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MRP-227 Revision 1

Proposed Revisions to

PWR Reactor Internals

Inspection and Evaluation Guidelines

March 31, 2015

Rockville, MD

Benefits of MRP-227 Rev. 1

- Maintaining guidance current with lessons learned and research developments
- Enhancing nomenclature and detail of internal component sketches
- Adding specificity to coverage requirements/acceptability of limitations
- Incorporating latest WCAP requirements for guide card wear
- Addressing lower support clevis/snubber bolting/pin/wear concern/OE
- Incorporate generic acceptance guidance
- Addressing NRC SE A/LAIs
- Adding technical bases and associated exam scope specificity for Core Barrel welds
- Incorporating new CASS criteria (if available – pending NRC approval)

Background – NEI 03-08 Industry Initiative

- Industry's policy for managing materials issues
  - Provides the framework within which primary system materials degradation and aging management work will be performed
- Objective is to assure safe, reliable and efficient operation of U.S. nuclear power plants in management of materials issues
- Each licensee endorses, supports and meets intent of NEI 03-08, Guideline for the Management of Materials Issues.
- The purpose of the Initiative is to provide for:
  - a consistent management process
  - prioritization of materials issues
  - proactive "forward-looking" approaches
  - integrated and coordinated approaches to materials issues
- Each owner must have formal Program that meets the NEI 03-08 requirements

Implementation Process

- Issue Programs identified mandatory, needed and good practice elements
- Those elements are specified in Section 7 of MRP-227-A
- These will be implemented by all plants or deviations will be developed and NRC notified. (All deviations are CAP items)
- INPO verifies implementation
- NRC's SE identified conditions and A/LAIs
- Conditions on the guidance were addressed in the update to MRP-227 Rev.0 to produce "MRP-227-A"
- A/LAIs were not made part of the guidance and are therefore not part of NEI 03-08 implementation requirements
- Section 7 identifies NEI 03-08 implementation requirements

Development and Evolution of MRP-227

… *MRP-227 continues as a living document*

Early Beginning	MRP-227 Rev. 0	MRP-227 Rev. 0 SE	MRP-227-A	MRP-227 Rev. 1	MRP-227 Rev. 1 SE	MRP-227 Rev. 1-A	MRP-227 Rev. 2
• EPRI takes lead for industry • Extensive research • *13 meetings with NRC*	• December, 2008 • Numerous RAIs • *5 meetings with NRC*	• November 2011	• December 2011 • AMP Submittal RAIs • *9 meetings with NRC*	• Target Sept 2015 • *1st NRC meeting 10/2014*	• Target July, 2017	• Target Jan. 2018	• Target Dec. 2020 • More OE based • SLR addressed

- Four major stakeholders influenced development under NEI 03-08
  - Owners, NRC, EPRI, NSSS Vendors
- Extensive interaction among stakeholders during development
- Implementation began in 2009 and continues each outage season
- Results of inspections are consistent with expectations
- MRP-227 Revision 1 will be available in late 2015

Proposed Revisions to Westinghouse and Combustion Engineering Inspection Guidelines

Objectives for Revisions to Inspection Guidelines for Westinghouse and CE Internals

- Clarify Component Identifications
  - Nomenclature
  - Illustrations
- Rationalize Primary/Expansion Relationships
  - Focused core barrel inspections
  - Components added in SE
  - Eliminate linkages to Westinghouse CRGT Flange Weld
- Address and/or Eliminate A/LAIs
  - Applicability of guideline
  - Review of CASS susceptibility (Integrated weld/CASS program)
- Update CRGT Guide Card Inspection
- Incorporate OE and Lessons Learned

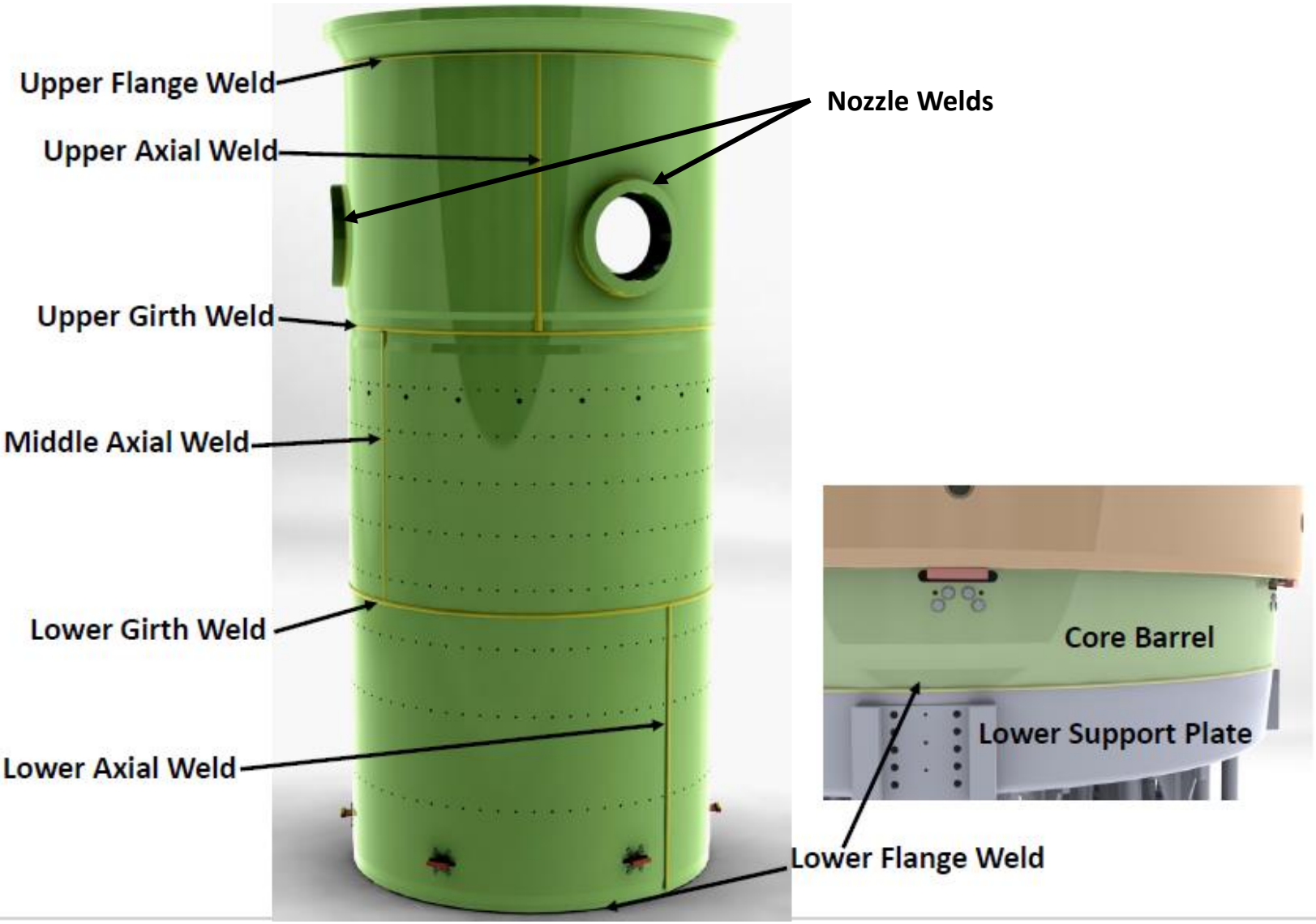
Integrated Strategy for Monitoring Degradation Mechanisms

- Irradiation Embrittlement (IE)
- Irradiation Assisted Stress Corrosion Cracking (IASCC)
- Void Swelling
- Stress Corrosion Cracking (SCC)
- Thermal Embrittlement of CASS Material (TE)
- Stress Relaxation (SR)
- Wear
- Fatigue

Westinghouse NSSS Core Barrel Weld Objectives for MRP-227 R1

1. Define standard nomenclature for welds in Westinghouse core barrel.
2. Eliminate inspection requirement for core barrel outlet nozzle welds.
3. Modify SCC linkage for core barrel welds with neutron fluences below IASCC threshold.
   - Propose upper flange weld as “Primary” inspection for SCC
   - Add inspections of other low fluence welds to “Expansion” list
4. Modify IASCC linkage for core barrel welds above the IASCC threshold
   - Propose lower girth weld as “Primary” inspection for IASCC
   - Add inspections of other high fluence welds to “Expansion” list
5. Establish weld specific coverage requirements.

