PWROG Relief Request from the Requirements of Code Case N-770-1 with Conditions

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Why We are Here

- To discuss concerns about the new coverage requirements imposed on Cold Leg nozzles DM Welds by the recently published restriction on Code Case N-770-1
- To explain the PWROG plan to develop a generic relief request to address this issue
- To gain NRC feedback on the planned relief request, so changes can be made, if needed, before finalization, and to minimize RAI requests

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Agenda

Time	Topic	Presenter
8:30 a.m. – 8:40 a.m.	Introductions and Opening Remarks	NRC/PWROG
8:40 a.m. – 10:00 a.m.	Review of the issues • N-770-2 issuance and basis • NRC comments and restrictions	PWROG
10:00 a.m. – 10:15 a.m.	Break	
10:15 a.m. – 11:40 a.m.	Review of the issues (continued) • Elements of the planned relief request • Technical basis for the planned relief request • Future activities	PWROG
11:40 a.m. – 11:50 a.m.	Public Comment / Discussion	
11:50 a.m. – 12:00 p.m.	Closing Remarks	NRC/PWROG
12:00 p.m.	Meeting Adjourned	

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Presentation Outline

- Examples of Inspection Challenges for CE Cold Leg Nozzles
- Cast Stainless Steel safe ends, and the effect of the recently imposed restriction on coverage calcs
- Discussion of the key elements of the relief request
- Technical Basis for the relief
  - Flaw Tolerance Results for some example cases
  - Inspection results to date
  - Probability of Cracking in these regions

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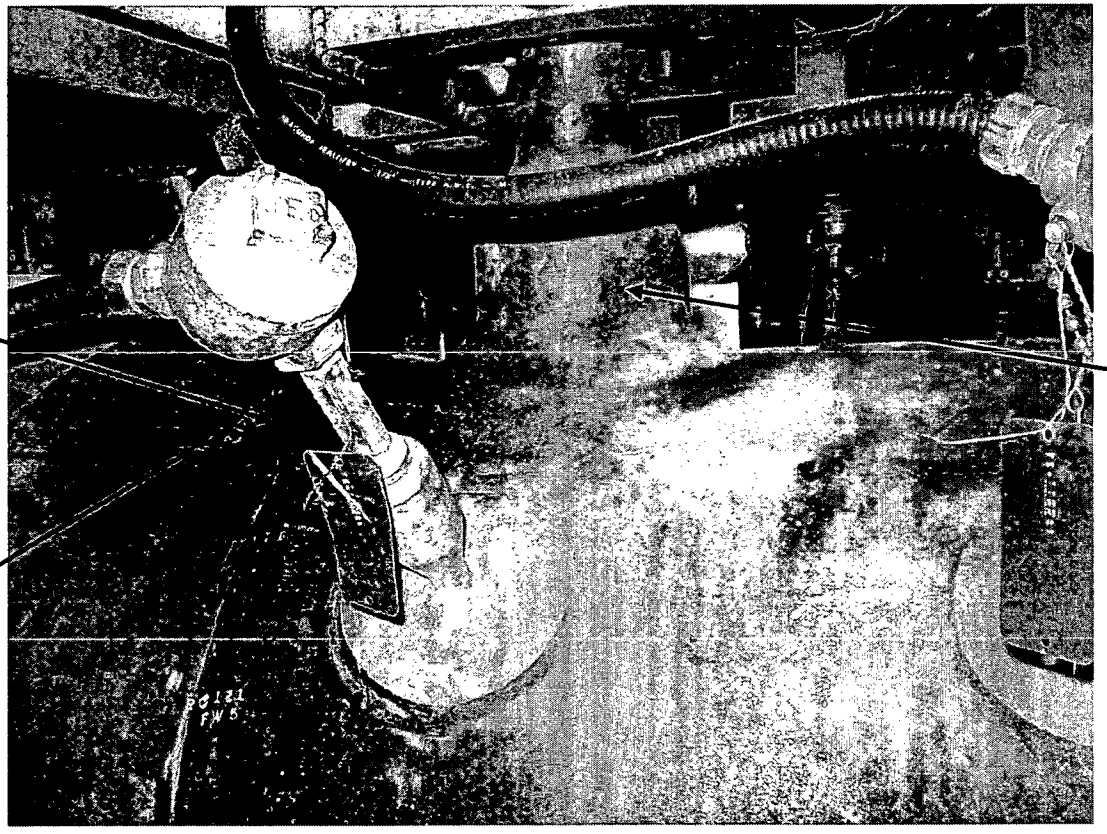
CE Reactor Coolant Pump Nozzle Weld Inspection Issues: an Example



