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10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

OCONEE NUCLEAR STATION, UNIT NOS. 1, 2 AND 3
DOCKET NOS. 50-269, 50-270, 50-287 / RENEWED LICENSE NOS. DPR-38, DPR-47 AND DPR-55

SUBJECT: Relief Request to Utilize an Alternative Acceptance Criteria for Code Case N-853, "PWR Class 1 Primary Piping Alloy 600 Full Penetration Branch Connection Weld Metal Buildup for Material Susceptible to Primary Water Stress Corrosion Cracking, Section XI, Division 1"

Ladies and Gentlemen:

Pursuant to 10 CFR 50.55a(z)(1), Duke Energy Carolinas, LLC (Duke Energy) requests U.S. Nuclear Regulatory Commission (NRC) approval to use an alternative volumetric inspection acceptance criteria for American Society of Mechanical Engineers (ASME) Code Case N-853, "PWR Class 1 Primary Piping Alloy 600 Full Penetration Branch Connection Weld Metal Buildup for Material Susceptible to Primary Water Stress Corrosion Cracking, Section XI, Division 1" at Oconee Nuclear Station Units 1, 2, and 3 (ONS). Specifically, in lieu of the ASME Code, Section III, NB-5330 acceptance criteria for Fabrication, Duke Energy proposes to use the preservice examination acceptance criteria of ASME Code, Section XI, IWB-3514. Enclosure 1 contains details regarding this request.

This submittal contains no new regulatory commitments. Duke Energy requests approval of this relief request prior to the next ONS Unit 3 refueling outage, currently scheduled to commence in April 2022. If you have questions concerning this request, please contact Art Zaremba, Manager, Fleet Licensing, at (980) 373-2062.

Sincerely,

Steven M. Snider
Site Vice President
Oconee Nuclear Station

Enclosure:

1. Relief Request RA-20-0334

cc: (all with Enclosure unless otherwise noted)

L. Dudes, Regional Administrator USNRC Region II
J. Nadel, USNRC Senior Resident Inspector – ONS
S. Williams, NRR Senior Project Manager – ONS

Enclosure 1
Relief Request RA-20-0334

1. **ASME Code Components Affected**

ONS1:

- Three 1A Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds (1-PHA-13, 1-PHA-14, & 1-PHA-15).
- Three 1B Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds. (1-PHB-13, 1-PHB-14, & 1-PHB-15).
- Four (4) Cold Leg RTE Mounting Boss Alloy 600 Nozzle Welds (1-PIA1-12, 1-PIA2-12, 1-PIB1-12, & 1-PIB2-12).

ONS2:

- Three 2A Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds. (2-PHA-13, 2-PHA-14, & 2-PHA-15).
- Three 2B Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds. (2-PHB-13, 2-PHB-14, & 2-PHB-15).
- Four (4) Cold Leg RTE Mounting Boss Alloy 600 Nozzle Welds (2-PIA1-12, 2-PIA2-12, 2-PIB1-12, & 2-PIB2-12).

ONS3:

- Three 3A Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds. (3-PHA-13, 3-PHA-14, & 3-PHA-15)
- Three 3B Hot Leg RTE Mounting Boss Alloy 600 Nozzle Welds. (3-PHB-13, 3-PHB-14, & 3-PHB-15).
- Two 3A Hot Leg Flow Meter Alloy 600 Nozzle Welds. (* Nearest Nozzle Butt Welds 3-RC-287-3 & 3-RC-287-63V).
- Two 3B Hot Leg Flow Meter Alloy 600 Nozzle Welds. (* Nearest Nozzle Butt Welds 3-RC-286-11 & 3-RC-286-58V).
- Four (4) Cold Leg RTE Mounting Boss Alloy 600 Nozzle Welds (3-PIA1-9, 3-PIA2-9, 3-PIB1-11, & 3-PIB2-9).
- One 3B1 Cold Leg Level Tap Alloy 600 Nozzle Weld. (* Nearest Nozzle Butt Weld 3-50-37-1).
- Three Cold Leg Drain Alloy 600 Nozzle Welds. (3PIA1-10, 3-PIA2-10, 3-PIB2-10).

