ENCLOSURE

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-324/LICENSE NO. DPR-62
INSERVICE INSPECTION PROGRAM FOR THE THIRD 10-YEAR
INTERVAL - EVALUATION FOR LEAKAGE AT BOLTED CONNECTIONS

Engineering Service Request 99-00279,
"B214R1 RPV Hydrotest Bolted Connection Corrective Action Evaluation"

Form 1 — **ENGINEERING SERVICE REQUEST**

ESR # 9900279 Rev # 0	WR/JO #	Other Documents (CR, OEF, etc.) -RELIEF REQUEST 17

Plant/Unit BNP 2	Primary System # 1005	Primary System Name B21,B11-NUCLEAR BOILER (INC.RX VESSEL &	[X] Multiple Systems Affected

Title	Originator/Phone
B214R1 RPV Hydrotest Bolted Connection Corrective Action Eva	STANLEY, BOYD J /850-2495

Plant Customers (Print Name, Sign, Date)

Engineering/Plant Programs (Print Name, Sign, Date)

ISI Jerry W. Crider Jerry W. Crider 5/13/99

Reviews (Print Name, Sign, Date)

Design Verification W. M. Dascey 5/14/99

☐ Other Reviews Required [X] Records Attached

Engineering Disciplines (Print Name, Sign, Date)

Mechanical Phillip Gore / Phillip Gore 5/14/99

Civil/Seismic W. M. Langlois 5/14/99

Materials Michael W. Guthrie, P.E. Michael W. Guthrie, P.E. 5/13/99

Plant/System Todd A Hamilton Todd A. Hamilton 5/13/99

Plant/System John C. Bass J.C. Bass 5/13/99

Plant/System

Response Type ENG EVAL	ESR Team	Quality Class
	JERRY CRIDER PHIL GORE MIKE GUTHRIE MARK GRANTHAM TODD HAMILTON JOHN BASS	A Safety-Related
Due Date 05-14-99		

APPROVALS

☐ NAS Before Approval/Implementation
☐ NAS Before Closeout
☐ PNSC Before Approval/Implementation
☐ NRC Before Implementation
☐ Plant General Manager

Is a 10CFR 50.59 Safety Review required per (plant specific procedure)?

[X] Yes [X] Safety Screen ONLY
☐ USQD
☐ N/A (Engineering Disposition Only)

Responsible Engineer BOYD J STANLEY B Stanley

Responsible Manager (Print Name, Sign, Date) J. McINTYRE J. McIntyre 5/14/99

Plant General Manager (Print Name, Sign, Date)

Form 1	ENGINEERING SERVICE REQUEST	
ESR # .	Rev #	Title
9900279	0	B214R1 RPV Hydrotest Bolted Connection Corrective Action Eva

Response:

The attached ESR text provides guidance for the evaluation of leaking ASME Class 1 pressure retaining bolted connections identified during VT-2 Examinations for the B214R1 RPV Leakage Test, OPT-80.1. This ESR implements pressure retaining bolted connection inspections which result from the upgrade of the ASME Section XI 1980 with 1981 Winter edition to the 1989 edition for the third ten year interval. It also implements Relief Request 17, Revision 2, dated 4May99. This guidance includes:

1. The classification of Corrective Action Levels based on observed leakage flow rates,

2. The General Visual Inspection requirements for bolted connections,

3. Details for the inspection methodology.

4. Specific exemption for mechanical packing and seal bolted connections.

Specific bolted connection evaluations for each identified leak are included in Attachment 5.

Form 1	ENGINEERING SERVICE REQUEST	
ESR # 9900279	Rev # 0	Title B214R1 RPV Hydrotest Bolted Connection Corrective Action Eva

Response:

The attached ESR text provides guidance for the evaluation of leaking ASME Class 1 pressure retaining bolted connections identified during VT-2 Examinations for the B214R1 RPV Hydrostatic Test, OPT-80.1. This ESR implements these inspections as a result of the upgrade from the ASME Section XI 1980 with 1981 Winter edition to the 1989 edition for the third ten year interval, and includes Relief Request 17 dated 4May99. This guidance includes:

1. The classification of Corrective Action Levels based on observed leakage flow rates,

2. The General Visual Inspection requirements for bolted connections,

3. Details for the inspection methodology.

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ESR Table of Contents

Purpose

The purpose of this engineering evaluation is to review the bolted connection history of the last two BNP Unit 2 refueling outage 0PT-80.1 RPV Leakage Test results, and to establish corrective action level guidelines for corrective measures for similar leaks if found during the B214R1 leakage in accordance with the ASME Section XI Code 1989 Edition, and BNP Relief Request 17, revision 2.

Problem Identification

Implementation of the ASME Section XI ,1989 edition, by Carolina Power and Light Company at the Brunswick Nuclear Plant (BNP) in June 1998 resulted in new requirements for evaluating pressure retaining bolted connections observed leaking during the VT-2 examination of 0PT-80.1, "Reactor Pressure Vessel ASME Section XI Pressure Test". BNP ASME Code Relief Request 17 revision 2 has been approved modifying the new requirements for the B214R1 refueling outage only. This ESR provides guidance for the evaluation of these bolted connections. The last two Unit 2 refueling outage 0PT-80.1 test results will be reviewed for generic material issues, and for historical component leakage candidates.

ESR Design specification

ESR Scope Description

This ESR applies to ASME Section XI Code Class 1 pressure retaining bolted connections included in the test boundary for the 0PT-80.1 RPV Leakage Test.

Design Inputs

Relief Request RR-17 Revision 2: Leakage at Bolted Connections
Carolina Power and Light Company at the Brunswick Nuclear Plant (BNP) implemented ASME Section XI,1989 edition, in May 1998. Upon completion of a VT-2 examination documenting pressure retaining bolted connection leakage in accordance with approved site procedure 0PT-80.1, "Reactor Pressure Vessel ASME Section XI Pressure Test" removal of bolting and a supplemental VT-3 examination is required for all leaks per IWA-5250(a). Subsequently, Relief Request RR-17 revision 2: "Leakage at Bolted Connections" was approved by the Nuclear Regulatory Commission as follows:

When leakage is detected at bolted connections, as an alternative to the requirements of IWA-5250(a)(2), the requirement of either 1 or 2 below shall be met:

1) The leakage shall be stopped and the bolting and component material shall be evaluated to determine joint integrity and the susceptibility of the bolting to corrosion and failure. The evaluation will, at a minimum, consider the following factors:
   a. The number and service age of the bolts
   b. Bolt and component materials
   c. Corrosivity of the process fluid that is leaking
   d. Leakage location and system function
   e. Leakage history at the connection or other system components
   f. Visual evidence of corrosion at the connection (i.e while the connection is assembled).

2) If the leakage is not stopped, the joint shall be evaluated in accordance with IWB-3142.4 to determine joint integrity and the susceptibility of the bolting to corrosion and failure. The evaluation will, at a minimum, consider the following factors:
   a. The number and service age of the bolts
   b. Bolt and component materials

c. Corrosivivity of the process fluid that is leaking
d. Leakage location and system function
e. Leakage history at the connection or other system components
f. Visual evidence of corrosion at the connection (i.e while the connection is assembled).

When the evaluation of the above factors is concluded, and if the evaluation determines that the leaking conditions has not degraded the fasteners, then no further action is required. However, reasonable attempts shall be made to stop the leakage as appropriate. In accordance with IWB-3144(b), the evaluation analyses will be submitted to the regulatory authority having jurisdiction at the plant site.

