ELECTRIC POWER RESEARCH INSTITUTE

MRP Materials Reliability Program_____MRP 2013-019

(via email)

August 5, 2013

To: NRC Document Control Desk

Subject: Proposed Edits to WCAP-17096-A Draft

As discussed at a public meeting with NRC staff in May 2013, this letter provides proposed text revisions for draft WCAP-17096-NP Revision 2. Changes were made based on the NRC RAIs, draft Safety Evaluation, and lessons learned from recent plant-specific work performed by AREVA. The updated text has been reviewed by the PWR Owner's Group Materials Subcommittee (MSC) and comments have been incorporated.

Subsequent letters from EPRI-MRP will provide additional proposed text revisions from Westinghouse.

Sincerely,

T. G. Wells
Chairman, Integration Committee
EPRI-Materials Reliability Program"

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Proposed Revisions to WCAP-17096 Rev. 2

(AREVA)

(Based on NRC RAIs and Draft SE)

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
Section 2.0 under "Evaluation Methodology"	RAI 1	• Evaluation Methodology – The procedures and criteria to be used by the engineering staff to evaluate relevant conditions. This includes: – Demonstration of functionality of the current configuration – Establishment of a re-inspection frequency of one or more refueling cycles – An engineering basis for repair/replacement/mitigation options	• Evaluation Methodology – The procedures and criteria to be used by the engineering staff to evaluate relevant conditions. This includes: – Demonstration of functionality of the current configuration – Establishment of a re-inspection frequency of one or more refueling cycles – An engineering basis for repair/replacement/mitigation options Note: Detailed repair/replacement/mitigation options are outside the scope of this document.	
Section 3.7	RAI 2	Three Expansion component items in the B&W designs have been designated for resolution by analysis. Inspection of these three components is considered to be impractical due to issues of accessibility. Therefore, should concerns about the integrity of these components be triggered by observations in the associated Primary	Three Expansion component items in the B&W designs have been designated for resolution by analysis.[1] Inspection of these three components is considered to be impractical due to issues of accessibility. Therefore, should concerns about the integrity of these components be triggered by observations in the associated Primary components, no inspection is	

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		components, no inspection is required. Resolution would require either detailed analysis or replacement. Acceptance criteria for these three Expansion components are not included in this task. A separate project authorization to support additional analysis of these three B&W components may be proposed to the PWROG.	required. Resolution would require either detailed analysis or replacement. Inspection acceptance criteria for these three Expansion components therefore are not included in this task. Footnote 1: The referenced three component items are: 1) the core barrel cylinder and welds, 2) the former plates, and 3) the bolting (core barrel-to-former bolts, internal [accessible, but currently unable to be ultrasonically inspected] and external baffle-to-baffle bolts, and associated locking devices).	
Table 5-1	General RAI	See attached Original Table 5-1	See attached Revised Table 5-1 (Component items edited to correspond to items in Tables 4-1 and 4-4 of MRP-227-A; changes also made to plenum cover and CSS top flange core clamping analytical and comments columns, CRGT spacer castings comments column, CSS vent valve retaining ring analytical column, and lower grid fuel assembly support pad items component item and comments columns)	Editorial changes
Appendix A, section A.1	N/A	• Primary component item information extracted directly from Table 4-1 of MRP-227. • This information is in tabular form and contains the item name, unit applicability, failure effect, failure mechanism(s), expansion link(s), examination method, examination frequency, and examination coverage. • Component item function(s), including whether	• Primary component item information extracted directly from Table 4-1 of MRP-227. This information is in tabular form and contains the item name, unit applicability, failure effect, failure mechanism(s), expansion link(s), examination method, examination frequency, and examination coverage. • Component item function(s), including whether or	Editorial changes

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		or not it has a core support safety function. • Observable effect(s). • Methodology for development of acceptance criteria. • Data requirements for development of acceptance criteria. • Existing documents (e.g., PWROG or AREVA).	not it has a core support safety function. • Observable effect(s). • Possible Examination Outcome(s). • Methodology for development of acceptance criteria. • Data requirements for development of acceptance criteria. • Existing documents (e.g., PWROG or AREVA).	
Appendix A. section A.1	General RAI and RAI 24	See original text	Revised text will be in accordance with MRP-227-A (too many changes to include in this format)	Each of the primary item table rows and columns have been revised accordingly and extracted from Table 4-1 of MRP-227-A; primary items (that were expansion items) have been incorporated into this section as well
Page A-2	RAI-5	A one-time physical measurement is to be obtained. The interference measurement to the nearest 0.001 inch is to be recorded at eight locations at approximately 45-degree intervals. Subsequent follow-up visual (VT-3) examinations are to be obtained during the ASME Code	A one-time physical measurement is to be obtained. The interference measurement to the nearest 0.001 inch is to be recorded at eight locations at approximately 45-degree intervals. Subsequent follow-up visual (VT-3) examinations are to be obtained during the ASME Code B-N-3 10-year ISI activities.	

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		B-N-3 10-year ISI activities. ONS has performed physical measurements on a unit-specific basis and no measurable wear has been observed. TMI-1 plans to obtain the data during the Fall 2009 outage. The remaining units have not completed the measurement to date.	ONS, TMI-1, and CR-3 have performed physical wear measurements on a unit-specific basis and no measurable wear has been observed. The remaining units have not completed the measurement to date.	
Page A-3	RAI 5	The acceptance criterion is based on engineering judgment, and is defined as a reduction of no greater than 0.004 inch compared to the original as-built data. The criterion of 0.004 inch reduction in interference is not be construed as an indication of inadequate clamping, but an indication that the surface conditions have changed since the unit was put into service. Additional inspection, using VT-3 for example, will be required to verify that wear is actually occurring. The general analytical methodology to be used for determining the wear acceptance criterion involves the following steps and inputs: • Determine the minimum core clamping preload required • This requires the differential pressure distribution on the core support cylinder due to reactor	The original 0.004-inch criterion in MRP-227-A is based on the estimated permanent deformation in the O-ring mating surfaces, which is not considered in the interference measurement. The original analytical solution predicted adequate clamping accounting for flow loadings with initial interference fit at zero also not accounting for the permanent deformation. The acceptance criterion is based on engineering judgment, and is defined as a reduction of no greater than 0.004 inch compared to the original as-built data. The original as-built results ranged from 0.004-inch interference to a 0.0004-inch clearance. Five of the seven B&W units have now been measured with no appreciable change in interference from the original as-built results. The criterion of 0.004 inch reduction in interference is not be construed as an indication of inadequate clamping, but an indication that the surface conditions have changed since the unit was put into service. Additional inspection, using VT-3 for example, will be required to verify that wear is actually occurring. The general analytical methodology to be used for determining the wear acceptance criterion involves the following steps and inputs:	

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		coolant flow
		• This also includes evaluation for different minimum pre-loads versus time at different operating conditions
		• Determine an uncertainty margin, which includes both input pressure differential and measurement error
		• Determine how the clamp load varies with operating conditions
		• Develop a wear estimate for time from discovery of wear to time for required remediation
			• Determine the minimum core clamping preload required
			  o This requires the differential pressure distribution on the core support cylinder due to reactor coolant flow
			  o This also includes evaluation for different minimum pre-loads versus time at different operating conditions
			• Determine an uncertainty margin, which includes both input pressure differential and measurement error
			• Determine how the clamp load varies with operating conditions
			• Develop a wear estimate for time from discovery of wear to time for required remediation	

Page A-4	N/A	Analytical efforts could be performed on a generic basis. The NDE inspection standard could also be developed generically.	Analytical efforts may need to be performed on a unit-specific basis due to the different initial interference. The NDE inspection standard could be developed generically.	Editorial change
CRGT spacer castings (originally on Page A-37)	General RAI	N/A	N/A	Moved information from Expansion items to Primary items

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CRGT spacer castings (originally on Page A-37)	N/A	Component Item Function Degradation of the spacer castings could result in degradation in the unit shutdown capability. The spacer castings do not have a core support safety function; however, they do have a safety function relative to control rod alignment, insertion and reactivity issues, and a stuck rod scenario.	Component Item Function The function of the spacer castings is to provide structural support to the 12 perforated vertical rod guide tubes and 4 pairs of vertical rod guide sectors within each CRGT assembly. Degradation of the spacer castings could result in degradation in the unit shutdown capability. The spacer castings do not have a core support safety function; however, they do have a safety function relative to control rod alignment, insertion and reactivity issues. Degradation of the spacer castings could result in degradation in the unit shutdown capability by hindering the insertion of the control rods into the core in the normal anticipated time.	Editorial change
CRGT spacer castings (originally on Page A-37)	N/A	Possible Examination Outcomes: • No relevant conditions identified • One or more areas are identified with a large crack like indication that would be a precursor to loosing a piece of material • One or more areas are identified with missing material • Evidence that the spacer is not centered	Possible examination outcomes: • No relevant conditions identified • One or more areas are identified with a large crack like indication that would be a precursor to losing a piece of material • One or more areas are identified with missing material • Evidence that the spacer is not centered	Editorial change
CRGT spacer castings (originally on Page A-37)	N/A	Methodology and Data Requirements: The general analytical methodology to be used for acceptance criteria for the CRGT spacer castings involves the following step and input:	Methodology and Data Requirements: The general analytical methodology to be used for acceptance criteria for the CRGT spacer castings involves the following steps and input: • Perform a degraded casting evaluation to determine the extent of degradation allowable	Editorial change and methodology revision