Cast SS restricts exam credit to 1 side

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Cold Leg DM Weld Inspection Issues

- Cast Stainless Steel Safe End has no Appendix VIII qualification, so inspections from this direction cannot be counted
- This results in one-sided Inspection coverage for CE Nozzles with CASS safe ends, although N770-1 encourages scanning from the CASS side to the extent possible
- Weld Contour/Nozzle Configuration Limit Inspections

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Cast Stainless Steel

- Cast stainless is a very good material, highly resistant to stress corrosion cracking
- Even fatigue crack growth is slower than other 300 series stainless steels
- Inspectability is not as good as for wrought products, but work is underway to improve these capabilities, both at MRP and NRC

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Key Elements of the Relief Request

- Applicable Code Requirement
- Reason for Request
- Proposed alternative
- Basis for the Proposed alternative
- Structural Integrity Considerations

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Applicable Code Requirement

ASME Code Case N-770-1 as Amended by 10CFR50.55a(g)(6)(ii)(F)(4)		
CLASS 1 PWR Pressure Retaining Dissimilar Metal Piping and Vessel Nozzle Butt Welds Containing Alloy 82/182		
Parts Examined	Insp Item	Extent and Frequency of Examination
Unmitigated butt weld at Cold Leg operating temperature (-2410) ≥ 525°F (274°C) and < 580°F (304°C)	B	Bare metal visual examination once per interval Essentially 100% volumetric examination for axial and circumferential flaws in accordance with the applicable requirements of ASME Section XI, Appendix VIII, every second inspection period not to exceed 7 years. Baseline examinations shall be completed by the end of the next refueling outage after January 20, 2012.

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Reason for Request

- We asking to credit previous inspections done to the applicable requirements at the time (MRP-139) to satisfy the baseline requirements of Code Case N770-1, as modified by 10 CFR50.55a
- This modification requires the exam volume to include the stainless steel, which is not part of the susceptible material
- There are two coverage issues:
  - Percentages for potential Circumferential flaws
  - Requirements for potential Axial flaws

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Example of Differences in coverage counting: MRP-139 vs. N-770-1 as modified by NRC

DM Weld Designator / ID	Location	Nozzle Size	Inspection Item Category	ASME Section XI Coverage	ASME Axial Scan (%)	ASME Circ Scan (%)	MRP-139 Coverage	MRP-139 Axial Scan (%)	MRP-139 Circ Scan (%)
109280 / 30-RC-21A-7	**21A RCP Inlet**	30"	B	57.60%	68.6	46.5	91.50%	100	83
109310 / 30-RC-21A-10	**21A RCP Outlet**	30"	B	57.50%	64	51	89.50%	97	82
110280 / 30-RC-21B-7	**21B RCP Inlet**	30"	B	35.00%	40.7	29.4	94.50%	100	89
110310 / 30-RC-21B-10	**21B RCP Outlet**	30"	B	50.20%	60.3	40	89.50%	94	85
111280 / 30-RC-22A-7	**22A RCP Inlet**	30"	B	49.00%	55	43	92.50%	100	85
111310 / 30-RC-22A-10	**22A RCP Outlet**	30"	B	62.60%	68.2	57	92.50%	100	85
112280 / 30-RC-22B-7	**22B RCP Inlet**	30"	B	51.00%	58	44	93.50%	100	87
112310 / 30-RC-22B-10	**22B RCP Outlet**	30"	B	61.00%	72	50	87.00%	100	74
115140 / 12-SI-2009-15	**Safety Injection to 21B Cold Leg**	12"	B	68.00%	68	68	100%	100	100
116190 / 12-SI-2010-13	**Safety Injection to 21A Cold Leg**	12"	B	71.00%	71	71	100%	100	100
117120 / 12-SI-2011-13	**Safety Injection to 22B Cold Leg**	12"	B	68.50%	68.5	68.5	100%	100	100
118120 / 12-SI-2012-13	**Safety Injection to 22A Cold Leg**	12"	B	71.00%	71	71	100%	100	100
137010 / 3-PS-2001-1	**PZR Spray from 21A Cold Leg**	3"	B	100%	100	100	100%	100	100
138010 / 3-PS-2002-1	**PZR Spray from 21B Cold Leg**	3"	B	100%	100	100	100%	100	100

