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Water Reactor Divisions

Nuclear Service Division

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PRESERVICE AND INSERVICE INSPECTION OF REACTOR VESSELS

1.0 PURPOSE

1.1 This document describes the equipment, calibration sequence, examination techniques, and recording requirements for preservice and inservice inspection of a reactor vessel with the remotely operated inspection tool. All operations described herein are intended to satisfy volumetric examination requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Procedure RV-ISI-01, "Reactor Vessel Examination Program Preparation and Documentation," is considered part of this procedure and should be used as applicable.

2.0 SCOPE

2.1 This document provides general requirements for straight and angle beam immersion ultrasonic examinations of pressure retaining carbon and low alloy steel welds, nozzle safe end welds, heat affected zones, specified base material, and weld repairs to base material which exceed 10% of the nominal wall thickness in the reactor vessel beltline regions.

2.2 Specific calibration and examination requirements, i.e., areas selected for examination, extent of examination, search unit sizes, angles, calibration standards, and water path distances, are defined in the plant specific Examination Program Plan.

3.0 EQUIPMENT

3.1 Examinations shall be performed using pulse-echo and/or transmit-receive techniques with immersion water path coupling using the equipment listed below.

3.1.1 Sonic Multichannel Time - Amplitude Ultrasonic System, consisting of the following modules and interconnects:

Pulser/Preamps	Mark VI Mainframe/CRT
Mark VI Receiver	Mark VI Interface
System Controller	Hardcopy Controller
Gate Monitor	Two Tektronix 613 Storage Scopes
Data Display	Tektronix 4613 Hardcopy Printer
Power Suppliers	Serial Data Link

RG-174 Cable, 23 ft.
Four Tektronix 2213 Auxiliary Displays

3.1.2 Westinghouse Computer System Model 2500

3.1.3 Westinghouse MK-1 Electronic Block Simulator (EBS)

3.1.4 Harisonic Transducers
2.25 MHz, 1.50 inches diameter
2.25 MHz, 0.75 inches diameter
1.0 MHz, 1.50 inches diameter
1.0 MHz, 0.75 inches diameter
5.0 MHz, 0.50 inches x 1.00 inches rectangular

3.1.5 Transducer array plates and transducer mounting assemblies

3.1.6 Calibration tank and manipulator

3.1.7 Calibration block

3.1.8 Mechanical Transfer Standard (MTS)

3.1.9 Spherical "Home" Target

3.2 Other transducers, calibration standards, and/or equipment may be used for special applications or where metallurgical characteristics or geometry preclude effective use of the equipment described above. These parameters shall be defined in the Examination Program Plan.

4.0 PERSONNEL REQUIREMENTS

4.1 Ultrasonic test operators performing activities per this procedure shall be qualified and certified Level II or Level III per W PA 10.1 or equivalent procedure based on SNT-TC-1A, as supplemented by the requirements of Section XI. Individuals qualified and certified Level I or Level I Trainees per W PA 10.1 or equivalent procedure as described above may perform these activities under direct supervision of a Level II or Level III. All recordable indications shall be evaluated by a Level II or Level III individual.

5.0 INSTRUMENT PERFORMANCE CHECKS

5.1 Instrument screen height linearity and amplitude control linearity shall be verified prior to the performance of any system calibrations and at the beginning and end of the examination period or every three months, whichever is less. The same EBS signal response(s) shall be used for the initial determination and subsequent field checks.

5.2 The ultrasonic instrument shall be verified as having a linear vertical presentation within ± 5% of the full screen height for at least 80% of the calibrated screen height in accordance with the following steps.

5.2.1 Utilizing the EBS and any given channel of the Sonic System obtain two EBS pulses on the CRT.

5.2.2 Adjust the EBS controls and the receiver gain control to set the first indication to 80% full screen height (FSH) and the second indication at 40% FSH.

5.2.3 Without changing the EBS controls, adjust the receiver gain to sequentially set the larger indication from 100% to 10% FSH in 10% increments. Record the smaller indication amplitude at each setting. Estimate the readings to the nearest 1% FSH.

5.2.4 The reading must be 50% of the larger amplitude, within ± 5% FSH.

5.2.5 Record all data and instrument settings on the appropriate data sheet.

5.3 The accuracy of the amplitude control of the ultrasonic system shall be verified as being within ± 20% of the nominal amplitude ratio over its useful range in accordance with the following steps.

5.3.1 Utilizing the EBS and any given channel of the Sonic System obtain an EBS pulse on the CRT.

5.3.2 Adjust the receiver gain to set the indication to 80% FSH. Record the receiver gain setting.

5.3.3 Decrease the receiver gain by 6dB and record the signal amplitude.

5.3.4 Decrease the receiver gain again by 6dB and record the signal amplitude. Decrease the receiver gain by an additional 6dB and record the signal amplitude.

5.3.5 Adjust the receiver gain to set the indication to 40% FSH. Record the receiver gain setting.

5.3.6 Increase the receiver gain by 6dB and record the signal amplitude.

5.3.7 Adjust the receiver gain to set the indication to 20% FSH. Record the receiver gain setting.

5.3.8 Increase the receiver gain by 12dB and record the signal amplitude.

5.3.9 Adjust the receiver gain to set the indication to 10% FSH. Record the receiver gain setting.

5.3.10 Increase the receiver gain by 18dB and record the signal amplitude.

5.3.11 Recorded readings must be within the following limits:

Indication Set at % of FSH	dB Control Change	Indication Limits % FSH
80%	-6dB	32 to 48%
80%	-12dB	16 to 24%
80%	-18dB	8 to 12%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%
10%	+18dB	64 to 96%

5.3.12 Record all data and instrument settings on the appropriate data sheet.

5.4 Verification of performance of instrument performance checks shall be documented. Documentation shall include the date, time, and the initials of the operator.

5.5 When specifically requested, a photographic record of the RF pulse waveform shall be obtained for each transducer, before and after each vessel examination.

6.0 SYSTEM CALIBRATION

6.1 Calibration Requirements - General

System calibration shall be performed at the Westinghouse Waltz Mill Site.

6.1.1 Calibration shall include the complete ultrasonic system using responses from reflectors in the basic calibration block(s). The ultrasonic system is defined as the ultrasonic instrument, cables, transducer, couplant, and any other apparatus, instrument or circuit between the instrument and the calibration block surface.

6.1.2 Basic calibration blocks used for calibration of the ultrasonic system shall be defined by the plant specific Examination Program Plan and shall meet the following requirements.

6.1.2.1 The material from which the block(s) are fabricated shall be from one of the following:

(a) a nozzle dropout from the reactor vessel
(b) a prolongation from the reactor vessel
(c) material of the same general material specification, product form, and heat treatment as one of the materials being joined.

6.1.2.2 Where the component material is clad, the block(s) shall be clad to the component clad nominal thickness. Deposition of the cladding may be by an automatic or manual technique so long as the method represents, to the extent practical, the method used on the reactor vessel.

6.1.2.3 The calibration block shall receive at least the minimum tempering temperature treatment required by the material specification and a post weld heat treatment of at least two hours.

6.1.3 The block(s) shall be placed in the calibration tank and carefully leveled and aligned. The zero degree index of the manipulator shall be defined.

6.1.4 Each calibration shall be performed from the calibration block surface, clad or unclad, corresponding to the surface of the component from which the examination will be performed. The calibration block, surface, referance reflectors, and scan directions used during calibration shall be defined on the calibration data sheets, If, for any reason, it is necessary to change any of the calibration parameters from those recommended in the Examination Program Plan, the changes shall be documented and reasons for those changes shall be transmitted to the NSID Inspection Services coordinator.

6.1.5 During calibration the search unit centerline shall be at least 1-1/2 inches from the nearest side of the basic calibration block.

6.1.6 The water temperature for calibration shall be within 25°F of the water temperature during scanning.

6.1.7 Transducers shall be calibrated in fixtures which provide the angle of incidence specified in the examination Program Plan. Upon completion of the calibration sequence the transducer/fixture assembly shall be mounted on the array plate at the specified location. The orientation of the transducer with respect to the fixture shall not be

changed. Bubbles shall not be present on the transducer face or the calibration block entry surface during the calibration sequence.

6.1.8 A calibration data sheet packet shall be completed for each transducer/inspection channel combination used to examine each volume required by the plant specific Examination Program Plan. All data will be fully recorded such that the operating parameters can be verified in the field. Calibration and examination data sheets are attached as Figures 1 through 5.

6.1.9 Measurements of beam spread shall be made for each transducer used during the inspection program. These measurements shall be performed per paragraph 6.11. These data will be included in the calibration data described in paragraph 6.1.8.

