**Case N-894**  
Repair of Class 1, 2, and 3 Austenitic Stainless Steel with Thermal Fatigue Cracking.

Section XI, Division 1

**Inquiry:** As an alternative to the provisions of IWA-4410 and IWA-4611, is it permissible to reduce the size of a defect as a fraction of the wall thickness in austenitic stainless steel piping, components, or welds, resulting from thermal fatigue, by increasing the wall thickness by deposition of weld overlay on the outside surface of the piping, component, or associated weld?

**Reply:** It is the opinion of the Committee that, in lieu of the requirements of IWA-4410 and IWA-4611, the size of a defect as a fraction of the wall thickness in austenitic stainless steel piping, a component, or a weld may be reduced to an acceptable size in accordance with IWB-3640, IWC-3640, or IWD-3640 from the 2021 Edition by deposition of weld reinforcement (weld overlay) on the outside surface of the piping, component, or associated weld, provided the following requirements are met.

**-1000 SCOPE**

(a) The repair shall be performed in accordance with a Repair/Replacement Program satisfying the requirements of IWA-4000 in the Edition and Addenda of Section XI applicable to the plant inservice inspection program.

(b) This Case provides requirements for weld overlay repairs of defects resulting from thermal fatigue cracking. However, in cases where the potential for stress corrosion cracking (SCC) is uncertain, the analysis rules of -3000(c) shall be used.

(c) This Case applies only to repairs of inside-surface-connected flaws in austenitic stainless steel welds, components, or base material.

**-2000 PREREQUISITES**

(a) Reinforcement weld metal shall meet following requirements.

(1) The weld metal shall be low carbon (0.035% max.) austenitic stainless steel applied 360 deg around the entire circumference on the outside surface of the piping, component, or associated weld, and shall be deposited using a Welding Procedure Specification (WPS) for groove welding, qualified in accordance with the Construction Code and Owner’s Requirements.

(2) Where there is a potential for intergranular stress corrosion cracking (IGSCC) degradation, the weld reinforcement shall consist of at least two weld layers having as-deposited delta ferrite content of at least 7.5 FN (ferrite number). The first layer of weld metal with delta ferrite content of at least 7.5 FN shall constitute the first layer of the weld reinforcement that may be credited toward the required thickness. Alternatively, the first layers of at least 5 FN are acceptable, provided the carbon content of the deposited weld metal is determined by chemical analysis to be less than 0.02%. A minimum of six FN measurements shall be taken using a magnetic measuring instrument and averaged. Alternatively, the FN may be determined from a representative coupon taken from a mockup prepared in accordance with the WPS for the weld reinforcement using filler material with a FN equal to or less than the filler material to be used for the weld reinforcement. The mockup base material shall have a Ni<sub>eq</sub>/Cr<sub>eq</sub> ratio, in accordance with the equation below, equal to or greater than the Ni<sub>eq</sub>/Cr<sub>eq</sub> ratio of the items to be repaired.

\[
\text{Ni}_{eq}/\text{Cr}_{eq} = \frac{(\text{Ni}+35\text{C}+20\text{N}+0.25\text{Cu})}{(\text{Cr}+\text{Mo}+0.7\text{Nb})}
\]

where the values are the weight percentage of the given element on the certified material test report. Use the following values if not reported: 0.06% N, 0.10% Cu, 0% Mo, and 0% Nb.

(3) Alternatively, a nickel alloy weld overlay may be applied, provided the following requirements are met, as applicable.

(-a) For repair of PWR piping, the filler metal shall contain at least 26% Cr. The first layer of weld metal with Cr content of at least 24% shall constitute the first layer of the overlay that may be credited toward the required thickness. The Cr content of the first layer may be determined by chemical analysis of a production weld, if applicable, or a representative coupon taken from a mockup prepared in accordance with the WPS for the production weld, if applicable. To reduce the potential of hot cracking when applying an austenitic nickel alloy over austenitic stainless steel, it is permissible to apply a layer or multiple layers of austenitic stainless steel filler material over the austenitic stainless steel base.

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1 The references in this Case are based on the 2021 Edition. For use with other editions or addenda, refer to the Guideline for Cross-Referencing Section XI Cases, Table 1.

2 Refer to Section XI Nonmandatory Appendix R, Table R-S2-1, for attributes of the IGSCC degradation mechanism. In addition, stagnant flow conditions should be considered.
material or austenitic steel weld metal. The combined thickness of the stainless steel and nickel alloy weld metal may be credited as structural reinforcement layers.

