unaffected base material specimens. However, if the average lateral expansion value of the HAZ Charpy V-notch specimens is less than the average value for the unaffected base material specimens and the procedure qualification meets all other requirements of this Case, either of the following shall be performed:

(-a) The welding procedure shall be requalified.
(-b) An adjustment temperature or lateral expansion value for the procedure qualification shall be determined and applied in accordance with the applicable provisions of NB-4335.2 of the 2001 Edition with the 2002 Addenda or later.

2.2 PERFORMANCE QUALIFICATION
Welders and welding operators shall be qualified in accordance with Section IX.

3 WELDING PROCEDURE REQUIREMENTS

(a) Weld metal shall be deposited using either of the following processes:
(1) machine or automatic GTAW process
(2) manual SMAW process

(b) Filler materials used with the SMAW process shall comply with the following requirements:
(1) Ferritic Filler Materials
(-a) Welding electrodes shall meet the requirements for supplemental designators, R indicating a moisture-resistant coating, and H4 indicating that they are low in diffusible hydrogen (<4 mL/100g), as defined in the applicable specifications in Section II, Part C. Welding electrodes shall be supplied in unopened hermetically sealed containers or vacuum-sealed packages.
(-b) Electrodes shall be used directly from vacuum-sealed packages, hermetically sealed containers, or shall be placed in storage at 225°F to 350°F (110°C to 180°C) prior to use.
(-c) Electrodes not consumed within 8 hr for E70XX electrodes, or 4 hr for E80XX and E90XX electrodes after removal from vacuum-sealed packages, hermetically sealed containers, or storage at 225°F to 350°F (110°C to 180°C) shall not be used for temper bead welding. The use of reheated or rebaked electrodes is not permitted.

(2) Austenitic or Nickel-Based Filler Materials
(-a) Welding electrodes shall be supplied in unopened hermetically sealed containers or vacuum-sealed packages.
(-b) Electrodes shall be used directly from vacuum-sealed packages, hermetically sealed containers, or shall be placed in storage at 225°F to 350°F (110°C to 180°C) prior to use.
(-c) Electrodes not consumed within 8 hr after removal from vacuum-sealed packages, hermetically sealed containers, or storage at 225°F to 350°F (110°C to 180°C) shall not be used for temper bead welding. Use of reheated or rebaked electrodes is not permitted.

(c) The maximum interpass temperature for field applications shall be 350°F (180°C) for all weld layers, regardless of the interpass temperature used during qualification. The interpass temperature limitations of QW-406.3 need not be applied.

(d) The interpass temperature shall be determined by direct measurement (e.g., pyrometers, temperature indicating crayons, thermocouples) during welding. If direct measurement is impractical, e.g., because of geometric limitations or radiological reasons, interpass temperature shall be determined in accordance with (1) or (2).

(1) heat flow calculations using at least the variables listed below
(-a) welding heat input
(-b) initial base material temperature
(-c) configuration, thickness, and mass of the item being welded
(-d) thermal conductivity and diffusivity of the materials being welded
(-e) time per weld pass and delay time between each pass
(-f) time to complete the weld
(2) measurement of the actual interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded. The maximum heat input of the welding procedure shall be used in the welding of the test coupon.

(e) Particular care shall be given to ensure that the weld region is free of potential sources of hydrogen. The surfaces to be welded, filler metal, and shielding gas (for GTAW) shall be suitably controlled.

4 EXAMINATION

(a) Except as permitted in (1), the following examinations shall be performed in accordance with the Construction Code or Section III.

(1) Prior to repair welding, surface examination shall be performed on the area to be welded. Alternatively, if surface examination materials cannot be cleaned from crevices in the area to be welded (e.g., trapped in crevices remaining after removal of the full thickness of a partial penetration or fillet weld), VT-1 visual examination may be performed, provided the requirements of (b) are met.

(2) Nondestructive examination of the welded region shall include both volumetric and surface examination methods.

(-a) If ferritic filler materials are used, the weld shall be nondestructively examined after the completed weld has been at ambient temperature for at least 48 hr.
(-b) If austenitic filler metals are used, the completed weld shall be nondestructively examined after the initial three temper bead layers have been in place for at least 48 hr.

(-c) As an alternative to (-b), the 48 hr hold need not be applied to the surface examination of the completed austenitic weld if all base materials adjacent to
and within the examination region of the weld are austenitic. This alternative does not apply to the volumetric examination.

(3) For repairs on the outside of the reactor vessel shell on ferritic material where fast neutron fluence exposure is indeterminate or greater than $1 \times 10^{17}$ n/cm$^2$ (E > 1 MeV), the following additional examinations shall be performed on the adjacent vessel base material.