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		• Perform a reactivity analysis to determine the number of CRDMs that are required for shut down of the reactor • A VT-1, ET, or UT examination may be needed to determine if flaws are emanating from the location where missing material may be identified.	such that unacceptable drop times of the control rods will not occur or the control rods will be unable to pass through the CRGT assembly In the event that the above effort is unsuccessful, the following action is to be taken: • Perform a reactivity analysis to determine the number of CRDMs that are required for shut down of the reactor	
Pages A-5 and A-6	RAI 7	N/A	N/A	Deleted CSS cast outlet nozzles information
Pages A-7 and A-8	RAI 6 and RAI 7	N/A	N/A	Deleted CSS vent valve disc information
Page A-9	RAI 7	N/A	N/A	Deleted CSS vent valve disc shaft (or, hinge pin) information
Page A-9	N/A	N/A	N/A	Deleted Note 1
Page A-9	RAI 6	<u>Component Item Function</u> Vent valves are passive devices that have no function during normal operation. The vent valve top and bottom retaining rings and the disc shaft (or, hinge pin) do not have a core support safety function; however, they do have a safety function in that degradation of the vent valve top and bottom retaining rings and the disc shaft	<u>Component Item Function</u> Vent valve assemblies are generally passive devices (although the hinge assembly and disc are identified as active components) with the primary function of relieving pressure in the interior of the core support assembly during a cold leg large break loss-of-coolant-accident (LOCA). For all normal operating conditions the vent valves are closed and another function of the vent valve is to prevent unacceptable bypass flow	

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		(or, hinge pin), which would prevent the vent valve from opening, could result in loss of the vent valve function during a large break loss-of-coolant-accident (LOCA).	during normal operation. The vent valve top and bottom retaining rings do not have a core support safety function; however, they do have a safety function in that degradation of the vent valve top and bottom retaining rings, which would prevent the vent valve from opening, could result in loss of the vent valve function during a large break loss-of-coolant-accident (LOCA).	
Page A-10	RAI 4	<u>Methodology and Data Requirements:</u> The general analytical methodology to be used for acceptance criteria for the vent valve top and bottom retaining rings and the disc shaft (or, hinge pin) involves the following steps and inputs: • Perform analysis to show that failure of vent valve items will not result in loss of function • Perform a bypass analysis to justify that sufficient DNB exists in the degraded condition • A VT-1, ET, or UT examination may be needed to determine if flaws are emanating from the location where missing material may be identified	<u>Methodology and Data Requirements:</u> The general analytical methodology to be used for acceptance criteria for the vent valve top and bottom retaining rings involves the following steps and inputs: • Perform analyses or evaluations, which will determine areas of the rings, if any, where the thermal embrittlement effects may be expected to result in cracking of these items • Summarize existing vent valve opening and flow assessments • Perform an assessment of operational loading relative to critical crack size in the degraded condition • Perform an assessment of vent valve opening characteristics in the event of a LOCA (loss-of-coolant-accident) • If the above efforts are unsuccessful in concluding continued functionality, a bypass analysis may need to be performed to justify that sufficient DNB exists in the degraded condition • A VT-1, ET, or UT examination may be needed to determine if flaws are emanating from the location where missing material may be identified	

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Page A-10	N/A	Existing Documentation: • CLB loadings (normal and faulted condition) are available, but a records search may need to be performed to identify them • Manufacturing and material data need to be identified to determine chemical composition and an assessment of the actual susceptibility to thermal aging embrittlement • No acceptable evaluation or analysis has been completed to date for determining a re-inspection schedule	Existing Documentation: • CLB loadings are available, but a records search may need to be performed to identify them • Procurement and fabrication data need to be identified to identify the non-destructive examinations performed on the as-installed retaining rings • No acceptable evaluation or analysis has been completed to date for determining a re-inspection schedule	Editorial change

Pages A-13 and A-14	N/A	Methodology and Data Requirements:
		
		The general analytical methodology to be used for acceptance criteria for the bolts involves the following steps and inputs if relevant conditions have been identified in the UCB bolts:
		
		• A finite element model (FEM) is to be developed for the local geometry with contact conditions, pretension elements, loads and boundary conditions
		• A thermal analysis is to be performed
		Determines bolt temperatures and temperature gradients for normal operating conditions
		• A structural analysis is to be performed in which
			Methodology and Data Requirements:
			
			The general analytical methodology to be used for acceptance criteria for the bolts involves the following steps and inputs if relevant conditions have been identified in the UCB bolts:
			
			• A finite element model (FEM) is to be developed for the local geometry with contact conditions, pretension elements, loads and boundary conditions
			• A thermal analysis is to be performed
			  o Determines bolt temperatures and temperature gradients for normal operating conditions
			• A structural analysis is to be performed in which failed bolts are inactive
			  o Stress concentration factors are calculated to determine the peak
				Editorial change and methodology revision

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		failed bolts are inactive • Stress concentration factors are calculated to determine the peak stresses at the bolt head-to-shank fillet region under normal operating conditions • Analysis is performed for all loads and load combinations required for an ASME evaluation (stress limits for threaded structural fasteners in subsection NG and Appendix F) • The effect of failed or missing bolts on overall effective core barrel stiffness is evaluated • A change of no more than 20% in stiffness when subjected to LOCA loads is acceptable (within the limits of other uncertainties accounted for in the evaluation of LOCA loadings) This corresponds to approximately 10% change in fundamental frequency of the	stresses at the bolt head-to-shank fillet region under normal operating conditions o Analysis is performed for all loads and load combinations required for an ASME evaluation (stress limits for threaded structural fasteners in subsection NG and Appendix F) o The effect of failed or missing bolts on overall effective core barrel stiffness is evaluated ▪ A change of no more than 20% in stiffness when subjected to LOCA loads is acceptable (within the limits of other uncertainties accounted for in the evaluation of LOCA loadings) • This corresponds to approximately 10% change in fundamental frequency of the structure o An evaluation of joint stability (or, openness) is also to be performed • Representative rejected UCB bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative	

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		structure • An evaluation of joint stability (or, openness) is also to be performed • Representative rejected UCB bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of UCB bolt UT inspection and laboratory test results, perform an evaluation to assess future UCB bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future UCB bolt failure into the operability evaluation and re-inspection requirement	UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of UCB bolt UT inspection and any laboratory test results, perform an evaluation to assess future UCB bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future UCB bolt failure into the operability evaluation and re-inspection requirement	
Page A-15	N/A	N/A	N/A	Revised document revisions under first, second, and third main bulleted items and

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				wording under fifth bulleted item under "Existing Documentation"
Page A-16	RAI 3	<u>What observations trigger examination into the Expansion category?</u> • Cracking observed in 10% (12) of the UCB bolts (LCB bolts are only considered in the expansion if they have not already been inspected). Damage to locking devices for failed bolt locations is not unusual and would be anticipated; however, if damage to locking devices is observed in non-failed bolt locations, the second trigger criterion would also be used. • Observation of more than two locking devices damaged or missing (if no bolts are observed to be failed), pending additional evaluation as to the potential cause.	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A.	
Page A-15	N/A	<u>Should it trigger expansion to all remaining bolt rings or a tiered approach?</u> When an inspection triggers into the expansion, there is a unit-specific need to evaluate the results against the differences in materials used for the different locations and results from other unit inspections. For example, if failures are noted in the Alloy A-286 UCB bolts, but the	<u>Should it trigger expansion to all remaining bolt rings or a tiered approach?</u> When an inspection triggers into the expansion, there is a unit-specific need to evaluate the results against the differences in materials used for the different locations and results from other unit inspections. For example, if failures are noted in the Alloy A-286 UCB bolts, but the UTS bolts are made from Alloy X-750 and no failures of this bolting material has been observed at	Editorial change

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		UTS bolts are made from Alloy X-750 and no failures of this bolting material has been observed at any of the operating B&W units, a justification not to expand to this location should be possible. In addition, should failures be noted in a heat of Alloy A-286 used at one unit, expansion into the other units may need to be considered. However, one or more of the bolts with indications need to be removed for laboratory testing to confirm the IGSCC failure mechanism and stress analyses need to be performed for each of the expansion bolt locations. Thus, expansion is not to be considered carte-blanche without additional evaluation.	any of the operating B&W units, a justification not to expand to this location should be possible. In addition, should failures be noted in a heat of Alloy A-286 used at one unit, expansion into the other units may need to be considered. However, one or more of the bolts with indications may need to be removed for laboratory testing to confirm the IGSCC failure mechanism and stress analyses may need to be performed for each of the expansion bolt locations. Thus, expansion is not to be considered carte-blanche without additional evaluation.	
Page A-17	N/A	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices are to be performed.	Editorial change
Page A-19	N/A	• Representative rejected LCB bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-	• Representative rejected LCB bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued	Editorial change and methodology revision