Nomenclature for Westinghouse Core Barrel Welds



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Elimination of Core Barrel Nozzle Welds as Expansion Item

- Nozzle Welds
  - Do not support core
  - Not a full penetration weld
  - Low neutron exposure
  - Flaw tolerant
  - Remain subject to Section XI inspection

SCC Linkage - Westinghouse

- Primary Inspection of Upper Flange Weld
  - Originally proposed in Rev. 0
  - EVT-1 Sampling 25% Weld Length Based on Operating Experience
    - Reasonable inspection sample to address SCC safety concern
    - Diminishing safety gain of over-sampling
    - Any observation of core barrel SCC would trigger further action by both Plant and MRP
  - Accessible weld subject to VT-3 ASME XI inspection
- Expansion Inspections
  - 75% EVT-1 sampling based on primary inspection observations
    - Upper Axial Weld
    - Upper Girth Weld
    - Lower Flange Weld
    - ~~Nozzle Welds~~ (deleted)

IASCC Linkage - Westinghouse

- Primary Inspection of Lower Girth Weld
  - Added to Rev. 0 by SE (TRC #2)
  - EVT-1 25% weld length sampling of accessible surfaces
    - Accessible portions provide reasonably adequate sampling to address safety concern
    - Any observation of core barrel IASCC would trigger further action by both Plant and MRP
    - MRP-232 results provide basis that this as a conservative approach
    - Welds historically subject to Section XI inspections
- Expansion Inspections
  - 75% in expansion scope
  - Middle Axial Welds
  - Lower Axial Welds
- Welds Included in TRC #2 that are <u>not</u> subject to IASCC
  - Core Barrel Assembly Upper Girth Weld
  - Control Rod Guide Tube Assembly Lower Flange Weld

Inspection Strategy for Westinghouse CB Welds

Primary (EVT-1)

CB Upper Flange Weld (SCC)

Expansion EVT-1

CB Upper Axial, Upper Girth, and Lower Flange Welds (SCC)

Primary EVT-1

CB Lower Girth Weld (IASCC, IE)

Expansion EVT-1

CB Lower & Middle Axial Welds (IASCC, IE)

Red: Proposed MRP-227 Rev. 1
Black: MRP-227-A Rev. 0

Proposed Revision to Westinghouse Integrated Inspection Strategy for VS, IASCC and IE

Primary UT

Baffle-Former Bolt (IASCC, IE)

Expansion UT

LSC Bolts (IASCC,IE)

Expansion UT

Core Barrel Bolts (IASCC, IE)

Primary VT-3

Baffle Edge Bolt (VS, IASCC, IE)

Primary VT-3

Baffle-Former Assembly (VS, IASCC)

Existing VT-3

Lower Core Plate (VS, IASCC, IE)

Primary EVT-1

Lower CB Girth Weld (IASCC, IE)

Expansion EVT-1

Lower & Middle CB Axial Welds (IASCC, IE)

Expansion VT-3

Lower Support Columns Bodies Cast/Non-Cast (IASCC, IE)

Expansion VT-3

Upper Core Plate(IE)

Red: Proposed MRP-227 Rev. 1

Black: MRP-227-A Rev. 0

Westinghouse CASS Components (TE)

Component	MRP-191 Peak Fluence	Degradation Screened In	MRP-191 FMECA/Cat	MRP-227-A Category / Inspection	MRP-227 R1
Lower Support Casting	10^{20}	TE	1/A	Expansion / EVT-1	**Expansion (Core Barrel UFW)/ VT-3**
Lower Support Column Bodies	$5x10^{22}$	TE, IE, IASCC, VS	1/B	Expansion / EVT-1	**Expansion (Core Barrel LGW)/ VT-3**
BMI Column Cruciforms	$5x10^{22}$	TE, IE, IASCC, VS	1/B	Expansion / VT-3	**Expansion (CRGT Lower Flange)/ VT-3**
Upper Support Column Bases	10^{21}	SCC, TE, IE	1/A	No Adverse Effects	NC
UHI Flow Column Bases	10^{21}	TE, IE	1/A	No Adverse Effects	NC
Mixing Devices	10^{21}	SCC, TE, IE	1/A	No Adverse Effects	NC
CRGT Intermediate Flanges	10^{20}	Fat, SCC, TE	1/A	No Adverse Effects	NC
CRGT Lower Flanges	10^{21}	Fat, SCC, TE, IE	2/B	Primary / EVT-1	NC

IE Screening Limit for CASS Material: $6.7x10^{20}$n/cm^2 E>1MeV (MRP-276)

Integrated Inspection Strategy for Weld and Castings

Primary EVT-1

CRGT Flange Weld (SCC, Fatigue, IE/TE)

Expansion VT-3

BMI Column Cruciforms (Fatigue, IE/TE)

Primary (EVT-1)

CB Upper Flange Weld (SCC)

Expansion VT-3

Lower Support Forging or Casting (Cracking, TE)

Expansion EVT-1

CB Upper Axial, Upper Girth, and Lower Flange Welds (SCC)

Primary EVT-1

CB Lower Girth Weld (IASCC, IE)

Expansion EVT-1

CB Lower & Middle Axial Welds (IASCC, IE)

Expansion VT-3

Lower Support Columns Bodies Cast/Non-Cast (IASCC, IE/TE)

Red: Proposed MRP-227 Rev. 1
Black: MRP-227-A Rev. 0

Stress Corrosion Cracking

- Core barrel weld strategy includes monitoring for SCC in low fluence welds
  - Core barrel welds are most probable site for initiation of SCC in austenitic stainless steels.
- Other locations monitored for SCC
  - CRGT Lower Flange Welds (Primary)
  - X-750 Clevis Insert Bolts (Existing)
  - Upper Support Plate Assembly (Existing)
    - Formerly Upper Support Ring or Skirt

Stress Relaxation

- High energy neutron irradiation can drive stress relaxation
- Stress relaxation is detrimental when function of component requires maintenance of load
  - Current inspection plan for Westinghouse and CE covers irradiated threaded fasteners
  - Although hold-down spring <u>not</u> in high fluence location, stress relaxation of Westinghouse type 304 SS springs also included in program. (This mechanism not applicable to type 403 SS)
- Stress relaxation is beneficial when stresses that promote failure are relaxed

