POWER AUTHORITY OF THE STATE OF NEW YORK

QUALITY ASSURANCE

NONDESTRUCTIVE EXAMINATION PROCEDURE

TITLE: ULSTASONIC EXAMINATION PROCEDURE FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING (IGSCC)	NDEP: 9.4-7
APPLICABILITY: NUCLEAR POWER PLANTS	REVISION: 1
APPROVAL: Dan Frangos — NDE - LEVEL III	DATE: 3/25/82
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SUPERCEDES: REV. 0, 2/10/82	

ULTRASONIC EXAMINATION PROCEDURE FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING (IGSCC)

1.0 PURPOSE

This procedure delineates the technique whereby ultrasonic examination by manual pulse/echo techniques may be performed on stainless steel piping for intergranular stress corrosion cracking (IGSCC).

2.0 APPLICABILITY

2.1 Area of Examinations

This document covers the ultrasonic examination procedures of stainless steel piping for intergranular stress corrosion cracking (IGSCC). IGSCC is typically detected in the area between the weld heat affected zone and a point 1/2 inch outward.

2.2 Type of Examination

2.2.1 Volumetric examination shall be performed using ultrasonic pulse echo nominal 45° angle beam shear wave and 0° longitudinal straight beam techniques applied to the outside surfaces of the piping.

2.2.2 The examination shall be performed using manual search units (transducers).

2.3 Time of Examination

This procedure shall govern the examination and re-examination of repaired areas of the pipe as required by the Nuclear Regulatory Commission.

2.4 Weld Configuration

2.4.1 The typical weld configurations and areas of IGSCC covered by this procedure are shown Figures 1 and 2.

2.4.2 Nominal weld thicknesses range from 0.120" to 1.125".

2.5 Materials

The piping is constructed for austenitic stainless steel.

2.6 Examination Intent

This procedure is intended to cover the piping ID surface adjacent to welds. We are interested in the detection of cracks which originate at the ID surface. The outside surface of each weld will be examined by the liquid penetrant method.

3.0 REFERENCES

The following documents form a part of this examination procedure:

3.1 ASME Boiler and Pressure Vessel Code, Section XI, 1974 Edition, Appendix III and supplements of the 1975 Winter Addenda.

3.2 Electric Power Research Institute (EPRI), Project Report 892 (1/79) "Workshop on In-Service Inspection of Stainless Steel Piping in Nuclear Systems."

3.3 Electric Power Research Institute (EPRI), "Seminar on Countermeasures for BWR Pipe Cracking." Jan 22, 23, 24, 1980 Session #8.

3.4 Electric Power Research Institute (EPRI), Special Report - Project 892, Aug. 1979 EPRI NP-1153.

3.6 ASNT Recommended Practice, SNT-TC-1A, 1975 Edition.

3.7 PASNY Procedure for "Ultrasonic Instrument Linearity Procedure", as modified by paragraph 5.11.2 of this procedure.

3.8 USNRC Bulletin 79-17 (7/26/79).

3.9 PASNY Procedure for Nondestructive Examination Personnel Qualification and Certification NDEP 1.1.

3.10 ASME - Section III Appendix IX

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5.0 GENERAL*

5.1 Personnel Requirements

5.1.1 All personnel performing the nondestructive examinations in accordance with this procedure shall be qualified and certified to at least Level I in accordance with SNT-TC-1A and NDEP 1.1 Procedure for Qualification and Certification of Nondestructive Examination Personnel.

*The examination procedures described in this document comply with Section XI, Appendix III of the ASME Boiler and Pressure Vessel Code, 1974 Edition, including the winter, 1975 Addenda except where examination coverage is limited by part geometry or access.

NOTE: At least one member of each examination crew shall have a minimum qualification of Level II. A Level II or III individual shall be responsible for witnessing the final interpretation on all ultrasonic examinations. He shall be responsible for the recording and acceptance of required data on ultrasonic examination reports.

5.2 Equipment

5.2.1 Pulse-echo ultrasonic equipment (Krautkramer USM2, Sonic MK1, Sperry Type UM, UJ or equivalent) shall be used. The ultrasonic instrument shall be equipped with a fine gain and/or attentuation control calibrated in units no larger than 2dB.

5.2.2 Search Units

5.2.2.1 Straight beam examination shall be performed using a ceramic, lithium sulfate, or barium titanate 5.0 MHZ nominal frequency to provide greater resolution and to minimize beam spread.

5.2.2.2 Angle beam examination shall be performed using a lead metaniobate 1.5 MNZ 45° (±.5 degrees) angle beam single or dual element search unit as stated below. The effective size of the single element units shall be .25" or .5". The effective area of the dual element units shall be 1/4" x 1/2" or 3/8" x 3/4".