6.2 Calibration for Straight Beam Examination of Vertical and Circumferential Welds

System calibration for each straight beam inspection channel/ transducer combination used for examination of vertical and circumferential welds, including safe end welds and the flange-to-upper shell weld from the shell side, shall be performed as described below.

6.2.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.2.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.2.3 Adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.2.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.2.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.2.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.2.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.2.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and block back surface reflection occupies 60% to 90% of the full sweep length.

6.2.4.2 Record the transit time between the entry surface reflection and the back surface reflection.

6.2.4.3 Calculate the sound velocity in the calibration block and record this value.

6.2.4.4 Adjust the selected gate controls to include all metal travel between the entry surface reflection and the back surface reflection.

6.2.5 Set the trace and gate baselines to zero percent of scale.

6.2.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 40% ± 1dB of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.2.7 Without changing instrument settings move the transducer to obtain the maximum responses from the remaining calibration holes. Mark the peak of the indications on the screen. Record the indication amplitudes and transit times from the water/steel interface to the indications.

6.2.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.2.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.2.10 The electronic DAC module function shall then be initiated.

6.2.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 40% FSH.

6.2.10.2 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.2.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be at 40% FSH ± 1dB. If not, review steps 6.2.1 through 6.2.10.3.

6.2.10.4 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.2.10.5 Increase the receiver gain by 6dB and record all pertinent calibration data on the calibration data sheets.

6.2.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.3 Calibration for Angle Beam Examination of Vertical and Circumferential Vessel Welds

System calibration for each angle beam inspection channel/transducer combination used for examination of vertical and circumferential vessel welds, including the flange-to-upper shell weld from the shell side, shall be performed as described below.

6.3.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.3.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.3.3 Position the transducer to obtain a maximum response from the square notch on the opposite surface or the block corner and adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.3.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.3.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.3.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.3.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.3.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the notch response or the block corner response occupies 50% to 80% of the full sweep length.

6.3.4.2 Record the transit time between the entry surface reflection and the notch response or block corner response.

6.3.4.3 Calculate the sound velocity in the calibration block and record this value.

6.3.4.4 Position the transducer to obtain the maximum response from the 3/4T hole after the beam has bounced from the opposite surface (5/8 node response) and adjust the selected gate controls to include all metal travel between the entry surface reflection and this indication.

6.3.5 Set the trace and gate baselines to zero percent of scale.

6.3.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 80% ± 1dB of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.3.7 Without changing instrument settings move the transducer to obtain the maximum responses from the other calibration holes including the 5/8 node response from the 3/4T hole. Mark the peaks of the indications on the screen. Record indication amplitudes and transit times from the water/steel interface to the indications. If the 5/8 node response from the 3/4T hole is not readily discernable, the DAC curve amplitude point shall be determined by calculating the dB difference between the 1/2T and 3/4T reflector amplitudes, decreasing the 3/4 T reflector amplitude by two times that difference, and marking the resulting amplitude at the point on the sweep that represents the transit time to the 5/8 node position.

6.3.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a

distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.3.9 Without changing the instrument settings position the transducer to obtain a maximum response from the square notch on the opposite surface, if applicable. Record the indication amplitude and transit time from the water/steel interface to the indication.

6.3.10 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.3.11 The electronic DAC module function shall then be initiated.

6.3.11.1 Adjust the electronic DAC controls so all EBS pulses at transit times from the entry surface reflection to and including the response from the 1/4T hole are nominally 80% FSH and those at transit times in excess of the 1/4T hole to the end of the gate are nominally 40% FSH.

6.3.11.2 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.3.11.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of the 1/4T hole should be at 80% FSH ± 1dB and the amplitudes of the 1/2T, 3/4T, and 5/8 node response from the 3/4T hole should be at 40% FSH ± 1dB. If not, review steps 6.3.1 through 6.3.11.3.

6.3.11.4 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer

assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak amplitude from each hole is detected. Decrease the receiver gain by an additional 8dB and once again scan over the block at or higher than the specified examination speed. The alarm should actuate when the peak amplitude from the 1/4T hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.3.11.5 Increase the receiver gain by 14dB and record all pertinent calibration data on the calibration data sheets.

6.3.12 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.4 Calibration for Examination of the Flange-to-Upper Shell Weld From the Flange Seal Surface

Complete coverage of the reactor vessel flange-to-upper shell weld from the seal surface typically requires interrogation by longitudinal waves at 0° and at one or two other angles. The

specific angles depend on the vessel flange dimensions and design and are defined in the plant specific Examination Program Plan. System calibration for each inspection channel/transducer combination shall be performed as described below.

6.4.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.4.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.4.3 Adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.4.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.4.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.4.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.4.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.4.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the reflection from the reference hole at the longest test metal distance occupies 60% to 90% of the full sweep length.

6.4.4.2 Record the transit time between the entry surface reflection and the reflection from the reference hole.

6.4.4.3 Calculate the sound velocity in the calibration block and record this value.

6.4.4.4 Adjust the selected gate controls to include all metal travel including the weld and specified adjacent base material on the shell and flange sides of the weld.

6.4.5 Set the trace and gate baselines to zero percent of scale.

6.4.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 80% $\pm$ 1dB of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.4.7 Without changing instrument settings move the transducer to obtain the maximum responses from the remaining calibration holes. Mark the peak of the indications on the screen. Record the indication amplitudes and transit times from the water/steel interface to the indications.

6.4.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.4.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.4.10 The electronic DAC module function shall then be initiated.

6.4.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 80% FSH.

6.4.10.2 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.4.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be at 80% FSH ± 1dB. If not, review steps 6.4.1 through 6.4.10.3.

6.4.10.4 Decrease the receiver gain by 14dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the

alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.4.10.5 Increase the receiver gain by 14dB and record all pertinent calibration data on the calibration data sheets.

6.4.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.5 Calibration for Examination of Nozzle-to-Shell Welds from the Nozzle Bore

Complete coverage of nozzle-to-shell welds from the nozzle bore typically requires interrogation by longitudinal waves at one angle normal to the weld and at one other angle to account for geometry. The specific angles required depend on the nozzle dimensions and design and are defined in the Examination Program Plan. System calibration for each inspection channel/transducer combination shall be performed as described below.

6.5.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly to the manipulator in the calibration tank.

6.5.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.5.3 Adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.5.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.5.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.5.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.5.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.5.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and

the reflection from the reference hole at the longest test metal distance occupies 60% to 90% of the full sweep length.

6.5.4.2 Record the transit time between the entry surface reflection and the reflection from the reference hole.

6.5.4.3 Calculate the sound velocity in the calibration block and record this value.

6.5.4.4 Adjust the selected gate controls to include all metal travel which will include the entire nozzle, the weld, and specified adjacent base material on the shell side of the weld. Consult the Examination Program Plan to verify that this gate length will monitor the required examination volume.

6.5.5 Set the trace and gate baselines to zero percent of scale.

6.5.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 80% (± 1dB) of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.5.7 Without changing instrument settings move the transducer to obtain the maximum responses from the remaining calibration holes. Mark the peak of the indications on

the screen. Record the indication amplitudes and transit times from the water/steel interface to the indications.

6.5.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.5.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.5.10 The electronic DAC module function shall then be initiated.

6.5.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 80% FSH.

6.5.10.2 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.5.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be at 80% FSH ± 1dB. If not, review steps 6.5.1 through 6.5.10.3.

6.5.10.4 Decrease the receiver gain by 14dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition

rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.5.10.5 Increase the receiver gain by 14dB and record all pertinent calibration data on the calibration data sheets.

6.5.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.6 Calibration for Examination of Nozzle Radii and Protrusions

System calibration for each angle beam inspection channel/transducer combination used for nozzle radius and protrusion examination shall be performed as described below.

6.6.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.6.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.6.3 Position the transducer to obtain a maximum response from the side drilled hole at the longest test metal distance

and adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.6.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.6.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.6.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.6.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.6.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the response from the reference hole at the longest test metal distance occupies 60% to 90% of the full sweep length.

6.6.4.2 Record the transit time between the entry surface reflection and the side drilled hole response.

6.6.4.3 Calculate the sound velocity in the calibration block and record this value.

6.6.4.4 Adjust the selected gate controls to include all metal travel between the entry surface reflection and the response from the specified side drilled hole at the longest test metal distance.

6.6.5 Set the trace and gate baselines to zero percent of scale.

6.6.6 Position the transducer to obtain the maximum response from the drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 80% ± 1dB of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.6.7 Without changing instrument settings move the transducer to obtain the maximum responses from the other calibration hole. Mark the peak of this indication on the screen. Record the indication amplitude and transit time from the water/steel interface to the indication.

6.6.8 Draw a line through the maximum response points on the CRT screen. The curve may be extended at either end for a distance equivalent to one-quarter the depth of the deepest hole. This line represents the basic calibration distance amplitude curve (DAC).