  Note *: Small Bore Piping (1” NPS) Nozzle Welds are not given explicit weld IDs on the original Drawings. These nine specific Small Bore Nozzle Welds are located by the nearest documented branch connection butt weld.

Materials of construction for all locations referenced above are:

- Reactor Coolant System Piping (RCS) – SA-106 Grade B (P-No. 1)
- Alloy 600 Nozzle – SB-166 UNS N06600 (P-No. 43)
- Alloy 82/182 Dissimilar Metal Weld (DMW) – ERNiCr-3, Spec. SFA 5.14 / ENiCrFe-3, Spec. SFA 5.11 (F-No. 43)

2. **Applicable Code Edition and Addenda**

The current edition for the Inservice Inspection (ISI) interval for ONS 1, 2, and 3 is the American Society of Mechanical Engineers (ASME) Code, Section XI, 2007 Edition with the

2008 Addenda (Reference 1). All three units are in the fifth 10-year inspection interval with a scheduled end date of July 15, 2024.

The Code of Construction for ONS 1, 2, and 3 is B31.7, 1969 Edition. The Code for this repair/replacement activity is the ASME Code, Section III, 1983 Edition, no Addenda.

American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Code Case N-722-1 as conditioned by 10CFR50.55a (Reference 2)

American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Code Case N-853 (Reference 3)

3. **Applicable Code Requirements**

Code Case N-722-1 (as conditioned by 10CFR50.55a) requires that piping hot leg/cold leg full penetration welds, susceptible to PWSCC be inspected in accordance with Table 1 of the Code Case as part of the ISI program. Duke Energy has decided to preemptively mitigate/repair selected nozzle butt welds on the RCS piping, utilizing a welded reinforcing pad and replacement nozzle. The NRC previously approved a relief request (Reference 7) to use ASME Code Case N-853 as modified in that relief request.

ASME Code, Section XI (Reference 1), Article IWA-4000 provides requirements for repair replacement activities:

> IWA-4421 states, in part:
> Defects shall be removed or mitigated in accordance with the following requirements...
>
> IWA-4422.1(a) states, in part:
> A defect is considered removed when it has been reduced to an acceptable size ...
>
> IWA-4422.1(b) states, in part:
> Alternatively, the defect removal area and any remaining portion of the defect may be evaluated, and the component accepted in accordance with the appropriate flaw evaluation provisions of Section XI ...

Article IWA-4000 does not provide specific guidance for the repair or mitigation of defects in dissimilar metal welds. Furthermore, the NRC in 10CFR50.55a paragraph (xxv) specifically prohibits the use of the provisions in IWA-4340, "Mitigation of Defects by Modification" when using the ASME Code, 2007 Edition through 2008 Addenda.

4. **Reason for Request**

The welds identified in Section 1 are unmitigated full penetration welds fabricated from materials susceptible to Primary Water Stress Corrosion Cracking (PWSCC), (Figures 1a and 1b). As these welds are unmitigated, there exists the potential that flaws may develop at these locations and result in leakage. In accordance with Code Case N-722-1, these welds require frequent visual examination for the identification of any RCS leakage.

ONS received approval via NRC safety evaluation dated February 26, 2020 (Ref. 7) to preemptively apply a mitigation/repair using the rules of Code Case N-853 with a PWSCC resistant nozzle attached to the new weld pad with a full penetration nozzle corner weld (Figure 3) using a non-temper bead manual welding technique, using PWSCC resistant nickel Alloy 52M filler metal, or with a "J" groove partial penetration weld as described in Code Case N-853 (Figure 2). The welded pads are to be designed and installed in accordance with Code Case N-853 except that the replacement nozzle material is UNS S31600 or UNS N06690. The new welded pad provides a full structural primary pressure boundary repair that takes no structural credit for either the existing 82/182 weld or the Alloy 600 nozzle material.

