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July 9, 1976

Mr. Dennis L. Ziemann, Chief
Operating Reactors Branch 2
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station Unit 3
Proposed Inspection Program for
Feedwater Nozzle Inspection
NRC Docket No. 50-249

Dear Mr. Ziemann:

Enclosed is the proposed feedwater nozzle inspection program for the Dresden Unit 3 refueling outage. The program, in essence, calls for an ultrasonic examination of the inner radius blend and of the nozzle bore if a satisfactory technique can be developed.

A description of the proposed ultrasonic inspection technique is provided for your technical review. You will find the sensitivity of the method adequate to detect defects of significance.

When the capabilities of the ultrasonic inspection technique are compared to those of a dye penetrant examination with its associated dollar cost and man rem exposure, the ultrasonic examination will be the most cost effective method of examination.

Please direct any questions to this office.

One original and 39 copies are provided for your use. An additional original copy will be provided as soon as the photographs are available.

Very truly yours,

7448

G. A. Abrell
Nuclear Licensing Administrator
Boiling Water Reactors

Enclosures (1) Dresden Station Unit 3 Feedwater Nozzle Inspection Program.

(2) Time and Exposure Estimates for Dresden Unit 3 Sparger Work.

(3) Validation of Inner Blend Radius Ultrasonic Examination Technique.

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Time and Exposure Estimates for Dresden 3 Sparger Work

NRC Docket No. 50-249

1) P.T. Accessible Portion of One Nozzle

Man Rem = 25

Critical Path Time - 3 Days (1)

2) P.T. Accessible Portion of All 4 Feedwater Nozzles

Man Rem = 100

Critical Path Time - 10 Days

3) Pull One Sparger and P.T. Blend and Inner Bore

Man Rem = 150

Critical Path Time - 15 Days

4) Pull All 4 Spargers and P.T. Blends and Inner Bore

Man Rem = 600

Critical Path Time = 60 Days (2)

(1) Based on Unit 2 Sparger Work-May 1976 (Unit 3 Dose Rates May be up to 1.5 times Unit)

(2) Based on Unit 3 Sparger Work-May-July 1975

Enclosure (2)

DRESDEN STATION
UNIT 3

Feedwater Nozzle Inspection Program

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Due to discovery of cracking of the feedwater nozzle inner blend radius, a special inspection program for these nozzles will be conducted during the fall 1976 refueling outage. This inspection program will include the following.

1. Examination of the visible portions of the four (4) spargers using underwater television equipment.

2. Ultrasonic examination of the inner blend radius of all four (4) nozzles using the so-called Gatti technique. This will be performed using the procedure used for the Unit 2 examination which was described in a report to D.L. Ziemann from G.A. Abrell dated May 17, 1976.

3. Ultrasonic examination of the four (4) feedwater nozzle safe ends.

4. If a suitable technique has been developed, ultrasonic examination of the bore of the four (4) feedwater nozzles.

Justification of Inspection Program.

1. Thorough grind out of cracking was accomplished during the last refueling outage.

2. Unit 3 will have limited number of startup/shutdown cycles prior to the refueling outage. As of June 15, 1976, the number of cycles is 9½.

3. The television inspection will confirm that sparger is intact. This will ensure that the sparger will minimize thermal cycling at the cladding.

4. The UT procedure based on the Gatti technique has been validated as described in the attached report and will detect cracks into base metal anywhere on the entire blend radius.

5. If cracking has extended beyond the blend radius into the safe end, it will be detected by ultrasonic examination of the safe end.

VALIDATION OF INNER BLEND RADIUS ULTRASONIC EXAMINATION TECHNIQUE

Introduction

The so-called "Gatti" ultrasonic technique for the detection of cracks in the inner radii of the nozzle-to-vessel transition area of feedwater nozzles was the basis of the procedure that was used at Dresden Station on May 1, 1976, to ultrasonically examine the inner radii of the four feedwater nozzles of Unit 2. This procedure will be used for future inspections of both Dresden Units 2 and 3.

This procedure will detect through-cladding cracks over the entire 90 degrees of the blend radii. This was demonstrated by actual test on a feedwater nozzle in a vessel. The demonstration was performed on a nozzle at the Breda Termomeccanica plant in Milan, Italy.