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		inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of LCB bolt UT inspection and laboratory test results, perform an evaluation to assess future LCB bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future LCB bolt failure into the operability evaluation and re-inspection requirement	operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of LCB bolt UT inspection and any laboratory test results, perform an evaluation to assess future LCB bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future LCB bolt failure into the operability evaluation and re-inspection requirement	
Pages A-19 and A-20	N/A	N/A	N/A	Editorial change: Revised document revisions under first, second, and third main bulleted items and wording under fifth bulleted item under "Existing Documentation"
Page A-20	RAI 3	What observations trigger examination into the	What observations trigger examination into the	

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		Expansion category? • Cracking observed in 10% (11) of the LCB bolts. Damage to locking devices for failed bolt locations is not unusual and would be anticipated; however, if damage to locking devices is observed in non-failed bolt locations, the second trigger criterion would also be used. • Observation of more than two locking devices damaged or missing (if no bolts are observed to be failed), pending additional evaluation as to the potential cause.	Expansion category? See Table 5-1 of MRP-227-A.	
Page A-20	N/A	Should it trigger expansion to all remaining bolt rings or a tiered approach? When an inspection triggers into the expansion, there is a unit-specific need to evaluate the results against the differences in materials used for the different locations and results from other unit inspections. For example, if failures are noted in the Alloy A-286 LCB bolts, but the UTS bolts are made from Alloy X-750 and no failures of this bolting material has been observed at any of the operating B&W units, a justification not to expand to this location should be possible. In addition, should failures be noted in a heat of Alloy A-286 used at one unit, expansion into the other units may need to be considered. However, one or more of the bolts with indications need	Should it trigger expansion to all remaining bolt rings or a tiered approach? When an inspection triggers into the expansion, there is a unit-specific need to evaluate the results against the differences in materials used for the different locations and results from other unit inspections. For example, if failures are noted in the Alloy A-286 LCB bolts, but the UTS bolts are made from Alloy X-750 and no failures of this bolting material has been observed at any of the operating B&W units, a justification not to expand to this location should be possible. In addition, should failures be noted in a heat of Alloy A-286 used at one unit, expansion into the other units may need to be considered. However, one or more of the bolts with indications may need to be removed for laboratory testing to confirm the IGSCC failure mechanism and stress analyses may need to be performed for each of the expansion bolt locations. Thus, expansion is not to	Editorial change

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		to be removed for laboratory testing to confirm the IGSCC failure mechanism and stress analyses need to be performed for each of the expansion bolt locations. Thus, expansion is not to be considered carte-blanche without additional evaluation.	be considered carte-blanche without additional evaluation.	
Page A-22	N/A	<u>Methodology and Data Requirements:</u> The general analytical methodology to be used for acceptance criteria for the BF bolts involves the following steps and inputs: • A global finite element model (FEM) is developed to evaluate bolt failures for use in developing the frequency for the I&E guidelines, acceptable failure pattern or numbers, and for use in preparing possible JCOs for the BF bolts • Representative rejected BF bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined	<u>Methodology and Data Requirements:</u> The general analytical methodology to be used for acceptance criteria for the BF bolts involves the following steps and inputs: • A global finite element model (FEM) is developed to evaluate bolt failures for use in developing the frequency for the I&E guidelines, acceptable failure pattern or numbers, and for use in preparing possible JCOs for the BF bolts • Representative rejected BF bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued.	Editorial change and methodology revision

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		bolt pattern may also be pursued.		
Page A-23	N/A	Analytical efforts could be performed on a generic basis, although there are two designs (ONS-1 and TMI-1 are one design and the other five units are the second design).	Analytical efforts could be performed on a generic basis, although there are two designs (ONS-1 and TMI-1 are one design and the other five units are the second design). The NDE inspection standard could also be developed generically.	Editorial change
Page A-23	RAI 10	<u>Existing Documentation:</u> • A FEM has been developed by the MRP Reactor Internals project that can be used in performing the evaluations A few bolts could be identified as failed (non-interpretable bolt UT signal; inaccessible bolt for UT; locking device observed to be missing, non-functional, or removed; partially cracked bolt; or completely cracked bolt) and shown to be acceptable with no further action needed A number of bolts (TBD) identified as failed (non-interpretable UT signal, partially cracked, or completely cracked) would initiate replacement activities and lead into the expansion category Past B&WOG work has determined the	<u>Existing Documentation:</u> • A FEM has been developed by the MRP Reactor Internals project that can be used in performing the evaluations ○ A few bolts could be identified as failed (non-interpretable bolt UT signal; inaccessible bolt for UT; locking device observed to be missing, non-functional, or removed; partially cracked bolt; or completely cracked bolt) and shown to be acceptable with no further action needed ○ A number of bolts (TBD) identified as failed (non-interpretable UT signal, partially cracked, or completely cracked) would initiate replacement activities and lead into the expansion category ▪ Past B&WOG work has determined the minimum number of bolts required for safe shutdown, but not for operation; i.e., no minimum bolt patterns have been determined ▪ The prior B&WOG effort was not explicitly used in establishing expansion criteria; rather a	

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		minimum number of bolts required for safe shutdown, but not for operation; i.e., no minimum bolt patterns have been determined • No acceptable evaluation or analysis has been completed to date for determining a re-inspection schedule	combination of results obtained in MRP-229 and industry data detailed in MRP-231 were used • No acceptable evaluation or analysis has been completed to date for determining a re-inspection schedule	
Page A-24	RAI 3	<u>What observations trigger examination into the Expansion category?</u> • Cracking observed in 5% (40) of the bolts or greater than 25% of the bolts on a single former plate	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A.	
Page A-25	N/A	<u>Component Item Function</u> Degradation of the baffle plates could result in increased core bypass flow and a reduction in margin to DNB, but would probably have a negligible effect on unit operations and would not be observed except by direct examination. The core barrel supports the fuel assemblies, lower grid, flow distributor, and incore instrument guide tubes. However, the baffle plates do not support any load. The primary function of the baffle plates during normal power operation is to provide a flow	<u>Component Item Function</u> Degradation of the baffle plates could result in increased core bypass flow and a reduction in margin to DNB, but would probably have a negligible effect on unit operations and would not be observed except by direct examination. The core barrel assembly supports the fuel assemblies, lower grid, flow distributor, and incore instrument guide tubes. However, the baffle plates do not support any load. The primary function of the baffle plates during normal power operation is to provide a flow envelope for the core and, thereby limit core bypass flow.	Editorial change

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		envelope for the core and, thereby limit core bypass flow. The baffle plates therefore do not have a direct core support safety function; however, they do have a safety function to control bypass around the core during a loss-of-coolant-accident (LOCA).	The baffle plates therefore do not have a direct core support safety function; however, they do have a safety function to control bypass around the core during a loss-of-coolant-accident (LOCA).	

Page A-26	RAI 11	<u>Methodology and Data Requirements:</u>
		
		The general analytical methodology to be used for acceptance criteria for the baffle plates involves the following steps and inputs:
		
		• Confirmation of required loading and combination requirements
		
		• Determine the expected crack opening displacement (COD) for development of the inspection standard
		
		• Perform a linear-elastic fracture mechanics (LEFM) evaluation to determine the critical crack size using the MRP-211 fracture toughness values
		
		• A flaw handbook could also be developed Or, justify the existing calculations in MRP-210
			<u>Methodology and Data Requirements:</u>
			
			The general analytical methodology to be used for acceptance criteria for the baffle plates involves the following steps and inputs:
			
			• Confirmation of required loading and combination requirements and determination of the high stressed regions in the baffle plates
			• Perform a linear-elastic fracture mechanics (LEFM) evaluation to determine the critical crack size using the MRP-211 fracture toughness values
			  ○ LEFM will be used to determine the applied stress intensity factors (SIFs) for a through-thickness flawed configuration, emanating from flow holes and bolt holes, with normal/upset condition loads
			  ○ The first objective would be to try to demonstrate that the cracks emanating from these flow/bolt holes are not likely to initiate
			  ○ Crack growth analysis is planned to be performed considering the normal/upset condition stresses and	

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		• Perform a bypass analysis to justify that sufficient DNB exists in the degraded condition • A VT-1, ET, or UT examination may be needed to further characterize the flaws or to determine if flaws are emanating from the location where missing material may be identified • An operability evaluation to operate at least one cycle based on possible inspection results for the plates should be performed • An evaluation of the consequences of leaving cracked plates securely in place during an inspection or replacement campaign should be performed	IASCC growth for a 10-year inspection interval o Critical crack sizes based on the degraded fracture toughness value and stresses under typical operating and LOCA conditions will be determined o Additionally, the minimum time to critical crack size will be determined • If the above efforts are unsuccessful in concluding continued functionality, a bypass analysis may need to be performed to justify that sufficient DNB exists in the degraded condition • A VT-1, ET, or UT examination may be needed to further characterize the flaws or to determine if flaws are emanating from the location where missing material may be identified • An operability evaluation to operate at least one cycle based on possible inspection results for the plates should be performed • An evaluation of the consequences of leaving cracked plates securely in place during an inspection or replacement campaign should be performed	
Page A-27	RAI 3	<u>What observations trigger examination into the Expansion category?</u> • Gross cracking (if confirmed) on two or more locations in the baffle plates shall trigger an evaluation of the inspectability of the accessible areas of the former plates and core barrel (particularly the core barrel upper flange-to-core barrel weld and upper HAZ area) using VT-3	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A.	