6.6.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.6.10 The electronic DAC module function shall then be initiated.

6.6.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 80% FSH.

6.6.10.2 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.6.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be 80% FSH $\pm$ 1dB. If not, review steps 6.6.1 through 6.6.10.3.

6.6.10.4 Decrease the receiver gain by 14dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.6.10.5 Increase the receiver gain by 14dB and record all pertinent calibration data on the calibration data sheets.

6.6.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which

fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.7 Calibration for Angle Beam Examination of Nozzle-to-Safe End Welds

System calibration for each angle beam inspection channel/transducer combination used for safe end inspection shall be performed as described below. When the calibration block is a mockup of the bimetallic weld, calibration shall be from the side of the weld, carbon steel or stainless steel, corresponding to the side of the weld from which the examination will be performed.

6.7.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly to the manipulator in the calibration tank.

6.7.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.7.3 Position the transducer to obtain a maximum response from the side drilled hole at the longest test metal distance and adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.7.3.1 Adjust the instrument range to the maximum achievable sweep range where the initial pulse

and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.7.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.7.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.7.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.7.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the response from the side drilled hole at the longest test distance occupies 50% to 70% of the full sweep length.

6.7.4.2 Record the transit time between the entry surface reflection and the response from the drilled hole at the longest test distance.

6.7.4.3 Calculate the sound velocity in the calibration block and record this value.

6.7.4.4 Adjust the selected gate controls to include all metal travel from the entry surface reflection to the equivalent of 1/4T past the 3/4T hole as a minimum.

6.7.5 Set the trace and gate baselines to zero percent of scale.

6.7.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set the indication amplitude to 40% ± 1dB of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and the transit time from the entry surface reflection to the indication.

6.7.7 Without changing instrument settings move the transducer to obtain the maximum responses from the other calibration holes. Mark the peaks of these indications on the screen. Record the indication amplitudes and transit time from the water/steel interface to the indications.

6.7.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.7.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.7.10 The electronic DAC module function shall then be initiated.

6.7.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 40% FSH.

6.7.10.2 Adjust the gate threshold (alarm level) value to 16% FSH and set for positive trigger.

6.7.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be 40% FSH ± 1dB. If not, review steps 6.7.1 through 6.7.10.3.

6.7.10.4 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.7.10.5 Increase the receiver gain by 6dB and record all pertinent calibration data on the calibration data sheets.

6.7.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.8 Calibration for Examination of Reactor Vessel Flange Ligaments

System calibration for each straight beam inspection channel/ transducer combination used for flange ligament inspection shall be performed as described below.

6.8.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly to the manipulator in the calibration tank.

6.8.2 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block and adjust for the required waterpath.

6.8.3 Adjust the instrument delay such that the lower left corner of the initial pulse starts at the 0 gradicule on the CRT.

6.8.3.1 Adjust the instrument range control to the maximum achievable sweep range where the initial pulse and entry surface reflection are displayed on the CRT screen. Record the transit time to the entry surface reflection.

6.8.3.2 Since the gate position controls of the ultrasonic system are calibrated directly in units of time, the gate can be moved to coincide with the entry surface reflection and travel time in microseconds can be read directly from the digital display. All transit time measurements can be made in this manner.

6.8.3.3 Determine the sound velocity and measure the water temperature. Record these values.

$$V = \frac{\text{Round Trip Distance}}{\text{Travel Time}}$$

6.8.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.8.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the reflection from the applicable reference hole at the longest test metal distance occupies 60% to 90% of the full sweep length.

6.8.4.2 Record the transit time between the entry surface reflection and the reflection from the reference hole.

6.8.4.3 Calculate the sound velocity in the calibration block and record this value.

6.8.4.4 Adjust the selected gate controls to include all metal travel between the water/steel interface and the far limit of the inspection volume as defined in the Examination Program Plan. This distance shall be the equivalent of one stud hole diameter, as a minimum.

6.8.5 Set the trace and gate baselines to zero percent of scale.

6.8.6 Position the transducer to obtain the maximum response from the side drilled hole which exhibits the highest amplitude. Adjust the preamplifier gain control to set

the indication amplitude to 40% (± 1dB) of full screen height. Mark the peak of the indication on the screen. Record instrument settings, indication amplitude, and transit time from the entry surface reflection to the indication.

6.8.7 Without changing instrument settings move the transducer to obtain the maximum responses from the remaining calibration holes. Mark the peak of the indications on the screen. Record the indication amplitudes and transit times from the water/steel interface to the indications.

6.8.8 Draw a line through the maximum response points on the CRT screen. The curve may be extrapolated at either end for a distance of one-quarter the thickness of the calibration block. This line represents the basic calibration distance amplitude curve (DAC).

6.8.9 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.8.10 The electronic DAC module function shall then be initiated.

6.8.10.1 Adjust the electronic DAC controls so all EBS pulses are nominally 40% FSH.

6.8.10.2 Adjust the gate threshold (alarm level) value to 16% FSH and set for positive trigger.

6.8.10.3 Disable the EBS, scan the block, and observe the responses from each applicable calibration reflector. The amplitude of each should be at 40% FSH ± 1dB. If not, review steps 6.8.1 through 6.8.10.3.

6.8.10.4 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer assembly over the calibration block at or greater than the specified examination speed. The gate alarm shall actuate when the peak response from each hole is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.8.10.5 Increase the receiver gain by 6dB and record all pertinent calibration data on the calibration data sheets.

6.8.11 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.9 Calibration for Full Node Angle Beam Examination of Vertical and Circumferential Vessel Welds

System calibration for each inspection channel/transducer combination used for full node angle beam examination of the volume of material near the vessel inside diameter shall be performed as described below.

6.9.1 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.9.2 Position the transducer to direct the sound toward the appropriate surface of the calibration block at the required waterpath. Record the transit time from the initial pulse to the entry surface reflection.

6.9.3 Position the transducer to obtain a maximum full node response from the square notch on the entry surface of the block.

6.9.4 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.9.4.1 Adjust the instrument range such that metal travel between the entry surface reflection and the notch response occupies 50% to 80% of the full sweep length.

6.9.4.2 Record the transit time between the entry surface reflection and the notch response.

6.9.4.3 Adjust the selected gate controls to include all metal travel between the 7/8 node and 1 1/8 node responses from the 1/4T hole.

6.9.5 Set the trace and gate baselines to zero percent of scale.

6.9.6 Adjust the preamplifier gain control to set the notch full node response indication to 40% $\pm$ 1dB of full screen height. Mark the peak of the indication on the screen.

Record instrument settings, indication amplitude, and transit time from the entry surface reflection to the indication.

6.9.7 Draw a horizontal line through the maximum response point on the CRT and extend it to include the entire gate length. This line represents the basic calibration distance amplitude curve (DAC).

6.9.8 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.9.9 Adjust the gate threshold (alarm level) to 16% FSH and set for positive trigger.

6.9.9.1 Disable the EBS, scan the block, and observe the response from the notch. The amplitude should be at 40% FSH ± 1dB. If not, review steps 6.9.1 through 6.9.9.1.

6.9.9.2 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer over the calibration block at or greater than the examination speed. The gate alarm should actuate when the peak response from the notch is detected. If the alarm is not observed for one or more of the holes, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, alarm level, etc.) which may require adjustment and make corrections, if necessary.

6.9.9.3 Increase the receiver gain by 6dB and record all pertinent calibration data on the calibration data sheets.

6.9.10 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of those for the primary reflectors in the basic calibration block where practical.

6.10 Calibration for Near Surface Examinations

System calibration for each inspection channel/transducer combination used for near surface examination of volumes of material near the vessel inside diameter shall be performed as described below.

6.10.1 Transducers used for these examinations shall be dual-element, transmit-receive, 2.25 MHz units of the type Ultran WKSI-2.25 WRV, WPSI-2.25 WRV, or equivalent. The nominal waterpath shall be 6.0 inches and the nominal incident angle shall be 12.5° unless otherwise specified.

6.10.2 Attach the transducer to the appropriate fixture for the required incident angle and mount the assembly on the manipulator in the calibration tank.

6.10.3 Position the transducer to direct the sound beam toward the appropriate surface of the calibration block at the required waterpath. Record the transit time from the initial pulse to the entry surface reflection.

NOTE

It may be necessary to increase the gain and/or use one search unit element in the pulse-echo mode to obtain a discernable entry surface reflection.

6.10.4 Position the transducer to obtain a maximum response from the 1/8-inch diameter side drilled hole located 3/4-inch in depth from the entry surface.

6.10.5 Adjust the instrument delay such that the lower left corner of the entry surface reflection starts at the 0 gradicule on the CRT.

