 2 and Surry Unit 1, even where leakage was suspected, no evidence of reactor vessel head degradation was found and the repairs that were completed should prevent future leakage at the affected locations.

No penetration leakage was identified at North Anna Unit 1 and Surry Unit 2. Therefore, we have concluded that there is no likelihood of any degradation or wastage of the reactor vessel head below the outside surface along the interface between the reactor vessel head and penetration tubes.

D. *Your schedule, plans, and basis for future inspections of the reactor pressure vessel head and penetration nozzles. This should include the inspection method(s), scope, frequency, qualification requirements, and acceptance criteria,*

Response:

A qualified bare-metal visual inspection of the reactor vessel head inside the ventilation shroud will be performed during each scheduled refueling outage for North Anna and Surry, until each unit's reactor vessel head is replaced. This includes the Surry Unit 2 refueling outage currently in progress. The inspections are planned using remote video equipment, as required, which has been demonstrated to provide detailed, high-resolution images of the bare-metal surface under the insulation. The scope will be modified as necessary to reflect industry experience and recommendations. Personnel responsible for the inspections will be at least qualified Level II, VT-2 inspectors. Acceptance criteria shall be equivalent to the applicable requirements of ASME, Section XI, paragraph IWB-3522. Any indications of leakage or degradation noted from these inspections will require resolution by evaluation and/or additional inspections using different techniques, such as NDE surface and volumetric examinations, and/or repairs. The requirement for the bare-metal visual inspection will be included in Dominion's Augmented Inspection Program, since the scope and frequency of these inspections exceed the requirements of current versions of ASME Section XI.

In addition to the bare-metal reactor vessel head inspections discussed above, visual examinations will continue to be performed above the vessel head insulation in accordance with our Augmented Inspection Program. The purpose of this inspection will be to identify signs of active reactor coolant leakage from sources other than the penetrations at the reactor vessel head-to-penetration interface, such as leaking mechanical connections or welds. Personnel responsible for the inspections will be at least qualified Level II, VT-2 inspectors. Acceptance criteria shall be equivalent to the applicable requirements of paragraph IWB-3522. Any indications of leakage noted from these inspections will require additional assessment given the possibility that such leakage could find its way through the joints in the insulation to the bare reactor vessel head. The requirement for these visual inspections is included in Dominion's Augmented Inspection Program since the scope and frequency of the inspections exceed the requirements of current versions of ASME Section XI.

As mentioned in 1.B above, we have determined that the interference fit for the reactor vessel head penetrations for the North Anna and Surry units is such that there is actually a gap at operating temperature and pressure. Consequently, any through-wall flaw in a penetration tube that extends above the J-groove weld or a flaw in the J-groove weld itself will result in leakage that would be apparent on the surface of the reactor vessel head.

E. *Your conclusion regarding whether there is reasonable assurance that regulatory requirements are currently being met (see the Applicable Regulatory Requirements, above). This discussion should also explain your basis for concluding that the inspections discussed in response to Item 1.D will provide reasonable assurance that these regulatory requirements will continue to be met. Include the following specific information in this discussion:*

1. *If your evaluation does not support the conclusion that there is reasonable assurance that regulatory requirements are being met, discuss your plans for plant shutdown and inspection.*

2. *If your evaluation supports the conclusion that there is reasonable assurance that regulatory requirements are being met, provide your basis for concluding that all regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.*

Response:

Part (1) - Not Applicable

Part (2) - There is reasonable assurance that regulatory requirements are currently being met. The following discussion provides the basis that all regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the additional inspections are performed.

Design Requirements: 10 CFR 50, Appendix A – General Design Criteria

Regulatory Requirement

"The applicable GDC include GDC 14 (Reactor Coolant Pressure Boundary), GDC 31 (Fracture Prevention of Reactor Coolant Pressure Boundary), and GDC 32 (Inspection of Reactor Coolant Pressure Boundary). GDC 14 specifies that the reactor coolant pressure boundary (RCPB) has an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. GDC 31 specifies that the probability of rapidly propagating fracture of the RCPB be minimized. GDC 32 specifies that components which are part of the RCPB have the capability of being periodically inspected to assess their structural and leaktight integrity; inspection practices that do not permit reliable detection of degradation are not consistent with this GDC."

The three referenced General Design Criteria (GDC) state the following:

- 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."

- 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 nonbrittle 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 thermal stresses, and (4) size of flaws."

- 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."