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		inspection • In addition, an evaluation of the operability of the former plates and core barrel in degraded conditions shall be performed • If a VT-3 examination is possible, it is required by completion of the next refueling outage		
Page A-28	N/A	<u>Component Item Function</u> The locking devices and welds are not normally loaded unless the bolt is broken or loose. Loading of the locking devices and welds could also occur due to the slip between the bolt and plate. The locking devices and welds have no core support safety function.	<u>Component Item Function</u> The baffle-to-baffle bolts and the baffle-to-former bolts are subjected to flow-induced vibratory loads and significant thermal stresses due to the gamma heating in the core region. Both of these phenomena tend to cause bold preload relaxation and a forcing function to unthread the bolts. The locking devices and welds serve to prevent unthreading and to capture the bolt head in the event that the bolt severs. They have marginal impact on maintaining bolt pre-load. The locking devices and welds are not normally loaded unless the bolt is broken or loose. Loading of the locking devices and welds could also occur due to the slip between the bolt and plate. The locking devices and welds have no core support safety function.	Editorial change

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Page A-29	RAI 3	<u>What observations trigger examination into the Expansion category?</u> • Confirmed rejectable indications in greater than or equal to 1% (or, 11) of the baffle-to-former and internal BB bolt locking devices shall trigger an evaluation of the locking devices for the external baffle-to-baffle bolts and core barrel-to-former bolts for the purpose of determining continued operation or replacement	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A.	
Flow Distributor bolts (originally on Page A-62)	RAI 24	N/A	N/A	Moved from Expansion item to Primary item
Flow Distributor bolts (originally on Page A-62)	N/A	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices are to be performed.	Editorial change
Flow Distributor bolts (originally on Page A-64)	N/A	• Representative rejected FD bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s)	• Representative rejected FD bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s)	Editorial change and methodology revision

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		NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of FD bolt UT inspection and laboratory test results, perform an evaluation to assess future FD bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future FD bolt failure into the operability evaluation and re-inspection requirement	NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of FD bolt UT inspection and any laboratory test results, perform an evaluation to assess future FD bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future FD bolt failure into the operability evaluation and re-inspection requirement	
Flow Distributor bolts (originally on Page A-64)	N/A	<u>Existing Documentation:</u> A generic flow distributor bolt stress analysis (for all units except TMI-1) was developed for the MRP reactor internals project in 2007 (see AREVA NP document 32-9059506). An NRC-accepted crack growth rate for Alloy A-286 or	<u>Existing Documentation:</u> A generic flow distributor bolt stress analysis (for all units except TMI-1) was developed for the MRP reactor internals project in 2007 (see AREVA NP document 32-9059506-003). An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350, AREVA	Editorial change

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		Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350) has identified some CGR data that is currently available for a feasibility study of a life assessment approach, if desired.	document 51-9079485-000) has identified some CGR data that is currently available. A CGR based life analysis has not been performed for any structural bolts. Based on the available CGR data, a life assessment based entirely on the CGR without considering crack initiation is judged unlikely to yield acceptable results.	
Flow Distributor bolts (not in original text)	RAI 3	[subheadings do not exist in current document]	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A. <u>Should it trigger expansion to all remaining bolt rings or a tiered approach?</u> When an inspection triggers into the expansion, there is a unit-specific need to evaluate the results against the differences in materials used for the different locations and results from other unit inspections. For example, if failures are noted in the Alloy A-286 FD bolts, but the UTS bolts are made from Alloy X-750 and no failures of this bolting material has been observed at any of the operating B&W units, a justification not to expand to this location should be possible. In addition, should failures be noted in a heat of Alloy A-286 used at one unit, expansion into the other units may need to be considered. However, one or more of the bolts with indications may need to be removed for laboratory testing to confirm the IGSCC failure mechanism and stress analyses may need to be performed for each of the expansion bolt locations. Thus, expansion is not to be considered carte-blanche without additional evaluation.	

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
Page A-31	N/A	Methodology and Data Requirements: The general methodology to be used for acceptance criteria for the dowel-to-guide block welds will be development of an NDE inspection standard that contains examples of acceptable and unacceptable dowel-to-guide block weld visual indications. The function of the weld can be maintained as long as a portion of the weld is in place. Significant cracking of the weld and subsequent loss of the dowel does not compromise the function of the guide block unless the bolt also fails. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the guide block dowels • Evaluate how many (if any) guide blocks are needed for operation • Evaluate the consequences of leaving partially cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what is rejectable and requiring further evaluation	Methodology and Data Requirements: The general methodology to be used for acceptance criteria for the dowel-to-guide block welds will be development of an NDE inspection standard that contains examples of acceptable and unacceptable dowel-to-guide block weld visual indications. The function of the weld can be maintained as long as a portion of the weld is in place. Significant cracking of the weld and subsequent loss of the dowel does not compromise the function of the guide block unless the dowel backs out of the guide block and loses engagement with the lower grid assembly. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the guide block dowels • Evaluate how many (if any) guide blocks are needed for operation • Evaluate the consequences of leaving partially cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what is rejectable and requiring further evaluation • Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A technical justification for removal of the guide block may be necessary. The NDE inspection standard could be developed generically.	Editorial change and methodology revision

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		• Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A UT examination of the guide block bolt or a technical justification for removal of the guide block may be necessary. Analytical efforts could be performed on a generic basis for the B&W units. The NDE inspection standard could also be developed generically.		
Page A-31	RAI 3	<u>What observations trigger examination into the Expansion category?</u> • Confirmed rejectable indications of two or more separated, cracked, or failed locking welds shall trigger a VT-3 examination of the expansion category locking welds by the next scheduled refueling outage	<u>What observations trigger examination into the Expansion category?</u> See Table 5-1 of MRP-227-A.	
Page A-32	N/A	<u>Component Item Function</u> Degradation of the IMI guide tube spiders could result in misalignment of the IMI nozzles and subsequent insertion of the in-core monitoring instrumentation. The IMI guide tube spiders do not have a core support safety function.	<u>Component Item Function</u> The purpose of the spiders is to provide lateral restraint for the IMI guide tubes and the purpose of the spider fillet welds is to hold the spiders in place. The spiders and spider-to-lower gird rib section welds have a minimal role in actually supporting the IMI guide tubes and do not provide a core support function. Although unlikely, significant degradation of the IMI guide tube spiders could result in misalignment of the guide tubes with the IMI nozzles and subsequent insertion or retraction of the in-core monitoring instrumentation.	Editorial change

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
Page A-32	N/A	Observable Effects A visual (VT-3) examination of the IMI guide tube spiders is to be performed. Subsequent visual examinations are to be performed during the ASME Code B-N-3 10-year ISI activities. The IMI guide tube spiders are being examined to detect spider arms that do not align with the lower fuel assembly support pad center bolt. The location that potentially contains the highest tensile stresses is near the heat-affected-zone (HAZ) of the spider-to-lower grid rib section weld, which is not readily accessible.	Observable Effects A visual (VT-3) examination of the IMI guide tube spiders is to be performed. Subsequent visual examinations are to be performed during the ASME Code B-N-3 10-year ISI activities. The IMI guide tube spiders are being examined to detect fractured or missing spider arms or any separated or missing welds. The location that potentially contains the highest tensile stresses is near the heat-affected-zone (HAZ) of the spider-to-lower grid rib section weld, which is not readily accessible.	Editorial change
Page A-33	N/A	Possible Examination Outcomes: • No relevant conditions identified • One or more areas are identified with a spider arm that is not aligned with the lower fuel assembly support pad center bolt or obvious separation or the spider arm from the lower grid rib section welded connection • One or more areas are identified with a missing spider arm	Possible examination outcomes: • No relevant conditions identified • One or more areas are identified with a fractured spider arm • One or more areas are identified with a separated weld • One or more areas are identified with a missing spider arm • One or more areas are identified with a missing weld	Editorial change

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Page A-33	RAI 22	Methodology and Data Requirements: The general analytical methodology to be used for acceptance criteria for the IMI guide tube spiders involves the following steps and inputs: • Prepare an analysis to show that one or more missing spider arms or a completely missing spider will not result in loss of function of the IMI guide tube • A VT-1, ET, or UT examination may be needed to determine if flaws are emanating from the location where missing material may be identified	Methodology and Data Requirements: The general analytical methodology to be used for acceptance criteria for the IMI guide tube spiders involves the following steps and inputs: • Prepare an evaluation, such as a flow-induced vibration (FIV) analysis, to insure that the IMI spider will have adequate structural integrity to prevent instability and loss of function • A VT-1, ET, or UT examination may be needed to determine if flaws are emanating from the location where missing material may be identified	
Page A-33	RAI 3	What observations trigger examination into the Expansion category? Confirmed evidence of misalignment, separation, gross damage, or a missing spider arm for two or more locations shall trigger VT-3 examination of 100% of the accessible surfaces at the 4 screw locations (at every 90°) of the CRGT spacer castings and the lower grid assembly support pad items and it is required by completion of the next refueling outage.	What observations trigger examination into the Expansion category? See Table 5-1 of MRP-227-A.	
Page A-34	N/A	• Expansion component item information	• Expansion component item information extracted	Editorial change

