COMMONWEALTH EDISON COMPANY

QUAD-CITIES STATION

UNIT 2

REACTOR WATER CLEAN-UP SYSTEM

TEMPORARY REPAIR OF

NON-ISOLABLE IGSCC

REVISED: MARCH 1, 1982

NRC DOCKET NO. 50-265

LICENSE NO. DPR-30

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I. INTRODUCTION

A. Description of the Problem

Unit 2 experienced a 15-week refueling outage which ended on December 26, 1981.

On January 2, 1982, a step increase of 0.5 gallons per minute was observed. This was attributed at the time to a possible valve packing leak. On January 15, 1982 the 2B Reactor Recirculation MG Set was tripped due to a problem with the exciter brushes. At that time the decision was made to rectify a low oil level alarm for the 2B Reactor Recirculation Pump motor that had previously annunciated, and to identify the existing drywell leakage As a result a drywell entry was made. While the Operating Engineer was in the drywell, he noticed that water was leaking from the insulation around the Reactor Water Clean-Up System suction piping. The unit was shut down.

B. NRC Discussions

Discussions over the telephone were held between the NRC and the station on numerous occasions between January 18, 1982 and January 23, 1982. Region III and/or NRR were involved in these conversations. On January 26, 1982, a meeting was held at Region III, to present the details of the repair program to the NRC. NRR personnel were also in attendance. Following additional phone conversations with the NRC, CECo received formal approval to proceed with the repair program on February 1, 1982. An action item list was transmitted to the station from Region III, giving

20 items which must be completed prior to proceeding with the repairs, and actions which must be taken following the repairs. The items required to be completed prior to starting the work were completed in a timely manner.

C. Schedule of Repairs - (Refer to Isometric Drawing on page 5 for location and nomenclature of weld identifications.)

Repair work commenced on February 3, 1982. The initial schedule called for installing the sleeve over weld F6; installing the weld pads over welds F12, S10, and S9; and installing the cone-shaped sleeve over weld F1A in that order. This work was expected to take at least three weeks to complete. A summary for the events comprising actual repair program is provided in Section VIII of this report.

II. INSPECTION AND FLAW CHARACTERIZATION

A. Inspection Results, Procedures, and Edison Review

Subsequent to the discovery of a leaking crack on the pipe side of weld joint S-14, a UT inspection program was initiated to examine two adjacent welds, S-15 and S-16 (see isometric drawing on page 5). As a result of discovering linear indication on these two welds, the program was expanded to inspect all butt welds in the RWCU line up to the outboard isolation valve.

Radiation levels were very high in this area (400 - 800 mR per hour). The UT examination was limited to discovery of flaws on the isolable side and required 17.9 Man-Rem, exposure to complete. However, the welds on the non-isolable side were examined thoroughly, sometimes by three different UT inspectors. Commonwealth Edison's three UT inspectors, including the Level III inspector, evaluated the results of contractor's work and where needed, personally examined some welds for verification of other inspectors' test results.

Based on these examinations, it was discovered that:

1. Eight out of eleven butt welds downstream of the inboard isolation valve (isolable) had UT reflectors indicative of cracks.

2. None of the four welds outside the containment had any unacceptable indications.

3. Four out of ten butt welds upstream from the inboard isolation valve showed UT indications.

4. All axial cracks were found on the elbow side of the welds.

5. All circumferential cracks were found in the Heat Affected Zone (HAZ) of the pipe.

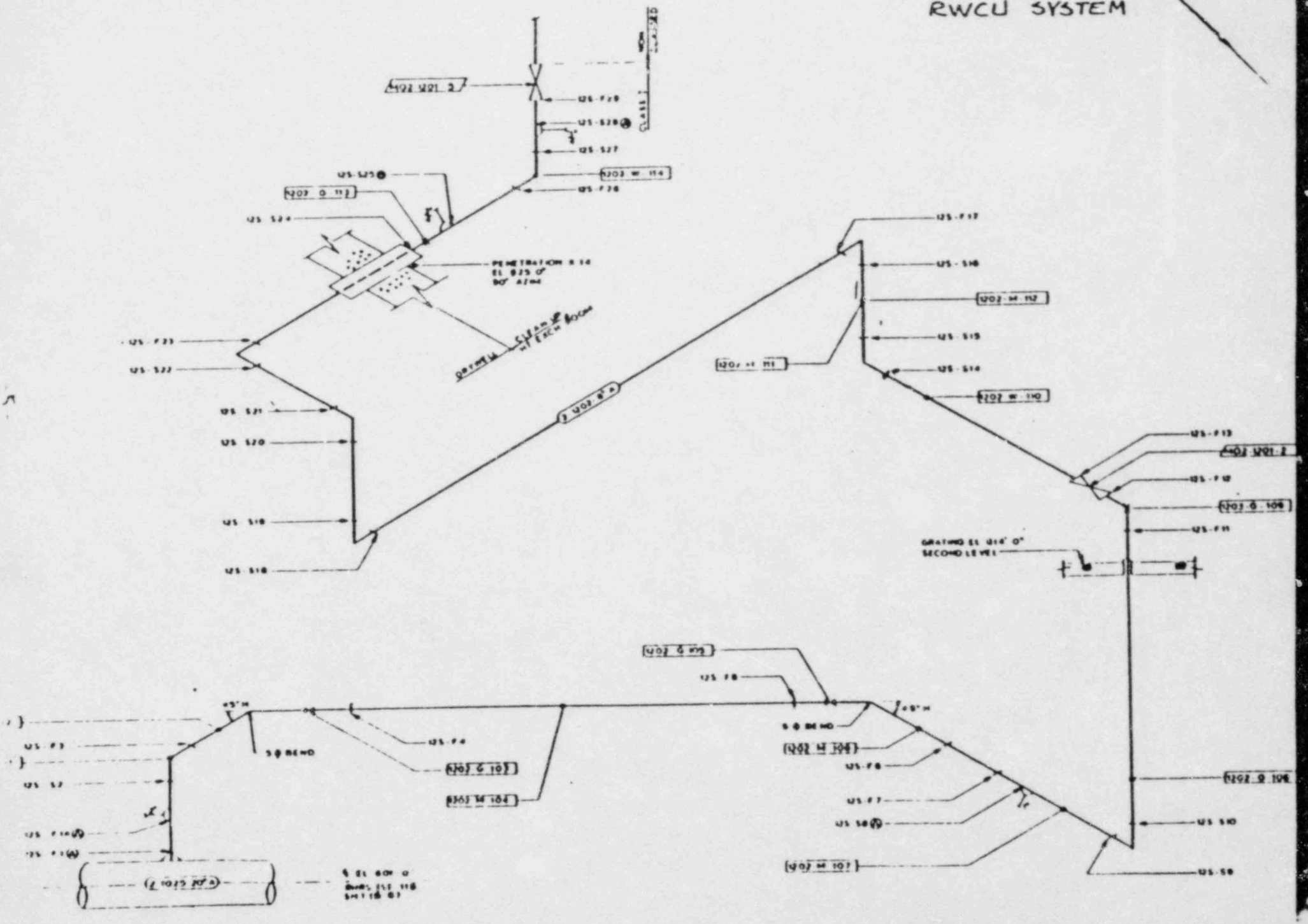
Test results are summarized in the table on page 8.

The isometric drawing on page 7 shows the locations of the welds identified in the summary table.

While the UT inspectors were performing inspections on the piping butt welds, one of the inspectors observed a droplet of water on the socket weld which attaches the 2-inch reactor vessel bottom drain line to the Sock-o-let on the RWCU line (Weld F-1A). Subsequent visual and high temperature penetrant examination failed to reveal any linear indications indicative of a through-wall crack.

INSPECTION & FLAW CHARACTERIZATION

QUAD CITIES UNIT 2
RWCU SYSTEM



SUMMARY OF UT RESULTS

WELD IDENTITY	INDICATION	COMMENT
ISOLABLE SIDE:		
F-23 PIPE - ELBOW	CIRC. - PIPE SIDE	———
S-20 ELBOW - PIPE	CIRC. - PIPE	SMALL
S-19 PIPE - ELBOW	CIRC. - PIPE	SMALL
S-18 ELBOW - PIPE	CIRC. - PIPE	1-1/2 - 2 INCH LONG
F-17 PIPE - ELBOW	AXIAL - ELBOW SIDE	50% T.W. ~1/2 - 3/4 INCH LONG
S-16 ELBOW - PIPE	CIRC. - PIPE	HIGH RAD - NO SIZING
S-15 PIPE - ELBOW	CIRC. - PIPE	HIGH RAD - NO SIZING
S-14 ELBOW - PIPE	CIRC. - PIPE	LEAKER
NON-ISOLABLE SIDE:		
F-12 VALVE - ELBOW	AXIAL - ELBOW SIDE	3 IND. DEEPEST 95% T.W. ~1/2 - 3/4 INCH LONG
S-10 PIPE - ELBOW	AXIAL - ELBOW	95% T.W. ~1/2 - 3/4 INCH LONG
S-9 ELBOW - PIPE	AXIAL - ELBOW	<50% T.W. ~1/2 - 3/4 INCH LONG
F-6 PIPE - PIPE	CIRC. - ONE SIDE ONLY	95% T.W. ~1-1/2 INCH LONG

III. DESIGN OF REPAIR

A. Repair Assumptions/Philosophy

The repair described in this section and in the repair program, which is in the Appendix to this report, is based on two assumptions.

The non-isolable section of the line cannot be replaced due to fuel storage concerns.

The fix is temporary; a permanent repair will be performed during the 1983 Unit 2 refuel outage.

The basic philosophy of the repair is to create a new pressure boundary using Inter-Granular Stress Corrosion Cracking (IGSCC) resistant materials (as identified in NUREG-0313 Revision 1 such as low carbon materials and weld metal). Implicit in this philosophy is that each flaw identified has developed to a through wall crack. Secondarily, the weld pad repairs offer a favorable residual stress distribution.

B. Circumferential Flaw Repair

The circumferential flaw repair (Figures 1A, 1B, and 1C) uses a low carbon stainless steel sleeve around the flawed weld extending approximately six inches on either side. The sleeve is machined from wrought material; and is split and welded around the pipe using full penetration welds. The sleeve ends are welded to the pipe using partial penetration welds with

cover fillets. The sleeve allows space for the existing weld crown. An 1/8 inch hole is drilled in the 6 inch pipe through a 1/4 inch threaded hole in the sleeve. This hole provides an unobstructed pathway to the annulus from the inside of the pipe to prevent excessive pressure buildup in the annulus due to a postulated flow path through the pipe crack. A threaded 1/4 inch plug is seal welded into the sleeve. The plug is shown in Figure 1D.

C. Axial Flaw Repair

The axial flaw repair (Figure 2) establishes a "cast - in place" pipe sleeve from weld metal. In addition to the favorable compressive residual stress pattern, the Type 308L weld metal is resistant to propagation of the IGSCC crack.

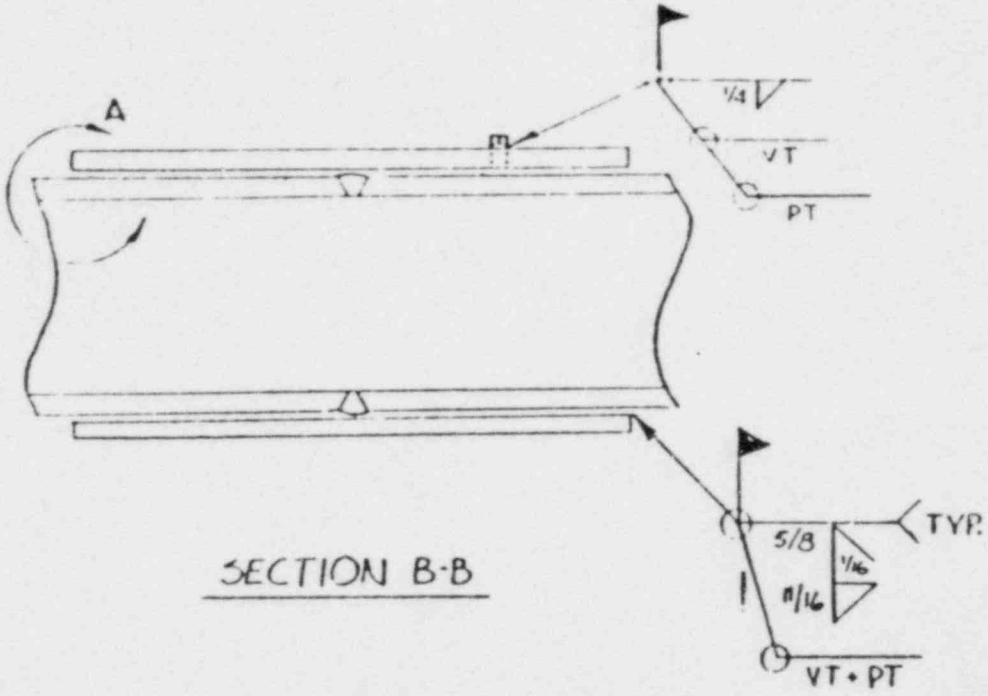
D. Sock-o-let Repair

A cone-shaped sleeve is provided around the sock-o-let connecting the two-inch drain line to the six-inch RWCU line. This repair is shown in Figure 3A and 3B. A 1/4 inch threaded hole is provided in the sleeve. It was originally intended that an 1/8 inch hole through the 1/4 inch hole into the two inch line, but this was not done due to the extreme likelihood that no crack existed in the first place. A 1/4 inch plug had been machined, and it is located in the QA storage area in the storeroom for future use, if necessary.

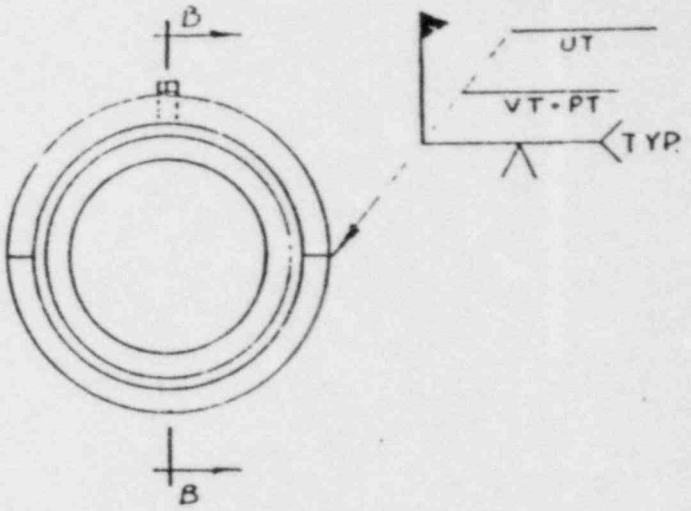
E. Analysis of Repairs

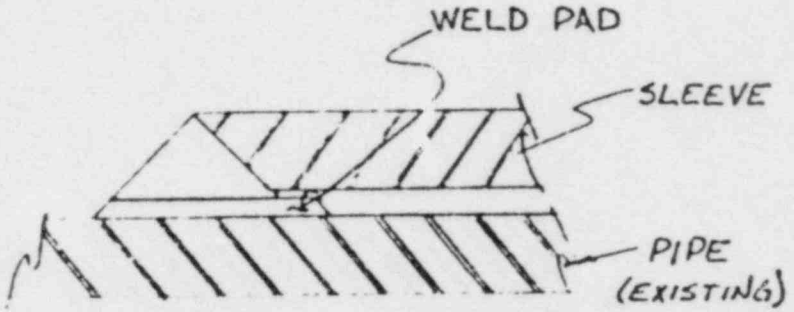
The stress analysis and flaw propagation calculations necessary to initially justify the repairs are contained in the Appendix to this report.

The unrepaired and unreinforced welds should not be subject to higher stresses as a result of this repair program, and should not have a higher propensity for cracking. The unisolable section of piping, including the MO-2-1201-2 isolation valve, was allowed freedom of movement during the repairs. Although the piping was adequately supported, there was allowance for shrinkage due to the weld deposits and to prevent stiffness. The isolable piping section repairs were not completed until after the sleeve and weld overlays were completed and inspected. A piece consisting of 40° and 47° elbows and a small 3-3/4 inch pipe section was installed at the very end to account for the shrinkage/distortion and to align the repaired and replaced (isolable piping) pipe sections. The distortion has been evaluated by NUTECH, and has been deemed acceptable.



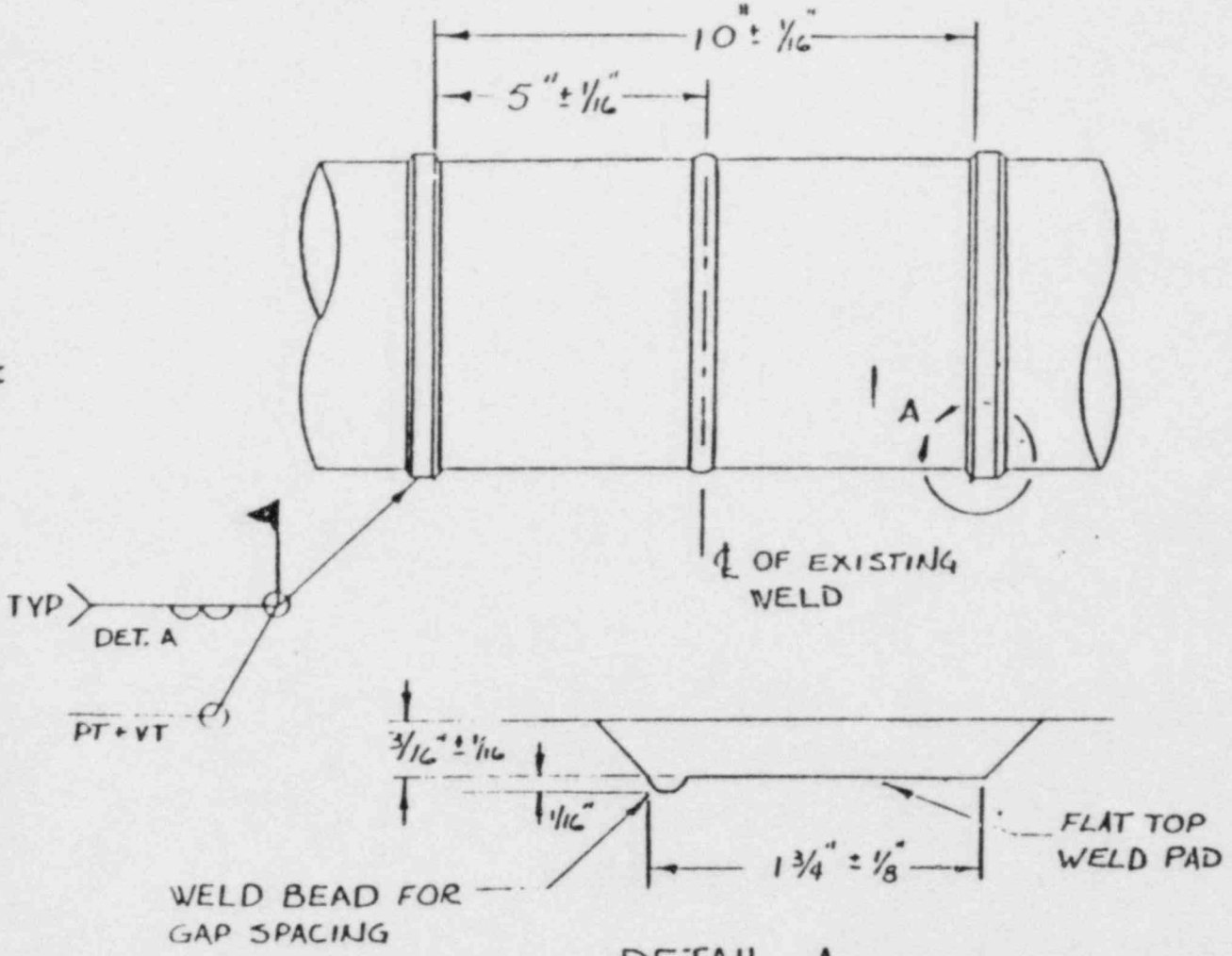
SECTION B-B





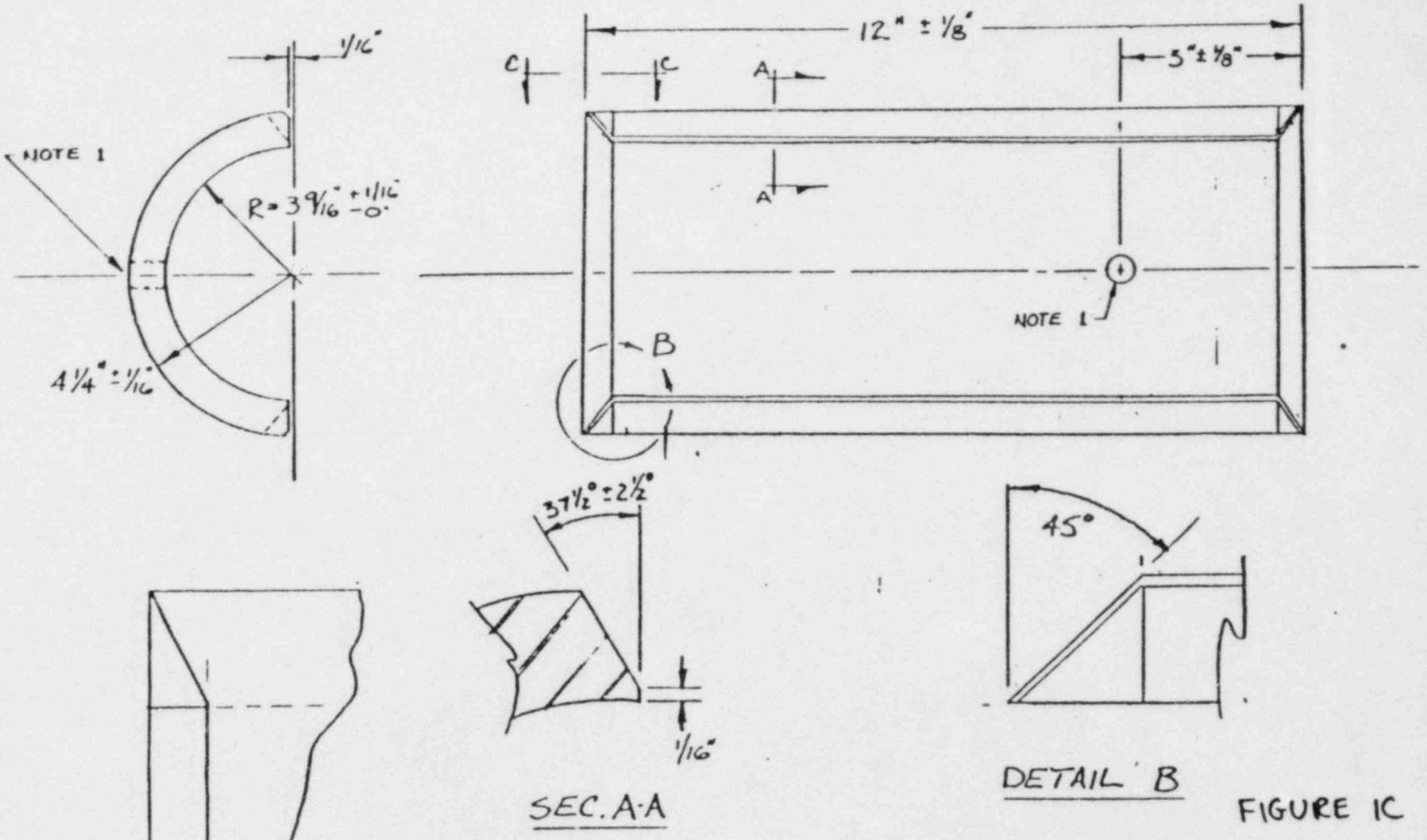
DETAIL A

FIGURE 1A



DETAIL A

FIGURE 1B



SEC. C-C

SEC. A-A

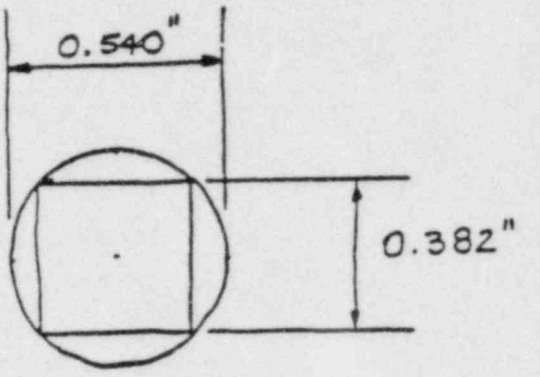
DETAIL B

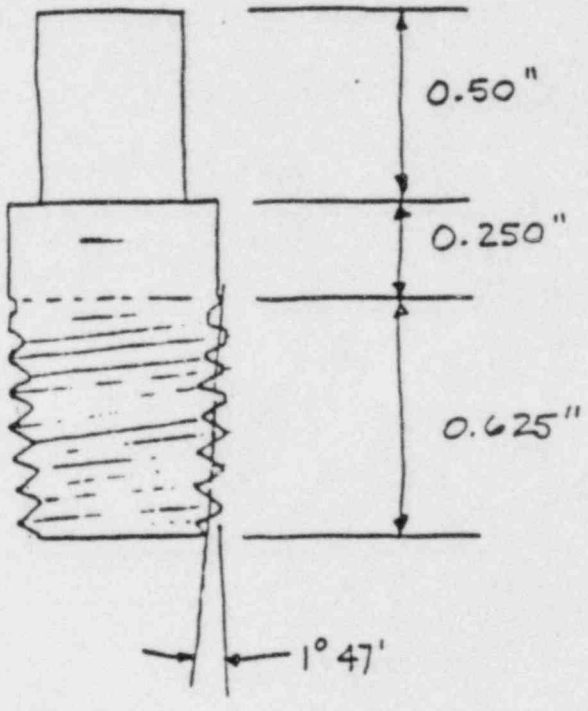
FIGURE 1C

1. DRILL & TAP 1/4"-18 NPT, ONE SLEEVE HALF ONLY.

NOTES:

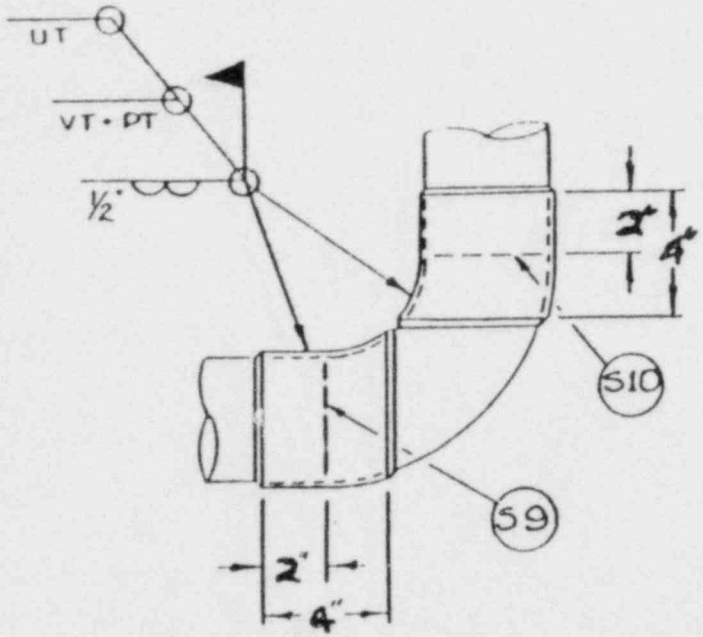
- 2 REQUIRED
- 1/4" NOMINAL PIPE SIZE, 18 THREADS PER INCH, USA STANDARD PIPE TAPER



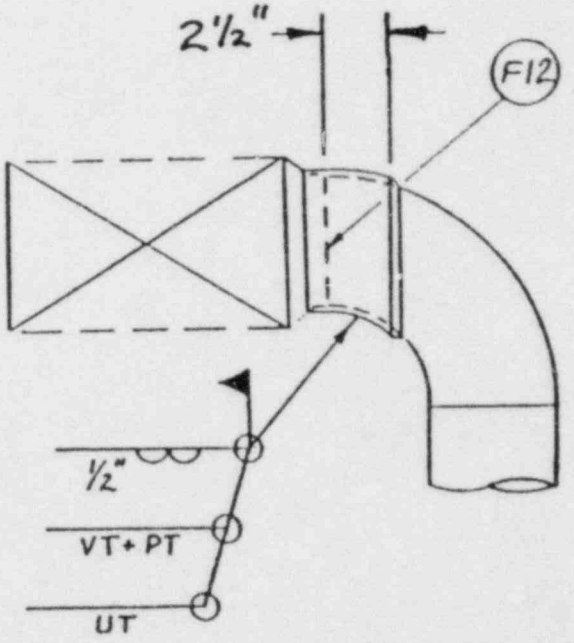


1/4 - 18 NPT

FIGURE 1 D

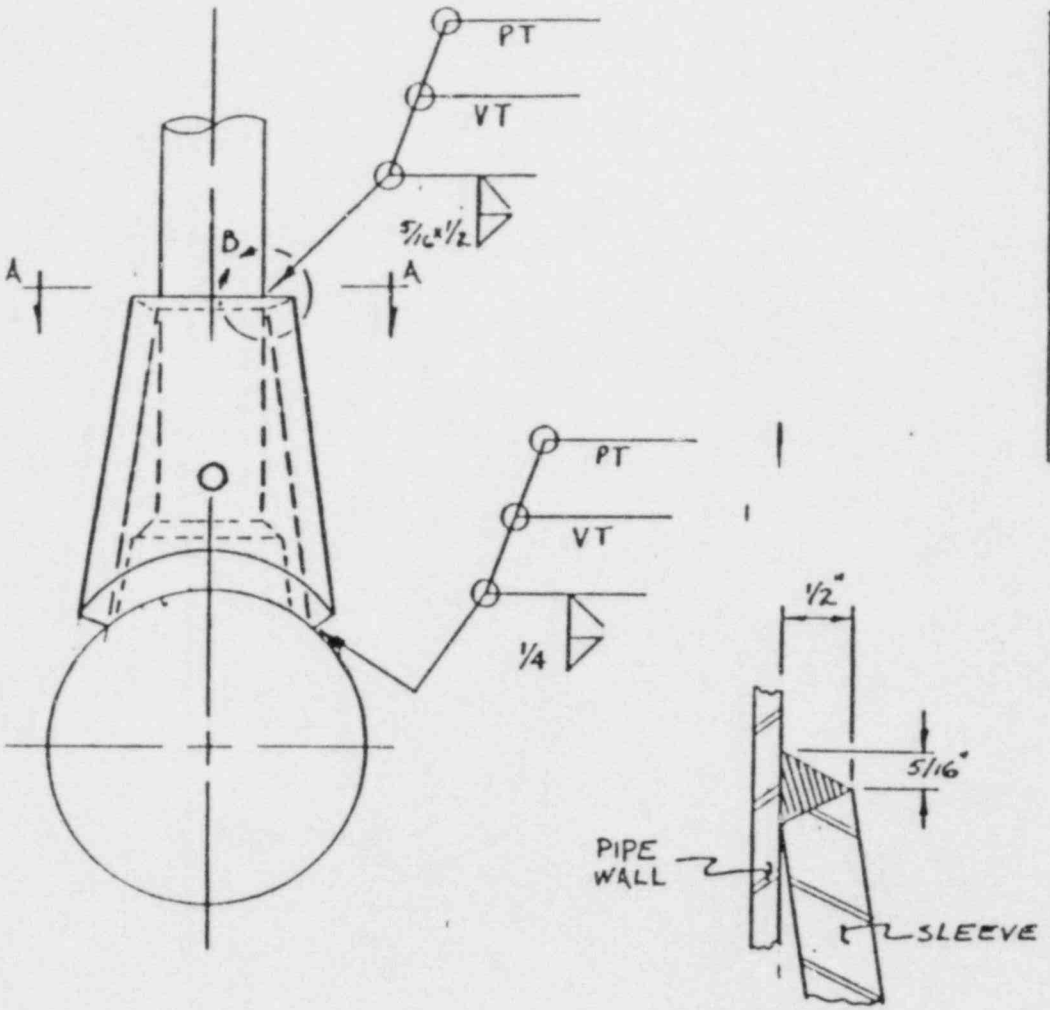


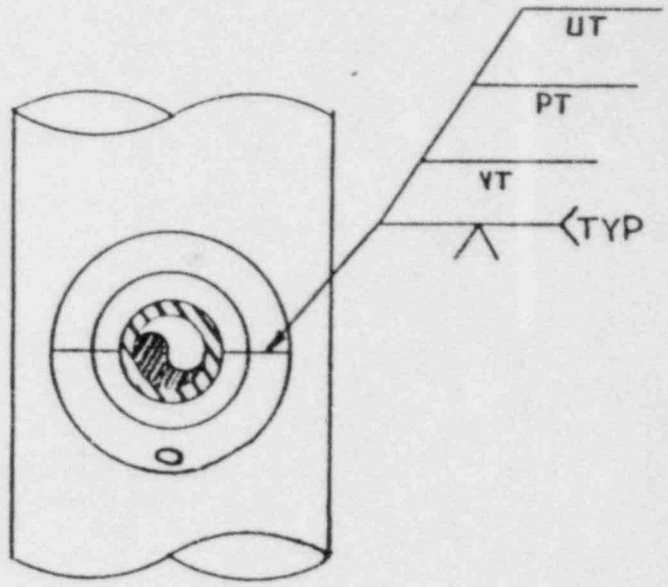
DETAIL A



DETAIL B

FIGURE 2

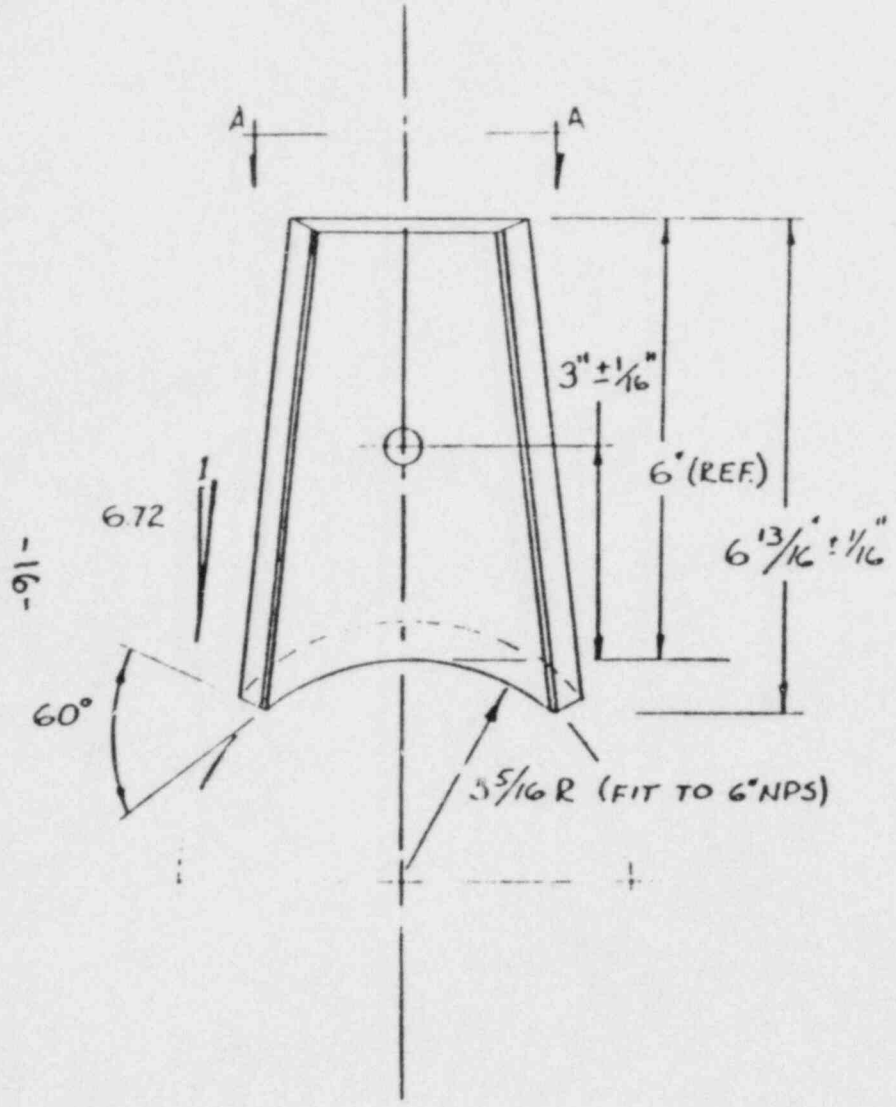


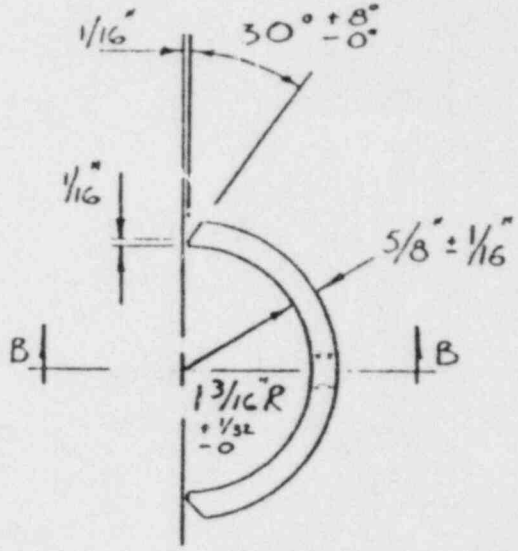


SECTION A-A

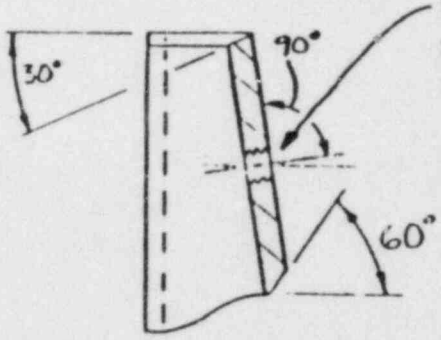
DETAIL B

FIGURE 3A





VIEW A-A
ROTATED 90°



DRILL & TAP HOLE IN ONE SLEEVE HALF ONLY
1/4 - 18 NPT

SECTION B-B

FIGURE 3B

IV. REPAIR PROCEDURES

A. Welding Procedures

Weld Overlay: CECo Automatic Weldi. Procedure WPS-8-8-DA.

Mechanical Incorporated Procedure WPS-800A.

Sleeve Welds: Axial Seam Welds using Mechanical Incorporated Procedure WPS-800A.

Circumferential welds using Mechanical Incorporated Procedure WPS-800A.

Sock-o-let Welds: Axial seams welds using Mechanical Incorporated Procedure WPS-800A.

Circumferential welds using Mechanical Incorporated Procedure WPS-800A.

B. Inspection Procedures

The following procedures were used to verify quality of the repair:

Welding Overlay:

PT of the first pass - CECo procedure.

UT of the joint - Developed by CECo from the mock-ups.

Sleeve Welds:

PT of the welds - CECo procedure.

UT of the welds - CECo standard procedure.

Sock-o-let Welds:

PT of the welds - CECo procedure.

C. Temporary Supports

During the course of the repair, the non-isolable piping was supported with temporary restraints. The supports account for normal pipe/water weight, repair equipment weight, and relocation of existing restraints. Restraints were removed or relocated to provide welder/welding equipment accessibility. Prior to removal/relocation of existing restraints, the temporary support system was installed.

Two existing restraints were affected by the repair. Spring hanger 1202-W-110 located on the isolable piping, was disengaged to allow piping replacement. Inboard Isolation valve MO 2-1201-2 was secured with chain hoists prior to disengagement of 1202-W-110. Restraint 1202-M-107 was removed to allow access to welds S9 and S10. Temporary blocking was placed near the downstream guide 1202-G-109, and chain hoists were placed upstream of weld S9 to account for removal of 1202-M-107.

D. Back-Up Measures

In the event that leakage occurred during the repair, back-up measures were established to stop the leak, and allow repairs to proceed. Mechanical clamps were designed for each generic repair zone. Prior to starting welding repairs on the 6 inch line (sleeve and weld pad installation), a freeze plug was established. For the weld pads, the freeze plug was removed after 1/8 inch of weld material was deposited.

The freeze plug equipment was standard liquid nitrogen freezing equipment sized as required. Each leak scenario was considered to assure that plugging can be accomplished for each scenario.

The mechanical clamping devices were designed for the pipe sleeve, the weld overlay, and the sock-o-let sleeve. A clamp capable of encompassing the pipe and the pipe sleeve was available. Clamping for the weld overlay consisted of various widths of standard pipe clamps combined with a rubber membrane. An example is shown on page 21.

The sock-o-let sleeve clamp, installed prior to the start of sleeve installation, consisted of a pipe clamp around the 2-inch line, which was tied to the six-inch RWCU line with cable. This clamp prevented any displacement during a postulated break in the sock-o-let, thus limiting any leakage to a small and manageable amount.

Training on the usage of the clamps, damage control organization and procedure, and photographs of the clamp devices are addressed and provided in the Administrative Procedure contained in the Appendix.

E. Administrative Control

A detailed procedure for administrative control and operational support of this repair has been written, and is appended to this report.

F. Quality Assurance

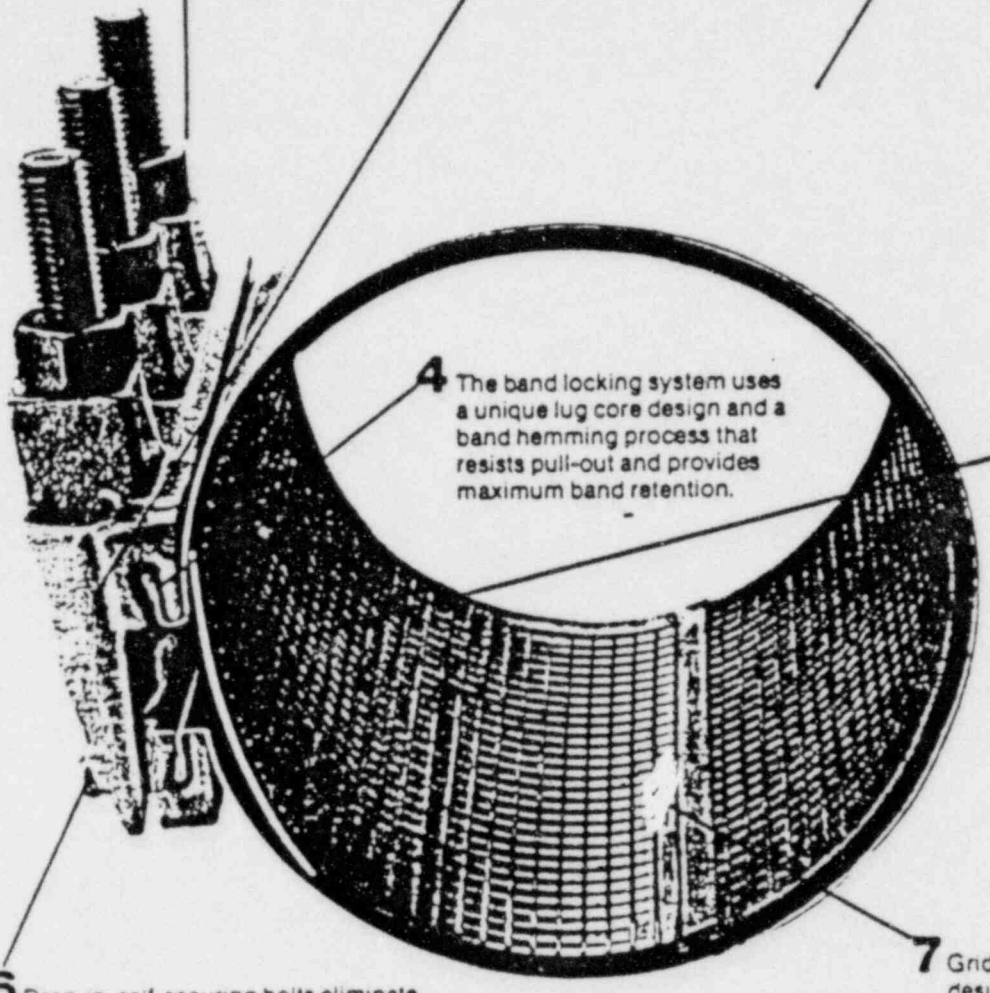
All work was performed in accordance with the Commonwealth Edison Company Quality Assurance Manual.

Clamp and Coupling products

1 A special high-strength ductile iron alloy lug utilizes a strength efficient computer-aided design that's not only stronger, but lighter and easier to install.

2 Lugs with mutually supporting sliding fingers to assure proper bolt alignment while tightening. Permits maximum torque without bending of bolts.

3 Full circumference, single or multiple section stainless steel bands available in 7½", 10", 12½", 15", 20" and 30" widths.



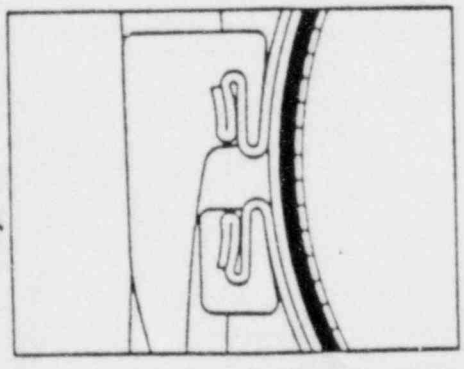
4 The band locking system uses a unique lug core design and a band hemming process that resists pull-out and provides maximum band retention.

5 Bridge plate flush mounted and bonded to the gasket assures even distribution of gasket pressure and prevents crimping.