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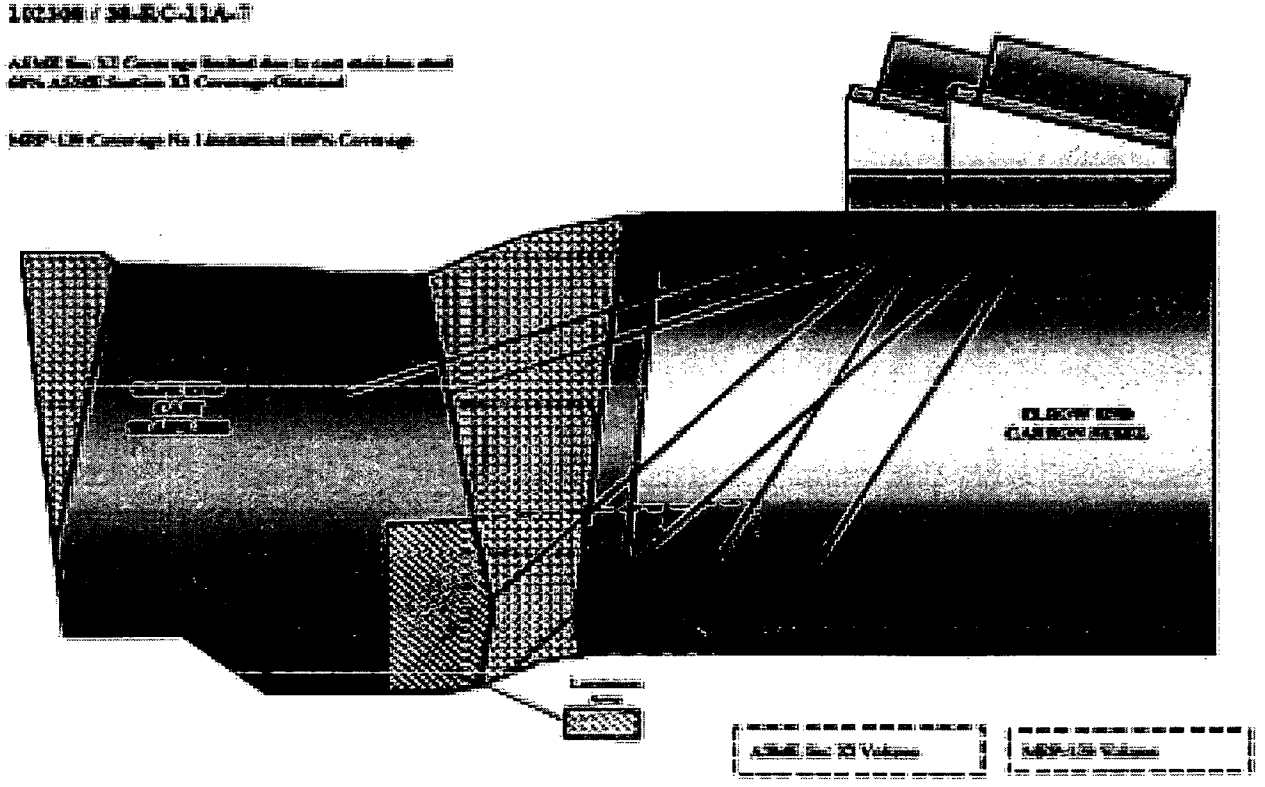
Example of Differences in coverage counting: Pump to safe end weld



