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July 23, 1979

DOCKET NUMBER
PROPOSED RULE PR - Misc Notice
Reg. Guide

Secretary of the Commission
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Docketing and Service Branch

Subject: Regulatory Guide 1.85 - Materials Code Case Acceptability, ASME Section III, Division 1

Dear Sir:

Page 4, paragraph B.(4) of subject document applies conditions to the acceptance of Code Case 1698(N-92), attached. The case is a waiver of the requirements to use the ultrasonic transfer method.

Using this method, "Transfer is accomplished by noting the difference between responses received from the same reference reflector in the basic calibration block and in the component and correcting for the difference." Machining reference reflectors in the component is generally prohibited, so an angle beam search unit acting as a reflector is generally used as the reference reflector on both the basic calibration block and the component. The resultant corrections have been proven to be erroneous. One documented proof appears on pages 6, 7, and 8 of the "March Through December 1972, Repair of Edwin I. Hatch No. 1 Nuclear Reactor Pressure Vessel" report (attached). Attenuation and transfer correction measurements were made on two basic calibration blocks which gave side-drilled hole amplitudes within ± 2 dB of each other. The attenuation and transfer correction measurements indicated differences of 5 to 10 dB between the blocks. Transfer corrections made on the basis of such measurements will create greater errors than corrections. Therefore, the transfer correction method was removed from Code requirements by committee action, Section XI, 1974, 1-4600, which prohibits the use of transfer methods for either straight beam or angle beam calibration, and Code Case 1698(N-92) was written to waive the transfer method requirements.

There are no practicable techniques of comparing ultrasonic attenuation in curved, clad specimens having variable surface roughness. The geometric variables are much greater than the material attenuation variable, so the attenuation and transfer measurements on pressure vessels are meaningless.

Acknowledged by card.

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Since the Code Case is a waiver of a requirement to perform an erroneous correction, I recommend that the last 12-1/2 lines of the conditioned acceptance be deleted so that it reads:

1698 (N-92)	6-30-75	Waiver of Ultrasonic Transfer Method, Section III, V, and VIII, Division 1

Code Case 1698 is acceptable subject to the following conditions in addition to those specified in the Code Case: The material from which the basic calibration block is fabricated should be of the same product form, alloy, and heat treatment as the material being examined.

Very truly yours,

W C McGaughey

W. C. McGaughey
Member
Subcommittee for Nondestructive Examination, and
Subgroup on Ultrasonics and Acoustic Emission
of the American Society of Mechanical Engineers,
Boiler and Pressure Vessel Committee

ov

Attachments: Code Case 1698(N-92)
Cover and pages 6, 7,
& 8 of Hatch 1 report.

cc: J. R. Mackay, w/attachments
R. C. Hudson "
P. J. Herbert "
D. A. Gomien "

Meeting of September 15, 1978
Approved by Council, November 20, 1978

This Case shall expire on November 20, 1981
unless previously annulled or reaffirmed.

Case N-92 (1698)
Waiver of Ultrasonic Transfer Method
Sections III, V and VIII, Division 1

Inquiry: May use of the ultrasonic transfer method specified in Section V, Article 5, Section III Appendix IX prior to the Winter, 1973 Addenda, and Section VIII, Division 1 Appendix U prior to the Summer, 1973 Addenda be waived?

Reply: It is the opinion of the Committee that use of the ultrasonic transfer method, as described in the Inquiry, may be waived.

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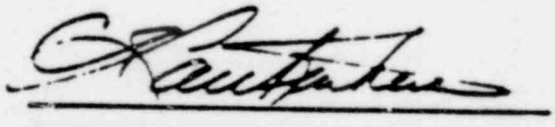
MARCH THROUGH DECEMBER 1972 REPAIR OF EDWIN I. HATCH NO. 1 NUCLEAR REACTOR PRESSURE VESSEL

VOLUME I
FINAL REPORT APPENDICES
SwRI Project No. 17-3038

Prepared for
Georgia Power Company

June 1973

Approved by:



C. E. Lautzenheiser, Vice President
Quality Assurance Systems
and Engineering Division

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TABLE 1. CRACK DEPTH DATA

Amplitude, % DAC		Crack Depth, in.	60-Deg Metal Path, in.	
60 deg	45 deg		Between Peaks	Between Extinction Points
150	80	0.4 to 0.5	single	3.5
120	100	0.1 to 0.2	0.2	3.3
80	40	0.4 to 0.6	0.3	3.0
60	25	0.4	1.0	3.2
25 to 30	20 to 25	0.7	0.4	3.1

Table 1 shows that crack depth neither correlates with amplitude nor changes in metal path between peaks or between extinction points. However, the data previously taken on change in metal path between the half maximum amplitude points in the area of the 0.4- to 0.6-in-deep crack was used in predicting the 3/4-in. maximum depth crack in N2C.

