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SUBJECT: Requests approval of revision to Relief Request RRPT-7 to ISI Pressure Test Program for plant, Units 1 & 2. Alternate provisions, listed.

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SUSQUEHANNA STEAM ELECTRIC STATION
REQUEST FOR APPROVAL OF REVISION TO
RELIEF REQUEST NO. RRPT-7 FOR THE ISI
PRESSURE TEST PROGRAM FOR UNITS 1 AND 2
PLA-4576 FILE R41-2

Docket Nos. 50-387
and 50-388

On February 3, 1997, (PLA-4553) Pennsylvania Power & Light Company submitted Relief Request No. RRPT-7 addressing leakage at the incore instrument flange-to-housing bolted connections. Following discussions with the NRC Staff on February 18, 1997, PP&L is submitting this revised relief request.

Pursuant to 10CFR50.55a(a)(3), Pennsylvania Power & Light Company requests the approval of the revision to Relief Request No. RRPT-7 to the ISI Pressure Test Program for Susquehanna Units 1 and 2. This letter supersedes our submittal (PLA-4553) on February 3, 1997. This revision to Relief Request No. RRPT-7 requests relief for ASME Section XI Class 1 incore instrument flange-to-housing bolted connections with leakage identified during pressure testing from:

The 1989 Edition of ASME Code Section XI paragraph IWA-5250(a)(2), stating:

"The source of leakages detected during the conduct of a system pressure test shall be located and evaluated by the Owner for corrective measures as follows: ... 'If leakage occurs at a bolted connection, the bolting shall be removed, VT-3 visually examined for corrosion, and evaluated in accordance with IWA-3100.'"

In lieu of this requirement, Pennsylvania Power & Light Company proposes to do the following alternate provisions:

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The source of leakage detected by VT-2 examination during a system pressure test shall be evaluated by the Owner to determine the susceptibility of the bolting to corrosion and potential failure.

If the evaluation determines that the leaking condition has not degraded the fasteners, then no further action is necessary. However, reasonable attempts to stop the leakage shall be taken.

If the evaluation indicates the need for further evaluation or no evaluation is performed, then a bolt in the leakage path will be removed. The removed bolt will receive a visual VT-3 exam and be evaluated in accordance with IWB-3140, "Inservice Inspection Visual Examinations". When the removed bolting shows evidence of rejectable degradation, all remaining bolting in the connection shall be removed, VT-3 examined, and evaluated in accordance with IWB-3140.

This relief is justified based upon the following:

- Any water leaking from any incore instrument flange-to-housing bolted connection is reactor coolant, which, due to its high purity, has reduced potential for inducing corrosion of this bolting. Any corrosion would occur at a comparatively slow rate.

- An additional factor inhibiting corrosion of the bolting at these connections is that they are all located within the drywell, which is inerted with a nitrogen atmosphere throughout the operating cycle. The elimination of atmospheric oxygen diminishes the potential for corrosion in this environment.

- The removal of bolts individually for VT-3 visual examination and disturbance of the seal at the incore instrument flange-to-housing bolted connection could necessitate the complete disassembly of the connection for replacement of the metallic O ring in the flange. Creating the possibility of metallic O ring replacement operation beneath the reactor vessel contradicts the need to keep personnel radiation exposure As Low As Reasonably Achievable.

- Removal, VT-3 visual examination, and reinstallation of all 4 bolts in any incore instrument flange exhibiting leakage or seepage would result in a minimum expenditure of 0.6 man-REM per flange under the optimum condition of holding the flange in position - if breaking of the flange were not necessary.

- Leakage from the incore instrument flange-to-housing bolted connection during the system pressure test generally decreases and stops with vessel heatup at operating pressure, due to the design of the special coated metallic O ring pressurizing gasket used in this connection.

- Significant leakage from the bolted connection would be detected by the leakage collection system (drywell sump) serving this equipment, be indicated in the control room, be investigated, and be corrected in accordance with plant Technical Specification 3.4.3.2.

- Industry studies on mechanisms of degradation and failure of bolting in nuclear power plants have quantified the experience of bolting failures and have identified the principle failure mechanisms associated with bolt degradation. The documents have shown that bolt failures have occurred primarily in pressurized water reactors, in both ambient and elevated temperature environments.