Example of Differences in coverage counting: Safety Injection nozzle to safe end weld

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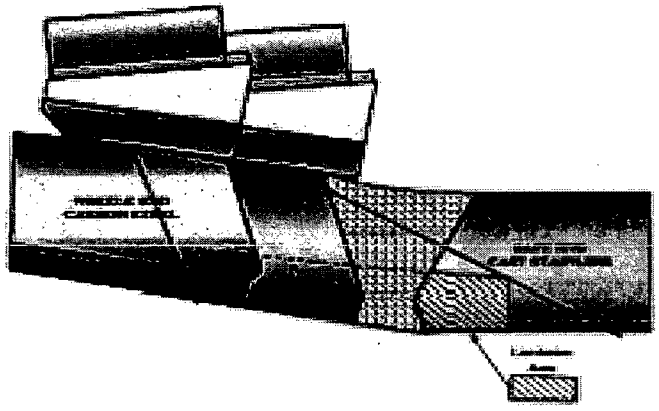

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Proposed alternative

- Periodic system Pressure Tests in accordance with Sect. XI
- UT Examinations to the maximum extent possible
- Walk-downs of Class 1 systems, in conjunction with the plant Boric Acid program
- Bare metal visual examinations of inspection Item "B" welds
- Coverage results less than those obtained in earlier inspections will be compiled and provided to NRC

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Inspection requirement Options of Code Case N-770 -2

- For Circumferential Flaws, If inspection coverage < 90%, and is a result of permanent obstructions, the following requirements ensue:
  - For Cold Leg locations, with diameters >14 inches, achieve maximum coverage possible, and perform a flaw tolerance evaluation
- Axial Flaws: Achieve maximum coverage possible, and document the limitations, provided 90% Circ. coverage is achieved

Structural Integrity Considerations

- All the welds are at Tcold:
  - Lower probability of cracking
  - Lower growth rate
- Very high Flaw Tolerance

Service Experience – Potential Locations

Large Diameter Cold Leg Weld Locations	Typical Temperature (°F)	Typical ID (inches)	Typical Number
Westinghouse Plants			
• Steam Generator Outlet Nozzles	550-560	--	--
• Reactor Vessel Inlet Nozzles		27.5	3
Combustion Engineering Plants			
• Reactor Coolant Pump Inlet Nozzles	549-560	30	4
• Reactor Coolant Pump Outlet Nozzles		30	4
Babcock and Wilcox Plants			
• Reactor Coolant Pump Inlet Nozzles		28	4
• Reactor Coolant Pump Outlet Nozzles	557	28	4
• Reactor Vessel Core Flood Nozzles		14	2
• Core Flood Tank Nozzle		14	2

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RV Nozzle PWSCC Experience

Plant	Temperature (°F)	EFPY (at time of cracking)
VC Summer	621	15.6
Seabrook	621	16.3
OHI 3	617	14.0
Ringhals 3	613	12.8
Ringhals 4	613	12.3
Salem 1	608	19.7

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SG Nozzle PWSCC Experience

Plant	Date	Number of Indications		
		A	B	C
Mihama Unit 2	September 2007	13 indications	0 indications	N/A
Tsuruga Unit 2	November 2007	1 indications	5 indications	23 indications
Takahama Unit 2	December 2007	3 indications	2 indications	4 indications
Genkai Unit 1	January 2008	3 indications	0 indications	N/A
Takahama Unit 3	February 2008	7 indications	16 indications	9 indications
Tomari Unit 2	April 2008	3 indications	10 indications	N/A
Takahama Unit 4	October 2008	7 indications	8 indications	21 indications
All indications in SG inlet nozzle welds				

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Statistical Analysis

- Performed to assess susceptibility of RCP nozzle welds to PWSCC
- Considered available experience data for all large diameter Alloy 82/182 weld locations
- Data fit to a Weibull distribution to calculate cracking probability with respect to EFPY
- Performed for 3 different temperatures and 3 different cases

