NB-5272  **Weld Metal Cladding**

Weld metal cladding shall be examined by the liquid penetrant method.

NB-5273  **Hard Surfacing**

Hard surfacing weld metal shall be examined by the liquid penetrant method in accordance with NB-2546, and the acceptance standards applicable to materials less than \( \frac{3}{8} \) in. (16 mm) thick shall apply. Penetrant examination is not required for hard surfacing on valves with inlet connections NPS 4 (DN 100) or less.

NB-5274  **Tube-to-Tubesheet Welded Joints**

Tube-to-tubesheet welded joints shall be examined by the liquid penetrant method.

NB-5275  **Brazed Joints**

Flux and flux residue shall be removed from all surfaces prior to examination. Joints shall be visually examined on all accessible surfaces to determine whether there has been adequate flow of brazing metal through the joint. Optical aids may be employed for indirect visual examination of joints which cannot be directly examined.

NB-5276  **Inertia and Continuous Drive Friction Welds**

(a) When radiographic examination is required by this Article, inertia and continuous drive friction welds shall also be examined by the ultrasonic method to verify bonding over the entire area.

(b) The materials used shall be those assigned a P-Number by Section IX, but shall not include rimmed or semikilled steel.

(c) One of the two parts to be joined must be held in a fixed position and the other part rotated. The two faces to be joined must be symmetrical with respect to the axis of rotation.

(d) The weld between the two members shall be a full penetration weld.

NB-5277  **Electron Beam Welds**

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electron beam welding process shall be ultrasonically examined.

NB-5278  **Electroslag Welds**

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electroslag welding process in ferritic materials shall be ultrasonically examined.

NB-5279  **Special Exceptions**

When the joint detail does not permit radiographic examination to be performed in accordance with this Article, ultrasonic examination plus liquid penetrant or magnetic particle examination of the completed weld may be substituted for the radiographic examination. The absence of suitable radiographic equipment shall not be justification for such substitution. The substitution of ultrasonic examination can be made provided the examination is performed using a detailed written procedure which has been proven by actual demonstration to the satisfaction of the Inspector as capable of detecting and locating defects described in this Subsection. The nondestructive examinations shall be in accordance with NB-5110 and meet the acceptance standards of NB-5300.

NB-5280  **PRESERVICE EXAMINATION**

NB-5281  **General Requirements**

(a) Examinations required by NCA-3252(c) shall be completed prior to completion of the N-5 Data Report.

(b) All volumetric and surface examinations shall be documented with results and identified in a form consistent with those required in NCA-4134.17 for transfer to the Owner.

NB-5282  **Examination Requirements**

(a) Components shall be examined as specified in Section XI, IWB-2500. The method of examination for the components and parts of the pressure-retaining boundaries shall comply with those tabulated in IWB-2500. Only the volumetric and surface examinations are required to be performed.

(b) For Control Rod housings, Examination Category B-O, the examination shall be extended to include essentially 100% of the welds in the installed peripheral control rod drive housing only.

NB-5283  **Components Exempt From Preservice Examination**

The following components or parts of components are exempted from the volumetric and surface examination requirements of this subarticle:

(a) piping of NPS 1 (DN 25) and smaller, except for steam generator tubing;

(b) reactor vessel head connections and associated piping, NPS 2 (DN 50) and smaller, made inaccessible by control rod drive penetrations; and

(c) integral attachments of supports and restraints that are inaccessible due to being encased in concrete, buried underground, or encapsulated by guard pipe.

NB-5300  **ACCEPTANCE STANDARDS**

NB-5320  **RADIOGRAPHIC ACCEPTANCE STANDARDS**

Indications shown on the radiographs of welds and characterized as imperfections are unacceptable under the following conditions:

(a) any indication characterized as a crack or zone of incomplete fusion or penetration;
(b) Category C full penetration corner welded joints shall be ultrasonically or radiographically examined.
(c) For corner joint constructions as illustrated in Figure NC-4265-1 sketches (b) and (c), except when dimension \( b \) is equal to or greater than \( t_a \), the unstayed flat head, prior to welding, shall be 100% examined by the ultrasonic method in accordance with the requirements of SA-435, except that no lamination in the head is acceptable.

NC-5254 Category D Welded Joints

(a) Category D full penetration butt welded joints shall be fully radiographed.
(b) Category D full penetration corner welded joints shall be ultrasonically or radiographically examined.
(c) Category D partial penetration or fillet welded joints shall be examined by either the liquid penetrant or magnetic particle method on all accessible surfaces.

NC-5257 Other Welded Joints for Vessels Designed to NC-3200

The requirements of NC-5260, NC-5270, and NC-5410 also apply to vessels designed to NC-3200.