(b) For repair of boiling water reactor (BWR) piping, the provisions of (3)(a) shall apply, except that the first layer of weld metal with Cr content of at least 20% shall constitute the first layer of the overlay that may be credited toward the required thickness.

(b) Prior to deposition of the weld reinforcement, the surface to be repaired shall be examined by the liquid penetrant method. Indications greater than 1/16 in. (1.5 mm) shall be removed, reduced in size, or corrected in accordance with the following requirements, prior to application of weld reinforcement.

(1) One or more layers of weld metal shall be applied to seal unacceptable indications in the area to be repaired with or without excavation.

(2) The thickness of these layers shall not be used in meeting weld reinforcement design thickness requirements. Peening the unacceptable indication prior to welding is permitted.

(c) If correction of indications in (b) is required, the area where the weld reinforcement is to be deposited, including any local repairs or initial weld overlay layers, shall be examined by the liquid penetrant method. The area shall contain no indications greater than 1/16 in. (1.5 mm) prior to the application of the structural layers of the weld overlay.

(d) The submerged arc welding method shall not be used for weld overlays.

-3000 FLAW GROWTH ANALYSIS AND DESIGN

The overlay design thickness shall provide reinforcement to the outside of the piping containing the flaw, such that the weld reinforcement is capable of supporting the design loads, without consideration of the piping, component, or associated weld beneath the weld reinforcement. The design of the weld overlay shall provide access for the examinations required in -4000, and shall be in accordance with (a), (b) and (c).

(a) Flaw growth analysis of the detected flaw including the -3000 weld overlay design shall be performed. Flaw characterization and analytical evaluation requirements shall be based on the as-found flaw. Flaw growth by fatigue shall be evaluated using the analytical evaluation provisions of IWB-3640, IWC-3640, or IWD-3640, as applicable, and the flaw growth rate curves representative of the material and operating environment. The flaw growth analysis shall evaluate the operating conditions and transients, including those believed to have caused the inside-surface-connected flaws, as well as all applicable loads. The results of the fatigue crack growth analysis shall be used to define the life of the overlay. The results of the fatigue crack growth analysis shall demonstrate an acceptable design life in accordance with IWB-3640, IWC-3640, or IWD-3640, as applicable, for at least two operating cycles.

(1) For determining the combined length of circumferential and axial flaws, multiple flaws shall be treated as one flaw in accordance with IWA-3300.

(2) A residual stress analysis shall be performed of the overlay and the underlying material at the defect location. The residual stress analysis shall include any residual stresses that existed prior to application of the overlay. The analysis shall address residual stresses due to the as-welded condition plus any machining or weld repairs that might have previously occurred. The flaw growth analysis of -3000(a) shall include the calculated residual stresses at operating conditions.

(b) The design of the weld overlay shall satisfy the following, using the requirements in (a). The design analysis required by (1) through (5) shall be completed in accordance with IWA-4311.

(1) The axial length and end slope of the weld overlay shall cover the affected volume and shall provide for load redistribution from the base material into the weld overlay and back into the base material without violating the applicable stress limits of Section III, NB-3200. The weld overlay design shall ensure that load redistribution complies with the preceding information. These requirements will usually be satisfied if the overlay full thickness length extends axially beyond the as-found flaw location and length, as determined in accordance with IWA-3300, by at least 0.75√Rt where R is the outer radius of the base material and t is the nominal wall thickness.

(2) Unless specifically analyzed in accordance with (b)(1), the end transition slope of the overlay shall not exceed 30 deg.

(3) The wall thickness at the weld overlay and

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The term material applies to base material and welds.
the effects of any discontinuity (e.g., another weld overlay or reinforcement for a branch connection) within a distance of $2.5\sqrt{Rt}$ from the toes of the weld overlay, shall be evaluated and shall meet the requirements of IWB-3640, IWC-3640, or IWD-3640, as applicable.

(4) The effects of any changes in applied loads, as a result of weld shrinkage, on other items in the piping system (e.g., support loads and clearances, nozzle loads, and changes in system flexibility and weight due to the weld overlay) shall be evaluated. Existing flaws previously accepted by analytical evaluation shall be evaluated in accordance with IWB-3640, IWC-3640, or IWD-3640, as applicable.

(5) In cases where the required overlay length extends over an adjacent weld or base material, the overlay design shall permit examination of the overlaid material in accordance with -4000.