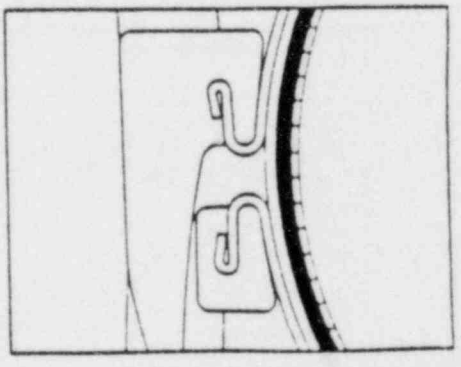
6 Drop-in, self-securing bolts eliminate loose parts, save time and make installation possible with only one wrench.

7 Gridded, tapered, overlapping gasket design offers superior full circumferential sealing and full adjustment to rough pipe surfaces.

Patent Pending



◀ Rockwell design that securely attaches the lugs to the band. ▶



V. TECHNICAL EVALUATION OF REPAIR

A. Crack Extension During Welding

The risk of causing a failure of the RWCU line during welding is non-existent due to the very high toughness of austenitic stainless steel. Studies by EPRI and General Electric on austenitic stainless steel have shown that flaws very much larger than those detected in the RWCU line would be stable under normal and upset operating conditions. The repairs were performed with 23 psig pressure in the pipe, and with the shutdown cooling the only system operating (intermittently) within the drywell. Stresses from these sources are insignificant.

Welding stresses could be significantly high in the localized weld regions. The attachments for the sleeve repair to the circumferential flaw in weld F6 were located several inches away from the existing weld. There was no significant thermal or mechanical stressing of the existing weld during sleeve attachment. The weld overlay repairs to the axial flaws could conceivably cause some extension of the flaws. Such extension could only take place with very high tensile stress present at the edge of the flaw. The stresses from welding are highly localized and any extension would be arrested in a very short distance due to the reduced stress field. A nearby through-wall flaw has the potential of extending radially to produce a small leak. Low heat input was used in depositing the first layer over the flaw regions to minimize penetration and stresses.

In the unlikely event that a small leak occured, a rubber-lined mechanical clamp was available to seal off the leak. With a freeze plug in place and the line drained to stop leakage, a localized repair to seal the leak would be performed. Once the leak is sealed off, the freeze plug would be allowed to melt and the repair completed as originally planned.

The sleeve repair to the sock-o-let was attached to the 6-inch RWCU line and to the 2-inch drain line above the existing socket weld. The attachment weld to the 6-inch line did not tie into the existing sock-o-let weld. There was no significant thermal or mechanical stressing of the existing welds during sleeve attachment.

Due to the uncertainty of the condition causing the water droplet noted during examination, a strap clamp was applied prior to attaching the sleeve. The strap clamp supplemented the existing rigid support on the 2-inch line to mechanically restrain the 2-inch line from pulling out of the sock-o-let in the very unlikely event of failure. If leakage were to occur during repair, attempts would be made to accomplish freeze plug isolation to permit completion of the repair.

B. Crack Extension Post Welding

IGSCC can only occur when the combination of sensitization, tensile stress, and aggressiveness of the environment is sufficient to cause it. The sleeve repairs will not change the degree of sensitization or the environment near the existing welds. The effect on residual stresses of adding the sleeves is uncertain, but it is not expected that any significantly

increased tensile stresses will result. Crack extension may occur during operation, but this is not of concern as the sleeves are designed as new, independent pressure boundaries around the existing welds. The sleeves can accomodate complete separation of the existing welds. If through-wall penetration occurs, the annulus between the sleeve and pipe will be wetted with primary water. The Type 304L sleeve material and Type 308L weld metal will resist initiation of IGSCC during service. It is extremely unlikely that IGSCC could initiate in the existing pipe near a sleeve attachment weld and propagate through pipe material under the weld to produce a crack. Even if such a crack were to occur, the result would be a detectable leak, and no risk of pipe breakage would be presented.

The weld overlay repairs to the axial flaws were performed by depositing circumferential stringer beads. The deposition was accomplished in layers with each layer completed before beginning the next layer. Circumferential stringer beads will produce a constrictive force as the underlying pipe, due to weld metal shrinkage. The accumulated effect of the stringer beads comprising the overlay will be to produce compressive circumferential residual stresses under the overlay. As the overlay will extend well beyond the existing axial flaws, propagation of these flaws during operation would be mitigated by the changed residual stress pattern. Also, crack extension in the axial direction would be mitigated due to the absence of butt weld sensitization from the original butt weld and the

reduced residual tensile stresses beyond the heat affected zone of the original weld. Even if crack extension were to occur, the crack would be arrested in the radial direction by the IGSCC resistant weld metal overlay. In the very unlikely event of extension in the axial direction to beyond the weld overlay, the result would be a detectable leak, and no risk to pipe breakage would be presented.

The weld overlay could produce residual tensile stresses at the inside surface of the existing pipe near the ends of the overlay. The magnitude of these stresses is reduced by tapering the ends of the overlay. IGSCC is unlikely to occur at these transition regions as significant sensitization is not expected at the inside surface. The overlay was applied at low heat input and the water present inside the pipe produced rapid cooling. The degree of sensitization produced by the weld overlay process was evaluated by a representative mock-up and metallurgical testing.

C. Materials Selection

The materials used to accomplish the repair have been selected to provide a high resistance to IGSCC. The wrought material for the sleeves is Type 304L stainless steel having 0.035 percent (maximum) carbon and meeting the mechanical requirements of regular Type 304. The consumable welding material is Type 308L stainless steel. Type 304L and Type 308L stainless steel are listed as acceptable materials in NUREG 0313 Revision 1 for construction of piping systems.

D. Mock-Up

The repair of axial cracks on the elbow side of the elbow to pipe joint called for deposition of weld metal on the O.D. surface to produce a weld pad approximately 4 inches long and 1/2 inch thick.

Commonwealth Edison has used this particular mechanized welding equipment previously at Dresden. CECo has the required procedures and is familiar with the equipment; however, a mock-up study was conducted to evaluate the following:

1. Feasibility of using mechanized welding on elbows:

   A new elbow was welded to a straight length of pipe for conducting this test. The test spool piece then was pad welded to produce a weld pad of 6-3/4 inches long and 1/2 inch thick. The feasibility of mechanized welding was adequately demonstrated.

2. Evaluation of quality of weld metal:

   The pad welded mock-up sample was examined by VT, PT and RT methods. The NDE results were evaluated to ASME Section III Class I acceptance standards, and found to be acceptable.

   The test sample was sectioned for metallurgical examination. The heat affected zone (HAZ), quality of weld deposit, and the bond along the fusion line were thoroughly investigated. Microstructure in the HAZ

has been evaluated using ASTM A 262 practice A. The degree of sensitization (DOS) observed has been compared with DOS generally observed in a typical butt welded sample. The final results indicate no evidence of adverse affects.

3. UT inspectibility of the pad weld.

A section of the pad welded sample has been retained for the development of a UT procedure. The latest UT technology has been applied to develop a UT procedure to inspect the production welds.

4. Extension of existing crack during pad weld repair.

The elbow to pipe joint (F-17) removed from service has been utilized for this purpose. The weld joint was radiographed to locate the crack. The pipe was filled with water and pad welded on the O.D. to produce a 6 inch - 1/2 inch thick pad.

After the first layer was laid down, the weld layer was prepared for a thorough PT examination. PT was performed to determine if the existing flaw has broken through the weld layer. The crack was found not to break through, and subsequent weld passes were deposited.

The completed weld repair was examined by radiography. Original and final radiographs were compared to determine if any significant crack extension had occurred. The final radiograph failed to demonstrate the crack indication because of weld buildup geometry.

5. Concern over welding on marginally sensitized material.

From previous metallurgical investigations, it is possible that the elbow material may be in a slightly sensitized condition. Concern has been raised over degradation of this slightly sensitized material due to additional welding. It is not possible to section the contaminated elbow and prepare for metallographic samples in a reasonable period of time.

VI. SAFETY EVALUATION

A. Leak Detection

To ensure that any postulated additional cracking will be detected prior to potential pipe rupture, leakage within the drywell is closely monitored. Reactor coolant leakage in the drywell is monitored in accordance with the appended Quad-Cities Station Procedure QOS 1600-7. The procedure ensures adequate leak detection, and the performance of this procedure is shown in the attached tabulation of leakage monitored at Unit 2. The procedure did identify the additional leakage due to the through wall IGSCC in the isolatable portion of the reactor water clean-up system. This leakage was well below limits, but the change in leakage was identified for this small defect.

A revision to QOS 1o00-7 was made (Temporary Procedure 1631) to reflect an NRC commitment to investigate a 1 gpm unidentified leakage increase over a 4 hour period subsequent to Unit 2 startup. This procedure will remain in effect until the next Unit 2 refueling outage.

B. Onsite Review

An on-site review of the proposed repair to the Unit 2 Reactor Water Clean-Up System IGSCC was conducted on January 25, 1982 and was recorded in Review Report Number 82-05. This review report is appended. Contained in the On-Site Review package are:

1. Event description.

2. 10CFR50.59 safety evaluation.

3. Isolable section repair program, with SNED approval.

4. Non-isolable proposed repair program and description with SNED approval.

C. Off-Site Review

An off-site review was conducted and the report is appended. The review is documented in report 82-03.

DAILY U-2 DRYWELL FLOOR DRAIN SUMP

PUMP READINGS

	GAL. PER 24 HOUR PERIOD	GAL. PER MIN AVG IN 24 HR PERIOD	
12/26/81	0 gal	0.00 gpm	
12/27/81	300 gal	0.02 gpm	START UP FOLLOWING REFUEL OUTAGE
12/28/81	280 gal	0.19 gpm	
12/29/81	330 gal	0.23 gpm	
12/30/81	370 gal	0.26 gpm	
12/31/81	410 gal	0.28 gpm	
01/01/82	770 gal	0.53 gpm	
01/02/82	1420 gal	0.99 gpm	
01/03/82	1090 gal	0.76 gpm	SCRAM RECOVERY
01/04/82	1590 gal	1.10 gpm	
01/05/82	1650 gal	1.15 gpm	
01/06/82	1670 gal	1.16 gpm	
01/07/82	1700 gal	1.18 gpm	
01/08/82	1710 gal	1.19 gpm	
01/09/82	1810 gal	1.26 gpm	
01/10/82	2030 gal	1.41 gpm	
01/11/82	1950 gal	1.35 gpm	
01/12/82	1930 gal	1.34 gpm	
01/13/82	1820 gal	1.26 gpm	
01/14/82	2020 gal	1.40 gpm	
01/15/82	1680 gal	1.17 gpm	
01/16/82	120 gal	0.08 gpm	UNIT SHUT DOWN

HIGHEST 4 HOUR PERIOD WAS 480 GAL OR 2 GPM (01/14/82). TECHNICAL SPECIFICATION LIMIT FOR UNIDENTIFIED LEAKAGE IS 5 GPM.

VII. REPAIR PROGRAM SUMMARY

The purpose of this section of the report is to provide a detailed summary of the events which took place as the repair program progressed, and to document completion of the program in accordance with the commitments and procedures associated with the program.

Prior to the start of the repair work, the items required by the NRC to be completed were verified to be satisfactorily done. A detailed work package, including a station traveler, was prepared and approved. Training sessions were conducted persuant to the work package, damage control, and administrative procedures to be in effect. Qualified welders and welding procedures were in-place, and the necessary clamps and freeze-seal equipment were made available. Fuel storage rack procurement was arranged for, and the prerequisites of the Administrative Procedure were satisfied. An ALARA evaluation was performed, and it was discussed by telephone with an NRC Region III representative.

The weld pads for the F6 weld sleeve, and the S9 and S10 overlays were to be performed using an automatic welding process. GAPCO, Inc. was contracted by the station to provide the equipment and personnel to perform the work. The weld overlay for weld F12 would be done manually due to the lack of space to utilize the automatic welder.

A detailed event chronology follows, which highlights the events that followed the progress of the repair program.

A. Detailed Event Chronology

2/3/82 Commenced establishing the freeze plug. The GAPCO welding equipment and remote video camera were set up to initiate welding the first pad for the sleeve over weld F6. Difficulty was encountered in establishing the freeze plug, and a second jacket was installed.

2/4/82 The freeze seal appeared to be holding, but after welding commenced, the heat caused the freeze seal temperature to rise. It was decided to augment the freeze seal process by using cans full of carbon dioxide (dry ice).

2/5/82 The use of dry ice resulted in the successful establishment of the freeze plug. Finished weld pads for F6 sleeve.

2/6/82 Commenced fit-up and welding of F6 sleeve halves to weld pads.

2/7/82 Started welding pad on weld F12, and completed 1/8 inch buildup. PT was successful. Started automatic welding for weld pad on S10.

2/8/82 Completed 1/8 inch buildup on S10, and PT was satisfactory. Started welding pad for weld S9.

2/9/82 Completed 1/8 inch buildup on weld pad for S9. Cone sleeve for 2 inch socolet (FIA) was fit up and welding began. Freeze seals were closed off and thawed. Automatic welding began on weld pad S9.

2/10/82 Completed 1/2 inch weld buildup on S9, and started welding on S10.

2/11/82 Completed welding on F1A cone sleeve.

2/12/82 Finished weld buildup on S10.

2/13/82 Started welding sleeve on F6.

2/14/82 Completed visual inspections of completed welds on F1A cone sleeve and F6 sleeve. Started welding pad on F12 using mechanical welding process.

2/15/82 Completed various NDE on completed welds.

2/16/82 Completed UT on completed F1A and F6 welds, and weld pads over S9 and S10.

2/17/82 through 2/19/82 Performed welding to buildup pad on weld F12.

2/19/82 Drilled 1/8 inch hole in pipe through F6 weld sleeve. Installed 1/4 inch plug and tightened. Started seal-welding plug. Clamp was removed from F1A cone.

2/20/82 F6 sleeve plug was seal-welded and PT was visually inspected. Weld buildup on F12 was completed.

2/21/82 PT on F12 weld pad was satisfactory. The Damage Control Team was released. UT was completed on F12 weld pad.

2/22/82 Pipe hangers were made up and temporary pipe hangers were removed.

2/23/82 Completed satisfactory hydro-test on non-isolable piping section.

B. Status of Piping Installation

The status of the Unit 2 non-isolable reactor water cleanup system repairs is summarized as follows:

1. Weld F6: Sleeve installed over weld F6, approximately 12 inches long. The sleeve has a 1/4 inch plug installed over a 1/8 inch hole in the pipe. The plug is screwed into the sleeve and seal-welded, and is located at a point on the sleeve 9 inches downstream from the edge of the sleeve facing the reactor side.

2. Weld F1A: A cone-shaped sleeve is installed over the sock-o-let and weld F1A. The sleeve has a 1/4 inch hole drilled into it at a point 3 inches up from where it is welded to the 6 inch cleanup pipe.

3. Welds S9 and S10: A 4 inch long, 1/2 inch thick weld pad is installed, centered over each elbow weld. The weld pads were installed by automatic welding process.

4. Weld F12: A 1/2 inch thick weld pad was mechanically installed over this elbow-to-valve weld, covering 2-1/2 inches over the elbow. Weld F11 was UT inspected after the F12 weld pad was completed, and the results were acceptable.

Photographs of the completed repairs are shown on page 38.

As requested by the NRC, tram marks were made on the pipe and elbows adjacent to the proposed repairs prior to initiating the repair work. Measurements were taken and documented before and after the repairs. This data is provided in this report on subsequent pages. The extent of distortion has been evaluated and deemed acceptable.

Pipe hangers were replaced upon completion of the repair program. The non-isolable piping section was connected to the isolable section by means of a 40° pipe elbow, a 47° pipe elbow, and a 3-3/4 inch long "pup" piece. These welds were PT and RT examined, and a hydro-test was satisfactorily performed.

C. Manpower and Radiation Exposure

A summary of the manpower and accumulated radiation exposure associated with the non-isolable Unit 2 reactor water cleanup system repair is provided on the following page. The exposure projections for the welding operations were conservative. However, a substantial amount of exposure was accumulated by the fitters and laborers in support of the work, and by the NDE and insulation personnel.

EXPOSURE ASSOCIATED WITH WELDING

WELD NUMBER	PROJECTED MAN-REM	ACUTAL MAN-REM	HAND WELDING	AUTO WELDING
12S-F-1A	21.0	13.643	13.643	
12S-F-6	23.0	23.589	19.297	4.292
12S-S9 & S-10	5.2	10.695		10.695
12S-F-12 (revised projection of 2/3/82)	80.0	52.283	52.283	
TOTALS	129.2	100.210	85.223	14.987

CONTRACTOR PERSONNEL

	CLASS OF CONTRACTOR PERSONNEL	NUMBER OF PERSONNEL	TOTAL EXPOSURE (IN MAN-REM)
	WELDERS (HAND)	69	85.223
	WELDERS (AUTO)	13	16.255
(1)	FITTERS	82	42.678
(2)	LABORERS	24	28.139
	INSULATORS	14	7.208
	CON-AM (NDE)	15	10.897

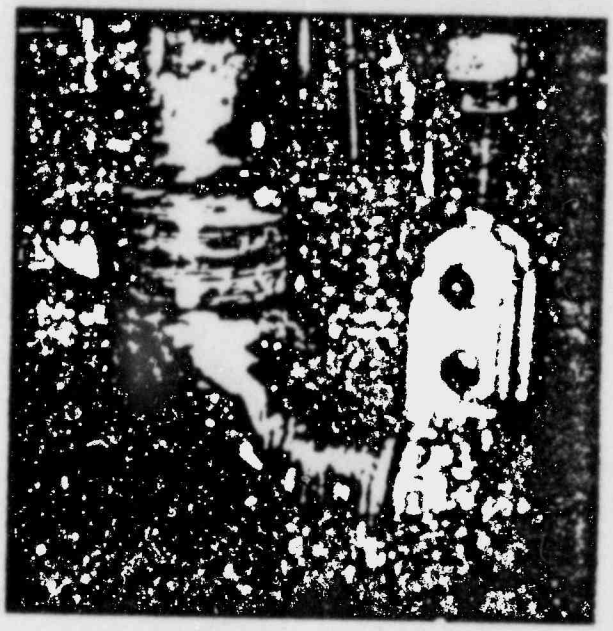
(1) The fitters also supported the automatic welders.

(2) The laborers set up and removed lead shielding and scaffolding.

EXPOSURE SUMMARY

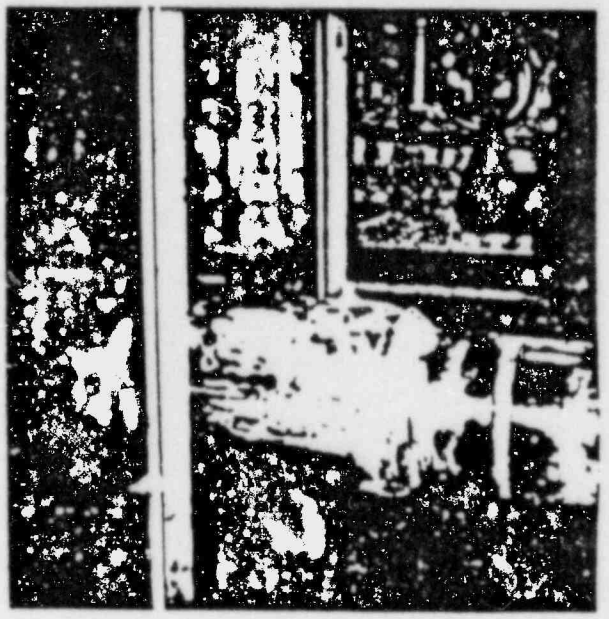
GROUP	MAN-REM
OPERATIONS	.429
MECH. MAINT. (SUPER)	5.074
MECH. MAINT. (UNION)	3.002
ELEC. MAINT. (SUPER)	.195
ELEC. MAINT. (UNION)	1.279
R.C.T.'s	.500
STATION SUPER	.109
TECH STAFF	2.174
Q.C.	2.904
WELDERS (MECH-INC)	85.223
FITTERS (MECH-INC)	42.678
LABORERS (MECH-INC)	28.139
CON-AM INSPECTION	10.897
AUTO WELDERS (GAPCO)	16.255
KREZ INSULATORS	7.208
	206.061

U-2 CLEANUP PIPE REPAIR
FEB., 1982
LINE 2-1202-6"-A, WELD 125-F12

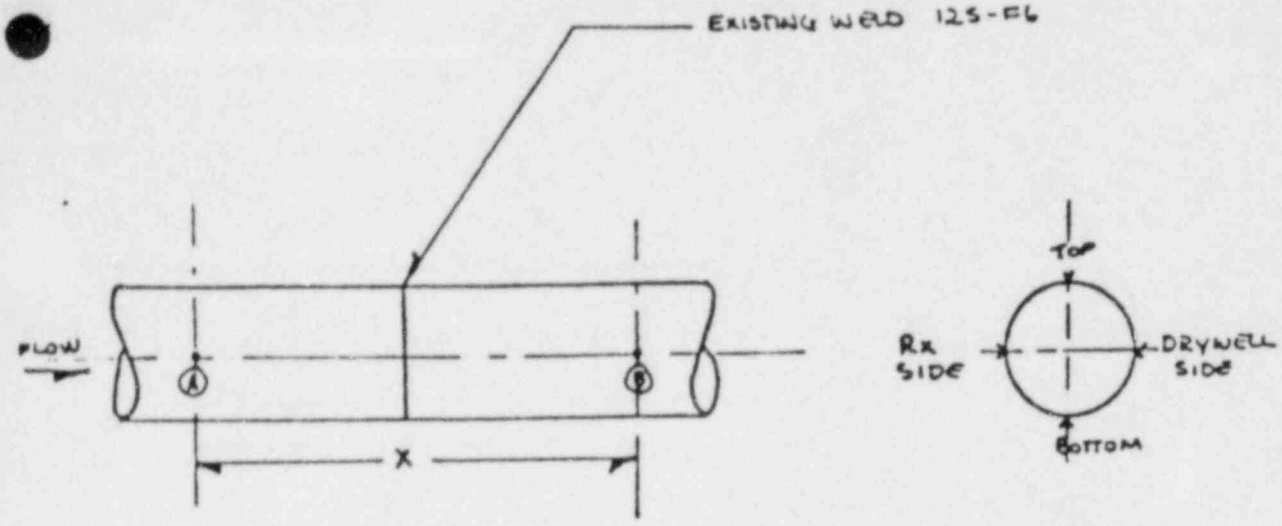


U-2 CLEANUP PIPE REPAIR
FEB., 1982
LINE 2-1202-6"-A, WELDS 125-39-510

2" LINE 1265"
COMING OFF OF
RWCU LINE 12C6"



U-2 CLEANUP PIPE REPAIR
FEB, 1982
LINE 2-1202-6"-A, WELD 125-F6



TRAM MARK SKETCH

FOR WELD BUILD UP AND SLEEVE FABRICATION/INSTALLATION FOR WELD 125-F6 REPAIR WORK REQUEST Q17244

BEFORE WELDING

	RX SIDE	DW SIDE	TOP	BOTTOM
X	16"	16 1/16"	16"	16 1/8"

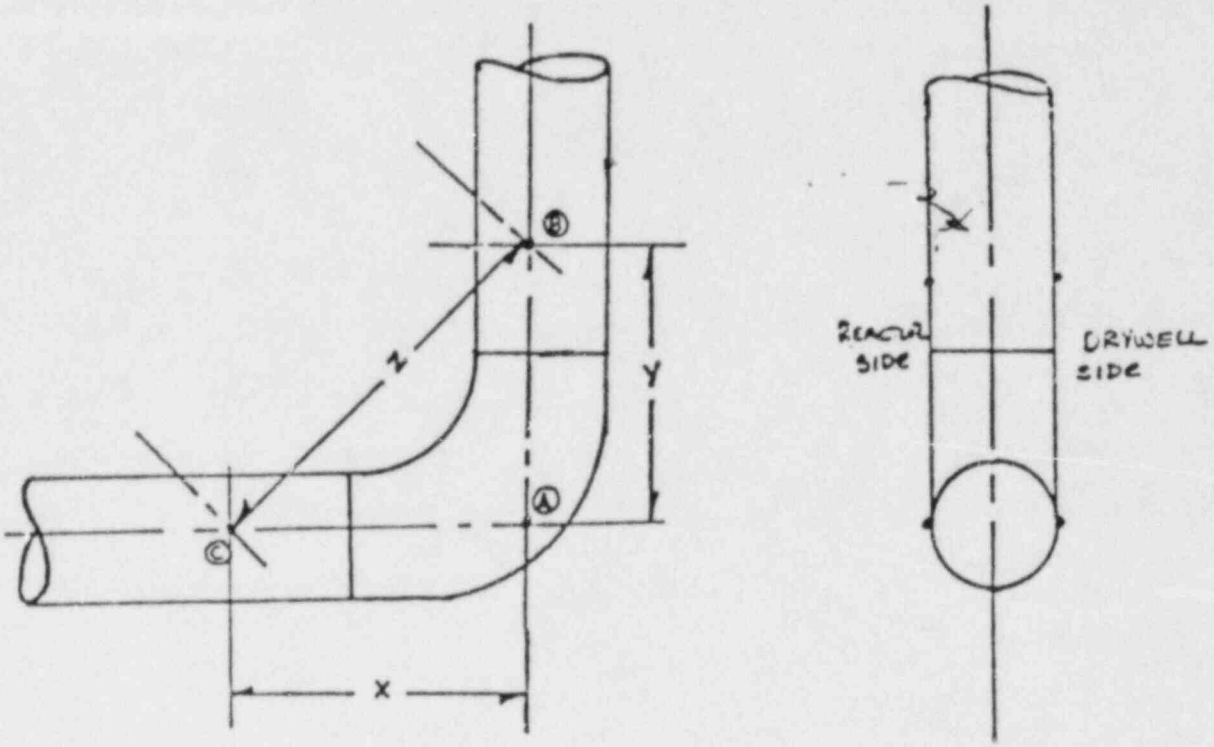
AFTER WELDING IS COMPLETE (SLEEVE INSTALLED).

