Millstone Power Station Unit 3

Proposed Alternative Request IR-3-39

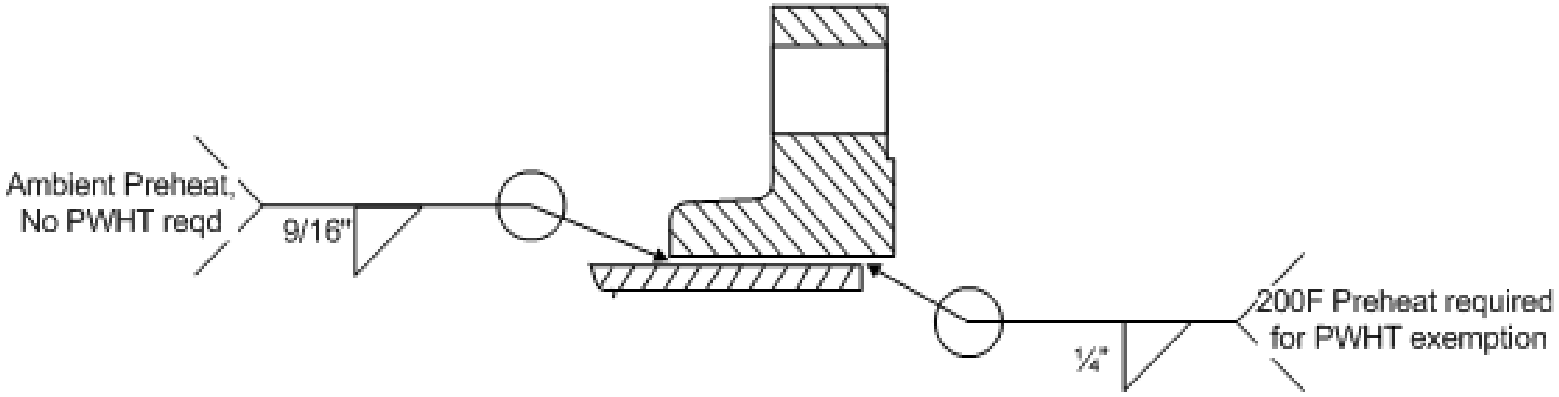
Fillet Weld Alternative to ASME Code Section XI, IWA-4221 (C)

Pre-Submittal Meeting

Dominion Energy®

Background & Request

- Dominion Energy requests an alternative to ASME Section XI, IWA-4221(c) requirements for fillet welds fabricated during the 'B' Reactor Plant Component Cooling Water (CCP) heat exchanger (HX) replacement project in Refueling Outage 17.
- Request will be submitted for two ASME Code Class 3, 24 inch Slip-on Flange inner diameter (ID) fillet welds (FW-12 and FW-30) made without ASME III Code required 200°F preheat or post weld heat treatment (PWHT) to remain in service without repair or replacement.



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Precedent

- The request follows the precedent established by Entergy for River Bend Unit 1 (ADAMS Accession No. ML13239A074) and was approved by the NRC on Jan 28, 2014 (ADAMS Accession No. ML13353A608).
- Millstone request will demonstrate an “acceptable level of quality and safety” per 10 CFR 50.55a(z)(1).
- Key technical differences between River Bend and Millstone requests are listed in the Table below:

River Bend	Millstone
Bimetallic - Stainless to Carbon Steel Welds	Carbon Steel Welds
Shield Metal Arc Weld (SMAW) E309L coated electrode	Gas Tungsten Arc Weld (GTAW) with ER 70S-2 bare wire
Cast SA216 Gr WCB base metal	Wrought SA 105 base metal
Various base metal thicknesses 2 to 5 in.	1.81” thick
Various chemical compositions	Single chemical composition
Automated Microhardness Map	Manual Microhardness Traverse
Automated Ball Indenture Testing	Tensile, Bend, and Impact Testing on original Weld PQR

Evaluation of Production Welds

- The ID fillet welds are not necessary to maintain structural integrity.
  - The fully Code compliant outside diameter (OD) fillet welds are capable of accommodating all design loads and maintaining structural integrity should the ID weld fail.
- Visual and magnetic particle (MT) examinations performed on production welds FW-12 and FW-30 did not result in any recordable indications.
- The original Welding Procedure Qualification Testing demonstrated that GTAW welds made using this process, filler metal, and parameters have acceptable strength, ductility, and toughness through the weld and HAZ.
  - Welding was performed per ASME section IX on 1-1/2” thick P-1 material with identical carbon content.
  - Welding was performed without elevated Preheat or PWHT.

Mockup Testing

- Identical Slip-on Flange Joint, Same Material and Weld Joint Details
- Same Welding Procedure and Sequence
- Areas laid out and welded (single pass & multipass) to represent:
  - Actual production ID fillet welds without 200 ^{o}F preheat
  - Code compliant fillet welds
- Two cross sections taken for each condition (single pass & multipass)
- Microsections were polished, etched, and examined at 400x
- Micro-hardness traverse across four regions representing:
  - Heat Affected Zone (HAZ) on base metal side (fine grained)
  - HAZ on weld side (course grained)
  - Weld metal near the fusion line
  - Weld metal at the weld throat (centerline)

Mockup Testing Results

- Multi-pass GTAW fillet welds on 1.81” thick SA105 low Carbon material without the 200 ^{o}F preheat produce comparable microstructures and lower hardness (of the weld and HAZ) with respect to equivalent code-compliant single pass fillet welds made with 200 ^{o}F preheat and on material ≤ 1 ½” thick without preheat.
- No cracking was observed in any mock up weld cross sections or detected by the MT examination of the actual field welds.
- Cracking of the ID fillet field weld and heat affected zones is unlikely because:
  - A very low hydrogen welding process was utilized,
  - The multipass GTAW weld and HAZ as deposited without 200^{o}F preheat have acceptable mechanical properties and excellent toughness, and
  - Operational stress in the ID fillet weld zone is low and predominantly compressive.

Conclusions

- The combination of low carbon content and multipass welding is more effective than 200 ^{o}F preheat in reducing HAZ hardness and preventing crack susceptible microstructures.

- The actual conditions used for these welds (base material, thickness, carbon content, multipass, and welding process variables) have been shown to produce welds with an acceptable level of quality and safety when compared to similar ASME III Code compliant welds.

- FW-12 & FW-30 made without ASME III Code required 200 ^{o}F preheat on the MPS3 ‘B’ CCP HX have acceptable properties for continued use without repair or replacement.

Schedule

- NRC Pre-Submittal Meeting on 01/22/2019
- Site Facility Safety Review Committee Review targeted for mid February 2019
- Alternative Request Submittal to the NRC expected by end of February 2019

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