(c) If the overlay is installed at a location with potential for SCC, the following provisions shall apply:

(1) The analytical evaluation in -3000(a) shall include consideration of the potential for SCC. If appropriate SCC growth rates are not established in Section XI for the material and environment, experimental data correlating stress distribution, pipe size, material, and environment as a function of sustained stress intensity factor ($K_t$) shall be used.

(2) The weld overlay material shall be resistant to SCC for the environment at the location of the repair and meet the requirements of -2000 (a).

-4000 EXAMINATION AND TESTING

Procedures, equipment and personnel used to perform examinations defined in -4100(c), -4100(e) and -4200(b) shall be qualified in accordance with Appendix VIII, Supplement 11. Procedures, equipment, and personnel used for examinations defined in accordance with -4100(g) and -4200(h) shall be qualified in accordance with Appendix VIII, Supplement 2.

-4100 ACCEPTANCE EXAMINATION

(a) The weld overlay shall have a surface finish of 250 μin. (6.3 μm) RMS or better and contour that permits ultrasonic examination in accordance with procedures qualified in accordance with Appendix VIII. The weld overlay shall be examined to verify acceptable configuration.

(b) The weld overlay and the adjacent base material for at least 1/2 in. (13 mm) from each side of the weld overlay (Figure -4100-1) shall be examined using the liquid penetrant method. The weld overlay shall satisfy the surface examination acceptance criteria for welds of the Construction Code or Section III, NB-5300. The adjacent base material shall satisfy the surface examination acceptance criteria for base material of NB-2500.

(c) The examination volume C-G-J-F and H-D-E-I in Figure -4100-1 shall be ultrasonically examined to assure adequate fusion (i.e., adequate bond) with the base material and to detect laminar flaws within the weld overlay material, which may obstruct subsequent inservice examinations (Figure -4100-2). The examination volume G-H-I-J, design reinforcement size required by -3000, shall be examined for laminar and planar flaws. Planar flaws in Class 1 overlays shall meet the acceptance standards of Table IWB-3514-1, and planar flaws in Class 2 or 3 overlays shall meet the acceptance standards of Table IWC-3514-3 and the following requirements. For evaluation of planar flaws within volume G-H-I-J, the thickness $t_1$, as shown in Figure -4100-1, shall be used when evaluating flaws for acceptability per Table IWB-3514-1 or IWC-3514-1. For evaluation of laminar flaws in volumes C-G-J-F and H-D-E-I the thickness $t_2$, as shown in Figure -4100-1, shall be used when evaluating flaws for acceptability per Table IWB-3514-3.

Figure -4100-1

Acceptance Examination

As-found flaw (see Note 4)

GENERAL NOTES:
(1) Surface A-B shall be examined per -4100 (b).
(2) Volume C-G-J-F and Volume H-D-E-I shall be examined for laminar flaws.
(3) Volume G-H-I-J, design reinforcement required by -3000, shall be examined for laminar and planar flaws.
(4) The as-found flaw may be within a weld, the base metal, or both.
(5) Thermal fatigue flaws may be oriented axially, circumferentially, or other orientations.

(1) The reduction in coverage of the examination volume in Figure -4100-2, due to laminar flaws, shall be less than 10%. The dimensions of the uninspectable volume are dependent on the coverage achieved with the angle beam examination of the overlay.

(2) Any uninspectable volume in the weld
overlay resulting from a laminar flaw shall be assumed to contain the largest radial planar flaw that could exist within that volume. This assumed flaw shall meet the acceptance standards of Table IWB-3514-1 for Class 1 base materials or Table IWC-3514-1 for Class 2 or 3 piping. Alternatively, the assumed flaw shall meet the requirements of IWB-3640, IWC-3640, or IWD-3640, as applicable. Both axial and circumferential planar flaws shall be assumed.

(d) After completion of all welding activities, affected restraints, supports, and snubbers shall be VT-3 visually examined to verify that design tolerances are met.

(e) The examination volume A-B-C-D in Figure -4100-2 shall be ultrasonically examined. The angle beam shall be directed perpendicular and parallel to the axis of the base material, with scanning performed in four directions to locate and size flaws. If the orientation of a flaw is not parallel or perpendicular to the pipe as detected during the initial examination prior to weld overlay, additional scan patterns shall be applied based on the actual orientation of the flaw. Examinations shall be performed to identify flaws in the outer 25% of the underlying pipe wall as a benchmark for subsequent examinations of the overlay.

