Case N-818-1

Use of NDE and Fracture Mechanics for Acceptance of Full Penetration Butt Welds in Lieu of Weld Repair, Class 1 and 2

Section III, Division 1

Inquiry: Under what conditions may use of NDE with acceptance criteria based on fracture mechanics be applied for acceptance of full penetration butt welds in ferritic vessels and in austenitic and ferritic piping in lieu of weld repair when the radiography required by NB-5200 and NC-5200 indicates that the acceptance standards of Article NB-5000 or Article NC-5000 are not satisfied?

Reply: It is the opinion of the Committee that full penetration butt welds in ferritic vessels and in austenitic and ferritic piping may be accepted using NDE with acceptance criteria based on fracture mechanics in lieu of weld repair when the radiography required by NB-5200 and NC-5200 indicates that the acceptance standards of Article NB-5000 or Article NC-5000 are not satisfied, provided the following requirements are met:

(a) Materials shall meet Article NB-2000 or Article NC-2000, as applicable, and shall be limited to the following:

(1) P-No. 1 and P-No. 3 ferritic steel meeting NB-2330 or NC-2330, and for vessels, Nonmandatory Appendix G, G-2110.2 toughness requirements

(2) P-No. 8 and P-No. 43 material

(3) Weld filler metal associated with the materials listed in (1) and (2)

(b) The ultrasonic (UT) method specified in this Case shall be applied in lieu of the radiographic (RT) method specified in NB-5200 or NC-5200 to examine welds in vessels and piping to characterize flaw indications. The UT method shall be qualified in accordance with Mandatory Appendix 1. Acceptance of flaws shall be in accordance with Mandatory Appendix II.

(c) The UT examination shall include 100% of the volume of the entire weld, plus 1/2 in. (13 mm) of base material on each side of the weld. The complete weld volume and base material for a distance of 1/4 in. (6 mm) from each weld toe shall additionally be interrogated to identify indications from mid-wall to far side, where reduced far surface UT responses may be obtained. The UT examination volume shall be accessible and scanned by angle beam in four directions: two directions perpendicular to the weld axis, except as provided in (1) below, and two directions parallel to the weld axis. A supplemental straight beam examination shall be used to measure component thickness, to provide far side profile information, and to detect laminations that could limit angle beam examination.

(i) Single-side access examination is permitted only for ferritic welds, provided the UT technique applied passes acceptable performance demonstration qualification using fabrication flaws of interest as described in Mandatory Appendix I, I-2. Where perpendicular scanning is limited on one side of such ferritic weld, a technique using the second leg of the V-path may be credited as access for the second perpendicular examination direction provided that the detection capability of that technique is included in the procedure demonstration described in (f) and (g).

(d) Weld surfaces shall be prepared in accordance with the qualified UT examination procedure. The surfaces shall be conditioned (smooth) such that transducers may properly couple with the scanning surface with no more than a 1/32-in. gap between the search unit and the scanning surface. For dissimilar metal and austenitic welds, and for single-side access examinations for ferritic welds, the weld crown shall be ground flush.

(e) Requirements of Section V, Article 4 shall not apply except as stated in (f).