Test

On May 18, 1976, J. Gatti and W. Conti of Breda, and E.E. Potter, Commonwealth Edison Level III performed the "Gatti test" on a feedwater nozzle of a boiling water reactor vessel under construction at Breda.

The nozzle, while not identical to a Dresden Unit 2/3 nozzle, had the same I.D. and had the same inner blend radius. It was clad with austenitic stainless steel and was of A-508, class 2 material, the same as the Dresden nozzles.

Two axial notches had been made on the inner blend radius of the Breda nozzle; one at the top, which extended down from the tangent formed between the blend curve to the vessel I.D., toward the center of the blend curve (see sketch 1, attached); the other at the bottom, which extended from the blend curve into the nozzle (see photo sheet 1). These notches were 7½ mm wide and about 7½ cm long. The top notch had a maximum depth of

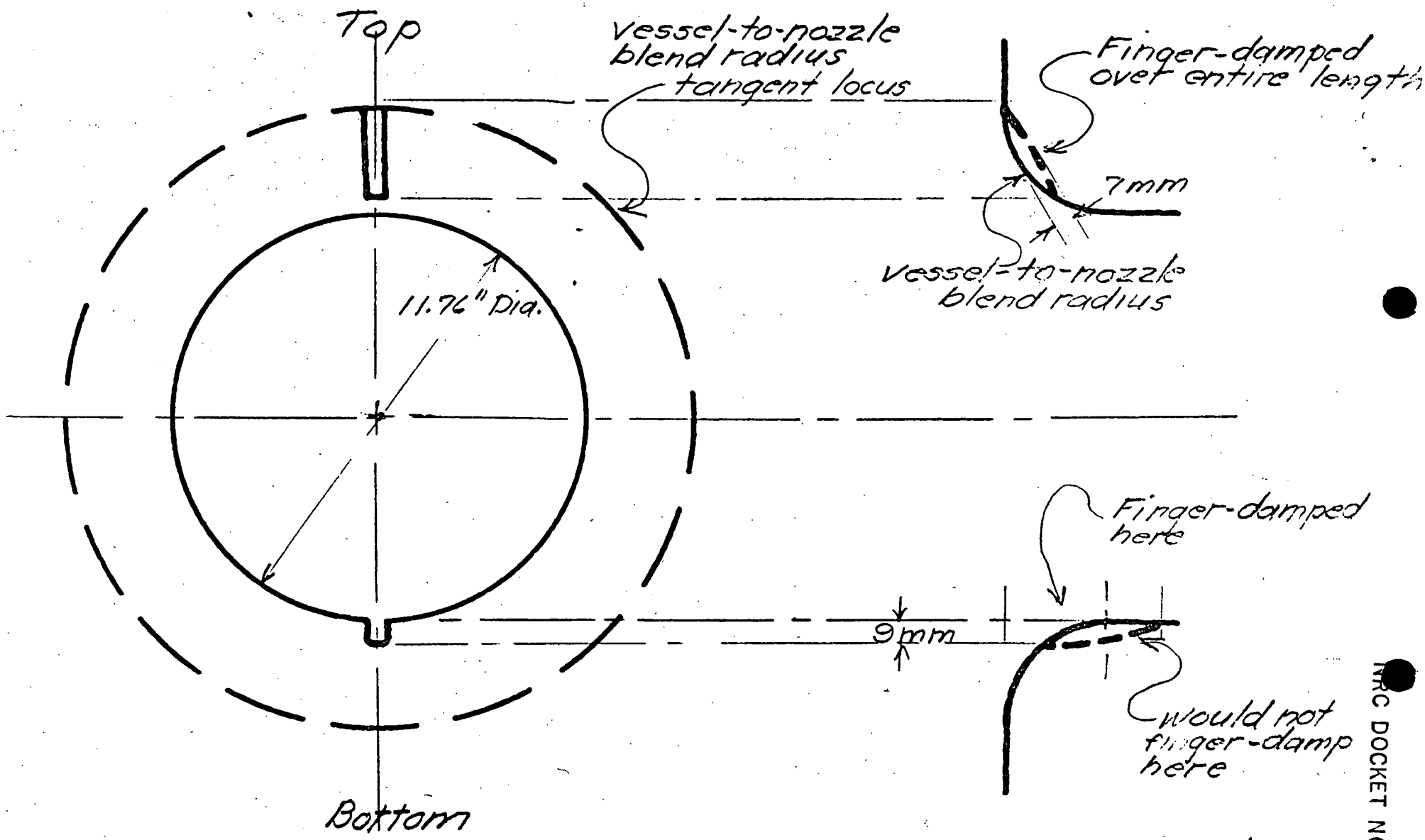
9 mm, while the bottom notch was 7 mm deep.