Additional cuts parallel to the outside surface were studied at the 40- and 100-deg locations. Two crack surfaces at the 40-deg end and one crack at the 100-deg end of the excavation continued into the weld. Vee cuts were made in N2B confirming the presence of a crack. The maximum crack depth noted was 0.3 inch. The remaining indications in N2B and N2C were removed by the arc air method which did not allow the collection of additional data for correlation. The excavations were prepared for welding.

C. Comparison of the Hatch and SwRI Basic Calibration Blocks

The July 1971 examination of the Hatch vessel was performed using the SwRI basic calibration block which is 7-1/8 in. thick, 5 in. wide, and 24 in. long, with 5/16-in.-diameter side-drilled holes at 1/4 and 3/4 of the thickness below the surface. The Hatch basic calibration block, which has been used for calibration in the recirculation course of the vessel since March 1972, is 7-1/4 in. thick, 10 in. wide, and 27 in. long, with 5/16-in.-diameter side-drilled holes at 1/4, 1/2, and 3/4 of the thickness below the surface. Both blocks were fabricated from clad nozzle dropouts from similar vessels. Mid-wall reflector amplitudes recorded in the July 1971 examination of the vessel are higher than the amplitudes recorded in the March 1972 reexamination; therefore, differences between the blocks were suspected, and comparative measurements of attenuation, beam angle, and distance amplitude curves were made.

1. Calibration Block Sensitivity Comparison

Since comparison of reflector amplitudes to the SwRI block gave higher amplitudes, it was suspected that the attenuation in the SwRI block was higher than the attenuation in the Hatch block. Five measurements of attenuation were attempted by use of methods that could be used for transfer correction from a block to the vessel. The methods, which were applied on both blocks using the Sonic Mark I portable ultrasonic instrument, consisted of:

(1) 5 MHz, 1/2 X 1-in., straight beam longitudinal wave back reflection measurement. (This approximates the wavelength of the 2-1/4 MHz angle beam shear wave.)

(2) 2-1/4 MHz, 1/2 X 1-in., straight beam longitudinal wave back reflection measurement.

(3) 2-1/4 MHz, 13/16 X 1-in., 45-deg angle beam shear wave transmitter to a 2-1/4 MHz, 1/2 X 1-in., 45-deg angle beam shear wave receiver through transmitted amplitude measurement on a Vee path, reflecting from the clad surface.

(4) The same as (3) except transmitting with the 1/2 X 1-in. transducer and receiving with the 13/16 X 1-in. transducer.

(5) 2-1/4 MHz, 1/2 X 1-in., 45-deg angle beam shear wave transmitter receiver reflection amplitude measurement on a Vee path, reflecting from the clad surface to the 13/16 X 1-in. search unit wedge and to the clad surface and back to the transmitting receiving search unit.

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TABLE 2. CALIBRATION BLOCK SENSITIVITY COMPARISON

Examination	Equal Sensitivity Amp., Screen Divisions		Gain of Equal Amp., dB	
	Hatch	SwRI	Hatch	SwRI
1. 5 MHz Straight Beam	3	10	10	–
2. 2-1/4 MHz Straight Beam	10	5.5	–	5
3. 2-1/4 MHz, 45-deg Angle Beam	5.5	10	5	–
4. Same as No. 3 Except Small T to Large R	4	10	8	–
5. 2-1/4 MHz, 45-deg Transmit Receive	*	*		

*No amplitudes detectable.

The results of these measurements are shown in Table 2. Since attenuation increases with an increase of frequency and a decrease in wavelength, Method No. 2 can be deleted, thus indicating that attenuation is higher by 5 to 10 dB in the Hatch block than in the SwRI block as measured by the transfer method. This is the reverse of the suspected condition.

2. *Beam Angle Measurements*

Beam angles were measured as follows: on the IIW block, from the indicated beam centerline on the search unit to the 2-in-diameter hole; on the SwRI block, from the 1/4 to 3/4 T holes; and, on the Hatch block, from the 1/4 to 1/2 T holes. (The SwRI block does not have a 1/2 T hole, and the 3/4 T hole in the Hatch block is partially blocked by laminations; thus, measurements were made as indicated.) Four 2-1/4 MHz, 1/2 × 1-in. search units were coupled to three 60- and one 45-deg angle beam shear wave wedges. Measurements were made using both a Sonic Mark I and a UM 775-5N Reflectoscope. Results of these measurements are shown in Table 3. Beam angles measured on the blocks are within 5 deg of the wedge design beam angle. The average Reflectoscope angle reading is about 1 deg smaller than readings on the Sonic instrument, and the average Hatch block angle reading is about 1 deg smaller than the readings on the SwRI block. No significance is attached to these small deviations in measured beam angle.

