



Peening Surface Stress Improvement to Mitigate PWSCC of Alloy 600/82/182 PWR Components: MRP Documents Supporting Implementation

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MRP-335 Topical Report Status

- MRP Assessment Committee endorsed in May
 - Vendor review and comments incorporated in parallel
- MRP Integration Committee comments incorporated
- MRP Integration approval expected by July 27
- Executive approval expected by August 24
- Publish by August 31

MRP-335 - Section 4: Examination Requirements

Recommended Inspection Requirements for Alloy 82/182 Piping Welds Mitigated by Peening (As currently stated in MRP-335)

- The nominal depth of the compressive residual stress produced by the peening treatment is assumed to be at least 0.04 in. (1 mm)
- Pre-mitigation exam:
 - UT volumetric exam
 - ET exam of ID surface*
 - May be delayed to after mitigation outage provided that the inspection requirements for unmitigated component apply until exam is performed and PWSCC must not be detected during the delayed exam for the relaxed inspection requirements to apply
- Follow-up exams:
 - Volumetric at 1st or 2nd RFO and VE at 1st, 2nd, and 3rd RFOs for hot-leg operating temperature $\leq 625^{\circ}\text{F}$
 - Volumetric and VE at 2nd or 3rd RFO for cold-leg operating temperature $\geq 525^{\circ}\text{F}$ and $< 580^{\circ}\text{F}$
- ISI volumetric exam:
 - Each Section XI interval for hot-leg operating temperature $\leq 625^{\circ}\text{F}$
 - Every 2nd Section XI interval for cold-leg operating temperature $\geq 525^{\circ}\text{F}$ and $< 580^{\circ}\text{F}$
- ISI direct visual exam of bare-metal surface (VE):
 - Each Section XI interval
- If planar flaws connected to the wetted surface or pressure boundary leakage were to be detected, then additional actions would be required

*It is not required that the ET exam meet the requirements of a Performance Demonstration qualification similar to Appendix VIII of Section XI

MRP-335 - Section 4: Examination Requirements

Recommended Inspection Requirements for RPVHPNs Mitigated by Peening (As currently stated in MRP-335)

- The nominal peening depth for the Alloy 600 nozzle ID surface is assumed to be at least 0.02 in. (0.5 mm), and the nominal peening depth for the Alloy 600 nozzle OD surface inboard of the weld and the wetted surface of the Alloy 82/182 J-groove weld is assumed to be at least 0.12 in. (3 mm). The extent of the required treated surface is defined by the examination volume/area of Figure 2 of N-729-1
- Pre-mitigation exam:
 - UT volumetric exam from nozzle ID
 - ET exam of nozzle ID surface*
 - *It is not required that the ET exam meet the requirements of a Performance Demonstration qualification similar to Appendix VIII of Section XI
 - May be delayed to after mitigation outage provided that the inspection requirements for unmitigated component apply until exam is performed and PWSCC must not be detected during the delayed exam for the relaxed inspection requirements to apply
- Follow-up exams:
 - Volumetric and VE at 1st RFO for $EDY \geq 8$
 - Volumetric and VE at 2nd or 3rd RFO (but within 5 calendar years) for $EDY < 8$
- ISI volumetric exam:
 - Each Section XI interval for $EDY \geq 8$
 - Every 2nd Section XI interval for $EDY < 8$
- ISI direct visual exam of bare-metal surface (VE):
 - Same as for unmitigated case
- If planar flaws connected to the wetted surface or pressure boundary leakage were to be detected, then additional actions would be required

Current Topical Report / SE Plans

- Submit for Approval & SE – MRP-335 provides the basis for inspection relief for CRDM/CEDM and DM welds after mitigation with peening
 - MRP-267 Revision 1 provides the technical basis for peening to mitigate PWSCC, provided as companion report

LIC-500 Pre-Submittal Meeting Topics

- Need for TR
 - Existing inspection requirements per NRC regulations need to be extended to cover peening mitigation of Alloy 600 RVH nozzles and Alloy 82/182 piping butt welds in PWRs
 - Peening mitigation has been extensively applied in Japan and is needed as an option in the US
- Purpose and Scope for TR
 - To define appropriate inspection requirements for peening mitigation of Alloy 600 RVH nozzles and Alloy 82/182 piping butt welds in PWRs
- Methodology for TR
 - Deterministic and probabilistic analyses based on extensive mockup and other testing and plant experience with peening
- Fee Waiver Request – yes (later in presentation)