Using the 70°, 1 MHz, search unit and the Sonic Mark 1 UT instrument that had been used at Dresden, Mr. Gatti, following his procedure, calibrated the system from a vessel calibration block of the appropriate material and thickness. The calibration notch, in the clad surface, was 3 mm deep and 10 cm long, and was shaped like an opened-up "U" in cross section. This notch differed from the one in the Dresden calibration block, but it was judged that the sensitivity derived from the Dresden block was probably as good as the Breda block. Tests were run later at Dresden to demonstrate this correlation. A report describing these tests is an Appendix to this report. The indication from the Breda calibration notch was set at 80% of screen height (see photo sheet 1), then the gain was increased by 20 dB and the controls locked.

An orbital line had been drawn on the vessel at the distance from the nozzle O.D. that had been calculated to give maximum sound exposure to the inner radius. The search unit was placed on this line in an area away from the notches and positioned so as to maximize clad noise (see photo sheet 1). The search unit was then moved toward the top of the vessel along the line, until the top notch produced an indication (see phote sheet 2). The notch indication was maximized by carefully moving the search unit until the optimum position was found. The notch was then finger damped, starting at the lower end; however, it was discovered that the image had too little stability to be able to see the damping effects, so it was decided to try a Gilardoni portable test unit instead of the Sonic. The serach unit was switched to the Gilardoni instrument and the system calibrated again on the clad vessel block. The new unit had a stable portrayal so the test was resumed.

Sketch 1

Sketch of Notches in Breda Vessel Feedwater Nozzle



Not drawn to scale

Lay-out of notches showing how finger-damping was used to demonstrate coverage of the entire 90 degrees of blend radius.

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BREDA TERMOMECCANICA
SERVIZIO CONTROLLO E COLLAUDI
QUALITY ASSURANCE & CONTROL DEPARTMENT
ISPETTORI OFFICINA NUCLEARE
NUCLEAR SHOP NDE INSPECTORS

CONTROLLO DIMENSIONALE
DIMENSIONAL CHECK

Sketch 2
DC
Foglio 2 di 2
Sheet 2 of 2

COMM. Job N° 70005	CLIENTE Customer KKI	IMPIANTO Plant	IPP	PART.	ITEM	PAGE	REV

Oggetto Object: UPPER SECTION 05 ASSEMBLY
Disegno Drawing: 7000018/6
Drawing: 7000962/5