Code Case N-853 and NRC SER (Ref. 7) specify that the volumetric examination of the pad repair material shall be in accordance with the construction code or Section III with acceptance criteria in NB-5330. The ASME Code, Section III acceptance standards are written for a range of fabrication flaws, including lack of fusion, incomplete penetration, cracking, slag inclusions, porosity, and concavity. However, experience and fracture mechanics have demonstrated that many of the flaws that would be rejected using the ASME Code, Section III acceptance criteria do not have a significant effect on the structural integrity of the component. These inspection criteria are derived on the basis of a radiographic (RT) examination, which does not have the granularity of current ultrasonic (UT) techniques. Therefore, any flaw identified by RT would be presumed to be unacceptable. That is why the NB-5330 inspection criteria, under Fabrication, does not allow any identified crack-like indications, regardless of size, orientation, depth, cause, or significance to the structural adequacy of the overall weld pad. Many flaws that are not detected with radiography have a high likelihood of being detected with UT, depending on its orientation. If identified by the more sensitive UT method, the RT-based acceptance criteria would require the removal of the defect and the weld pad repaired and re-inspected. This could significantly alter the beneficial residual stress pattern and produce a less optimal final, stress field protecting the RCS pressure boundary.

Therefore, Duke Energy is requesting relief under 10 CFR 50.55a(z)(1) to utilize alternative acceptance criteria for volumetrically inspecting the weld pad that provides an acceptable level of quality and safety.

5. **Proposed Alternative and Basis for Use**

In lieu of the NB-5330 acceptance criteria for Fabrication, it is proposed to use the preservice examination acceptance criteria of IWB-3514 for the welded pad material and HAZ.

Per Reference 7, the PWSCC resistant branch connection weld metal buildup is to be designed in accordance with Code Case N-853. Code Case N-853 has been reviewed and is approved for unconditional use by the NRC in Regulatory Guide 1.147 (Reference 4).

The Reference 7 SER provides for two optional deviations to Code Case N-853 as follows: a) the new nozzle material may be manufactured from UNS S31600 material instead of UNS N06690, and b) the new nozzle may be attached by a full penetration nozzle corner weld (Figure 3) instead of a partial penetration "J" groove weld (Figure 2).

Code Case N-853 requires a UT volumetric examination to be demonstrated in accordance with Section V of the ASME Code. This procedure is then used to volumetrically examine the newly deposited pad material and Heat Affected Zone (HAZ) in accordance with the Construction Code or Section III, with NB-5330 as the acceptance criteria.

The IWB-3514 acceptance criteria are based on UT examination methods. In using the rules in IWB-3514 for evaluation of flaws in the weld pad, the thickness of only the weld pad will be used. The IWB-3514 rules were previously used (Reference 8) for UT volumetric examination of Alloy 690 Full Structural Weld Overlays (FSWOs), preemptively applied in accordance with Section XI, Appendix Q. The proposed inspection criteria will detect flaws in the weld overlays such as inter-bead lack of fusion, inclusions, or cracks, and must meet the standards of IWB-3514 to be acceptable. The N-853 weld pad is also preemptively applied and uses the same Alloy 690 weld material and welding process as the FSWOs and is also subjected to these same potential welding defects. Applying the proposed alternative inspection criteria better matches the sensitivity of the UT inspection technique that will be used for the weld pad, as discussed in the Reference 8 NRC safety evaluation, and repeated here:

> "ASME Code, Section III, flaw acceptance standards are derived from the capability of radiography to detect and size flaws originating from the fabrication process used during new facility construction. The ASME Code, Section III acceptance criteria do not allow for the presence of any cracks or crack-like indications, regardless of their size, and are geared more towards volumetric flaws. The capability of radiography is a function of density differences such as 2 percent or greater changes in density. The density changes normally associated with cracks, depending on orientation, are much less than the detection capability of radiography. There is an inherent, unknown tolerance in the ASME Code, Section III acceptance criteria for radiography which encompasses tight cracks and densities below the detection capabilities of radiography. Flaws detected using radiography are not precise enough for applying ASME Code, Section XI crack growth analyses, as flaw depth cannot be measured with radiography. ASME Code, Section III radiography is not applicable for evaluating flaws for continued plant operations because of the difficulty associated with depth-sizing flaws."

The inspection and examination criteria of the underlying base metal material for lamellar tearing per Code Case N-853(3)(d)(3) remains unchanged.