Wear Monitoring in Westinghouse Plants

- Wear Inspections
  - CRGT Guide Cards (Primary)
  - Thermal Shield Flexures (Primary)
  - Upper Core Plate (Expansion)
  - Core Barrel Upper Flange (Existing)
  - Lower Core Plate (Existing)
  - Flux Thimble Tubes (Existing)
  - Clevis Inserts/Bolts (Existing)
  - Upper Core Plate Alignment Pins (Existing)

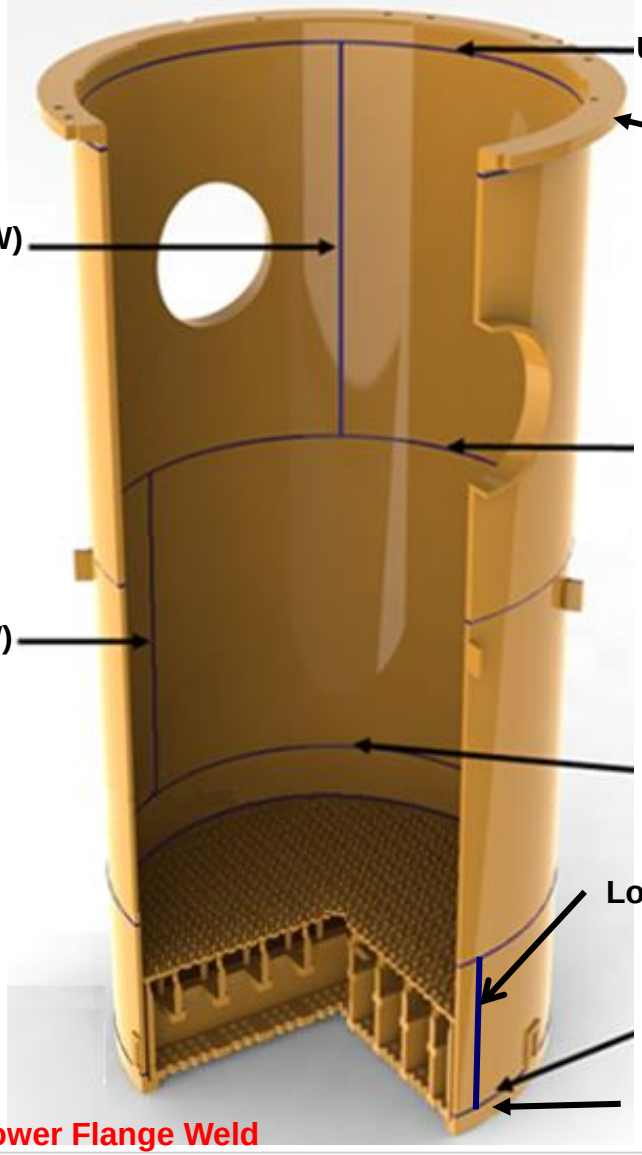
Fatigue Monitoring in Westinghouse Plants

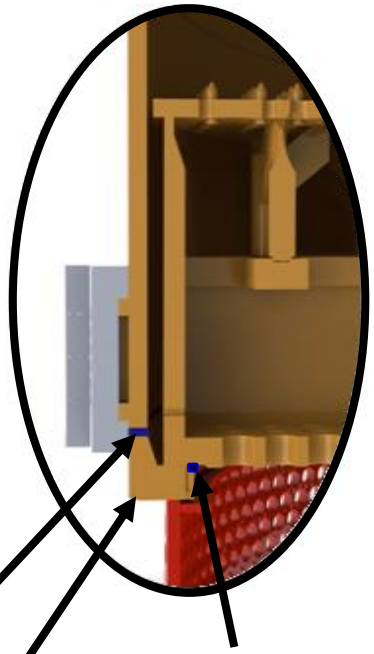
- Fatigue Inspections
  - CRGT Lower Flange Welds (Primary)
  - Baffle Edge Bolts (Primary)
  - Baffle-Former Bolts (Primary)
  - Thermal Shield Flexures (Primary)
  - Upper Core Plate (Expansion)
  - Baffle-Former Bolts (Expansion)
  - Lower Support Column Bolts (Expansion)
  - BMI Column Bodies (Expansion)
  - Upper Support Plate Assembly (Existing)
  - Lower Core Plate (Existing)

Combustion Engineering Core Barrel Weld Objectives for MRP-227 R1

1. Define standard nomenclature for welds in CE core support barrel.
2. Re-establish SCC monitoring based on inspection of key welds in core support barrel
3. Eliminate Expansion requirement to inspect Type 304 upper flange surface for SCC
4. Establish requirements for IASCC monitoring based on inspection of key locations in core support barrel
5. Establish weld specific coverage requirements

Nomenclature for Combustion Engineering Core Barrel Welds





* Naming varies also Lower Flange Weld

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SCC Linkage - CE

- Primary Inspection of Upper Flange Weld (UFW)
  - Originally proposed in Rev. 0
  - EVT-1 25% Weld Length Sampling Based on Operating Experience
    - Reasonable inspection sample to address SCC safety concern
    - Diminishing safety gain of over-sampling
    - Any observation of core barrel SCC would trigger further action by both Plant and MRP
  - Accessible welds have been subject to Section XI inspections
- Expansion Inspections
  - EVT-1 75% weld length sampling
    - Upper Axial Weld (UAW)
    - Upper Girth Weld (UGW)
    - Lower Girth Weld (LGW)
    - Lower Flexure Weld (CSB FW)

IASCC Linkage - CE

- Primary Inspection of Middle Girth Weld
  - Added to Rev. 0 by SE (TRC #2)
  - EVT-1 25% weld length sample
    - Reasonable sample to address safety concerns
    - Diminishing safety gain of over-sampling
    - Any observation of core barrel IASCC would trigger further action by both Plant and MRP
- Expansion Inspections
  - 75% weld length sampling
    - Middle Axial Welds
    - Lower Axial Welds
- Welds Included in TRC #2 that are <u>not</u> subject to IASCC
  - Core Barrel Assembly Upper Girth Weld (fluence under review)

CE Inspection Strategy for CSB Welds

Primary EVT-1

CSB Upper Flange Weld (SCC)

Expansion EVT-1

CSB Upper Axial, Upper Girth, and Lower Girth Welds (SCC)

Primary EVT-1

CSB Flexure Weld (Fatigue)

Primary EVT-1

CSB Middle Girth Weld (IASCC, IE)

Expansion EVT-1

CSB Lower & Middle Axial Welds (IASCC, IE)

Red: Proposed MRP-227 Rev. 1
Black: MRP-227-A Rev. 0

CE Inspections for IE, IASCC and/or VS

- Core Support Barrel Welds (See Previous slide)
- Core Shroud Welds (Multiple)
- Core Shroud Bolts (Primary)
- Core Support Barrel Bolts (Expansion)
- Lower Core Support Column Bolts (Expansion)
- Lower Core Support Column Weld (Primary)
- Bolted Core Shroud Assembly (Primary)
- Lower Core Support Plate (Primary)
- Lower Support Structure Deep Beams (Primary)
- Fuel Alignment Pins – Lower (Primary/Existing)

CE Integrated Inspection Strategy for Welds and Castings

Primary EVT-1

CSB Upper Flange Weld (SCC)

Expansion EVT-1

CSB Upper Axial, Upper Girth, and Lower Flange Welds, Lower Core Support Beams (SCC)

Primary EVT-1

CSB Flexure Weld (Fatigue)

