

NUCLEAR PLANT  
SERVICES DEPARTMENT

SUBJECT: SUPPLEMENT FOR MANUAL ULTRASONIC  
EXAMINATION OF DISSIMILAR METAL WELDS

UT-AUSTENITIC-M

SUPPLEMENT 2

REV. 2

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## 1.0 SCOPE

- 1.1 This supplement defines the techniques, equipment, and requirements for manual contact ultrasonic examination of dissimilar metal welds, weld buttering, and cladding materials for circumferentially and axially oriented flaws.
- 1.2 These examinations should be performed in addition to the ASME Section XI examinations.

## 2.0 GENERAL

- 2.1 The ultrasonic examinations shall consist of 1/2 VEE path techniques, utilizing longitudinal wave search units. The applicable material thickness range for this examination is from 0.200" to 2.50".
- 2.2 Examinations shall be performed from the outside surface of the components.
- 2.3 The techniques described in this supplement are the results of work performed by the General Electric Company. The work was sponsored by the BWR Owners Group through EPRI.
- 2.4 The provisions permitted in ASME Section XI Paragraph IWA-2240 are the basis of this supplement.

## 3.0 REFERENCES

- 3.1 The references identified in Section 2.0 of UT-AUSTENITIC-M are considered a part of this supplement as applicable.
- 3.2 EPRI Final Report, NP4606.LD, May 1986, Examination of Dissimilar Metal Welds in BWR Nozzle to Safe-End Joints.

## 4.0 PERSONNEL REQUIREMENTS

- 4.1 General personnel requirements are as described in Section 3.0 of UT-AUSTENITIC-M.
- 4.2 Examination personnel shall be indoctrinated in the use of the applicable procedures and this supplement. Evidence of this indoctrination shall be included in the final records package.

## 5.0 EQUIPMENT

### 5.1 Ultrasonic Instrument

5.1.1 General requirements for the Ultrasonic Instrument are as described in Section 4.1.1 of UT-AUSTENITIC-M.

### 5.2 Search Units

5.2.1 Dual element, ceramic type search units operating at nominal frequency from 1.0 to 4.0 MHz shall be used for this examination. The examination shall be performed using refracted longitudinal waves with nominal angles in the range of 30° to 70°. Maximum piezoelectric element size (each individual element) shall be 1" x 1.5". Various roof angles and focal distances should be evaluated to choose the search unit with the maximum signal-to-noise (S/N) ratio. Search unit size shall be selected based upon the diameter and configuration of the material to be examined . . allow maximum ultrasonic coupling.

5.2.2 Transducers/Wedges of other sizes, angles, mode of propagation, or frequencies may be used where required by material characteristics, geometric configuration or for the evaluation of indications, with the approval of the responsible Level III.

### 5.3 Cables

5.3.1 Coaxial cable sets should not exceed 12 ft. in length. The length and type of cable used shall be recorded on the Calibration Data Sheet.

#### 5.4 Calibration Blocks

- 5.4.1 The calibration block shall be made from material of the same nominal diameter and wall thickness as the component to be examined. The calibration block shall be fabricated and welded from materials of the same or similar product form(s), analyses, and specifications as the welds being examined.
- 5.4.2 The calibration block shall contain, as a minimum, inside surface axial and circumferential EDM notch reflectors. Notch depths shall be approximately 20% of the Basic Calibration Block thickness. The length of the axial notch should not exceed 0.5". The length of the circumferential notch shall be at least 0.5" and not more than 1.0" in length.
- 5.4.3 The surface finish of the calibration block shall be representative of the surface finish of the component to be examined. It is recommended that the surface finish of the weld should be approximately 125 RMS with no valleys or weld beads present.
- 5.4.4 An IIW-2, DSC, or rompus block may be used as a simulator block for calibration checks. Other simulator blocks may also be used for the purpose of calibration checks provided they contain sufficient reflectors to establish the checks.

#### 5.5 Couplant

- 5.5.1 The couplant shall be in accordance with Section 4.7 of UT-AUSTENITIC-M.

### 6.0 CALIBRATION

#### 6.1 Instrument Linearity Verification

- 6.1.1 Verification of the ultrasonic instrument linearity shall be in accordance with 5.1 of UT-AUSTENITIC-M.

#### 6.2 System Calibration

- 6.2.1 The general requirements for calibration of the complete ultrasonic system shall be in accordance with 5.2 of UT-AUSTENITIC-M.

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6.2.2 Determination of beam index - Position the angle beam search unit on an IIW-2 block or other suitable reference block so that the beam is directed toward the appropriate radius surface. Move the transducer parallel to the sides of the block until a maximum echo is obtained from the reflecting radius. The beam index point is now above the centerline of the radius, as scribed on the applicable block. Place a mark on the side of the wedge to identify the index point.

### 6.3 Sweep Calibration

6.3.1 Calibration of the UT system sweep shall be in accordance with 5.3.5 of UT-AUSTENITIC-M for the 1/2 VEE path calibration.