Compliance Basis

During the initial plant licensing of North Anna Units 1 and 2 and Surry Units 1 and 2, it was demonstrated that the design of the reactor coolant pressure boundary met the regulatory requirements in place at that time. The GDC included in Appendix A to 10 CFR Part 50 did not become effective until May 21, 1971. The Construction Permits for Surry Units 1 and 2 and North Anna Units 1 and 2 were issued prior to May 21, 1971; consequently, these units were not subject to GDC requirements. (Reference SECY-92-223 dated September 18, 1992.) However, the following information demonstrates compliance with the design criteria relative to the cracking of reactor vessel head nozzles and the potential for subsequent wastage of the reactor vessel head:

- Pressurized water reactors licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or other austenitic materials with excellent corrosion resistance and extremely high fracture toughness, for reactor coolant pressure boundary materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts. NRC reviews of operating license submittals subsequent to issuance of Appendix A included evaluating designs for compliance with the General Design Criteria. The standard review plans (SRPs) in effect at the time of licensing did not address the selection of Alloy 600. They only required that ASME Code requirements be satisfied.
- Although stress corrosion cracking of primary coolant system penetrations was not originally anticipated during plant design, it has occurred in the reactor vessel head nozzles at some plants. The robustness of the design has been demonstrated by the small amounts of leakage that has occurred and by the fact that none of the cracks in Alloy 600 reactor coolant pressure boundary materials has rapidly propagated or resulted in catastrophic failure or gross rupture. The suitability of the originally selected materials has been confirmed. Given the inherently high fracture toughness and flaw tolerance of the Alloy 600 material, there is in fact an extremely low probability of a rapidly propagating failure and gross rupture. It should be noted that early versions of the GDCs specified requirements in terms of extremely low probability of gross rupture or significant leakage throughout design life.
- The ASME requirement for the J-groove CRDM welds is for a visual examination of 25% of the penetrations for leakage during pressure testing.

The component was designed for that inspection. That examination, which at least for the near future will be conducted on the bare-metal of the reactor vessel head, is capable of assessing the structural and leak tight integrity of the reactor vessel head penetrations. NDE and enhanced visual examination can be performed using specialized methods.

- Recent events at the Davis-Besse plant have demonstrated that the design of the reactor vessel head is very robust and that it can tolerate significant degradation without rapidly propagating failure or gross rupture. The enhanced inspection program planned for North Anna Units 1 and 2 and Surry Units 1 and 2 will be capable of discovering wastage or degradation of the reactor vessel head and will ensure continued structural and leak tight integrity.

As described above, the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32, respectively, were satisfied during each plant's initial licensing review, and continue to be satisfied during operation, even in the presence of a potential for stress corrosion cracking of the reactor vessel head penetrations and/or subsequent wastage of the reactor vessel head.

Inspection Requirements: 10 CFR 50.55a and ASME Section XI

Regulatory Requirement

"NRC regulations in 10 CFR 50.55a state that American Society of Mechanical Engineers (ASME) Class 1 components (which includes the reactor coolant pressure boundary) must meet the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. For example, Table IWA-2500-1 [IWB-2500-1[1]] of Section XI of the ASME Code provides examination requirements for reactor vessel head nozzles and references IWB-3522 for acceptance standards. IWB-3522.1(c) and (d) specify that conditions requiring correction include the detection of leakage from insulated components and discoloration or accumulated residues on the surfaces of components, insulation, or floor areas which may reveal evidence of borated water leakage, with leakage defined as 'the through-wall leakage that penetrates the pressure retaining membrane.' Therefore, 10 CFR 50.55a, through its reference to the ASME Code, does not permit through-wall degradation of the reactor vessel head penetration nozzles.

For through-wall leakage identified by visual examinations in accordance with the ASME Code, acceptance standards for the identified degradation

[1] An erratum appears to exist in the Bulletin. Table IWA-2500-1 is cited, but does not exist. It appears that the citation should have been IWB-2500-1.

are provided in IWB-3142. Specifically, supplemental examination (by surface or volumetric examination), corrective measures or repairs, analytical evaluation, and replacement provide methods for determining the acceptability of degraded components."

Compliance Basis

Title 10 of the Code of Federal Regulations, Part 50.55a requires that inservice inspection and testing be performed per the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the reactor coolant pressure boundary.

Requirements for partial penetration welds attaching CRDM housings to the reactor vessel head are contained in Table IWB-2500-1, Examination Category B-E, "Pressure Retaining Partial Penetration Welds in Vessels," Item Numbers: B4.10, "Partial Penetration Welds;" B4.11, "Vessel Nozzles;" B4.12, "CRDM Nozzles;" and B4.13, "Instrumentation Nozzles." The Code requires a VT-2 visual examination of 25% of the CRDM nozzles from the external surface. Since the reactor vessel head is insulated, and the nozzles do not represent a bolted flange, paragraph IWA-5242(b) permits these inspections to be performed with the insulation left in place. Future inspections planned for the reactor vessel heads, which will be done each refueling outage, exceed the requirements of ASME Section XI in both scope and frequency.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures" and IWB 3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels, and Examination Category B-P, All Pressure Retaining Components." Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Plants may not return to service after finding a leak from a reactor vessel head nozzle without first having repaired the nozzle and having assessed any wastage of the reactor vessel head the leakage may have caused.