If the evaluation of the factors in 1 or 2 above indicates the need for further evaluation, then a bolt closest to the source of leakage shall be removed. The bolt will receive a VT-1 examination and be evaluated and dispositioned in accordance with IWB-3517. If the removed bolting shows evidence of rejectable degradation, all remaining bolts shall be removed and receive a VT-1 examination in accordance with IWB-3140. If leakage is identified when the bolted connection is in service and the information in the evaluation is supportive, the removal of the bolt for the VT-1 examination may be deferred until the next refueling outage.

ASME IWA- 2212(a) Visual Examination VT-2

The VT-2 visual examination shall be conducted to locate evidence of leakage from pressure retaining components, or abnormal leakage from components with or without leakage collection systems as required during the conduct of system pressure or functional test.

ASME IWA- 2213 (a) Visual Examination VT-3

General mechanical and structural condition of components and supports such as the verification of clearances, settings, physical displacements, loose or missing parts, debris, corrosion, wear, erosion, or the loss of integrity at bolted or welded connections.

ASME IWA 5250 (a)(2) If leakage occurs at bolted connections perform a VT-3

(a) The source of leakage detected during the conduct of a system pressure test shall be located and evaluated by the Owner for corrective measures as follows:
(2) 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.

ASME IWB 3141(b) General

(b) Acceptance of components for continued service shall be in accordance with IWB-3142 though IWB-3144.

ASME IWB-3142.4 Acceptance by Analytical Evaluation

Components containing relevant conditions shall be acceptable for continued service if an analytical evaluation demonstrates the component's acceptability. The evaluation analysis and evaluation acceptance criteria shall be specified by the owner. Components accepted for continued service based on analytical evaluation shall be subsequently examined in accordance with IWB-2420(b) and (c).

ASME IWB 3144(b) Review by Authorities

Evaluation analyses of examination results as required by IWB-3142.4 shall be submitted to the regulatory authority having jurisdiction at the plant site.

<u>ASME IWB 3517 Standards for Examination Category B-G-1, Pressure Retaining Bolting Greater than 2 in. in Diameter, and Examination Category B-G-2, Pressure Retaining Bolting 2 in. and Less in Diameter</u>

IWB-3517.1 visual Examination, VT-1

the following relevant conditions shall require correction to meet the requirements of IWB-3122 prior to service or IWB-3142 prior to continued service:

(a) crack-like flaws that exceed the allowable linear flaw standards of IWB-3515;
(b) more than one deformed or sheared thread in the zone of thread engagement of bolts, studs, or nuts;
(c) localized general corrosion that reduces the bolt or stud cross- sectional area by more than 5%;
(d) bending, twisting, or deformation of bolts or studs to the extent that assembly or disassembly is impaired;
(e) missing or loose bolts, studs, nuts, or washers;
(f) fractured bolts, studs, or nuts;
(g) degradation of protective coatings on bolting surfaces; or
(h) evidence of coolant leakage near bolting.

ASME TABLE IWB 2500-1, Examination B-G-1

See attachment 1

ASME TABLE IWB 2500-1, Examination B-G-2

See attachment 1

ASME TABLE IWB 2500-1, Examination B-P

See attachment 1

General Visual Inspection Criteria:
A general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) to detect evidence of corrosion at the "as-found" bolted connection.

References

ASME Section XI, 1989 Edition, no addenda.
Relief Request 17: Leakage at Bolted Connections
ESR 96-00208, Evaluation of 0PT-80.1 RPV Leakage test results performed 7Mar96
ESR 97-00486, Evaluation of 0PT-80.1 RPV Leakage test results performed 9Oct97
EER 90-0059, Unit 2 CRD Flange Bolt Evaluation
SEEF 94-0009, Upgrade of CRD Flange Bolting

Specific reference information for each pressure retaining bolted connection identified leaking will be described on the datasheet in Attachment 5.

Evaluation

*Discuss why mechanical packing and seal leaks do not require a bolted connection evaluation

The new ASME Section XI requirements for evaluating bolted connections found leaking during the 0PT-80.1 RPV Leakage test VT-2 examinations are for pressure retaining bolted connections and do not apply to non pressure retaining mechanical seals and packing which are designed to wear in service and to leak during the service life of the component. ASME Section XI IWA-5250 Corrective Measures, specifies that the bolting shall be removed and a VT-3 examination for indications of corrosion be performed. The ANII confirmed that a packing gland does not constitute a bolted connection subject to the requirements of IWA-5250,and this is documented by memo in Attachment 3. Therefore, mechanical packing and seal leaks are concluded to be outside the bounds of this ESR, and an "EXEMPT" action level classification for corrective measures is specified.

*Discuss each valve/ component from the tabulated listing that was observed to leak during the last two refueling outages (B212R1 and B213R1):

1. CRD flange bolting (reference EER 90-059)
2. LPRM/ IRM flange bolting
3. Recirculating Water Valve 2-B32-F023A/B
4. Recirculating Water Valve 2-B32-F031A/B
5. Recirculating Water Valve 2-B32-F032A/B
6. Recirculating Water Valve 2-B32-F044A/B
7. Main Steam Inboard Isolation Valve 2-B21-F022A/B/C/D
8. Main Steam Outboard Isolation Valve 2-B21-F028A/B/C/D

*Review fastener materials for susceptibility to corrosion and damage.

Review of materials:

CRD:
Manufacturer: GE
8 Cap Screws required , SA-193 Grade B7 (AISI 4140 steel) originally supplied by GE. EER 91-0324, U2 CRD Flange Bolt Evaluation. All original cap screws were replaced in B210R1 and B211R1 outages per EER action item 2.
SEEF 94-0009 approved use of AISI-4340 bolting material as equivalent on 21Feb94.
There are no nuts installed in this designed use of cap screws. The fasteners thread directly into the reactor Vessel CRD flange housings.

IRM/ LPRM:
Manufacturer: GE
4 Cap Screws required , SA-193 Grade B7 originally supplied by GE.

Recirc Valves:
Manufacturer: Anchor Darling Valve Company
Bonnet Studs: A193 grade B7
Bonnet Nuts: A194 grade B8

B32-F023A/B, 28 required, 1/2FP-05363
B32-F031A/B, 28 required, 1/2FP-05363
B32-F032A/B, 8 required, 0FP-05365
B32-F043A/B, 24 required, 0FP-05364
B32-F044A/B, 8 required, 0FP-05366

MSIV:
Manufacturer: Rockwell International Manufacturing Co
Bonnet Studs: ASTM-540 grade B23
Bonnet Nuts: A194 grade 7

B21-F022A/B/C/D, 20 studs and nuts required, 1/2FP-55013 sheet 3
B21-F028A/B/C/D, 20 studs and nuts required, 1/2FP-55013 sheet 3

Recirc piping cleanout bolting:
Manufacturer: Provided with GE supplied piping assembly
1 1/8" stud, AM, Std.
8 required, 0FP-05109 sheet 2

For these applications, the original materials include the following steel types:
Stud and cap screw bolting material, A193 grade B7, with A194 grade 8 nuts.
New CRD cap screws, and MSIV bolting material, ASTM A-540 grade B23. MSIV nuts are A194 grade 7.