The weld pads to be installed at ONS will be thick (approximately 1.3" thick) and wide (about 14 inches square). Their deposition by welding produces a complex residual stress field that is used to evaluate the fatigue crack growth per the N-853 requirements. Current rules in Section III would not allow for any crack like defects, regardless of size, orientation, depth, cause, or significance to the overall structural integrity of the pad and its protection of the underlying pressure boundary material. Section III criteria would require removal of a portion of the pad, that would then have to be rewelded and re-inspected. The primary benefit to using the IWB-3514 acceptance criteria is that small, structurally insignificant

defects, i.e., those that meet the IWB acceptance criteria, if found, would be allowed to remain without repair. This would result in a structurally acceptable, unrepaired weld pad producing an intact residual stress field that would protect the RCS pressure boundary components from PWSCC. The proposed alternative does not alter the required examination coverage, or the specific UT method used for the inspection. In addition, the manual pad repairs are dose and time intensive processes; therefore, not repairing a weld pad enhances outage personnel safety by reducing potential injuries during grinder usage and the accumulation of less dose.

Section XI, IWB-3514 is the general acceptance criteria used for fabricated components and welds. IWB-3514-2 was originally incorporated into the ASME Code during the 1980s and has been utilized for accepting planar flaws for IWB-2500 inspected components with a good service history. It should be noted that ID connected defects in SCC susceptible material cannot use the IWB-3500 acceptance criteria. Since the welded pad deposit will be applied with SCC resistant material (Alloy 52M), this concern does not exist.

In summary, Duke Energy is requesting relief under 10 CFR 50.55a(z)(1) from the ASME Code, Section XI Code Case N-853 inspection requirements. The repair/replacement activity will follow the requirements stated in Code Case N-853 and modified herein. The requested relief is based on the use of CC N-853 (with the noted deviations/exceptions) that will provide an alternative with an acceptable level of quality and safety. The subject welds will be preemptively mitigated or repaired by application of a PWSCC resistant reinforcing pad and attachment of a PWSCC resistant nozzle. The use of CC N-853 as guidance for the repair/replacement activity, as modified herein, will provide an acceptable level of quality and safety.

6. **Precedents**

Reference 8 Safety Evaluation, Relief Request NOS. 06-ON-004 AND 07-ON-001 Oconee Nuclear Station, Units 1, 2, AND 3.

The ONS RR approved in the Reference 8 safety evaluation requested to use ASME Code Case N-638-1 with alternate acceptance criteria, for performing weld overlays to mitigate PWSCC. Approval was received to utilize the acceptance criteria of ASME Code, Section XI, Code Case N-504-2, and Nonmandatory Appendix Q, in lieu of the N-638-1 acceptance criteria of NB-5330 of ASME Code, Section III. This precedent replaced NB-5330 criteria with the Appendix Q preservice inspection criteria, which uses IWB-3514 requirements. Therefore, the logic used for the past approval is directly applicable for this RR for N-853. Thus, the established pre-service NDE acceptance criteria in IWB-3514 for weld pads made with Alloy 52M weld metal should also be applied to the portion of the weld pad made during the application of N-853, so that an adequate level of safety and quality will be maintained.

7. **Duration of Proposed Alternative**

The alternative is requested to be implemented for the remainder of the fifth 10-year inspection interval for ONS 1, 2, and 3, which is scheduled to end on July 15, 2024. The duration of each physical repair is requested for the remainder of the current licensed operating life of each ONS unit. The repairs will be designed to meet the requirements of Code Case N-853, ASME Code, Section III (Reference 6), and ASME Code, Section XI (Reference 1). The design will consider operation until the end of the current renewed operating licenses for each unit as follows:

	Docket Number	License Expires
Unit 1	05000269	02/06/2033
Unit 2	05000270	10/06/2033
Unit 3	05000287	07/19/2034