5.2.2.3 Exit Point: A standard IIV block will be used before examinations are performed each day to verify or correct the exit point on the transducer shoe.

5.2.2.4 Beam Angle: After the exit point has been determined, the beam angle shall be checked with the IIW block to confirm that the transducer meets the angle ranges specified in 5.2.2.2.

5.2.2.5 Wedge Rework: Any transducer wedge not providing the angle tolerances specified in 5.2.2.2 shall be reworked and the measurements specified in 5.2.2.3 and 5.2.2.4 repeated until the unit complies with the tolerances.

5.2.2.6 Shear Wave: A 45 degree beam shall be used.

5.2.2.7 At the discretion of the Level III, transducers of different size, shape, and frequency may be used as permitted by Section III, Appendix IX. These changes shall be documented on the data sheets.

5.2.2.8 When variables such as weld preparation, weld crown width, or physical interference preclude 1/2 Vee path examination of the weld root, and when these variables are such that the distance from the sound beam exit point on the search unit to the weld (root) centerline is greater than 0.93t, the beam path shall be increased at least 1 Vee path. Alternately, the interference may be eliminated by:

1. Reducing the dimension of the wedge edge-to-beam exit point;
2. Reducing search unit size;
3. Increasing beam angle.

5.2.2.9 Cable Type and length shall be recorded on the calibration data sheet. <1>

5.3 Miniature Angle Beam Calibration Standard

5.3.1 As per Figure #4.

5.4 Thermometer

5.4.1 Calibrated for ±5% of reading; calibrated every 3 months max.

5.5 Wedges - 45° Shear and Longitudinal, 1/4" and 1/2"

5.5.1 Lucite-type for single element transducer.

5.6 Surface Preparation:

The examination surface shall be free of dirt, loose scale, machining or grinding particles, weld spatter, or other loose foreign matter. The surface finish shall be sufficiently smooth to maintain acoustical bond minimize surface noise. A mill finish may be adequate for testing.

5.7 Couplant:

A suitable liquid, semi-liquid, or paste couplant medium such as water, oil, glycerin, grease, or Hamikleer shall be applied to the examination surface. Each batch of materials used on stainless steels or nickel base alloys shall have been tested for residual

2. Observe signal shape, behavior, and search unit distance from the weld centerline. This will yield information as to the nature of the indication. Make notes of your observations during the recording process.

8.2 Plotting of Indications

All recorded indications shall be plotted full scale on Figure 9 or on graph paper in the following mannér:

1) Trace the O.D. contour from the contour gauge.

2) Plot the thicknesses.

3) Connect the thickness points to recvonstruct the I.D. contour.

4) Plot the "W max", "W_1", and "W_2" dimensions on the applicable side of the weld.

5) All the "W max" position use a protractor to lay out the actual path to the indication origin by measuring along the metal path.

6) For the forward measurements (W_1) use an angle which is 3 degrees less than the "W max" angle, this allows a reasonable amount for beam spread. Plot the metal path to termination.

7) For the background measurements (W_2) use an angle which is 3 degrees greater than the "W max" angle. Plot the metal path to termination.

8) Connect the 3 metal path termination points to reconstruct the shape of the reflector.

8.3 Evaluationm of Indications

8.3.1 Indications where plots confirm that they are caused by geometry shall be marked as such.

8.3.2 Indications where plots confirm that they are cracks shall be reported to the examination supervisor who will notify the Plant Owner within 24 hours.

8.3.3 Indications where plots yield inconclusive information shall be reported to the examination supervisor for disposition.

9.0 EXAMINATION RECORDS

9.1 Certification of Records

The Examiner shall complete and sign all data lsheets immediately upon the completion of each weld examination. The data sheets may be reviewed by the Authorized Code Inspector.

9.2 Record of Examination Results: A copy of the examination data shall be provided the Authority with the following information:

A. Contract Number
B. Examination Personnel
C. Instrument
D. Method of Test
E. Couplant
F. Calibration Sheets
G. Weld Identification and Location
H. Type, Size, and Frequency of Search Unit
I. Ultrasonic Wave Mode
J. Calibration Block Number
K. Chart of Results
L. Procedure
M. Date(s) of Examination
N. Examination Surface
O. Layout of Weld Seams

9.3 Reports

9.3.1 A detailed Ultrasonic examination report shall be prepared using Indication Data Sheet and any additional sketches or photographs as may be applicable. If no reportable indications are detected, it shall be so noted on report form. All final Data Sheets shall be in black ink.