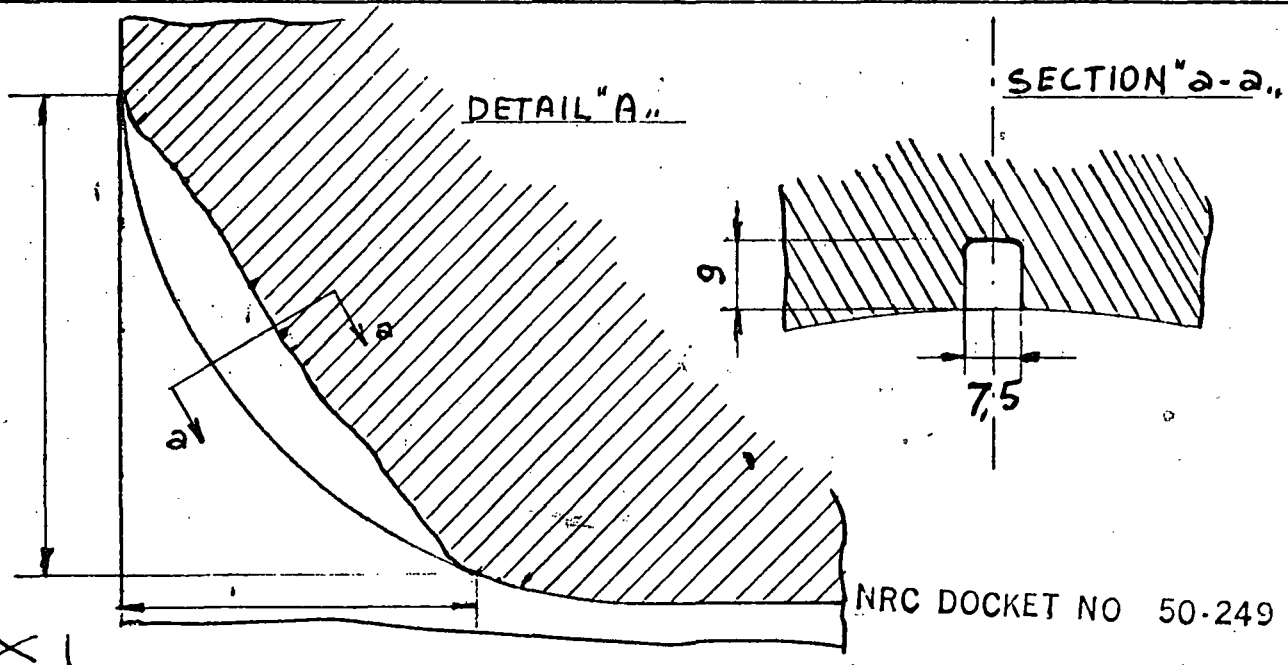
Stadio di lavorazione
Working step

Esame secondo
Check according to

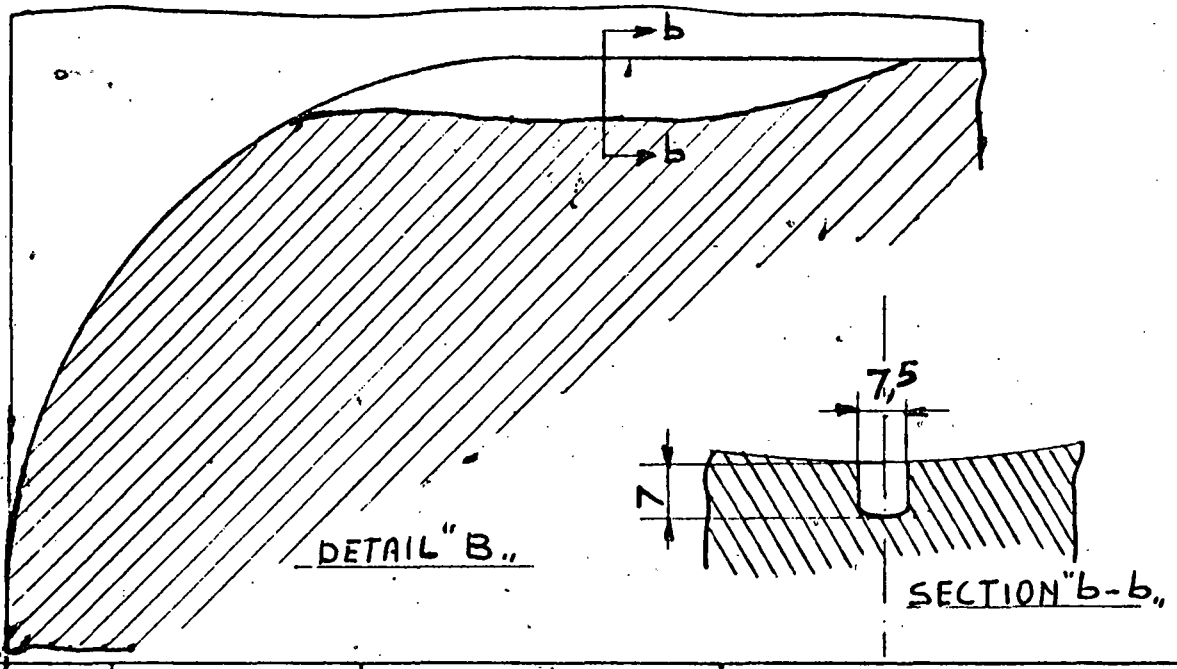
CONTROLLO
Control

Eseguito da Performed by	Località Place of test	Data Date
1		
2		
3		
4		

Data emissione certificato
Date of certificate issue



NRC DOCKET NO 50-249