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		extracted directly from Table 4-4 of MRP-227 • This information is in tabular form and contains the item name, unit applicability, failure effect, failure mechanism(s), expansion link(s), examination method, examination frequency, and examination coverage. • Component item function(s), including whether or not it has a core support safety function • Observable effect(s) • Methodology for development of acceptance criteria • Data requirements for development of acceptance criteria • Existing documents (e.g., PWROG or AREVA)	directly from Table 4-4 of MRP-227 This information is in tabular form and contains the item name, unit applicability, failure effect, failure mechanism(s), expansion link(s), examination method, examination frequency, and examination coverage. • Component item function(s), including whether or not it has a core support safety function • Observable effect(s) • Possible examination outcome(s). • Methodology for development of acceptance criteria • Data requirements for development of acceptance criteria • Existing documents (e.g., PWROG or AREVA)	
Page A-35	RAI 12	<u>Component Item Function</u> These welds serve as loose part prevention devices and are not structural. Small cracks in the locking weld are acceptable since the locking function can be maintained as long as any part of the weld is present. The fuel assembly support pads serve as guidance for loading of	<u>Component Item Function</u> These welds serve as loose part prevention devices and are not structural. Small cracks in the locking weld are acceptable since the locking function can be maintained as long as any part of the weld is present. The upper and lower fuel assembly support pads serve as guidance for loading and alignment of the fuel assemblies	

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		the fuel into the core. Once the fuel assemblies are loaded into the core, the support pads no longer have any function. Therefore, the dowel-to-grid fuel assembly support pad welds have no core support safety function.	into the core. The lower fuel assembly support pads also provide the vertical load path for both the dead weight and fuel spring load into the lower grid assembly. The upper fuel assembly support pads transfer the fuel spring load to the upper grid assembly. The dowels maintain the horizontal position of the fuel support pads. There are minor horizontal operating loads on the pads due to cross flow in the fuel and fuel interference due to bowing. The upper and lower support pads are assumed to be in the seismic load path from the fuel assembly to the lower and upper grid, respectively. Therefore, the dowels provide a core support function.	
Page A-35	RAI 12	Observable Effects: A visual (VT-3) examination of the dowel-to-grid fuel assembly support pad (upper and lower grids) welds is to be performed. Loss of the locking function of the weld is the main concern and therefore the dowel-to-grid fuel assembly support pad welds are to be examined to identify if any are separated or missing, if a dowel is missing, or the support pad is misaligned (clearly out of perpendicularity).	Observable Effects: A visual (VT-3) examination of the dowel-to-grid fuel assembly support pad (upper and lower grids) welds is to be performed. Loss of the locking function of the weld is the main concern and therefore the dowel-to-grid fuel assembly support pad welds are to be examined to identify if any welds are separated or missing. The examination will also identify if a dowel is missing, or the support pad is misaligned (clearly out of perpendicularity).	
Page A-36	N/A	Possible Examination Outcomes: No relevant conditions exist • A single weld is observed to be damaged or partially missing	Possible examination outcomes: • No relevant conditions exist • A single weld is observed to be damaged or partially missing	Editorial change

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		• Several welds are observed to be damaged or partially missing • A single weld or dowel is missing Several welds or dowels are missing A support pad is misaligned (clearly out of perpendicularity) or missing • Several support pads are misaligned (clearly out of perpendicularity) or missing	• Several welds are observed to be damaged or partially missing • A single weld and dowel is missing • Several welds and dowels are missing • A support pad is misaligned (clearly out of perpendicularity) or missing • Several support pads are misaligned (clearly out of perpendicularity) or missing	
Page A-36	N/A	Methodology and Data Requirements: The general methodology to be used for acceptance criteria for the dowel-to-grid fuel assembly support welds will be development of an NDE inspection standard that contains examples of acceptable and unacceptable dowel-to-grid fuel assembly support pad welds visual indications. The function of the weld can be maintained as long as a portion of the weld is in place. Significant cracking of the weld and subsequent loss of the dowel does not compromise the function of the fuel assembly support pad unless the bolt also fails. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the fuel assembly support pad dowels	Methodology and Data Requirements: The general methodology to be used for acceptance criteria for the dowel-to-grid fuel assembly support welds will be development of an NDE inspection standard that contains examples of acceptable and unacceptable dowel-to-grid fuel assembly support pad welds visual indications. The function of the weld can be maintained as long as a portion of the weld is in place. The loss of the dowel engagement in the fuel assembly support pad will result in support pad misalignment and invalidate the loading analysis assumptions for the fuel assembly support pad supports. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the fuel assembly support pad dowels • Evaluate the consequences of leaving partially cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what	Editorial change and methodology revision

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		• Evaluate the consequences of leaving partially cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what is rejectable and requiring further evaluation • Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A UT examination of the fuel assembly support pad bolt or a technical justification for removal of the fuel assembly support pad may be necessary. Analytical efforts could be performed on a generic basis for the applicable locations at each of the B&W units. The NDE inspection standard could also be developed generically.	is rejectable and requiring further evaluation • Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A technical justification for removal of the fuel assembly support pad may be necessary. The NDE inspection standard could be developed generically.	
Page A-39	N/A	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices are to be performed.	Editorial change

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Page A-40	N/A	• Representative rejected UTS bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of UTS bolt UT inspection and laboratory test results, perform an evaluation to assess future UTS bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future UTS bolt failure into the operability evaluation and re-inspection requirement	• Representative rejected UTS bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of UTS bolt UT inspection and any laboratory test results, perform an evaluation to assess future UTS bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future UTS bolt failure into the operability evaluation and re-inspection requirement	Editorial change and methodology revision
Page A-41	N/A	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available.	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350, AREVA	Editorial change

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		However, the PWROG project (PA-MSC-350) has identified some CGR data that is currently available for a feasibility study of a life assessment approach, if desired.	document 51-9079485-000) has identified some CGR data that is currently available. A CGR based life analysis has not been performed for any structural bolts. Based on the available CGR data, a life assessment based entirely on the CGR without considering crack initiation is judged unlikely to yield acceptable results.	
Page A-42	N/A	Observable Effects: A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices	Observable Effects: A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices are to be performed.	Editorial change

Pages A-43 and A-44	N/A	Methodology and Data Requirements:
		
		The general analytical methodology to be used for acceptance criteria for the studs/nuts or bolts involves the following steps and inputs if relevant conditions have been identified in the SSHT studs/nuts or bolts:
		
		• A thermal analysis is to be performed
		
		Determines bolt temperatures and temperature gradients for normal operating conditions
		
		• A structural analysis is to be performed in which failed studs/nuts or bolts are inactive
		
		Stress concentration factors are calculated to determine the peak stresses at the bolt head-to-shank fillet region or stud/nut
			Methodology and Data Requirements:
			
			The general analytical methodology to be used for acceptance criteria for the studs/nuts or bolts involves the following steps and inputs if relevant conditions have been identified in the SSHT studs/nuts or bolts:
			
			• A finite element model (FEM) is to be developed for the local geometry with contact conditions, pretension elements, loads and boundary conditions
			• A thermal analysis is to be performed
			  o Determines bolt temperatures and temperature gradients for normal operating conditions
			• A structural analysis is to be performed in which failed studs/nuts or bolts are inactive
			  o Stress concentration factors are calculated to determine the peak stresses at the bolt head-to-shank fillet region or stud/nut thread region
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		thread region under normal operating conditions Analysis is performed for all loads and load combinations required for an ASME evaluation (stress limits for threaded structural fasteners in subsection NG and Appendix F) An evaluation of joint stability (or, openness) is also to be performed • Representative rejected SSHT studs/nuts or bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of SSHT bolt UT inspection and laboratory test results, perform an evaluation to assess future SSHT stud/nut or bolt failure	under normal operating conditions o Analysis is performed for all loads and load combinations required for an ASME evaluation (stress limits for threaded structural fasteners in subsection NG and Appendix F) o An evaluation of joint stability (or, openness) is also to be performed • Representative rejected SSHT studs/nuts or bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of SSHT bolt UT inspection and any laboratory test results, perform an evaluation to assess future SSHT stud/nut or bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region or stud/nut thread region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future SSHT stud/nut or bolt failure into the operability evaluation and re-inspection requirement	

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		potential. The changes to the peak stress at the bolt head-to-shank fillet region or stud/nut thread region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC. • Incorporate the effect of future SSHT stud/nut or bolt failure into the operability evaluation and re-inspection requirement The general methodology to be used for acceptance criteria for the locking devices will be development of an NDE inspection standard that contains examples of acceptable and unacceptable locking device visual indications. The acceptance of locking devices is evaluated in two ways: a) observations with "failed" studs/nuts or bolts and b) observations with all studs/nuts or bolts intact. Observations of damaged locking devices with all studs/nuts or bolts intact represent a condition very different from that of locking device damage at a stud/nut or bolt location that is failed. In addition, a damaged or missing welded locking clip versus a crimpled locking cup potentially represents different initiating phenomena that need to be evaluated. Since there are only two units, and one has studs/nuts and the other has bolts, unit-specific analyses are required.	The general methodology to be used for acceptance criteria for the locking devices will be development of an NDE inspection standard that contains examples of acceptable and unacceptable locking device visual indications. The acceptance of locking devices is evaluated in two ways: a) observations with "failed" studs/nuts or bolts and b) observations with all studs/nuts or bolts intact. Observations of damaged locking devices with all studs/nuts or bolts intact represent a condition very different from that of locking device damage at a stud/nut or bolt location that is failed. In addition, a damaged or missing welded locking clip versus a crimpled locking cup potentially represents different initiating phenomena that need to be evaluated. Since there are only two units, and one has studs/nuts and the other has bolts, unit-specific analyses and NDE inspection standards are required.	

