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WSRC-RP-89-1311

Savannah River Laboratory
Equipment Engineering Section
Reactor Tank Inspection Program

Keywords: Irradiation
Degradation Mechanisms
ISI IGSCC
Robot Restart

FINAL SUMMARY REPORT FOR 1989 INSERVICE INSPECTION (ISI) OF SRS 100-P REACTOR TANK

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Issued: December 15, 1989

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Westinghouse Savannah River Company
Prepared for the U. S. Department of Energy Contract DE-AC09-88SR18035

DOCUMENT: WSRC-RP-89-1311

TITLE: FINAL NDE INSPECTION REPORT FOR 1989 INSERVICE INSPECTION (ISI) CYCLE OF SRS 100-P REACTOR TANK

DATE: December 15, 1989

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FINAL SUMMARY REPORT FOR 1989 INSERVICE INSPECTION (ISI) OF SRS 100-P REACTOR TANK

INTRODUCTION

The integrity of the SRS reactor tanks is a key factor affecting their suitability for continued service since, unlike the external piping system and components, the tanks are virtually irreplaceable. Cracking in various areas of the process water piping systems has occurred beginning in 1960 as a result of several degradation mechanisms, chiefly intergranular stress corrosion cracking (IGSCC) and chloride-induced transgranular cracking. IGSCC, currently the primary degradation mechanism, also occurred in the "knuckle" region (tank wall-to-bottom tube sheet transition piece) unique to C Reactor and was eventually responsible for that reactor being deactivated in 1985.

A program of visual examinations of the SRS reactor tanks was initiated in 1968, which used a specially designed immersible periscope. Under that program the condition of the accessible tank welds and associated heat affected zones (HAZ) was evaluated on a five-year frequency. Prior to 1986, the scope of these inspections comprised approximately 20 percent of the accessible weld area. In late 1986 and early 1987 the scope of the inspections was expanded and a 100 percent visual inspection of accessible welds was performed of the P-, L-, and K-Reactor tanks. Supplemental dye penetrant examinations were performed in L Reactor on selected areas which showed visual indications. No evidence of cracking was detected in any of these inspections of the P-, L-, and K-Reactor tanks.

The SRL Equipment Engineering Section (EES) initiated development of robotic equipment to enable volumetric and surface examinations of the reactor tank inside surfaces and weld areas using ultrasonic (UT) and eddy current (ET) techniques. An Inservice Inspection (ISI) Plan for the reactor primary coolant system was also prepared in 1988, patterned after the requirements of the ASME Code Section XI. This Plan noted that, with respect to the tank inspections, volumetric and surface examinations are preferred and should be implemented as soon as the capability is developed (1). The ISI Plan basically specifies that the accessible tank weld HAZ be completely inspected every five years, suggesting a one-third examination approximately every 18 months. The EES development efforts through the Reactor Tank Inspection Program culminated in a robotic inspection system ready for deployment this year. Consequently, the 1989 P-Reactor inspection reported herein was the first such inspection undertaken in accordance with the provisions of the ISI Plan (2). The inspection was performed under Test Authorization TA1-2300 and Special Procedure 2453 (3, 4).

SUMMARY

The basic purpose of this inspection was to determine if the portions of the accessible P-Reactor tank wall selected for examination indicated any signs of IGSCC. These portions included areas in and beyond the weld HAZ, extending out as far as three inches from the centerline of the welds, plus selected areas of base metal at the intersection of the main vertical and tank mid-girth welds. No evidence of such degradation was found.

A number of other indications which were determined to be from tank fabrication processes were found and were recorded in the permanent data base for reference in future inspections.

These include areas of weld repair during original fabrication, fabrication anomalies, and geometric reflectors associated with some of the welds, and evidence of current and former attachments to the tank. In no case do any of these findings represent a concern with respect to the structural integrity of the tank.

Consistent with the plan to inspect 100 percent of the accessible weld HAZ every five years, this inspection comprised about 40 percent of the accessible weld length in the P-Reactor tank. Initial setup of the tank, which included a full charge of unirradiated Mark 22 fuel and Mark 60B blanket assemblies, began on August 28, 1989. Following the inspection, the fuel and other components were returned to their original preinspection locations by November 7, 1989. The total elapsed reactor time thus devoted to this inspection was 72 days.

PURPOSE AND SCOPE OF INSPECTION

This inspection comprised the initial ultrasonic inspection required by the ISI Plan for the 100-P Reactor tank. The primary objective of the P tank inspection was the detection and sizing of IGSCC in the HAZ of the accessible weldments of the reactor tank, and the evaluation of any such IGSCC with respect to the approved acceptance criteria (5). Linear discontinuities resulting from the original tank fabrication welding process were investigated, evaluated against the acceptance standards, and documented for future reference.

In accordance with the provisions of the ISI Plan, the following weld areas were scheduled for examination by UT and ET techniques:

100%	Tank shell vertical welds (P-VC1, P-VC2, P-VD1, P-VD2)[a]
33%	Tank-to-expansion ring horizontal weld (P-H2) and horizontal weld in expansion ring immediately above (P-H1)[b]
33%	Tank shell horizontal mid-girth weld (P-H3)
33%	Tank shell-to-tank bottom nozzle assembly (TBNA) extension ring horizontal weld (P-H4)
33%	TBNA extension ring-to-TBNA horizontal weld (P-H5)
33%	Outlet nozzle-to-tank vertical welds (P-VF4, P-VF5, P-VF10, P-VF11)

The area to be examined was specified in Reference 6 as base metal and the HAZ within two inches on either side of the weld centerline. In most cases this coverage was extended to three inches from the weld centerline on each side of the weld. In addition, regions of the tank base metal in the vicinity of the intersection of the main tank shell vertical and horizontal welds were scheduled for inspection. Due to the inclusion of all the main tank vertical weld HAZ, this P tank inspection program comprised approximately 40 percent of the accessible welds, on both a weld length and a weld count basis (7).

The area of the expansion ring in the vicinity of welds P-H1 and P-H2 was inspected by ET only, due to the relatively thin (3/16-inch) wall thickness of the expansion ring and the fact that the UT transducer and procedure at the time of the test were qualified specifically for the 1/2-inch tank wall. During the course of the inspection an alternate UT transducer and

[a] See weld identifications on Figures 1-A and 1-B.

[b] Not required by ISI Plan.

procedure designed for the 3/16–inch expansion ring area were developed and qualified, and are now available for backup use to the ET procedure if required in future inspections.

The inspection of some of the welds in the vicinity of the outlet nozzles was limited by the capability of the inspection robot to access geometrically complex areas. Also, the inspection of the T–joint weld joining the nozzle assembly to the bottom tube sheet could not be accomplished with the present robot; this capability is still under development. For reference purposes, Figures 1–A and 1–B are unfolded views of the major weld areas in the vertical section of the tank. The view is from the center of the tank looking outward.

INSPECTION SYSTEM DESCRIPTION

The reactor tank inspection system was developed by the Equipment Engineering Section according to the requirements of the Functional Specification (8) and NDE Methodology (6). These references contain details of the equipment and inspection techniques. One of the major development challenges was to design and fabricate the various components of the system for compatibility with the approximately 4–inch inside diameter of the permanent tubes in the plenum and top shield. These tubes provide the only practical access for equipment to the interior of the reactor tank.

The basic inspection system consisted of: (1) a remotely operated robotic manipulator capable of conducting ultrasonic and eddy current examinations of all accessible areas of the reactor tank wall; (2) equipment for in–tank lighting, cameras, and calibration of the UT/ET system; (3) instrumentation and controls for the full range of UT, ET, and video operations; (4) a two–ton gantry crane for insertion and removal of equipment to and from the reactor tank; and (5) support equipment for communication between the process room and the control trailer, including lighting, closed circuit television, audio, etc. In addition, an onsite facility mockup of the P–, L–, and K–Reactor tanks was constructed in Building 305–A to test, qualify, and demonstrate the in–tank tooling and to train and qualify inspection personnel. The NDE data acquisition system is based on an Intraspect/98^{TM} Ultrasonic (UT) imaging system and a Zetec^{TM} MIZ 18 ET system. The capabilities of the Intraspect/98^{TM} have been evaluated in detail with respect to SRS applications (9). The NDE data acquisition system is supplemented by high–resolution in–tank REES^{TM} cameras. In all, the complement of in–tank inspection equipment consists of one UT/ET robot, one calibration mast, and three tools each containing one camera and two lights. Photographs of the key inspection tools are shown in Figures 2–5.

PROGRAM OVERSIGHT AND IMPLEMENTATION

A number of reviews were conducted at different times during the development of the inspection system, to guide its development and implementation as well as to gain assurance that both the system and the reactor facility were ready for the safe and effective deployment of the inspection equipment.

During the development period a Design Review Team was formed to ensure conformance of the inspection system design to the requirements and characteristics of the reactor facilities. The Design Review Team met at frequent intervals and was composed of representatives of EES, Reactor Engineering, and Reactor Operations–Component Handling. Also during this period an NDE Oversight Committee was formed to provide an independent outside review of the Reactor Tank Inspection Program (RTIP) hardware, software, robotic system, NDE techniques, etc. The NDE Oversight Committee was chaired by Dr. Gary J. Dau, EPRI, and included five other members as indicated in Appendix A. The committee met several times, and its final report was issued on March 1, 1989 (10).

In early 1989 as the development effort was drawing to a close, a Reactor Tank Inspection Implementation Team was formed to coordinate the plans and activities leading to the P tank inspection. This team met weekly until the inspection equipment was deployed. It included representatives of EES, Reactor Engineering, Reactor Operations, Reactor Operations–Component Handling, Engineering and Projects Division, Reactor Programs, and Outage Management. Daily reports of the Inspection Review Committee are reproduced in Appendix B.

A number of preservice/readiness reviews were conducted immediately prior to equipment deployment. A WSRC internal Preservice Review was conducted to review the capability of the inspection system to perform satisfactorily from a functional standpoint. The review included component/system functionality and reliability, systems integration, checkout and operational procedures, training for operation and maintenance, etc. The review was conducted in two stages. The first stage was accomplished by representatives of EES, Reactor Engineering, Reactor Operations, and Reactor QA. The second stage was conducted by two representatives of the Westinghouse Energy Center in Pittsburgh. Results from these efforts were documented in a final report (11). A separate readiness review was held with a DOE group led by U. Y. Park. The findings of all these reviews were favorable, permitting the inspection to begin.

QUALITY ASSURANCE PROGRAM

The Reactor Tank Inspection Program (RTIP) QA Plan (12) is applicable to both the development of NDE inspection equipment systems and the implementation of the NDE inspection program.

The QA Plan defines the responsibilities and procedural controls to be administered by the Program Management Team to assure that pre–established requirements (Functional Specification and NDE Methodology) are attained. This QA Plan is consistent with the SRS /SRL Quality Assurance Program requirements.

Procedures applicable to the implementation of the program are listed in the RTIP QA Plan and are supplemented by task–specific procedures, identified in Appendix C.

A Quality Improvement Plan (QIP) was also required by the RTIP procedures. The QIP was implemented with two postinspection reviews. In the first review, suggestions for improvements in all categories (equipment design and maintenance, safety, procedures, QA, etc.) were contributed by members of the EES and RTIP staffs. These suggestions were used as inputs to a second review, in which the number of affected organizations represented was enlarged to include Reactor Operations, Reactor Engineering, Reactor QA, Health

Protection, Reactor Maintenance/E&I, DOE and others. Action items resulting from these reviews have been prioritized and are currently being incorporated in preparation for the K-Reactor tank inspection scheduled for early 1990.