Topical Report Review Process Schedule

- Preliminary for Pre-Submission Meeting – July 20, 2012

Task	Description	Start Date	End Date	Deliverable
1	Meet with NRC to discuss TR submission	07/20/12	07/20/12	Presentation
2	Publish MRP-267 R1, and MRP-335	8/10/12	8/10/12	Reports
3	Submit MRP-335 (TR) for SE with MRP-267 Rev 1 as Companion Reference, and Fee Waiver Request	09/01/12	09/01/12	Transmittal Letter, Reports, and Fee Waiver Request
4	NRC performs TR Acceptance and Fee Waiver Reviews	09/01/12	10/1/12	Acceptance Letter with RAI and Milestones Schedule, and Fee Waiver Decision
5	Technical meeting with NRC to Review Documents	09/18/12	09/18/12	Presentations
6	Issue Work Plan	09/04/12	10/30/12	Work Plan
7	Complete Review and Approval by Work Plan	09/4/12	12/31/13	SE

Fee Waiver Discussion

§ 170.11 Exemptions.

- a) No application fees, license fees, renewal fees, inspection fees, or special project fee shall be required for:
 - 1) A special project that is a request/report submitted to the NRC
 - ii) In response to an NRC request from the Associate Office director level or above to resolve an identified safety, safeguards, or environmental issue, or to assist NRC in developing a rulemaking, regulatory guide, policy statement, generic letter, or bulletin;
- **NRC Perspective?**

Options for Topical Report review

- Continue current plan to submit topical report for approval, SE and maintain engagement in normal Code process
- Submit topical report for information only and continue MRP support to expedite via the Code process
- Submit topical report for approval, SE and continue MRP support to expedite via the Code process

- **Discuss Pros and Cons**

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Backup slides

Recommended Inspection Requirements with Peening Mitigation

Code Case		Nominal Peening Depth (Note 1)	Pre-Mitigation	Follow-up Exams	ISI Volumetric Exam	ISI Direct Visual Exam of Bare-Metal Surface (VE)
N-729	Alloy 600 Reactor Vessel Head (EDY ≥ 8)	N/A	N/A	N/A	All nozzles every 8 Yr prior to RIY = 2.25	Each RFO
N-729	Alloy 600 Reactor Vessel Head (EDY < 8)	N/A	N/A	N/A	All nozzles every 8 Yr prior to RIY = 2.25	Every 3 rd RFO or 5 Yr, whichever is less (Note 3)
	Peened Alloy 600 Reactor Vessel Head (EDY ≥ 8)	Note 2	Volumetric and ET from nozzle ID only (Note 4)	Volumetric and VE at 1 st RFO	Each Interval (Note 5)	Each RFO
	Peened Alloy 600 Reactor Vessel Head (EDY < 8)	Note 2	Volumetric and ET from nozzle ID only (Note 4)	Volumetric and VE at 2 nd or 3 rd RFO (but within 5 Yr)	Every 2 nd Interval (Note 5)	Every 3 rd RFO or 5 Yr, whichever is less (Note 5)
N-770	Unmitigated Alloy 82/182 Piping Butt Weld HL Operating Temperature ≤ 625°F (Item A-2)	N/A	N/A	N/A	Every 5 Yr (if not cracked)	Each RFO
N-770	Unmitigated Alloy 82/182 Piping Butt Weld CL Operating Temperature ≥ 525°F and < 580°F (Item B)	N/A	N/A	N/A	Every 2 nd Inspection Period, not to exceed 7 Yr (if not cracked)	Each Interval
	Peened Alloy 82/182 Piping Butt Weld HL Operating Temperature ≤ 625°F	ID surface of 82/182 at least 0.040 in. (1 mm)	Volumetric and ET of ID (Note 4)	Volumetric at 1 st or 2 nd RFO; VE at 1 st , 2 nd , and 3 rd RFOs	Each Interval (Note 5)	Each Interval (Note 5)
	Peened Alloy 82/182 Piping Butt Weld CL Operating Temperature ≥ 525°F and < 580°F	ID surface of 82/182 at least 0.040 in. (1 mm)	Volumetric and ET of ID (Note 4)	Volumetric and VE at 2 nd or 3 rd RFO	Every 2 nd Interval (Note 5)	Each Interval (Note 5)