6.10.5.1 Adjust the instrument range such that metal travel between the entry surface reflection and the response from the 1/8" diameter side drilled hole at 3/4-inch depth occupies 50% to 75% of the full sweep range.

6.10.5.2 Record the transit time between the entry surface reflection and the hole response.

6.10.5.3 Adjust the selected gate controls to include as a minimum all metal travel from the lower left corner of the entry surface reflection to at least 10 microseconds past the response from the 1/8-inch diameter hole at 3/4-inch depth.

6.10.6 Set the trace and gate baselines to zero percent of scale.

6.10.7 Adjust the preamplifier gain control to set the indication from the 1/8-inch diameter hole at 3/4-inch depth to 80% ± 1dB of full screen height. Mark the peak of the indication on the screen.

6.10.8 Without changing instrument settings move the transducer to obtain maximum responses from the two remaining calibration holes and the square notch on the entry surface of the block.

6.10.9 Record instrument settings, indication amplitudes (i.e., 100% FSH + 6dB), and transit times from the water/steel interface (see Note Paragraph 6.10.5) to the indications.

6.10.10 Draw a horizontal line through the response from the 3/4 inch deep hole on the CRT screen. The curve shall be extrapolated at either end to cover the entire gate length as set in Paragraph 6.10.5.3.

6.10.11 Adjust the EBS pulse train to follow the DAC. Record the EBS control settings.

6.10.12 Adjust the gate threshold (alarm level) to 40% FSH and set for positive trigger.

6.10.12.1 Disable the EBS, scan the block, and observe the response from the 1/8 inch diameter side drilled hole at 3/4 inch depth. The amplitude should be at 80% FSH $\pm$ 1dB. If not, review steps 6.10.2 through 6.10.12.1.

6.10.12.2 Decrease the receiver gain by 6dB. Switch the system to the cycle mode and scan the transducer over the calibration block at or greater than the examination speed. The gate alarm shall actuate when the peak response from the 3/4 inch deep 1/8 inch diameter side drilled hole is detected. If the alarm is not observed, investigate to identify the test system parameter(s) (e.g., alarm count, repetition rate, etc.) which may require adjustment and make corrections, if necessary.

6.10.12.3 Increase the receiver gain by 6 dB and record all pertinent calibration data on the calibration data sheets.

6.10.13 Position the transducer to obtain the peak responses from at least three cylindrical reflectors in the MTS which fall within the gated sweep length. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse.

Reflectors selected for this step shall provide transit times representative of the transducer focal distance, approximately nine inches in water.

6.11 Beam Spread Measurements

Beam spread measurements shall be made for each transducer used during the inspection program. Data will be recorded on the appropriate calibration data sheet.

6.11.1 Establish the location of the scribe line on the reference block as a zero reference point.

6.11.2 Position the transducer to obtain the maximum indication amplitude from the applicable calibration hole at the nearest test distance in the appropriate basic calibration block. Record the manipulator carriage location with respect to the zero reference point and the transit time to the indication.

6.11.3 Move the transducer toward the reference hole until the indication amplitude drops to 50% of its peak amplitude. Record the manipulator carriage location with respect to the zero reference point and the transit time to the indication. Move the transducer toward the reference hole

until the indication amplitude drops to 20% of its peak amplitude and record data defined above.

6.11.4 Move the transducer away from the reference hole until the indication amplitude passes through maximum and again drops to 50% of its peak amplitude. Record the manipulator carriage location with respect to the zero reference point and the transit time to the indication. Move the transducer away from the reference hole until the indication amplitude drops to 20% of its peak amplitude and record data defined above.

6.11.5 Repeat these measurements on the other applicable calibration holes.

6.12 Field System Calibration

On site the system calibration shall be established and verified with the EBS per Paragraph 6.12.1 at the beginning and end of each scan routine, with any change of equipment, or every four hours, whichever is less. Calibration shall be established and verified on the MTS cylindrical reflector array per paragraph 6.12.2 at the beginning and end of each series of examinations.

6.12.1 Enable the EBS and observe the pulse train.

6.12.1.1 If any point on the DAC curve has decreased by 20% or 2dB of its original amplitude, calibration shall be re-established and all areas since the previous acceptable calibration or check reexamined.

6.12.1.2 If any point on the DAC curve has increased by 20% or 2dB of its original amplitude,

calibration shall be re-established and all reportable indications since the previous acceptable calibration or check reevaluated.

6.12.2 Disable the EBS function and position the transducer array such that it is directed toward the cylindrical reflector array mounted on the tool 0° leg. Each applicable transducer/inspection channel should be checked as follows:

6.12.2.1 Position the transducer to obtain the peak responses from each cylindrical reflector in the MTS array used during initial system calibration at the specified waterpaths. Record the reflector identification, indication amplitude, and transit time to the indication from the initial pulse in microseconds.

6.12.2.2 The recorded values should be compared to the data obtained during the initial calibration at Waltz Mill.

6.12.2.2.1 If the response from any reflector has decreased by 20% or 2dB of its original amplitude, calibration shall be reestablished and all areas since the previous acceptable calibration or check reexamined.

6.12.2.2.2 If the response from any reflector has increased by 20% or 2dB of its original amplitude, calibration shall be reestablished and all reportable

indications since the previous acceptable calibration or check reevaluated.

6.12.2.2.3 If the response from any reflector in the gated sweep length has moved on the sweep line more than 10% of the sweep reading, correct the sweep range calibration and note the correction in the examination record. If recordable reflectors are noted on the data sheets, those data sheets shall be voided, the new calibration shall be recorded, and areas relative to the voided data re-examined.

6.12.3 Verification of the performance of calibration checks shall be documented. Documentation shall include the date, time, and initials of the operator. See Figure 6.

6.13 Transducer RF Waveforms

When photographic records of transducer RF waveforms are required, they shall be collected as follows. These records may be made at the calibration facility or at the reactor site.

6.13.1 Position the transducer to obtain the peak response from one of the cylindrical reflectors in the MTS array.

6.13.2 Display the RF waveform on a calibrated oscilloscope.

6.13.3 Adjust the oscilloscope sweep controls to clearly display the waveform.

6.13.4 Adjust the oscilloscope veritical display so the amplitude of the response is two to four centimeters.

6.13.5 Photograph the displayed waveform and record all pertinent data on the Transducer RF Waveform Data Sheet, Figure 7.

6.13.6 Photographic records of transducer RF waveforms collected after reactor vessel examinations should be made using the same reflector, electronics, waterpath and instrument settings as used prior to the examinations when practical.

7.0 EXAMINATION REQUIREMENTS

7.1 The following activities shall have been completed prior to the performance of any in-field ultrasonic examination of a reactor vessel using the remotely operated inspection tool.

7.1.1 The reactor vessel Examination Program Plan identifying specific plant inspection parameters such as search unit incident angles, calibration standards, water paths, scan lengths, scan locations, and scan increments shall have been prepared in accordance with WNSID Procedure RV-ISI-01.

7.1.2 The ultrasonic equipment shall have been calibrated for all examinations required by the Examination Program Plan and all data recorded in accordance with paragraph 6.0 of this procedure.

7.1.3 The reactor vessel inspection tool shall have been assembled in the configuration on the arrangement drawing applicable to the specific vessel being examined as listed in the Examination Program Plan.

7.1.4 Prior to placing the inspection tool on the reactor vessel, the following tests and checks shall be performed to demonstrate the tool is fully operational and to assure the tool can be safely set on the reactor vessel.

7.1.4.1 Establish "home" position and record all resolver readings and other relevant data. Mechanically measure the distance from the face of transducer zero (TR0) or transducer twenty (TR20) to the spherical target and record this value.

7.1.4.2 Test to ensure that all drives are functional both in manual and computer control.

7.1.4.3 Visually verify that all appropriate hardware is properly secured by lockwire or other suitable means.

7.1.4.4 Check each transducer and associated pulser/amplifier channel by tapping on the face of the transducer and observing the initial pulse.

7.1.4.5 Cavity water clarity shall be adequate to assure visibility of the vessel flange, keyways, and/or core barrel seating surface.

7.1.4.6 Verify that no specimen capsules are installed where the inspection tool legs will seat.

7.1.5 The calibration settings of each transducer/instrumentation system shall be checked using the data previously entered in the Electronic Block Simultor (EBS) with the Sonic system control settings as defined on the Calibration Data Sheets for each examination to be performed.

7.1.6 Once the inspection tool is set on the reactor vessel the tool home position shall be verified by monitoring the TRO or TR20 straight beam inspection channel and positioning the search unit to obtain a peaked response from the spherical target without changing waterpath from that set mechanically in 7.1.4.1. Contact the control room, obtain the refueling water temperature, and record this value. If the temperature is not within ± 25°F of that used during calibration, advise the control room to notify when temperature is within this range. Water temperature may be measured directly with a thermometer.