RTIP QUALIFICATIONS

The WSRC inspection team was supplemented by ten AmData subcontracted NDE specialists. Contracted personnel who executed the 100-P Reactor tank ultrasonic examination and analyzed the resulting data were chosen by EES to participate in the inspection on the basis of their high degree of experience in the detection and sizing of IGSCC in the commercial nuclear industry. All data analysts possessed current certifications from the EPRI NDE Center, which represents the industry standard for applications in piping. In addition, prior to the start of the P tank inspection, all contracted analysts and the EES RTIP UT Level III personnel were required to comply with the two basic elements of the RTIP UT qualification program:

- All WSRC and contracted UT personnel must be certified to a minimum of Level II in accordance with the applicable document which implements the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A. Certifications of contracted personnel were reviewed and accepted by a RTIP EES Level III prior to the start of the P inspection.
- WSRC and contracted UT personnel, the AmData Intraspect/98 Ultrasonic system, and the EES RTIP ultrasonic inspection procedure RTIP 008, Revision 1 (13) must successfully pass a performance demonstration developed and administered by the EPRI NDE Center.

Performance demonstrations utilized test plates fabricated from SA240-Tp304 stainless steel plate which represented the material used to fabricate the SRS reactor tanks. The plates were sensitized and had IGSCC artificially induced into them. The plates were then characterized by the EPRI NDE Center and subsequently used for administering the demonstrations. All demonstrations were proctored by EPRI personnel and certificates of achievement were issued by EPRI to personnel who successfully met program requirements. In addition, the formal qualification program developed by EPRI is on file for future use by the RTIP program.

The performance demonstration provided evidence of personnel and system proficiency in data collection as well as analysis. The following personnel successfully completed the EPRI performance demonstration:

<u>Personnel who met the requirements for UT Data Acquisition:</u>

B. D. Howard, EES RTIP UT Level III
J. D. Buchanan, Contracted UT Specialist (Jr.)
W. P. Gunnels, Contracted UT Specialist (Jr.)

<u>Personnel who met the requirements for IGSCC Detection (Data Analyst):</u>

B. D. Howard, EES RTIP UT Level III
M. A. McKaig, Contracted UT Level III
I. D. Hill, Contracted UT Specialist (Sr.)
C. L. Allen, Contracted UT Specialist (Sr.)
L. D. Kidd, Contracted UT Specialist (Sr.)
J. W. Sparrow, Contracted UT Specialist (Sr.)

Personnel who met the requirements for IGSCC Length Sizing (Data Analyst):

B. D. Howard, EES RTIP UT Level III
M. A. McKaig, Contracted UT Level III
I. D. Hill, Contracted UT Specialist (Sr.)
C. L. Allen, Contracted UT Specialist (Sr.)
L. D. Kidd, Contracted UT Specialist (Sr.)
J. W. Sparrow, Contracted UT Specialist (Sr.)

Personnel who met the requirements for IGSCC Depth Sizing (Data Analyst):

M. A. McKaig, Contracted UT Level III
I. D. Hill, Contracted UT Specialist (Sr.)
C. L. Allen, Contracted UT Specialist (Sr.)
L. D. Kidd, Contracted UT Specialist (Sr.)
J. W. Sparrow, Contracted UT Specialist (Sr.)

In addition to the UT qualifications, the ET personnel, system, and RTIP Procedure RTIP 009, Revision 0 (14), were subjected to a performance demonstration similar to that which was administered to the UT program.

The plates which were developed for the UT qualification program were used for the ET demonstrations. The ET capabilities were witnessed by EPRI personnel and attested to (certificates of achievement were not issued since EPRI does not formally qualify ET personnel). Also, a formal qualification was performed by the EES RTIP ET Level III with SRS Quality Assurance personnel in attendance per the requirements of RTIP 009, Revision 0, Attachment 1. These demonstrations are considered to meet ASME code requirements and provide qualification of the ET capabilities as follows:

- All WSRC and contracted ET personnel are certified to Level III in accordance with the applicable document which implements ASNT Recommended Practice No. SNT-TC-1A.
- Adequate capability to accurately locate the centerline of vertical and/or horizontal welds.
- Adequate capability to detect and size length of IGSCC.

Personnel who have met the requirements for ET qualification (Data Collection and IGSCC detection/analysis):

V. Cech, EES RTIP ET Level III
K. M. King, Contracted ET Level III

REACTOR TANK UT ACCEPTANCE CRITERIA

Prior to performing the first UT inspection of the SRS reactor tanks, acceptance criteria were required to disposition any indications that might be found. A working group was assembled to develop these criteria, and included WSRC consultants who are nationally recognized experts in the nuclear industry. The resulting acceptance criteria are contained in three documents, which are attached to a summary document, WSRC-RP-89-208 (5). These three documents contain the criteria, the technical basis for the criteria, and a sampling plan.

The acceptance criteria provide specific response requirements for indications that meet or exceed any of three standards. These standards are developed specifically for IGSCC, or more generally for planar indications that are open to the tank surface. The three size criteria and required responses are summarized as follows:

(1) An indication greater than or equal to 20 percent throughwall and 5 inches in length exceeds the reexamination standard. These indications are acceptable for continued operation but must be reexamined within 18 months.

(2) An indication greater than or equal to 20 percent throughwall and 10 inches in length exceeds the acceptance standard. These indications require additional analysis using specific configuration, location, and material property data to demonstrate acceptability for continued operation. If acceptable, they shall be reinspected at an interval to be determined by the analysis.

(3) An indication less than 20 percent throughwall and greater than 20 inches in length is also subject to additional analysis and/or supplemental examination. If found to be acceptable for continued operation, it shall be reinspected at an interval determined by the analysis.

(4) An indication which does not exceed any of the above standards is acceptable for continued operation. The ISI Plan for the SRS Reactor Process Water System requires reinspection of all areas every five years (1).

PERFORMANCE OF INSPECTION

The 1989 in-tank portion of the P-Reactor inspection was conducted during the months of September and October. A total elapsed time of 72 calendar days was consumed, counting time required for relocating fuel and components in the tank to create sufficient vacant positions to charge the inspection equipment for the first phase of the test, time to rearrange these components for the second phase of the test, and time to return all components to their original positions following test completion. The 72-day total also includes all noninspection time such as crew rest during weekends, equipment moves in the reactor tank, troubleshooting and equipment maintenance, obtaining and analyzing videotapes of the inspection region, and various other activities. The total time spent in setting up, rearranging, and returning the tank to normal, and in verifying proper initial moderator chemistry amounted to 40 days, leaving 32 days available for all other inspection-related activities. Of these, 20.5 days were required to perform the actual inspection, while 11.5 days were needed for maintenance, crew rest, etc., as described above. The dates corresponding to these activities are:

Begin preparations for fuel/component moves for Phase 1 Test	August 28
Inspection equipment inserted in tank, ready for inspection	September 15
Complete Phase 1 Inspection	October 2
Begin Phase 2 Inspection	October 15
Complete Phase 2 Inspection	October 30
Complete removal of inspection equipment from tank	October 30
Return P tank fuel/components to normal	November 7

The two inspection phases referred to above correspond to the two opposite 60° (approximate) regions of the P tank scheduled for inspection in 1989 as indicated in Figures 1-A and 1-B. These regions are also outlined on the reactor face map in Figure 6. The reactor tank was subdivided into 18 inspection sectors, each corresponding roughly to the extent of the tank circumference that can be reached by the robot from a single four-inch position. The six sectors selected for this inspection were:

Test Phase	Sector	Tank Coordinate of UT/ET Robot
1	3C	X13-Y69
1	3D	X19-Y75
1	3E	X25-Y81
2	1F	X43-Y27
2	2A	X37-Y21
2	2B	X31-Y15

The vertical inspection range of the UT/ET end effector in each robot position was adjusted in three discrete increments, or "windows" (upper, middle, and lower) to cover the entire accessible height of the tank. The locations of these windows are indicated by the horizontal dashed lines in Figures 1-A and 1-B.

A total of about 115 feet of reactor weld HAZ was inspected in this test (7). Due to overlap of the inspection area of the circumferential tank welds between sectors, the UT/ET probes actually examined a total of about 130 ft of weld HAZ (15).

REPORTING OF RESULTS

In accordance with the requirements of inspection procedure RTIP 002 (16), inspection results were reviewed by a WSRC Inspection Review Committee (IRC). The members of the IRC were:

Name	Organization
J. M. Morrison, Chairman	Reactor Programs
T. J. French	Equipment Engineering/RTIP
D. R. Ketcham	Reactor Engineering

Name	Organization
R. L. Boyleston	Reactor Operations
R. L. Malloy	Quality Assurance
E. J. Majzlik	Equipment Engineering/Materials

In addition, C. D. Cowfer, Reactor Engineering, served as ISI Counsel to the Committee.

The IRC was responsible for reviewing the UT/ET results and data packages, as presented by the appropriate Level III analysts, in accordance with the requirements of the approved flaw acceptance criteria (5). In so doing, the IRC was responsible for dispositioning the results, such as by acceptance or by deferral with request for additional inspection and analysis, and issuing a formal report following each committee meeting. The IRC was further responsible for reporting the results to WSRC and DOE management on a daily basis as the inspection progressed, for conduct of daily briefings on progress and status, and for preparation of this final summary report.

For purposes of data review and disposition, the IRC met a total of 23 times and generated 22 daily reports numbered 1 through 21 (including reports 8 and 8A). Copies of these reports are presented in Appendix B. The IRC reviewed a total of 17 UT data packages and 20 ET data packages, as follows:

Data Packages Reviewed by IRC

UT	ET
SRS-008-001	SRS-009-001
-002	-002
-003	-003
-004	-004
-005	-005
-006	-006
-007	-007
-008	-008
-009	-009
-010	-010
-011	-011
-011A	-012
-011B	-013
-012	-014
-012A	-015
-013	-015A
-014	-016
	-016A
	-017
	-018

Original copies of the above data packages have been archived in the permanent inspection records file (17).

INSPECTION RESULTS

The primary goal of this inspection was to determine if the inspection areas of the accessible P-Reactor tank weld HAZ indicate any signs of IGSCC. The examination results clearly showed no evidence of such degradation. A number of other indications which were determined to be from tank fabrication processes were found and were noted on the analysts' reports for reference during future inspections. Some examples of these are described below. In no case did any finding in the inspection impact the structural integrity of the reactor tank. All UT/ET data obtained during the examination were permanently recorded on magnetic tape and, together with selected videotape records, have been placed in archival storage for future reference (17). No Non-Conformance Reports (NCRs) were generated during this inspection. Specific inspection results of note are summarized below.

(1) Vertical welds:

The main tank vertical welds in P tank were located in Sectors 3E and 2B, consistent with their locations based on historical records from visual examinations prior to 1986. The upper and lower vertical welds are not continuous over the entire height of the main tank shell, but are offset about four inches at the mid-girth weld as indicated in Figure 1-A and 1-B. The bottom vertical weld is rotated clockwise from the top weld as viewed from the center of the tank.

(2) Weld repairs:

Evidence of fabrication weld repairs was found in a number of locations. The presence of these repairs was revealed as ultrasonic indications. One of the more significant of these was detected during UT scanning of weld P-H5 in Sector 3D (horizontal shop weld of tank bottom nozzle assembly to nozzle assembly extension; see Figure 1-A). The anomaly was indicated by UT to be up to about 16 inches in length, including a portion extending into Sector 3E. The anomaly was examined extensively by both UT and ET, supplemented by visual examination of the inside surface, with the observations that it was located within the weld zone, tracked the weld over its length, and showed no crack openings to the surface. Subsequent examination of the original fabrication radiographs for this region confirmed conclusively the presence of a weld repair with an irregular surface, which in turn caused its detection by the highly sensitive UT instrumentation. The radiographs also showed there are two other such repair areas in this weld, but these will not be encountered until future inspections. The weld repair does not present a concern within the scope of the acceptance criteria. More details of the analysis are presented in the attachment to IRC Report No. 8, Appendix B. It should be noted that many, perhaps 90 percent, of the fabrication radiographs for P-Reactor tank are no longer readable due to aging.

