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PALISADES NUCLEAR PLANT
ENGINEERING ANALYSIS COVER SHEET

EA-SC-93-087-02

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Title Half bead welding for modifications to TE-0101 and TE-0102

INITIATION AND REVIEW

Calculation Status	Preliminary ☐	Pending ☐	Final ■	Superseded ☐

Rev #	Description	Initiated By	Initiated Date	Init Appd By	Review Method: Alt Calc	Review Method: Detail Review	Review Method: Qual Test	Technically Reviewed By	Technically Reviewed Date	Revr Appd By	CPCo Appd
0	Original Issue	TJ Nordby	10/15/93	DWJ		X		PD Flenner	10/15/93	DWJ	

OBJECTIVE

This EA is written to allow the use of ABB Combustion Engineering (CE) welding procedure specification (WPS) SMA-3.43-937 for modification of TE-0102. In addition, this EA shall define the manner in which the half bead welding rules of ASME Section XI are applied for the modification of both TE-0101 and TE-0102. Specifically, the use of the ferritic rules for the base metal requirements and the use of the dissimilar metal weld rules for the filler metal and examination requirements. It should be noted that this EA only applies to the half bead welding portion of SMA-3.43-937.

Reference/Comment

ANALYSIS INPUT

1. ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components", 1983 edition including the Summer 1983 addenda.

2. ASME Section III, "Rules for Construction of Nuclear Power Plant Components", Subsection NB, 1986 edition.

3. ASME Section IX, "Welding and Brazing Qualifications", 1993 edition.

ASSUMPTIONS

MAJOR ASSUMPTIONS

None

MINOR ASSUMPTIONS

None

ANALYSIS

BACKGROUND

Two thermowell nozzles on the pressurizer (T-72) require modification to eliminate leak paths due to axial cracks. Because the nozzles are welded only to the inside of the vessel, the leak path is through the nozzle wall at a location beyond this weld. Therefore, the nozzles will be modified by first welding a pad of inconel filler material on the vessel around the nozzle on the outside of the vessel penetration and then welding the nozzle to the pad.

The material used for the vessel head and shell course is SA533 Grade B Class 1. Per ASME Section III (SC III) rules, welding on the head or shell course would normally require a postweld heat treatment (PWHT) at 1100°F to 1250°F. Since PWHT at these temperatures is not practical, SC XI provides alternate rules for welding on this material without a full PWHT. This welding technique is called "half bead welding".

CONCERNING THE MODIFICATION TO TE-0102

One of the rules for qualification of a half bead welding procedure is that the procedure test coupon material be of the same specification type, grade, and class. CE WPS SMA-3.43-937 was qualified for half bead welding on SA533 Grade B Class 1 material. As stated above, this is the same material as used for the pressurizer head and shell course. However, a welded boss of E8018-G filler metal (A No. 10 chemistry) exists at the location of TE-0102. In other words, the modification would will be made on the E8018-G boss not on the vessel shell course proper.

Reference/Comment

SC IX IWB-4320 states that "Repair to P-Nos. 1, 3, 12A, 12B, 12C base materials and associated welds may be made by welding in accordance with Section III without the specified postweld heat treatment requirements of NB-4622, provided the requirements of IWB-4321 through IWB-4324 are met." The E8018-G boss is an "associated weld". It should be noted that the corresponding SC III paragraph (NB-4622.9) does not use the term "associated welds" but specifically "A-No. 1, 2, 10, 11 weld filler metal".

A No. 10 chemistry would best fit as a P No. 3 Group 3 material. SA533 Grade B Class 1 (SA533) is also a P No. 3 Group 3 material. Although SC XI is very restrictive with regards to qualification coupon material, SC III, which has nearly identical rules for half bead welding (called temper bead welding in SC III), only requires that the material used for qualification of half bead (temper bead) welding be of the same P No. and Group No.

The main difference between the E8018-G boss and SA533 is nickel content. The E8018-G deposit has a higher nickel content. All else being equal, increases in nickel content correspond to increases in toughness and decreases in hardenability. Welding on the E8018-G boss should be less of a concern from a toughness and hardenability point of view than welding on SA533. In other words, qualification on SA533 plate is more conservative than the actual application of welding on the E8018-G boss.

CONCERNING APPLICATION OF HALF BEAD RULES

SC XI rules for half bead welding are broken up into two categories for pressure boundary materials. These categories are for restoring ferritic only base and\or weld metal and for restoring welds between ferritic and austenitic or nickel metals.

Basically both sets of rules are very similar. The only real difference is in the choice of filler metal and the preheat/interpass temperatures. While the pressurizer base metal is clearly ferritic, the filler metal to be used of the modifications is inconel (non-ferritic, F-43). For this modification portions of both sets of rules apply. However, when combined, these "portions" will address all of the concerns of either set of rules.

Because the filler metal being used is inconel, the general requirements of IWB-4341 are more applicable. This paragraph (and the corresponding ferritic general requirements) concern the control of filler metal.

For welding qualifications, IWB-4342 is more applicable. This paragraph references most of the requirements of the corresponding ferritic paragraph (IWB-4322) but is modified to take into account the non-ferritic filler metal.

Because the vessel base metal is ferritic, paragraph IWB-4323 should apply. The use of this paragraph will allow higher preheat and interpass temperatures which will help prevent underbead cracking and reduce residual stresses. While paragraph IWB-4343 would have set lower

Reference/Comment

reheat and interpass temperatures (especially outside the 3/16" layer covering the ferritic material), these higher temperatures are not a concern to the inconel filler metal as would be the case for austenitic stainless steel filler metals. (It should be noted that since inconel filler metal is used, the requirement of part (c) concerning removal of a final reinforcement layer to temper the final layer does not apply.)

For examination requirements, IWB-4344 is more applicable. Once again this is due to the use of inconel filler metal.

CONCLUSION

The welded boss in place at TE-0102 is an "associated weld" with an analysis comparable to P No. 3 Group 3 material, as described in IWB-4320. Therefore, SMA-3.43-937 is qualified for welding on this boss using the half bead welding technique.

The modifications to TE-0101 and TE-0102 both involve the use of the half bead welding technique. Both modifications use an inconel filler metal on a ferritic base metal. Because of the manner in which SC XI splits the rules for making half bead welds, the requirements for making these modifications do not fit neatly into a single category as provided by SC XI. In fact strict adherence to either category is impractical. However, it is also necessary to address all of the code concerns for making a half bead weld. Therefore, the applicable paragraphs for the half bead welding portion of the modifications to TE-0101 and TE-0102 are IWB-4341, IWB-4342, IWB-4323, and IWB-4344.