(f) For Class 1 piping, the examination acceptance standards of Table IWB-3514-1 shall be satisfied, and for Class 2 or 3 piping, the examination acceptance standards of Table IWC-3514-1 shall be satisfied for the weld overlay. For evaluation of planar flaws within volume A-B-C-D of Figure -4100-2 the thickness \( t_1 \) defined in Figure -4100-1 shall be used as the nominal wall thickness in Table IWB-3514-1 or IWC-3514-1. Planar flaws in the outer 25% of the base metal thickness shall meet the design analysis requirements of -3000.

(g) The material\(^3\) adjacent to the weld overlay shall be ultrasonically examined to the maximum extent practicable within a distance of \( 2\sqrt{Rt} \) from the toe(s) of the weld overlay. The outer radius of the adjacent base material\(^3\) shall be used for establishing the axial examination distance from the toe(s) of the overlay as shown in Figure -4200-1. The depth of the examination volume shall be 1/3 of the thickness of the base material as shown in Figure -4200-1. If the overlay transitions onto a nozzle with a larger outer diameter than the overlay, the base metal beyond the overlay on the nozzle transition side may be excluded from the ultrasonic examination. The examination method shall be the same process used for detection of the overlaid flaw. For Class 1 piping, the acceptance standards of Table IWB-3514-1 shall be satisfied, and for Class 2 or 3 piping, the acceptance standards of Table IWC-3514-1 shall be satisfied. For evaluation of planar flaws within the adjacent material, the thickness \( t \), as shown in Figure -4200-1, shall be used when evaluating flaws for acceptability per Table IWB-3514-1 or IWC-3514-1. Alternatively, for Class 1, 2, or 3 piping, the acceptance criteria of IWB-3640, IWC-3640, or IWD-3640, as applicable, shall be satisfied. The analysis of the flaw shall meet the requirements of -3000(a).

(1) If flaws are detected within the adjacent material\(^3\) that do not meet the acceptance criteria in (g) the overlay may be extended over the affected area provided that the new design configuration meets the provisions of this Case.

**-4200 INSERVICE EXAMINATION**

(a) Inservice examinations shall be conducted in accordance with Table 1 and the following:

(1) For weld overlay examination, the examination volume in Figure -4100-2 shall be ultrasonically examined no later than the first refueling outage following application of the weld overlay.

(2) For the adjacent material\(^3\) examination, the examination volume in Figure -4200-1 shall be examined in accordance with (h) no later than the second refueling outage after installation of the overlay, if no flaws were detected during the -4100 exam. If flaws were detected during the -4100 examination, then the volume in Figure -4200-1 shall be examined during the first refueling outage after installation of the overlay.

(b) The weld overlay examination volume in Figure -4100-2 shall be ultrasonically examined to determine if any new or existing flaws have propagated into the outer 25% of the base material\(^3\) or into the overlay. The angle beam shall be directed perpendicular and parallel to the axis of the base material, with scanning performed in four directions. If the orientation of a flaw detected during the -4100(e) examination is not parallel or perpendicular to the pipe, additional scan patterns shall be applied based on the actual orientation of the flaw.
(c) For Class 1 piping, the in-service examination acceptance standards of Table IWB-3514-1 shall be satisfied, and for Class 2 or 3 piping, the in-service examination acceptance standards of Table IWC-3514-1 shall be satisfied for the examination volume in Figure -4100-2. For evaluation of planar flaws within volume A-B-C-D of Figure -4100-2 the thickness $t_1$ defined in Figure -4100-1 shall be used as the nominal wall thickness in Table IWB-3514-1 or IWC-3514-1. Planar flaws in the outer 25% of the base metal thickness shall meet the design analysis requirements of -3000. Alternatively, for Class 1, 2, or 3 piping, the acceptance criteria of IWB-3640, IWC-3640, or IWD-3640, as applicable, shall be satisfied for the weld overlay. If flaw growth beyond the size predicted in the -3000 analysis, either within the material or weld overlay, is observed, the overlaid material is not acceptable for continued service and shall be repaired in accordance with -4200 (f).

(d) If the examinations of -4200(a) show no indication of flaw growth or new flaws, subsequent examinations shall be as follows.

(1) For repaired flaws with originally-measured depths greater than or equal to 75% of the original wall thickness, the overlay shall be examined at one-half the time interval over which the predicted flaw depth reaches the outer 25% of the original material, as determined in accordance with -3000. The minimum inspection interval need not be sooner than a refueling outage interval and the maximum inspection interval shall not exceed 10 yr regardless of flaw analysis results. The examination shall be repeated at the time when the -3000 analysis predicts that the flaw will reach the outer 25% of the original material. The overlay shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b), as applicable.