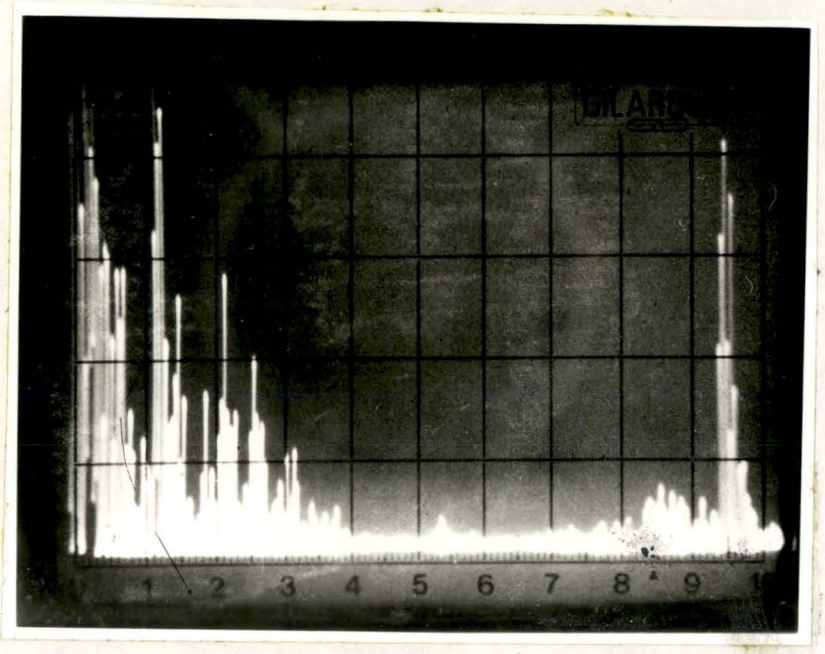


ENTI COLLAUDATORI Surveyors	DATA COLLAUDO Testing date	DATA FIRMA Check dato	FIRMA Signature	CONTROLLATO DA QC Supervisor

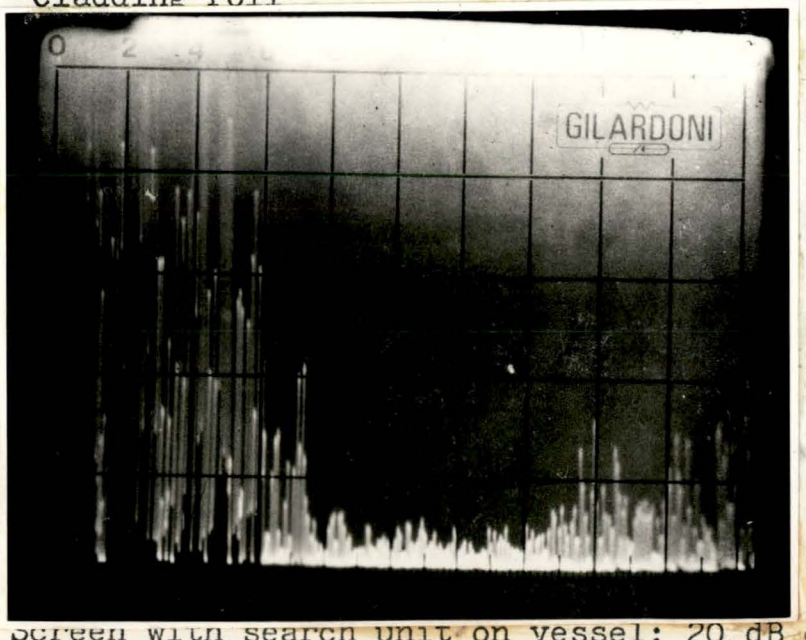
M-1091-76

Cathode Ray Tube Portrayals of
Feedwater Nozzle Inner Radius Blend
Areas, Breda Works, Milan, Italy