	RX SIDE	DW SIDE	TOP	BOTTOM
X	15 3/8	15 1/2	15 9/16	15 9/16

MARK WITH CENTERPUNCH at LOCATIONS (A) AND (B) at FOUR LOCATIONS ON EACH SIDE of EXISTING WELD 125-F6.

(A) MARK ON PIPE UPSTREAM at 8" FROM EXISTING WELD ℄.

(B) MARK ON PIPE DOWNSTREAM at 8" FROM EXISTING WELD ℄.



TRAM MARK SKETCH
FOR WELD BUILD UP
ON WELDS 125-59 AND 125-510
WR Q17244

BEFORE WELDING

DRYWELL SIDE		REACTOR SIDE	
X	12 7/8"	X	12 5/8"
Y	12 3/4	Y	12 11/16"
Z	21 7/8"	Z	21 1/16"

AFTER WELDING IS COMPLETE

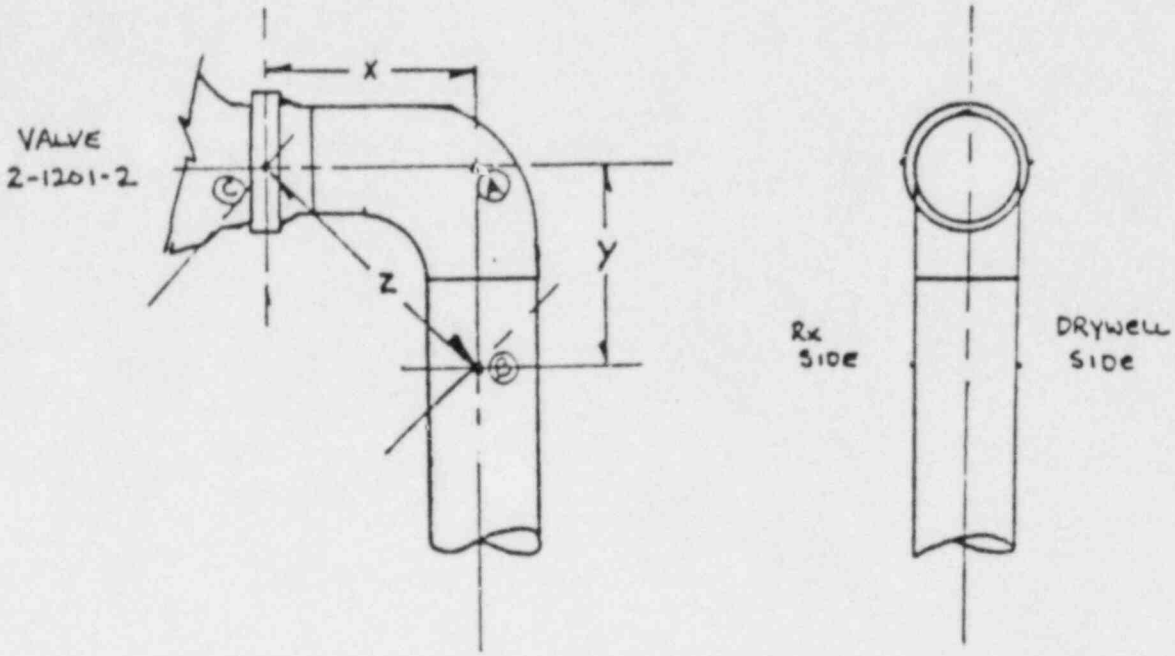
DRYWELL SIDE		REACTOR SIDE	
X	12 5/16	X	12 3/16
Y	12 3/16	Y	12 7/16
Z	20 11/16	Z	20 3/16

MARK WITH CENTER PUNCH AT LOCATIONS Ⓐ, Ⓑ & Ⓒ DWSIDE AND RX SIDE.

Ⓐ MARK AT ELBOW CENTERLINE AT INTERSECTING POINT OF Ⓑ AND Ⓒ

Ⓑ MARK ON VERTICAL PIPE APPROXIMATELY 6" FROM EXISTING WELD ℄

Ⓒ MARK ON HORIZONTAL PIPE APPROXIMATELY 6" FROM EXISTING WELD ℄



TRAM MARK SKETCH
FOR WELD BUILD UP
ON WELD 125-F12
WR Q17244

BEFORE WELDING

DRYWELL SIDE		REACTOR SIDE	
X	6"	X	6"
Y	19 5/16"	Y	23"
Z	21 1/8	Z	* UNABLE TO RECORD

AFTER WELDING IS COMPLETE

DRYWELL SIDE		REACTOR SIDE	
X	5 13/16	X	5 7/8
Y	MARK ↕	Y	23
Z	GONE ↕	Z	—

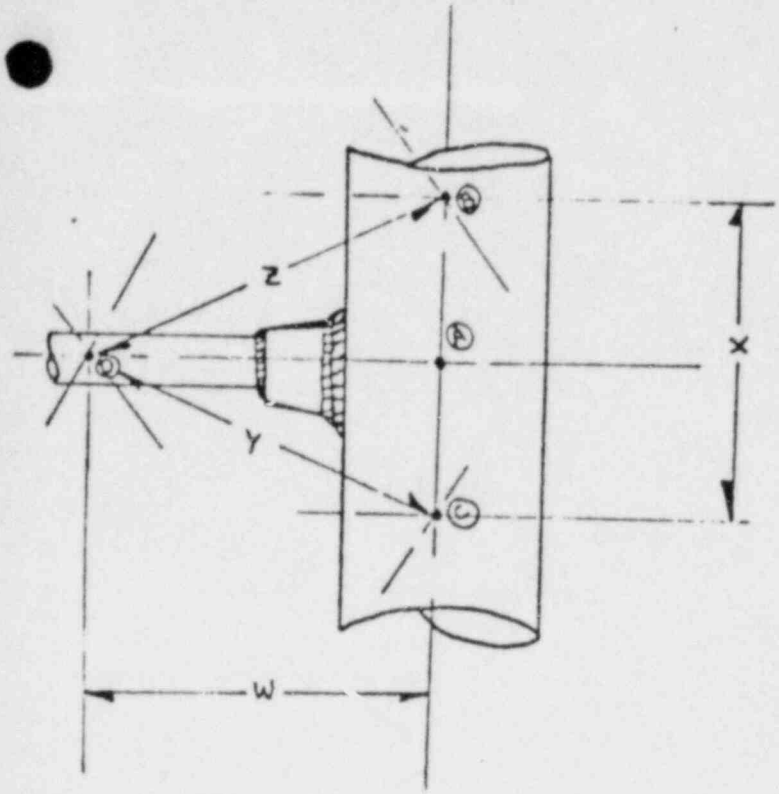
MARK WITH CENTERPUNCH AT LOCATIONS Ⓐ, Ⓑ AND Ⓒ, DRYWELL SIDE AND REACTOR SIDE.

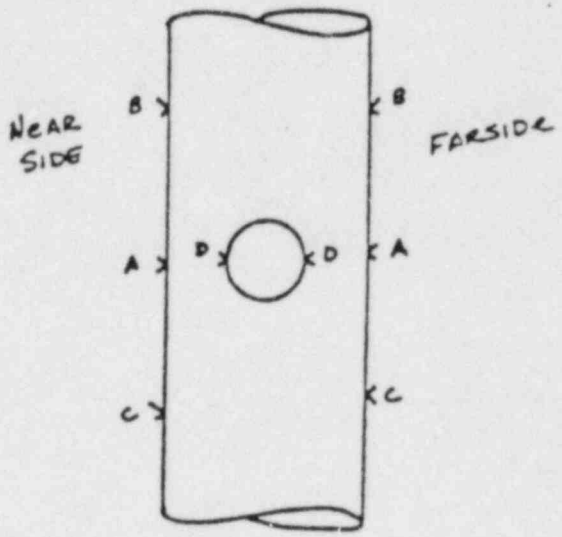
Ⓐ Mark AT ELBOW centerline at INTERSECTING POINT of Ⓑ & Ⓒ

Ⓑ Mark ON Vertical Pipe APPROX. 6" FROM EXISTING WELD ℄.

Ⓒ Mark ON VALVE RAISED BOSS at HORIZONTAL ℄.

* UNABLE TO MEASURE A SIDE "Z" READING DUE TO INTERFERENCE.





TRAM MARK SKETCH
FOR FIA SOCKET SLEEVE INSTALLATION
WORK REQUEST Q 17244

BEFORE WELDING

	NEAR SIDE	FAR SIDE
W	19 1/2"	19 1/2"
X	24"	24"
Y	23"	23"
Z	22 3/4"	22 3/4"

AFTER WELDING IS COMPLETED.

	NEAR SIDE	FAR SIDE
W	19 3/8	19 3/16
X	23 15/16	24
Y	22 9/16	22 15/16
Z	22 1/2	22 7/16

MARK WITH CENTERPUNCH at LOCATIONS (A), (B), (C) AND (D) ON NEARSIDE & FARSIDE of 12S-FIA SOCOLET.

(A) Mark at ℄ of 6" vertical pipe at intersecting line w/℄ of 2" pipe.
(B) Mark on ℄ of 6" pipe ~12"-14" above (A) mark
(C) Mark on ℄ of 6" pipe ~12"-14" below (A) Mark
(D) Mark on ℄ of 2" pipe AS close to Clamp as PRACTICAL.

VIII. TABLE OF APPENDICES

1. QOS 1600-7, Reactor Coolant Leakage in the Drywell (Temporary Procedure 1631).

2. On-Site Review No. 82-05, including proposed repair program.

3. Off-Site Review No. 82-03.

4. Administrative Control Procedure for Repair of Non-Isolable Unit 2 Clean-Up Pipe in Drywell (Temporary Procedure 1634).

5. Freeze Seal Procedures.

6. Preliminary Calculations and Analysis.

7. Administrative Procedure Training Documentation.

8. Fuel Rack Availability Letter.

9. Preliminary ALARA Review.

10. NRC Required Actions Prior to Start of Repair Program.

11. Mock-Up Examination Report.

REACTOR COOLANT LEAKAGE IN THE DRYWELL

ID/7D

A. PURPOSE

The purpose of this procedure is to detect and monitor identified and unidentified leakage in the drywell.

B. REFERENCES

1. ~~None~~. NUREG-0313.

APPROVED TEMPORARY PROCEDURE 1631-1

FOR REFERENCE ONLY

NOT VALID AFTER FEB 28

C. PREREQUISITES

1. None.

D. PRECAUTIONS

1. None.

E. LIMITATIONS AND ACTIONS

1. In the event that any one or more the following criteria are exceeded, commence an orderly shutdown if:

   a. The volume pumped from the drywell floor drain sump in a four hour period is equal to or greater than:

      (1) 1200 gallons (5 gpm).

      (2) 480 gallons greater than the previous 4 hour pump down (2gpm)

   b. The volume (Δ gallons) pumped from the drywell floor drain sump at the end of any four hour period when averaged with the previous five Δ gallons is greater than twice the average of the previous six Δ gallons.

   c. The volume pumped from the drywell equipment drain sump in an eight hour period is equal to or greater than 9600 gallons (20 gpm).

   d. If leakage is excessive but below limits, notify the Shift Supervisor to contact Rad Protection to perform a drywell manitored sample survey to identify the leakage source.

2. If either integrator reading has drifted from the end of one pump to the start of the next write a work request to correct it.

3. If the volume pumped from the drywell floor drain sump in a 4-hour period is equal to or greater than 240 gallons (but less than 480 gallons) greater than the previous 4-hour pump down, a dry well entry shall be made to identify the source of leakage. This shall apply to any Unit 2.

APPROVED AUG 21 1981 QOS S.R.

F. PROCEDURE

1. Drywell equipment drain sump.

   a. Pump down the drywell equipment drain sump twice a shift (approximately 4 hours).

   b. Record drywell equipment drain sump integrator readings, 901-4(902-4), on QOS 1600-S13 immediately before and after pumping the sump.

   c. Transfer the sum of the pumping for the shift to the Operation's Department Weekly Summary of Daily Surveillance, QOS 005-S1.

   d. Compare the volume pumped against the limiting criteria. If unacceptable, notify the Shift Engineer and refer to Technical Specification 3.6.D.

2. Drywell floor drain sump.

   a. Pump down the drywell floor drain sump every four hours.

   b. Record drywell floor drain sump integrator readings, 901-4(902-4), on QOS 1600-S9 immediately before and after pumping the sump.

   c. Close isolation valves immediately after pump trips on low level.

   d. Record integrator reading and A gallons pumped on the "Unit Drywell Floor Drain Sump Data Sheet."

   e. Average the latest A gallons with the five previous recorded gallons and record the new calculated 24 hour average.

   f. Once a shift (approximately 8 hours) transfer the sum of the pumping for the shift on Operation's Department Weekly Summary of Daily Surveillance QOS 005-S1 item 2.

   g. Compare the volume pumped per four hours against the limiting criteria. If unacceptable, notify the Shift Engineer to contact Rad Protection to perform a drywell air manifold sample and refer to Technical Specification 3.6.D.

G. CHECKLISTS

1. Operation's Department Weekly Summary of Daily Surveillance QOS 005-S1.

2. QOS 1600-S9, Unit Drywell Floor Drain Sump Data Sheet.

3. QOS 1600-S13, Unit Drywell Equipment Drain Sump Data Sheet.

H. TECHNICAL SPECIFICATION REFERENCES

1. Section 3.6.D.

2. Section 4.6.D.

May 1975

QUAD-CITIES STATION ONSITE REVIEW ASSIGNMENT

DATE 1/22/82

REVIEW NO. 82-05

REVIEW PARTICIPANTS:
L. Gerner
W. Burkamper
R. Bax
T. Tamlyn
J. Tietz

CONSULTANTS:
R. Gaitonde (OAD)
R. Tamminga (NSD-Maint)
J. Gavula (NUTECH)
D. Pitcairn (NUTECH)
G. Schulte (NSD-Maint)
T. Spry (NST-Maint)
E. Hemzy (Off-Site Staff)

ASSIGNMENT:
Provide 10 CFR 50.59 Safety Evaluation of Proposed Repair Program for Unit 2 Reactor Water Cleanup System Pipe Cracks in the Drywell

L. Gerner for
STATION SUPERINTENDENT

1 (final)

APPROVED
SEP 5 1975
Q. C. O. S. R.

QUAD-CITIES STATION
ON-SITE REVIEW REPORT

QAP 1900-12
Revision 2
February 1977

Reference Information:

OSR No: 82-05

Review Date: 1/22/82

Request Date: 1/22/82

OSR Request Originator:

Station X Off-Site Review ____

NLA ____ Other ____

NFS ____ Was Request Complete:

SNED ____ Yes ____ No ____
(Attach material submitted)

Subject: UNIT TWO Reactor Water Clean-Up System Piping Repair

Reason For Review:

Tech. Spec. 6.1.G.2.a ____ (On-Site)

Tech. Spec. 6.1.G.1.a ____ (Off-Site)

Other: NRC Bulletin ____ Deviation X

AIR Request ____ Station X

On-Site Reference Materials (attach):

Safety Evaluation X Procedures Affected ____

Tech Spec Pages ____ MOD Number ____

FSAR Pages ____ AIR Number ____

QA Manual Pages ____ Other ____

Off-Site Completion Info:

Check List Complete X Advance Notification 1/23/82 - W. Kiefer

Forward to Off-Site X Date 1/24/82

Off-Site Review Number 82-3 Person R. Gottberg
J. Colavouishi, E. Budzichowski

Disposition:

Routine Report		X
Off-Site Review for Concurrence (T.S. 6.1.G.2.a.(5))		X
AIR Issued (#)		
NRC Submittal Needed		
Technical Specification Change		
Unreviewed Safety Question		
Other		
No Further Action		
Other		

APPROVED
MAR 2 1977
U.S.A.E.C.

ON-SITE REVIEW REPORT

OSR NO 92-05

ON-SITE REVIEW SUMMARY: See Attached

ON-SITE REVIEW RECOMMENDATION: See Attached

PARTICIPANTS: [illegible]

OSR FORM - 1
RECORD OF REQUEST FOR OFFSITE REVIEW

Station Quad-Cities Onsite Review No. 82-05

Submitted by G. Tietz Date 1/22/82

____ Test or experiment not involving an unreviewed safety question.
____ Proposed test or experiment involving an unreviewed safety question
____ Proposed change to procedure, equipment or system involving an unreviewed safety question.
____ Proposed change to Tech. Spec. or license.
____ Unanticipated deficiency of design or operation of safety related structures, systems, or components.
____ Proposed change to QSEP.
__X__ Referral by T. S. Supervisor, Station Superintendent, Division Vice President Nuclear Stations, or Manager of Quality Assurance

Additional subject description: The Unit Two Reactor Water Clean-Up System Piping Repair

Supporting documents attached: Safety Evaluation, M. C. Strait Letter of January 22, 1982, to N. J. Kalivianakis, Repair Program COM 3402-002 Rev. 1 Repair Program COM 3402-003 Rev. 0, Baseline Data Figure 65-11

Date required for Offsite Review completion: _____

Received by _____ Date _____
Senior Participant

Offsite Review No. _____

Quad-Cities Station
On-Site Review No. 82-5

Unit Two Reactor Water Clean-up Piping Repair

SUMMARY

The Unit Two Reactor Water Clean-up piping butt welds inside the Drywell on line 2-1202-6"-A, from the RHRS Shutdown Cooling Suction tie-in to penetration X-14 were UT examined by CONAM and G.E., and the data obtained were verified by OAD. The indications found were divided into two categories; 1) isolable, downstream of isolation valve MO-2-1201-2 and; 2) Non-isolable, upstream of the isolation valve.

There were 8 indications discovered on the 11 butt welds on the isolable portion. Seven of these eight welds had circumferential indications on the pipe side HAZ. One weld (12S-S17) and an axial indication on the elbow side of the weld.

Of the 10 butt welds on the non-isolable line, four indications were found. A circumferential crack indication was found in the HAZ of one side of the pipe to pipe weld 12S-F6. Axial flaws were found in the elbow side of the elbow to pipe welds 12S-S9 and 12S-S10. Three axial crack indications were found in the elbow side of the elbow to valve weld 12S-F12.

A visual observation of the sockolet weld to bottom vessel drain line 2-1265-2"-A revealed this may also have a possible flaw. This weld will be PT examined to confirm the visual observation.

The repair to the isolable portion of this line consists of replacing the existing piping from isolation valve MO-2-1201-2 to the containment penetration. The original routing and pipe supports will be utilized. New piping will consist of stainless steel type 304L having the mechanical properties of type 304 stainless steel.

The repair to the non-isolable portion of line 2-1202-6"-A consists of three separate methods. The first method will install a welded sleeve around the pipe-to-pipe weld 12S-F6. This sleeve will encompass the entire Heat Affected Zone, HAZ, of weld 12S-F6, and consist of two halves welded together longitudinally with a full penetration weld and a circumferential partial penetration weld to the pipe. The axial flaws will be repaired using an automatic welding machine to lay a pad of weld material over the indicated flaws.

Should the two inch sockolet weld require repair, a sleeve will be installed which covers the crack. The sleeve will consist of two halves welded longitudinally, full penetration weld to the six-inch pipe, and circumferential partial penetration welds to the two-inch pipe. Temporary pipe restraints shall be provided to assure the integrity of the socolet welds during the sleeve installation.

The following 10 CFR 50.59 Safety Evaluation is provided for the proposed repair program for the non-isolable weld flaws:

1. The probability of an occurrence or the consequence of an accident, or malfunction of equipment important to safety as previously evaluated in the FSAR is not increased.

   The pipe from the RHRS Shutdown Cooling tie-in to the MO-2-1201-2 valve will remain intact and will not be cut open during this repair. All welding will be performed on the external pipe surfaces, thus maintaining primary coolant boundary integrity. To mitigate the consequences of a highly improbable pipe leak, the following measures will be taken:

   a. A pipe clamp will be available to expeditiously plug a small leak, freeze plug equipment will then be utilized to isolate the line prior to commencing further repairs.
   b. The LPCI Mode of RHRS, both Core Spray subsystems, and a Condensate Feedwater flow path with pumping capability will be operable.
   c. Current Standby Diesel Generator Technical Specifications will apply.