7.1.7 Calculate the water velocity, record this value, and compare with that determined during system calibration.

7.1.8 Check the instrument calibration and system calibration.

7.2 Prior to initiating a scan per the Examination Program Plan, the flange area shall be subject to preliminary scans while monitoring the TRO or TR20 inspection channel to determine that the tool is properly centered, level, and that water paths (compensated for difference in water velocity, if necessary) correspond with those used during calibration.

7.3 The area to be examined shall be subject to a preliminary scan while monitoring the TRO inspection channel to determine the thickness of the examination area, if possible. Use this information to verify that all gates have been set properly. If gating adjustments are necessary at any time during the examination they shall be documented. See Figure 8.

7.4 Each area of the reactor vessel identified in the Examination Program Plan shall be scanned in accordance with the requirements of the Examination Program Plan.

7.4.1 The computer "home" routine shall be used to determine the actual reference position for the nine axes of tool movement at least once each day. When a computer "home" is achieved, a peaked response from the spherical target should be observed on the TRO or TR20 inspection channel and the axes resolver readings shall be noted and compared with those original values recorded per paragraph 7.1.4.1.

7.5 During scanning the following parameters shall be maintained unless otherwise specified in the Examination Program Plan.

7.5.1 Scanning shall be conducted at the calibration sensitivity.

7.5.2 The rate of search unit movement shall be 5 inches per second maximum.

7.5.3 Scan increments shall be three-quarter inches maximum for 1-1/2 inch diameter transducers and three-eighth inches maximum for 3/4 inch diameter transducers.

7.5.4 The required examination volume for welds shall include the weld, both heat affected zones, and one-half the weld thickness of adjacent base material on both sides of the weld.

7.6 The following paragraphs provide general scanning requirements for each area of the reactor vessel. Specific requirements are provided in the Examination Program Plan.

7.6.1 Base Metal Examination

When specified in the Examination Program Plan, the base metal through which angle beams will pass shall be completely scanned by straight beam to detect laminar reflectors where practical.

7.6.1.1 Sensitivity shall be established at a location free of indications by adjusting the first back surface reflection to 80% FSH.

7.6.1.2 Set the back wall gate to monitor the back surface reflection and alarm when the echo amplitude drops to 16% FSH.

7.6.1.3 Areas in the base metal containing laminar indications that cause either or both of the following shall be recorded.

a) All areas where indications are equal to or exceed the amplitude of the remaining back reflection.

b) All areas that produce a continuous total loss of back reflection accompanied by a continuous indication in a singular plane.

7.6.1.4 Areas identified per paragraph 7.6.1.3 shall be recorded on the data printout in terms of the transit time to the indication, peak indication amplitude, remaining backwall amplitude, location, and extent.

7.6.1.5 Areas identified per paragraph 7.6.1.3 a) shall be investigated to determine if and to what extent they interfere with angle beam examinations. Where the reflectors do interfere, the angle beam technique(s) shall be reviewed toward achieving at least the minimum required coverage of the volume required to be examined, and modified to the extent necessary and practical to accomplish this.

7.6.1.6 Areas identified per paragraph 7.6.1.3 b) shall be investigated in terms of the appropriate acceptance criteria for laminar reflectors.

7.6.1.7 Alternately, the base metal examination may be conducted as an extension of straight beam examination in accordance with paragraph 7.6.2.1 provided the sensitivity is at least that required in paragraph 7.6.1.1 and the gating and alarm requirements of paragraph 7.6.1.2 are employed.

7.6.2 Vertical and Circumferential Vessel Welds

The extent of each reactor vessel vertical and/or circumferential weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.2.1 The entire weld, both heat affected zones, and specified adjacent base material are examined from the vessel ID by longitudinal waves at 0°.

7.6.2.2 The entire weld, both heat affected zones, and specified adjacent base material are examined from the vessel ID by transverse waves at two angles, the difference between which shall be at least 10°, in two opposite directions parallel to the weld and two opposite directions perpendicular to the weld. For purposes of minimum required coverage, adjacent base material need not be examined with both angle beams in both directions. Any combination of two angle beams will satisfy this requirement.

7.6.3 Reactor Vessel Flange-to-Upper Shell Weld

The extent of the reactor vessel flange-to-upper shell weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.3.1 The reactor vessel flange-to-upper shell weld, both heat affected zones, and specified adjacent base material are examined from the vessel flange seal surface using longitudinal waves at angles as defined in the Examination Program Plan.

7.6.3.2 When the core barrel is removed the flange-to-upper shell weld may be examined from the vessel ID in accordance with Paragraph 7.6.2, except angle beam scanning perpendicular to the weld will be performed from the vessel shell side only.

7.6.4 Reactor Vessel Nozzle-to-Shell Welds

The extent of each reactor vessel nozzle-to-shell weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.4.1 The reactor vessel nozzle-to-shell weld, both heat affected zones, and specified adjacent base material are examined from the nozzle bore using longitudinal waves at angles as defined in the Examination Program Plan.

NOTE

RHR flow should be off or reduced to the extent possible during this examination. Water clarity shall be such that the nozzle opening is clearly visible from the operating deck.

7.6.5 Nozzle Radius and Protrusion

The extent of each nozzle radius or protrusion identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.5.1 The entire area defined by the Examination Program Plan is examined from the nozzle ID by transverse waves in both circumferential directions.

NOTE

RHR flow should be off or reduced to the extent possible during this examination. Water clarity shall be such that the nozzle opening is clearly visible from the operating deck.

7.6.6 Nozzle-to-Safe Ends Welds

The extent of each reactor vessel nozzle-to-safe end weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.6.1 The entire weld, both heat affected zones, and specified adjacent base material are examined from the nozzle bore by longitudinal waves at 0°.

7.6.6.2 The entire weld, both heat affected zones, and specified adjacent base material are examined from the nozzle bore by angled longitudinal waves in two directions parallel to the weld and two directions perpendicular to the weld.

NOTE

RHR flow should be off or reduced to the extent possible during this examination. Water clarity shall be such that the nozzle opening is clearly visible from the operating deck.

7.6.7 Reactor Vessel Flange Ligaments

The extent of the threaded ligaments in the reactor vessel flange identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.7.1 The ligaments between threaded stud holes are examined from the top of the flange using longitudinal waves at 0°.

7.6.8 Full Node Angle Beam Examination of Vertical and Circumferential Vessel Welds

When full node angle beam examinations are specified, the extent of each reactor vessel vertical and/or circumferential weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.8.1 The volume of material including the weld, both heat affected zones, and specified adjacent base material within 1/8T of the vessel ID shall be examined in two directions parallel to the weld and two directions transverse to the weld.

7.6.9 Near Surface Examinations of Vertical and Circumferential Vessel Welds

When near surface examinations are specified, the extent of each reactor vessel vertical and circumferential weld identified in the Examination Program Plan shall be examined in accordance with the following requirements where practical.

7.6.9.1 The volume of material including the weld, both heat affected zones, and specified adjacent base material within one inch of the vessel ID shall be examined in two directions parallel to the weld and two directions transverse to the weld.

8.0 INTERPRETATION AND INVESTIGATION

8.1 The Level II or Level III examiner shall interpret indications in accordance with criteria listed below such that he can assess their being valid or not valid.

8.1.1 The interpretation and investigation level is 50% of the primary reference DAC for:

8.1.1.1 All indications detected during straight beam examinations of vertical and circumferential welds.

8.1.1.2 Indications detected during angle beam examinations of vertical and circumferential welds at transit times representing 25 percent and greater of the vessel through-wall thickness measured from the inner surface.

8.1.1.3 Indications detected during examinations of the flange-to-upper shell weld from the seal surface at locations representing 25 percent and greater of the vessel through-wall thickness measured from the inner surface.

8.1.1.4 Indications detected during examinations of nozzle-to-shell welds from nozzle bores at locations representing 25 percent and greater of the vessel through-wall thickness measured from the inner surface.

8.1.1.5 All indications detected during straight and angle beam examinations of nozzle-to-safe end welds.

8.1.1.6 All indications detected during examinations of reactor vessel flange ligaments.

8.1.1.7 All indications detected during full node angle beam examinations of vertical and circumferential welds.

8.1.1.8 All indications detected during near surface examinations.

8.1.2 The interpretation and investigation level is 20% of the primary reference DAC for:

8.1.2.1 Indications detected during angle beam examinations of vertical and circumferential welds at transit times which represent the inner 25 percent of the vessel through-wall thickness measured from the inner surface.

8.1.2.2 Indications detected during examinations of the flange-to-upper shell weld from the seal surface at locations which are within 25 percent of the vessel through-wall thickness measured from the inner surface.