(2) For repaired flaws with originally measured depths less than 75% of the original wall thickness, the overlay shall be examined at one-half the time interval over which the predicted flaw depth reaches the outer 25% of the original material, as determined in accordance with -3000. The minimum inspection interval need not be sooner than a refueling outage interval and the maximum inspection interval shall not exceed 10 yr regardless of flaw analysis results. The examination shall be repeated at the time when the -3000 analysis predicts that the flaw will reach the outer 25% of the original material. The overlay shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b), as applicable.

(e) If the examinations of -4200(a) show no indication of flaw growth or new flaws, subsequent examinations shall be as follows.

(1) For repaired flaws with originally-measured depths greater than or equal to 75% of the original wall thickness, the overlay shall be examined at one-half the time interval over which the predicted flaw depth reaches the allowable flaw depth for the combined thickness of the original material and overlay, as determined by the -3000 analysis. The minimum inspection interval need not be less than then length of a refueling cycle, and the maximum inspection interval shall not exceed 10 yr regardless of flaw analysis results. The examination shall be repeated at the time at which the -3000 analysis predicts that the flaw will reach the allowable flaw depth. The overlay shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b), as applicable.

(f) For weld overlay examination volumes with unacceptable indications as described in (c), the weld overlay shall be removed, including the original defective piping, and corrected by a repair/replacement activity in accordance with Article IWA-4000. Addition of weld metal to increase the overlay thickness is prohibited.

(g) If the source of fatigue cracking has not been identified, the examination of -4200 shall be performed during subsequent refueling outages, until the source is identified.

(h) Adjacent material within a minimum distance of $2\sqrt{Rt}$ from the toe(s) of the weld overlay shall be examined in accordance with -4100(e) and Figure -4200(1). For Class 1 piping, the in-service examination acceptance standards of Table IWB-3514-1 shall be
satisfied, and for Class 2 or 3 piping, the inservice examination acceptance standards of Table IWC-3514-1 shall be satisfied. For evaluation of planar flaws within the adjacent material, the thickness \( t \), as shown in Figure -4200-1, shall be used when evaluating flaws for acceptability per Table IWB-3514-1 or IWC-3514-1. Alternatively, for Class 1, 2, or 3 piping, the acceptance criteria of IWB-3640, IWC-3640, or IWD-3640, as applicable, shall be satisfied. The IWB-3640, IWC-3640, or IWD-3640 analysis shall include evaluation of the operating conditions and transients, including those believed to have caused the detected flaws, as well as all applicable loads. Subsequent examinations shall be in accordance with the following.

1. If no flaws are detected during the inservice examination of (h), the examination volume shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b), as applicable.

2. If inservice examinations in accordance with Figure -4200-1 reveal flaw growth or new flaws, meeting the requirements of (h), the volume shall be reexamined in accordance with the following.

   - (a) The volume containing the flaw shall be reexamined during the first refueling outage following discovery of flaw growth or new flaws. An analysis in accordance with IWB-3640, IWC-3640, or IWD-3640 shall be performed, and shall include operating conditions and transients, including those believed to have caused the detected flaws, as well as all applicable loads.

   - (b) Figure -4200-1 examination volumes examined during subsequent refueling outages that show no additional indication of flaw growth or new flaws, shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b), as applicable.

   - (c) If flaw growth, beyond that predicted in the -3000 analysis is observed, and the cause for the unpredicted flaw growth is understood and corrected, then the overlay design may be extended over the affected area provided that the new design configuration meets the provisions of this Case. Alternatively, the flaw shall be corrected by a repair/replacement activity in accordance with Article IWA-4000.

-4300 PRESSURE TESTING
Pressure testing shall be conducted in accordance with IWA-4540. Pressure testing is required only when flaws are through-wall, or become through-wall during weld operations.
### Table 1
**Inservice Examination Categories**

Class 1, 2 & 3 PWR & BWR Pressure Retaining Weld Overlays for Thermal Fatigue Flaws and Adjacent Base Metal Materials