The A193, Grade B7 bolting and A194, Grade 7 nut materials are chromium-molybdenum steels with nominal composition of 1.0% chromium, 0.2% molybdenum, 0.85% manganese, and 0.25% silicon.

The A194, Grade 8 nut material is an austenitic stainless steel grade with nominal composition of 19% chromium, 9.25% nickel, and 2 % manganese.

The A540, Grade B23 is a chromium-nickel-molybdenum alloy bolting material with nominal composition of 0.8 % chromium, 1.8 % nickel, and 0.25 % molybdenum.

The austenitic stainless steel material is very resistant to general corrosion, and should not be affected by leakage of reactor coolant water. The other low alloy materials have good resistance to limited exposure to reactor coolant water, but are subject to light general corrosion if exposed to water and oxygen over long periods of time. General corrosion is a dissolution process on the surface of a metal or alloy exposed to a corrosive environment. Corrosion rates are time dependent and tend to decrease to a low level after prolonged exposure in neutral or slightly alkaline aqueous environments particularly in the absence of aggressive anions such as chloride and sulfate. Samples areas of known or suspected leakage should be visually inspected for general corrosion products within 2 cycles of identification of the leakage.

Reactor coolant, during operation with hydrogen and zinc addition, will be slightly acidic to close to neutral. With a loss of hydrogen addition, the pH of the coolant will become more acidic. During shutdown the coolant will be acidic. During acidic conditions, the corrosion rate is slightly higher than in the neutral or alkaline conditions. Since hydrogen interruptions are infrequent, the overall corrosion rate would be expected to be low due to the generally neutral environment.

The presence of lubricants, particularly nickel based lubricants, inhibits general corrosion by preventing the steel from contacting water and oxygen. As lubricants are removed, such as by sprays of water, this benefit may be reduced. In the valve bolting applications, lubricants may significantly delay or retard the degree of corrosive attack due to general corrosion.

Galvanic corrosion occurs when dissimilar metals are in contact with each other and are each simultaneously in contact with an electrolyte (fluid which conducts electrical current due to ion exchange). The chloride and sulfate concentrations in the reactor coolant are low (0.5 ppb and 1-2 ppb respectively) during operation and during shutdown. This prevents galvanic corrosion from being a problem, since low chloride and sulfate ion concentrations do not promote ion exchange in the electrolyte at the cathode and anode surfaces in a galvanic cell, which is necessary to complete the circuit in such a cell.

*Establishment of action levels

Corrective Action Levels:

The following corrective action levels are established to supplement the 0PT-80.1, RPV Hydrotest VT-2 leakage results for pressure retaining bolted connections.

1.) For leakage greater than 120 drops per minute:
Take corrective action to reduce leakage. This may include retorque of bolting.
Evaluate the bolted connection for structural integrity, or remove the bolt and perform a VT-1 examination as directed in the Inspection Guidelines.

2.) For leakage equal to or less than 120 drops per minute, but greater than 30 drops per minute:
Corrective action should be taken to reduce leakage. This may include retorque of bolting.
Acceptable risk for continued operation. Expected to seal during normal plant heat up and be acceptable for the current operating cycle.

3.) For leakage less than 30 drops per minute:
Acceptable risk for continued operation. Expected to seal during normal plant heat up and be acceptable for the current operating cycle.

Exempt: All non pressure retaining bolted connections which are designed to leak such as mechanical packing or seals are exempted from these examination requirements and require no further action. Economic issues rather than technical ones are employed by management to evaluate the need to correct these leakage sources. Refer specific recommendations to the Outage Management Team.

*Establishment of inspection criteria
The inspection guidelines listed below should be followed in the sequence specified, and documented on an Attachment 5 "0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet"for each pressure retaining bolted connection leak. Upon completion the Reviewer shall sign and date the evaluation for final review and approval of this ESR. The Reviewer shall be a currently qualified System or Component Engineer familiar with the component being evaluated.

Inspection Guidelines:

1. Verify that a pressure retaining bolted connection is leaking in accordance with the RPV Leakage Test 0PT-80.1 data sheets.

2. Is it a mechanical seal, packing or other joint designed to leak as a function of wear, or other non pressure retaining bolted connection? These are exempted from further evaluation, and no further action is required.

3. Refer to the Corrective Action Level guidelines and perform the applicable recommendations for sealing.

4. Request QC to perform a General Visual Inspection of the AS FOUND condition for each bolted connection. Document the inspection on the form in Attachment 4.

5. If the General Visual Inspection results are acceptable, then the pressure retaining bolt is qualified for continued service.

6. If the General Visual Inspection identifies unacceptable indications, one of the following actions must be taken:

Attachment 1: ASME TABLE IWB 2500-1, Examination B-G-1
ASME TABLE IWB 2500-1, Examination B-G-2
ASME TABLE IWB 2500-1, Examination B-P

Attachment 2: Leakage results from ESR's 96-00208 and 97-00486

Attachment 3: Memo to Jerry Crider from Ray Acomb, ANII dated 5May99, Section XI - - 5250

Attachment 4: General Visual Inspection Data Sheet for ASME Class 1 Bolted Connections

Attachment 5: 0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-G-1, PRESSURE RETAINING BOLTING, GREATER THAN 2 in. IN DIAMETER

Item No.	Parts Examined[1]	Examination Requirements/ Fig. No.	Examination Method	Acceptance Standard	Extent and Frequency of Examination: 1st Inspection Interval[2,3]	Extent and Frequency of Examination: Successive Inspection Intervals, 2nd, 3rd, 4th[2,3]	Deferral of Inspection to End of Interval[5]
	Reactor Vessel				All bolts, studs, nuts, bushings, threads in flange stud holes	Same as for 1st interval	
B6.10	Closure Head Nuts	*	Surface	*			Not permissible
B6.20	Closure Studs, in place	IWB-2500-12	Volumetric	IWB-3515			Not permissible
B6.30	Closure Studs, when removed	IWB-2500-12	Surface and volumetric	IWB-3515			Permissible
B6.40	Threads in Flange	IWB-2500-12	Volumetric	IWB-3515			Not permissible
B6.50	Closure Washers, Bushings	Surfaces	Visual, VT-1	IWB-3517			Not permissible
	Pressurizer				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.60	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.70	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.80	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			
	Steam Generators				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.90	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.100	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.110	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			
	Heat Exchangers				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.120	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.130	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.140	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			

NOTES:
See Notes at end of Examination Category B-G-1.
*In course of preparation.

ATTACHMENT 1

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TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-G-1, PRESSURE RETAINING BOLTING, GREATER THAN 2 in IN DIAMETER (CONT'D)

Item No.	Parts Examined[1]	Examination Requirements/ Fig. No.	Examination Method	Acceptance Standard	Extent and Frequency of Examination: 1st Inspection Interval[2,3]	Extent and Frequency of Examination: Successive Inspection Intervals, 2nd, 3rd, 4th[2,3]	Deferral of Inspection to End of Interval[5]
	Piping				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.150	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.160	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.170	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			
	Pumps				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.180	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.190	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.200	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			
	Valves				All bolts, studs, nuts, bushings, and flange surfaces	Same as for 1st interval	Not permissible
B6.210	Bolts and Studs	IWB-2500-12	Volumetric	IWB-3515			
B6.220	Flange Surface,[4] when connection disassembled	Surfaces	Visual, VT-1	IWB-3517			
B6.230	Nuts, Bushings, and Washers	Surfaces	Visual, VT-1	IWB-3517			

NOTES:

(1) Bolting may be examined:
  (a) in place under tension;
  (b) when the connection is disassembled;
  (c) when the bolting is removed.