(3) Other fabrication anomalies:

Geometric reflectors and areas of heavy grinding during fabrication, none of which constituted a concern, were found in a number of weld areas. Several other fabrication anomalies were located. In three separate instances in weld P-H5, subsurface reflectors were detected. One of these was detected in Sector 1F on October 18. In the second case, the indication occurred in Sector 2B and was about 14 inches long. In the third case, a one-inch-long similar indication was detected in Sector 3D. UT and ET scans were made of these volumes, with the result that the indications were determined to be straight along the path of the weld, to have maximum "depth" less than 0.10 inches, and not to extend to either surface. These reflectors were concluded to represent fabrication anomalies of some type, possibly sidewall lack of fusion, and are within the acceptance criteria. No conclusive information could be obtained by examination of the radiographs. The findings of the Level III analysts are attached to IRC reports Number 8, Number 13, and Number 18 in Appendix B.

(4) Attachments:

Evidence of both present and former attachments to the tank was found during the inspection. Two of the six motion measurement brackets welded to the inside top of the 0.5-inch main tank shell immediately below the 3/16-inch expansion ring were encountered. The motion measurement brackets were installed during tank fabrication to aid in measuring relative motion between the tank and the plenum and top shield. Three of the motion measurement detectors were for vertical motion and three were for horizontal motion. The system is no longer in use; the instrumentation in the one-inch reactor thimble positions has been removed, but the brackets welded to the tank remain. The first bracket was observed in Sector 3E, and the second in Sector 2A. The brackets could be examined only visually and no evidence of cracking adjacent to the attachment fillet welds was apparent.

Other evidence was found throughout the test of areas where attachments had been formerly welded to the tank and subsequently removed by cutting and/or grinding during fabrication. These were numerous, not confined to any one location, and occurred on both the inside and outside surfaces. On the O.D. it was not possible to tell conclusively if the item was still there or removed. These attachments probably included lifting lugs and alignment pins used during fabrication and construction, thermocouple pads for tank temperature measurement, etc. None of these areas of current or former attachments showed any indication of crack openings to the surface or depth into the tank wall.

Specific instances of such findings are contained in the archival data (17).

REFERENCES

(1) DPSTM-88-100-1, "ISI Plan for the Savannah River Production Reactors Process Water System," December 1988.

(2) OPS-RRP-890008, J. L. Gallagher, WSRC, letter to J. R. Patterson, DOE, "System Integrity Status and Recommendation on Ultrasonic Testing for K, L, and P Reactors," May 25, 1989.

(3) TAI-2300, "Ultrasonic Inspection of Reactor Tank Welds," WSRC-OX-89-9-001, July 12, 1989.

(4) SP-2453, "Ultrasonic Inspection of Reactor Tank - P Area," TA WSRC-OX-9-001, August 25, 1989.

(5) WSRC-RP-89-208, "Reactor Tank UT Acceptance Criteria," May 1989.

(6) Savannah River Laboratory, Technical Division, Equipment Engineering, Reactor Tank Inspection Program, "NDE Methodology," Rev. 3, Effective Date July 31, 1989.

(7) RP-SI-89-11, J. M. Morrison, memorandum to A. F. McFarlane, "Fraction of Tank Welds Inspected by UT," October 3, 1989.

(8) EED 870463, "Functional Specification for Ultrasonic Survey Capability of Savannah River Reactors P, L, and K," September 1986; Rev. 1, March 1987; Rev. 2, July 1987, Rev. 3, November 1988.

(9) IR-AMD-011, "Automated Detection and Sizing of Intergranular Stress Corrosion Cracking with the AmData Intraspect/98," January 1989.

(10) "Review of the Savannah River Plant Reactor Tank Inspection System," SRL-Du Pont NDE Oversite Committee, March 1, 1989.

(11) SRL-MAT-890089, E. J. Majzlik, memorandum to P. S. Hebert, "Reactor Tank Inspection Program, Preservice Review-Final Report," August 25, 1989.

(12) EED 880364, "QA Plan-Reactor Tank Inspection Program," Effective Date May 27, 1988.

(13) Procedure RTIP-008, "Automated Ultrasonic Inspection of SRS Reactor Tanks," September 8, 1989.

(14) Procedure RTIP-009, "Automated Eddy Current Examination," September 8, 1989.

(15) RP-SI-89-13, J. M. Morrison, memorandum to J. L. Gallagher, "Reactor Tank Weld Scanning Speed," October 31, 1989.

(16) Procedure RTIP-002, "Data Communication - Phase II", September 8, 1989.

(17) DPSOL 324-2-2005, EES Procedure, "EED Records," Rev. 2, July 14, 1988.