Primary EVT-1

CSB Middle Girth Weld (IASCC, IE)

Expansion EVT-1

CSB Lower & Middle Axial Welds (IASCC, IE)

Primary VT-3

Lower Support Column Welds (IE, TE, IASCC, SCC, Fatigue)

Primary VT-1

Core Shroud Assembly (Welded) (IE, IASCC, VS)

Primary EVT-1

Shroud to Former Welds or Axial Welds* (IE, IASCC)

Expansion EVT-1

Remaining Shroud Welds (IE, IASCC)

* Design dependent

Red: Proposed MRP-227 Rev. 1
Black: MRP-227-A Rev. 0

CE CASS Components (TE)

Component	MRP-191 Peak Fluence	Degradation Screened In	MRP-191 FMECA/Cat	MRP-227-A Category / Inspection	MRP-227 R1
Lower Support Structure – Core Support Column Welds	10^{22}	IASCC, Fat, TE, IE	1/B	Primary/ VT-3	**Primary/ VT-3***
CEA Shrouds	10^{20}	TE	1/A	No Adverse Effects	NC
CEA Shroud Bases	$7x10^{20}$	TE	1/A	No Adverse Effects	NC
Modified CEA Shroud Extension Shaft Guides	10^{20}	TE	1/A	No Adverse Effects	NC

* Revised Coverage Description

IE Screening Limit for CASS Material: $6.7x10^{20}$n/cm^2 E>1MeV (MRP-276)

CE SCC Inspection Strategy

Primary EVT-1

CSB Upper Flange Weld (SCC)

Expansion EVT-1

CSB Upper Axial, Upper Girth, and Lower Flange Welds, Lower Core Support Beams (SCC)

Primary/Expansion VT-3

Instrument Guide Tubes (SCC, Fatigue)

Red: Proposed MRP-227 Rev. 1
Black: MRP-227-A Rev. 0

Stress Relaxation for CE

- High energy neutron irradiation can drive stress relaxation
- Stress relaxation is detrimental when function of component requires maintenance of load (e.g., some threaded fasteners).
  - Current inspection plan for CE covers irradiated threaded fasteners:
    - Core Shroud Bolts (Primary)
    - Core Support Barrel Bolts (Expansion)
    - Lower Core Support Column Bolts (Expansion)
    - Fuel Alignment Pins–Lower (Existing)
    - Guide Lug Insert Bolts (Existing)
- Stress relaxation is beneficial when stresses that promote failure are relaxed

Wear Monitoring in CE Plants

- Wear Inspections
  - Guide Lug Inserts (Existing)
  - Fuel Alignment Pins-Lower (Existing)
  - Core Support Barrel Upper Flange (Existing)

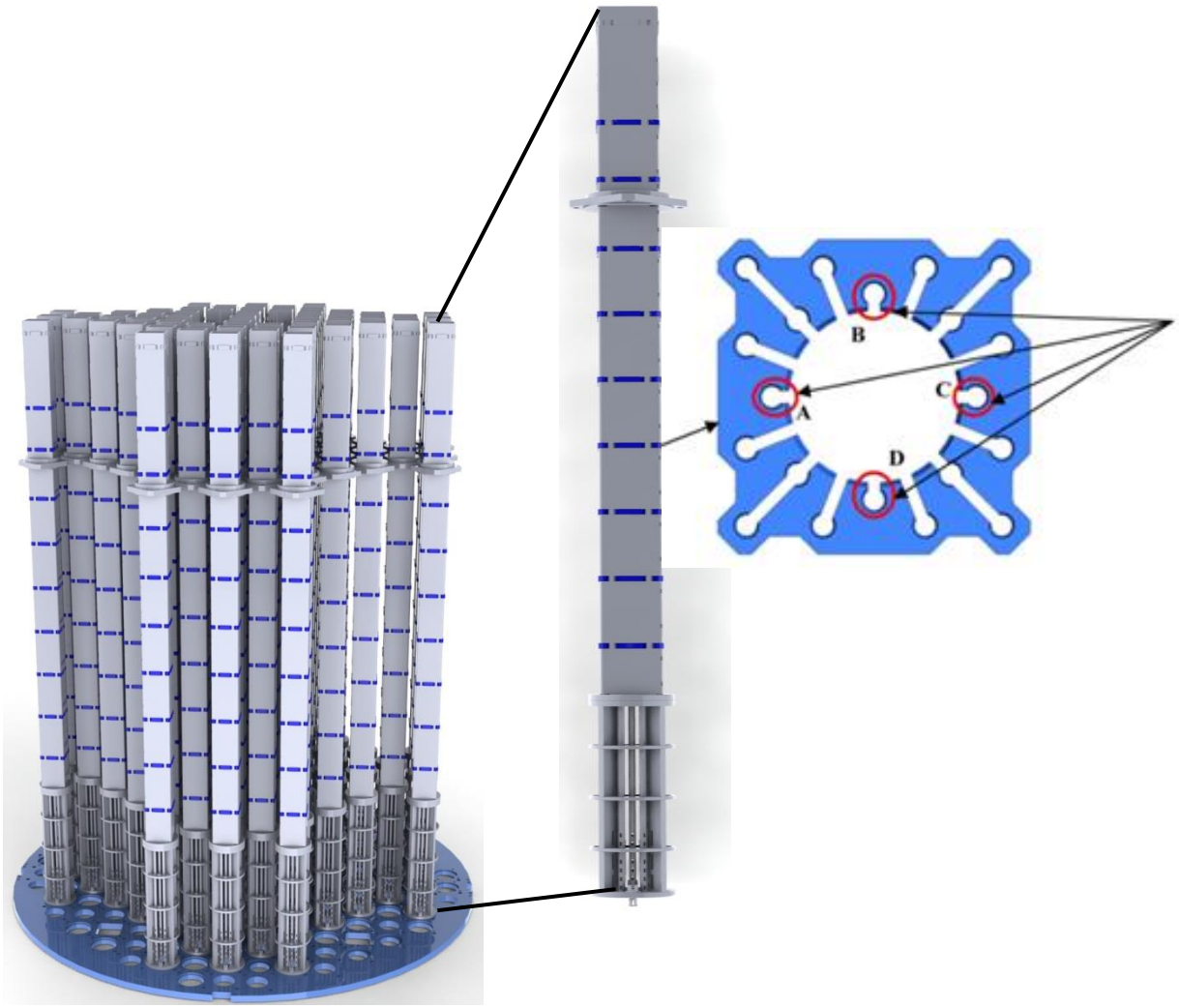
Fatigue Monitoring in CE Plants

- Fatigue Inspections
  - Core Shroud Bolts (Primary)
  - Core Support Column Welds (Primary)
  - Core Support Plates (Primary)*
  - Core Support Barrel Flexure Weld (Primary)*
  - Fuel Alignment Pins (Design Dependent) (Primary)*
  - Barrel Shroud Bolts (Expansion)
  - Core Support Column Bolts (Expansion)
  - Lower Core Support Beams (Expansion)

**** Reference to TLAA removed***

Westinghouse Guide Card Wear OE Implementation in MRP-227 R1

Control Rod Guide Tube Assembly
Guide plates (cards)



Inspection Location Example (Plant-specific configuration dependent)

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Interim Guidance on Guide Card Wear
MRP 2014-006

- Utilities must modify their CRGT examination plans to adhere to the requirements of WCAP-17451-P Revision 1 (and MRP-2014-006) or prepare a deviation under the NEI 03-08 protocol.
- The attached MRP-227 R1 table entry summarizes the guidance.