NRC DOCKET NO 50-249



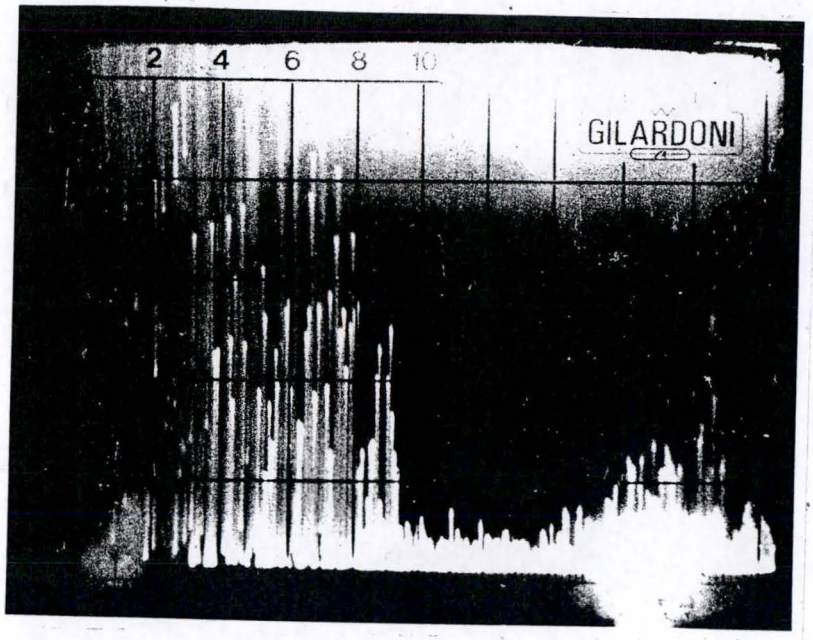
Photograph of Ultrasonic Scope screen after calibration. Indication at right of screen breaking the 80% level is 120° "Vee" notch, 3 mm deep, in cladding, cluster of small indications at its base is "cladding roll"



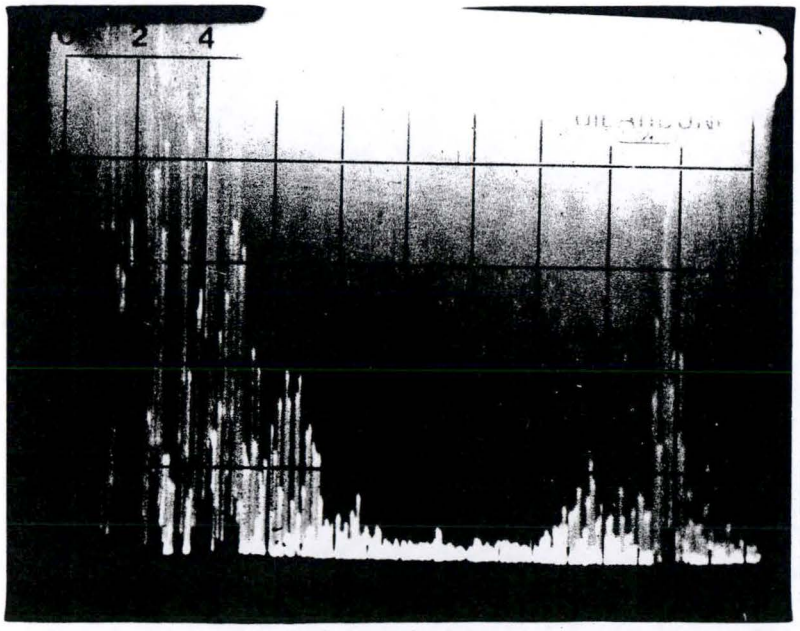
Screen with search unit on vessel; 20 dB of gain added, aimed at inner radius but 90° from notch. Note "clad roll" at lower right-hand quadrant.

Cathode Ray Tube Portrayals of Feedwater Nozzle Inner Radius Blend

NRC DOCKET NO 50-249



Screen, with search unit aimed at top notch. Finger-damping showed notch reflecting over its entire length.



Screen, with search unit aimed at bottom notch. Finger-damping effective only from end of notch in blend curve to slightly beyond point of tangency.