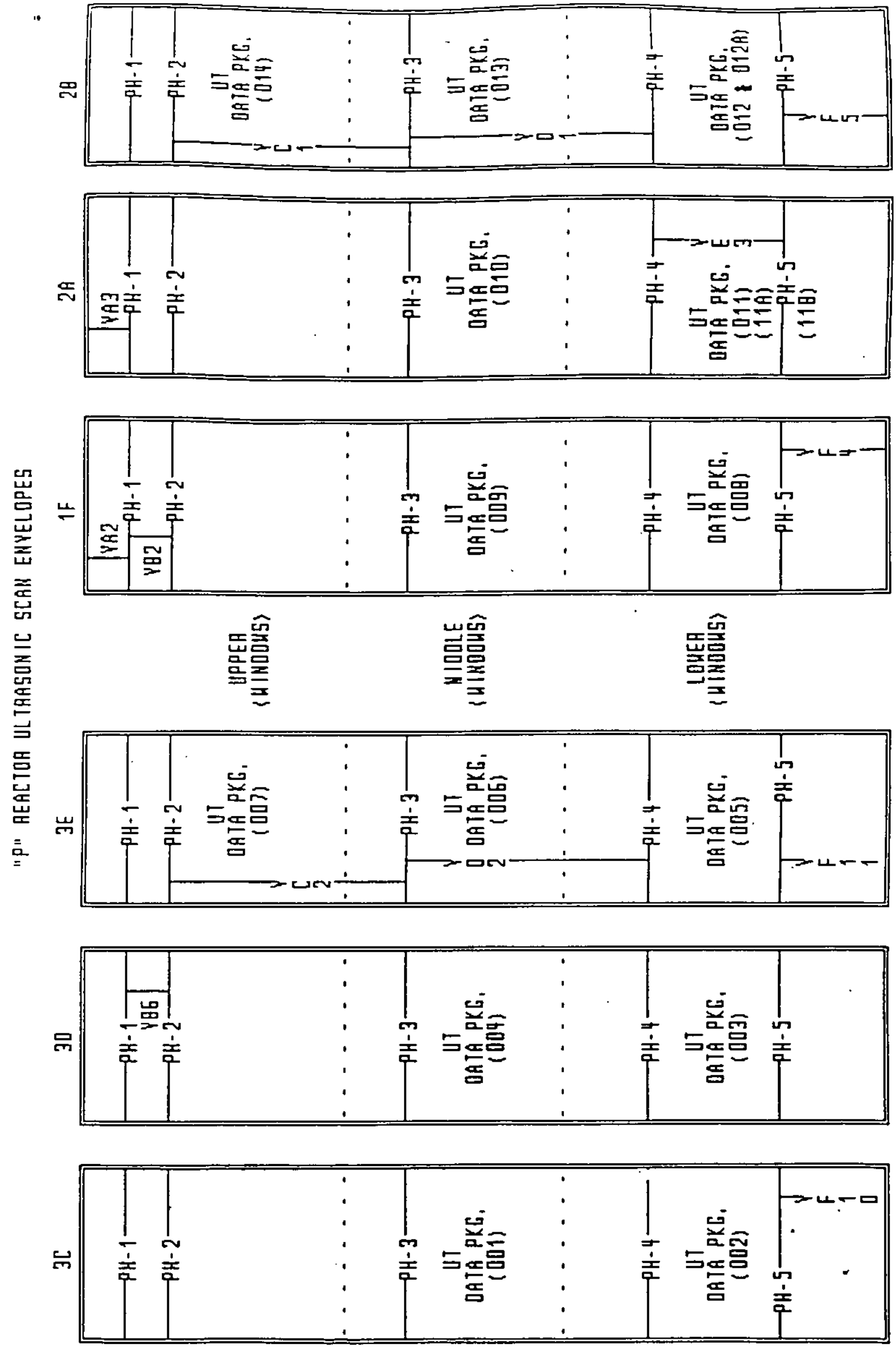


FIGURE 1-A. P-Reactor Ultrasonic Scan Envelopes

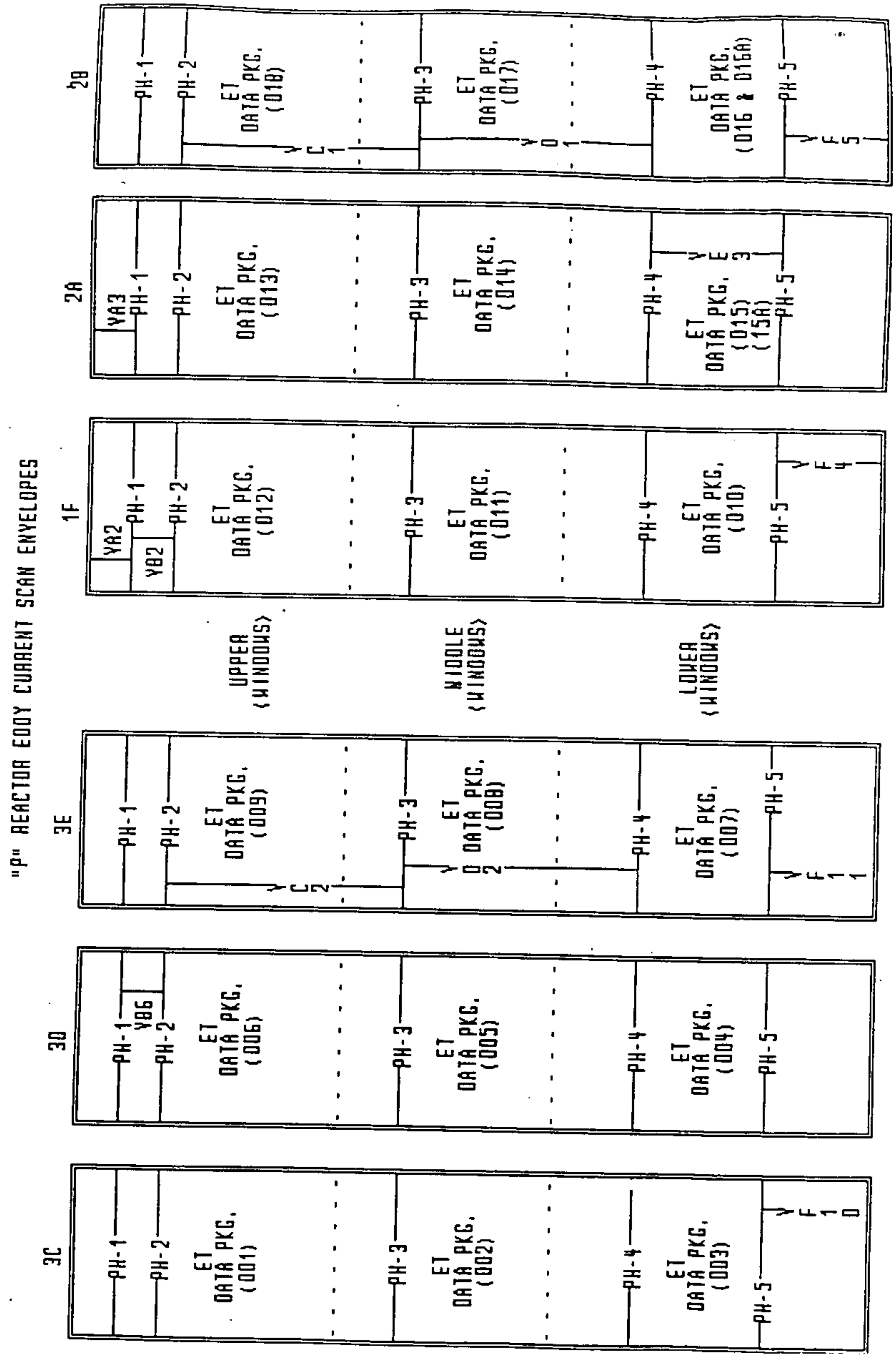


FIGURE 1–B. P–Reactor Eddy Current Scan Envelopes

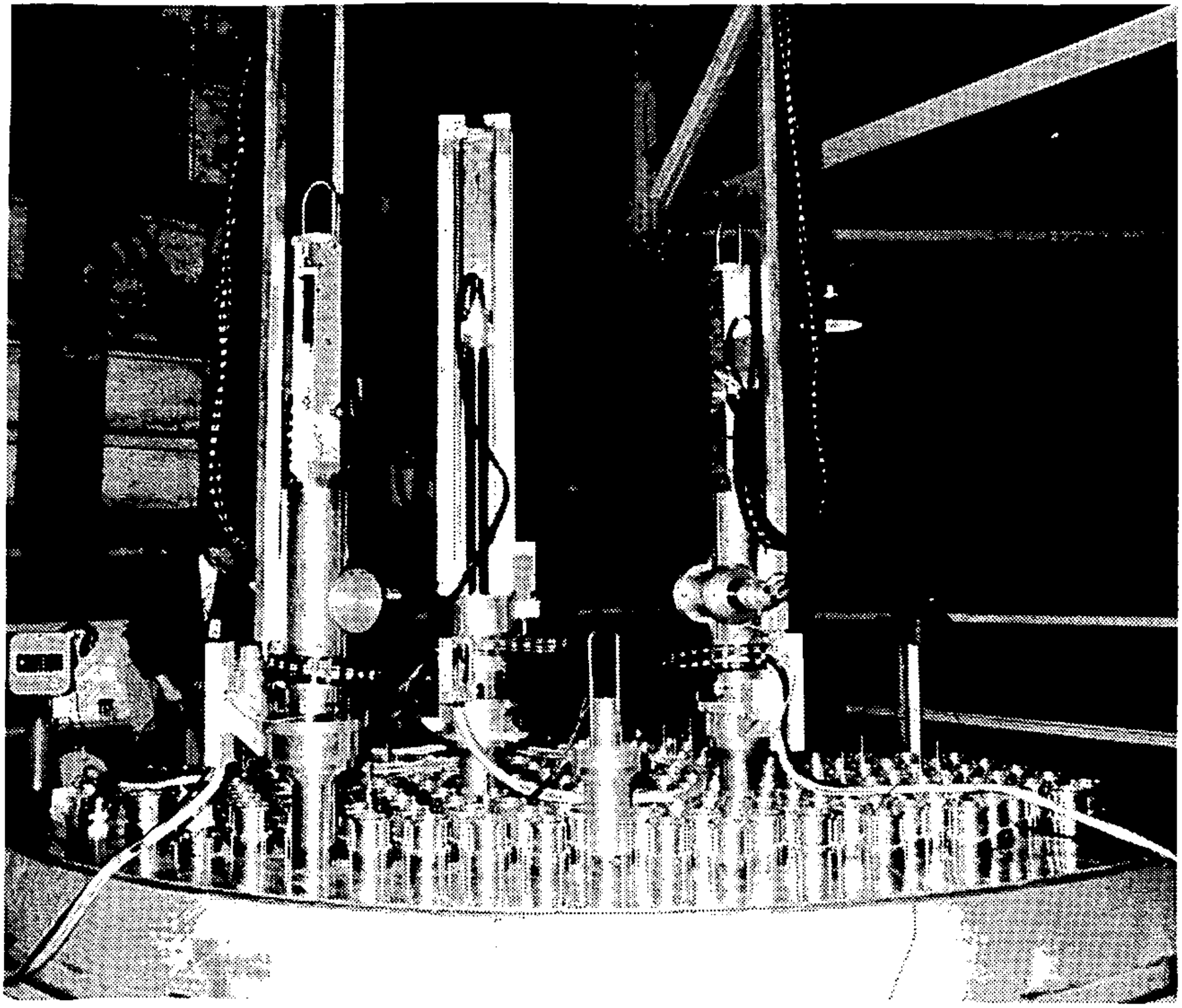


FIGURE 2
Top View of Inspection Tools Inserted in 305-A Mockup Facility

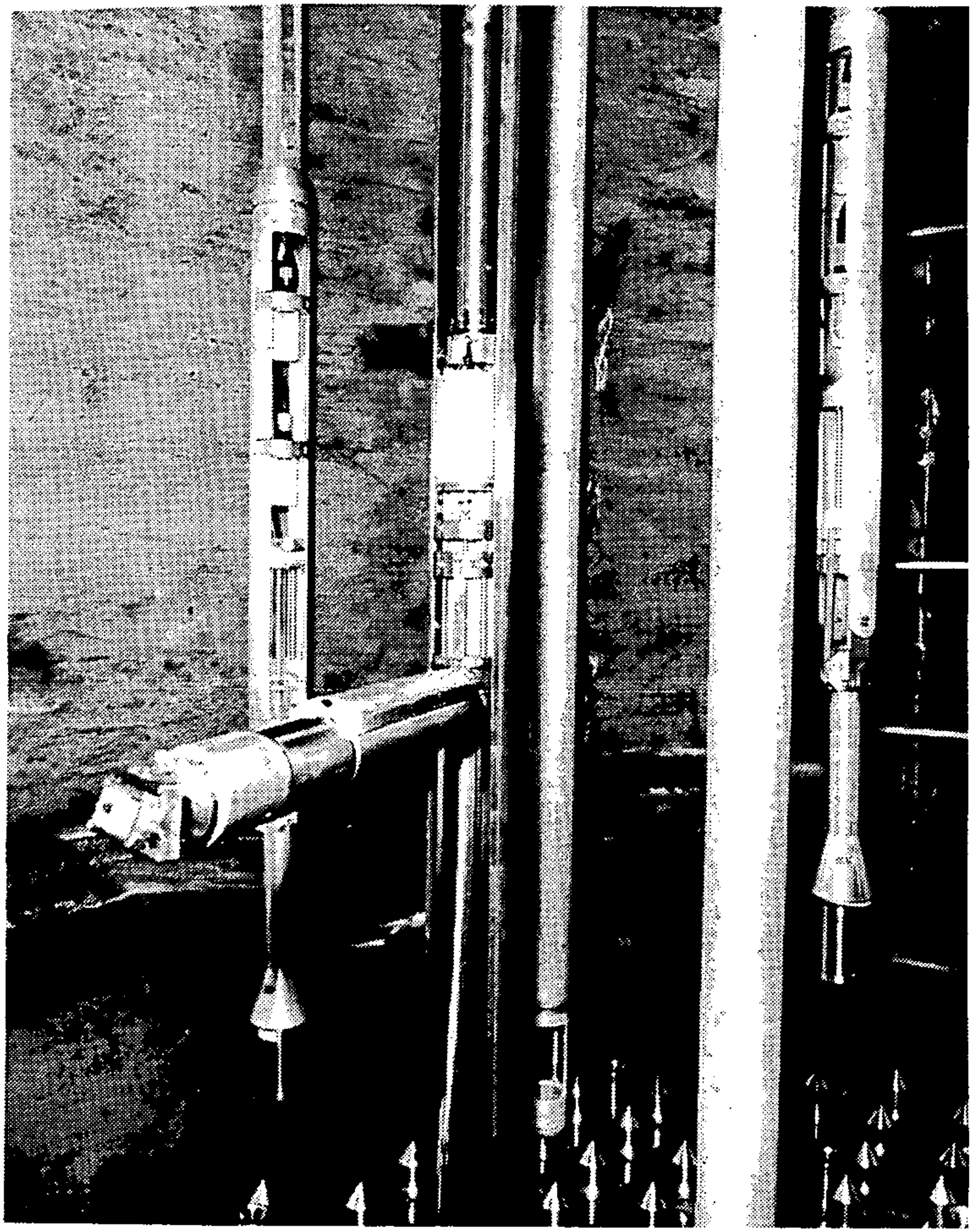


FIGURE 3
In-Tank (Mockup) View of Inspection Tool Configuration
(L-R) Camera, Robot, Two Simulated USHs, and Camera

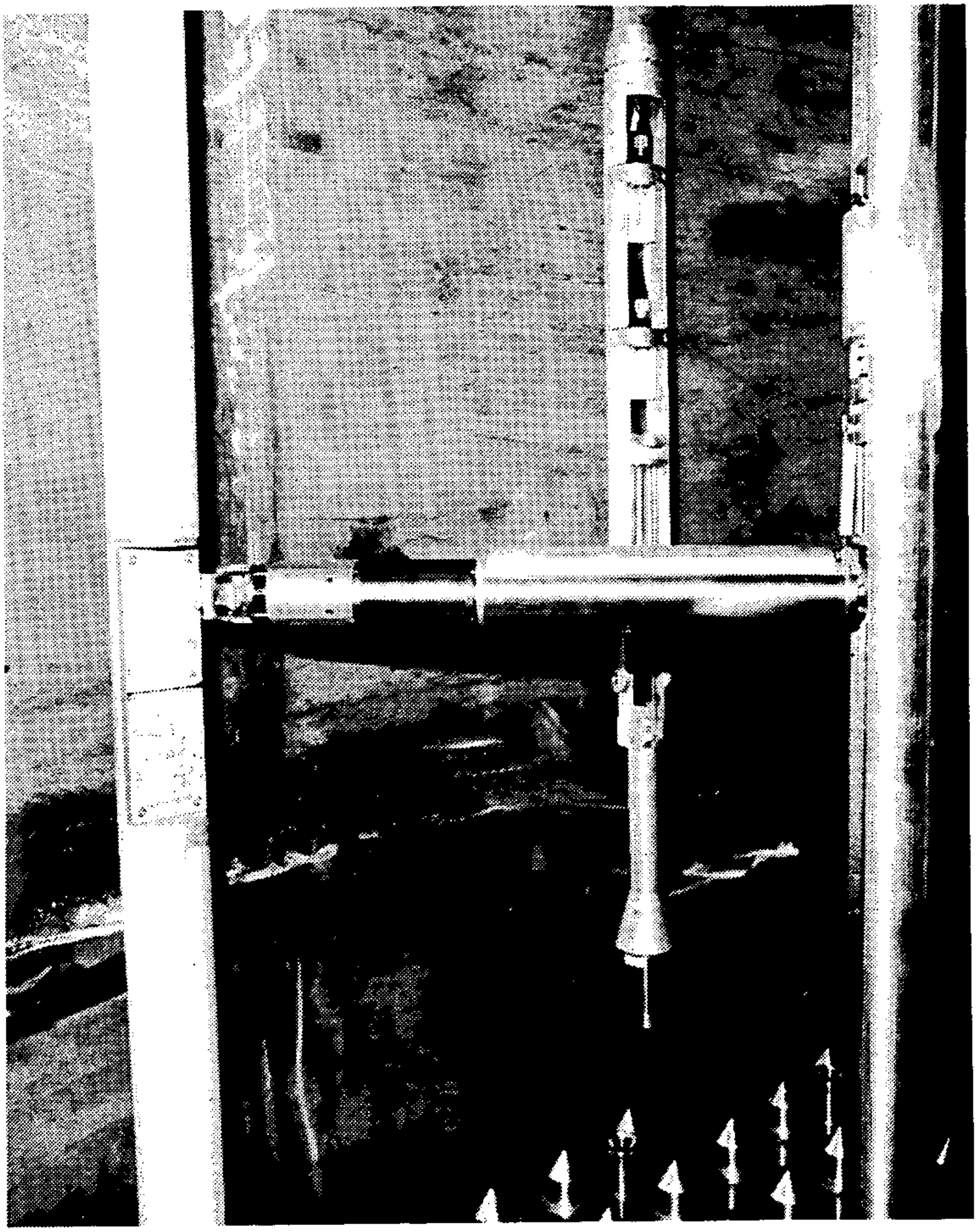


FIGURE 4
View of Robot End Effector with UT/ET Transducers,
Preparing to Contact Calibration Plate