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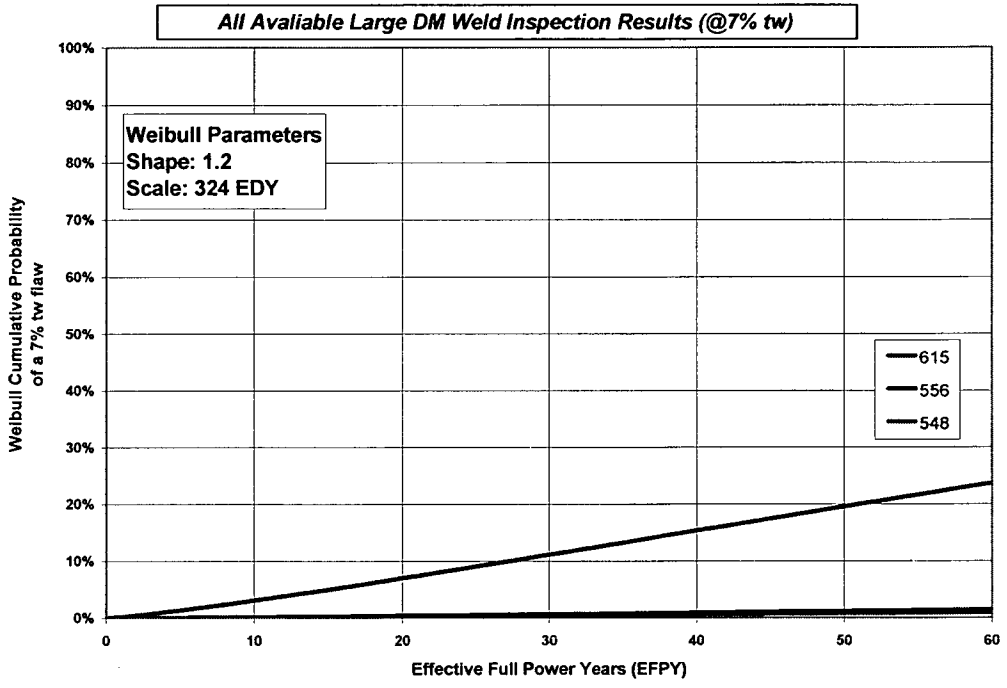
Statistical Analysis Results

Probability of Cracking			
At EFPY	**Case 1**	**Case 2**	**Case 3**
Temperature 548°F			
20	0.25%	0.00%	0.01%
40	0.57%	0.03%	0.05%
60	0.93%	0.12%	0.15%
Temperature 556°F			
20	0.38%	0.01%	0.02%
40	0.88%	0.10%	0.13%
60	1.42%	0.35%	0.35%
Temperature 615°F			
20	6.98%	20.92%	9.84%
40	15.32%	86.63%	44.34%
60	23.71%	99.92%	80.10%



Case 1 – All RV nozzles, SG Nozzles, Pump Nozzles and PZR Nozzles
Case 2 – All Nozzles Except PZR Nozzles
Case 3 – RV Outlet Nozzles and RCP Nozzles

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Flaw Tolerance Evaluations

- Determined time for postulated flaws to reach ASME allowable flaw size
- CE RCP nozzle welds and Westinghouse RV inlet nozzle welds evaluated
- Performed in accordance with ASME Section XI IWB-3640 guidelines
- Residual stresses calculated using FEA techniques
- Weld repairs of different magnitudes considered