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Control Rod Guide Tube Assembly Guide plates (cards)	All plants	Loss of Material (Wear)	None	Visual (VT-3) and specialized measurements per the requirements of WCAP-17451-P, including subsequent examinations (note 7)	Examination coverage per the requirements of WCAP-17451-P Revision 1 (Note 7) See Figure 4-20

Notes to Table 4-3:

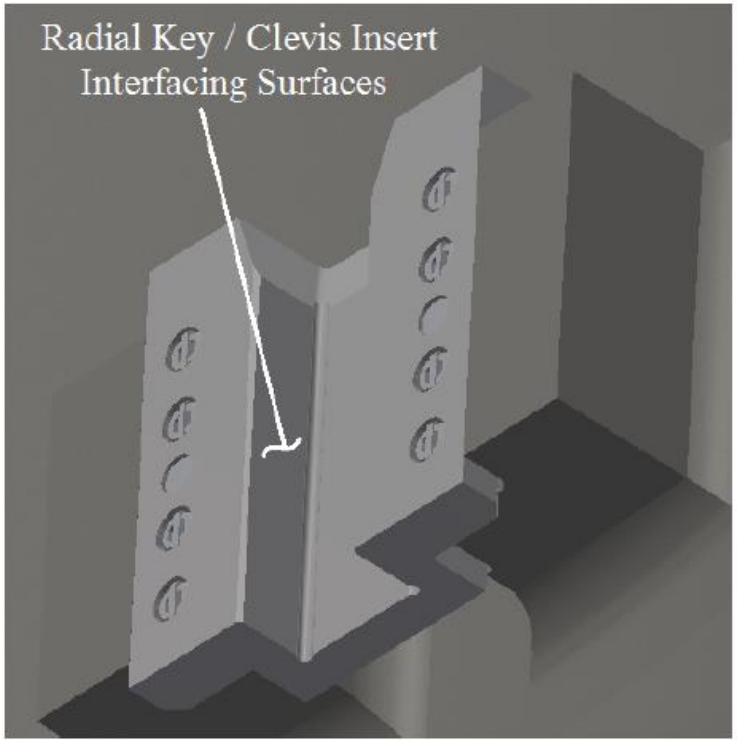
1. Examination acceptance criteria and expansion criteria for the Westinghouse components are in Table 5-3.
7. *In WCAP-17451-P Revision 1 the baseline examination schedule has been adjusted for various CRGT designs, the extent of individual CRGT examination modified, and flexible subsequent examination regimens correlating to initial baseline sample size, accuracy of wear estimation and examination results.*

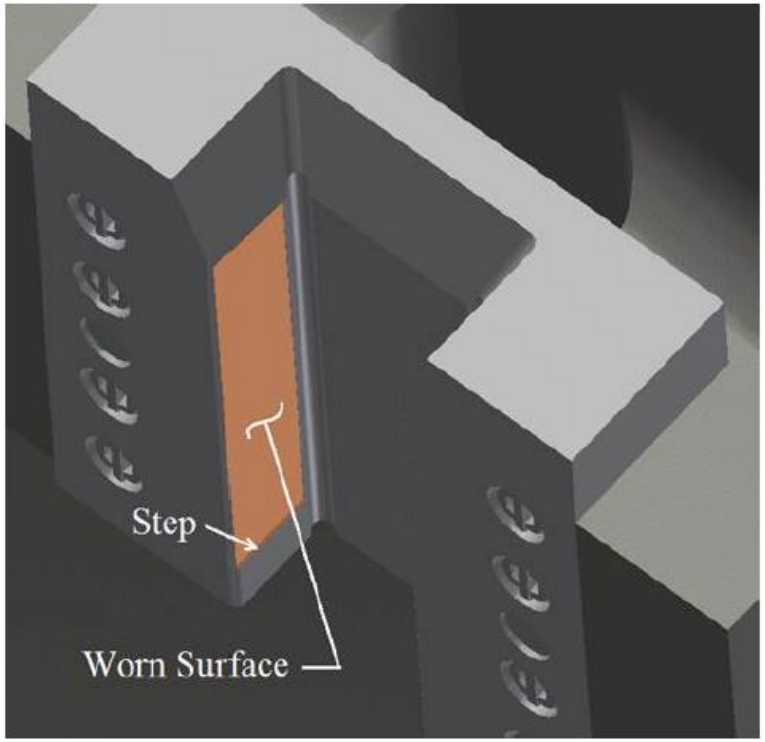
Clevis Insert Bolt OE Implementation in MRP-227 R1

Clevis Insert Bolt Operating Experience

- Addressing OE as required by industry standard
- Westinghouse Technical Bulletin TB-14-5
  - Failure of the bolts would not result in a loss of safety function
  - Significant number of redundancies prevent the loss of the intended safety function
  - Concerns related to bolt failures are commercial
- MRP-227 R1 will add descriptive note to Existing examination, to refer to the Technical Bulletin

Clevis Insert Inspection Guidelines
Westinghouse TB-14-5





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Cold Work

Cold Work in Components in Operating Plants

- NRC RAIs call for plants to identify “Non fastener materials that may contain more than 20% cold work in austenitic stainless steels”
- 20% cold work limitation was already recognized at the time of plant construction, i.e., from 1970’s
- Plant fabricators quality programs were in place to adhere to limitations in cold work in austenitic stainless steels in these times
- PWROG plant specific assessments have been conducted in response to RAI’s over the last two years
  - More than 1/3 of operating PWRs assessed
  - No non-fastener austenitic stainless steel materials with >20% Cold Work found to date

Reviews completed to date provide reasonable assurance that generic assessments apply to all currently operating plants.

To implement MRP-227-A plants must confirm that no modifications have been completed that would introduce cold work.

Together…Shaping the Future of Electricity

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MRP-227 Revision 1 B&W Primary and Expansion Component Item Table Updates

Information Exchange Meeting with NRC staff

Stephen Fyfitch
AREVA INC

3/31/2015

B&W Plants Primary and Expansion Component Items

- Updates to Primary and Expansion component items tables made to incorporate modified information contained in MRP-231 Rev. 3
  - MRP-231 Rev. 3 incorporates updates to MRP-189 Rev. 2
  - Updates of screening parameters
  - Updates of component items and welds resulting from completion of records searches performed for all B&W units
    - Generic listing of B&W design component items maintained
      - Where applicable, unit-specific differences identified
    - Some unit-specific differences remain that are outside of MRP-227 listings
- New or revised figures included

B&W Plants Primary and Expansion Component Items

- Primary component items (Table 4-1)
  - Some new Primary items included
  - Some modifications to Expansion links
  - Editorial changes
    - Component “Item” column
    - “Effect (Mechanism)” column
    - “Examination Method/Frequency” column
    - “Examination Coverage” column
- Expansion component items (Table 4-4)
  - Some new Expansion items included
  - Some modifications to Primary links
  - Editorial changes
    - Component “Item” column
    - “Applicability” column
    - “Effect (Mechanism)” column
    - “Examination Coverage” column

B&W Plants Primary Component Item Examples

Table 4-1 examples are preliminary and still subject to revision

B&W Plants Primary Component Item Examples

- Example 1:
  - Current MRP-227-A content:

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 2)	Examination Method/Frequency (Note 2)	Examination Coverage
Plenum Cover Assembly & Core Support Shield Assembly Plenum cover weldment rib pads Plenum cover support flange CSS top flange	All plants	Loss of material and associated loss of core clamping pre-load (Wear)	None	One-time physical measurement no later than two refueling outages from the beginning of the license renewal period. Perform subsequent visual (VT-3) examination on the 10-year ISI interval.	Determination of differential height of top of plenum rib pads to reactor vessel seating surface, with plenum in reactor vessel. See Figure 4-1.