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
Page A-44	N/A	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350) has identified some CGR data that is currently available for a feasibility study of a life assessment approach, if desired.	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350, AREVA document 51-9079485-000) has identified some CGR data that is currently available. A CGR based life analysis has not been performed for any structural bolts. Based on the available CGR data, a life assessment based entirely on the CGR without considering crack initiation is judged unlikely to yield acceptable results.	Editorial change
Page A-45	RAI 15	Component Item Function Degradation of the core barrel cylinders and welds could result in increased core bypass flow and a reduction in margin to DNB, but would probably have a negligible effect on unit operations and would not be observed except by direct examination. The core barrel supports the fuel assemblies, lower grid, flow distributor, and incore instrument guide tubes. The primary function of the core barrel cylinders and welds during normal power operation is to provide a flow envelope for the core and, thereby limit core bypass flow. The core barrel cylinders and welds therefore do not have a direct core support safety function; however, they do have a safety function to control bypass around the core during a loss-of-coolant-accident (LOCA).	Component Item Function Degradation of the core barrel cylinders and welds could result in increased core bypass flow and a reduction in margin to DNB, but would probably have a negligible effect on unit operations and would not be observed except by direct examination. The core barrel supports the fuel assemblies, lower grid, flow distributor, and incore instrument guide tubes. The core barrel and flanged connections at the ends that bolt to the core support shield assembly and lower grid assembly, respectively, directly perform the core support function and provide a flow envelope for the core that limits core bypass flow, particularly during a loss-of-coolant-accident (LOCA).	

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
Page A-45	RAI 15	Observable Effects: The core barrel cylinders and welds are mostly inaccessible without disassembly. Therefore, no examination is currently required in MRP-227. The core barrel upper flange-to-core barrel wed and upper HAZ area is partially accessible and could potentially be VT-3 examined. Nothing is being examined at this time.	Observable Effects: The core barrel cylinder and welds are inaccessible without disassembly. Therefore, no examination is currently required in MRP-227. Nothing is being examined at this time.	

Page A-46	N/A	Methodology and Data Requirements:
		
		The general analytical methodology to be used for acceptance criteria for the core barrel cylinders and welds involves the following steps and inputs:
		
		• Confirmation of required loading and combination requirements
		
		• Perform a linear-elastic fracture mechanics (LEFM) evaluation to determine the critical crack size using the MRP-211 fracture toughness values
		
		• A flaw handbook could also be developed
			Methodology and Data Requirements:
			
			The general analytical methodology to be used for acceptance criteria for the core barrel cylinders and welds involves the following steps and inputs:
			
			• Confirmation of required loading and combination requirements
			• Perform a fracture mechanics (linear-elastic fracture mechanics (LEFM), or elastic-plastic fracture mechanics, (EPFM), as necessary) evaluation to determine the critical crack size using the MRP-211 fracture toughness values
			  o LEFM or EPFM will be used to determine the applied stress intensity factors (SIFs) for a through-thickness flawed configuration with normal/upset condition loads
			  o Crack growth analysis is planned to be performed considering the
				Methodology revision

Section or page of WCAP-17096-Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		Or, justify the existing calculations in MRP-210 • Perform a bypass analysis to justify that sufficient DNB exists in the degraded condition • An operability evaluation to operate at least one cycle based on possible degradation of the core barrel cylinders and welds should be performed • An evaluation of the consequences of leaving cracked core barrel cylinders and welds in place during an inspection or replacement campaign should be performed Analytical efforts could be performed on a generic basis.	normal/upset condition stresses and IASCC growth for a 10-year inspection interval o The applied SIF for the final crack size is planned to be evaluated with consideration of the faulted condition loads ▪ This applied SIF is planned to be compared against the lower bound irradiated fracture toughness, K_{JC}, for these plate materials o The maximum acceptable initial crack length (without crack growth) as well as the final length of the crack (with crack growth) emanating from a weld or bolt hole location at the end of the 10-year inspection interval will thereby be determined • Perform a bypass analysis to justify that sufficient DNB exists in the degraded condition • An operability evaluation to operate at least one cycle based on possible degradation of the core barrel cylinders and welds should be performed • An evaluation of the consequences of leaving cracked core barrel cylinders and welds in place during an inspection or replacement campaign should be performed Analytical efforts could be performed on a generic basis.	
Page A-47	RAI 16	Observable Effects: The former plates are mostly inaccessible without disassembly. Therefore, no examination is currently	Observable Effects: The former plates are mostly inaccessible without disassembly. Therefore, no examination is currently	

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		required in MRP-227. The former plates are partially accessible through openings in the core barrel assembly and could potentially be VT-3 examined. Nothing is required for examination at this time.	required in MRP-227. The top portion of the uppermost former plate is partially accessible from above the core barrel assembly and portions of the remaining former plates are partially accessible through openings in the core barrel assembly that could potentially be VT-3 examined if techniques were required to be developed, but substantial development efforts would be needed, which is why they are not currently required to be examined. Nothing is required for examination at this time.	

Page A-47	N/A	<u>Methodology and Data Requirements:</u>
		
		The general analytical methodology to be used for acceptance criteria for the former plates involves the following steps and inputs:
		
		• Confirmation of required loading and combination requirements
		
		• Perform a linear-elastic fracture mechanics (LEFM) evaluation to determine the critical crack size using the MRP-211 fracture toughness values
		
		  • A flaw handbook could also be developed
		
		  • Or, justify the existing calculations in
			<u>Methodology and Data Requirements:</u>
			
			The general analytical methodology to be used for acceptance criteria for the former plates involves the following steps and inputs:
			
			• Perform an evaluation to assess the potential of degradation with respect to the baffle plates
			• This will include comparison of similarity of materials, accumulated irradiation fluence and stresses in the former plates versus the baffle plates
			Excluding the stresses in the former plates at the threaded holes it is expected that the former plates will be shown to be less susceptible to embrittlement than the baffle plates.
			
			If the above effort is inconclusive then the possibility of limited examination of the former plate will be assessed, with the objective of confirming that the former plates had not cracked through to the surface around the threaded connections.
				Methodology revision

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		MRP-210 • An operability evaluation to operate at least one cycle based on possible degradation of the former plates should be performed • An evaluation of the consequences of leaving cracked former plates in place should be performed Analytical efforts could be performed on a generic basis.	Analytical efforts could be performed on a generic basis.	

Page A-50	N/A	<u>Methodology and Data Requirements:</u>
		
		The general analytical methodology to be used for acceptance criteria for the BB bolts involves the following steps and inputs:
		
		• A global FEM model is developed to evaluate failures for use in developing the frequency for the I&E guidelines, acceptable failure pattern or numbers, and for use in preparing possible JCOs for the BF and CF bolts
		  • Evaluations for these bolt locations will consider BB bolts to be failed and structurally inactive
		  • No specific pattern will need to be evaluated as the BB bolts do not
			<u>Methodology and Data Requirements:</u>
			
			The general analytical methodology to be used for acceptance criteria for the BB bolts involves the following steps and inputs:
			
			• A global FEM model is developed to evaluate failures for use in developing the frequency for the I&E guidelines, acceptable failure pattern or numbers, and for use in preparing possible JCOs for the BF and CF bolts
			  o Evaluations for these bolt locations will consider BB bolts to be failed and structurally inactive
			  o No specific pattern will need to be evaluated as the BB bolts do not perform any core support function, nor are they required to maintain the geometry of the core cavity
			  o In addition, no specific acceptance criteria
				Methodology revision