NC-5260 FILLET, PARTIAL PENETRATION, SOCKET, AND ATTACHMENT WELDS

NC-5261 Fillet, Partial Penetration, and Socket Welded Joints

Fillet and partial penetration welds, except for non-structural attachments (NC-1132.1), and socket welds shall be examined by the magnetic particle or liquid penetrant method.

NC-5262 Structural Attachment Welded Joints

Structural attachment welded joints made to pressure-retaining material shall be examined by either the magnetic particle or liquid penetrant method.

NC-5270 SPECIAL WELDS

NC-5271 Welds of Specially Designed Seals

Welds of this type shall be examined by either the magnetic particle or liquid penetrant method.

NC-5272 Weld Metal Cladding

Weld metal cladding shall be examined by the liquid penetrant method.

NC-5273 Hard Surfacing

Hard surfacing shall be examined by the liquid penetrant method in accordance with NC-2546, and the acceptance standards applicable to materials less than \( \frac{7}{8} \) in. (16 mm) thick shall apply. Penetrant examination is not required for hard surfacing on valves with inlet connections NPS 4 (DN 100) or less.

NC-5274 Tube-to-Tubesheet Welds

Tube-to-tubesheet welds shall be examined by the liquid penetrant method.

NC-5275 Brazed Joints

Flux and flux residue shall be removed from all surfaces prior to examination. Joints shall be visually examined on all accessible surfaces to determine whether there has been adequate flow of brazing metal through the joint. Optical aids may be employed for indirect visual examination of joints which cannot be directly examined.

NC-5276 Inertia and Continuous Drive Friction Welds

(a) When radiographic examination is required by this Article, inertia and continuous drive friction welds shall also be examined by the ultrasonic method to verify bonding over the entire area.
(b) The materials used shall be those assigned a P-Number by Section IX, but shall not include rimmed or semikilled steel.
(c) One of the two parts to be joined must be held in a fixed position and the other part rotated. The two faces to be joined must be symmetrical with respect to the axis of rotation.
(d) The weld between the two members shall be a full penetration weld.

NC-5278 Electroslag Welds

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electroslag welding process in ferritic materials shall be ultrasonically examined.

NC-5279 Special Exceptions

When the joint detail does not permit radiographic examination to be performed in accordance with this article, ultrasonic examination plus liquid penetrant or magnetic particle examination of the completed weld may be substituted for the radiographic examination. The absence of suitable radiographic equipment shall not be justification for such substitution. The substitution of ultrasonic examination can be made, provided the examination is performed using a detailed written procedure which has been proven by actual demonstration to the satisfaction of the Inspector as capable of detecting and locating defects described in this Subsection. The nondestructive examinations shall be in accordance with NC-5110 and meet the acceptance standards of NC-5300.

NC-5280 WELD JOINTS IN STORAGE TANKS

NC-5281 Examination Procedures

Nondestructive examinations of welds in storage tanks shall be in accordance with the examination procedures of Section V.
WB-5244 Weld Metal Buildup at Openings for Nozzles

When weld metal buildup is made to a surface as shown in Step 1 of Figure WB-4244(c)-1, the weld metal buildup and the parent metal beneath the weld metal buildup shall be ultrasonically examined. The parent material beneath the weld metal buildup shall be ultrasonically examined to detect laminar defects after weld metal buildup. Nozzles may then be attached by a full penetration weld as shown in Step 2 of Figure WB-4244(c)-1. The full penetration butt-welded joint shall be examined by either the ultrasonic or radiographic method, and either the magnetic particle or liquid-penetrant method and the weld metal buildup shall be examined by either the magnetic particle or liquid-penetrant method.

WB-5245 Partial Penetration Welded Joints

Partial penetration welded joints, as permitted in WB-3252.4(b), and as shown in Figure WB-4244(d)-1, shall have the surface of the finished welded joint examined by either the magnetic particle or liquid penetrant method.

WB-5260 FILLET, PARTIAL PENETRATION, SOCKET, AND ATTACHMENT WELDED JOINTS

WB-5261 Fillet, Partial Penetration, and Socket Welded Joints

Fillet and partial penetration welded joints, except for nonstructural attachments (WB-1132.1), and socket welds shall be examined by the magnetic particle or liquid penetrant method.

WB-5262 Structural Attachment Welded Joints

Structural attachment welded joints made to containment material shall be examined by either the magnetic particle or liquid penetrant method.

WB-5270 SPECIAL WELDED JOINTS

WB-5272 Weld Metal Cladding

Weld metal cladding shall be examined by the liquid penetrant method.

WB-5273 Hard Surfacing

Hard surfacing weld metal shall be examined by the liquid penetrant method in accordance with WB-2546, and the acceptance standards applicable to materials less than 5/6 in. (16 mm) thick shall apply.

WB-5277 Electron Beam Welds

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electron beam welding process shall be ultrasonically examined.