  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Plenum Cover Assembly & Core Support Shield Assembly Plenum cover weldment rib pads Plenum cover support flange Plenum cover support ring CSS top flange	All plants	Loss of material and associated loss of core clamping pre-load (Wear)	None	One-time physical measurement no later than two refueling outages following entry into the period of extended operation. Subsequent visual (VT-3) examination prior to the end of each 10-year ISI interval.	Determination of differential height of top of plenum rib pads/plenum cover support ring location to reactor vessel seating surface, with plenum in reactor vessel. See Figure 4-1.

Header Note 1 or 2 remains the same: Examination acceptance criteria and expansion criteria for the B&W components are in Table 5-1.

B&W Plants Primary Component Item Examples

- Example 2:
  - Current MRP-227-A content:

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 2)	Examination Method/Frequency (Note 2)	Examination Coverage
Control Rod Guide Tube Assembly CRGT spacer castings	All plants	Cracking (TE), including the detection of fractured spacers or missing screws	None	Visual (VT-3) examination during the next 10-year ISI. Subsequent examinations on the 10-year ISI interval.	Accessible surfaces at each of the 4 screw locations (at every 90°) of 100% of the CRGT spacer castings (limited accessibility). See Figure 4-5.

  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Control Rod Guide Tube Assembly CRGT spacer castings	All plants	Cracking (TE), including the detection of fractured spacers or missing screws (Note 3)	Vent valve bodies	Visual (VT-3) examination prior to the end of the fourth 10-year ISI. Subsequent examination prior to the end of each 10-year ISI interval.	Accessible surfaces at each of the four screw locations (at every 90º) of 100% of the CRGT spacer castings. (limited accessibility) See Figure 4-5.

Header Note 1 or 2: Examination acceptance criteria and expansion criteria for the B&W components are in Table 5-1. (Same in current and Rev. 1)

Rev. 1 Note 3: Loss of ductility and fracture toughness is the effect of IE and/or TE. Cracking is the effect being examined, which could occur as the result of loss of ductility and fracture toughness. (This is a new note.)

B&W Plants Primary Component Item Examples

- Example 3:
  - Current MRP-227-A content:
    - Table entry for this component item not currently present
  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Expansion Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Vent Valve Assembly Original locking devices (pressure plate, spring retainer, spring, U-cover)	Notes 3, 4	Loss of material from locking device (Wear associated with jack screw spring and pressure plate)	None	Visual (VT-3) examination during the next 10-year ISI interval (Note 5) Subsequent examinations prior to the end of each 10-year ISI interval.	100% of accessible surfaces, including the overall valve symmetry in the mounting ring and the overall jackscrew thread extension from the lower retaining ring threaded flange. See Figure 4-10

Note 3: As of May 2014, TMI-1 and DB have been verified to have original vent valve assembly locking devices only, while ONS-1, ONS-2, ONS-3, and ANO-1 have both original and modified vent valve assembly locking devices installed. (This is a new note.)

Note 4: A detailed review of the ANO-1 fabrication records and/or field change packages to identify all component items and welds associated with the vent valve assembly locking devices has not been performed. Therefore, the vent valve assembly locking device component items and welds listed in this report are based on the results of the ONS-1, ONS-2, ONS-3, TMI-1, and DB evaluations. (This is a new note.)

Note 5: In addition to the Primary vent valve assembly visual (VT-3) examinations identified in this table, the following testing and inspection requirements are currently performed and will continue to be performed by the B&W units: (This is a new note.)

> A verification of the operation of each vent valve shall also be performed through manual actuation of the valve. Verify that the valves are not stuck in the open position and that no abnormal degradation has occurred. Examine the valves for evidence of leakage between the valve disc and the valve body (i.e., flow lines across the sealing surface), cracking of lock welds and locking cups, jackscrews for proper position, and wear. The frequency is defined in each unit's technical specifications or in their pump and valve in-service test programs (see BAW-2248A, page 4-3 and Table 4-1).

B&W Plants Expansion Component Item Examples

Table 4-4 examples are preliminary and still subject to revision

B&W Plants Expansion Component Item Examples

- Example 1:
  - Current MRP-227-A content:
    - Table entry for this component item not currently present
  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Primary Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Vent Valve Assembly Vent valve bodies	All plants	Cracking (TE), including the detection of fractured vent valve bodies, surface irregularities (damaged, grossly cracked, or missing portions) of the vent valve bodies, as a result of damage to the jackscrews or locking devices. (Note 3)	CRGT spacer castings	Visual (VT-3) examination. Subsequent examinations during each 10-year interval unless an applicant/licensee provides an evaluation for NRC staff approval that justifies a longer interval between inspections.	Accessible surfaces of 100% of the vent valve bodies on the plenum side (core side) of the vent valve. (Limited accessibility) See Figures 4-9 and 4-10. (Note 4)

Note 1: Examination acceptance criteria and expansion criteria for the B&W components are in Table 5-1. (same in current and Rev. 1)

Note 3: Loss of ductility and fracture toughness is the effect of IE and/or TE. Cracking is the effect being examined, which could occur as the result of loss of ductility and fracture toughness. (This is a new note.)

Note 4: It is known that some of the CSS vent valves originally-installed to the B&W units were replaced with spares due to locking device issues. While the ferrite contents of the originally-installed vent valve bodies are known, the serial number [S/N] and corresponding ferrite contents of the currently-installed vent valve bodies is not fully known for the B&W units. Therefore, it is recommended that the each utility identify the body S/N and heat number for each installed vent valve. The S/N numbers may be visible with an underwater video camera, e.g., during vent valve exercising. If the ferrite content of the currently-installed vent valve bodies can be verified to be under the TE screening criterion for the material, the vent valve bodies can be removed as an Expansion component item for the particular B&W unit and become a No Additional Measures component item. However, since vent valve assemblies are typically replaced in whole rather than by part, each time any changes are made to vent valve assemblies (e.g., replacement of a whole assembly), the vent valve body serial number, heat number, and ferrite content need to be verified. If, at any time, the ferrite content of any installed vent valve body is greater than the screening criterion for thermal embrittlement, that vent valve body will need to be included as an Expansion component item. (This is a new note.)

B&W Plants Expansion Component Item Examples

- Example 2:
  - Current MRP-227-A content:
    - Table entry for this component item not currently present
  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Primary Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Lower Grid Assembly Lower grid rib section	All plants	Cracking (IE), including the detection of readily detectable cracking (Note 3)	Baffle plates	Visual (VT-3) examination. Subsequent examinations prior to the end of each 10-year interval unless an applicant/licensee provides an evaluation for NRC staff approval that justifies a longer interval between inspections.	100% of accessible surfaces of the lower grid rib section heat-affected zone (HAZ) adjacent to the spider-to-lower grid rib section welds. See Figures 4-3 and 4-6.

