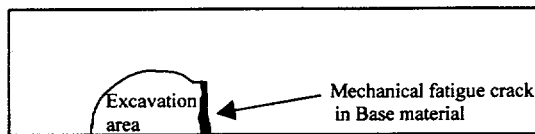


Proposed Code Case and Code change to ASME Section XI, Appendix VIII, Supplement 11

The following proposed Code action is the result of NRC, PDI, and EPRI attempts to consolidate the requirements contained in the current Code Appendix VIII rules and the NRC Final Rulemaking. Outstanding items were identified and resolved during a joint meeting with NRC, PDI, and EPRI on 10/11/00 and they were finalized during a PDI and EPRI meeting on 11/28/00. The Code action is presented as both a Code Case and a Code Change because selected revisions are needed quickly to address implementation commitments and concerns.

The major difficulty with the current Supplement 11 is that it requires that all flaws be cracks. As illustrated below implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side. For this reason paragraph 1.1(d)(1) was modified to allow for the use of alternative flaw mechanisms under defined conditions.



The existing specimens used to date for qualification to the Tri-party (NRC/BWROG/EPRI) agreement have a population density greater than allowed by the current Code requirements. These samples have been used successfully for all previous qualifications. As a result, several paragraphs were revised to allow closer spacing of flaws provided they didn't interfere with detection or discrimination. Additionally, the requirement for axially oriented overlay fabrication flaws was excluded, along with the use of IWA-3300 for flaw evaluation (paragraph 1.1(e)(2)). This revision also incorporates lessons learned from hundreds of qualifications. For example, it requires a larger sample set size with 100% detection for procedure qualification and modifies the requirements for identifying flawed regions to candidates. Flaws were consistently referenced as either base "metal" or overlay "fabrication" flaws. These later revisions are contained in several individual paragraphs. The "critical miscall" requirement in paragraph 3.2(b) for reporting all extensions of cracking into the overlay was omitted. It was never used as such in the previous Tri-party qualification program and is inappropriate considering the additional use of RMS values for flaw depth sizing.

The following presents the noted changes in a two column format. The left most column is the current Code requirements from the 95 Edition, 96 Addenda. The right column presents the needed revisions.

Submitted by: Mike Gothard, (704) 547-6131 (FAX 6028), mgothard@epri.com

**SUPPLEMENT 11 — QUALIFICATION
REQUIREMENTS FOR FULL STRUCTURAL
OVERLAID WROUGHT AUSTENITIC
PIPING WELDS**

1.0 SPECIMEN REQUIREMENTS

Qualification test specimens shall meet the requirements listed herein, unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure (e.g., pipe size, weld joint configuration, access limitations). The same specimens may be used to demonstrate both detection and sizing qualification.

1.1 General. The specimen set shall conform to the following requirements.

(a) Specimens shall have sufficient volume to minimize spurious reflections that may interfere with the interpretation process.

(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 in. to $+0.25$ in. of the maximum nominal overlay thickness for which the procedure is applicable.

(c) The surface condition of at least two specimens shall approximate the roughest surface condition for which the examination procedure is applicable.

(d) *Flaw Conditions*

(1) *Base metal flaws.* All flaws must be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. ~~Flaws may extend 100% through the base metal and into the overlay material; in this case,~~ intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.

(2) *Overlay fabrication flaws.* At least 40% of the flaws shall be non-crack fabrication flaws (e.g., sidewall lack of fusion or laminar lack of bond) in the overlay or the pipe-to-overlay interface. At least 20% of the flaws shall be cracks. The balance of the flaws shall be of either type.

(e) *Detection Specimens*

(1) At least 20% but less than 40% of the flaws shall be oriented within ± 20 deg. of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. ~~The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.~~

(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.

(a)(1) A base grading unit shall include at least 1 in. of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal-to-overlay interface.

(a) A minimum of 70 percent of the flaws in the detection and sizing tests shall be cracks. Alternative flaw mechanisms, if used, must provide crack like reflective characteristics and be limited by the following:

(1) Alternative flaws must be limited to the case where implantation of cracks precludes obtaining a realistic ultrasonic response.

(2) Alternative flaws must be semielliptical with a tip width of less than or equal to 0.006 inches.

base metal

metal

fabrication

Flaws shall not interfere with ultrasonic detection or characterization.

metal

(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 in. of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.

(3) When a base grading unit is designed to be unflawed, at least 1 in. of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. The segment of weld length used in one base grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.

(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 sq in. The overlay grading unit shall be rectangular, with minimum dimensions of 2 in.

(2) An overlay grading unit designed to be unflawed shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. around its entire perimeter. The specific area used in one overlay grading unit shall not be used in another overlay grading unit. Overlay grading units need not be spaced uniformly about the specimen.

(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.

(f) Sizing Specimen

(1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.

(2) At least 20% but less than 40% of the flaws shall be oriented axially. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access.

(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.

(4) Depth sizing specimen sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 in. in the through-wall direction.

2.0 CONDUCT OF PERFORMANCE DEMONSTRATIONS

The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular

metal

Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws.

fabrication

for a length of at least 1 in.

Overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to preclude interfering reflections from adjacent flaws.

fabrication

metal

fabrication

For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets and, within the scope of the procedure, 100% of the flaws must be detected. Extension of qualifications to qualify new values of essential variables requires at least one personnel qualification set.

For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. Extension of qualifications to qualify new values of essential variables requires at least one personnel qualification set.

specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited. ←

The overlay fabrication flaw test and the base metal flaw test may be performed separately.

2.1 Detection Test. Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.

metal
fabrication

2.2 Length Sizing Test

(a) The length sizing test may be conducted separately or in conjunction with the detection test.

(b) When the length sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region.

(c) For a separate length sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region.

(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.

metal

2.3 Depth Sizing Test. ~~For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate.~~ The candidate shall determine the maximum depth of the flaw in each region.

all flaws are detected and

3.0 ACCEPTANCE CRITERIA

3.1 Detection Acceptance Criteria. Examination procedures, ~~equipment, and personnel~~ are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for ~~both detection and false calls.~~ The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.

Examination equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls.

metal
fabrication

3.2 Sizing Acceptance Criteria. Examination procedures, equipment, and personnel are qualified for sizing when the results of the performance demonstration satisfy the following criteria.

(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position. **A96**

~~(b) All extensions of base metal cracking into the overlay material by at least 0.1 in. are reported as being intrusions into the overlay material.~~

A96 (e) The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 in.