8.1.2.3 Indications detected during examinations of nozzle-to-shell welds from nozzle bores at locations which are within 25 percent of the vessel through-wall thickness measured from the inner surface.

8.1.2.4 All indications detected during examinations of nozzle radii and protrusions.

8.2 Valid indications are the result of flaw reflectors such as cracks, lack of penetration, lack of fusion, inclusions, slag and porosity. All other indications are considered not valid, including those due to: scanning noise, grain structure, beam redirection, loss of interface gating, spurious noise from electrical sources, clad interface, straight beam back surface, mode conversion and geometric reflectors.

8.3 Valid indications meeting the criteria of paragraphs 8.1 and 8.2 shall be investigated by the examiner in terms of the recording requirements in paragraph 9.0.

8.4 Other transducers, search units, frequencies, techniques, etc., may be used to aid interpretation and investigation.

9.0 RECORDING REQUIREMENTS

9.1 All indications shall be identified as valid or non-valid on the data printout. Valid indications having amplitudes which equal or exceed the appropriate interpretation and investigation level within the OD and ID boundaries of the area being examined shall be recorded per the additional requirements of Paragraph 9.4. Valid indications having amplitudes less than the appropriate interpretation and investigation level need only have peak amplitudes noted on the data printout.

9.2 The "Flaw Detect" data acquisition system provides the following information.

9.2.1 A digital readout defining the location of each of the nine axis of tool motion.

9.2.2 Identity of the inspection channel.

9.2.3 The number of indications exceeding the primary reference level.

9.2.4 A digital readout in microseconds of the transit time to the indication(s) referenced from the channel 0 interface position.

9.2.5 The indication amplitude(s) in percent of FSH.

9.3 For examinations of nozzle-to-shell welds from the nozzle bore, "A" scan data will be permanently recorded on videotape for review and interpretation in lieu of use of the "Flaw Detect" data acquisition

system. The "A" scan recording system is diagrammed in Figure 9. Operation of the system is described as follows:

9.3.1 Adjust the Sonic Mark VI delay and range controls such that the artificial interface marker, set at the transit time defined during system calibration, falls on the first major screen division (10% of sweep length) and the end of the gate set, as a minimum, at the length defined during system calibration, falls on the ninth major screen division (90% of sweep length).

9.3.2 Calculate the Sonic Mark VI horizontal sweep calibration in usec/div at those sweep settings.

9.3.3 Establish an EBS pulse train to start at the sweep location described for the artificial interface and end at the sweep location described for the end of the gate.

9.3.4 Calibrate the sweep of the auxiliary "A" scan oscilloscope as follows. Adjust the sweep delay and range controls of the auxiliary "A" scan oscilloscope until the EBS signals described in 9.3.3 are at identical sweep locations as on the Sonic Mark VI. After this adjustment is made, tape down the horizontal fine adjustment knob. The horizontal sweep calibration (usec/div) of the auxiliary "A" scan oscilloscope is then the same as that determined for the Sonic Mark VI in paragraph 9.3.2.

9.3.5 Calibrate the vertical scale of the auxiliary "A" scan oscilloscope as follows. Adjust the EBS attenuation controls to obtain a 100% full screen height response for one EBS pulse on the Sonic Mark VI. View this same EBS pulse on the auxiliary "A" scan oscilloscope and adjust the vertical scale such that the amplitude is also 100% of

full screen height. After this adjustment is made, tape down the vertical fine adjustment knob.

9.3.6 Check the vertical linearity of the "A" scan oscilloscope per paragraph 5.2.

9.3.7 Field calibration checks with the EBS shall be recorded at the beginning and end of each nozzle examination.

9.3.8 The following information, as a minimum, shall be prominently displayed on the recording.

9.3.8.1 Plant identification.

9.3.8.2 Nozzle identification.

9.3.8.3 Transducer/channel identification.

9.3.8.4 Artificial interface transit time and sweep position on the auxiliary display.

9.3.8.5 Gate delay and length. Specify the gate end sweep position on the auxiliary display.

9.3.8.6 Sweep calibration in usec/div.

9.3.9 "A" scan, tool position, and timing information shall be permanently recorded for scans of nozzle-to-shell welds from the nozzle bores performed per paragraph 7.6.4.

9.4 The following additional information shall be generated and recorded on an indication data sheet, Figure 10, for each recordable indication using the inspection tool under manual (jog) control. Prior to recording indications with a particular transducer/

inspection channel, calibration and instrument linearity shall be verified. The indication recording sequence is illustrated in Figure 11.

9.4.1 Maximum indication amplitude in percent of the DAC calibration curve, search unit location as defined by the nine axis of tool motion, and transit time from the water/steel interface to the indication.

9.4.2 Jog the search unit toward the reflector. Where a 20% DAC interpretation and investigation level is specified, record the search unit location as defined by the nine axes of tool motion and transit time from the water/steel interface to the indication for positions where the indication amplitude drops to 100% DAC, half-maximum amplitude (for indications with peak amplitudes exceeding 100% DAC), 50% DAC, and 20% DAC. Where a 50% DAC interpretation and investigation level is specified, this information shall be recorded for the 100% DAC, half-maximum amplitude (for indications with peak amplitudes exceeding 100% DAC), and 50% DAC positions only.

9.4.3 Jog the search unit away from the reflector. Where a 20% DAC interpretation and investigation level is specified, record the search unit location as defined by the nine axes of tool motion and transit time from the water/steel interface to the indication for positions where the indication amplitude drops to 100% DAC, half-maximum amplitude (for indications with peak amplitues exceeding 100% DAC), 50% DAC,and 20% DAC. Where a 50% DAC interpretation and investigation level is specified, this information shall be recorded for the 100% DAC, half-maximum amplitude (for indications with peak amplitudes exceeding 100% DAC), and 50% DAC positions only.

9.4.4 Jog the search unit back to the area of maximum amplitude and peak the indication. Where a 20% DAC interpretation and investigation level is specified, the length of the reflector shall be determined by scanning along the reflector's major dimension and recording search unit locations as defined by the nine axes of tool motion where the indication amplitude drops to 100%, 50%, and 20% of the DAC curve. Where a 50% DAC interpretation and investigation level is specified, this information shall be recorded for the 100% and 50% DAC positions only.

9.5 Disassembly of the inspection tool shall not commence until all recordable indications have been evaluated by WNSID.

10.0 EXAMINATION RECORDS

The following information shall be provided to document the examinations.

10.1 The test procedure

10.2 Description of the test system

10.3 Calibration records

10.4 Identification and location of extent of areas examined

10.5 Record of all indications recorded

10.6 Record of all evaluations of indications

10.7 Personnel certifications

10.8 Dates and times of examinations

10.9 Basic calibration block identification

10.10 Couplant

10.11 Surface condition and surfaces from which examinations were performed.

WESTINGHOUSE NUCLEAR SERVICE DIVISION
INSPECTION SERVICES
REACTOR VESSEL U.T. EXAMINATION

PLANT	UNIT	SKETCH
OUTAGE		PROCEDURE

PACKAGE NO.	(1) TRANSDUCER ID.	TRANS-DUCER SERIAL NO.	(3) CHANNEL ID. NO.	SIZE	FREQ.	INCIDENT ANGLE	REFRACTED ANGLE	WATER PATH	CALIBRATION BLOCK ID.	(2) HOLES-NOTCHES

(1) SEE SKETCH OF TRANSDUCER ARRAY PLATE FOR POSITION OF TRANSDUCER
(2) SEE SKETCH OF THE CALIBRATION BLOCK FOR NOTCH AND/OR HOLE LOCATIONS, ALSO ENTRY SURFACE
(3) SEE DATA SHEET FOR PROGRAM CONTROL DATA

REMARKS:

8814-2

FIGURE 1

ULTRASONIC TEST DATA PACKAGE INFORMATION SHEET

WESTINGHOUSE N.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT
	OUTAGE	PROCEDURE ISI REV.

LINEARITY

BEFORE [ ] CALIBRATION [ ] EXAMINATION

CHANNEL NO.	PREAMP GAIN	E.B.S. ATTENUATION COARSE	E.B.S. ATTENUATION FINE	EXAMINER	DATE/TIME

AMPLITUDE CONTROL LINEARITY

REFERENCE AMPLITUDE	db CHANGE	AMPLITUDE AFTER CHANGE	LIMITS	RECEIVER GAIN
80% FSH	- 6 db		32-48	
80% FSH	-12 db		16-24	
80% FSH	-18 db		8-12	
40% FSH	+ 6 db		64-96	
20% FSH	+12 db		64-96	
10% FSH	+18 db		64-96	

VERTICAL LINEARITY (% F.S.H.)