Notes:

- (1) The nominal peening depth refers to the depth of the compressive stress produced by the peening treatment.
- (2) The nominal peening depth for the Alloy 600 nozzle ID surface is at least 0.020 in. (0.5 mm), and the nominal peening depth for the Alloy 600 nozzle OD surface inboard of the weld and the wetted surface of the Alloy 82/182 J-groove weld is at least 0.120 in. (3 mm). The extent of the required treated surface is defined by the examination volume/area of Figure 2 of N-729-1.
- (3) Note 4 of Table 1 of N-729-1 requires that no flaws unacceptable for continued service under -3130 or -3140 have been detected, or else the VE visual exam is performed each RFO.
- (4) It is not required that the pre-mitigation ET exam meet the requirements of a Performance Demonstration qualification similar to Appendix VIII of Section XI.
- (5) If planar flaws connected to the wetted surface or pressure boundary leakage were to be detected, then additional actions would be required.

Provide to staff for information and continue via ASME Process

- Favorable aspects
 - Review fees not an issue
 - Requirements must be incorporated into Code eventually
- Potential weaknesses
 - Does not provide for as broad an NRC review, only Code participants
 - NRR would not provide official input until Rulemaking
 - Early implementers would be uncertain of meeting NRC's expectations for relief
- **NRC Perspective?**

ASME Code Case N-770 and N-729 Revision Process

Task	Description	Date	Deliverable
1	TGHSNAI - Present proposed N-770 Rev and discuss Technical Basis WG Flaw Eval - Present Peening plan and prep them for review Interpretations Committee - Present Interpretations and get resolution	August 2012	Draft Code Case, Presentation to WG, Section III & XI Interpretations
2	TGHSNAI - Resolve Comments and finalize N-770 Rev with TG approval WG Flaw Eval - Present N-770 Rev and seek approval SG Water Cooled - Present N-770 for comment	November 2012	Comment resolution CC, TG and WG Approval, Presentation to SG
3	TGHSNAI - Resolve N-770 comments from WG and SG, Present draft of N-729 Rev to include peening WG Flaw Eval - Resolve N-770 comments get WG approval and introduce N-729 revision SG Water Cooled - Resolve N-770 comments seek approval Standards Committee - Present N-770 for approval by Section XI	February 2013	WG and SG comment resolution in CC 770, TG, WG and SG Approval, Standards Approval, Draft of CC-729 to TG
4	TGHSNAI - Resolve N-729 revision WG Flaw Eval - Introduce N-729 rev to WG and seek comment SG Water Cooled - Introduce N-729 rev to SG and seek comment	May 2013	TG Comment N-729, Presentation to WG, SG
5	TGHSNAI - Resolve SG and WG comments on N-729 WG Flaw Eval - Resolve WG comments and get approval SG Water Cooled - Resolve SG comments and get approval	August 2013	WG & SG comment resolution CC 729, WG & SG Approval
6	TGHSNAI - Resolve all outstanding issues on N-729 WG Flaw Eval - Resolve all outstanding issues on N-729 SG Water Cooled - Resolve all outstanding issues on N-729 Standards Committee - Get approval by Section XI	November 2013	Final TG, WG and SG Approval, Presentation to Standards
7	NRC endorses with or without comment per Regulation Guide 1.147	~2015	

Submit Topical Report for Approval, SE

- Favorable aspects
 - Facilitates a broad, formal technical review
 - Standard process 2 years for SE
 - Expedited process 1 year for SE
 - RAIs within 6 months would give implementers a good understanding of any issues
- Potential weaknesses
 - Potential review fees
 - Could hinder Code process, schedule

NRC Perspective?

Dual Path - ASME Code and Topical report

- Favorable aspects
 - Eliminates surprises
 - When topical report SE completed and/or Code Cases approved no changes expected
 - Even if Code case is slowed down utilities will have received NRC feedback through RAIs
 - Requirement would eventually have to be incorporated into Code
- Potential weaknesses
 - Potential review fees
 - Could hinder Code process
- **NRC Perspective?**