### 6.4 Sensitivity Calibration

6.4.1 Position the search unit on the applicable calibration block to detect the signal from the circumferential I.D. notch located within the weld material. Maximize the signal and adjust the response to 80% FSH. This establishes the primary reference level.

6.4.1.1 If a calibration block is not available that meets the specifications of 5.4 then an alternate calibration block(s) for the side under examination shall be utilized. Position the search unit on the applicable calibration block to detect the signal from the calibration notch(es). Maximize the signal and adjust the response to 80% FSH, repeat this process if more than one calibration block is needed. Note the gain setting for each calibration block used. Next a comparison on a welded mockup block should be performed. Maximize the signal from the applicable ID notch in the welded mockup, adjust the gain setting until this signal is 80% FSH, repeat this process for both sides of the weld. Any dB changes necessary between calibration block(s) and the welded mockup shall be noted. The Level III responsible for the examination shall evaluate the recorded dB changes and determine the appropriate adjustment to the primary reference sensitivity. This comparison need only be performed once per UT system/calibration block combination.



- 6.5.2 It is recognized that at given gain setting, there will be some difference in the response between the axially oriented I.D. notch and the circumferentially oriented I.D. notch. To account for this difference, maximize the amplitude from the circumferential I.D. notch at 80% FSH and then maximize the amplitude of the axial I.D. notch at 80% FSH. Note this dB change on the Calibration Data Sheet for future reference. This determination shall be performed for each calibrated UT system/calibration block combination.

#### 6.6 Calibration Record

- 6.6.1 All calibration and calibration verification data shall be recorded on the Calibration Data Sheet.

### 7.0 EXAMINATION

#### 7.1 General

- 7.1.1 Examinations shall be performed in accordance with Section 6.0 of UT-AUSTENITIC-M as applicable.
- 7.1.2 Examinations shall be performed using nominal angles of both  $45^\circ + 3^\circ$  and  $60^\circ + 3^\circ$  to supplement scans 1 through 4 (Figure 3) of UT-AUSTENITIC-M. For circumferential scans, the refracted angle shall not exceed the arc sin of the inside radius/outside radius. Alternate angles may be used if it is determined by the responsible Level III that more meaningful data can be obtained.
- 7.1.3 Scanning sensitivity shall be established so that the average base line noise level is between 10% and 20% FSH. Base line noise levels in excess of 30% FSH shall be approved by the Level III responsible for the examination.

### 8.0 DATA RECORDING

- 8.1 If, during the examination the Level II believes that indications are caused by cracks, or they are believed to be crack like in nature, they shall be noted on the Examination Data Sheet(s) regardless of amplitude.
- 8.2 All indications in excess of 10% FSH above the average noise level shall be recorded. If in the opinion of the Examiner a signal may mask the recording of others, the scan shall be completed. The suspect area shall be rescanned with a calibration that allows determination of whether a masking condition exists.

## 9.0 REPORTS AND RECORDS

### 9.1 Minimum Information Requirements

9.1.1 Examination records shall include, but not necessary be limited to the following:

#### 9.1.2 Calibration Data Sheet

- a) Calibration sheet identification, date and time period of calibration.
- b) name(s) of examination personnel.
- c) examination procedure number and revision.
- d) basic calibration block identification.
- e) ultrasonic instrument identification and serial number.
- f) beam angle, couplant, and mode of wave propagation in the material.
- g) orientation of search unit with respect to the pipe (longitudinal or circumferential).
- h) search unit identification - frequency, size, Manufacturer, and serial number.
- i) reviewers signature, level and date.
- j) search unit cable type, and length.
- k) times of initial calibration and subsequent and final calibration checks.
- l) instrument settings, amplitudes, and sweep positions used to establish primary reference sensitivity.
- m) thermometer serial number and required calibration block temperatures.

#### 9.1.3 Examination Data Sheet

- a) data sheet identity, examination date and time period of examination
- b) name(s) and ASNT Level(s) of examination personnel
- c) examination procedure and revision
- d) applicable calibration sheet identity
- e) weld identification
- f) record of indications or of volume free from indications
- g) volume scanned and scan limitations if any
- h) reviewers signature, level and date
- i) search unit position and locations of recorded indications
- j) thermometer serial numbers and examination surface
- k) acoustic equivalency adjustment where necessary



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## 9.2 Qualification Report

- 9.2.1 The adequacy of the selected ultrasonic system/calibration block/procedure combination shall be demonstrated once on a representative mockup before the actual examination is performed. The mockup may be the basic calibration block. The demonstration will be considered successful if the 20% notches are detected with a signal to noise ratio of 2:1 or greater.
- 9.2.2 A report shall be prepared to document the demonstration. Any change to the specified ultrasonic system/calibration block/procedure combination shall require a demonstration on a representative mockup and preparation of a new qualification report. The report for this demonstration may be combined with that for automated examinations if automated exams are performed.

## 10.0 DATA EVALUATION

- 10.1 Ultrasonic data shall be evaluated in accordance with LIM-UTI-Evaluation.
- 10.2 Evaluated data shall be reviewed by a GE Level III and forwarded in accordance with contract and QA Manual requirements for final disposition.