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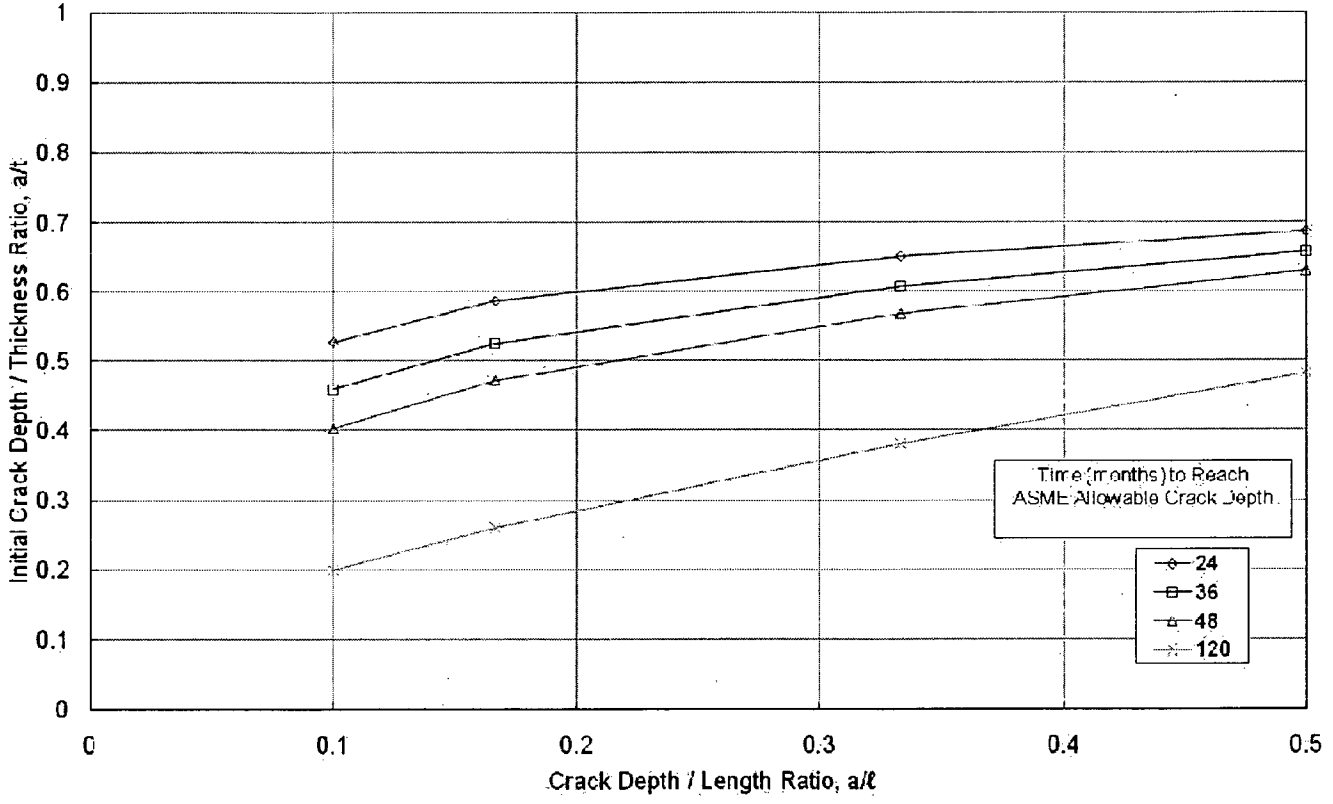
Allowable ASME End-of-Evaluation Period Flaw Depths (% Wall Thickness): CE Design Pumps

Flaw Orientation	Pump Suction and Discharge
Axial	75
Circumferential	73 to 75

Maximum ASME End-of-Evaluation Period Flaw Depths: CE Design SI Nozzles

Flaw Orientation	SI Nozzles
Axial	75%
Circumferential	66 to 75%

RCP Nozzle Results



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Structural Integrity Conclusions

- No known PWSCC events in large diameter cold leg welds
- Flaw tolerance for these locations is high
- PWSCC initiated flaws will take > 10 years to grow to maximum Code allowed depth
- Probability of cracking is small

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Summary and Conclusions

- Introduced the issue of coverage for cold leg nozzles
- Relief is requested to allow credit for previous exams conducted to the rules in place at the time.
- The technical basis for the relief is strong
- What is your feedback on the draft relief request?
- Comments on our approach to dealing with this issue in the Code?
- Future Actions

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