TABLE 3. BEAM ANGLE MEASUREMENTS IN DEGREES

Search Unit No.	Wedge	IIW		Hatch		SwRI	
		Sonic	Reflectoscope	Sonic	Reflectoscope	Sonic	Reflectoscope
6	60	58.5	58	65	59	64	63
7	60	59	56	62	59	62	61.5
8	60	61	61	61	50.5	64	64.5
9	45	45	45	43	49	45	44

3. *Distance Amplitude Curve Data*

This data was taken on the 1/4, 1/2, and 3/4 T holes in the Hatch block and on the 1/4 and 3/4 T holes in the SwRI block. Two instruments and three 2-1/4 MHz, 1/2 × 1-in., 60-deg angle beam shear wave search units were used. Each search unit and instrument were adjusted to give an eight-division amplitude on the 1/4 T hole in the Hatch block, and amplitudes were read on the other four holes at this sensitivity. The data is plotted as DAC in Figure 6. Each frame shows data from three search units, the top frames representing DAC's taken with the UM 775-5N Reflectoscope and the bottom frames, with the Sonic Mark I. Left-hand frames are DAC's taken on the Hatch block, while right-hand frames are taken from the SwRI block. Note that the amplitude from the 1/4 T hole in the SwRI block is within +25 percent and −12 percent (less than ± 2 dB) of the amplitude from the same hole in the Hatch block, confirming that there is negligible difference in attenuation between the two blocks. A six-division amplitude at midthickness (metal path four sweep divisions) was measured with respect to each DAC (Table 4). With the same

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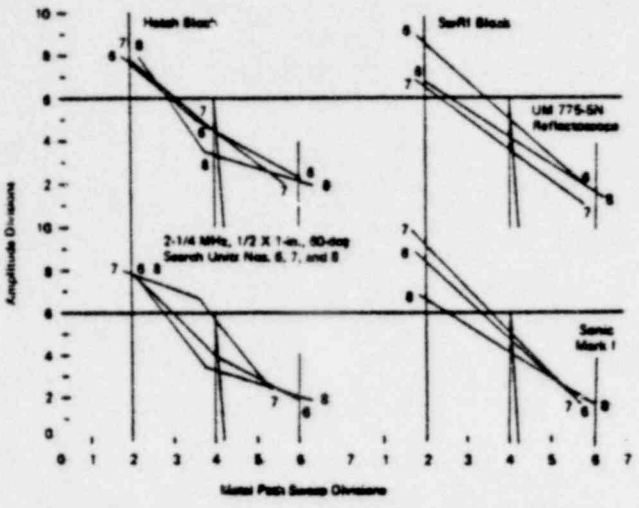

FIGURE 6. 2-1/4 MHz, 1/2 × 1, 60-DEG DAC'S ON HATCH AND SwRI BASIC CALIBRATION BLOCKS

instrument, Search Units Nos. 6 and 8 gave 17- to 38-percent DAC higher readings on the six-division amplitude compared to the Hatch block, while Search Unit No. 7 gave 10- to 27-percent DAC higher readings compared to the SwRI block. Search units and instruments gave greater deviations than the deviation between blocks, thus confirming that the search unit instrument combination must be calibrated on a basic calibration block of material similar to the component to be examined.

The results of this investigation indicate that the transfer methods used in the investigation should not be used in making corrections for attenuation between block and vessel. The transfer method measurement of 5- to 10-dB difference between blocks is false since side-drilled hole amplitudes are within ± 2 dB. Transfer corrections should not be made since it is probable that they will create greater errors than corrections. The best method is to calibrate the examination system on a block of material from, or similar to, the component to be examined and assume acoustic equality between block and component. This method was used for all examinations on the reactor pressure vessel.

TABLE 4. DISTANCE AMPLITUDE CURVE DATA

Search Unit No.	Percent DAC			
	Hatch Block		SwRI Block	
	UM 775-5N	Sonic	UM 775-5N	Sonic
6	133	150	116	120
7	133	104	160	114
8	176	176	140	138

4. *Reexamination of Vessel Welds and Examination of Excavations Before Welding*

Following the confirmation of the presence of cracks in Welds Nos. N2B and N2C, a meeting was held in Atlanta on April 19, 1972, with Southern Services, Georgia Power, General Electric, and SwRI participating. It was decided that a prerepair reexamination of the entire vessel should be considered in order to reference all vessel reflectors to a permanent set of Hatch basic calibration blocks which would be kept indefinitely at the site. In preparation for this decision, a meeting was held in San Antonio on April 25 to 27, 1972, with General Electric, Combustion Engineering, and SwRI personnel to prepare the "SwRI Hatch I Special Procedure" (Appendix 2A). At the same time, an examination was performed at the site on N2J as a sample of information that might be obtained from the reexamination. On April 28, 1972, Southern Services, Georgia Power, General Electric, Combustion Engineering, and SwRI personnel met in Atlanta and decided to proceed with the reexamination.

During the period April 29 through May 6, 1972, the recirculation course of the vessel was reexamined. All reflectors exceeding 10-percent DAC amplitude were recorded in order to prevent the appearance of new reflectors between pre- and postrepair examinations. For example, if an 18-percent DAC amplitude was not recorded in the prerepair examination and was measured and recorded at 22-percent DAC in the postrepair examination, it would appear to be a new reflector. However, small changes in amplitude between examinations within the ± 2-dB accuracy of the

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