Pennsylvania Power and Light Company requests that this relief be approved by March 12, 1997, so that the relief can be used during the Unit 2 Eighth Refueling Outage.

If you have any questions, please call, Mr. C. T. Coddington at (610) 774-7531.

Very truly yours,

R. G. Byram

Attachment

copy: NRC Region I
Mr. K. Jenison, NRC Sr. Resident Inspector
Mr. C. Poslusny, NRC Sr. Project Manager

RELIEF REQUEST RRPT-7

I. RELIEF REQUEST APPLICABILITY

A. Units:	1 and 2
B. Code Examination Category:	N/A
C. Code Item Number:	N/A
D. Code Reference:	ASME Section XI (1989 Edition), Paragraph IWA-5250(a)(2), Corrective Measures

II. IDENTIFICATION OF COMPONENTS

ASME Section XI Class 1 incore instrument flange-to-housing bolted connections with leakage identified during pressure testing. This bolting is as specified in Table IWB-2500-1, Examination Category B-G-2, Item Number B7.10.

III. CODE REQUIREMENTS FROM WHICH RELIEF IS REQUESTED

The 1989 Edition of ASME Code Section XI paragraph IWA-5250(a)(2), stating:

"The source of leakages detected during the conduct of a system pressure test shall be located and evaluated by the Owner for corrective measures as follows: ... 'If leakage occurs at a bolted connection, the bolting shall be removed, VT-3 visually examined for corrosion, and evaluated in accordance with IWA-3100.'"

IV. BASIS FOR RELIEF

Pursuant to 10CFR50.55a(a)(3), relief is requested from the requirement of ASME Code Section XI paragraph IWA-5250(a)(2) because compliance with this requirement would result in hardship without any compensating increase in the level of quality and safety.

Any water leaking from any incore instrument flange-to-housing bolted connection is reactor coolant, which, due to its high purity, has reduced potential for inducing corrosion of this bolting. Any corrosion would occur at a comparatively slow rate.

An additional factor inhibiting corrosion of the bolting at these connections is that they are all located within the drywell, which is inerted with a nitrogen atmosphere throughout the operating cycle. The elimination of atmospheric oxygen diminishes the potential for corrosion in this environment.

The removal of bolts individually for VT-3 visual examination and disturbance of the seal at the incore instrument flange-to-housing bolted connection could necessitate the complete disassembly of the connection for replacement of the metallic O ring in the flange. With the reactor head on (following completion of the ASME Class 1 System Leakage or Hydrostatic test), the reactor would have to be disassembled to allow replacement of the metallic O ring in the flange. Removal of all bolting from this leaking connection beneath a reactor vessel loaded with fuel could force extensive disassembly of the reactor vessel, with resultant additional wear and tear on reactor components. The prevention of uncontrolled draining of reactor coolant out through a disassembled flange would require removal of the reactor vessel head, removal of fuel bundles adjacent to the incore instrument, removal of the incore instrument itself, and insertion of a plug into the top of the incore instrument guide tube. This limits the inventory loss to the coolant between the plug and the flange. Thus, significant loss of contaminated reactor coolant would be created by the act of removing the bolting, breaking the flange, and replacing the metallic O ring in the flange. Creating the possibility of this additional metallic O ring replacement operation beneath the reactor vessel contradicts the need to keep personnel radiation exposure As Low As Reasonably Achievable.

Removal, VT-3 visual examination, and reinstallation of all 4 bolts in any incore instrument flange exhibiting leakage or seepage would result in a minimum expenditure of 0.6 man-REM per flange under the optimum condition of holding the flange in position - if breaking of the flange were not necessary. The hardship of this personnel radiation exposure is without any compensating increase in nuclear safety because the incore instrument flange-to-housing bolted connection is designed with safety margin.

The ASME Class 1 System Leakage Test is performed at cold conditions (reactor coolant test temperature is limited to $\leq 212°F$ by plant technical specification test exception 3.10.6) and for only a brief period. Leakage observed from an incore instrument flange-to-housing bolted connection during the System Leakage Test is not representative of its condition during an extended period at rated pressure and temperature. Leakage from the incore instrument flange-to-housing bolted connection during the system pressure test generally decreases and stops with vessel heatup at operating pressure, due to the design of the special coated metallic O ring pressurizing gasket used in this connection.