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CONTROLLO DIMENSIONALE
DIMENSIONAL CHECK

Photo Sheet 3
DC
Foglio 1 di 2
Sheet 1 of 2

COMM. Job N° 70'005	CLIENTE Customer KKI	IMPIANTO Plant	IPP	PART.	ITEM	PAGE	REV

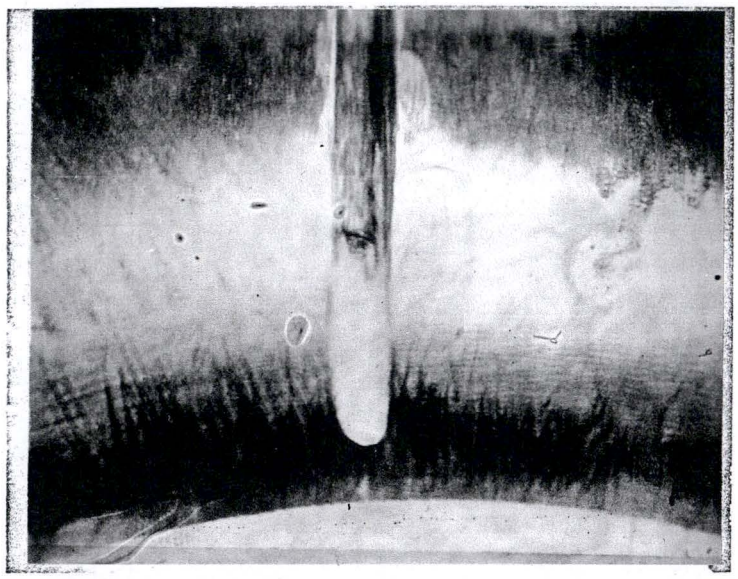
Oggetto Object UPPER SECTION 05 ASSEMBLY
Disegno Drawing 7000018/6
7000962/5

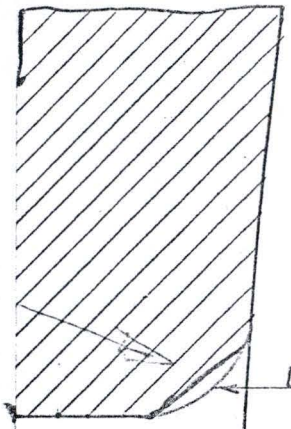
Stadio di lavorazione
Working step

CONTROLLO
Control

	Eseguito da Performed by	Località Place of test	Data Date
1			
2			
3			
4			

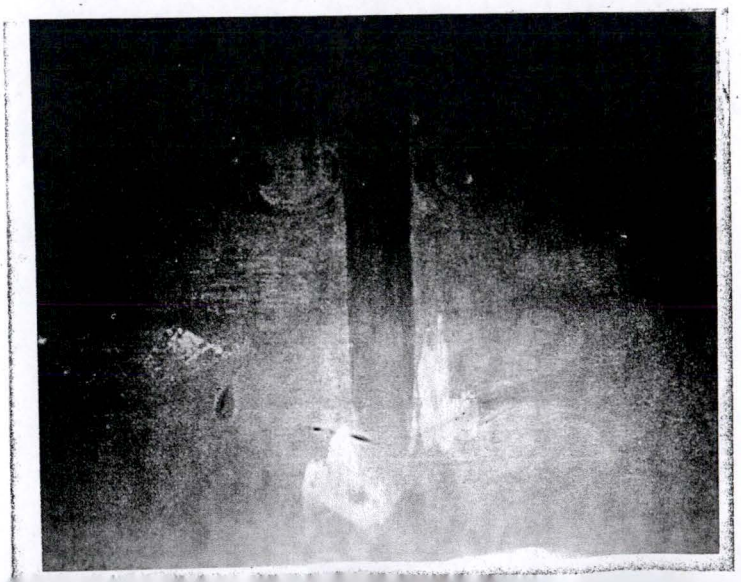
ata emissione certificato
ate of certificate issue