Note 1: Examination acceptance criteria and expansion criteria for the B&W components are in Table 5-1. (same in current and Rev. 1)

Note 3: Loss of ductility and fracture toughness is the effect of IE and/or TE. Cracking is the effect being examined, which could occur as the result of loss of ductility and fracture toughness. (This is a new note.)

B&W Plants Expansion Component Item Examples

- Example 3:
  - Current MRP-227-A content:

Item	Applicability	Effect (Mechanism)	Primary Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Lower Grid Assembly Alloy X-750 dowel-to-lower grid fuel assembly support pad welds	All plants	Cracking (SCC), including the detection of separated or missing locking welds, or missing dowels	Alloy X-750 dowel-to-guide block welds	Visual (VT-3) examination. Subsequent examinations on the 10-year ISI interval unless an applicant/licensee provides an evaluation for NRC staff approval that justifies a longer interval between inspections.	Accessible surfaces of 100% of the support pad dowel locking welds. See Figure 4-6.

  - Draft MRP-227 Rev. 1 content:

Item	Applicability	Effect (Mechanism)	Primary Link (Note 1)	Examination Method/Frequency (Note 1)	Examination Coverage
Lower Grid Assembly Alloy X-750 dowel-to-lower grid fuel assembly support pad welds	All plants (except DB) (Note 2)	Cracking (SCC), including the detection of separated or missing locking welds, or missing dowels	Alloy X-750 dowel-to-guide block welds	Visual (VT-3) examination. Subsequent examinations prior to the end of each 10-year interval unless an applicant/licensee provides an evaluation for NRC staff approval that justifies a longer interval between inspections.	Accessible surfaces of 100% of the support pad dowel locking welds. See Figure 4-6.

Note 1: Examination acceptance criteria and expansion criteria for the B&W components are in Table 5-1. (same in current and Rev. 1)

Note 2: For the alternate configuration at DB, the difference in configuration shall be addressed on a unit-specific basis. (This is a new note.)

B&W Plants Examination Acceptance and Expansion Criteria Examples

Table 5-1 examples are preliminary and still subject to revision

B&W Plants Examination Acceptance and Expansion Criteria

- Table 5-1 will be revised to correlate with changes in Table 4-1
  - New items included
  - Revised text
  - Editorial changes for clarification
- Examples to follow

B&W Plants Examination Acceptance and Expansion Criteria

Item	Applicability	Primary Item Examination Acceptance Criteria (Notes 1, 2)	Expansion Link(s)	Expansion Criteria	Expansion Item Examination Acceptance Criteria
Plenum Cover Assembly & Core Support Shield Assembly Plenum cover weldment rib pads Plenum cover support flange Plenum cover support ring CSS top flange	All plants	One-time physical measurement. In addition, a subsequent visual (VT-3) examination is conducted for these items. The measured differential height from the top of the plenum rib pads and plenum cover support ring to the vessel seating surface shall average less than 0.004 inches compared to the as-built condition. The specific relevant condition for the subsequent VT-3 of these items is a) evidence of a general polished area over the plenum cover support ring and plenum cover weldment rib pad region and a smeared image of the RV closure head contact region, or b) observance of an interrupted ring in the circumferential direction on the plenum cover support flange and topside of the CSS top flange contact regions.	None	N/A	N/A

Note 1: The examination acceptance criterion for visual examination is the absence of the specified relevant condition(s).

Note 2: Refer to MRP-231 Section 3.3 for additional details on expansion acceptance criteria.

B&W Plants Examination Acceptance and Expansion Criteria

Item	Applicability	Primary Item Examination Acceptance Criteria (Notes 1, 2)	Expansion Link(s)	Expansion Criteria	Expansion Item Examination Acceptance Criteria
Vent Valve Assembly Original locking devices (pressure plate, spring retainer, spring, U-cover)	Notes 3,4	Visual (VT-3) examination. The specific relevant condition is evidence of damage or wear to the U-cover; misalignment of the pressure plate with the jackscrew, U-cover, or spring retainer; damage to the pressure plate or spring retainer; or the jackscrew out of the design configuration. Other specific relevant conditions are evidence that the valve is not symmetrical in the mounting ring or the jackscrew thread extensions from the lower retaining ring threaded flange are unequal.	None	N/A	N/A
Vent Valve Assembly Original locking devices (key ring, pin)	Notes 3,4	Visual (VT-3) examination. The key ring and pin are inaccessible items, therefore, the specific relevant condition is evidence that the valve is not symmetrical in the mounting ring or the jackscrew thread extensions from the lower retaining ring threaded flange are unequal.	None	N/A	N/A

Note 3: As of May 2014, TMI-1 and DB have been verified not to have modified vent valve assembly locking devices, while ONS-1, ONS-2, ONS-3, and ANO-1 have both original and modified vent valve assembly locking devices installed.

Note 4: A detailed review of the ANO-1 fabrication records and/or field change packages to identify all component items and welds associated with the vent valve assembly locking devices has not been performed. Therefore, the vent valve assembly locking device component items and welds listed in this report are based on the results of the ONS-1, ONS-2, ONS-3, TMI-1, and DB evaluations.

B&W Plants Primary, Expansion, and Examination Acceptance and Expansion Criteria Tables

- Summary:
  - Updates completed to B&W-design basis documents (MRP-189 and MRP-231) completed since MRP-227-A issuance resulting from:
    - Completion of unit-specific record searches
    - Completion of A/L Action Items (e.g., A/L AI 2 and AI 4)
    - New analyses performed in PWROG or unit-specific programs
    - Editorial (e.g., clarifications)
  - These efforts result in minor changes and additions to Primary, Expansion, and Examination Acceptance and Expansion Criteria table row listings (MRP-227 Tables 4-1, 4-4, and 5-1)

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MRP-227 Revision 1 (A/LAIs from –A SER)

Information Exchange Meeting with NRC staff

3/31/2015

NRC S.E.R. Items from MRP-227-A

A/LAI # 1 related to Generic Applicability of MRP-227:

Each applicant/licensee is responsible for assessing its plant's design and operating history and demonstrating that the approved version of MRP-227 is applicable to the facility. … Describe the process used for determining plant-specific differences in the design.

- MRP-227 Rev. 1 Section 2.4 addresses applicability
- Added statement to Section 2.4*: "Users of these guidelines are expected to confirm with reasonable assurance that each reactor managed with the guidelines satisfies the assumptions discussed below"*
- Designs and vendor design changes through 2007 considered in MRP-227 Rev. 1 (no change)
- Subsequent design changes and power uprates implemented after 2007 must be considered by the owner
- Specific consideration of core power density, core offset from upper core plate and peripheral core power now addressed in Section 2.4 by reference to Appendix B with content from MRP-2013-025, and NRC staff assessment ML14309A484.
- Cold worked SS items is no longer an issue based on extensive reviews
- A/LAI #1 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 2 related to MRP-227 Scope and Applicability to 10CFR54.4 LR:

- *Consistent with the requirements addressed in 10 CFR 54.4, each applicant/licensee is responsible for identifying which RVI components are within the scope of LR for its facility.*
- *Applicants/licensees shall review the information in Tables 4-1 and 4-2 in MRP-189, Revision 1, and Tables 4-4 and 4-5 in MRP-191 and identify whether these tables contain all of the RVI components that are within the scope of LR for their facilities in accordance with 10 CFR 54.4.*
- By original intent, MRP-227 includes components with safety functions, and others that could affect safety functions
- MRP-227 Section 2.4 includes expectation to review design changes
- Experience to date shows that alternate materials and nomenclature for components do not warrant changes to generic program requirements
- MRP-227 Revision 1 provides guidance to owners for this applicability assessment in Section 2
- A/LAI #2 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 3 related to Adequacy of Plant-Specific Existing Programs:

- Applicants/licensees of CE and Westinghouse are required to perform plant-specific analysis to either justify the acceptability of an applicant/licensee's existing programs, or to identify changes to the programs that should be implemented to manage the aging of these components ….
  - CE thermal shield positioning pins [one plant]
  - CE in-core instrumentation (ICI) tubes [top mounted ICI designs only]
  - W control rod guide tube support pins (split pins)
- For CE instrumentation tubes and Westinghouse X-750 split pins, most plant owners have replaced them
  - Replacement accounts for growth of zircaloy ICI tubes
  - Replacement of X-750 split pins removes PWSCC as significant issue
  - For plants with non-replaced components, they have a plan to replace
- MRP-227-A Section 2.4 includes expectation to review design changes
- Existing guidance requires action and is expected to be in plant documents
- The plant owners are addressing this issue via plant-specific submittals
- MRP-227 Revision 1 will include guidance to owners regarding adequacy of existing programs and/or need for proactive component replacements
- A/LAI #3 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 4 related to B&W Core Support Structure Upper Flange:

- *The B&W applicants/licensees shall confirm that the core support structure upper flange weld was stress relieved during original fabrication of the reactor pressure vessel …*
- Areva has confirmed stress relief operation was performed during fabrication of core support structure upper flange weld for all B&W units
- Documentation of vendor review supplied to each plant
- A/LAI #4 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 5 related to Application of Physical Measurements:

- *Applicants/licensees shall identify plant-specific acceptance criteria to be applied when performing the physical measurements required by … MRP-227 …*
  - Westinghouse hold down spring height
  - CE shroud joint gap distortion
- For hold down spring, intent is to maintain assembly hold down force margin
  - Prevents relative motion, potential wear, and other cascading issues
  - Value depends on fuel design, mass flow rates
  - Allowable measured value best determined just prior to measurement
- Shroud distortion could be effect of void swelling, if present
  - Partly a matter of data gathering to understand effect
  - Structural integrity impact minimal
  - Functional limit based mainly on core bypass flow assumptions
- MRP-227 Rev.1 Tables 5-2 and 5-3 notes include clarification for the development of plant-specific acceptance criteria one fuel cycle prior to inspection to be performed
- A/LAI #5 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 6 related to Evaluation of Inaccessible B&W Components:

- *Applicants/licensees shall justify the acceptability of these components for continued operation through the period of extended operation ….*
  - Core barrel cylinders and welds
  - Former plates
  - Core barrel to former bolts/locking devices
  - External baffle-to-baffle bolts/locking devices and internal baffle-to-baffle bolts
- These are Expansion items, and inspection is not required unless Primary inspection items fail criteria in Chapter 5, Table 5-1
- Evaluation of Primary items requires utilization of WCAP-17096
- Draft SE for WCAP-17096 requires detailed plant-specific analysis justifying operation of a Primary component with degradation exceeding acceptance criteria to be submitted to NRC within one year of the detection of the degradation
- No need to adjust MRP-227 Revision 1
- A/LAI #6 has been adequately resolved

NRC S.E.R. Items from MRP-227-A

A/LAI # 7 related to Plant-Specific Evaluation of CASS Components:

- *Applicants/licensees are required to develop plant-specific analyses to be applied for their facilities to demonstrate that [certain cast austenitic stainless steel components] will maintain their functionality during the period of extended operation …*
    - B&W IMI guide tube assembly spiders and CRGT spacer castings,
    - CE lower support columns, and
    - Westinghouse lower support column bodies
    - Additional CASS, martensitic or precipitation hardened components
- B&W CASS IMI spiders and CRGT spacers already subject to inspection with good experience to date
- CE and Westinghouse lower support components comprise redundant assembly, that is inherently resistant to loss of function
    - Adequate fabrication NDE, lack of specific active flaw initiators
    - Functionality analysis of W lower support columns recently completed
    - Additional industry activity is ongoing to reinforce this conclusion
    - Proprietary PWROG document was provided to staff (PWROG-14048-P)
- Industry needs clarification/rewording of A/LAI 7 expectation from staff
- MRP-227 Revision 1 does not require modification
- A/LAI # 7 adequately addressed via ongoing actions

NRC S.E.R. Items from MRP-227-A

A/LAI # 8 relates to Submittal for Staff Review and Approval:

- Focus of MRP-227 is to provide owners with materials aging management guidance, not licensing related activities
- If required by commitment, submittal of AMP for review and approval to NRC is inherent
- For new LR applicants, requires submittal of additional information related to 10CFR Part 54 requirements
- For new LR applicants, AMP must be included in application
  - MRP-227 AMP should be treated like any other AMP
- MRP-227 Revision 1 does not require modification
- A/LAI 8 has been adequately resolved

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MRP-227 Revision 1 Transition Plan

Information Exchange Meeting with NRC staff

Glenn Gardner

Dominion

3/31/2015

Transition Considerations

- What baseline inspections completed to date?
  - Under MRP-227 Rev. 0
  - Under MRP-227-A
- Proposed changes in MRP-227 Rev. 1 inspections enhance the aging management program
  - Many changes are editorial clarifications or administrative
  - Changes in Primary to Secondary linkages are moot if no Primary items exceed Section 5 acceptance criteria
  - Inspection coverage changes / clarifications for visual inspections
  - Change in Westinghouse guide card inspections are required under interim guidance MRP-2014-006 regardless of version of MRP-227
  - Timing of implementation has no impact on safety
- Additional issues related to implementation timing include
  - Inspection plans are essentially frozen by owners two cycles prior to inspection outage
  - Inspection vendor selection, integration with other outage scope, development of any required tooling

Transition Considerations

- Implementation and integration into licensee's process is complex and is a function of plant-specific process
  - Early plants, LR approved, with individual commitments regarding AMP submittal and approval
  - Plants, LR approved, with AMP approvals under MRP-227-A complete
  - Plants, LR approved, with AMP submittals under MRP-227-A in Review, responding to RAIs
  - Plants with LR approved compliant with GALL Rev. 1, no AMP yet
  - Plants with new applications submitted compliant with GALL Rev. 2, including interim staff guidance
  - Plants still planning to submit applications
- Focus of MRP-227 is to provide owners with proactive materials aging management technical guidance, not licensing guidance
  - MRP-227 must remain a living document
  - MRP-227 Rev. 1 will be handled via the NEI 03-08 protocol
  - NEI 03-08 protocol and process assure adequate implementation

Summary, MRP-227 Rev. 1 Transition

- The various states of program submittals, approvals and baseline inspections completed require careful consideration
- Orderly transition to MRP-227 Rev. 1 is anticipated based on NEI 03-08 process and protocols, and sets precedent for future transitions
- Continued coordination between industry and staff will be beneficial to all stakeholders

Final Thoughts

- Industry desire is to obtain NRC endorsement of MRP-227 Rev. 1
- A/LAIs have been addressed or resolved as appropriate.
- Industry has reviewed with the staff the things we are adjusting and why.
- These proposed changes address many staff requests.
- Are staff reviewers receptive to these changes?
  - What are the staffs' hard-spots?
  - Did we miss something?
- What else does the staff need from the industry team?
- Any feedback from staff reviewers would be appreciated.

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