WB-5279 Special Exceptions

When the joint detail, or environmental conditions (i.e., background radiation), does not permit radiographic examination to be performed in accordance with this Article, ultrasonic examination plus liquid penetrant or magnetic particle examination of the completed weld may be substituted for the radiographic examination. The absence of suitable radiographic equipment shall not be justification for such substitution. The substitution of ultrasonic examination can be made, provided the examination is performed using a detailed written procedure which has been proven by actual demonstration to the satisfaction of the Inspector as capable of detecting and locating defects described in this Division. The non-destructive examination shall be in accordance with WB-5110 and meet the acceptance standards of WB-5300.

WB-5300 ACCEPTANCE STANDARDS

WB-5320 RADIOGRAPHIC ACCEPTANCE STANDARDS

Indications shown on the radiographs of welds and characterized as imperfections are unacceptable under the following conditions:

(a) any indication characterized as a crack or zone of incomplete fusion or penetration;

(b) any indication characterized as incomplete penetration or incomplete fusion, except that such indications in welds between P-8 metals that were made using GTAW or SMAW in which the deposit analysis in A-8 or A-9 are acceptable provided they do not exceed the length in (c).

(c) any other elongated indication which has a length greater than:

1. 5/4 in. (6 mm) for t up to 3/4 in. (19 mm), inclusive
2. 3/2 t for t from 3/4 in. to 2 3/4 in. (19 mm to 57 mm), inclusive
3. 3/4 in. (19 mm) for t over 2 3/4 in. (57 mm)
   where t is the thickness of the thinner portion of the weld;

(d) internal root weld conditions are acceptable when the density change or image brightness difference as indicated in the radiograph is not abrupt; elongated indications on the radiograph at either edge of such conditions shall be unacceptable, as provided in (c) above;

(e) any group of aligned indications having an aggregate length greater than t in a length of 12t, unless the minimum distance between successive indications exceeds 6L, in which case the aggregate length is unlimited, L being the length of the largest indication;

(f) rounded indications in excess of that shown as acceptable in Section III Appendices, Mandatory Appendix VI.
the parent metal beneath the attachment surface for details shown in Figure WC-4266(b)-1 sketches (c), (d), (d-1), (e), and (g) and beneath the weld surface in sketches (a) and (b) shall be ultrasonically examined after welding to assure freedom from lack of fusion and laminar defects.

**WC-5244 Weld Metal Buildup at Openings for Nozzles**

When weld metal buildup is made to a surface as shown in Step 1 of Figure WC-4266(c)-1, the weld metal buildup and the parent metal beneath the weld metal buildup shall be ultrasonically examined. The parent material beneath the weld metal buildup shall be ultrasonically examined to detect laminar defects after weld metal buildup. Nozzles may then be attached by a full penetration weld as shown in Step 2 of Figure WC-4266(c)-1. The full penetration butt-welded joint shall be examined by either the ultrasonic or radiographic method, and either the liquid penetrant or magnetic particle method and the weld metal buildup shall be examined by either the magnetic particle or liquid-penetrant method.

**WC-5245 Other Welded Joints**

Other welded joints, as shown in Figures WC-4266(d)-1 and WC-4266(e)-1, shall be examined progressively using either the magnetic particle or liquid penetrant methods. The increments of examination shall be the lesser of one-half of the maximum welded joint dimension measured parallel to the center line of the connection or \( \frac{1}{2} \) in. (13 mm). The surface of the finished welded joint shall also be examined by either method.

**WC-5250 EXAMINATION OF CONTAINMENT CLOSURE WELDS**

Containment closure welds meeting the requirements of WC-3262 shall be examined in accordance with (a) below:

(a) Full and partial penetration welds shall be examined in accordance with the requirements of Table WC-3262-1. Acceptance criteria shall be in accordance with WC-5340 or WC-5350.

**WC-5260 FILLET, PARTIAL PENETRATION, SOCKET, AND ATTACHMENT WELDED JOINTS**

**WC-5261 Fillet, Partial Penetration, and Socket Welded Joints**

Fillet and partial penetration welded joints, except for nonstructural attachments and socket welds shall be examined by the magnetic particle or liquid penetrant method.

**WC-5262 Structural Attachment Welded Joints**

Structural attachment welded joints made to containment material shall be examined by either the magnetic particle or liquid penetrant method.

**WC-5270 SPECIAL WELDS AND BRAZED JOINTS**

**WC-5272 Weld Metal Cladding**

Weld metal cladding shall be examined by the liquid penetrant method.

**WC-5273 Hard Surfacing**

Hard surfacing weld metal shall be examined by the liquid penetrant method in accordance with WC-2546, and the acceptance standards applicable to materials less than \( \frac{5}{8} \) in. (16 mm) thick shall apply.