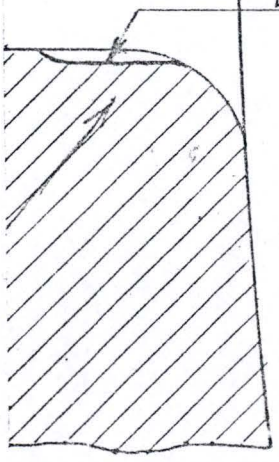




NRC DOCKET NO 50-249

XI





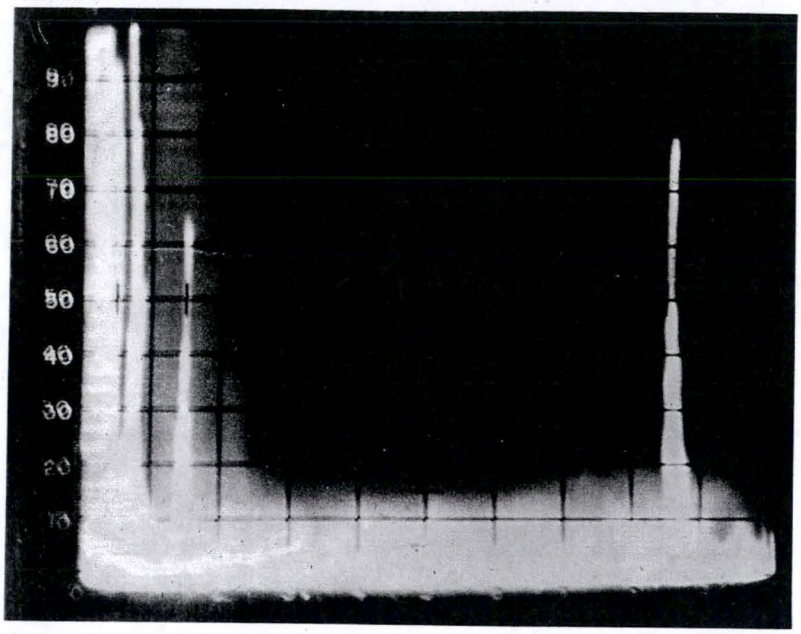
FIRMA
Signature

CONTROLLATO DA
QC Supervisor

IL CAPO DEL CONTROLLO

Cathode Ray Tube Portrayal of Feedwater Nozzle Inner Radius Blend Areas

NRC DOCKET NO 50-249



Photograph of the screen of the Sonic Mark I ultrasonic tester during calibration. This machine not used in Breda tests because of "trembling" image that obscured effects of finger-damping.

APPENDIX

NRC DOCKET NO 50-249

Dresden Corroborative Tests

Tests were made at Dresden on June 4, 1976, to correlate the results of the Breda tests and the tests made on Dresden Unit 2.

The tests that were made on the Dresden Unit 2 feedwater nozzles were done using the procedure developed by Breda but with several detail changes to accommodate the differences between the Dresden site and the Breda procedure. These differences were as follows:

1. Calibration Block - The calibration block used at Dresden was an unclad standard used as the calibration standard for the reactor vessel. The calibration notch was rectangular, 1 inch long and .250 inches deep. The calibration block used at Breda was a vessel calibration block of the appropriate material and thickness. The calibration block was clad and had a notch of length 4", depth 3 mm and shape of an opened "U" cut into the cladding.
2. Search Unit - The search unit used at Dresden was a 70° degree search unit 1" x 1" with a frequency of 1 megahertz. The search unit was the same used on Dresden Unit 2 and at Breda. This combination proved to provide the highest sensitivity.
3. Scanning Technique - The scanning technique used during the Dresden inspection and the Breda test was that of manual scanning using an orbital line drawn around the nozzle to determine general location of the search unit, but the noise off the clad was used for exact search unit positioning.

Commonwealth Edison ultrasonic test procedure NDT-C-24 was prepared to perform the inspection on the Dresden Unit 2 feedwater nozzles.

Corroborative Test Technique

The calibration block used on Dresden Unit 2 was clad in an area that did not interfere with its other uses, yet gave a sound path equaling that to the notch in an unclad area. This patch of cladding was ¼" thick, extending across the face of the block (4") and was 3" long.

A notch that duplicated the Breda notch was cut across it at its midpoint. Using the same search unit as used at Breda and on Unit 2, the indication from this notch was set at 50% of screen height and the gain settings were marked. The search unit was then directed at the notch used for the Unit 2 calibration, and maximized. The gain was adjusted to bring the indication amplitude back to 50% of screen height, and the dB change required was noted. The gain had to be reduced a minimum of 4 dB to decrease to 50% of screen height.

Analysis of Test Results

The results of the corroborative test at Dresden and Breda lead to the following conclusions:

1. The Breda calibration block, with an "open-U" notch, 3 mm in depth, cut in the cladding proved to be the most sensitive. Actual test data showed that the Breda notch was 37% more sensitive than the Dresden Unit 2 calibration notch. This difference can be attributed to the attenuation of the sound through the clad inner-face. Even with a 37% reduction in sensitivity, the two notches in the Breda nozzle would have still been seen using the NDT-C-24 procedure, therefore the validity and the conclusions drawn from the Breda tests remain unchanged.
2. Using procedure NDT-C-24 calibration and scanning techniques and the data obtained from the tests at Breda and subsequent tests

at Dresden, it can be concluded that the tests performed on the Dresden Unit 2 feedwater nozzles encompassed the entire 90° of blend curvature and would have detected any cracks extending .025 inches into ferritic base material.