Flaws identified by NDE methods, which are not addressed by specific ASME Section XI acceptance criteria are evaluated in accordance with the flaw evaluation rules for piping contained in Section XI of the ASME Code. This approach has been accepted by the NRC. Any flaw not meeting requirements for the intended service period would be repaired before returning it to service.

Repairs to the reactor vessel head nozzles will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

North Anna and Surry comply with these ASME Code requirements through implementation of their inservice inspection programs. If a VT-2 examination detects the conditions described by IWB-3522.1(c) and (d), then corrective actions per IWB-3142 will be performed in accordance with the plant's corrective action program. No new plant actions are necessary to satisfy the cited regulatory criteria.

Quality Assurance Requirements: 10 CFR 50, Appendix B

Regulatory Requirement

"Criterion V (Instructions, Procedures, and Drawings) of Appendix B to 10 CFR Part 50 states that 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. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual and volumetric examinations of the reactor coolant pressure boundary are activities that should be documented in accordance with these requirements."

Compliance Basis

Any of the work undertaken to inspect, evaluate, and/or repair the North Anna and Surry reactor vessel head penetrations will be conducted and documented in accordance with existing or new procedures which comply with the Company's Quality Assurance (QA) Topical Report, the QA program, and Criterion V of Appendix B to 10 CFR Part 50.

Regulatory Requirement

"Criterion IX (Control of Special Processes) of Appendix B to 10 CFR Part 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements. Within the context of providing assurance of the structural integrity of the reactor coolant pressure boundary for the degradation observed at Davis-Besse, special requirements for visual examination and/or ultrasonic testing would generally require the use of qualified visual and ultrasonic testing methods. Such methods are ones that a plant-specific analysis has demonstrated would result in the reliable detection of degradation prior to a loss of specified reactor coolant pressure boundary margins of safety. The analysis would have to consider, for example, the as-built configuration of the system and the capability to reliably detect and accurately characterize flaws or degradation, and contributing factors such as the presence of insulation, preexisting deposits, and other factors that could interfere with the detection of degradation."

Compliance Basis

As discussed previously in this submittal, the designed range of the interference fit of the reactor vessel head penetration nozzles in the North Anna and Surry reactor vessel heads has been shown to result in gaps between the penetration tube and bore in the reactor vessel head at operating pressure and temperature. Consequently, flaws breaching the reactor vessel head penetration will result in discernable leakage. The visual inspection technology that North Anna and Surry will rely on is either a remote robotic video system, a boroscope with video camera or direct visual inspection if applicable. This video technology has been demonstrated to be effective at detecting small amounts of boric acid accumulation on the reactor vessel head with sufficient resolution and sensitivity to distinguish between leakage occurring at reactor vessel head penetration nozzles versus leakage from other sources. The inspections will be recorded on videotape. Personnel involved with the evaluation of the inspections will be VT-2 qualified and familiar with the anticipated type of indication that leakage would cause. For inspections above the reactor vessel head insulation, more traditional VT-2 inspection procedures with demonstrated effectiveness will be used. Additionally, the qualification of any other NDE technique that might be used for the inspections will be demonstrated prior to use.

Regulatory Requirement

"Criterion XVI (Corrective Action) of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions. For degradation of the reactor coolant pressure boundary, the root cause determination is important for understanding the nature of the degradation present and the required actions to mitigate future degradation. These actions could include proactive inspections and repair of degraded portions of the reactor coolant pressure boundary."

Compliance Basis

Criterion XVI contains two important attributes pertinent to the potential for reactor vessel head penetration cracking.

The first of these is "...that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected." This criterion implies a licensee's responsibility to be aware of industry experience, and has been interpreted in this manner in most plants' corrective action programs. A licensee should determine if industry experience applies to its plant and what, if any, corrective actions are appropriate. This approach is consistent with the NRC's generic communication process for an Information Notice, which reports industry experience but does not require a response to the NRC. Licensees are expected to evaluate the applicability of the occurrence to their plant and document a record of the plant specific assessment for possible NRC review during inspections.