(2) Bushings and threads in base material of flanges are required to be examined only when the connections are disassembled. Bushings may be inspected in place.

(3) For heat exchangers, piping, pumps, and valves, examinations are limited to components selected for examination under Examination Categories B-B, B-J, B-L-2, and B-M-2.

(4) Examination includes 1 in. annular surface of flange surrounding each stud.

(5) Deferral of the inspection is permissible except when the detected leakage of borated water requires a visual VT-1 in accordance with IWA-5250(a)(2).

ATTACHMENT 1

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TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-G-2, PRESSURE RETAINING BOLTING, 2 in. AND LESS IN DIAMETER

Item No.	Parts Examined[1]	Examination Requirements/ Fig. No.	Examination Method	Acceptance Standard	Extent and Frequency of Examination: 1st Inspection Interval[2]	Extent and Frequency of Examination: Successive Inspection Intervals, 2nd, 3rd, 4th[2]	Deferral of Inspection to End of Interval
	Reactor Vessel						
B7.10	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Pressurizer						
B7.20	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Steam Generators						
B7.30	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Heat Exchangers						
B7.40	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Piping						
B7.50	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Pumps						
B7.60	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	Valves						
B7.70	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	All bolts, studs, and nuts	Same as for 1st interval	Not permissible
	CRD Housings						
B7.80	Bolts, Studs, and Nuts	Surface	Visual, VT-1	IWB-3517	Bolts, studs, and nuts in CRD housing when disassembled	Same as for 1st interval	Not permissible

NOTES:
(1) Bolting may be examined:
(a) in place under tension;
(b) when the connection is disassembled;
(c) when the bolting is removed.
(2) For heat exchangers, piping, pumps, and valves, examinations are limited to components selected for examination under Examination Categories B-B, B-J, B-L-2, and B-M-2.

ATTACHMENT 1

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TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-H, INTEGRAL ATTACHMENTS FOR VESSELS

Item No.	Parts Examined[1]	Examination Requirements/ Fig. No.	Examination Method	Acceptance Standard	Extent and Frequency of Examination: 1st and 3rd Inspection Intervals of Inspection Program A	Extent and Frequency of Examination: 1st and 2nd Inspection Intervals of Inspection Program B	Deferral of Inspection to End of Interval
	Reactor Vessel						
B8.10	Integrally Welded Attachments	IWB-2500-13, -14, and -15	Volumetric[4] or surface, as applicable	IWB-3516	Weld[2]	Weld[2]	Not permissible
	Pressurizer						
B8.20	Integrally Welded Attachments	IWB-2500-13, -14, and -15	Volumetric[4] or surface, as applicable	IWB-3516	Weld[2]	Weld[2]	Not permissible
	Steam Generator						
B8.30	Integrally Welded Attachments	IWB-2500-13, -14, and -15	Volumetric[4] or surface, as applicable	IWB-3516	Weld[2] in one generator support[3]	Weld[2] in one generator support[3]	Not permissible
	Heat Exchangers						
B8.40	Integrally Welded Attachments	IWB-2500-13, -14, and -15	Volumetric[4] or surface, as applicable	IWB-3516	Weld[2] in one heat exchanger support[3]	Weld[2] in one heat exchanger support[3]	Not permissible

NOTES:

(1) Weld buildup on nozzles that is in compression under normal conditions and provides only component support is excluded from examination. Examination is limited to those integrally welded attachments that meet the following conditions:

(a) the attachment is on the outside surface of the pressure retaining component;

(b) the attachment provides component support as defined in NF-1110;

(c) the attachment base material design thickness is 5/8 in. or greater; and

(d) the attachment weld joins the attachment either directly to the surface of the vessel or to an integrally cast or forged attachment to the vessel.

(2) The extent of the examination includes essentially 100% of the length of the attachment weld at each attachment subject to examination.

(3) In case of multiple vessels of similar design, size, and service, the examination is limited to the attachment welds of one vessel.

(4) For the configuration shown in Fig. IWB-2500-14, a volumetric examination of volume A-B-C-D from one side (B-C) of the circumferential weld may be performed in lieu of the surface examination.

ATTACHMENT 1

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TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-P, ALL PRESSURE RETAINING COMPONENTS

Item No.	Parts Examined	Test Requirements[3]	Examination Method[4]	Acceptance Standard	Extent and Frequency of Examination: 1st Inspection Interval	Extent and Frequency of Examination: Successive Inspection Intervals, 2nd, 3rd, 4th	Deferral of Inspection to End of Interval
	Reactor Vessel						
B15.10	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.11	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible
	Pressurizer						
B15.20	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.21	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible
	Steam Generators						
B15.30	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.31	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible
	Heat Exchangers						
B15.40	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.41	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible

NOTES:
See Notes at end of Examination Category B-P.

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TABLE IWB-2500-1 (CONT'D)
EXAMINATION CATEGORIES

EXAMINATION CATEGORY B-P, ALL PRESSURE RETAINING COMPONENTS (CONT'D)

Item No.	Parts Examined	Test Requirements[3]	Examination Method[4]	Acceptance Standard	Extent and Frequency of Examination: 1st Inspection Interval	Extent and Frequency of Examination: Successive Inspection Intervals, 2nd, 3rd, 4th	Deferral of Inspection to End of Interval
	Piping						
B15.50	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.51	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible
	Pumps						
B15.60	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.61	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible
	Valves						
B15.70	Pressure Retaining Boundary	System leakage test[1,7] (IWB-5221)	Visual, VT-2	IWB-3522	Each refueling outage[5]	Each refueling outage[5]	Not permissible
B15.71	Pressure Retaining Boundary	System hydrostatic test[2] (IWB-5222)	Visual, VT-2	IWB-3522	One test[6]	One test per interval[6]	Permissible

NOTES:

(1) The pressure retaining boundary during the system leakage test shall correspond to the reactor coolant system boundary, with all valves in the normal position, which is required for normal reactor operation startup. The VT-2 examination shall, however, extend to and include the second closed valve at the boundary extremity.

(2) The pressure retaining boundary during the system hydrostatic test shall include all Class 1 components within the system boundary.

(3) System pressure tests of the reactor coolant system shall be conducted in accordance with IWA-5000. System pressure tests for repaired, replaced, or altered components shall be governed by IWA-5214(c).

(4) Visual examination of IWA-5240.

(5) The system leakage test (IWB-5221) shall be conducted prior to plant startup following each reactor refueling outage.

(6) The system hydrostatic test (IWB-5222) shall be conducted at or near the end of each inspection interval.

(7) A system hydrostatic test (IWB-5222) and the accompanying VT-2 examination are acceptable in lieu of the system leakage test (IWB-5221) and VT-2 examination.