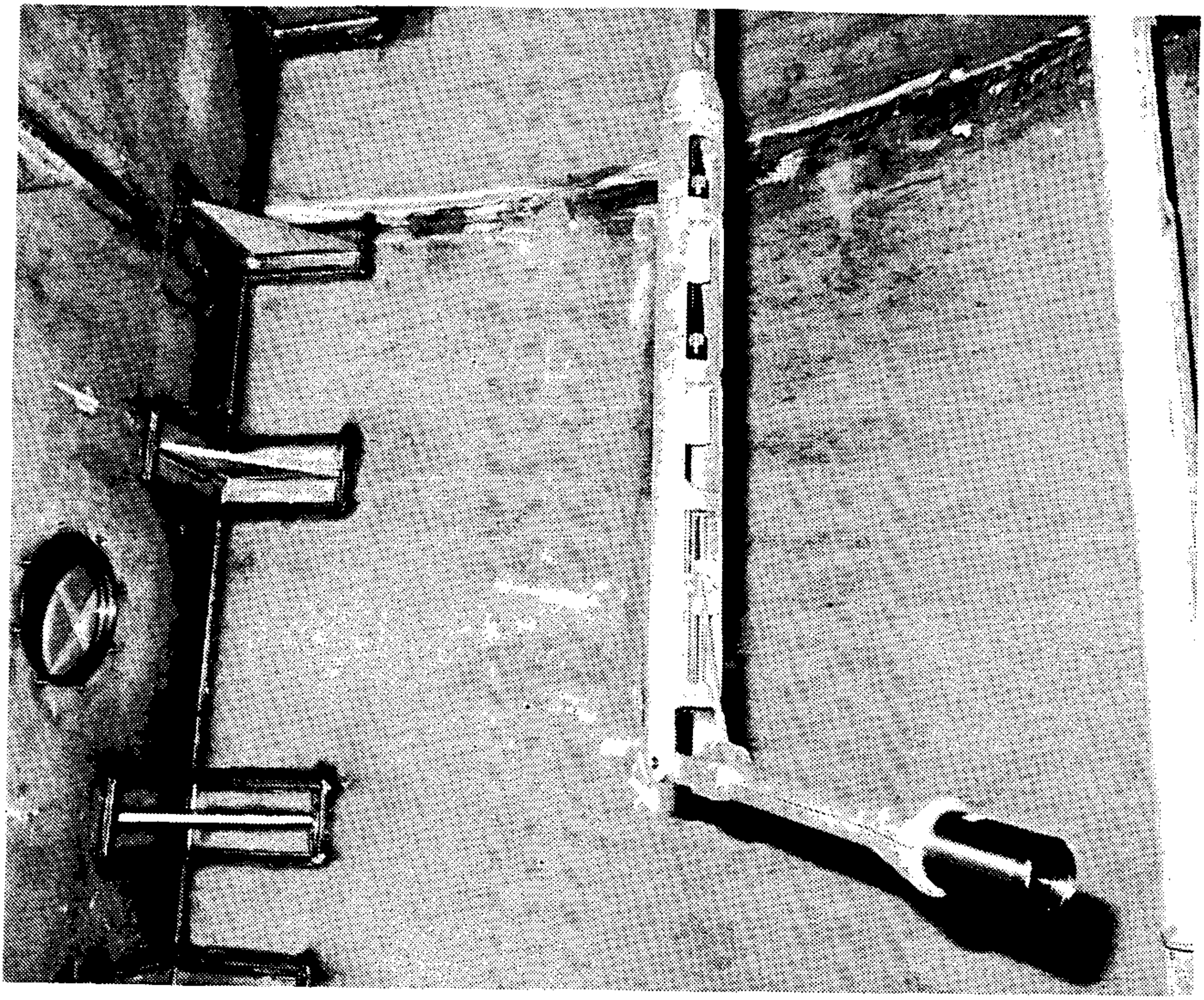
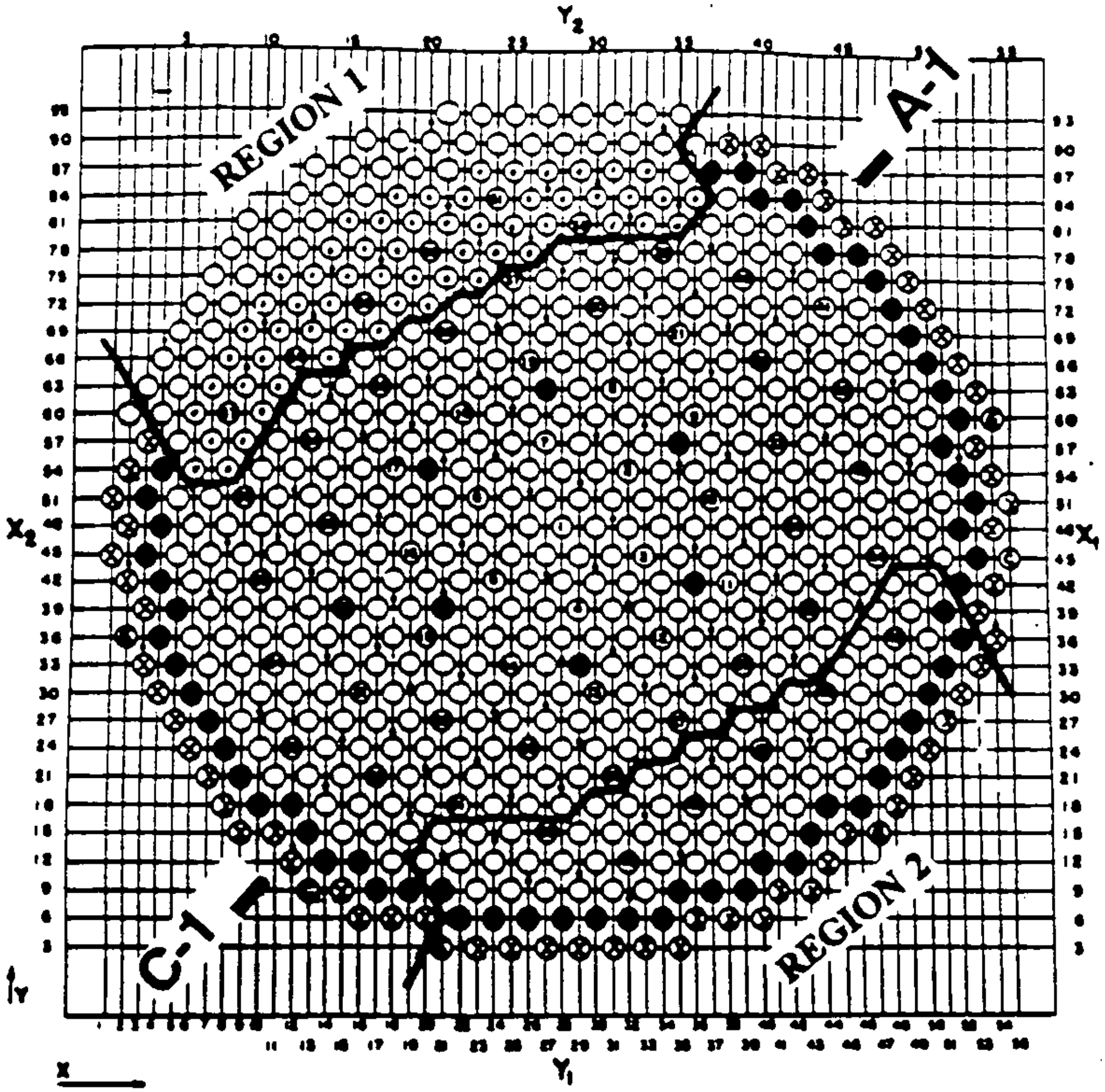


FIGURE 5
View of In-Tank Camera with Arm in Position
to View Mockup Tank Wall



Ⓒ CHR (3)
Ⓖ Gasport (6)
● Mark 60B's
⊗ Relocated Mark 22's
㉛ Septifoil (61)
⊙ Vacated Mark 22 Positions

FIGURE 6. Assembly Component Configurations for P-Area Tank UI Inspection

Appendix A

SRL–Du Pont NDE Oversight Committee Membership

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Phone: 509/375–1871

Dr. R. B. Pond, Jr.
Principal Metallurgist
Baltimore Gas & Electric Company
FSRC
P. O. Box 1475
Baltimore, MD 21203
Phone: 301/787–5501

Appendix B

Copies of Inspection Review Committee Daily Reports

RTIF IRC Daily Report Report No.: 1

RTIF - 002 (Exhibit) Date: 9-18-89

Members In Attendance:

Chairman: J. K. Morrison / Name, Signature

EES/RTIP: T. J. French / Name, Signature

Rx. Eng.: D. R. Ketchum / Name, D. R. Ketchum Signature

Rx. Ops.: R.L. Bowleston / Name, R L Bowleston Signature

EES/MAT : E J. MAZZUK, Jr. / Name, E J Mazzuk Jr. Signature

QA. : R.L. Molloy / Name, R Molloy Signature

Inspection Reports Reviewed:

NONE

(REVIEW OF FIRST SHIFT PROGRESS)

Relevant Indication (Tank Location and Dimensions):

Classification of Indication:

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report
RTIP - 002 [Exhibit 1]

Report No.: 2
Date: 9-19-89

Members In Attendance:

Chairman: James M. Morrison / J.M. Morrison
Name / Signature

EES/RTIP: T.J. FRENCH / T.J. French
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R.L. Boyleston / R.L. Boyleston
Name / Signature

EES/MAT : E.J. Mazzuk / E.J. Mazzuk, Jr.
Name / Signature

QA. : R.L. MALLOY / R.L. Malloy
Name / Signature

Inspection Reports Reviewed: SRS-008-001
WELD PH-3 FROM S = 348.8 TO 392.8

Relevant Indication [Tank Location and Dimensions]:
NO REPORTABLE INDICATIONS. INDICATIONS OF GEOMETRIC REFLECTORS REMAINING FROM ORIGINAL FABRICATION WERE FOUND.

Classification of Indication:
NA

NCR's Generated: (Yes [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report Report No.: 3

RTIP - 002 [Exhibit 1] Date: 9-20-89

Members In Attendance:

Chairman: James M. Morrison / JMMorrison
Name / Signature

EES/RTIP: TJFRENCH /
Name / Signature

Rx. Eng.: D.R. Ketcham / D.R. Ketcham
Name / Signature

Rx. Ops.: R.L. Boylston /
Name / Signature

EES/MAT : E.J. MAIZUK Jr. /
Name / Signature

QA. : R.L. MALLOY / RMalloy
Name / Signature

Inspection Reports Reviewed:

None, Analysis not complete.

Relevant Indication (Tank Location and Dimensions):

N/A.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments: Scans completed on welds P-H4, P-H5, and P-VF10 in Section 3C-lower. Analysis in progress.

RTIP IRC Daily Report

RTIP - 002 (Exhibit 1)

Report No.: 4

Date: SRS-008-002 and SRS-009-001

9/21/89 JMM

Members In Attendance:

Chairman: J. M. Morrison, JMMorrison
Name, Signature

EES/RTIP: T. J. FRENCH, T.J. French
Name, Signature

Rx. Eng.: D. R. Ketchem, D.R. Ketchem
Name, Signature

Rx. Ops.: R.L. Boyleston, RL Boyleston
Name, Signature

EES/MAT : J D SCARBROUGH, JD Scarbrough
Name, Signature

QA. : R. L. MALLOY, R L Malloy
Name, Signature

Inspection Reports Reviewed: SRS-008-002 for welds P-H4, P-H5 (348.8" to 396.1"/395.7") and P-VF10 from 159.2" to 172"; SRS-009-001 for welds P-H1 and P-H2 (349.5" to 394.5").

Relevant Indication (Tank Location and Dimensions):
No reportable indications. Indications of geometric reflectors remaining from original fabrication were found. An indication (also visual) was found of a temporary attachment weld on the inside of the expansion ring between welds P-H1 and P-H2.

Classification of Indication:

N/A.