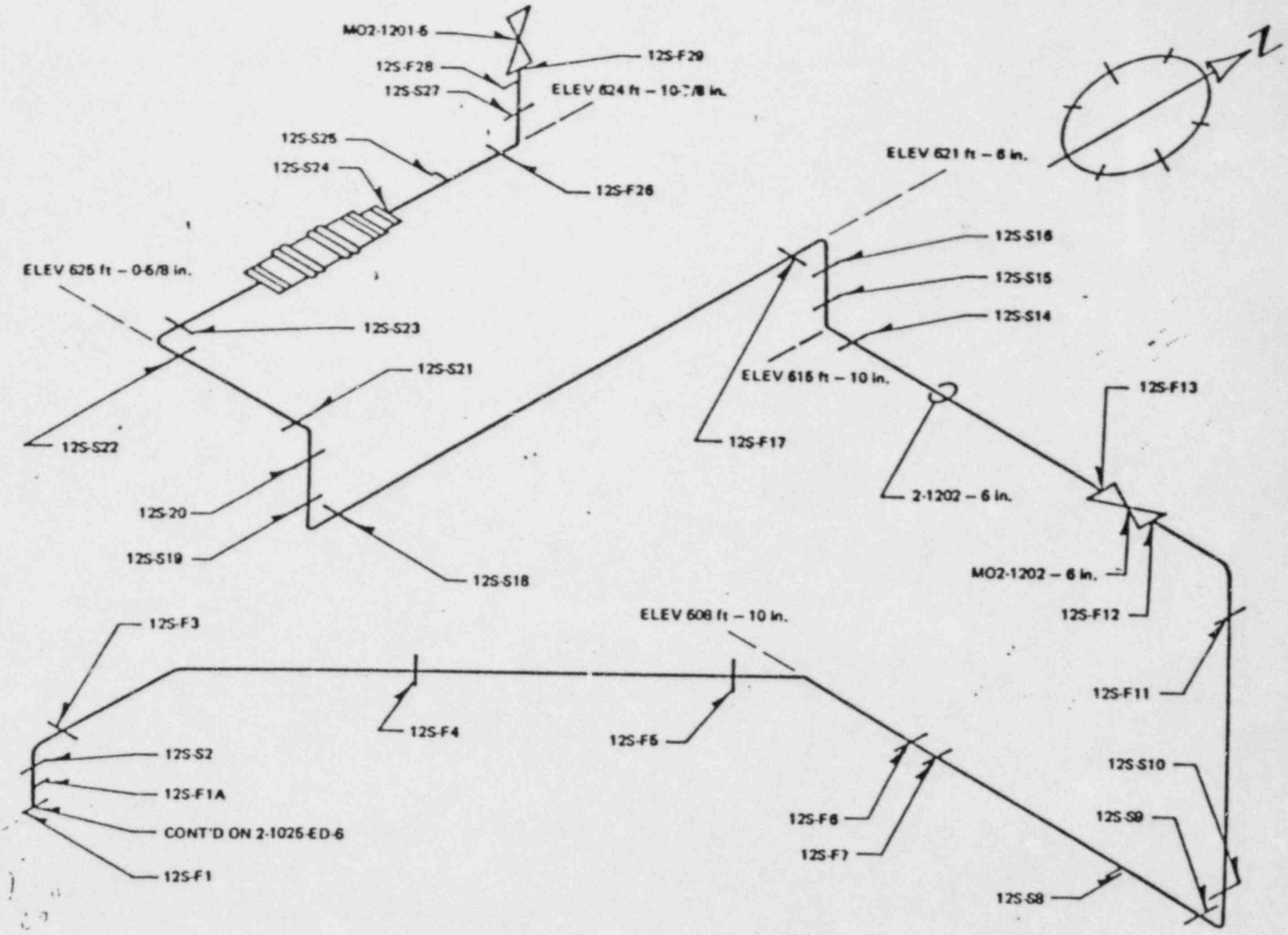
   The repair program will be performed and documented in accordance with the Commonwealth Edison Company Quality Assurance Program as approved by the NRC and the AIA. Detailed installation and inspection procedures will be written and approved to execute this repair program in a manner consistent with the highest quality of safety-related work. Quality Control, Quality Assurance, and the ANI will provide evaluations and hold points throughout the program. The sleeve installation, weld overlay and sockolet sleeve are being evaluated to meet ASME Section III Stress allowables. The piping section to be repaired serves as a primary coolant pressure boundary; however, the Reactor is in the Cold Shutdown condition with normal water level. Therefore, only head pressure (approximately 23 psig) is seen at the pipe elevation. Since this piping system does not involve an engineered safeguard system, it is not being structurally degraded during the repair program, and the Reactor is shutdown, no adverse safety implications are presented.

2. The possibility for an accident or malfunction of a different type than any previously evaluated in the FSAR is not created.

   The repair program will utilize established materials, procedures, welding techniques, and examination methods that have been utilized previously. No new nor unapproved methods or materials will be used. During the next refueling outage, a permanent repair will be implemented. Protection for personnel involved with the repair work will be afforded proper radiological protective practices to assure that personnel exposures will be ALARA.

3. The margin of safety, as defined in the basis for any Technical Specification is not reduced.

   The safety limit of maintaining Reactor water level greater than 12 inches above TAF with the Reactor in cold shutdown will be maintained. Redundant water level instrumentation will remain operable, and routine surveillance will continue to be performed. Secondary containment, SBGTS, Reactor Building vent isolation capability, and all low-pressure ECCS will be operable per Technical Specification requirements.



6J-253

Figure 6J-11. Reactor Cleanup (Ref. Dwg. 2-1202-ED-1 & 2)

RECOMMENDATION

It is the conclusion of the On-Site Review Committee that the above repair program is technically feasible and sound. When NUTECH, the ANI, the NRC and Commonwealth Edison OAD, SNED, TSN, NSD-Maint., and QA organizations have concurred with this program, the repair will be initiated. The above Safety Evaluation is hereby approved, and it is recommended that the repair program be carried out to completion.

January 22, 1982

Subject: Reactor Water Clean-up Line
Repair Program COM-3402-002, Rev. 1,
Dated January 19, 1982

Mr. M.J. Kalivianakis,

SNED has reviewed the subject program and concur with the requirements. However, we would like to emphasize that the new pipe should be routed identical to the old pipe routing. There has been an analysis of the old routing which would apply to the new piping provided no dimensions are changed. This will save time, because the same supports could be used. An as-built drawing should be forwarded to SNED to confirm the new pipe routing is the same as the old pipe. If you have any questions or comments, please contact us.

RECEIVED
1842282

ROUTE:
___ A (Asst. Supt.)
___ B (Operations)
___ C (Maintenance)
___ D Admin. & Tech.
___ E Personnel
___ _____
___ _____
___ _____
Initial _____

M.C. Strait
M.C. Strait

Approved:
D.S. Abel
SNED Manager

MCS:anh
1509D

Telecopy to: Dick Bax
Quad Cities
from: M. Strait
SNED

COM-3402-002
Revision 1
January 19, 1982

RECEIVED
JAN 19 '82

ROUTE:
MNT I
A (Asst. Supt.)
B (Operations)
C (Maintenance)
D Admin. & Tech.
E Personnel
Initial

REPAIR PROGRAM

REACTOR WATER CLEAN-UP LINE

QUAD CITIES UNIT 2

A. Description of Repair

This program addresses the replacement of the 6" NPS schedule 80S Reactor Water Clean Up Line, Line No. 2-1202-6"A. The line will be replaced from the inboard isolation valve, valve no. 2-1201-2, downstream to the drywell penetration to the insert pipe. Pup pieces at the valve and at the penetration will be left in place to simplify the replacement.

B. Jurisdictional Concerns

1. The maintenance of nuclear power components is addressed in Section VIII of the Illinois Boiler Safety Act, 1978, which references the ASME Boiler and Pressure Vessel Code, Sections III and XI. In addition, 10CFR50 dictates the use of ASME Section XI for the repair.

2. This repair program shall be submitted to the Authorized Nuclear Inspector. In addition, this program is subject to review by all enforcement and regulatory authorities having jurisdiction at the plant.

3. The repair shall meet the requirements of ASME Section XI, 1977 Edition up to and including the Summer 1978 Addenda.

C. Code of Construction

The Reactor Water Clean-Up Line downstream of the isolation valve was designed, fabricated, examined and tested in accordance with USAS B31.1.0-1967 and Sargent & Lundy Specification R-2330.

D. Code of Repair

This repair shall be performed in accordance with the original Code of Construction and Design Specification referenced in Section C, except as modified in Section F of this program.

E. Flaw Description and Failure Mode Evaluation

1. The flaws are circumferential and longitudinal stress corrosion cracks located in the drywell between the inboard isolation valve and the drywell.

2. The initial flaw was revealed by water leakage. Subsequent flaws were revealed by ultrasonic testing.

3. The failure mode is intergranular stress corrosion cracking. In order to prevent future occurrence of this type of failure, low carbon stainless steel will be used as replacement material.

F. Repair Requirements

1. Material

a. Existing:

(1) The existing pipe is ASTM A312 TP 304.

(2) The existing fittings are ASTM A403, Gr. WP304.

b. New material shall meet the requirements of USAS B31.1.0-1967 and shall be as follows:

(1) pipe: ASME SA-312 TP 304L with physical properties meeting the requirements of TP 304.

(2) fittings: ASME SA-403, Gr. WP304 with carbon content limited to 0.035% maximum.

2. Fabrication

a. All welding shall be performed in accordance with welding procedure specifications which have been qualified in accordance with ASME Section IX.

b. All welders shall be qualified in accordance with ASME Section IX.

c. The repair is exempt from postweld heat treatment.

3. Testing

A system pressure test shall be performed in accordance with Article IWA-5000 of ASME Section XI. The test shall be performed at 1.10 times the operating pressure at 100°F.

4. Nondestructive Examination

a. All welds shall be visually examined, liquid penetrant examined and radiographically examined in accordance with Commonwealth Edison Special Process Procedures.

b. All welds shall be ultrasonically examined to establish a new preservice record.

5. Code Stamping

Code stamping of the replacement is not required and shall not be performed.

G. Quality Assurance

All work shall be performed in accordance with the Mechanical Incorporated Quality Assurance Program as it interfaces with Commonwealth Edison's Quality Assurance Program.

H. Records

1. Code Data Report

An ASME Section XI NIS-1 Form shall be prepared and shall be signed by the Authorized Nuclear Inspector.

2. Documentation

Permanent records to be maintained by Quad Cities Station are:

a. Certified Material Test Reports for all material.

b. Welding Procedure Specifications and Qualification Records.

c. Welder Qualification Records

d. Nondestructive Examination Reports

e. Nondestructive Examination Procedures and Personnel Qualifications

f. Completed Station Traveler

g. Repair Program

h. As-built Drawings of sketches of the repair

i. Code Data Report for the repair

JAN 21 '82

ID/QC ROUTE:

A (Asst. Supt.)
B (Operations)
C (Maintenance)
D Admin. & Tech.
E Personnel

(initial)

COM-3402-003
Revision 0
January 20, 1982

REPAIR PROGRAM
NON-ISOLATABLE PORTION OF
REACTOR WATER CLEAN-UP LINE

QUAD-CITIES UNIT 2

A. Description of Repair

This program addresses the repair of the 6" NPS schedule 80S Reactor Water Clean Up Line, Line No. 2-1202-6"A. These repairs are located between the tie-in to the 20" recirculation line and the inboard isolation valve (2-1201-2).

B. Jurisdictional Concerns

1. The maintenance of nuclear power components is addressed in Section VIII of the Illinois Boiler Safety Act, Vessel Code, Sections III and XI. In addition, 10CFR50 dictates the use of ASME Section XI for the repairs.

2. This repair program shall be submitted to the Authorized Nuclear Inspector. In addition, this program is subject to review by all enforcement and regulatory authorities having jurisdiction at the plant.

3. The repair shall meet the requirements of ASME Section IX, 1977 Edition up to and including the Summer 1978 Addenda.

C. Code of Construction

The Reactor Water Clean-Up Line from the reactor vessel to the isolation valve was designed, fabricated, examined and tested in accordance with the 1965 Edition of ASME Section I with the Winter 1966 Addenda and Sargent & Lundy Specification R-2330.

D. Code of Repair

This repair shall be performed in accordance with the original Code of Construction and Design Specification referenced in Section C, except as modified in Section F of this program.

E. Flaw Description and Failure Mode Evaluation

1. The flaws are circumferential and logitudinal stress corrosion cracks located in the drywell between the inboard isolation valve and the reactor.

2. The flaws were revealed by ultrasonic examination.

3. The failure mode is intergranular stress corrosion cracking. In order to prevent future occurrence of this type of failure, low carbon stainless steel and stainless steel weld metal will be used as repair material.

F. Repair Requirements

1. Material

a. Existing:

(1) The existing pipe is ASTM A312 TP 304.

(2) The existing fittings are ASTM A403, Gr. WP304.

b. New material shall meet the following:

(1) Pipe: ASME SA-312 Tp 304L with physical properties meeting the requirements of TP 304.

(2) Plate: ASME SA-240 Type 304L with physical properties meeting the requirements of TP 304. Rolled plate shall be solution annealed.

(3) Welding material: Type 308L stainless steel.

(4) Bar stock: Type 304L stainless steel.

2. Fabrication

a. All welding shall be performed in accordance with welding procedure specifications which have been qualified in accordance with ASME Section IX.

b. All welders shall be qualified in accordance with ASME Section IX.

c. The repair is exempt from postweld heat treatment.

3. Testing

An initial service leak test shall be performed.

4. Nondestructive Examination

a. All full penetration butt welds shall be visually examined, liquid penetrant examined and ultrasonically examined in accordance with Commonwealth Edison Special Process Procedures.

b. All other welds shall be visually and liquid penetrant examined in accordance with Commonwealth Edison Special Process Procedures.

5. Code Stamping

Code stamping of the repair is not required and shall not be performed.

G. Quality Assurance

All work shall be performed in accordance with the Mechanical Incorporated Quality Assurance Program as it interfaces with Commonwealth Edison's Quality Assurance Program.

H. Records

1. Code Data Report

An ASME Section XI NIS-1 Form shall be prepared and shall be signed by the Authorized Nuclear Inspector.

2. Documentation

Permanent records to be maintained by Quad-Cities Station are:

a. Certified Material Test Reports for all material.

b. Welding Procedure Specifications and Qualification Records.

c. Welder Qualification Records.

d. Nondestructive Examination Reports.

e. Nondestructive Examination Procedures and Personnel Qualifications.

f. Completed Station Traveler.

g. Repair Program.

h. As-built drawings of sketeches of the repair.

i. Code Data Report for the repair.

ID/DAILY-D

REACTOR WATER CLEANUP SYSTEM
REPAIR DESCRIPTION

A. Findings

1. The initial leak was noted in weld S-14 (ref. drwg. ISI-119).

2. UT exam of all 6" RWCU butt welds between the 20" shutdown cooling suction header to the outboard isolation valve (outside containment) was performed.

3. Within containment 8 of 11 butt welds downstream of the inboard isolation valve had UT reflectors indicative of cracks.

4. Seven of these 8 welds had circumferential indications on the pipe side HAZ. One weld (F17) had an axial indication on the elbow side of the weld.

5. No indications were found in welds outside containment.

6. The isolable portion of the RWCU line within containment will be replaced with Type 304L stainless steel having .035 max. carbon and meeting the mechanical requirements of regular Type 304.

7. The non-isolable side has 10 butt welds. The ultrasonic examination found indications in 4 of the welds.

8. A circumferential crack indication approximately 95% through wall and 1-1/2" in length was found in the HAZ of one side of the pipe to pipe weld identified F6.

9. Longitudinal crack indications were formed in the elbow side of the elbow to pipe welds designated S9 and S10. These indications were approxmiately 3/4" long and 50% of wall.

10. Three longitudinal crack indications were found in the elbow side of the elbow to valve weld F12. These indications were approximately 3/4" long and 50% to 95% of wall.

11. A suspected leak was noted at a 2" branch line to sockolet weld. The sockolet to 6" line weld is designated F1A.

12. Weld F5 had been examined under the ISI program during the recent refueling outage and again at this time. The weld was found to be acceptable.

B. Repair

The pipe to pipe joint F6 containing the circumferential crack indication will be repaired using a sleeve as shown in Figure 1. The sleeve will provide an independent pressure boundary around and to either side of the existing weld F6. Partial penetration welds as shown in Fig. NB-4244(d)2

of ASME Section III will be used for the circumferential welds of the pipe sleeve. The final sleeve dimensions and attachment weld size will be determined by stress analysis. The sleeve material will be Type 304L stainless steel with 0.035 max carbon and having mechanical properties of Type 304. The sleeve provides pressure boundary integrity for mechanically separated 6" pipe sections.

The longitudinal crack indications in the elbows at joints S9, S10, and P17 will be repaired by depositing weld metal 360° around and to either side of the existing welds (Figure 2). The weld deposited bands will be approximately 6" long and 1/2" thick although final dimensions will be determined by stress analysis. The bands will provide pressure boundaries independent of the of the underlying original weld joints.

The suspected leak in the 2" side of the sockolet will be repaired with a sleeve as shown in Figure 3. This sleeve similar to a standard type sockolet will provide an independent pressure boundary around the entire existing sockolet by attaching to the 6" RWCU line and to the 2" drain line above the sockolet.

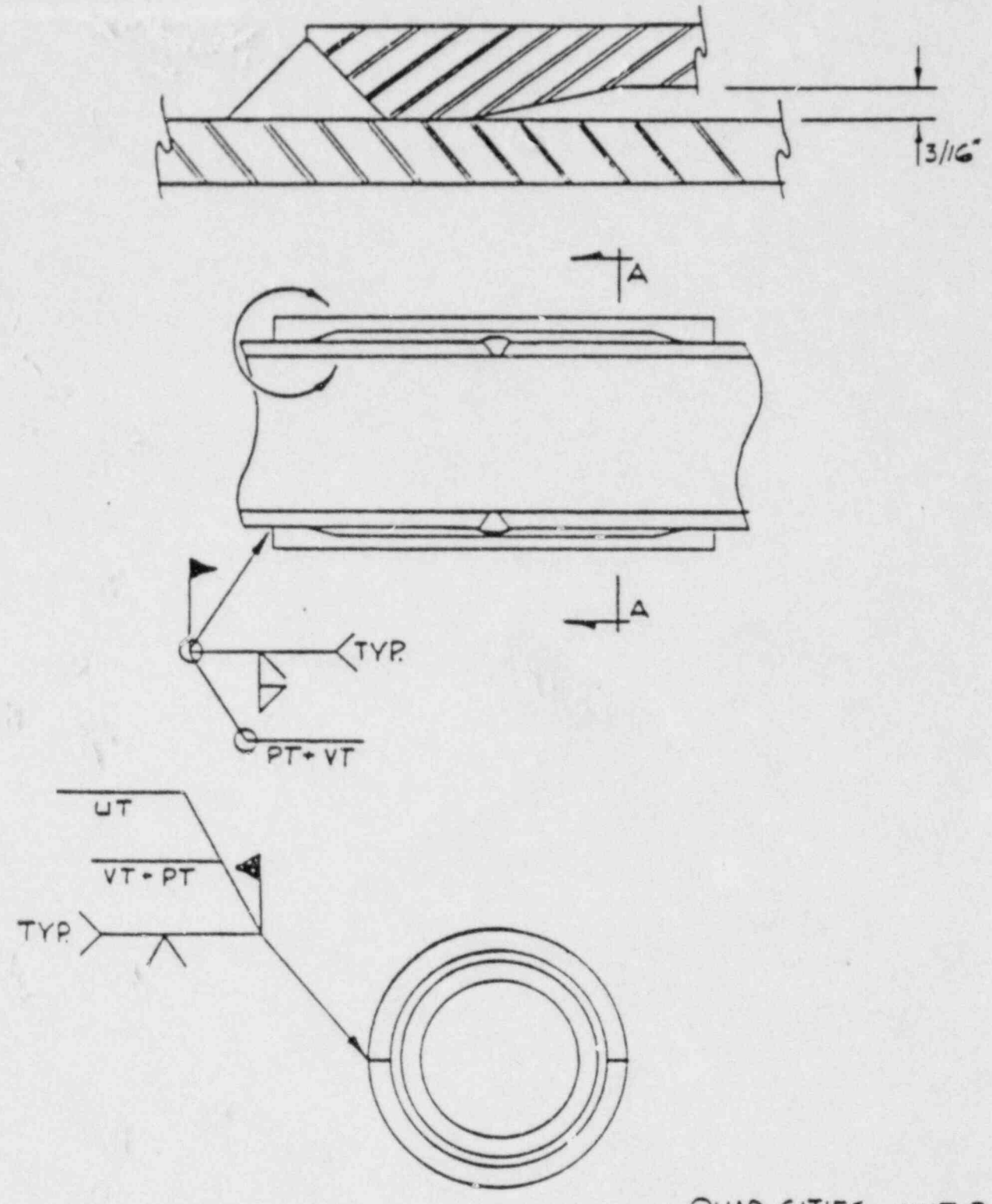
The repairs to the non isolable portion of the RWCU line are temporary and the line will be replaced at the next refueling outage planned for the spring of 1983.

C. Technical Evaluations

The crack indications in all instances are assumed to be intergranular stress corrosion cracking (IGSCC). The sleeve repairs are straight forward in establishing an independent pressure boundary around the welds with indications. IGSCC is associated with the weld heat affected zones (HAZ) of Type 304 stainless steel. The existing crack indications may propagate in the heat affected zones and become through wall; however, the conditions for IGSCC only exist in the HAZ where sensitization has occurred due to the heat of welding and residual stresses due to welding are relatively high. The sleeve designs can accomodate complete separation of the existing welds. The type 304L sleeve material is highly resistant to IGSCC in the welded condition and is listed as an acceptable material in NUREG 0313 Rev. 1.

The weld deposited bands over the longitudinal crack indications are similar to sleeves and provide independent pressure boundaries around the existing welds. Longitudinal IGSCC cracks should not propagate significantly beyond the HAZ due to the absence of sensitization and the reduced weld residual stresses. The lengths of the longitudinal crack indications in the RWCU line are similar to those found in the investigation of the Quad-Cities Unit 2 core spray piping. The shrinkage of the weld metal during deposition of the bands is expected to produce compressive circumferential stresses in the underlying base and weld metal. Compressive residual stresses should mitigate propagation of the existing indications. Weld metal has proven to be highly resistant to propagation of IGSCC. Therefore even if the existing crack indications should propagate through wall, they would be arrested by the weld metal bands.