8. **References**

1. American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, 2007 Edition with the 2008 Addenda.
2. American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Code Case N-722-1, “Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated With Alloy 600/82/182 Materials, Section XI, Division 1,” Approval Date: January 26, 2009.
3. American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Code Case N-853, “PWR Class 1 Primary Piping Alloy 600 Full Penetration Branch Connection Weld Metal Buildup for Material Susceptible to Primary Water Stress Corrosion Cracking, Section XI, Division 1,” Approval Date: June 27, 2016.
4. U. S. Nuclear Regulatory Commission; REGULATORY GUIDE 1.147, Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1, Revision 19, October 2019.
5. Waskey, D., McCracken, S., (2016); “TECHNICAL BASIS FOR CODE CASE N-853 – A600 BRANCH CONNECTION WELD REPAIR FOR SCC MITIGATION”; Proceedings of the ASME 2016 Pressure Vessels and Piping Conference; PVP2016; July 17-21, 2016, Vancouver, British Columbia, Canada; PVP2016-63902.
6. American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III, 2013 Edition.
7. NRC Safety Evaluation, “Safety Evaluation by the Office of Nuclear Reactor Regulation Proposed Alternative Request 19-ON-001 to use Modified American Society of Mechanical Engineer’s Boiler and Pressure Vessel Code Case N-853, Duke Energy Carolinas, LLC, Oconee Nuclear Station, Units 1, 2, and 3, Docket Numbers 50-269, 50-270, and 50-287,” dated February 26, 2020, ADAMS Accession No. ML20055F571.
8. NRC Safety Evaluation, “Safety Evaluation by The Office of Nuclear Reactor Regulation Inservice Inspection Program Relief Request NOS. 06-ON-004 AND 07-ON-001 Oconee Nuclear Station, Units 1, 2, AND 3 Duke Power Company LLC Docket NOS. 50-269, -270, -287,” dated August 6, 2007, ADAMS Accession Number ML071280781.