UNIT-2

ATTACHMENT 2

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COMPONENT	NATURE OF LEAK	LEAKAGE RATE	CORRECTIVE ACTION
2-E21-V27	Packing leak.	60 dpm	Corrected by Maintenance.
2-B21-744-¾-603	Through wall.		WR/JO 96-ACPB1 *
2-B21-F005	Packing leak.	80 dpm	Corrected by Maintenance.
2-B21-F011A	Packing leak.	80 dpm	WR/JO 96-ACGH1 *
2-E11-F009	Packing leak.	50 dpm	Corrected by Maintenance.
2-B21-F019	Packing leak.	25 dpm	Corrected by Maintenance.
2-B21-F028B	Packing leak.	50 dpm	Corrected by Maintenance.
2-B21-F028C	Packing leak.	10 dpm	Corrected by Maintenance.
2-B21-F028D	Packing leak.	20 dpm	Corrected by Maintenance.
2-B32-F044B	Body/bonnet leak.	5 dpm	Heatup.
2-E41-F002	Packing leak.	20 dpm	Corrected by Maintenance.
2-B32-F043A	Packing leak.	5 dpm	Heatup.
2-B32-F031B	Packing leak. Body/bonnet leak.	5 dpm Steady stream.	Heatup. WR/JO 96-ACJT1 (Heatup)
2-B32-F025A	Packing leak.	30 dpm	Corrected by Maintenance.
2-B32-F023B	Body/bonnet leak.	Steady stream.	Heatup.
2-B32-F032A	Packing leak.	3 dpm	Heatup.
2-E11-F015B	Packing leak.	2 dpm	Acceptable.
2-B21-V55	Packing leak.	1 dpm	Heatup.
2-B11-CRD(18-31)	Flange leak.	5 dpm	Heatup.
2-B11-CRD(22-23)	Flange leak.	3 dpm	Heatup.
2-B11-CRD(42-19)	Flange leak.	60 dpm	Acceptable Risk that heatup will seal leakage based on previous operating experience
2-B11-CRD(34-39)	Flange leak.	60 dpm	Acceptable Risk that heatup will seal leakage based on previous operating experience
2-B11-CRD(50-31)	Flange leak.	40 dpm	Acceptable Risk that heatup will seal leakagebased on previous operating experience
2-B11-CRD(02-35)	Flange leak.	60 dpm	Acceptable Risk that heatup will seal leakagebased on previous operating experience
2-B11-CRD(10-15)	Flange leak.	60 dpm	Acceptable Risk that heatup will seal leakagebased on previous operationg experience
2-B11-CRD(22-03)	Flange leak.	60 dpm	Acceptable Risk that heatup will seal leakage based on previous operating experience
2-B11-CRD(14-47)	Flange leak.	8 dpm	Heatup.

* RECOMMENDED PRIOR TO STARTUP

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LEAKAGE RESULTS OUTSIDE DRYWELL

COMPONENT	NATURE OF LEAK	LEAKAGE RATE	CORRECTIVE ACTION
2-E21-F005B	Packing	40 dpm	Adjust packing (97-AGSK1)*
2-E11-F017A	Packing	47 dpm	Adjust packing (97-AGRM1)*
2-E41-V176	Packing	1 dpm	Heatup
2-E11-F008	Packing	1 dpm	Adjusted packing (97-AGRP1)
2-E11-V103	Packing	1 dpm	Heatup
2-B21-V169	Packing	2 dpm	Toolpouch work (ADM-NGGC-104)*
2-B21-F042	Packing	<1 dpm	Heatup
2-E21-F005A	Packing	10 dpm	Adjust packing (97-AGSJ1)*
2-E21-F004A	Packing	60 dpm	Adjust packing (97-AGSI1)*
2-B21-V49	Packing	1 dpm	Heatup
2-B21-V50	Packing	1 dpm	Heatup
2-B21-V51	Packing	1 dpm	Heatup
2-B21-V45	Packing	1 dpm	Heatup
2-B21-F028A	Packing	10 dpm	Heatup
2-B21-F028B	Packing	3 dpm	Heatup
2-B21-F028B	Body / Bonnet	3 dpm	Heatup
2-B21-F028C	Body / Bonnet	3 dpm	Heatup
2-B21-F028D	Packing	10 dpm	Heatup
2-C12-V101/V102(xx-yy)	Packing	Total of 38 leaks noted, all ≤2 dpm	Heatup, repair via Toolpouch work on-line if necessary
2-C12-F101(10-31)	Plug	20 dpm	Repair (97-AGRX1)*
2-C12-F101(10-19)	Plug	60 dpm	Repair (97-AGRY1)*
2-C12-F101(18-19)	Plug	20 dpm	Repair (97-AGRZ1)*
2-C12-F101(10-39)	Plug	20 dpm	Repair (97-AGSA1)*
2-C12-F101(46-11)	Plug	80 dpm	Repair (97-AGSB1)*
2-C12-F101(30-23)	Plug	2 dpm	Repair (97-AGSC1)*
2-C12-F102(18-07)	Plug	20 dpm	Repair (97-AGSD1)*
2-C12-F102(22-07)	Plug	20 dpm	Repair (97-AGSE1)*
2-C12-F102(14-31)	Plug	20 dpm	Repair (97-AGSA1)*
2-C12-F102(14-11)	Plug	20 dpm	Repair (97-AGSA1)*
2-B21-V10	Packing	1 dpm	Heatup
2-C12-F102(06-15)	Plug	20 dpm	Repair (97-AGSA1)*

*= Recommended prior to Unit 2 startup.

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LEAKAGE RESULTS INSIDE DRYWELL

COMPONENT	NATURE OF LEAK	LEAKAGE RATE	CORRECTIVE ACTION
2-E41-F002	Packing	1/16" stream	Adjusted packing (97-AGRQ1)
B11-CRD (06-23)	Flange	30 dpm	Acceptable risk that heatup will seal leakage based on previous operating experience.
B11-CRD (02-35)	Flange	50 dpm	Acceptable risk that heatup will seal leakage based on previous operating experience.
B11-CRD (06-19)	Flange	20 dpm	Acceptable risk that heatup will seal leakage based on previous operating experience.
B11-CRD (34-39)	Flange	Steady stream (<150 dpm)	Flange bolt torque checked. Indication of some leakage found at pipe connection. Acceptable risk that heatup will seal o-ring leakage based on previous operating experience.
2-B32-F023B	Body / Bonnet	1/8" stream	Heatup
2-B32-F031B	Body / Bonnet	1/8" stream	Heatup
2-B32-V39	Packing	1 dpm	Heatup
2-B32-V38	Packing	1 dpm	Fixed
2-B21-F011A	Packing	40 dpm	Toolpouch work (ADM-NGGC-104)*
2-B32-F043A	Packing	60 dpm	Toolpouch work (ADM-NGGC-104)*
2-E21-V40	Packing	1 dpm	Heatup
2-E21-V25	Packing	1 dpm	Heatup
2-E21-V26	Packing	5 dpm	Toolpouch work (ADM-NGGC-104)*
2-E21-V27	Packing	5 dpm	Toolpouch work (ADM-NGGC-104)*
2-E21-V28	Packing	5 dpm	Toolpouch work (ADM-NGGC-104)*
2-B21-F022C	Packing	12 dpm	Heatup
RCR Bypass Cleanout Flange	Flange leak	1/8" stream	Repair (97-AGRU1)*

* = Recommended prior to Unit 2 startup.

Memo

To: Jerry Crider

From: Ray Acomb -- ANII

CC: L. Wheatley

Insp. File

Date: May 5, 1999

Re: Section XI -- IWA - 5250

Jerry :

Per a discussion with H. S. B.'s Home Office Engineering and RSES E. L. Farrow, it's our position that a packing gland does not constitute a bolted connection. Therefore if leakage is detected from a packing gland during a system pressure test the requirements of IWA -- 5250 do not apply.