TO BE INSERTED:

ATTACHMENT (FIGURE) #1 THROUGH 9.

ATTACHMENT NO. 5

RECIRCULATION SYSTEM

STRESS RULE INDEX

CARBON CONTENT (%)

	0-1.20	1.21-1.50	1.51-2.00	≥ 2.01
≥ 0.070	22-22	12-59 22-28 22-29 28-27 28-30 28-49* 28-50	12-3 12-8 12-9 12-13 12-14 12-18 12-19 12-60 12-65 12-66 12-70 12-71 12-77	12-4 12-10 12-76
0.060-0.069	22-6 22-63 22-80	4-93 22-5 22-11 22-16 22-21 22-62 22-68 22-79 22-86 28-31 28-32 (1) 28-36 (1) 28-53 28-85 28-89 28-90 (1) 28-103 (1) 28-112	4-38 4-47 4-102 12-25 12-83 12-84 22-73 22-87 28-52 28-88 28-111*	4-42 4-43 4-97 4-98 12-15 12-20 12-26 12-61 12-67 12-72 12-78
			REGION III (HIGH SUSCEPTIBILITY)	
0.050-0.059	28-34 28-35 28-48* 28-50A 28-51 28-56 28-104* 28-106* 28-113	12-58* 28-33 28-37 28-54 28-91 28-92* 28-107 28-108 28-109 28-110 28-110A*	12-2 12-24 12-64* 12-69* 12-75* 12-81* 12-82 28-57 28-105 28-115 28-116	4-41 4-99
0.035-0.049		4-100	4-39 4-40 4-44 4-96 4-101 12-1* 12-7* 12-12* 12-17* 12-23*	4-45 4-46 4-94 4-95
			REGION II (MODERATE SUSCEPTIBILITY)	
< 0.035			REGION I (LOW SUSCEPTIBILITY)	

*Carbon known for only one wrought component of a weld joint. Depending on the carbon content of the other base material, the position in the matrix may change. (cast material is exempted)

(1) Bypass weldolet

LEGEND: xx-yy

- xx: nominal pipe diameter
- yy: individual weld number

ATTACHMENT NO. 6

3.6 (cont'd)

4. Except as specified in 3.6.C.3 above, the reactor coolant water shall not exceed the following limits with steaming rates greater than or equal to 100,000 lb/hr and during reactor shutdowns.

Conductivity	5 μmho/cm
Chloride ion	0.5 ppm

5. If Specification 3.6.C cannot be met, the reactor shall be placed in a cold condition within 24 hours.

D. Coolant Leakage

1. Anytime irradiated fuel is in the reactor vessel and the reactor coolant temperature is above 212°F, the reactor coolant leakage into the primary containment shall be limited to:

   a. 5 gpm unidentified leakage

   b. 2 gpm increase in unidentified leakage within any 24 hour period. (This limitation shall apply only after a period of 24 hours at operating pressure.)

   c. The total reactor coolant leakage into the primary containment shall not exceed 25 gpm.

2. With any reactor coolant system leakage greater than any one of the limits specified in a. or c. above, the leakage rate shall be reduced to within the limits

4.6 (con't)

4.6.D Coolant Leakage

Reactor coolant leakage rate inside the primary containment shall be established once/day utilizing the Equipment and Floor Drain Sump Monitoring Systems.

3.6 (cont'd)

within 4 hours or the reactor shall be in at least the hot standby condition within the following 12 hours and in cold condition within the next 24 hours.

3. If the increase in unidentified leakage as specified in 3.6.D.1.b is exceeded, the source of the leakage shall be identified within 4 hours or the reactor shall be in at least hot standby condition within the next 12 hours and in cold condition within the following 24 hours.

4. The following reactor coolant system leakage detection systems shall be operable during reactor power operation:

   a. Drywell Sump Monitoring System (equipment drain sump monitoring and floor drain sump monitoring),

   b. Drywell Continuous Atmosphere (particulate) Radioactivity Monitoring System, and

   c. Drywell Continuous Atmosphere (gaseous) Radioactivity Monitoring System.

4.5 (cont'd)

5. With only two of the leakage detection systems operable (3.6.D.4), operation may continue for up to 30 days provided grab samples of the drywell atmosphere are obtained and analyzed at least once per 24 hours when the required gaseous or particulate monitoring system is inoperable; otherwise, be in at least hot shutdown within the next 12 hours and in cold shutdown within the next 24 hours.

3. Drywell Continuous Atmosphere Radioactivity Monitoring System instrumentation shall be functionally tested and calibrated as specified in Table 4.6-2.