FIRST PULSE	10	20	30	40	50	60	70	80	90	100
SECOND PULSE								40		

AFTER [ ] CALIBRATION [ ] EXAMINATION

CHANNEL NO. (SAME AS ABOVE)	PREAMP GAIN (SAME AS ABOVE)	E.B.S. ATTENUATION COARSE	E.B.S. ATTENUATION FINE	EXAMINER	DATE/TIME

AMPLITUDE CONTROL LINEARITY

REFERENCE AMPLITUDE	db CHANGE	AMPLITUDE AFTER CHANGE	LIMITS	RECEIVER GAIN
80% FSH	- 6 db		32-48	
80% FSH	-12 db		16-24	
80% FSH	-18 db		8-12	
40% FSH	+ 6 db		64-96	
20% FSH	+12 db		64-96	
10% FSH	+18 db		64-96	

VERTICAL LINEARITY (% F.S.H.)

FIRST PULSE	10	20	30	40	50	60	70	80	90	100
SECOND PULSE								40		

REMARKS:

8107-1

FIGURE 2

SCREEN HEIGHT AND AMPLITUDE CONTROL LINEARITY

DATA SHEET

WESTINGHOUSE N.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT	SKETCH 1-1100
	WELD(S)	PACKAGE NO.	OUTAGE
	EXAMINER	DATE	PROCEDURE ISI REV.

SONIC SYSTEM CONTROLS

CRT

SWEEP DELAY
COURSE ________ FINE ________

SWEEP RANGE
COURSE ________ FINE ________

MODE ____NORM____
SYNC ____DELAY____

RECEIVER

DB COARSE ________
DB GAIN ________
FREQUENCY ________
FILTER ________
DISPLAY ________
CLIPPER ____OFF____

ALARM GATES

BACK GATE

THRESHOLD ________
WIDTH ________
ATTENUATION ________

MONITOR GATE

THRESHOLD ________
ALARM COUNT ________

SYSTEM CONTROLLER

CLOCK ____INT/EXT____ REP. RATE ________ PULSES/SCAN ________ ARTIFICIAL I. F. ________

CHANNEL NO.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PULSER NO.																
PREAMP NO.																
PREAMP GAIN																
DEC/GATE NO.																
DEC DELAY 1																
DEC DELAY 2																
DEC DELAY 3																
DEC DELAY 4																
DEC SLOPE 1																
DEC SLOPE 2																
DEC SLOPE 3																
DEC SLOPE 4																
GATE DELAY																
GATE WIDTH																
GATE LOGIC																
REMARKS:																

6107-7

UT SYSTEM CONTROLLER DATA SHEET

FIGURE 3

WESTINGHOUSE N.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT	SKETCH 1-1100
	WELD(S)	PACKAGE NO.	OUTAGE
	EXAMINER	DATE	PROCEDURE ISI REV.

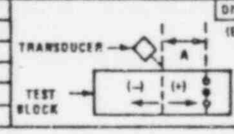
(1) CHANNEL NO.	(2) TRANSDUCER	TRANSDUCER SERIAL NO.	SIZE (DIA.)	FREQUENCY (MHZ)	INCIDENT ANGLE	REFRACTED ANGLE	WATER PATH	CALIBRATION BLOCK I.D.	CABLE LENGTH

DISTANCE – AMPLITUDE CALIBRATION

(3) REFLECTOR LOCATION	SIGNAL AMPLITUDE	TOTAL TRANSIT TIME	TRANSIT TIME FROM IF TO % OF PEAK					DISTANCE A (SEE FIGURE BELOW)				
			-20%	-50%	100%	+50%	+20%	-20%	-50%	100%	+50%	+20%
IF												
NOTCH												

WATER TEMPERATURE	CALIBRATION	EXAM	METAL VELOCITY (in./μ second)	CALCULATED METAL DISTANCE	
				REFLECTOR	CALCULATION
WATER VELOCITY (in./μ second)	CALIBRATION	EXAM			

DISTANCE A (ENTRY POINTS)



E.B.S. INFORMATION

SERIAL DATA LINK FREQUENCY PULSE DELAY PULSE PERIOD ATTENUATION COARSE

GAIN FINE

PULSE ADDRESS NO.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PULSE HT. (HEXADECIMAL SETTING)																

NOTES:
(1) SEE THE DATA SHEET ENTITLED "SONIC SYSTEM CONTROLS" FOR THE INSTRUMENT SETTINGS
(2) SEE THE SKETCH OF THE TRANSDUCER ARRAY PLATE FOR THE TRANSDUCER POSITION
(3) SEE THE SKETCH OF THE CALIBRATION BLOCK FOR INFORMATION ON THE NOTCHES AND/OR HOLES

REMARKS: ______

8107-8

ULTRASONIC CALIBRATION DATA SHEET

FIGURE 4

WESTINGHOUSE N.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT	SKETCH 1-1100
	WELD(S)	PACKAGE NO.	OUTAGE
	TRANSDUCER	CHANNEL NO.	PROCEDURE ISI- REV

VERIFICATION OF TRANSDUCER CALIBRATION

CALIBRATION

REFLECTOR ID.	CALCULATED WATER PATH (INCHES)	TRANSIT TIME (μ SECONDS)	AMPLITUDE (% F.S.H.)	PREAMP GAIN	RECEIVER GAIN	DISTANCE AMPLITUDE CALIBRATION SETTINGS (SETTINGS FOR EXAMINATION)		
						PREAMP GAIN	RECEIVER GAIN	DEC DELAY NO. 1
				EXAMINER				
				DATE	TIME	TYPE OF REFLECTOR(S):		

BEFORE EXAM

REFLECTOR ID.	CALCULATED WATER PATH (INCHES)	TRANSIT TIME (μ SECONDS)	AMPLITUDE (% F.S.H.)	PREAMP GAIN (SAME AS ABOVE)	RECEIVER GAIN (SAME AS ABOVE)	REMARKS:
				EXAMINER		
				DATE	TIME	

AFTER EXAM

REFLECTOR ID.	CALCULATED WATER PATH (INCHES)	TRANSMIT TIME (μ SECONDS)	AMPLITUDE (% F.S.H.)	PREAMP GAIN (SAME AS ABOVE)	RECEIVER GAIN (SAME AS ABOVE)	REMARKS:
				EXAMINER		
				DATE	TIME	

8187-3

FIGURE 5

MTS CALIBRATION DATA SHEET

WESTINGHOUSE R.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT	SKETCH 1-1100
	WELD(S)	PACKAGE NO.	OUTAGE
	TRANSDUCER(S)		PROCEDURE ISI- REV.

EXAM LOG				
WELDS	CALIBRATION VERIFICATION (DATE/TIME)		SIGNATURE OF EXAMINER	EXAM RESULTS/REMARKS
	BEFORE EXAM	AFTER EXAM		

8187-8

FIGURE 6 - FIELD CALIBRATION VERIFICATION DATA SHEET

WESTINGHOUSE NUCLEAR SERVICE INTEGRATION DIVISION

TRANSDUCER RF WAVEFORM DATA SHEET

UTILITY ______________________ PLANT ______________________

☐ PRE-INSPECTION ☐ POST INSPECTION

TRANSDUCER INFORMATION

Manufacturer ______________

Frequency ________ MHz ________

Active Element Dimension ________

Connector Type ____ UHF ________

Focal Type ______________

Serial Number ______________

TEST DATA

Target ______________

____

Waterpath ______________

Refracted Angle ______________

SONIC MARK VI DATA

Serial Number ______________

Receiver Gain/Coarse ______________

Receiver Gain/Fine ______________

Frequency ______________

Filter ______________

Display ______________

Clipper ______________

PROGRAM DATA

Channel ______________

Pulser ______________

Preamp ______________

Preamp Gain ______________

MONITOR OSCILLOSCOPE

Manufacturer ______________

Model Number ______________

Serial Number ______________

Vertical Scale ____________ /div.

Horizontal Scale ____________ usec/div.