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		perform any core support function, nor are they required to maintain the geometry of the core cavity • In addition, no specific acceptance criteria are required for BB bolts • A hydraulic analysis for evaluation of changes in jet momentum flux due to changes in gaps will be performed to assess changes in jetting and possible fuel failures Analytical efforts could be performed on all bolt locations on a generic basis.	are required for BB bolts Analytical efforts could be performed on all bolt locations on a generic basis.	
Page A-53	N/A	<u>Methodology and Data Requirements:</u> Locking device failure in itself is not a safety concern and an assessment can be prepared stating this as such. Failure of the bolting locations is of more concern and is covered in the bolting summary pages. Analytical efforts could be performed on a generic basis for the B&W units.	<u>Methodology and Data Requirements:</u> Locking device failure in itself is not a safety concern and an assessment can be prepared stating this as such. Failure of the bolting locations is of more concern and is covered in the bolting summary pages.	Methodology revision
Page A-54	General RAI	Lower grid fuel assembly support pad items are mostly subject to irradiation embrittlement, with some also susceptible to thermal aging and irradiation	Lower grid fuel assembly support pad items are subject to irradiation embrittlement, which if a flaw would be present and they are subjected to loading that exceeds the	

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		embrittlement, which if a flaw would be present and they are subjected to loading that exceeds the materials degraded fracture toughness, such a condition could potentially lead to cracking. There is no known history of OE for cracking of these materials in PWR reactor vessel internals applications.	materials degraded fracture toughness, such a condition could potentially lead to cracking. There is no known history of OE for cracking of these materials in PWR reactor vessel internals applications.	
Page A-54	N/A	<u>Component Item Function</u> These welds serve as loose part prevention devices and are not structural. Small cracks in the locking weld are acceptable since the locking function can be maintained as long as any part of the weld is present. The fuel assembly support pads serve as guidance for loading of the fuel into the core. Once the fuel assemblies are loaded into the core, the support pads no longer have any function. Therefore, the lower grid fuel assembly support pad items have no core support safety function.	<u>Component Item Function</u> The cap screw locking welds serve as loose part prevention devices and are not structural. Small cracks in the locking weld are acceptable since the locking function can be maintained as long as any part of the weld is present. The fuel assembly support pads serve as guidance for loading of the fuel into the core and provide both vertical and lateral support for the fuel assembly. The fuel support pads are attached to the lower grid by the cap screws and maintain their alignment and lateral support capability through the Alloy X-750 dowels.	Editorial change
Page A-55	N/A	<u>Possible Examination Outcomes:</u> • No relevant conditions exist • A single weld is separated or missing • Several welds are separated or missing	<u>Possible examination outcomes:</u> • No relevant conditions exist • A single weld is separated or missing • Several welds are separated or missing • A single dowel is missing	Editorial change

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		• A single dowel is missing • Several dowels are missing • A support pad is misaligned (clearly out of perpendicularity) or missing • Several support pads are misaligned (clearly out of perpendicularity) or missing	• Several dowels are missing • A support pad is misaligned (clearly out of perpendicularity) or missing • Several support pads are misaligned (clearly out of perpendicularity) or missing • A single cap screw or locking weld is missing • Several cap screws or locking welds are missing	
Page A-55	N/A	<u>Methodology and Data Requirements:</u> The general methodology to be used for acceptance criteria for the lower grid fuel assembly support items will be development of an NDE inspection standard that contains examples of acceptable and unacceptable lower grid fuel assembly support pad item visual indications. The function of the support pad can be maintained as long as a portion of any of the welds is in place. Significant cracking of the welds and subsequent loss of the dowel does not compromise the function of the fuel assembly support pad unless the screw also fails. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the fuel assembly support pad dowels • Evaluate the consequences of leaving partially	<u>Methodology and Data Requirements:</u> The general methodology to be used for acceptance criteria for the lower grid fuel assembly support items will be development of an NDE inspection standard that contains examples of acceptable and unacceptable lower grid fuel assembly support pad item visual indications. The function of the cap screw and Alloy X-750 dowel locking welds can be maintained as long as a portion of the welds is in place. Significant cracking of the welds and subsequent loss of the dowel will result in misalignment of the fuel assembly support pad and loss of lateral support for the fuel assembly end fitting. The following items will be examined to establish VT-3 acceptance criteria and the technical justification: • Identify normal and faulted operating loads for the fuel assembly support pad dowels • Evaluate the consequences of leaving partially cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what	Editorial change and methodology revision

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
		cracked locking welds securely in place during an inspection • Identify the areas to be examined containing what is rejectable and requiring further evaluation • Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A UT examination of the fuel assembly support pad screw or a technical justification for removal of the fuel assembly support pad may be necessary. Analytical efforts could be performed on a generic basis for the B&W units. The NDE inspection standard could also be developed generically.	is rejectable and requiring further evaluation • Develop repair strategies for leaving in place if secured from being a loose part or removal and replacement activities A technical justification for removal of the fuel assembly support pad may be necessary. The NDE inspection standard could be developed generically.	
Page A-56	N/A	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices	<u>Observable Effects:</u> A volumetric examination (UT) of the bolts and a visual (VT-3) examination of the bolt locking devices are to be performed.	Editorial change
Page A-58	N/A	• Representative rejected lower grid shock pad bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC	• Representative rejected lower grid shock pad bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any	Editorial change and methodology revision

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		mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of lower grid shock pad bolt UT inspection and laboratory test results, perform an evaluation to assess future lower grid shock pad bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC.	other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of lower grid shock pad bolt UT inspection and any laboratory test results, perform an evaluation to assess future lower grid shock pad bolt failure potential. The changes to the peak stress at the bolt head-to-shank fillet region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC.	
Page A-58	N/A	<u>Existing Documentation:</u> An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350) has identified some CGR data that is currently available for a feasibility study of a life assessment approach, if desired.	<u>Existing Documentation:</u> An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350, AREVA document 51-9079485-000) has identified some CGR data that is currently available. A CGR based life analysis has not been performed for any structural bolts. Based on the available CGR data, a life assessment based entirely on the CGR without considering crack	Editorial change

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			initiation is judged unlikely to yield acceptable results.	
Page A-59	N/A	Observable Effects: A volumetric examination (UT) of the studs/nuts or bolts and a visual (VT-3) examination of the stud/nut or bolt locking devices	Observable Effects: A volumetric examination (UT) of the studs/nuts or bolts and a visual (VT-3) examination of the stud/nut or bolt locking devices are to be performed.	Editorial change
Page A-61	N/A	• Representative rejected LTS studs/nuts or bolts are to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of LTS bolt UT inspection and laboratory test results, perform an evaluation to assess future LTS stud/nut or bolt failure	• Representative rejected LTS studs/nuts or bolts may need to be removed for laboratory testing to confirm the UT inspection results and IGSCC mechanism, or to identify any other failure mechanism(s) NOTE: One alternative to removing representative UT rejected bolts for laboratory examination is to re-inspect all bolts at the next refueling outage if continued operation for one additional fuel cycle can be supported by a technical evaluation. Other possible options such as replacement of a predefined bolt pattern may also be pursued. • Based on the results of LTS bolt UT inspection and any laboratory test results, perform an evaluation to assess future LTS stud/nut or bolt failure potential. The changes to the peak stress at the bolt head-to-shank	Editorial change and methodology revision

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		potential. The changes to the peak stress at the bolt head-to-shank fillet region or stud/nut thread region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC.	fillet region or stud/nut thread region as a result of the identified failures should be included for evaluation of increased susceptibility to SCC.	
Page A-61	N/A	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350) has identified some CGR data that is currently available for a feasibility study of a life assessment approach, if desired.	Existing Documentation: An NRC-accepted crack growth rate for Alloy A-286 or Alloy X-750 material is not currently available. However, the PWROG project (PA-MSC-350, AREVA document 51-9079485-000) has identified some CGR data that is currently available. A CGR based life analysis has not been performed for any structural bolts. Based on the available CGR data, a life assessment based entirely on the CGR without considering crack initiation is judged unlikely to yield acceptable results.	Editorial change
Pages B-2 through B-24	RAI 15, RAI 16, RAI 21, RAI 22.	[see original flowcharts]	[see modified flowcharts]	All flowcharts modified and edited to align with RAI

Section or page of WCAP-17096 Rev. 2	NRC RAI	Current Wording	Proposed Revision	Remarks
	and RAI 23			responses, edits, and changes detailed in main text for each primary and expansion component item

Original Table 5-1

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items			
	Develop Generic Acceptance Criteria?[1]		
Component Item	Analytical	NDE Standard	Comments
Primary Items			
Plenum Cover Assembly & Core Support Shield Assembly Plenum cover weldment rib pads Plenum cover support flange CSS top flange	Yes	Yes	
Core Support Shield Assembly CSS cast outlet nozzles (Applicable to ONS-3 and DB only)[2]	Yes	Yes	Analytical efforts applicable to both ONS-3 and DB could be performed, although unit-specific analytical efforts may provide additional margin for one or both units.
Core Support Shield Assembly CSS vent valve discs[2]	Yes	Yes	A unit-specific bypass analytical effort is required for DB, since the number of vent valves is different.
Core Support Shield Assembly CSS vent valve top retaining ring CSS vent valve bottom retaining ring CSS vent valve disc shaft or hinge pin	Yes	Yes	Analytical efforts could be performed on a generic basis for all B&W units, although unit-specific analytical efforts may provide additional margin (particularly for DB).