Please contact me if I can be of further assistance.

Ray Acomb -- ANII

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: ________________________ Exam Date: ____________

Exam Method: ☐ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☐ NO degradation noted.

☐ Localized general corrosion that appears to have reduce the bolt or stud cross-sectional by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

____

____

____

____

____

QC Examiner: ________________________________ Date: ____________________

ATTACHMENT 5
0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

Refueling outage: B214R1 Date: 12MAY99 0PT-80.1 Attachment 1, Figure 10, Page 54

1. Location and description of Bolted Connection Leakage:
   2-B32-F031A, Recirc Loop A Discharge Valve; RB2, EL014, DW Az 111
   The valve was observed leaking less than 1 Drop per minute at the body to bonnet bolted connection.
   (See attached the General Visual Examination Data Sheet)
2. Other References (P&ID, system drawings, vendor foreign prints etc):
   C-02409 (shs 00019-1 and 0020-1), Tech Manual FP-50274, DBD-02, D-02548 sh0002B, D-02548 sh002A, 1/2 FP-5363, D-02518 (sh0001A and 0001B)
3. The number and service age of the bolts :
   28 studs and nuts greater than 10 years old
4. Bolt and component material :
   Body to bonnet studs A193 grade B7
   Bonnet nuts A194 grade 8
5. Corrosiveness of the process fluid that is leaking:
   The corrosiveness of the reactor coolant is described in the Evaluation section of ESR 99-00279.
6. System function of the leaking bolted connection:
   Recirc discharge valves close to isolate the loop on a LOCA ECCS signal to prevent LPCI flow diversion, pressure retaining boundary, isolation for pump and valve maintenance.
7. Leakage history at the connection or other system components:
   2-B32-F031B body to bonnet leak the last two hydros. There was no leakage for the 2-B32-F031A during the last two cycles identified.

Evaluation:

Inspection results indicate only light corrosion on the studs for the body to bonnet leak identified. The one drop per minute leakage identified for this bolted connection during the RPV leakage test is insignificant and will seal up during the plant heatup and operations as has been shown for other similar valves located in the Drywell on the recirc system. No corrective action is required for this condition.

Joint integrity is acceptable for this connection based on the following:

- *No significant corrosion or other degradation of the bolting was observed.*
- *Plant experience with this bolting and flange material on primary system connections confirms that significant degradation will not occur with minor leakage.*
- *Plant operational history indicates that leakage will be reduced or eliminated during plant heatup.*
- *General corrosion rates are very low for this bolting material when exposed to reactor coolant.*
- *Plant and industry experience with this bolting material in BWR service confirms that service age is not a significant factor in degradation.*

Accordingly, no further evaluation is warranted.

Reviewer: ________ Date: 5/13/99

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: 2B32-F031A Exam Date: 5-12-99

Exam Method: ☒ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☑ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

VALVE WAS WEEPING AT BONNETT TO BODY, LESS THAN ONE DROP PER MINUTE. LIGHT RUST ON STUDS.

QC Examiner: [signature] Date: 5-12-99

0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

Refueling outage: B214R1 Date: 12MAY99 0PT-80.1 Attachment 1, Figure 4 page 7

1. Location and description of Bolted Connection Leakage:
   2-B32-F031B, Recirc Loop B, Discharge Valve; RB2, El 015, DW Az 291
   The valve was observed leaking 120 drops per minute from the body to bonnet bolted connection.
   (See attached the General Visual Examination Data Sheet)
2. Other References (P&ID, system drawings, vendor foreign prints etc):
   C-02409 (shs 00019-1 and 0020-1), Tech Manual FP-50274, DBD-02, D-02548 sh0002B, D-02548 sh002A, 1/2 FP-5363, D-02518 (sh0001A and 0001B)
3. The number and service age of the bolts
   28 studs and nuts greater than 10 years old
4. Bolt and component material
   Body to bonnet studs A193 grade B7
   Bonnet nuts A194 grade 8
5. Corrosiveness of the process fluid that is leaking:
   The corrosiveness of the reactor coolant is described in the Evaluation section of ESR 99-00279.
6. System function of the leaking bolted connection
   Recirc discharge valves close to isolate the loop on a LOCA ECCS signal to prevent LPCI flow diversion, pressure retaining boundary, isolation for pump and valve maintenance
7. Leakage history at the connection or other system components
   2-B32-F031B body to bonnet leak the last two hydros.

Evaluation:

The 2-B32-F031B valve was observed leaking 120 drops per minute during the RPV leakage test. The bolted connection General Visual Inspection data sheet found a light corrosion on the studs, and no degradation was noted. This valve historically has seen a steady 1/8 inch stream of leakage during the last two leakage tests, and has been visually inspected during heatup to seal for normal plant operation. Historical retorquing of the body to bonnet bolts for this valve has not reduced the leakage. With the emergent work associated with the body to bonnet bolted connection on the 2-B32-F023B Recirc Suction Valve of the same Anchor Darling pattern during this B214R1 outage, WR/JO 99-ADKA1 was initiated to work this valve during the next refueling outage B215R1. This will provide sufficient time to develop a detailed work plan in a high dose area in the drywell. No corrective actions are required at this time.

Joint integrity is acceptable for this connection based on the following:

- *No significant corrosion or other degradation of the bolting was observed.*
- *Plant experience with this bolting and flange material on primary system connections confirms that significant degradation will not occur with minor leakage.*
- *Plant operational history indicates that leakage will be reduced or eliminated during plant heatup.*
- *General corrosion rates are very low for this bolting material when exposed to reactor coolant.*
- *Plant and industry experience with this bolting material in BWR service confirms that service age is not a significant factor in degradation.*

Accordingly, no further evaluation is warranted.

Reviewer: [signature] Date: 5/13/99

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VISUAL EXAMINATION DATA SHEET

Component: 2B32-F031B Exam Date: 5-12-99

Exam Method: [x] Direct [ ] Remote

NOTE: For all bolted connections with identified leakage, a general visual examination SHALL be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

[x] NO degradation noted.

[ ] Localized general corrosion that appears to have reduce the bolt or stud cross-sectional by more than 5 percent.

[ ] Bending, twisting, or deformation of bolts or studs.

[ ] Missing bolts, studs, or nuts.

[ ] Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

LIGHT CORROSION ON STUDS.

John Campbell
QC
5-12-99

[signature]
QC
5-12-99

ATTACHMENT 5

0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

Refueling outage: B214R1 Date: 12MAY99 0PT-80.1 Attachment 1, Figure 4, page 7

1. Location and description of Bolted Connection Leakage:
   2-B32-F044B, Recirc Pump 2B Equalizer Bypass Valve; RB2, El 035, DW Az 197
   The valve was observed to leak 4 drop per minute at the body to bonnet bolted connection
   (See attach the General Visual Examination Data Sheet)

2. Other References (P&ID, system drawings, vendor foreign prints etc):
   D-02548 sh002A

3. The number and service age of the bolts
   8 studs and nuts greater than 10 years old

4. Bolt and component material
   Body to bonnet studs A193 grade B7
   Bonnet nuts A194 grade 8

5. Corrosiveness of the process fluid that is leaking:
   The corrosiveness of the reactor coolant is described in the Evaluation section of ESR 99-00279.