NCR's Generated: (Yes [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report

RTIP - 002 [Exhibit 1]

Report No.: 5

Date: 9-25-89

Members In Attendance:

Chairman: J.M. Morrison (Name), James M. Morrison (Signature)

EES/RTIP: M.W. Loibl for French (Name), Marc W. Loibl (Signature)

Rx. Eng.: D.R. Ketcham (Name), D.R. Ketcham (Signature)

Rx. Ops.: R.L. Boyleston (Name), R.L. Boyleston (Signature)

EES/MAT : E.J. MAJZLIK (Name), E J Majzlik Jr (Signature)

QA. : R.L. MALLOY (Name), R Malloy (Signature)

Inspection Reports Reviewed:

None, Work suspended 9/22/89 due to cable failure in Robot #1 following discharge in anticipation of hurricane. Robot #2 charged 9/24/89 and inspection has been resumed.

Relevant Indication [Tank Location and Dimensions]:

N/A.

Classification of Indication:

N/A

NCR's Generated: Yes [✓ No]

NCR Nos.:

Comments:

RTIP IRC Daily Report — **Report No.:** 6

RTIP - 002 [Exhibit 1] — **Date:** 9-26-89

Members In Attendance:

Chairman: J. M. Morrison / J.M. Morrison
Name / Signature

EES/RTIP: T.J. FRENCH / T.J. French
Name / Signature

Rx. Eng.: D·R· Ketcham / D·R·Ketcham
Name / Signature

Rx. Ops.: R.L. BOYLESTON / R.L. Boyleston
Name / Signature

EES/MAT : E.J. MAJZLIK, Jr. / E.J. Majzlik, Jr.
Name / Signature

QA. : R.L. MALLOY / R.L. Malloy
Name / Signature

Inspection Reports Reviewed: NONE.
SECTOR 3D INSPECTION COMPLETE. PRELIMARY ANALYSIS WAS DISCUSSED FINAL ANALYSIS TO BE COMPLETE TOMORROW

Relevant Indication [Tank Location and Dimensions]:

N/A.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report

RTIP - 002 [Exhibit 1]

Report No.: 7

Date: 9-27-89

Members In Attendance:

Chairman: J.M. Morrison / J.M. Morrison
Name / Signature

EES/RTIP: M.W. Loibl for French / M.W. Loibl
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R.L. Boyleston / R.L. Boyleston
Name / Signature

EES/MAT : E.J. Marzluk Jr. / E.J. Marzluk
Name / Signature

QA. : R.L. Malloy / R.L. Malloy
Name / Signature

Inspection Reports Reviewed: None, Data analysis still in progress from sector 3D.

Relevant Indication [Tank Location and Dimensions]:

N/A.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report **Report No.:** 8

RTIP - 002 (Exhibit 1) **Date:** 9-27-89 (5:00 p.m.)

Members In Attendance:

Chairman: J.M. Morrison / J M Morrison
Name / Signature

EES/RTIP: T.J. French / TJ French
Name / Signature

Rx. Eng.: D.R. Kitchen / D.R. Kitchen
Name / Signature

Rx. Ops.: RL Boyleston / RL Boylston
Name / Signature

EES/MAT : E J. MAZZLIK Jr / EJ Mazzlik Jr
Name / Signature

QA. : R.L. MALLOY / R Malloy
Name / Signature

Inspection Reports Reviewed:

SRS-008-003
WELDS PH-4 & PH-5 SECTOR 3-D
AREA OF WELD REPAIR DETECTED EXTENDING INTO AREA 3E - SEE ATTACHMENT 1

Relevant Indication (Tank Location and Dimensions):

Classification of Indication:

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments: ORIGINAL RADIOGRAPHS WERE REVIEWED TO CLOSE ISSUE.

SAVANNAH RIVER LABORATORY
Equipment Engineering Section
Reactor Tank Inspection Program
(IRC Report No. 8)

September 27, 1989

Subj: ANALYSIS OF WELD P-H5, SECTOR 3D
IRC Report No. 8
(Attachment No. 1)

1. Purpose:

1.1. This attachment will document the steps taken to investigate and evaluate the ultrasonically detected indication in weld PH5, Sector 3D/3E, Bottom Envelope.

2. Background:

2.1. On September 25, 1989, during the data analysis of weld P-H5 (3D-Bottom envelope), a series of ultrasonic (UT) reflectors were identified which warranted further investigation as to their extent and origin.

2.2. The investigation of these reflectors utilized the capabilities of the RTIP Ultrasonic I/98 system, Eddy Current (ET) system, in-tank camera/video system, and information obtained from a review of the radiographs produced during the original tank fabrication.

3. Investigation:

3.1. Ultrasonic (UT) Information

3.1.1. The UT reflectors in question are identified by data package number SRS-008-003, scan form "Set EC3", from coordinate S=411.7 to S=420.8 (S=420.8 being a vertical line which defines the horizontal limit of the sector 3D).

3.1.2. The series of reflectors appeared to be linear in nature and intermittent. Their orientation appeared to be parallel to the weld and located at the "toe" of the weld. Although the reflectors imaged as intermittent, the spacing between reflectors was not sufficient to enable any one reflector to be considered individually. Therefore, the series of reflectors were considered as a single reflector.

3.1.3. The reflectors extended beyond the limits of the 3D sector into the adjacent sector, 3E.

3.1.4. In addition to the series of reflectors noted above, a singular, linear indication approximately one inch in length was noted which was located within the weld at the fusion line between the weld and the base material. This indication was believed to be the remains of a weld flaw which may have been the cause for a weld repair to have been performed in this area.

3.1.5. Although the UT information from the reflectors did not conclusively indicate the presence of IGSCC indications, there was neither conclusive evidence that IGSCC indications were not present. Therefore, the decision was made to obtain further information which would allow a complete characterization of the reflectors to be made including the acquisition of NDE data from the adjacent sector (3E) prior to final data analysis.

3.2. Eddy (ET) Current Information

3.2.1. The robotic tool was returned to the bottom envelope of sector 3D in order to perform an automated ET scan of the area in question. This scan showed that:

3.2.1.1. The centerline of the weld had been mislocated by approximately 0.150". This was due to the fact that the original centerline had been located by the "manual" mode of the ET system. This mode is slightly less accurate than the automated mode.

3.2.1.2. The ET signal indicated a pronounced lift-off effect which can be typical of a rough surface profile.

3.2.1.3. The ET information showed that there were no indications present which were open to the inside surface (a pre-requisite for IGSCC indications).

3.2.2. Although the ET data indicated that the reflectors in question did not originate from an IGSCC type of flaw, final analysis was withheld until the data from sector 3E could be obtained and reviewed. The ET information is represented by data package SRS-009-004.

3.3. Additional Data - Sector 3E

3.3.1. The robotic tool was placed into the adjacent sector

3E-bottom envelope. UT data was taken on weld P-H5 (data package SRS-008-005, scan form "Set EA4/EC4") from coordinate S=420.9 to S=444.9. Automated ET scans were also performed in this area (data package SRS-009-007). This additional information showed no evidence that IGSCC indications were present.

3.3.2. Visual inspections which utilized the in-tank, high resolution Rees cameras were performed of the area in question in order to examine the surface condition of the weld in an attempt to determine the cause of the ET lift-off signals. The video scans covered the entire length of the questioned area and video tapes were made which will be archived as records. The visual scans revealed evidence of a weld deposit which is located at the upper edge of the weld P-H5. This weld deposit appears to have been ground flat but was not blended into the surrounding metal. As a result, distinct edges can be seen which will typically result in UT reflectors.

3.4. Review of Radiographs

3.4.1. A review of the original New York Shipbuilding Corporation drawings was performed to determine the identification of the weld designated to be P-H5. Drawing 5-5 generically identified this weld as **TBNA-EX**.

3.4.2. Further review of the original fabrication records identified P-tank as unit "3". A search of the records showed the radiographic film for weld TBNA-EX3 to be in storage in the Atlanta repository.

3.4.3. Since "as-built" records, which would provide traceability of the individual film locations back to specific areas on the weld joint, were not available, a SRS Level III in radiography was requested to review the film in order to establish a) the quality of the RT's and to b) establish the traceability of the individual film to specific weld locations by comparison of the radiographs to the geometry of the tank and the geometry of weld PH5.

3.4.4. This review identified four areas of weld PH5 which showed evidence that a weld repair had been performed during the original fabrication. One of the repaired areas coincided with the area under investigation.

4. Conclusions:

4.1. The origin of the UT reflectors was attributed to geometric anomalies associated with a weld repair which was performed during the original fabrication of the tank. It is believed that the repair was performed to remove welding defects prior to the tank being placed into service. This conclusion is based on the following:

4.1.1. The UT data indicates that the reflectors are coincident with the weld and are located within the weld. Although they are located at the fusion zone of the weld, they follow the path of the weld and show no behaviorial evidence which would suggest the presence of IGSCC.

4.1.2. The ET data indicates that none of the reflectors breach the inside surface of the tank. This supports the evaluation that the reflectors do not originate from IGSCC indications. The ET data also suggests from the lift-off signals that the surface of the weld was not ground smooth.

4.1.3. The visual inspections show a surface configuration which is indicative of a weld repair area. A reworked area of weld is apparent which has an obviously rough surface. This is consistent with the ET data and accounts for the lift-off signals.

4.1.4. The review of the original radiographs showed that the RT's still retain a radiographic quality that allows more than adequate interpretability. Review of interval 22-23 and 23-24 of weld TBNA-EX3 indicates the presence of a weld repair area which is coincident with the area in question.

5. Evaluation:

5.1. The area of concern, which starts at S=411.2 and ends at S=427.5, is **not** indicative of the presence of IGSCC indications. It results from a weld repair which is outside the scope of the Reactor Tank Inspection Program and is, therefore, a nonrelevant indication due to its association with a weld repair.

5.2. The indications have been classified as nonreportable but have been noted as "remarks" in the data packages as baseline information for use in future inspections.

6. <u>Remarks:</u>

6.1. Athough the information obtained from the radiographic review was used to support the evaluation of the UT reflectors, it is stressed that the final evaluation of the reflectors was made prior to the results of the RT review being available.

6.2. While the indicated length of the area is 16.3 inches, the actual length is slightly shorter. This is due to the fact that the inspection system's programmed coordinate database for adjacent sectors does not necessarily coincide with each other. IE., S=420.8 is not necessarily a databased point common to both sectors 3D and 3E. Although it has been confirmed visually and by a review of the UT data that sufficient scanning overlap exists between sector 3D and 3E, the coordinates of the two bottom envelopes indicate that the scans do not meet by 0.100". This would indicate a length oversizing of two to three inches.