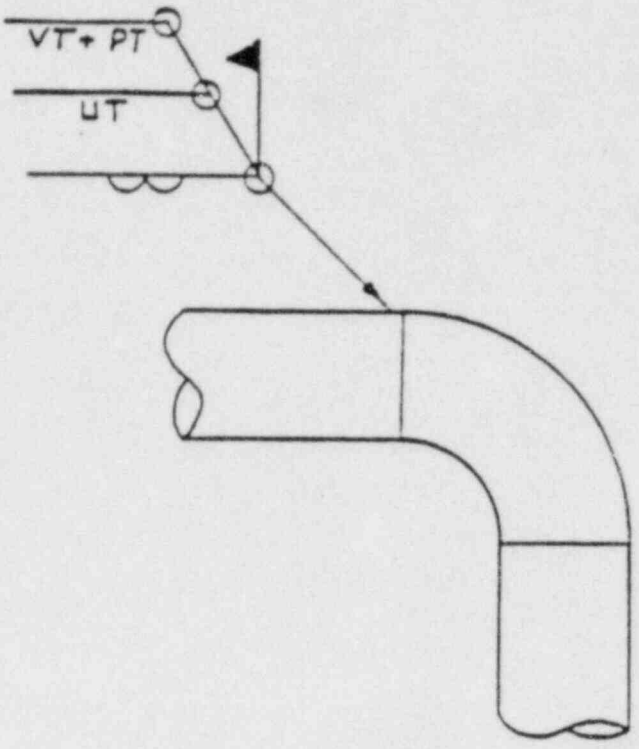
FIG. 1

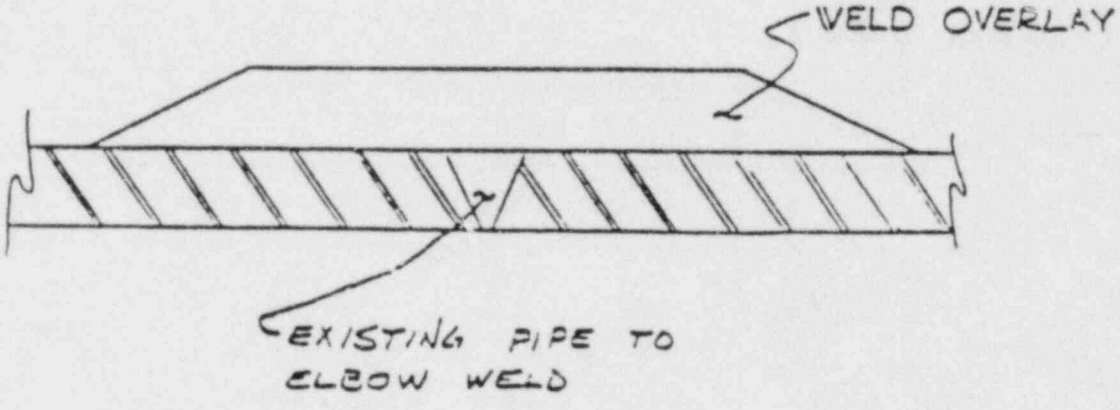


SEC. AA

QUAD CITIES UNIT 2
F6 WELD SLEEVE
RWCU SYSTEM

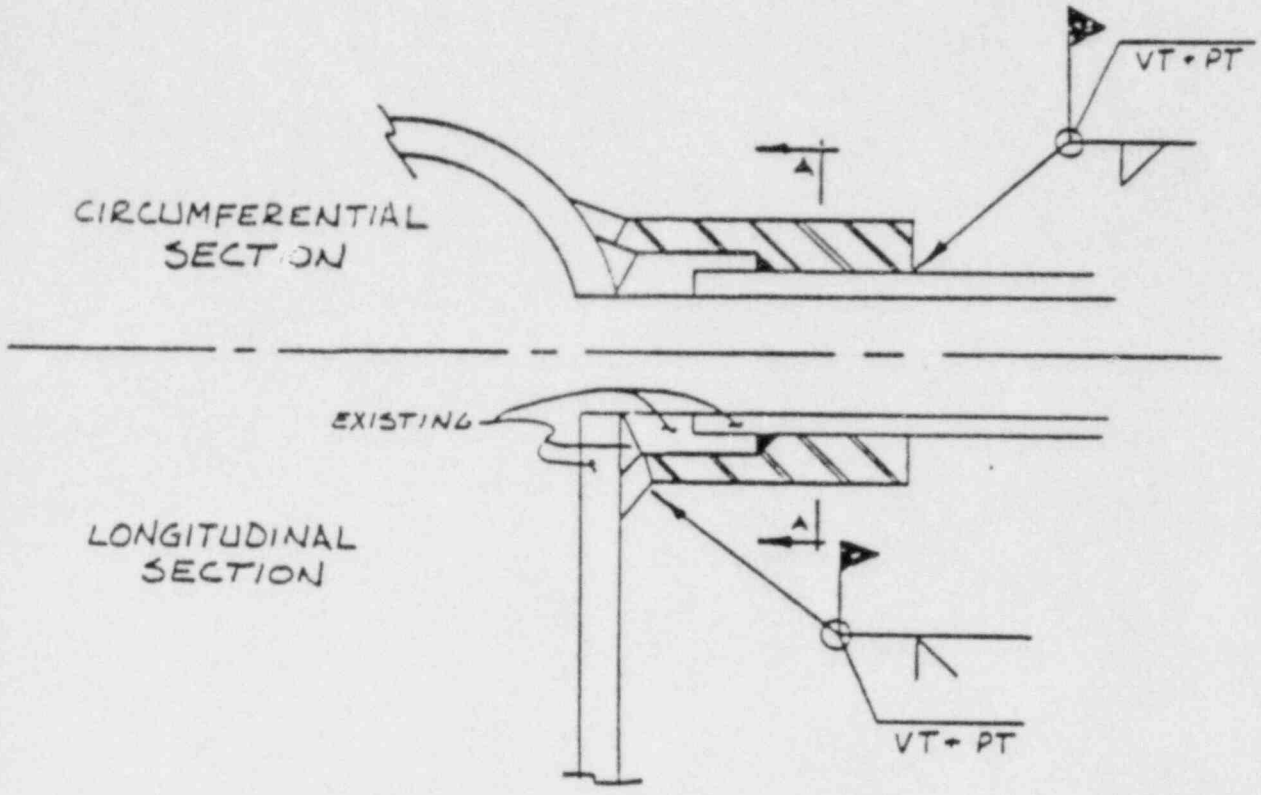
FIG. 2

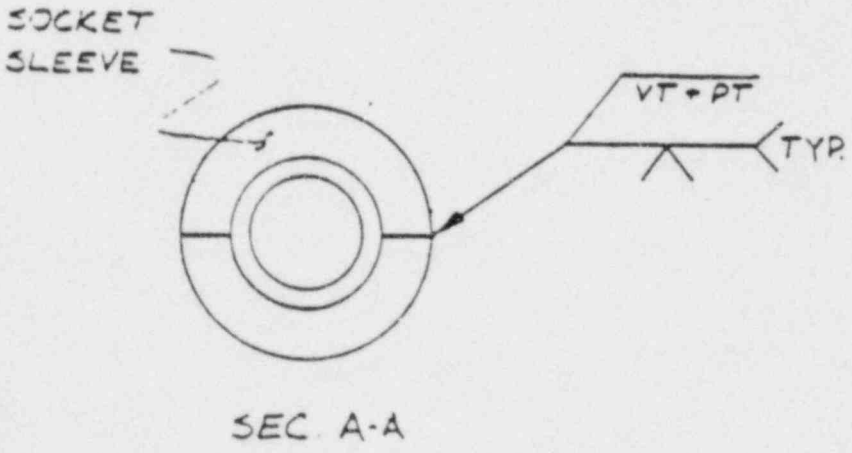




QUAD CITIES UNIT 2
WELD OVERLAY
F12, S10, S9 WELDS
RVCU SYSTEM

FIG. 3





SEC. A-A

QUAD CITIES UNIT 2
SOCKET SLEEVE
F.I.A. WELD
RWCU SYSTEM

January 25, 1982

Quad Cities Offsite Review 82-3
Subject: Unit Two Reactor Water Clean-up
System Piping Repair

Background and Discussions

On Thursday, January 14, 1982 Quad Cities Unit 2 experienced a B Recirculation Pump MG set trip resulting from improper exciter brush seating reducing reactor power to approximately 50%. After repair of brushes and subsequent pump restart, a low oil level alarm was received on the lower motor bearing necessitating a drywell entry for inspection. During the inspection, leakage was detected from a clean-up system 6" line weld located at an elbow downstream of the inboard M.O. isolation valve.

Prior to the Recirculation MG set trip an upward trend had been detected on the drywell floor drain sump input indicating some additional unidentified leakage over normal. The unit was immediately shutdown for a determination of the extent of the leakage and repair.

On Sunday, January 24, 1982 three Nuclear Safety personnel attended a briefing meeting at the station to review the safety significance of the proposed repair.

During the station briefing and subsequent telecons, the repair program was determined to be adequate based on the technical expertise involved and in conformance with the ASME Code methods allowed for repair. The station onsite review lists those Company personnel involved in the development of the repair program.

Conclusion

Offsite Review concurs with the program presented in Quad Cities OnSite Review 82-05 for the Unit 2 reactor water clean-up system pipe repair.

Offsite Review believes that the present leak detection methods are adequate for detecting future pipe cracks and recommends that because the pipe configuration of Unit 1 is the same as Unit 2, Offsite Review recommends a visual inspection of Unit 1 clean-up system at pressure during the next outage.

Participants/Disciplines
E. Budzichowski a,b,c,h
J. S. Kolanowski a,b,c

E. Budzichowski
Senior Participant

Supervisor of Offsite Review
and Investigative Function

Administrative Procedure for Unit Two Reactor Water Clean-up
Pipe Repair Upstream of MO-2-1201-2

A. Purpose

The purpose of this procedure is to outline the method to provide administrative instructions, procedures, and guidelines to assure that the repair of the non-isolable section of the Unit Two Reactor Water Clean-up Pipe is carried out in a manner that will assure the safety of the Reactor and plant personnel.

B. References

1. Quad-Cities Station On-Site Review 82-05, including 10 CFR 50.59 Safety Evaluation.

2. Repair Program COM-3402-003, Revision 0, dated January 20, 1982, including repair description.

3. Work Request Package Q17244, with associated travelers, procedures, and supporting documentation.

4. Quad-Cities Station Operating Surveillance Procedures QOS 005-2 (Normal Control Room Inspection) and QOS 005-S1 (Weekly Summary of Daily Surveillance).

5. Commonwealth Edison Company Quality Assurance Manual.

6. Abnormal Operating Procedures QGA-1 (Large Line Break Inside Containment) and QGA-2 (Small Leak Inside Containment), and QGA-18 (Loss of Feedwater).

7. Operating Procedures QOP 1000-5 and 1000-12.

C. Prerequisites

1. Prior to initiating the repair programs and procedures outlined in On-Site Review 82-05 and Work Request Package Q17244, the following prerequisites must be satisfied:

   a. An Operating Engineer shall be on-site at all times during the repair program.

   b. The LPCI Mode of RHRS shall be operable.

c. Both Core Spray subsystems shall be operable at all times, including the Core Spray pumps and valves constituting the injection paths being in their normal configuration.

d. Both the 1/2 & 2 Diesel Generators shall be operable. Technical Specification 3.9.E.2 (Diesel Generator preventative maintenance for one and one-half hours) may be applied during this clean-up pipe repair period.

e. A Condensate-Feedwater System flow path shall be available, with pumping capability.

f. Suppression Pool water level within Technical Specification limits (between -2 inches and +2 inches).

g. Contaminated Condensate Storage Tanks at sufficient levels to provide backup water to Suppression Pool for Core Spray and LPCI.

h. Secondary Containment shall be in effect with both SBGT Systems operable and the capability for Reactor Building Ventilation isolation in effect.

i. Reactor water temperature being properly controlled utilizing the intermittent operation of the Shutdown Cooling Mode of RHRS in accordance with QOP 1000-5, or equivalent.

j. Reactor water level shall be closely monitored at all times during this repair program from all Control Room Reactor Water Level instrumentation. Normal Control Room inspection procedure, QOS 005-2, shall govern this item, and procedure QOS 005-51 shall be used to document the normal routine level instrument checks. Level is to be maintained between +20" and +40" indicated level.

k. The control switches on panel 902-4 for the Drywell floor and Equipment Drain Sump Pumps shall be kept in pull-to-lock, except when the sumps are pumped every four hours, per procedures.

l. Clamps for 6 inch ID pipe and freeze-seal equipment available. Clamp assembly installed to restrain 2 inch bottom vessel drain pipe to the 6 inch clean-up lines. Clamp available that will cover up the 6 inch pipe sleeve assembly and weld F-6. Various other clamp and seal devices (straps, rubber, Devcon, etc.) should be available as contingencies.

m. The Master Electrician or Electrical Foreman will inspect the set-up, installation, and arrangement of all welding machines. The Operating Engineer will verify that the electrical load from the machines is compatible with present bus loads.

n. Communications will be established between the Control Room and the Drywell. Normal communications will be maintained using radios or the P.A. System. Backup communications are provided by the dial phones in the Drywell, and adjacent to the desk outside the Drywell.

o. Radiation surveys and air samples taken to assure proper radiation exposure planning and management to keep doses ALARA. Shielding should be installed so that exposures are optimized and kept as low as possible.

p. The Shift Engineer shall be notified just prior to the initiation of automated welding.

q. Freeze-seal jackets in place for 6 inch pipe weld repairs. In addition, prior to initiating weld overlay repairs, a freeze plug shall be established ~~for the first weld~~ until sufficient weld metal has been deposited as specified in the station traveler.

2. Prior to starting welding on the non-isolable section of clean-up system piping inside the Drywell, a detailed training session shall be held, and documented as per Attachments 1A, 1B, and 1C:

a. Job Supervisory and Damage Control personnel shall be instructed on the condition of the Reactor, the level of water in the Reactor, the piping configuration with respect to the Reactor, and the implications of a leak in the system.

b. Job Supervisory and Damage Control personnel shall be instructed in the organization outline and malfunction procedure given in Attachment 2.

c. Damage Control Supervisors shall be instructed on the use of the freeze-seal equipment.

and Damage Control

d. Supervisory personnel shall be instructed in the use of the pipe clamp devices.

THE ABOVE PREREQUISITES ARE DOCUMENTED ON ATTACHMENT 3 BY THE OPERATING ENGR.

D. Precautions

1. Monitor Reactor water level throughout the repair period.

2. All personnel in the area of the repair will wear the proper protective clothing and respiratory equipment, as prescribed by Radiation Protection. The RCT on duty at the Drywell has responsibility to ensure radiation exposures are properly documented. The ALARA Coordinator shall evaluate the shielding effectiveness throughout the repair program, based on dose received and work conditions. Periodic air samples and area surveys shall be taken. Exposure approvals shall be in compliance with QRP 100-1, Radiation Control Standards.

3. Strict enforcement of and adherence to the Out-Of-Service procedure involving the Unit Two Clean-up System is necessary.

E. Limitations and Actions

1. If during the repair, a critical step is in progress at shift change of the repair personnel, the critical path operation shall be completed prior to the shift change.

2. A shift log shall be maintained by a cognizant CECo supervisor at the Drywell. Significant items should be logged, including time, description, and any necessary corrective or supplementary actions taken. Status of the repair should be understood by all supervisory personnel.

3. Surveillance on plant systems and components in accordance with the Technical Specifications is permissible upon concurrence with the Operating Engineer.

4. Should either LPCI, a Core Spray, a DG or SBGTS train become inoperative enter appropriate Tech Spec LCO. Should a Condensate - feedwater flow path become inoperative, assure availability of LPCI and Core Spray.

APPROVED TEMPORARY PROCEDURE NOT VALID AFTER

F. Procedure

1. Perform the repair program in accordance with the work Package.

2. A pipe leak caused by the welding process is very unlikely. However, to mitigate the consequences of a leak should it occur on the 6 inch line, a pipe clamp is available to be installed on the line adjacent to the location of the weld deposit areas. Upon the discovery of a leak, the following is to be performed:

a. As quickly as possible, remove the welding apparatus from the area.

b. Install the clamp over the leak and tighten down on the bolts sufficiently to slow down and stop the leak. The water in the pipe will be at approximately 23 psig pressure (with 30 inches Reactor water level indicated).

c. Initiate malfunction procedure as per Attachment 2.

d. Using freeze-seal equipment, install freeze plug in line upstream of the leak using approved procedure.

e. After leakage has stopped, remove clamp and continue with repair.

NOTE

Water leakage of a minor quantity will flow to the Drywell floor drain sump. Routine pumping of the sump will keep it from overflowing. There will be no likely response on the Reactor water level instrumentation for a small leak.

3. To mitigate the consequences of a leak from the 2 inch bottom vessel drain line where it ties into the 6 inch clean-up line, the following is to be performed:

a. As quickly as possible, remove the welding apparatus from the area.

b. Tighten down on straps to bring 2 inch pipe into the sockolet. This should reduce the leakage.

c. Initiate malfunction procedure as per Attachment 2.

d. Steps will be taken to stop the leak.

4. Should a highly unlikely catastrophic failure occur that causes significant leakage that cannot be stopped, perform the following:

a. Initiate malfunction procedure as per Attachment 2. Isolate the Reactor Building Vent System and START an SBGTS train.

b. Using the Condensate-Feedwater System, add water to the Reactor vessel as follows:

(1) START, or verify running a Condensate-Condensate Booster Pump.

(2) Verify Feedwater Heater isolation valves are OPEN.

(3) OPEN a Feedwater isolation valve, either MO-2-3205A or MO-2-3205B.

(4) Use low flow Feedwater Regulator AO-2-643 to control Reactor vessel level.

(5) Avoid water level drop to Group II Isolation/Reactor scram level (+8 inches) or ECCS initiation level (-59 inches).

(6) Pump water from the Suppression Pool to the Condenser Hotwell using procedure QOP 1000-12.

b. If a Condensate-Feedwater malfunction occurs, Core Spray or LPCI must be used to fill the vessel. Refer to QGA-18.

(1) Core Spray:

(a) START either 2A or 2B Core Spray Pump.

(b) OPEN injection valve MO-2-1402-25A/B to admit water to the vessel.

(c) Core Spray injection valves cannot be throttled; therefore, to stop flow, the pump must be shut off and then re-started to add water to the vessel again.

(d) Initiate redundant Core Spray Loop, if necessary, using above steps.

(2) LPCI:

(a) On loop that is not being used for shutdown cooling, START an RHRS pump and OPEN injection valve MO-2-1001-29A/B.

(b) Throttle flow using valve MO-2-1001-28A/B to maintain desired water level. START the other RHR pump in that loop if more flow is needed.

(c) Initiate additional flow capacity by terminating shutdown cooling and starting up the redundant [illegible] injection loop.

G. Checklists

1. Attachment 1, Training Documentation.
2. Attachment 2, Organization Outline.

H. Technical Specification References

1. Section 1.1.D.
2. Section 3.5.F.2.
3. Section 3.7.C.1.

JK VW
DB ES

ATTACHMENT 1A

CECo Supervisory Personnel Training
for
Non-Isolable Unit Two
Reactor Water Clean-up Pipe Repair

1. I have received training on the condition of the Reactor, Reactor water level, Clean-up Piping configuration, and implications of system leakage.

SIGNATURE _____ DATE _____ TIME _____

2. I have been instructed in the organizational outline and malfunction procedure.

SIGNATURE _____ DATE _____ TIME _____

3. I have been instructed in the use of the pipe clamp devices.

SIGNATURE _____ DATE _____ TIME _____

4. I have instructed welders and fitters on the significance of the job and who to notify should a leak develop.

SIGNATURE _____ DATE _____ TIME _____

INSTRUCTOR _____ DATE _____ TIME _____

APPROVED
TEMPORARY
PROCEDURE 1631
NOT VALID AFTER
2

GH
MJ
RT
JP

ATTACHMENT 1B

CECo Damage Control Supervisory Personnel Training
for
Non-Isolable Unit Two
Reactor Water Clean-up Pipe Repair

1. I have received training on the condition of the Reactor, Reactor water level, Clean-up Piping configuration, and implications of system leakage.

SIGNATURE _____ DATE _____ TIME _____

2. I have been instructed in the organizational outline and malfunction procedure.

SIGNATURE _____ DATE _____ TIME _____

3. I have been instructed in the use of the pipe clamp devices.

SIGNATURE _____ DATE _____ TIME _____

4. I have been instructed on the use of freeze-seal equipment.

SIGNATURE _____ DATE _____ TIME _____

INSTRUCTOR _____ DATE _____ TIME _____

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TEMPORARY
PROCEDURE 1631
NOT VALID AFTER

ATTACHMENT 1C

CECo Damage Control Mechanic Personnel Training
for
Non-Isolable Unit Two
Reactor Water Clean-up Pipe Repair

1. I have received training on the condition of the Reactor, Reactor water level, Clean-up Piping configuration, and implications of system leakage.

SIGNATURE	DATE	TIME

2. I have been instructed in the organizational outline and malfunction procedure.

SIGNATURE	DATE	TIME

3. I have been instructed in the use of the pipe clamp devices.

SIGNATURE	DATE	TIME

INSTRUCTOR	DATE	TIME

ATTACHMENT 2

Unit Two Reactor Water Clean-up
System Repair - Non-Isolable Portion

Organization Outline

Manpower Requirement/Shift

Operating Engineer: 1 SRO
Job Supervisor: 1 Supervisor
Damage Control: at least one supervisor & 1 mechanic shall be at the Drywell - 2 supervisors and 2 mechanics

Radiation Protection: 1 RCT
Others: (1) Authorized Nuclear Inspector
(2) NDE Personnel
(3) CECo Q.C. and CECo Q.A.
(4) Welders, Pipe Fitters as necessary

Malfunction Procedure

If a malfunction should occur, the Damage Control Team should be promptly notified. For a small leak, these personnel should enter the Drywell in rubber gear (if necessary) and administer the installation of the pipe clamp. They should then proceed to install the freeze-seal on the pipe if it is not established already. The RCT should dress-up and enter the Drywell to assess the leak from a personnel contamination and exposure viewpoint. The Control Room should be notified of the problem, who will notify the Shift Engineer. The Job Supervisor should assist the Damage Control Team, and direct the need for further assistance. For a large leak, the Damage Control Supervisors and the RCT should enter the Drywell in rubber gear to assess the situation. Personnel should be evacuated from the Drywell in this case. The Control Room must be promptly notified to initiate Reactor water level restoration. The Damage Control Supervisors and Team will determine the proper equipment and manpower necessary to stop the leak. They will then re-enter the Drywell and terminate the leak. The Job Supervisor and Damage Control Team personnel shall be trained in the usage of clamps, while Damage Control Supervisors will be trained on the use of freeze-seal equipment.