Calibration Date ______________

Calibration Valid Until ______________

Performed by ______________

Date ______________

FIGURE 7

TRANSDUCER RF WAVEFORM DATA SHEET

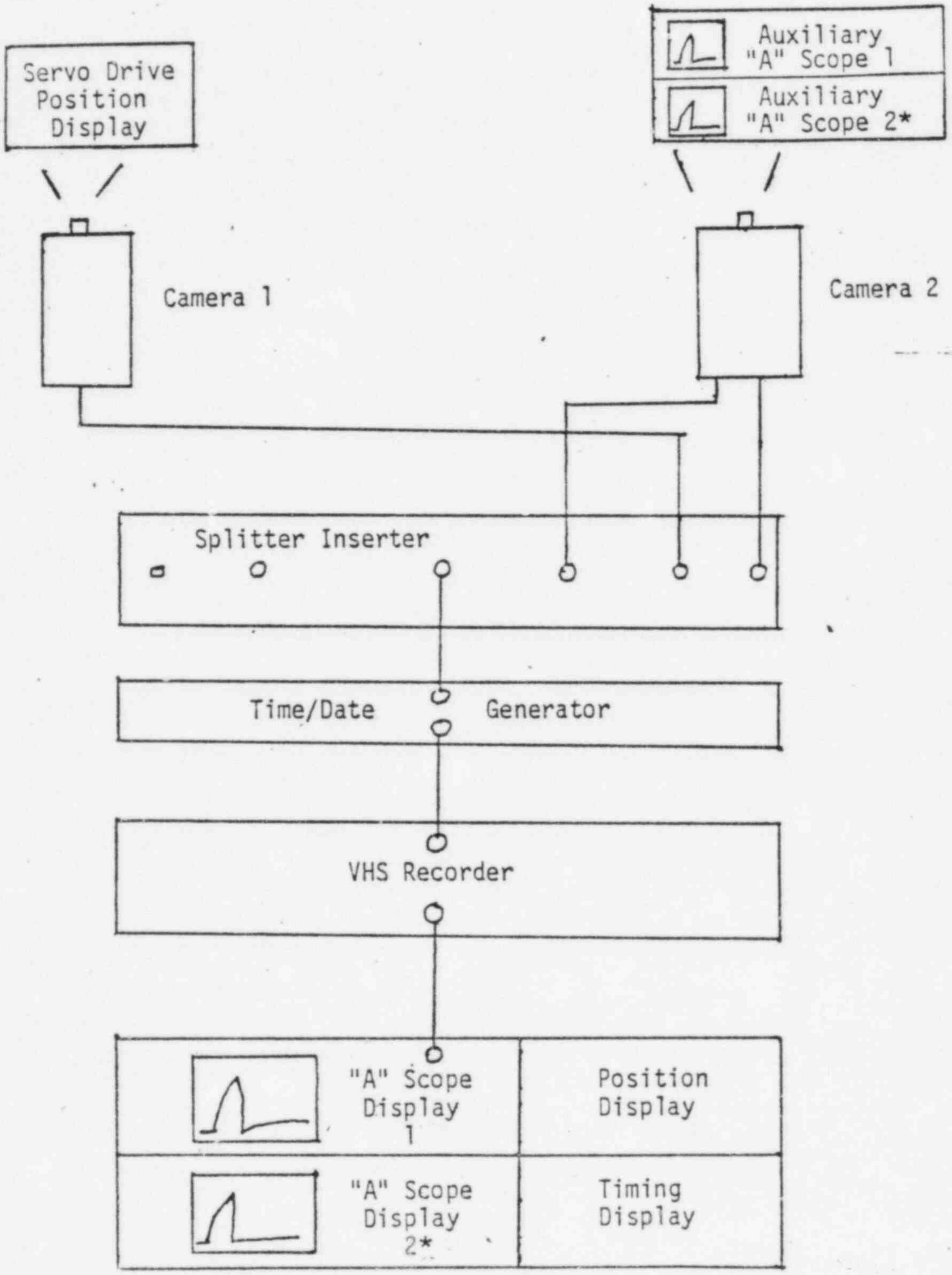
WESTINGHOUSE R.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT	UNIT	SKETCH 1-1100
	WELD (S)	PACKAGE NO.	OUTAGE
	EXAMINER	DATE/TIME	PROCEDURE ISI- REV.

ACTUAL I.F. POSITIONS AND GATE CORRECTIONS (IN μ SECONDS)

TRANSDUCER I.D.	INTERFACE POSITION (ON CRT)	GATE DELAY POSITION	GATE WIDTH POSITION	1/4 T	BEAM REDIRECTION	TOTAL METAL TRAVEL	REMARKS

8107-4

FIGURE 8 - EXAMINATION PARAMETER RECORDS SHEET



Video Display Monitor

*Auxiliary "A" Scope 2 may be used to display with expanded sweep. Use of this second scope is optional.

FIGURE 9

TYPICAL "A" SCOPE VIDEO RECORDING SYSTEM

WESTINGHOUSE N.S.I.D. INSPECTION SERVICES REACTOR VESSEL U.T. EXAMINATION	PLANT/UNIT	CAL. PACKAGE NO.	SKETCH 1-1100
	WELD	TRANSDUCER/CHANNEL	OUTAGE
	EXAMINER	DATE	PROCEDURE ISI- REV.

REFLECTOR SIZING DATA

POSITION ON PRINT OUT

AXIS IN COUNTS

Z	Y	A	B	C	D	E	F	G

DEPTH ______ RADIUS ______ ALPHA ______ INCREMENT NO. ______

MEASUREMENT DATA

MEASURED WATER PATH ______ μ SECONDS
REFRACTED ANGLE ______
PEAK REFLECTOR AMPLITUDE (% DAC) ______
METAL VELOCITY ______ IN./μ SECOND

LENGTH MEASUREMENT

LENGTH AXIS ______ ______ COUNTS PER ______

% DAC	20	50	100	PEAK	100	50	20
COUNTS							

WIDTH MEASUREMENT(S)

WIDTH AXIS ______ ______ COUNTS PER ______

LENGTH POSITION NO. 1 ______ AXIS ______ COUNTS ______

% DAC	20	50	100	PEAK	100	50	20
WIDTH COUNTS							
METAL PATH							

LENGTH POSITION NO. 2 ______ AXIS ______ COUNTS ______

% DAC	20	50	100	PEAK	100	50	20
WIDTH COUNTS							
METAL PATH							

LENGTH POSITION NO. 3 ______ AXIS ______ COUNTS ______

% DAC	20	50	100	PEAK	100	50	20
WIDTH COUNTS							
METAL PATH							

REMARKS:

8187-2

FIGURE 10

ULTRASONIC INDICATION DATA SHEET

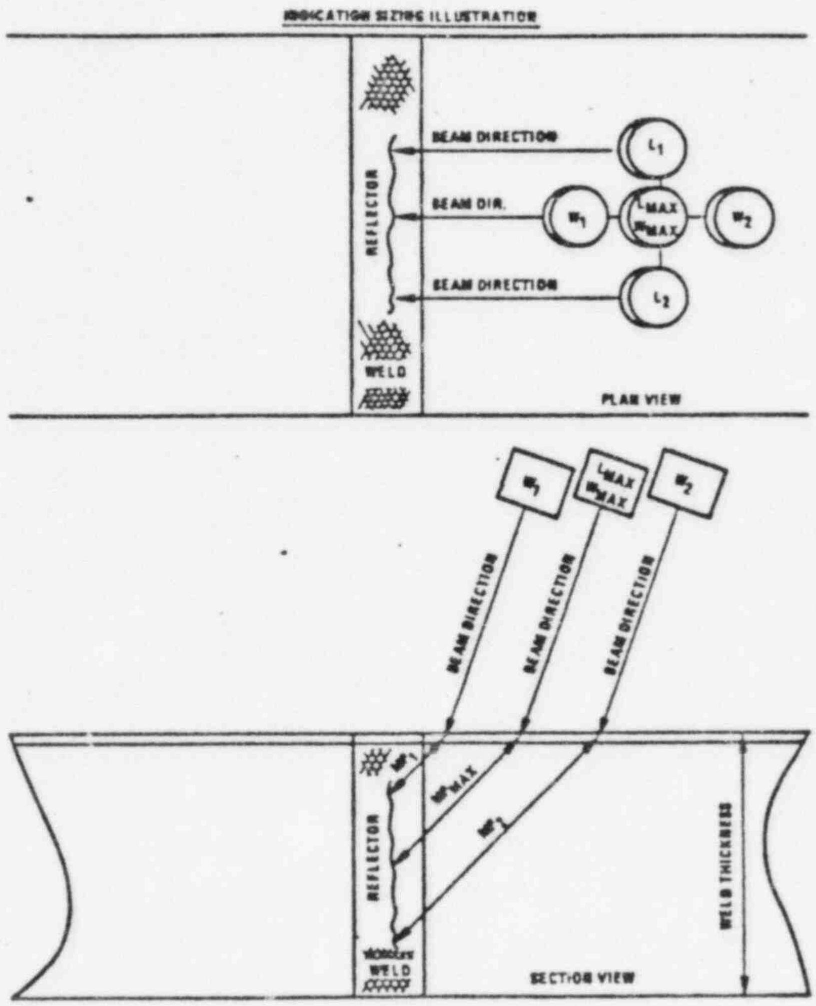


FIGURE 11

ULTRASONIC INDICATION DATA RECORDING ILLUSTRATION