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Recent NRC RAIs on MRP-169

Background

- Two new RAIs related to OWOLs received in draft form on July 31:
  1. If OWOL design/installation or associated NDE does not perform as expected, a crack could grow 100% thru-wall and 360° thus violating the OWOL design basis
  2. Industry position does not provide sufficient basis for 10 ksi ID surface stress criteria (CC-N-770 requires surface stresses to be compressive for successful mitigation by stress improvement).

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Industry Responses

- Draft responses transmitted informally on August 27
  1. Industry emphasized that the hypothetical flaw growth postulated by staff is extremely unlikely, but nonetheless performed limit load analyses for three actual plant OWOL designs under this extreme assumption, which demonstrated adequate margins under normal + OBE loading conditions (albeit not full Sec XI Code required margins)
  2. Provided additional technical basis for 10 ksi limit plus emphasized that MRP-169 imposes dual criteria (surface stress plus very conservative crack growth criteria) for acceptance of WOL residual stresses

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Further Questions & Responses

- Staff questioned whether the three limit load analysis cases represent limiting loads for the fleet - are they bounding so that the SFs listed are the lowest they could expect or might there be plants with lower SFs.
  - The three cases analyzed are typical but not necessarily bounding.
  - The limit load analyses performed were not intended to establish a new design requirement, but to illustrate the impact on margins of the extremely conservative flaw assumption hypothesized by the staff
  - Defining limiting loads for the fleet would be a difficult task and would require prior knowledge of which plants/nozzles OWOLs will be applied to – arbitrary use of fleet bounding load is unreasonable since the most highly loaded plants might never apply OWOLs
  - If it becomes a design requirement to perform OWOL1 analysis for each application, then the SFs will be determined with plant/nozzle specific loads for any OWOL application

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Further Questions and Responses (cont'd)

- Staff questioned why we didn't consider all loading conditions (Normal, Upset, Emergency, and Faulted)
  - No problem considering Normal, Upset (OBE) and Emergency (SSE) loads. The problem is with Faulted, which for the three example plants included SSE + LOCA. That case yields SFs < 1 and would require significant increases in OWOL thickness (2 to 3 extra layers)
  - Precedent exists from MRP-216 study to consider Normal + SSE loads, but not LOCA
  - Also supported by probabilistic arguments. We're already postulating an extremely low probability flaw assumption – no need to combine that with an extremely improbable load case assumption

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Further Questions and Responses (cont'd)

- Why shouldn't the Limit Load Analyses be required to meet full Section XI Structural Margins
  - If it's required to meet full Section XI margins with the extreme flaw assumption, then <u>by definition</u>, the OWOLS will become FSWOLs
  - Industry counter-proposal is to perform the analysis for Emergency Conditions (Norm + SSE) and meet Faulted Condition SFs (~1.4; See Table which follows)
  - SF of 1.4 under Norm + SSE is basis for critical crack size calculations in LBB evaluations (*Standard Review Plan, 3.6.3*) which also address a hypothetical flaw assumption
  - MRP-216 study used SF on load of 1.2 for normal operation

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Sample Calcs – Structural Factors vs. Code Required Margins

Sample Calculations: Plant/Nozzle	Case:	OWOL Thickness (in.)	360° Flaw Depth (assumed)	Structural Factors: Normal Operation	Structural Factors: Norm + OBE	Structural Factors: Norm + SSE
Plant A / RPV Outlet	OWOL	0.58	75%	4.68	3.45	2.72
	OWOL1	0.58	100%	2.49	1.83	1.44
Plant B / Pump Suction	OWOL	0.504	75%	6.75	5.05	4.32
	OWOL1	0.504	100%	2.04	1.52	1.30
Plant C / Pump Discharge	OWOL	0.65	75%	6.51	4.19	3.30
	OWOL1	0.65	100%	2.71	1.74	1.38

Service Level	Sec XI Required Structural Factors: Membrane Stress	Sec XI Required Structural Factors: Bending Stress
Level A (Normal)	2.7	2.3
Level B (Upset)	2.4	2
Level C (Emerg)	1.8	1.6
Level D (Faulted)	1.3	1.4

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Further Questions and Responses (cont'd)

- Because of this RAI concern, the staff does not support sample inspection (e.g., inspecting 25% of the population) of OWOLs.
  - MRP-169 does not endorse the 25% sample approach for WOLs
  - MRP-169 ISI requirements (Section 7.2) are consistent with MRP-139, except they apply to both FSWOLs and OWOLs. Specifically:
    - Cat. B – Welds inspected per Sec. XI, App. VIII immediately prior to WOL and found clean; Future ISI per current ASME Code requirements (once every ten years)
    - Cat. F – Welds not inspected or inspected and found cracked; Inspect once in first five years; if no change, then return to current ASME Code requirements
  - Since these RAIs are associated with NRC approval of MRP-169, then this is not an issue

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