Operating Engineer Checklist
for Procedure Prerequisites

DAY*		1											
ITEM	SHIFT	2			2	1	2			2	1	2	
1. Oper Eng On-Site													
2. LPCI Operable													
3. Both Core Spray Operable													
4. DG 1/2 & 2 Operable													
5. Cond-FW Available													
6. Torus Level Normal													
7. CCST Level Normal													
8. Secondary Cont. in Effect													
9. SBGTS, RB Vent Isol Oper													
10. Rx Water Temp Normal													
11. Rx Water Level Normal													
12. DW Sump pumps in PTL (except during pumping)													
13. Clamps Available													
14. Freeze-seal Equip Available													
15. Welding Machine Setup Inspected													
16. Communications Established													
17. Rad Surveys & Air Samples Current													
18. Shift Engineer Informed													
19. Damage Control Personnel Trained													
20. Damage Control Locker Inventoried													

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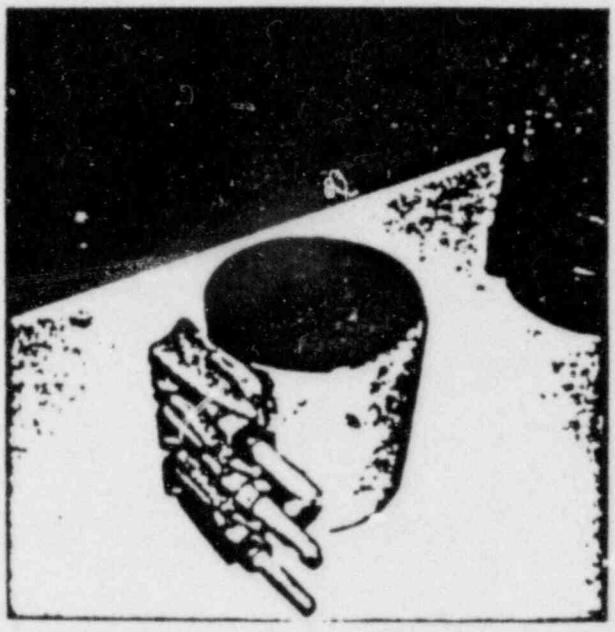
* Use additional sheets if necessary



6-INCH PIPE CLAMP

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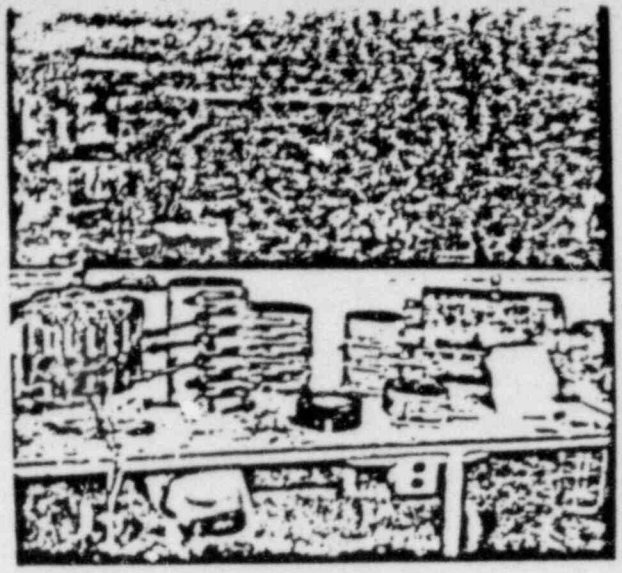
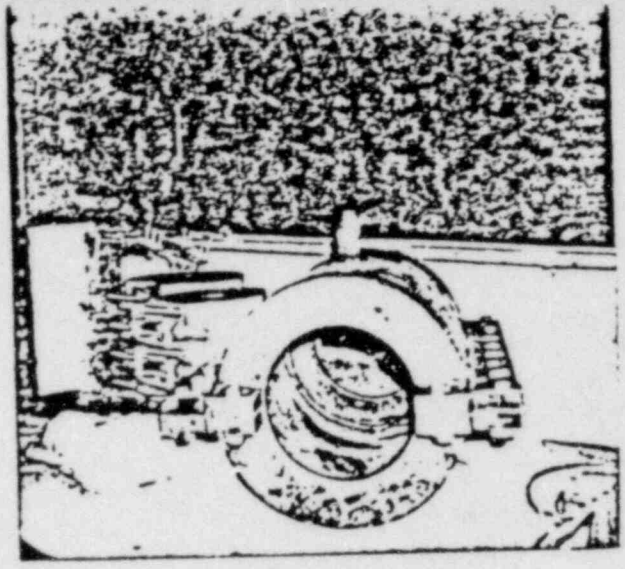
TEMPORARY

[illegible] 1981

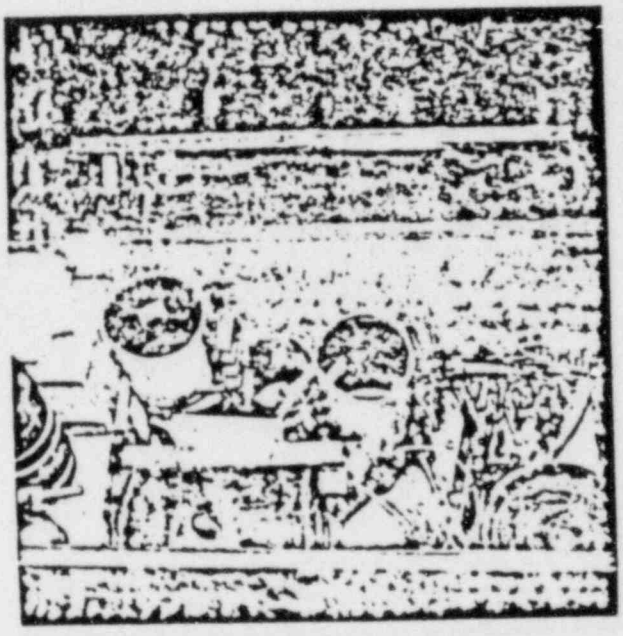
NOT VALID AFTER



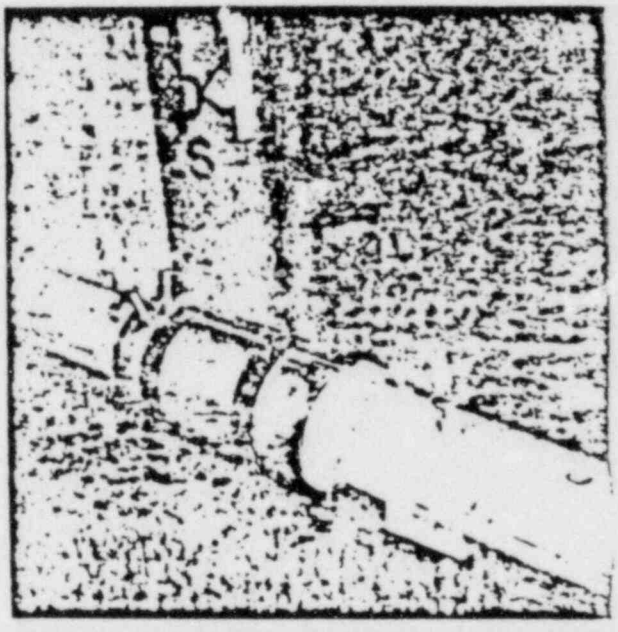
CLAMP DEVICES



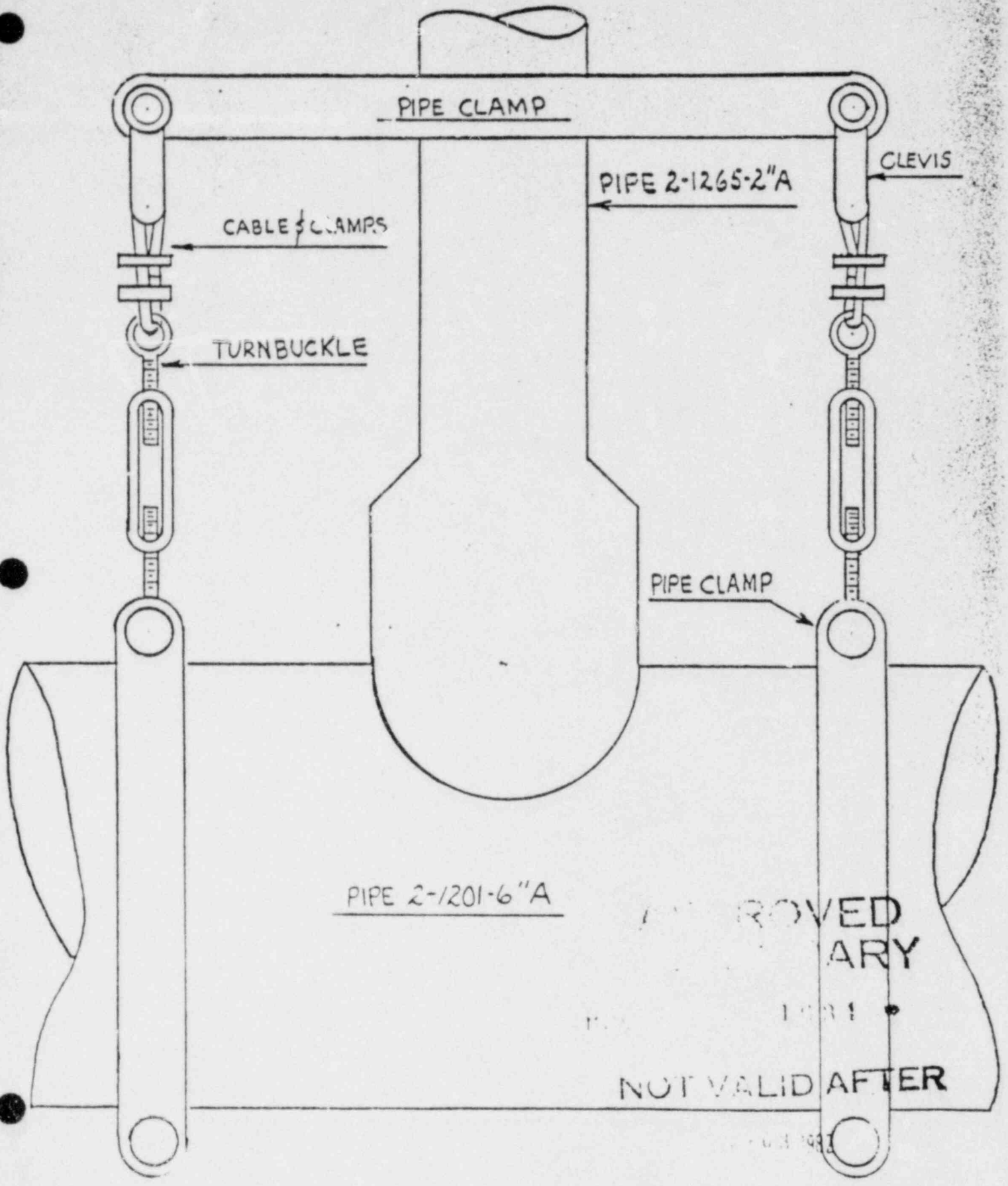
SLEEVE CLAMP



DAMAGE CONTROL LOCKER



FREEZE SEAL JACKET



DAMAGE CONTROL LOCKER INVENTORY

Skinner Pipe Clamps	(2)
Rockwell Full Circle-3 Bolt Clamp	(3)
Rockwell Elbow Clamp-1 Bolt	(3)
8" Dresser Full Circle Clamp	(1)
12" Dresser Full Circle Clamp	(1)
Band-It Bander	(1)
2" to 6" Adjustable Restraint	(1)
Sleeve Clamp-(weld 12S-F6 with Sleeve)	(1)
1/4" Band Clamps	2 Dozen
1 ft. Wide Rubber Gasket Material	1 Roll
1/4" Thick Gum Rubber	4 Sheets
Presstite Permagum-Plastic Duct Seal	2 Packages
Duct Tape	6 Rolls
Miscellaneous Hand Tools	

FREEZE SEAL PROCEDURE USING JACKETS

A. PURPOSE

The purpose of this procedure is to outline the method to freeze seal a pipe using jackets and liquid nitrogen (LN_2).

B. REFERENCES

1. None.

C. PREREQUISITES

1. Before freeze sealing a pipe, the normal operating pressure and temperature of the system should be reduced as low as possible in accordance with the approved cooldown procedure. The pressure of the system should be reduced to atmospheric and the pipe cooled to ambient temperature. When it is impractical to attain atmospheric pressure and ambient temperature, the following maximum conditions shall prevail:

   a. Ambient Temperature - 110°F.

   b. System Water Temperature - 200°F.

   c. Maximum differential pressure across freeze plug:

      (1) Stainless Steel - 200 psi.

      (2) Carbon and Low Alloy Steel - 0 psi.

      (Pressure may be higher with Maintenance Engineer [illegible])

2. Material and components needed to freeze seal pipe:

   a. Adequate supply of liquid nitrogen (LN_2).

   b. Freeze chambers of proper size.

   c. Heat transfer cement (Dow Corning 340 heat sink compound) or (Thermon).

   d. 3/8" copper tubing with rubber refrigeration insulation and fittings.

   e. Thermometers with remote bulbs (two or more).

   f. Insulation to provide minimum two inches on chamber.

   g. Duct tape.

   h. Tools/supplies pursuant to individual seal.

D. PRECUATIONS

1. A man should be assigned to control each freeze. He should have no other duties.

2. The same man may control two freezes if they are in close proximity and he has no other duties.

3. The man assigned a freeze must not leave his post. The foreman is responsible to provide a relief when required.

4. Precautions should be taken to protect both personnel and material in the event that the ice plug should be blown out of the pipe, e.g. the freeze area should be located so that a pipe elbow or bend lies between the freeze area and the location where the pipe will be cut.

5. Because of its low temperature, liquid N_2 can destroy human tissue. Precautions must be taken to cover exposed parts of the body. Wear insulated (non-porous) gloves, a face shield and protective clothing.

6. The work area must be adequately ventilated to insure an oxygen content of at least 18% by volume.

E. LIMITATIONS AND ACTIONS

1. When two ice plugs are to be used to isolate a single pipe section, they must be located greater than 30 pipe-diameters apart.

2. No freeze seal shall be applied less than 20 pipe-diameters from a closed valve or other component that blocks the flow of expansion water as the ice plug forms.

3. The freeze area must not include any fittings.

4. The pipe must be full of water before initiating freeze seal operations.

5. The ice plug must be completely melted before the pipe is restored to service. If it is not allowed to melt completely, pressure may build up in the pipe, or the ice plug may damage a component inside the pipe if it breaks loose.

6. Freeze sealing carbon and low alloy steel. To insure against brittle fracture when freezing water in carbon and low alloy steel pipe, the following must be observed:

   a. The pressure in the pipe must be reduced to zero before attempting a freeze seal.

   b. The lowest temperature to which the material can be subjected is -40°F.

c. The pipe must be adequately supported (temporary pipe supports may be used to supplement permanent pipe hangers), and must not be subjected to any shock or impact forces.

F. PROCEDURE

1. Filling LN_2 bottles from main storage tank:

a. Notify Shift Engineer prior to filling.

b. The following safety precautions must be observed:

(1) Do not inhale gas vapors.

(2) Personnel must wear gloves and entire arm must be covered. (Liquid is at -320°F; will boil at -280°F.)

c. Check level of main tank. If below 50" H_2O, check with Maintenance Engineer before filling any bottles.

NOTE

Level will drop approximately 2" H_2O for each 160 liter (42 gallon) bottle filled.

d. Hook up bottle to fill connection. (Inspect bottle for damage).

NOTE

Main tank supply is at 120 - 140#; bottle relief is set at 22#.

e. Open vent on bottle to vent gas. (Stay clear of vent and relief valve.)

f. Open fill valve on bottle (1 turn), then slowly crack open main tank valve, (1/4 - 1/2 turn).

g. Slowly feed nitrogen through bottle to cool it down.

h. Fill slowly until level indicator shows full. Fill slow enough so that relief does not open. (Keep bottle pressure between 15 - 20 pounds).

NOTE

Normal operating pressure for these bottles is 170 psig, which is above main storage tank pressure of 140 psig, so there is little danger of bottle bursting even if the 22 psig relief lifts.

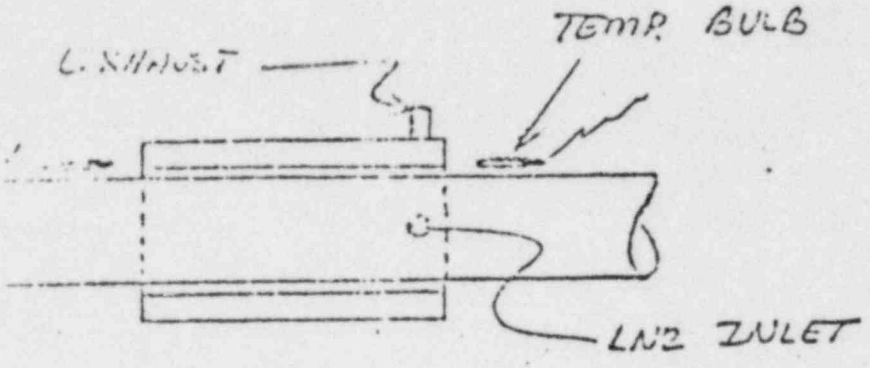
i. Close fill valve on main tank, then close valve on bottle and quickly disconnect fill hose, making sure to de-pressurize line through connector before removing.

j. Close vent on bottle.

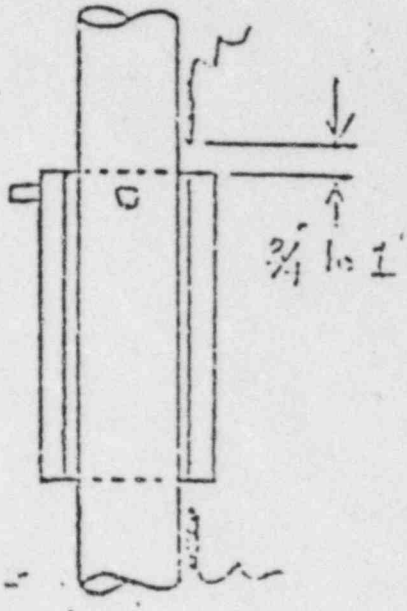
k. Secure equipment.

2. Installation of Freeze Chambers

HORIZONTAL



VERTICAL



NOTES

a. Heat transfer compound is applied to cover I.D. of the chamber halves before installation on pipe.

b. Chamber halves are secured on pipe with exhausts at highest point using hose clamps, band-its, or cloth reinforced tape.

c. Temperature bulbs are located 3/4" to 1" from the chamber.

d. Chambers are insulated with 2 layers of spun fiberglass and extends at least 6 inches beyond the chamber.

e. LN_2 piping arrangement from bottle to chamber should be as follows:

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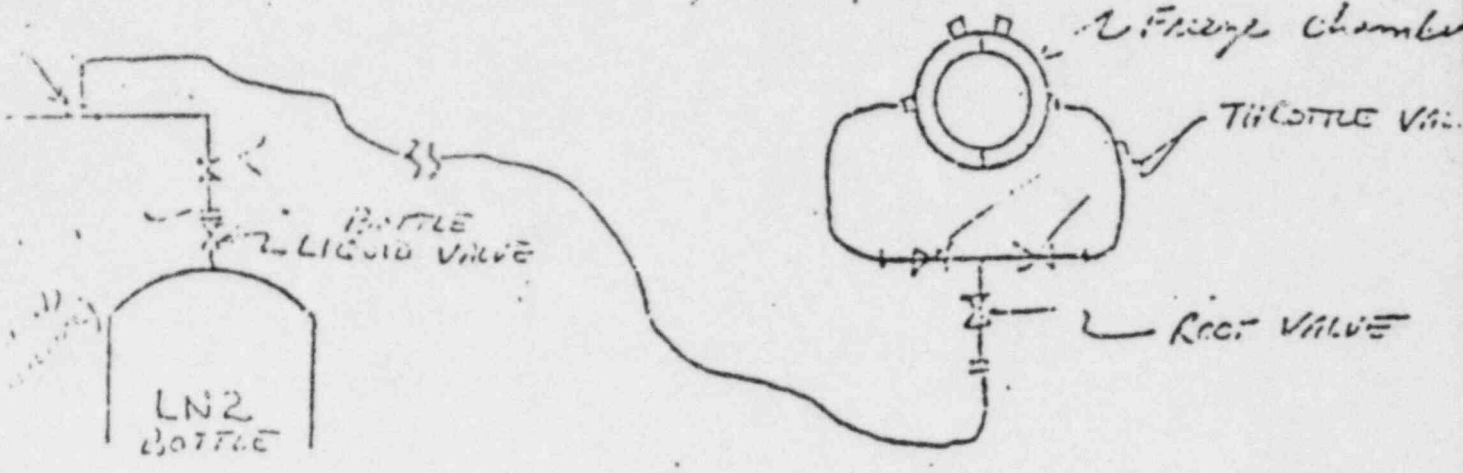

IMPORTANT

a. Each side of the chamber must have its own throttling valve.

b. The LN_2 bottle manifold is optional, if one is not used, the supply line may be connected directly to a LN_2 bottle at point A.

c. Connect line to a LIQUID valve on bottle.

d. Provide for additional exhaust capability if area is not well ventilated.

3. LN_2 Freeze Instructions

a. Establishing a freeze seal.

(1) Open all valves in supply line to allow maximum flow to seal chambers.

(2) Adjust the throttling valve for one side of the chamber to equalize the splashing and overflow between the two chambers. (Keep one of the throttle valves open full at all times.) Use the root valve to control splashing/overflow from both chambers simultaneously.

(3) When both temperatures are less than -10°F, shut the root valve. A freeze is now established.

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b. Maintaining a freeze seal.

(1) When the highest temperature reaches -10°F, open the root valve until both chambers are overflowing with LN2 or until the lowest temperature is not lower than -40°F, then shut the root valve.

NOTE

DO NOT ATTEMPT TO "THROTTLE" THE LN2 TO MAINTAIN A TEMPERATURE.

G. CHECKLISTS

1. Freeze Seal Data Sheet QMP 800-S4.
2. Table For Freeze Seals QMP 800-T1.
3. Freeze Seal Log QMP 800-S5.

H. TECHNICAL SPECIFICATION REFERENCES

1. None.

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QMP 800-54
Revision 1
August 1978

FREEZE SEAL DATA SHEET

1. PLANNING

This section must be completed before seal application for each freeze location.

	1	2	3	4
Location No.				
Pipe Spool No.				
Nom. Size (inches)				
Elevation				
Location				
Vert. or Horiz.				
Seismic Class				

Pipe Spool Inspection Requirements:

- ☐ Visual
- ☐ Measurements
- ☐ Pentrant Test (Before & After) (Req'd for Class 1) (Attach all results)

SKETCH OF LOCATIONS

FOR REFERENCE ONLY

- ☐ Maintain freeze
- ☐ Thaw and re-freeze

Total LN_2 requirements (calculate) _____

- ☐ Make arrangements for change area and Radiation Protection coverage.

Details of INTERIM OR BACKUP ISOLATION _____

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SEP 14 1978

O.C.O.

II. Chamber Installation (to be completed by foreman). Initial when complete.

	INITIAL COMPLETION			
Location No.	1	2	3	4
Pipe Spool Inspection Complete				
Temp. bulb location verified				
Installed & insulated per Dwg. A				
LN_2 supply & exhaust inspected				
Indicate quantity of LN_2 on hand				

Verbal approval to start freeze(s) obtained from Shift Engineer.

Foreman _____ Date _____ Time _____

III. Establish and maintain freeze per instructions.

1. Maintain temperature log for each location (attach).
2. Obtain verbal approval from Shift Engineer to open system.

Foreman _____ Date _____ Time _____

NOTE: Keep Shift Engineer informed of installation or removal of backup isolation, thawing and re-freezing operations.

IV. When work is complete, disassemble freeze chambers. Initial when complete.

	INITIAL COMPLETION			
Location No.	1	2	3	4
Pipe spool cleaned*				
Pipe spool inspection complete				
Insulation re-installed				
Piping released for service				
Freeze equip. returned to locker				

* IMPORTANT

Use only approved cleaning solvents to clean stainless steel piping. (Denatured Alcohol, Acetone and Sovasol #5 are approved for such use.)