Should significant leakage from this bolted connection persist, it would be detected by the leakage collection system (drywell sump) serving this equipment, be indicated in the control room, be investigated, and be corrected, in accordance with plant Technical Specification 3.4.3.2.

Although ASME Code editions subsequent to 1989 have improved the approach to corrective action for leakage at bolted connections, the improvement does not well address the situation of the incore instrument flange-to-housing bolted connection. In the 1990 Addenda and later editions of ASME Code Section XI, paragraph IWA-5250(a)(2) has been improved to state, "If leakage occurs at a bolted connection, one of the bolts shall be removed, VT-3 examined,

and evaluated in accordance with IWA-3100. The bolt selected shall be the one closest to the source of leakage. When the removed bolt has evidence of degradation, all remaining bolting in the connection shall be removed, VT-3 examined, and evaluated in accordance with IWA-3100." This approach is not appropriate for the incore instrument flange-to-housing bolted connections because it disturbs the pattern of bolt tension at the connection and could exacerbate the leakage.

Considerations that are important in assessing leakage through pressure retaining bolted connections include: location of the leak in the system or plant; time in the plant cycle; leaking medium; materials exposed to the leak; Technical Specification limitations; capability for isolating or monitoring the leak; and the capability for redirecting or capturing the leak.

Industry studies on mechanisms of degradation and failure of bolting in nuclear power plants have quantified the experience of bolting failures and have identified the principle failure mechanisms associated with bolt degradation. The documents have shown that bolt failures have occurred primarily in pressurized water reactors, in both ambient and elevated temperature environments. The following three potential bolt failure mechanisms have been identified and considered for relevance to the incore instrument flange-to-housing bolted connection at Susquehanna:

-Stress corrosion cracking: This mechanism is intensified by moist environment, presence of oxygen, high preload stresses, use of lubricants containing molybdenum disulfide (MoS_2), and improper heat treatment of the bolt material.

-Fatigue: This mechanism is primarily induced by improper preload torquing.

-Borated water: This mechanism is a chemical attack caused by presence of water containing boron.

Consideration of the applicability of these bolting failure mechanisms to the Susquehanna incore instrument flange-to-housing bolting has produced the following observations:

-Stress corrosion cracking: The material of the Susquehanna incore instrument flange-to-housing bolts meets ASME SA193, grade B7 specifications. This is a chromium-molybdenum material which is considered low strength and generally not susceptible to stress corrosion cracking. This bolting is purchased in accordance with Susquehanna Quality Assurance requirements. Approved lubricants are controlled by procedures. The

lubricants used for these bolts are nickel-based lubricants very low in halogens and sulfur.

-Fatigue: The incore instrument flange-to-housing bolts are torqued to a preload stress of about 42% of the yield strength, to minimize fatigue.

-Borated water: Unlike pressurized water reactors, Susquehanna does not use borated water in its primary coolant system. The reactor coolant system is frequently monitored for chemical composition and contaminants. No corrosion-inducing additives are used or allowed. Additionally, the atmosphere in the drywell during operation is required by plant Technical Specifications to be inerted with nitrogen. This starves the bolted connection of oxygen, mitigating the processes of both chemical and stress corrosion cracking.

V. ALTERNATE PROVISIONS

The source of leakage detected by VT-2 examination during a system pressure test shall be evaluated by the Owner to determine the susceptibility of the bolting to corrosion and potential failure. This evaluation will consider the following variables at a minimum:

- Location of leakage
- History of leakage
- Fastener materials
- Evidence of corrosion with the connection assembled
-Corrosiveness of the process fluid
-History and studies of similar fastener material in a similar environment
-Other components in the vicinity that may become degraded due to leakage

When the evaluation of the variables is concluded and the evaluation determines that the leaking condition has not degraded the fasteners, then no further action is necessary. However, reasonable attempts to stop the leakage shall be taken.

If the evaluation of the variables above indicates the need for further evaluation or no evaluation is performed, then a bolt in the leakage path will be removed. The removed bolt will receive a visual VT-3 exam and be evaluated in accordance with IWB-3140, " Inservice Inspection Visual Examinations". When the removed bolting shows evidence of rejectable degradation, all remaining bolting in the connection shall be removed, VT-3 examined, and evaluated in accordance with IWB-3140.