Criterion XVI provides the objectives and goals of the corrective action program, but licensees are responsible for determining a specific process to accomplish these goals and objectives. With regard to the bulletin response, Criterion XVI does not provide specific guidance as to what is an appropriate response, but rather, the licensee is responsible for determining actions necessary to maintain public health and safety. Specifically, in this case, the licensee must justify its actions for addressing the potential of stress corrosion cracking of reactor vessel head penetrations. Furthermore, the regulatory criteria of 10 CFR 50.109(a)(7), provides supporting evidence when it states that "...if there are two or more ways to achieve compliance . . . then ordinarily the applicant or licensee is free to choose the way which best suits its purposes."

The second attribute of Criterion XVI that should be considered is that for "... significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions." The bulletin suggests that for cracking of reactor vessel head penetrations and degradation of the reactor vessel head, the root cause determination is important in understanding the nature of the degradation and the required actions to mitigate future cracking and degradation. As part of its corrective action program, a licensee, through its own efforts or as part of an industry effort, would determine the cause of cracks in the reactor vessel head penetration and/or degradation of the reactor vessel head, if they were detected. However, if no known degradation of the reactor vessel heads is identified through reasonable quality assurance measures or inspection and monitoring programs, this criterion would not require specific action on the part of a licensee for remaining in compliance with the regulation.

In summary, the integrated industry approach to inspection, monitoring, cause determination, and resolution of the identified CRDM nozzle cracking and reactor vessel head degradation is clearly in compliance with the performance-based objectives of Appendix B.

Operating Requirement: 10 CFR 50.36 - Plant Technical Specifications

Regulatory Requirement

"Plant technical specifications pertain to the issue insofar as they do not allow operation with known reactor coolant system pressure boundary leakage."

Compliance Basis

Title 10 of the Code of Federal Regulations, Part 50.36 (10 CFR 50.36) contains requirements for Plant Technical Specifications. Paragraphs 2 and 3 of 10 CFR Part 50.36 are particularly relevant:

- 10 CFR 50.36 (2) Limiting Conditions for Operation

  "(i) Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. ... (ii) A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one or more of the following criteria: ...

  Criterion 3: A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

  Criterion 4: A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

- 10 CFR 50.36 (3) Surveillance Requirements

  "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

The reactor coolant pressure boundary is one of the three physical barriers to the release of radioactivity to the environment. Therefore, our plant Technical Specifications (TS) include a requirement and associated action statements addressing reactor coolant pressure boundary leakage. The limits for reactor coolant pressure boundary leakage at North Anna and Surry are 1 gallon per minute (gpm) for unidentified leakage, 10 gpm for identified leakage, and no leakage from a non-isolable fault in the reactor coolant system pressure boundary (i.e., component body, pipe well, vessel wall, or pipe weld).

Leaks observed in other plants from Alloy 600 reactor vessel head penetrations due to PWSCC have been well below the sensitivity of on-line leakage detection systems. These plants have evaluated the condition and have determined that appropriate inspections are bare-metal visual inspections of the reactor vessel head for boric acid deposits during plant shutdowns and/or NDE examination of the CRDMs. If leakage or unacceptable indications are found, then the defect must be repaired before the plant returns to power operations. Hypothetically, if a through-wall pressure boundary leak develops and increases to the point that the leakage is detected by the on-line leak detection systems, the leak must be evaluated per the specified TS acceptance criteria, and the plant shut down if the leak is determined to be non-isolable reactor coolant system pressure boundary leakage (i.e., component body, pipe well, vessel wall, or pipe weld). Plant TS requirements continue to be met.

Regulatory Requirement

Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," requested licensees to provide assurance that a program was implemented at their facility to ensure that boric acid corrosion due to leakage will not lead to degradation of the Reactor Coolant System Pressure Boundary. The program was to include the following attributes:

- Determination of the principal locations where leaks may occur and cause significant boric acid corrosion of the primary pressures boundary.

- Procedures for the location of small coolant leaks (i.e., leakage rates at less than technical specification limits).

- Methods for conducting examinations and performing engineering evaluations to establish the impacts on the RCS pressure boundary when leakage is located.

- Corrective actions to prevent recurrence of this type of corrosion.

Compliance Basis

North Anna and Surry enhanced existing programs to accomplish the intent of Generic Letter 88-05. In determining the principal locations where leaks may occur, these programs focused on components and connections susceptible to aging, fatigue and other forms of degradation due to boric acid corrosion. The program focused on finding and repairing leaking components to prevent boric acid corrosion and wastage of low alloy steel components in the Reactor Coolant

Pressure System boundary.

Leakage sources external to the reactor vessel head and penetration attachment welds (such as CRDM housing closures, reactor vessel head flange, reactor vessel head vent connections, etc.) were thought the most likely sources of leakage with the potential to initiate corrosion of the reactor vessel head. These areas/components are inspected for evidence of leakage, and if found, the required evaluations and corrective actions described in Generic Letter 88-05 are completed.