Boyd Howard
B. D. Howard
RTIP UT Level III

M A McKaig
M. A. McKaig
AmData UT Level III

V. Cech
RTIP ET Level III

K M King
K. M. King
AmData ET Level III

O. L. Gaston, Jr.
SRS RT Level III

M W Loibl
M. W. Loibl
RTIP Program Team Leader

SAVANNAH RIVER LABORATORY
Equipment Engineering Section
Reactor Tank Inspection Program
(IRC Report No. 8)

DISTRIBUTION:

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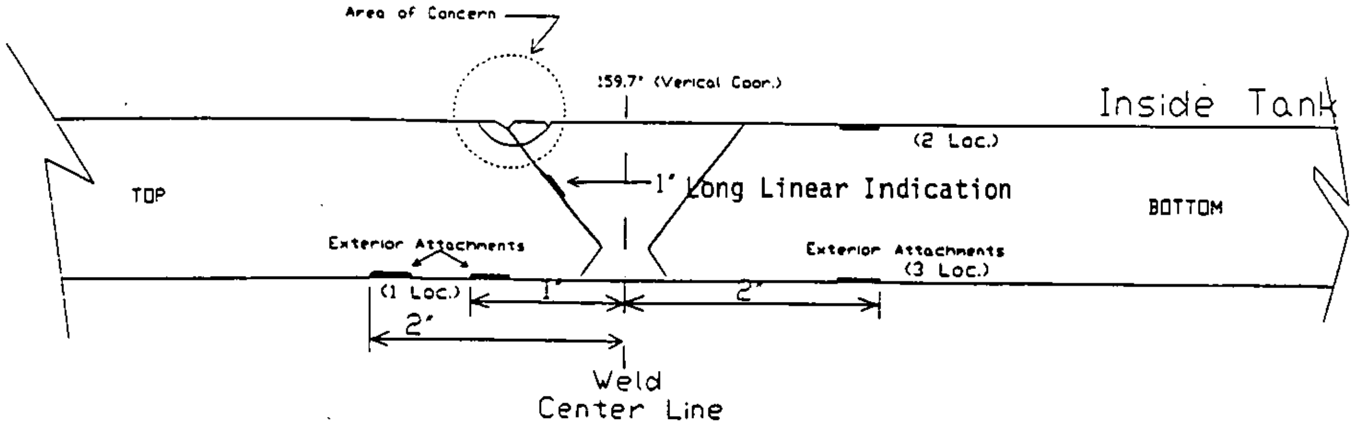
K. M. King, 305-1A
O. L. Gaston, 730-A
mwl
IRC Report 8 (original)



"P" Tank

Weld PH-5

RTIP IRC Daily Report
RTIP - 002 [Exhibit 1]

Report No.: 8A
Date: 9-27-89

Members In Attendance:

Chairman: J.M. Morrison / JM Morrison
Name / Signature

EES/RTIP: T. J. FRENCH / TJ French
Name / Signature

Rx. Eng.: D.R.Kitchen / D.R. Kitchen
Name / Signature

Rx. Ops.: D.W. MeldRUM / DW Meldrum
Name / Signature

EES/MAT : E.J. MAZLIK Jr / EJ Mazlik Jr
Name / Signature

QA. : R.L. MALLOY / R Malloy
Name / Signature

Inspection Reports Reviewed: SRS-008-004 & SRS-009-006 (THIS SET SCAN DATA FOR WELDS PH-1 AND PH-2)

Relevant Indication [Tank Location and Dimensions]:
NONE

Classification of Indication:

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments: REPORT 8 & 8A WERE SPLIT AT THE REQUEST OF ED MAJZLIK TO ENSURE THAT THE DATA ON IRC REPORT #8 WAS NOT CONFUSED WITH OTHER DATA SETS.

RTIP IRC Daily Report
RTIP - 002 [Exhibit 1]

Report No.: 9
Date: 9-28-89

Members In Attendance:

Chairman: J. M. Morrison / J M Morrison
Name / Signature

EES/RTIP: M.W. LOIBL for FRENCH / MW Loibl
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R.L. Boyleston / RL Boyleston
Name / Signature

EES/MAT : E.J. MAJZLIK Jr / EJ Majzlik Jr
Name / Signature

QA. : R.L. MALLOY / RL Malloy
Name / Signature

Inspection Reports Reviewed: None. Scans in progress in Sector 3E-lower.

Relevant Indication [Tank Location and Dimensions]:

N/A

Classification of Indication:

N/A

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report **Report No.:** 10

RTIP - 002 [Exhibit 1] **Date:** 9-29-89

Members In Attendance:

Chairman: J. M. Morrison / JM Morrison
Name / Signature

EES/RTIP: M.W. LOIBL for FRENCH / M Loibl
Name / Signature

Rx. Eng.: D.R. Ketchem / D.R. Ketchem
Name / Signature

Rx. Ops.: R.L. Boyleston / RL Boyleston
Name / Signature

EES/MAT : EJ MAJZLIK / EJ Majzlik
Name / Signature

QA. : R.L. MALLOY / RL Malloy
Name / Signature

Inspection Reports Reviewed: None. Analysis of data packages from Sector 3 E still in progress.

Relevant Indication [Tank Location and Dimensions]:

N/A

Classification of Indication:

N/A

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report

RTIP - 002 [Exhibit 1]

Report No.: 11

Date: 10-2-89

Members In Attendance:

Chairman:	J. M. Morrison **Name**	James M. Morrison **Signature**
EES/RTIP:	T. J. FRENCH **Name**	T.J. French **Signature**
Rx. Eng.:	D.R. Ketchen **Name**	D.R. Ketchen **Signature**
Rx. Ops.:	R.L. Boylston **Name**	R L Boylston **Signature**
EES/MAT :	E.J. MASZUK Jr **Name**	E J Maszuk Jr **Signature**
QA. :	R.L. MALLOY **Name**	R Malloy **Signature**

Inspection Reports Reviewed: SRS-009-007, -008, -009 (ET), and SRS-008-005, -006 (UT), for Sector 3E in P Reactor.

Relevant Indication [Tank Location and Dimensions]:

No reportable indications.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report Report No.: 12

RTIP - 002 [Exhibit 1] Date: 10-17-89

Members In Attendance:

Chairman: J. M. Morrison / James M. Morrison
Name / Signature

EES/RTIP: M.W. Loibl for T. French / M W Loibl
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R.L. Boylston / R.L. Boylston
Name / Signature

EES/MAT : E.J. Mazzuk Jr / E J Mazzuk Jr
Name / Signature

QA. : R.L. Malloy / R L Malloy
Name / Signature

Inspection Reports Reviewed: None. Data taking underway in Sector 1F.

Relevant Indication (Tank Location and Dimensions):

N/A.

Classification of Indication:

N/A.

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report
Report No.: 13
RTIP - 002 [Exhibit 1]
Date: 10-18-89

Members In Attendance:

Chairman: J.M. Morison / J M Morison
Name / Signature

EES/RTIP: M.W. CLIFFORD FOR T. FREMAN / M.W. Clifford
Name / Signature

Rx. Eng.: D.R. Ketcham / D. R. Ketcham
Name / Signature

Rx. Ops.: R.L. Boyleston /
Name / Signature

EES/MAT : E.J. MAIZLIK /
Name / Signature

QA. : R.L. MALLOY / R Malloy
Name / Signature

Inspection Reports Reviewed: SRS-008-008, SRS-008-009, and SRS-009-012, in Sector 1F.

Relevant Indication [Tank Location and Dimensions]:
No reportable indications. One anomaly was detected in weld P-H5, about 3 inches in length but not breaking either surface. Refer to UT data package SRS-008-008 for further characterization. Judged to be associated with original fabrication.

Classification of Indication:
N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

SAVANNAH RIVER LABORATORY
EQUIPMENT ENGINEERING SECTION
Reactor Tank Inspection Program
(IRC Report No. 13)

November 27. 1989
Page 1 of 3

SUBJECT: ANALYSIS OF WELD DISCONTINUITY IN SECTOR 1F, WELD P-H5
IRC Report No. 13
(Attachment No. 1)

1.0 Purpose:

1.1 This attachment will document the steps taken to investigate and evaluate the ultrasonically detected, linear indication in weld PH5, Sector 1F, Bottom Envelope.

2.0 Background:

2.1 On October 17, 1989 RTIP data analysts determined that a linear discontinuity was present and that further tests were necessary.

2.2 The linear discontinuity was more fully investigated by re-interrogating the area ultrasonically, performing an eddy current test, visually inspecting the area, and reviewing the original radiographic films.

3.0 Investigation:

3.1 Ultrasonic Testing Information

3.1.1 The linear indication in question is documented in UT data package numbers SRS-008-008, scan form SETEA6.

3.1.2 Due to the presence of the effluent nozzle muff bars the circumferential coordinates (S) of this particular scan begins at 75" and terminates at 90.1".

3.1.3 The linear indication in question begins at 75" and ends at 78", for a confirmed length of 3". The anomaly could extend to the left of the 75" coordinate; however, the indication was ultrasonically detectable from only the lower side of the weld (0º skew), thus no ultrasonic or eddy current tests were performed on the lower side of the weld to the left of the 75" coordinate due to the effluent nozzle's presence.

3.1.~~6~~4 The depth of the linear indication is approximately 0.3", as measured from the inside surface of the tank.

3.1.~~7~~5 The through-wall (planar) dimension of the weld anomaly appears to be significantly less than 0.10".

3.2 Eddy Current Testing Information

3.2.1 An automated, eddy current test was conducted in the area in which the linear indication was detected. The UT scan pattern was used for the eddy current scan, with the exception that ET data spacing increments were 0.05" apart instead of 0.10".

3.2.2 Eddy current testing results are documented in data package SRS-009-010.

3.2.3 No surface indications were detected in the area of interest.

3.3 Visual Inspection

3.3.1 The area of interest was closely examined using the in-tank, high-resolution REES cameras.

3.3.2 No visual indications were found in the area of interest.

3.2.3 The visual examination was documented on video tape.

3.4 Review of Radiographic Films

3.4 Review of Radiographic Films

3.4.1 The shop-fabricated weld was identified as TBNA-EX3, which means tank bottom nozzle assembly to extension.

3.4.2 Radiographs of the area of interest were evaluated. This includes the portion of the weld to the left of the 75" coordinate.

3.4.3 There had been some weld repair work in the area in which the linear indication was detected ultrasonically.

3.4.4 No radiographically unacceptable discontinuities are present in the area of interest or in that area to the left of the 75" coordinate.

4.0 Conclusions

4.1 The origin of the ultrasonic indication, which was located between circumferential coordinates 75" and 78", is considered to be a welding anomaly associated with a repair which was performed to remove a discontinuity in the original weld.

4.2 The area of concern does not have any characteristics of intergrannular stress corrosion cracking.

4.3 The presence of the 3" long, linear indication shall be noted on the appropriate UT/ET indication report sheets and shall be monitored in subsequent ultrasonic examinations.

Boyd Howard 11/27/89
B. D. Howard, RTIP UT Level III

11/27/89
V. Cech, RTIP ET Level III

Michael A. McKaig 11/28/89
M. A. McKaig, AMDATA UT Level III

MWLoibl 11/28/89
M. W. Loibl, RTIP Program Leader

RTIP IRC Daily Report
RTIP - 002 [Exhibit 1]

Report No.: 14
Date: 10-19-89

Members In Attendance:

Chairman: J. M. Morrison, Name / J M Morrison, Signature
EES/RTIP: M.W. Lobb for T. Ferrera, Name / Mike Lobb, Signature
Rx. Eng.: D.R. Ketcham, Name / D. R. Ketchum, Signature
Rx. Ops.: R.L. Boyleston, Name / Signature
EES/MAT : E.J. Maizuk, Name / Signature
QA. : R.L. Malloy, Name / R Malloy, Signature

Inspection Reports Reviewed: SRS-009-013, for upper window of Sector 2A.

Relevant Indication [Tank Location and Dimensions]: No reportable indications relevant to the Acceptance Criteria.

Classification of Indication:

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments: Located 3 vertical indications of weld deposits, about one inch apart, where former attachments may have been removed, similar to previous findings in the expansion ring.

RTIP IRC Daily Report

RTIP - 002 (Exhibit 1)

Report No.: 15

Date: 10-20-89

Members In Attendance:

Chairman: J. M. Morrison, J M Morrison
Name / Signature

EES/RTIP: Mu'Lusl For T. FRENCH, McTraff
Name / Signature

Rx. Eng.: D.R. Ketchom, D. R. Ketchum
Name / Signature

Rx. Ops.: R.L Boylston, R L Boylston
Name / Signature

EES/MAT : E.J. MAZZUK Jr, E J Mazzuk Jr
Name / Signature

QA. : R.L. MALLOY, R L Malloy
Name / Signature

Inspection Reports Reviewed: SRS-009-014, SRS-008-010 for middle window of Sector 2A.

Relevant Indication (Tank Location and Dimensions):

No reportable indications. No indications of present or former attachments to tank. This window contains only the mid-girth weld.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIF IRC Daily Report

RTIF - 002 (Exhibit 1)

Report No.: 16

Date: 10-23-89

Members In Attendance:

Chairman: J. M. Morrison / Signature
Name

EES/RTIF: M. W. Luisi for T. French / Signature
Name

Rx. Eng.: D.R. Ketchem / Signature
Name

Rx. Ops.: R.L. Boylston / Signature
Name

EES/MAT : E.J. MARZLUK Jr. / Signature
Name

OA. : R.L. MALLOY / Signature
Name

Inspection Reports Reviewed: None, due to robot failure.