6. System function of the leaking bolted connection
   Valve is closed and no longer used for plant manipulation. Pressure retaining boundary

7. Leakage history at the connection or other system components
   Body to bonnet leak the B212R1 hydros.

Evaluation:

Inspection results indicate only light corrosion on the studs for the body to bonnet leak identified. The four drop per minute leakage identified for this bolted connection during the RPV leakage test is insignificant and will seal up during the plant heatup and operations as has been shown for other similar valves located in the Drywell on the recirc system. No corrective action is required for this condition.

Joint integrity is acceptable for this connection based on the following:

- *No significant corrosion or other degradation of the bolting was observed.*
- *Plant experience with this bolting and flange material on primary system connections confirms that significant degradation will not occur with minor leakage.*
- *Plant operational history indicates that leakage will be reduced or eliminated during plant heatup.*
- *General corrosion rates are very low for this bolting material when exposed to reactor coolant.*
- *Plant and industry experience with this bolting material in BWR service confirms that service age is not a significant factor in degradation.*

Accordingly, no further evaluation is warranted.

Reviewer: [signature] Date: 5/13/99

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: 2-B32-F044B Exam Date: 5/12/99

Exam Method: ☑ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☑ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

Body to bonnet flange leak @ 4 dpm.

QC Examiner: Thomas A. [signature] Date: 5/12/99

ATTACHMENT 5

0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

Refueling outage: B214R1 Date: 12MAY99 0PT-80.1 Attachment 1, Figure (A) 21, page 26
(B) 25 page 30
(C), 29 page 34

1. Location and description of Bolted Connection Leakage:
   2-B21-F028A, Main Steam Outboard Isolation Valve, RB2, El 020, WW L/21R, 2DPM
   2-B21-F028B, Main Steam Outboard Isolation Valve, RB2, El 020, WW L/21R, 2 DPM
   2-B21-F028C, Main Steam Outboard Isolation Valve, RB2, El 020, WW L/21R, 10 DPM
   These valves were observed leaking from the body to bonnet connections
   (See attached the General Visual Examination Data Sheets)

2. Other References (P&ID, system drawings, vendor foreign prints etc):
   1/2 FP-55013 sh013, FP-50554, DBD-25, 0FP-05101

3. The number and service age of the bolts
   20 studs and nuts required. No studs or nuts changed in last 3 years

4. Bolt and component material
   Body to bonnet studs ASTM-540 grade B23
   Body to bonnet nuts ASTM-194 grade 7

5. Corrosiveness of the process fluid that is leaking:
   The corrosiveness of the reactor coolant is described in the Evaluation section of ESR 99-00279.

6. System function of the leaking bolted connection
   MSIVs fail closed with a variety of primary containment isolation signals. Pressure retaining boundary.

7. Leakage history at the connection or other system components
   2-B21-F028B, and 2-B21-F028C were observed leaking B213R1.

Evaluation:

Inspection results indicate only light corrosion on the studs for the body to bonnet leak identified. The three observed leaks, with rates from two to ten drops per minute, identified for these bolted connections during the RPV leakage test is insignificant and will seal up during the plant heatup and operations as has been shown previously by plant history. The valves are located in the MSIV pit which is an enclosure which has limited air flows during operation and is subject to high ambient temperatures as a result of the waste heat from the main steam lines passing through the pit from the reactor vessel to the turbine building. No corrective action is required for this condition.

Joint integrity is acceptable for this connection based on the following:

- *No significant corrosion or other degradation of the bolting was observed.*
- *Plant experience with this bolting and flange material on primary system connections confirms that significant degradation will not occur with minor leakage.*
- *Plant operational history indicates that leakage will be reduced or eliminated during plant heatup.*
- *General corrosion rates are very low for this bolting material when exposed to reactor coolant.*
- *Plant and industry experience with this bolting material in BWR service confirms that service age is not a significant factor in degradation.*

Accordingly, no further evaluation is warranted.

Reviewer: BStanley Kenneth R Woodard KENNETH R. WOODARD Date: 13 may 99

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: F028A Exam Date: 5-12-99

Exam Method: ☒ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☐ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

Light Rust on Bolting and Flange of Body To Bonnet
leaking at Bottom 180° - 6" of Bottom Flange AREA
covered with Insulation

QC Examiner: [signature] Date: 5-12-99

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: F028B Exam Date: 5-12-99

Exam Method: ☒ Direct ☐ Remote

NOTE. For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☐ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

Light Rust on Bolting and Flange of Body to Bonnet - leaking at Bottom 180° -

QC Examiner: [signature] Date: 5-12-99

Attachment 4

VISUAL EXAMINATION DATA SHFET

Component: F028C Exam Date: 5-12-99

Exam Method: ☒ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☐ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

Light Rust on Bolting and Flange of Body To Bonnet – leaking 270° around Flange – Bottom 6" of Flange Has Insulation on

QC Examiner: [signature] Date: 5-12-99

ATTACHMENT 5

0PT-80.1 RPV Leakage Test Bolted Connection Leakage Evaluation Data Sheet

Refueling outage: B214R1 Date: 12MAY99 0PT-80.1 Attachment , Figure 58, Page 73 and 74

1. Location and description of Bolted Connection Leakage:
   2-B11-CRD(02-19), Control Rod Drive Assembly, RB2, El 023, DW Az 000, 100 DPM
   2-B11-CRD(06-23), Control Rod Drive Assembly, RB2, El 023, DW Az 000, 4 DPM
   2-B11-CRD(06-35), Control Rod Drive Assembly, RB2, El 023, DW Az 000, 4 DPM
   2-B11-CRD(14-47), Control Rod Drive Assembly, RB2, El 023, DW Az 000, 15 DPM
   2-B11-CRD(26-07), Control Rod Drive Assembly, RB2, El 023, DW Az 000, 15 DPM

   (See attached General Visual Examination Data Sheet)

2. Other References (P&ID, system drawings, vendor foreign prints etc):
   RICSIL No, 019, SIL 483 rev 1 and 2, GE Dwg 36242107A, FP-05920, DBD-08, EER 91-0324, EER 90-0059, SEEF 94-009, GE Memo dated 3AUG93 Control Rod Drive Flange Leakage Guidelines

3. The number and service age of the bolts
   8 cap screws required. All cap screws replaced between 1991 and 1993. Cap screws are replaced every time the CRD mechanism is replaced or rebuilt.

   2-B11-CRD(02-19) and 2-B11-CRD(06-23) were replaced in 1997 with AISI-4340 bolting material.

4. Bolt and component material
   Cap screws were SA-193 Grade B7 (AISI 4140 steel) as originally supplied by GE. Per EER 91-0324, U2 CRD Flange Bolt Evaluation, all original cap screws were replaced with new original bolting material. SEEF 94-0009 approved use of ASTM-540 grade B23 (AISI-4340) bolting material as equivalent on 21Feb94. Greater than 50% of the cap screws have been replaced with the improved corrosion resistant material since then. There are no nuts installed in this designed use of cap screws. The fasteners thread directly into the reactor Vessel CRD flange housings in a blind threaded hole.

5. Corrosiveness of the process fluid that is leaking:
   The corrosiveness of the reactor coolant is described in the Evaluation section of ESR 99-00279.