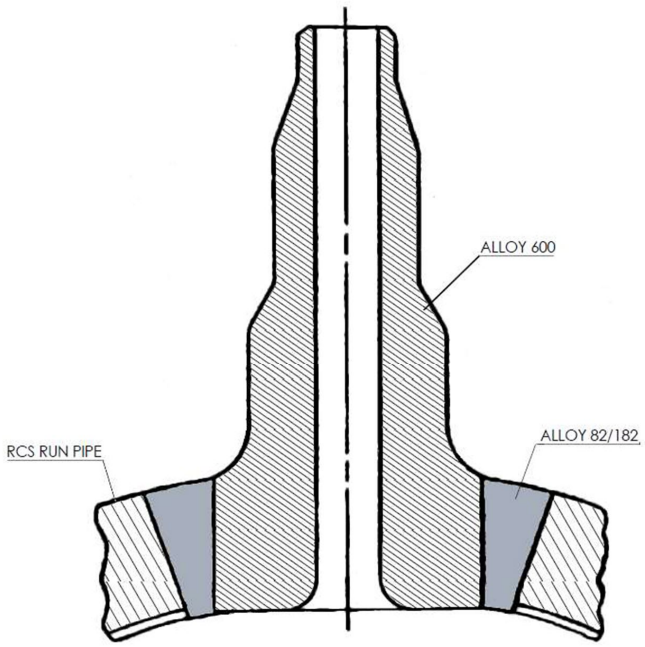

Figure 1a: Sketch of Example Existing Nozzle Configuration

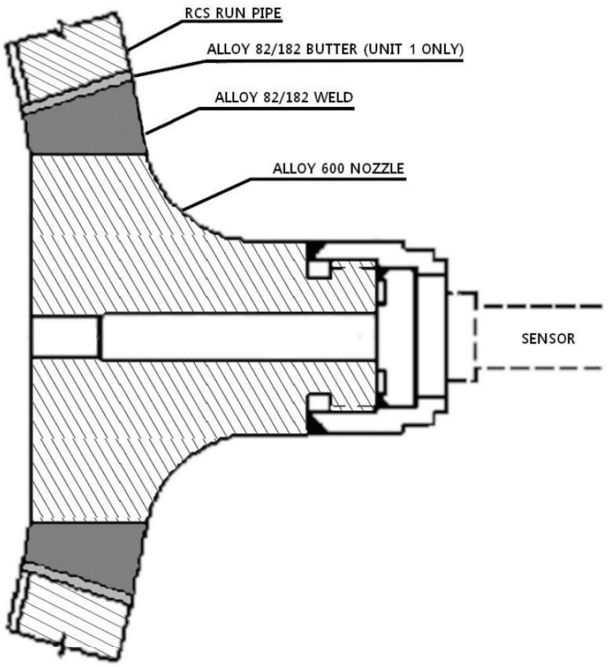

Figure 1b: Sketch of Example Fast RTE Nozzle Connection

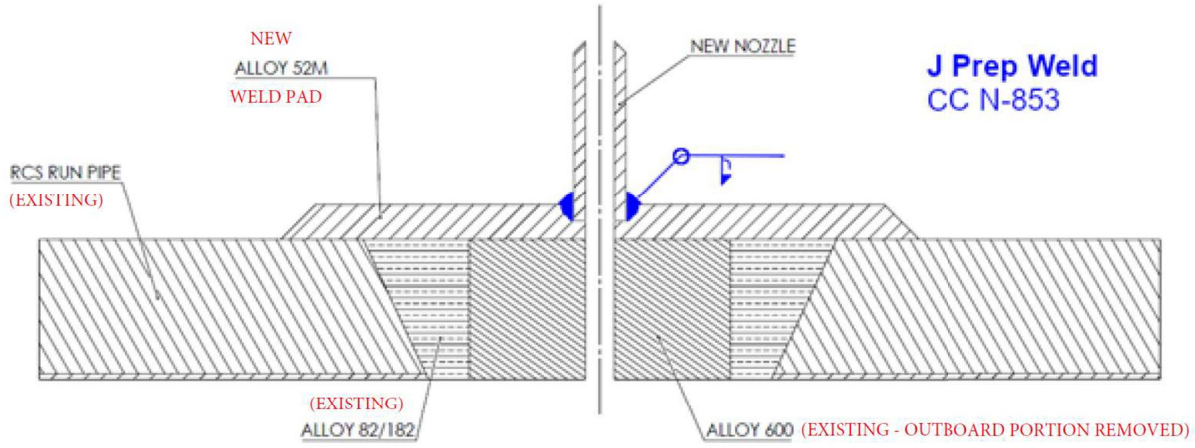

Figure 2: Sketch of Example Repaired Nozzle Configuration with Code Case N-853 J-Groove Weld

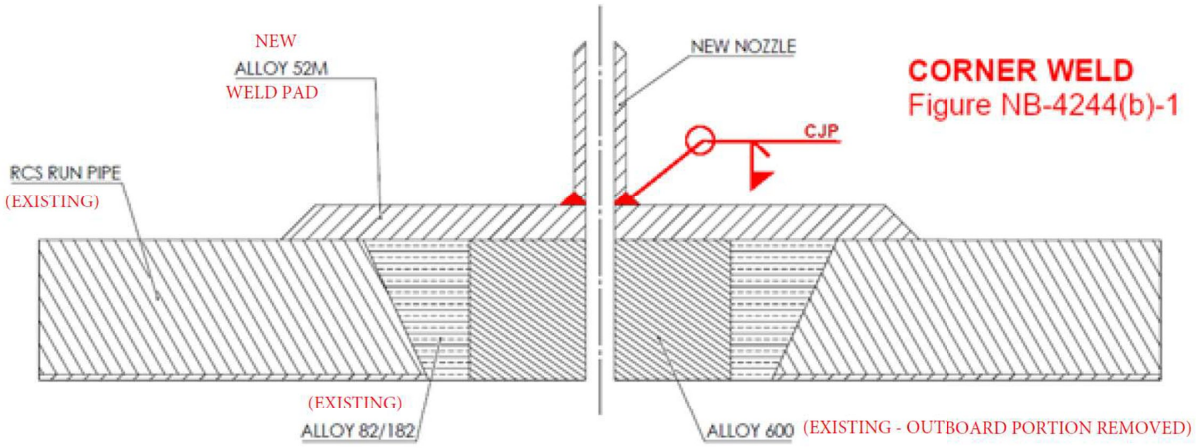

Figure 3: Sketch of Example Repaired Nozzle Configuration with Alternative Full Penetration Corner Weld