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items			
	Develop Generic Acceptance Criteria?[1]		
Component Item	Analytical	NDE Standard	Comments
Core Support Shield Assembly Upper core barrel (UCB) bolts and their locking devices	No	Yes	Due to the variations in bolt materials used and loadings among the units, unit-specific analytical efforts are required. The generic efforts have already been completed in the PWROG PA-MSC-350 work.
Core Barrel Assembly Lower core barrel (LCB) bolts and their locking devices	No	Yes	Due to the variations in bolt materials used and loadings among the units, unit-specific analytical efforts are required. The generic efforts have already been completed in the PWROG PA-MSC-350 work.
Core Barrel Assembly Baffle-to-former bolts	Yes	N/A	There are two designs (ONS-1 and TMI-1 are one design, and the other five units are the second design).
Core Barrel Assembly Baffle plates	Yes	Yes	
Core Barrel Assembly Locking devices, including locking welds, of baffle-to-former bolts and internal baffle-to-baffle bolts	N/A	Yes	There are two designs (ONS-1 and TMI-1 are one design and the other five units are the second design).
Lower Grid Assembly Alloy X-750 dowel-to-guide block welds	Yes	Yes	

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items			
	Develop Generic Acceptance Criteria?[1]		
Component Item	Analytical	NDE Standard	Comments
Incore Monitoring Instrumentation (IMI) Guide Tube Assembly IMI guide tube spiders IMI guide tube spider-to-lower grid rib section welds	Yes	Yes	
Expansion Items			
Upper or Lower Grid Assembly Alloy X-750 dowel-to-upper grid fuel assembly support pad welds or Alloy X-750 dowel-to-lower grid fuel assembly support pad welds	Yes	Yes	
Control Rod Guide Tube Assembly CRGT spacer castings	No	Yes	Reactivity analyses are dependent upon fuel loading and must be performed on a unit-specific basis.
Core Barrel Assembly Upper thermal shield (UTS) bolts and their locking devices	Yes	Yes	Analytical efforts for the UTS bolt failures could be performed on a generic basis for all units except TMI-1, although use of unit-specific loadings could reduce the conservatism for some units.
Core Barrel Assembly Surveillance specimen holder tube (SSHT) studs/nuts (CR-3) or bolts (DB) and their locking devices	No	No	There are only two units: one has studs/nuts and the other has bolts.

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items

Component Item	Develop Generic Acceptance Criteria?[1]		Comments
	Analytical	NDE Standard	
Core Barrel Assembly Core barrel cylinder (including vertical and circumferential seam welds) Former plates	Yes	N/A	
Core Barrel Assembly Baffle-to-baffle bolts Core barrel-to-former bolts	Yes	N/A	There are two designs (ONS-1 and TMI-1 are one design, and the other five units are the second design).
Core Barrel Assembly Locking devices, including locking welds, for the external baffle-to-baffle bolts and core barrel-to-former bolts	Yes	N/A	
Lower Grid Assembly Lower grid fuel assembly support pad items: pad, pad-to-rib section welds, Alloy X-750 dowel, cap screw, and their locking welds (Note: The pads, dowels, and cap screws are included because of TE/IE of the welds.)	Yes	Yes	
Lower Grid Assembly Lower grid shock pad bolts and their locking devices (TMI only)	No	No	TMI unit-specific

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items

Component Item	Develop Generic Acceptance Criteria?[1]		Comments
	Analytical	NDE Standard	
Lower Grid Assembly Lower thermal shield studs/nuts or bolts (LTS) and their locking devices	No	Yes	Due to the variations in stud/nut or bolt materials used and loadings among the units, unit-specific analyses are required.
Flow Distributor Assembly Flow distributor (FD) bolts and their locking devices	Yes	Yes	Analytical efforts for the FD bolts could be performed on a generic basis (for all units except TMI-1), although unit-specific analyses could decrease the conservatism for some units.

Notes:

1. Analytical efforts include finite element analysis or fracture mechanics analysis. An NDE inspection standard contains examples of acceptable and unacceptable visual indications or ultrasonic testing flaw sizes.
2. These items may potentially be removed from examination if a records search identifies that actual material heats used for fabrication could be screened out as not being susceptible to the thermal aging degradation mechanism.

Revised Table 5-1

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items			
	Develop Generic Acceptance Criteria?[1]		
Component Item	Analytical	NDE Standard	Comments
Primary Items			
Plenum Cover Assembly & Core Support Shield Assembly Plenum cover weldment rib pads Plenum cover support flange CSS top flange	Yes	Yes	A generic core clamping evaluation can be performed.
Control Rod Guide Tube Assembly CRGT spacer castings	N/A	Yes	A generic degraded casting evaluation can be performed. Reactivity analyses, if necessary, are dependent upon fuel loading and must be performed on a unit-specific basis.
Core Support Shield Assembly CSS vent valve top retaining ring CSS vent valve bottom retaining ring	N/A	Yes	
Core Support Shield Assembly Upper core barrel (UCB) bolts and their locking devices	No	Yes	Due to the variations in bolt materials used and loadings among the units, unit-specific analytical efforts are required. The generic efforts have already been completed in the PWROG PA-MSC-350 work.

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items

Component Item	Develop Generic Acceptance Criteria?[1]		Comments
	Analytical	NDE Standard	
Core Barrel Assembly Lower core barrel (LCB) bolts and their locking devices	No	Yes	Due to the variations in bolt materials used and loadings among the units, unit-specific analytical efforts are required. The generic efforts have already been completed in the PWROG PA-MSC-350 work.
Core Barrel Assembly Baffle-to-former bolts	Yes	Yes	There are two slightly different designs that need to be analyzed.
Core Barrel Assembly Baffle plates	Yes	Yes	
Core Barrel Assembly Locking devices, including locking welds, of baffle-to-former bolts and internal baffle-to-baffle bolts	N/A	Yes	There are two slightly different designs that need to be analyzed.
Flow Distributor Assembly Flow distributor (FD) bolts and their locking devices	Yes	Yes	Analytical efforts for the FD bolts could be performed on a generic basis (for all units except TMI-1), although unit-specific analyses could decrease the conservatism for some units.
Lower Grid Assembly Alloy X-750 dowel-to-guide block welds	N/A	Yes	A generic evaluation of the minimum number of needed guide blocks can be performed.

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items			
	Develop Generic Acceptance Criteria?[1]		
Component Item	Analytical	NDE Standard	Comments
Incore Monitoring Instrumentation (IMI) Guide Tube Assembly IMI guide tube spiders IMI guide tube spider-to-lower grid rib section welds	Yes	Yes	
Expansion Items			
Upper or Lower Grid Assembly Alloy X-750 dowel-to-upper grid fuel assembly support pad welds or Alloy X-750 dowel-to-lower grid fuel assembly support pad welds	N/A	Yes	A generic evaluation of the consequences of failure of the weld, and if necessary, any additional examination required to confirm functional acceptability can be performed. (Note: Davis-Besse is an exception for the upper welds.)
Core Barrel Assembly Upper thermal shield (UTS) bolts and their locking devices	Yes	Yes	Analytical efforts for the UTS bolt failures could be performed on a generic basis (for all units except TMI-1), although use of unit-specific loadings could reduce the conservatism for some units.
Core Barrel Assembly Surveillance specimen holder tube (SSHT) studs/nuts (CR-3) or bolts (DB) and their locking devices	No	No	There are only two units: one has studs/nuts and the other has bolts, so unit-specific analyses are required.
Core Barrel Assembly Core barrel cylinder (including vertical and circumferential seam welds) Former plates	Yes	N/A	

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items

Component Item	Develop Generic Acceptance Criteria?[1]		Comments
	Analytical	NDE Standard	
Core Barrel Assembly Baffle-to-baffle bolts Core barrel-to-former bolts	Yes	N/A	There are two slightly different designs that need to be analyzed.
Core Barrel Assembly Locking devices, including locking welds, for the external baffle-to-baffle bolts and core barrel-to-former bolts	N/A	N/A	
Lower Grid Assembly Lower grid fuel assembly support pad items: pad, pad-to-rib section welds, Alloy X-750 dowel, cap screw, and their locking welds (Note: The pads, dowels, and cap screws are included because of IE of the welds.)	N/A	Yes	An evaluation of the lower grid assembly items of the consequences of failure for each item and, if necessary, any additional examination required to confirm functional acceptability could be performed generically.
Lower Grid Assembly Lower grid shock pad bolts and their locking devices (TMI only)	No	No	TMI unit-specific
Lower Grid Assembly Lower thermal shield studs/nuts or bolts (LTS) and their locking devices	Yes	Yes	Generic efforts can be performed for 1) stud/nut and 2) bolt materials, although use of unit-specific analyses could decrease the conservatism for some units.

Table 5-1 Applicability of Potential Generic Acceptance Criteria for B&W-Design Primary and Expansion Component Items

Component Item	Develop Generic Acceptance Criteria?[1]		Comments
	Analytical	NDE Standard	

Notes:

1. Analytical efforts include finite element analysis or fracture mechanics analysis. An NDE inspection standard contains examples of acceptable and unacceptable visual indications or ultrasonic testing flaw sizes; the generic portion to be developed includes the item description, fabrication records information, function definition, operating history, the degradation mechanism(s) of interest, relevant conditions to be reported for further evaluation, and any unit-specific information.