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Parts Examined</th>
<th>Exam Requirements/ Fig. No.</th>
<th>Examination Method</th>
<th>Acceptance Standard Extent and Frequency of Examination</th>
<th>Deferral of Examination to End of Interval</th>
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<tr>
<td>A</td>
<td>Weld overlay of thermal fatigue flaw with flaw depth less than 75% of original thickness. [Note (1)]</td>
<td>Figure -4100-2</td>
<td>Volumetric [Note (2)]</td>
<td>-4200(c) The examination volume shall be examined during the first refueling outage following the installation of the overlay. The examination volume shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b) as applicable. An examination is also required at one-half the time at which the projected potential flaw growth reaches the outer 25% of the original material as determined in accordance with -3000. The examination shall be repeated at the time when the -3000 analysis predicts that the flaw will reach the outer 25% of the original material. [Note (3)], [Note (4)] [Note (5)]</td>
<td>Not permissible</td>
</tr>
<tr>
<td>B</td>
<td>Weld overlay of thermal fatigue flaw with flaw depth equal to or greater than 75% of original thickness. [Note (1)]</td>
<td>Figure -4100-2</td>
<td>Volumetric [Note (2)]</td>
<td>-4200(c) The examination volume shall be examined during the first refueling outage following the installation of the overlay. The examination volume shall be added to the Inspection Program as a new item in accordance with IWB-2411(b), IWC-2411(b), or IWD-2411(b) as applicable. An examination is also required at half the time for the flaw to reach the through-wall depth limit per the -3000 analysis. The examination shall be repeated at the time when the -3000 analysis predicts that the flaw will reach the allowable flaw depth. [Note (3)], [Note (4)] [Note (5)]</td>
<td>Not permissible</td>
</tr>
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<td>C</td>
<td>Weld overlay of thermal fatigue flaw where flaw growth or new flaws are detected.</td>
<td>Figure -4100-2</td>
<td>Volumetric [Note (2)]</td>
<td>-4200(c) If flaw growth or new flaws are observed during in-service examination meeting the requirements of -4200(c) the examination volume in Figure -4100-2 shall be examined each refueling outage until no flaw growth or new flaws are observed per -4200(e). [Note (3)], [Note (4)]</td>
<td>Not permissible</td>
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<tr>
<td>D</td>
<td>Uncracked adjacent material[^3]</td>
<td>Figure -4200-1</td>
<td>Volumetric [Note (1)]</td>
<td>-4200(h) The examination volume shall be examined no later than the second refueling outage following the installation of the overlay. Examinations following the first examination after installation shall be once per interval. [Note (3)], [Note (4)], [Note (6)]</td>
<td>Yes</td>
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<td>E</td>
<td>Cracked adjacent material[^3]</td>
<td>Figure -4200-1</td>
<td>Volumetric [Note (1)]</td>
<td>-4200(h) Each refueling outage if flaw growth or new flaws were detected during last examination. Following an examination in which no new flaw growth or no new flaws are identified, subsequent examinations shall be performed in accordance with -4200(b)(2)(b). [Note (3)], [Note (4)]</td>
<td>Not permissible</td>
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</table>

**NOTES:**

1. The flaw repaired by overlay may be within the weld and/or base material.
2. The examination shall meet the requirements of -4000.
3. If the source of fatigue cracking has not been identified, the examination of -4200 shall be performed during each refueling outage in accordance with -4200(g).
4. Weld overlay and material[^3] examination volumes with unacceptable indications in accordance with -4200(c) shall be removed in accordance with -4200(f).
5. The minimum inspection interval need not be sooner than a refueling cycle, and the maximum inspection interval shall not exceed 10 yr regardless of flaw analysis results.
6. If a new flaw is detected, the part examined shall meet Inspection Item E requirements.
### 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:**

1. This table is for use with Cases N-532-4, N-561-3, N-562-3, N-575-1, N-575-2, N-569-1, N-638-4, N-638-5, N-638-6, N-638-7, N-638-8, N-638-9, N-638-10, N-638-11, N-638-12, N-638-13, N-638-14, N-638-15, N-638-16, N-638-17, N-638-18, N-638-19, N-638-20, and N-638-21.
2. When using Case N-532-4 with Code Editions and Addenda and later than the 2005 Addenda, the paragraph references listed in Table 1 shall apply.
3. When using Cases N-638-4, N-638-5, N-638-6, or N-638-7 with Code Editions and Addenda later than the 2004 Edition, the paragraph references listed in Table 1 shall apply.
4. When using Cases N-576-1 with Code Editions and Addenda later than the 2000 Addenda, the paragraph references listed in Table 1 shall apply. Enter Table 1 in the 2000 Addenda column.
5. When using Cases N-730, N-730-1, N-730-2, or N-730-3 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.
6. When using Case N-733-1 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.