**WC-5275 Brazed Joints**

Flux and flux residue shall be removed from all surfaces prior to examination. Joints shall be visually examined on all accessible surfaces to determine whether there has been adequate flow of brazing metal through the joint. Optical aids may be employed for indirect visual examination of joints which cannot be directly examined.

**WC-5277 Electron Beam Welds**

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electron beam welding process shall be ultrasonically examined.

**WC-5279 Special Exceptions**

Except for those closure welds addressed in WC-5250, when the joint detail, or environmental conditions (e.g., background radiation), does not permit radiographic examination to be performed in accordance with this Article, ultrasonic examination plus liquid penetrant or magnetic particle examination of the completed weld may be substituted for the radiographic examination. The absence of suitable radiographic equipment shall not be justification for such substitution. The substitution of ultrasonic examination can be made, provided the examination is performed using a detailed written procedure which has been proven by actual demonstration to the satisfaction of the Inspector as capable of detecting and locating defects described in this Article. The nondestructive examination shall be in accordance with WC-5110 and meet the acceptance standards of WC-5300.
WD-5220 REQUIREMENTS FOR RADIOGRAPHY OR ULTRASONIC AND LIQUID PENETRANT OR MAGNETIC PARTICLE EXAMINATION

When required by the Certificate Holder (Table WD-3240-1), welds shall be radiographically examined and the external and accessible internal weld surfaces and adjacent base metal for at least \( \frac{1}{2} \) in. (13 mm) on each side of the weld examined by either the magnetic particle or liquid penetrant method. Ultrasonic examination may be substituted for radiography except for those materials and welds that have coarse grains or configurations that do not yield meaningful results by ultrasonic methods.

WD-5230 REQUIREMENTS FOR LIQUID PENETRANT OR MAGNETIC PARTICLE EXAMINATION

WD-5231 Requirements for Progressive Liquid Penetrant or Magnetic Particle Examination

When required by the Certificate Holder (Table WD-3240-1), welds shall be either liquid penetrant or magnetic particle examined progressively at the lesser of either one-third of the thickness of the weld joint or each \( \frac{1}{2} \) in. (13 mm), and on the external and accessible internal weld surfaces and the adjacent base material for \( \frac{1}{2} \) in. (13 mm) on each side of the weld. For welds \( \frac{3}{8} \) in. (10 mm) thick or less, examination of the root, each subsequent layer, and the external and accessible internal weld surfaces and adjacent base material for at least \( \frac{1}{2} \) in. (13 mm) on each side of the weld is permitted in lieu of the above.

WD-5232 Requirements for Root and Final Liquid Penetrant or Magnetic Particle Examination

When required by the Certificate Holder (Table WD-3240-1), welds shall be either liquid penetrant or magnetic particle examined after the root and final passes on the external and accessible internal weld surfaces and the adjacent base material for at least \( \frac{1}{2} \) in. (13 mm) on each side of the weld.

WD-5233 Requirements for Surface Liquid Penetrant or Magnetic Particle Examination

When required by the Certificate Holder (Table WD-3240-1), welds shall be either liquid penetrant or magnetic particle examined on the external and accessible internal weld surfaces and the adjacent base material for at least \( \frac{1}{2} \) in. (13 mm) on each side of the weld.

WD-5260 REQUIREMENTS FOR SURFACE VISUAL EXAMINATION

WD-5261 Visual Examination in Addition to Other NDT Examination

All welds shall be visually examined to the acceptance criteria of WD-5361. This visual examination shall be in addition to all other required examinations.

WD-5262 Visual Examination for Weld Surface Integrity

When required by the Certificate Holder (Table WD-3240-1), welds shall be visually examined on the final surface to the acceptance criteria of WD-5362.

WD-5270 SPECIAL WELDED JOINTS

WD-5272 Weld Metal Cladding

Weld metal cladding shall be examined by the liquid penetrant method.

WD-5273 Hard Surfacing

Hard surfacing shall be examined by the liquid penetrant method in accordance with WD-2546, and the acceptance standards applicable to materials less than \( \frac{5}{8} \) in. (16 mm) thick shall apply.

WD-5277 Electron Beam Welds

In addition to the requirements for the type of weld being examined, all complete penetration welds made by the electron beam welding process shall be ultrasonically examined.

WD-5279 Special Exceptions

When the joint detail, or environmental conditions (i.e., background radiation), does not permit radiographic examination to be performed in accordance with this Article, ultrasonic examination plus liquid penetrant or magnetic particle examination of the completed weld may be substituted for the radiographic examination. The absence of suitable radiographic equipment shall not be justification for such substitution. The substitution of ultrasonic examination can be made provided the examination is performed using a detailed written procedure that has been proven by actual demonstration to the satisfaction of the Inspector as capable of detecting and locating defects described in this Subsection. The nondestructive examination shall be in accordance with WD-5110 and meet the acceptance standards of WD-5300.