6. System function of the leaking bolted connection
   Insert and withdrawal of the control rod blades for reactivity control. Pressure retaining boundary.

7. Leakage history at the connection or other system components
   Typically, there are several CRD assemblies which exhibit leakage during each hydrotest.
   2-B11-CRD(06-23) leaked 30 DPM during the B213R1 outage as compared to 4 DPM this outage. 2-B11-CRD(14-47) leaked 8 DPM during the B212R1 outage, did not leak during B214R1 and leaked 4 DPM this outage. The other CRD's found leaking did not exhibit leakage during the last two refueling outages.

Evaluation:

In the late 1980's, GE observed a cap screw susceptibility to stress corrosion of the CRD bolting. The original material was upgraded to a high strength more stress corrosion resistant material by GE SIL 483 revisions 1 and 2. CP&L replaced all the original bolting with new original bolting material between 1991 and 1993, and performed a VT-1 examination for each bolt installed. Since 1994 we have replaced cap screws with the new upgraded material each time that a CRD assembly is removed for replacement. Currently there are greater than 50% of the cap screws which have been upgraded to the new material. Between 1989 and 1991 three evaluations on CRD bolting were performed by the HE&EC to evaluate pitting and stress corrosion cracking on cap screws which had been in service in Unit 2 for 16+ years. They found that the tensile testing results indicated that the pitting and stress corrosion did not significantly affect the tensile strength of the bolting, and that the transition zone between the bolt head and shank was the area of greatest susceptibility to corrosion and pitting.

The CRD's routinely exhibit leaking flange connections during the RPV hydrotest performed each refueling outage. CP&L has established guidelines which follow the general guidance specified in the GE Memo dated 3Aug93 for system manipulations to reduce leakage flow to less than 30 drops per minute. Historical inspections have verified that during plant startup/ heatup to normal operating conditions the CRD flange leaks seal up.

The General Visual Inspection performed per this ESR to identify bolted connection leakage is limited to only the top of the CRD cap screw since the CRD assembly is fastened to the RPV guidetube flange using blind threaded holes. Inspection of the cap screw transition zone between the head and the shank of the bolt which is the most sensitive to pitting and corrosion cannot be performed unless the cap screw is removed. The General Visual Inspection preformed indicated no degradation noted.

Summary:
Based on a minimum previously evaluated service life of 16+ years, and work practices which routinely replace the cap screws with new corrosion resistant bolting since 1994, the probability of bolted connection failure resulting in equipment damage is very low. Historical verification has confirmed that leaks less than 30 drops per minute will seal up during startup/ heatup of the plant. The CRD was not found to exhibit significant corrosion when the General Visual Inspection was performed.

Joint integrity is acceptable for this connection based on the following:

- *No significant corrosion or other degradation of the bolting was observed.*
- *Plant experience with this bolting and flange material on primary system connections confirms that significant degradation will not occur with minor leakage.*
- *Plant operational history indicates that leakage will be reduced or eliminated during plant heatup.*
- *General corrosion rates are very low for this bolting material when exposed to reactor coolant.*
- *Plant and industry experience with this bolting material in BWR service confirms that service age is not a significant factor in degradation.*

Accordingly, no further evaluation is warranted.

Reviewer: John A. Hamilton Date: 5/13/99

Attachment 4

VISUAL EXAMINATION DATA SHEET

Component: CRD * Exam Date: 5-12-99

Exam Method: ☑ Direct ☐ Remote

NOTE: For all bolted connections with identified leakage, a general visual examination **SHALL** be performed either DIRECTLY or REMOTELY with sufficient illumination (natural or artificial) and resolution (suitable for the local environmental conditions) using the examination attributes listed below.

Check, as applicable:

☑ NO degradation noted.

☐ Localized general corrosion that appears to have reduced the bolt or stud cross-sectional area by more than 5 percent.

☐ Bending, twisting, or deformation of bolts or studs.

☐ Missing bolts, studs, or nuts.

☐ Other damage, deformation, or degradation that may be detrimental to the material condition of the bolted connections.

Remarks:

* B11-CRD-02-19
B11-CRD-06-23
B11-CRD-06-35
B11-CRD-14-47
B11-CRD-26-07

QC Examiner: Carmon B. Underwood Jr. Date: 5-12-99

FORM 2
Sheet 1 of 1
Generic ESR Comment Sheet

ESR No: 99-00279 **Revision: 0**
Reviewed by: Jerry W. Crider Organization: BESS

Item #	Comments	Resolution
1	Page 5, Design Inputs, Relief Request 17 - "June 1998" should be "May 1998". The requirements of the `89 Edition of Section XI when in effect May 11, 1998.	Revised
2	Page 6, Since we are not performing a VT-3 examination, why is IWA-2213 included in the ESR?	Describes original requirements for comparison.
3	Page 7, Evaluation - Should be clarified that CP&L's position is that RR#17 does not apply to non-pressure retaining bolted connections, such as packing gland. This position was discussed with the ANII and he agreed. The ANII concurrence is document in Attachment 3.	wording revised following discussion with Reviewer.
4	Corrective Action Level, 2) - Recommend changing "Retorque bolting…" to "Take corrective action to reduce leakage"	Revised
5	Inspection Guideline, 6) - Recommend rewording as follows "If the General Visual Examination identifies unacceptable indications, one of the following actions must be taken: 1) evaluate the degraded bolting for structural integrity for continued service OR 2) remove the degraded bolt closest to the source of leakage and perform a VT-1 examination of the bolting using the following attributes:…	Revised
6	Attachment 4, Add a line for the examiner to sign and date the data sheet.	Revised
7	Attachment 5, 1. - Change "Attach QC visual inspection report (VT-1)…" to " Attach the Visual Examination Data Sheet."	Revised

Comments have been satisfactorily resolved and incorporated in the ESR:
RE B Stanley Date 13 May 99

ATTACHMENT 2
Sheet 1 of 1
Record of Lead Review

Design ESR 9900279 Revision 0

The signature below of the Lead Reviewer records that:

- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☒ **Design Verification Review** ☐ **Engineering Review** ☐ **Owner Review**

☒ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☐ **Special Engineering Review** ______

☐ YES ☒ N/A **Other Records are attached.**

W. M. LANGLOIS — MECH — 5/14/99
Lead Reviewer (print/sign) **Discipline** **Date**

Item No.	Deficiency	Resolution/Date
1.	CORRECTIVE ACTION LEVEL 1.) NOT PER INSPECTION GUIDELINES OR RELIEF REQUEST: a. "EVALUATE FOR REPAIR OR REPLACEMENT, ..." SHOULD BE "PULL A BOLT FOR VT-1, ..."	INCORPORATED. 5/14/99
	b. DELETE "... AND SYSTEM SEES STEAM SERVICE".	
2.	ATTACHMENST 4+5. ESR BODY OR FORMS	
	SHOULD STATE WHO WILL COMPLETE THE FORMS + DO THE REVIEWS + WHAT ARE THEIR REQUIRED QUALIFICATIONS.	INCORPORATED. 5/14/99
3.	50.59 SCREEN: QUESTION 1.C. SHOULD BE CHECKED "YES". THEN FOLLOW INSTRUCTIONS ON FORM.	SER AVAILABLE BUT DOESN'T COVER REVIEW OF DATA. SER ATTACHED. + QUESTION 3 COMPLETED 5/14/99

FORM EGR-NGGC-0003-2-0