(-a) The surface examination shall include $\frac{1}{2}$ in. (13 mm) of the reactor vessel base material beyond the deposited weld metal.

(-b) If practical, the volumetric examination shall include the following:

(-1) the heat affected zone below the weld deposit

(-2) the reactor vessel base material adjacent to the deposited weld metal to a distance of $\frac{1}{2}$ in. (13 mm) and to a depth of $\frac{3}{16}$ in. (5 mm)

(-c) Ultrasonic examination shall be performed using procedures qualified in accordance with Section V, Article 14, low rigor requirements.

(4) Areas from which any weld-attached thermocouples have been removed shall be ground and examined using a surface examination method.

(5) Acceptance criteria for surface and volumetric examination shall be in accordance with the Construction Code or Section III.

(b) VT-1 visual examinations performed in accordance with 1(h) or (a)(1) shall meet the following:

(1) VT-1 visual examination shall be performed using a procedure that meets the requirements of IWA-2210 and shall be capable of resolving lowercase text characters without ascenders or descenders (e.g., a, c, e, o) not exceeding a height of 0.044 in. (1.1 mm) at the examination distance. The maximum direct VT-1 distance shall not exceed 2 ft (610 mm).

(2) VT-1 visual examination personnel shall be qualified in accordance with IWA-2300 and shall receive additional training in examination of weldments for fabrication conditions, including dimensional requirements and fabrication flaws.

(3) Visual examination acceptance standards shall comply with the following:

(-a) Linear indications are indications in which the length is more than three times the width. Rounded indications are circular or elliptical with length equal to or less than three times the width.

(-b) Only indications with major dimensions greater than $\frac{1}{16}$ in. (1.5 mm) shall be considered relevant. The following relevant indications are unacceptable:

(-1) any cracks or linear indications

(-2) rounded indications with major dimensions greater than $\frac{1}{16}$ in. (1.5 mm)

(-3) four or more rounded indications in a line separated by $\frac{1}{16}$ in. (1.5 mm) or less edge to edge

(-4) ten or more rounded indications in any 6 in.$^2$ (4 000 mm$^2$) of surface with the major dimension of this area not to exceed 6 in. (150 mm) with the area taken in the most unfavorable location relative to the indication being evaluated

Alternatively, the preservice acceptance standards of ASME Section XI (e.g., IWB-3500) may be used for the volumetric examination provided:

(-a) The volumetric examination shall be performed using the ultrasonic examination method as qualified in accordance with 4(a)(4).

(-b) The ultrasonic examination method shall be capable of characterizing flaw lengths and depth in accordance with IWA-3300.
Table 1
Cross-Reference List for Section XI Cases (Cont'd)

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Legend:
- A = IWA
- B = IWB
- C = IWC
- D = IWD
- TB = Table IWB

GENERAL NOTES:
(a) This table is for use with Cases N-532-4, N-561-3, N-562-3, N-576-1, N-576-2, N-609-1, N-638-4, N-638-5, N-638-6, N-638-7, N-638-9, N-661-3, N-661-4, N-666-1, N-730-1, N-731, N-733, N-731-3, N-751, N-754-2, N-769-1, N-769-2, N-771, N-786-1, N-786-2, N-786-3, N-789-2, N-789-3, N-792, N-793, N-795, N-847, N-853, N-865, and N-896
(b) When using Case N-532-4 with Code Editions and Addenda later than the 2009 Addenda, the paragraph references listed in Table 1 shall apply.
(c) When using Case N-532-4 with Code Editions and Addenda later than the 2009 Addenda, the paragraph references listed in Table 1 shall apply.
(d) When using Case N-532-4 with Code Editions and Addenda later than the 2009 Addenda, the paragraph references listed in Table 1 shall apply.
(e) When using Case N-370-1, N-730-1, N-730-2, N-731-3, N-733, N-736-1, or N-769-2 with Code Editions and Addenda later than the 2009 Addenda, the paragraph references listed in Table 1 shall apply. Enter Table 1 in the 2009 Addenda column.
(f) When using Case N-370-1, N-730-1, N-730-2, N-731-3, N-733, N-736-1, or N-769-2 with Code Editions and Addenda later than the 2009 Addenda, the paragraph references listed in Table 1 shall apply. Enter Table 1 in the 2009 Addenda column.
(g) When using Case N-373-1 with Code Editions and Addenda earlier than the 2007 Edition, the paragraph references listed in Table 1 shall apply. Enter Table 1 in the 2007 Edition column.

Note: Table 1 was previously updated to add Cases N-888 and N-888-1 under Record 22-786 (Board Approved 10/13/22)