Relevant Indication (Tank Location and Dimensions):

N/A.

Classification of Indication:

N/A.

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report
Report No.: 17

RTIP - 002 (Exhibit 1)
Date: 10-24-89

Members In Attendance:

Chairman: J. M. Morrison / J M Morrison
Name / Signature

EES/RTIP: M.W. LOIBL FOR T. FRENCH / M Loibl
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R.L. Boylston / R L Boylston
Name / Signature

EES/MAT : E.J. MAIZLIK / E J Maizlik Jr
Name / Signature

QA. : R.L. MALLOY / R Malloy
Name / Signature

Inspection Reports Reviewed: SRS-009-015, -015A (ET); SRS-008-011, -011A, and -011B (UT), covering lower window of Sector 2A.

Relevant Indication (Tank Location and Dimensions):

None, Several indications of attachments (former or current) on O.D. surface of tank bottom nozzle assembly extension, with no depth. Evidence of considerable grinding at junction of field circumferential weld and vertical weld in ring (P-VE3) during weld preparation.

Classification of Indication:

N/A.

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report
RTIP - 002 (Exhibit 1)

Report No.: 18
Date: 10-26-89

Members In Attendance:

Chairman: J. M. Morrison / JMMorrison
Name / Signature

EES/RTIP: M.W. Loibl for T. French / MWLoibl
Name / Signature

Rx. Eng.: D.R. Ketcham / D.R. Ketcham
Name / Signature

Rx. Ops.: R.L. Boyleston / RLBoylestn
Name / Signature

EES/MAT : /
Name / Signature

QA. : R.L. Malloy / RMalloy
Name / Signature

Inspection Reports Reviewed: UT reports SRS-008-12 and SRS-008-12A.

Relevant Indication (Tank Location and Dimensions): No relevant indications. Indications were found by UT of a fabrication anomaly in Weld P-H5, similar to what was found earlier (near System 2 nozzle) except longer. For consistency with the previous analysis, the IRC requested an ET scan before final disposition of this anomaly.

Classification of Indication:

N/A

NCR's Generated: (Yes/ [✓ No])

NCR Nos.:

Comments:

SAVANNAH RIVER LABORATORY
EQUIPMENT ENGINEERING SECTION
Reactor Tank Inspection Program
(IRC Report No. 18)

November 27, 1989
Page 1 of 3

SUBJECT: ANALYSIS OF WELD DISCONTINUITY IN SECTOR 2B, WELD P-H5
IRC Report No. 18
(Attachment No. 1)

1.0 Purpose:

1.1 This attachment will document the steps taken to investigate and evaluate the ultrasonically detected, linear indications in weld PH5, Sector 2B, Bottom Envelope.

2.0 Background:

2.1 On October 25, 1989 RTIP data analysts determined that two (2) colinear discontinuities were present and that further tests were necessary.

2.2 The linear discontinuities were more fully investigated by reinterrogating the area ultrasonically, performing an eddy current test, visually inspecting the area, and reviewing the original radiographic films.

3.0 Investigation:

3.1 Ultrasonic Testing Information

3.1.1 The linear indications in question are documented in UT data package number SRS-008-012 and SRS-008-012A, scan form SETEC10 and SETECI0.

3.1.2 The linear indication in question is in fact two (2) colinear indications. The two (2) colinear indications are separated by 3" of defect-free weld metal.

3.1.3 The circumferential coordinates of the two (2) colinear indications are 138.4" to 140.9" and 144.0" to 156.0", respectively.

3.1.4 Both indications are oriented parallel with the original weld and are totally contained within the volume of the original weld. They do not intersect with either the inside or the outside surface of the tank wall.

3.1.5 The indications were ultrasonically detected from the upper side of weld PH5 only (180° skew).

3.1.6 The depth of the linear indication is approximately 0.23", as measured from the inside surface of the tank.

3.1.7 The through-wall (planar) dimension of the weld anomaly appears to be significantly less than 0.10".

3.2 Eddy Current Testing Information

3.2.1 An automated, eddy current test was conducted in the area in which the linear indications were detected. The UT scan pattern was used for the eddy current scan, with the exception that ET data spacing increments were 0.05" apart instead of 0.10".

3.2.2 Eddy current testing results are documented in ET data package SRS-009-016A.

3.2.3 No surface indications were detected.

3.3 Visual Inspection

3.3.1 The area of interest was closely examined using the in-tank, high-resolution REES cameras.

3.3.2 No visual indications were found in the area of interest.

3.2.3 The visual examination was documented on video tape.

3.4 Review of Radiographic Films

3.4.1 The shop-fabricated weld was identified as TBNA-EX3, which means tank bottom nozzle assembly to extension.

3.4.2 Radiographs of the area of interest were evaluated.

3.4.3 There had been some weld repair work to the right of the area in which the two colinear indications were detected (S coordinate greater than 156"). There did not appear to be any radiographically unacceptable discontinuities in the original weld in the area of interest; however not all welding anomalies are radiographically detectable.

4.0 <u>Conclusions</u>

4.1 The origin of the ultrasonic indications, which are located between circumferential coordinates 138" and 156", are considered to be anomalies in the original weld that were not radiographically detectable and thus were not excavated.

4.2 The colinear indications do not have any characteristics of intergrannular stress corrosion cracking.

4.3 The two (2) colinear indications shall be noted on the appropriate UT/ET indication report sheets and shall be monitored in subsequent ultrasonic examinations.

Boyd Howard 11/28/89
B. D. Howard, RTIP UT Level III

11/28/89
V. Cech, RTIP ET Level III

Michael A. McKaig 11/28/89
M. A. McKaig, AMDATA UT Level III

MWLoibl 11/29/89
M. W. Loibl, RTIP Program Leader

RTIF IRC Daily Report

RTIF - 002 [Exhibit 1]

Report No.: 19

Date: 10-27-89

Members In Attendance:

Chairman: J. M. Morrison, Name / J M Morrison, Signature

EES/RTIP: M.W. LeGibe for T. Feagan, Name / Signature

Rx. Eng.: D.R. Ketchum, Name / D R. Ketchum, Signature

Rx. Opr.: R.L. Boyleston, Name / R L Boyleston, Signature

EES/MAT : E.J. MAZLIK Jr, Name / E J Mazlik Jr, Signature

QA. : R.L. MALLOY, Name / R L Malloy, Signature

Inspection Reports Reviewed: ET data packages SRS-009-016 and SRS-009-016A, for the lower window of Sector 2B.

Relevant Indication (Tank Location and Dimensions): Data package SRS-009-016A was reviewed to complete the evaluation of the UT indication discussed in yesterday's report. It was concluded that the indication represents a fabrication anomaly, possibly sidewall lack of fusion, not connected to either surface and similar to previous findings in weld P-H5. ET confirmed no opening to the inside surface. This finding is within the Acceptance Criteria for the test.

Classification of Indication: ~~[illegible]~~ JMM Fabrication anomaly. (For comparison, see Report #13, 10/18/89).

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments:

RTIP IRC Daily Report

Report No.: 20

RTIP - 002 [Exhibit 1]

Date: 10-28-89

Members In Attendance:

Chairman: J. M. Morrison / J M Morrison
Name / Signature

EES/RTIP: M.W. LOIBL FOR T FRENCH / M.W. Loibl
Name / Signature

Rx. Eng.: D.R. Ketchum / D.R. Ketchum
Name / Signature

Rx. Ops.: R I HORTON / R Horton
Name / Signature

EES/MAT : E.J. MAZZUK / E J Mazzuk
Name / Signature

QA. : R.L. MALLOY / R Malloy
Name / Signature

Inspection Reports Reviewed: Data packages SRS-008-013 and SRS-009-017, for middle window of Sector 2B.

Relevant Indication [Tank Location and Dimensions]: No reportable indications.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments: Areas noted of rough weld and heavy grinding in mid-girth weld at junctions of vertical welds, similar to observations in past visual exams (eg., in 1962).

RTIP IRC Daily Report
Report No.: 21

RTIP - 002 (Exhibit 1)
Date: 10-30-89

Members In Attendance:

Chairman: J. M. Morrison, J M Morrison
Name / Signature

EES/RTIP: M.W. Loibl for T. French,
Name / Signature

Rx. Eng.: D. R. Ketcham, D. R. Ketcham
Name / Signature

Rx. Ops.: R.L. Boykston, R L Boykstan
Name / Signature

EES/MAT: E.J. MAJZLIK Jr, E J Majzlik Jr
Name / Signature

QA.: R.L. MALLOY, R Malloy
Name / Signature

Inspection Reports Reviewed: SRS-008-014 (UT) and SRS-009-018 (ET), for upper window of Sector 2B.

Relevant Indication (Tank Location and Dimensions):

No reportable indications.

Classification of Indication:

N/A.

NCR's Generated: (Yes/[✓ No])

NCR Nos.:

Comments: Evidence of former attachments to I.D. of expansion ring in 2 locations. & Evidence of uneven weld width in upper vertical weld, particularly on O.D.

APPENDIX C

RTIP Procedures

PROCEDURE TITLE	PRO. NO.	STATUS	AUTHOR	DRAFT/DUE
FIELD INSPECTION	Rev. 0 RTIP 001	8/24/89 APPROVED	LOIBL	JUN 26,89
DATA COMMUNICATION	Rev. 0 RTIP 002	8/24/89 APPROVED	FRENCH	JUN 22,89
DOCUMENT CONTROL	Rev. 1 RTIP 003-1	8/24/89 APPROVED	BRAGAN	
RECORDS CONTROL	Rev. 1 RTIP 003-2	8/24/89 APPROVED	BRAGAN	
INSTS.,PROC.,& DWGS.	Rev. 1 RTIP 003-3	8/24/89 APPROVED	BRAGAN	
NDE CONTROL	RTIP 003-4	COMBINED RTIP 008	MCKAIG	MAY 19,89
MATERIAL CONTROL	Rev. 1 RTIP 003-5	8/24/89 APPROVED	BRAGAN	
TELE ZOOM LENS OP	Rev. 0 RTIP 004	10/17/89 APPROVED	TURNER	MAY 19,89
OVERHD. CR.& TOOL ERT	Rev. 0 RTIP 005	8/25/89 APPROVED	PAK	JUL 21,89
MOBILE CNTRL. TRA.	Rev. 0 RTIP 006	8/22/89 APPROVED	SAMBORSKY	JUN 27,89
CBL. HK-UP & CK-OUT	Rev. 0 RTIP 007	8/24/89 APPROVED	SAMBORSKY	JUN 26,89
ULTRASONIC EXAM.	Rev. 1 RTIP 008	8/24/89 APPROVED	HOWARD	MAY 19,89
EDDY CURRENT EXAM.	Rev. 0 RTIP 009	8/24/89 APPROVED	CECH	MAY 19,89
INSP. TOOL MAINT.	Rev. 0 RTIP 010	8/29/89 APPROVED	PAK	JUL 24,89
CAM & AUDVIS EQUIP OPER.	Rev. 0 RTIP 011	9/06/89 APPROVED	KILLIAN	JUL 24,89
TOOL PLACEMENT	Rev. 0 RTIP 012	9/06/89 APPROVED	PAK	JUL 21,89
AIR COMPRESSOR AND AIR STATION OPERATION	Rev. 0 RTIP 013	8/28/89 APPROVED	PATTERSON	
ROBOT OPERATION	Rev. 0 RTIP 014	8/28/89 APPROVED	PARKS	JUL 19,89
QUALITY IMPROVEMENT	Rev. 0 RTIP 015	9/13/89 APPROVED	KITCEY	SEPT 11,89
SOFTWARE UPDATE	Rev. 0 RTIP 016	11/30/89 APPROVED	PARKS	

STATUS 12/05/89 Bragan