V. Work completed by: _____, _____ Date _____
Mechanic(s) Foreman

TABLE FOR FREEZE SEALS

*
Minimum time and refrigerant required for making freeze seals in horizontal or vertical stainless steel pipe.

Pipe Size (Inch)	Min. Jacket Length (Inch)*	Min. N_2 (Lbs.)	Min. Time (Min.)
1/2	4	3	6
1	5	5	10
1-1/2	6	10	30
2	7	20	40
3	9	40	50
4	11	70	60
6	13	110	105

* Jacket Length is the distance between the inside edges of the masking tapes or shop fabricated container.

NOTES:

(1) Freeze-sealing temperature and time allowances vary with the [illegible] Interpret them with care.

(2) Time requirements are for temperatures (water, pipe and area) of 70°F. A longer time will be required when any of these temperatures is above 70°F.

(3) Minimum amounts of N_2 are for making the seal; amount does not include maintaining the seal.

(4) Times are based on no flow through the freeze seal.

FOR REFERENCE ONLY

QMP 800-55
Revision 1
August 1973

FREEZE SEAL LOG

Date _____

Work Request No. _____

Location No. _____

APPROVED
SEP 14 1973
Q.C.O.C.R.

Time	Exhaust End Temp.	Opposite End Temp.	Time	Exhaust End Temp.	Opposite End Temp.	Time	Exhaust End Temp.	Opposite End Temp.

NOTES:

1. Establish and maintain freeze per written instructions.
2. Record temperature readings every 10 minutes.
3. Notify Foreman immediately if either temperature cannot be maintained below +20°F.
4. Do not trap LN_2 between two closed valves.
5. Take frequent oxygen readings. Notify foreman if O_2 percentage decreases to 18%. Secure freeze and leave area if O_2 percentage decreases to 16%.

Description of Analytical Effort to Support Implementation of Temporary Fixes for Quad Cities 2 RWCU System Pipe Cracks

1.0 Pipe Sleeve

1.1 Strength/load capacity comparison for fix versus original configuration

1.2 Stress analysis for region of temporary fix using axisymmetric thin shell of revolution mathematical model.

1.3 Loads applied to model taken from piping analysis of system performed for IE bulletin 79-14.

1.4 Stresses from analysis compared to allowable stress values from ASME Code Subsection NC.

1.5 Analysis to assess stress and fatigue effects of differential thermal expansion between sleeve and pipe.

1.6 Fracture mechanics analysis of pipe to sleeve weld to evaluate susceptibility of weld to intergranular stress corrosion cracking.

2.0 Sockolet

2.1 Strength/load capacity comparison for fix versus original configuration.

2.2 Analysis to assess stress and fatigue effects of differential thermal expansion between sleeve and pipe.

2.3 Fracture mechanics analysis of pipe to sockolet sleeve weld to evaluate susceptibility of weld to intergranular stress corrosion cracking.

3.0 Weld Overlay

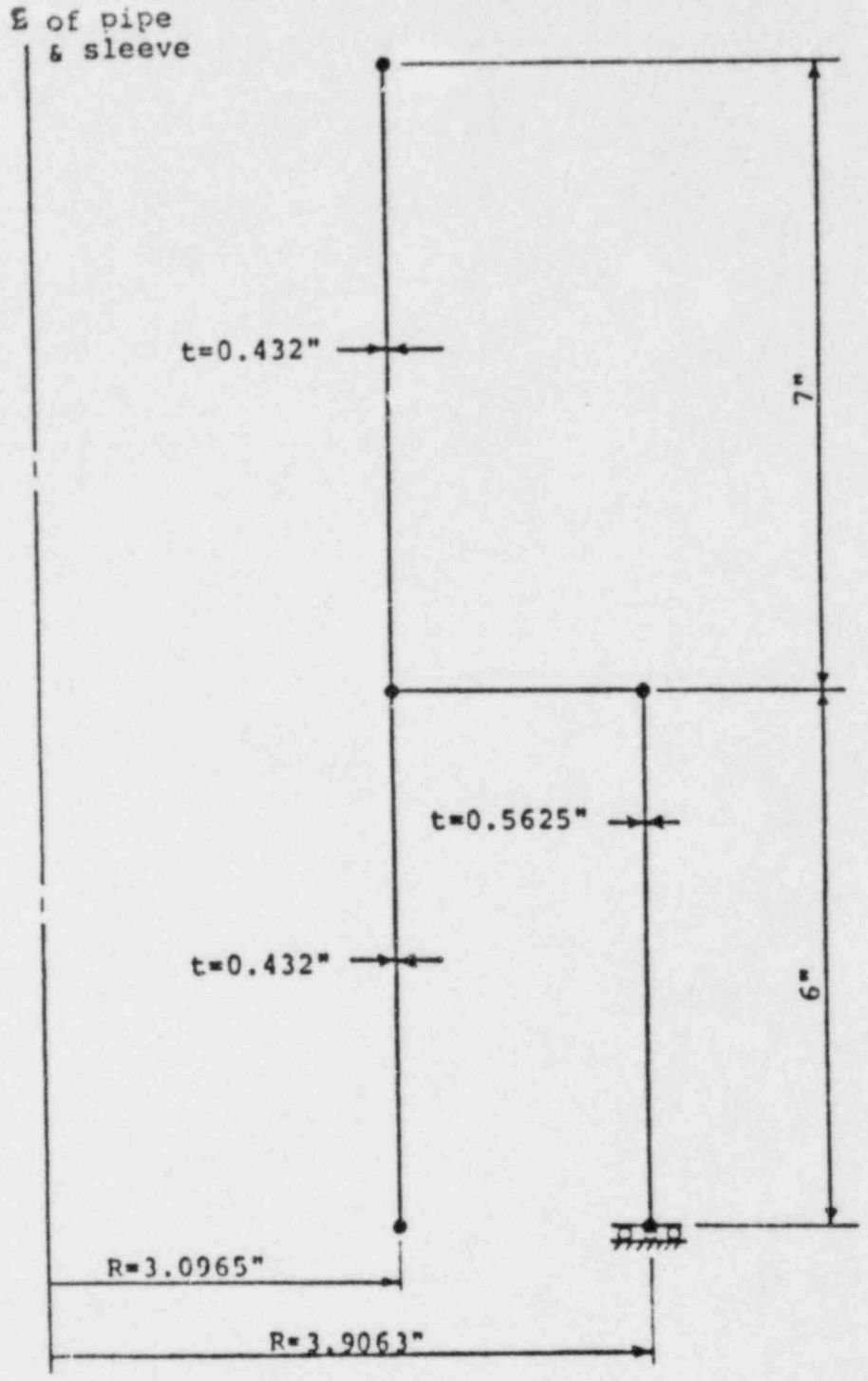
3.1 Strength/load capacity comparison for fix versus original configuration

3.2 Analysis to assess stress and fatigue effects of differential thermal expansion between pipe and weld overlay.

3.3 Fracture mechanics analysis of weld overlay to evaluate susceptibility of weld to intergranular stress corrosion cracking.

Strength Comparison of Temporary Pipe Sleeve Fix Versus Original Confirguration

Quantity	Original Configuration	Temporary Fix
Weld Cross-Sectional Area ($in.^2$)	8.4	16.6
Weld Moment of Inertia ($in.^4$)	40.5	90.8
Sleeve/Pipe Cross Sectional Area ($in.^2$)	8.4	13.8
Sleeve/Pipe Moment of Inertia ($in.^4$)	40.5	105.3



Mathematical Model of Pipe/Sleeve Temporary Fix

Piping Analysis Forces Used in Stress Analysis of Temporary Fix

Force Component	Gravity	Thermal	Seismic Anchor Movement plus OBE	Maximum Combined
F_x (Axial)	-20.	423.	768.	1191.
F_y (Shear)	588.	-90.	324.	912.
F_z (Shear)	-10.	-301.	153.	464.
Mx (Torsion)	-7344.	-19,056.	16,368.	42,768.
My (Bending)	4260.	-22,872.	16,680.	39,552.
Mz (Bending)	15,792.	-13,500.	25,608.	41,400.

Notes:

1) Internal pressure of 1250 psi also used in stress analysis of temporary fix

Stresses in Region of Temporary Fix

Excluding Pipe/Sleeve Differential Thermal

Expansion Stresses

Component	Membrane		Membrane Plus Bending	
	Calc.	Allowable	Calc.	Allowable
Pipe	9.0	15.9	40.5	47.7
Sleeve	5.1	15.9	29.5	47.7
Weld	3.6	9.5	15.8	17.7

Notes

1) Allowable stresses for pipe and sleeve taken from ASME Subsection NC.

2) Allowable weld stresses based on a joint efficiency factor of 0.60 for shear and 0.74 for tension

Strength Comparison of Sockolet Sleeve Versus Original Configuration

Quantity		Original Configuration	Temporary Fix
Weld Cross-Sectional Area ($in.^2$)	at base	4.6	7.2
	at top	1.3	2.6
Weld Moment of Inertia ($in.^4$)	at base	5.1	14.8
	at top	0.9	1.9
Sleeve/Sockolet Cross Sectional Area ($in.^2$)	at base	4.5	7.2
	at top	2.2	5.2
Sleeve/Sockolet Cross Sectional ~~Area~~ Moment of Inertia ($in.^4$)	at base	5.1	14.8
	at top	2.0	5.6

Strength Compraison of Weld Overlay Fix

Versus Original Configuration

Quantity	Original Configuration	Temporary Fix
Cross Sectional Area ($in.^2$)	8.4	11.2
Moment of Inertia ($in.^4$)	40.5	71.4

U-2 Cleanup Pipe Repair
Administrative Procedure Training
2/1/82

Instructor - L. Gerner

Attendees (Signature)

Frederick F. Bergi
Gary [illegible]
Roch Robey
Dave Breyer
Ted Lihou
[illegible]
B. Heilman
[illegible]
Jeffrey [illegible]
James Schmitzmeyer
G. Tuf
Wm Buckamper
[illegible]
[illegible]
[illegible]
Roger Mucker
[illegible]
[illegible]

Keith Snegurth
Duane F. Blaufuss
[illegible] Wilgus

NTK
C (M,C,T)

February 2, 1982

DJS Ltr. #82-147

TO: N. J. Kalivianakis

SUBJECT: Possible Use of Dresden Fuel Racks at Quad Cities Station

This letter confirms Dresden Station's support, if necessary, to ship used spent fuel storage racks, which are currently stored in our Unit 1 fuel transfer pool, to Quad Cities Station. Dresden Station possesses a steel transfer container of strong, tight construction with a bolted cover which was designed and constructed to allow transfer of these racks from the Unit 3 fuel storage pool to the Unit 1 fuel transfer pool. We would use this shipping container and company transportation as an exclusive use carrier to transport two racks at a time from Dresden to Quad Cities as Low Specific Activity (LSA) material. We estimate that the first shipment could be on the road to Quad Cities within 12 hours of your notification of need.

Using a conservative assumption of 16 hours turnaround time, we project that 8 spent fuel racks could be delivered to Quad Cities within 64 hours from your initial notification. A total of 15 racks are available for shipment to Quad Cities. Based on dose rate measurements taken of the racks during their transfer from the Unit 3 pool to the Unit 1 pool, we are confident that the activity level of the racks is such that they can be shipped as LSA material.

D J Scott

D. J. Scott
Station Superintendent
Dresden Nuclear Power Station

DJS/jth

cc: C. Myrick
File/Misc.
File/Numerical

JWP-82-1

February 1, 1982

TO: Larry Gerner

SUBJECT: ALARA Review of Repairs to Clean-Up Line on U-2

The following is a summary of estimated hours and man-rem on the repairs to the U-2 Clean-up Line.

Weld Number	Welding by Hand Hours	Auto. Welding Hours	Exposure Man-Rem
12S-F1A	24	0	21.0
12S-F6	24 (20)	8 (3)	23.0
12S-S9 and S10	0	40	5.2
12S-F12	24	0	33.0
			82.2

If the following recommendations are followed the above man-rem totals should be met.

12S-F12 (24 hours)

Repair Weld on 1201-2 Valve

4 R/hr @ contact with Valve 1 R/hr @ 1' 850 mr/hr Working

Dose Rate w/o Shielding General Area 200 - 300 mr/hr

1. The man not welding to remain in a shielded area. By doing this the man-rem would be 38, using 850 mr/hr dose rate.

2. Try to shield the valve body to reduce dose rate to 750 mr/hr. The man-rem would then be 33.

3. Try to shield the valve body to reduce dose rate to 450 mr/hr. The man-rem would then be 18.

4. Shield four foot of the vertical line below elbow. The man-rem estimate was taken from #2 above.

120 HRS WELDING = 114.9 MAN-REM } @ 850 MR/HR
12 HRS FITTER = 2.5
137.4

120 HRS WELDER = 80.0 } @ 500 MR/HR
12 HRS FITTER = 6.0
86.0

20 HRS WELDER = 45.0 } @ 200 MR/HR
2 HR FITTER = 4.4

12S-S9 and S10 (40 hours)

Welds on Elbow

Dose Rates: @ contact 2.2 R/hr, @ 1' 1 R/hr, 850 mr/hr working dose rate w/o shielding General Area 100 - 150 mr/hr

1. Use lead shield enclosure to reduce exposure:

   A - to 60 mr/hr = 7.5 man-rem for the job
   B - to 5 mr/hr = 5.2 man-rem for the job
   The man-rem above includes setting up welder.

The man-rem estimate was taken from B above.

12S-F6
Weld Sleeve

2 R/hr @ contact	1 R/hr @ 1'	850 mr/hr working Dose Rate w/o Shielding
General Area	100 - 150 mr/hr	

Automatic Welding (8 hours)

1. The man using the welder should have a small lead blanket enclosure made to reduce exposure to 100 mr/hr or less.

2. The man setting up the welder should know how to set up welder as quickly as possible as no shielding can be done for this part of the job. The total exposure for this job should be 3 man-rem. This includes set-up time.

Hand Welding (24 hours)

1. When the hand welding is being done the man not welding should be in the enclosure used by the man that ran the automatic welder.

2. Rig chain falls on both sides of the area to be welded, after automatic welding is complete and cover 3' to 4' of the line on either side of the sleeve.

   20 man-rem exposure would be required, unless the sleeve reduces dose rate thereby reducing the man-rem.

28-FA (24 hours)

Weld Sleeve on 2" Line

5 R/hr @ contact 1.4 R/hr @ 1' Working Dose Rate 750 mr/hr w/o Shielding

1. Shielding should be placed on R.H.R. Line, the vessel drain line, and the Recirc. Line including the 48 valve.

2. By shielding to 600 mr/hr = 39 man-rem
   to 500 mr/hr = 34 man-rem
   to 250 mr/hr = 21 man-rem

3. Build or find shieldec area for man not welding.

I think we should shield to this level.

John Piercy
ALARA Coordinator

JWP:mko

The following identifies actions which must be completed prior to proceeding with the Reactor Water Cleanup System repairs and actions which must be taken following the repairs.

1. Prior to starting sockolet weld repair, install mechanical restraint on 2" line. Verify accessibility and clearance for welding truncated cone sleeve in place. Recognizing space limitations, demonstrate capability to minimize leak, should one develop, during the repair of the sockolet.

2. Establish and maintain a freeze plug during the first 1/8" thickness of weld overlay on the flaw repairs for weld joint S-9, S-10, and F-12. Maintain the equipment in place for the remainder of the weld repair such that the freeze plug could be reestablished.

3. Personnel designated to install the three types of mechanical clamping devices are to be familiar with and instructed in the installation of the devices.

4. Prepare, review, and approve all procedures to be used during the RWCU line repair prior to the start of work. This includes all Quad Cities procedures included and referenced in the handout given to NRC at RIII on January 26, 1982.

5. Welding procedures and welders are to be qualified in accordance with ASME Section IX prior to start of work.

6. Mock-up studies, metallurgical examinations and evaluations included in the handout for the January 26, 1982 meeting will be completed prior to start of work on the weld overlays.

7. Establish ANI concurrence and ASME Code acceptability of all parameters of this repair. Also, assure all ANI hold points are established.

8. Establish by use of instrumentation or mechanical devices the extent of distortion of each point of repair. Acceptability of any distortion will be evaluated prior to startup.

9. Mechanical clamping devices will be available at the work place. At least one supervisor shall be available in the repair area (may be outside of drywell) ready to install the clamp should a leak develop.

10. The capability to provide fuel storage racks shall be arranged for, such that, if needed, the racks can be inscalled onsite such that removal of fuel from the ore can commence following removal of the reactor head.

11. Ultrasonically examine weld joint F-11 after the repair of weld joint F-12.

12. A complete summary of stress analyses performed will be available early during the morning of February 1, 1982. The summary will include as a minimum, a description of the methods and analys's being done, the load combina ions used, and the results of the analysis.

13. Communications will be established between the welding operator supervisor and the control room during welding operations.

14. The inboard isolation valve 2-1201-2 will be chain locked to prevent inadvertent opening. The valve may be cracked to relieve pressure when the freeze plug is established.

15. ALARA evaluation for the repair program has been performed prior to start of work.

16. Perform visual inspection of repaired sections of piping when unit is in hot standby.

17. Establish temporary procedures to be used during reactor operation to require that if the volume pumped from the drywell floor drain sump in a 4-hour period exceeds the previous 4-hour pumpdown by 240 gallons or more, drywell entry will be made to investigate and determine the cause of the increase. The unit will be shut down if the increase is determined to be caused by pipe degradation or if any of the limits in QOS 1600-7 are exceeded.

18. Update and submit to Region III, the summary of repairs document handed out during the January 26, 1982 meeting.

19. Perform a pump operability test for CS and LPCI prior to start of repairs.

20. During the repairs, the vessel water level will be maintained with all four ranges indicating the normal level.

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MET-585-82
2-17-82

ROUTE:

A (Asst Supt.)
B (Operations)
C (Maintenance)
D Admin & Tech.
E Personnel

SYSTEM MATERIALS ANALYSIS DEPARTMENT REPORT
ON
REACTOR WATER CLEAN-UP SYSTEM,
QUAD CITIES UNIT 2

On January 15, 1982, leaks were found in the Reactor Water Clean-Up System suction piping at Quad Cities Station, Unit 2. A repair procedure was developed which required a technical evaluation of a mock-up spool piece. As part of the technical evaluation of the repair, a straight length of 6 inch schedule 80 type 304L stainless steel was welded to a 90° elbow of the same material. This spool piece (figure 1) was used to evaluate the feasibility of mechanized welding as well as to evaluate the quality of weld metal, and degree of sensitization (DOS) in the heat affected zone (HAZ) of the base metal.

The mechanized welding machine deposited a pad ½ inch thick 6 3/4 inches long over a pipe to elbow joint. Stringer beads (approx. 1/32" thick) of type ER308L SFA 5.9 A-6 filler metal were deposited layer by layer to build-up the ½ inch thick pad. During fabrication of the spool piece, a 300°F maximum interpass temperature limitation was followed. To facilitate in completion of the mock-up, as well as to simulate expected field conditions. The spool piece was kept filled with water.

The spool piece was radiographed prior to destructive examination as per ASME Section 3. The radiographs were reviewed by a level 3 inspector and determined to be in compliance with the ASME Section 3 standards.

The spool piece was sectioned longitudinally through the axis of symmetry. Four longitudinal strips were removed; two from the top and two from the bottom. The strips were mounted and polished for metallurgical examination. Practice A from the ASTM A 262 specification was used to etch the samples and determine the degree of sensitization (DOS). Figures 2 and 3 are typical microstructures depicting the DOS, each of which are classified as acceptable structures per ASTM A 262 practice A. Figure 4 is a photomicrograph of an area away from the weld on the pipe side unaffected by the heat of welding. The area has an unsensitized (stepped), solution annealed structure.

Measurements were made to determine the depth of penetration. Using worst case observations, a conservative approach, the average depth of penetration is 0.050 inches. Figures 5 and 6 are photomicrographs showing the depth of penetration at the toe of the pad weld on the pipe and elbow sides respectively.

Discussion & Conclusion

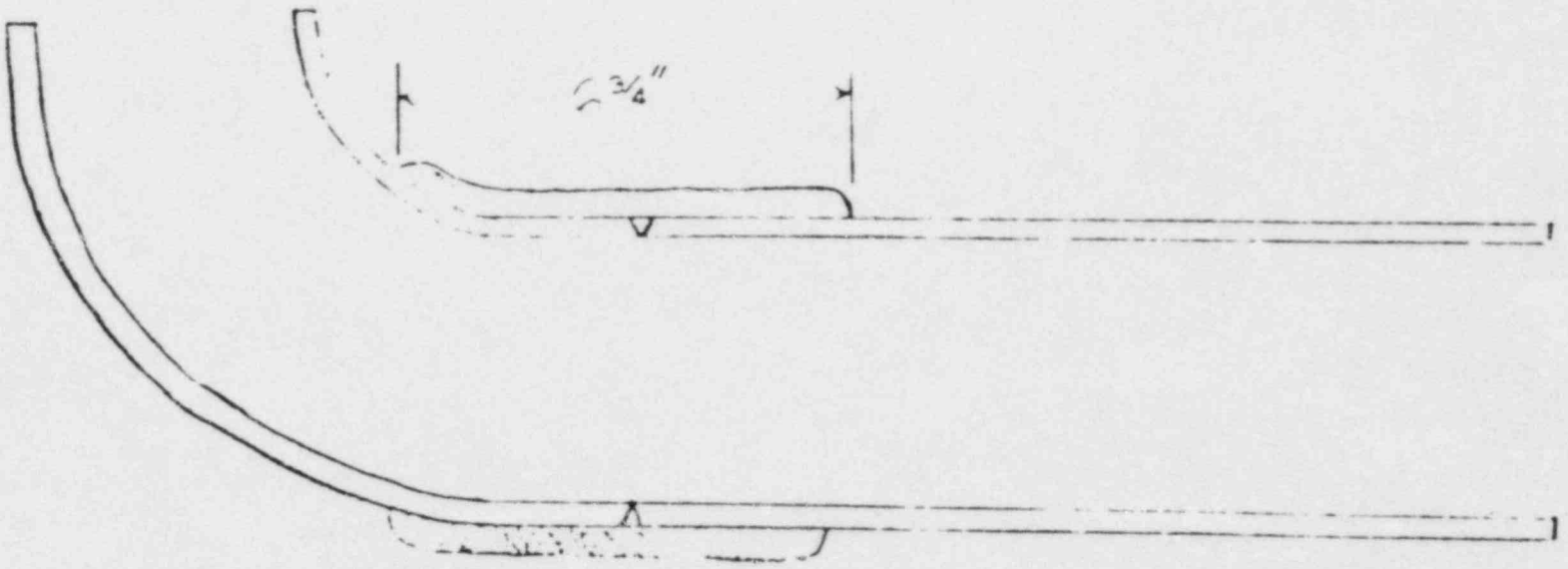
Results presented above as well as observations made in the field, inidicate that there is no degradation of the base metal as a result of the proposed repair procedure.

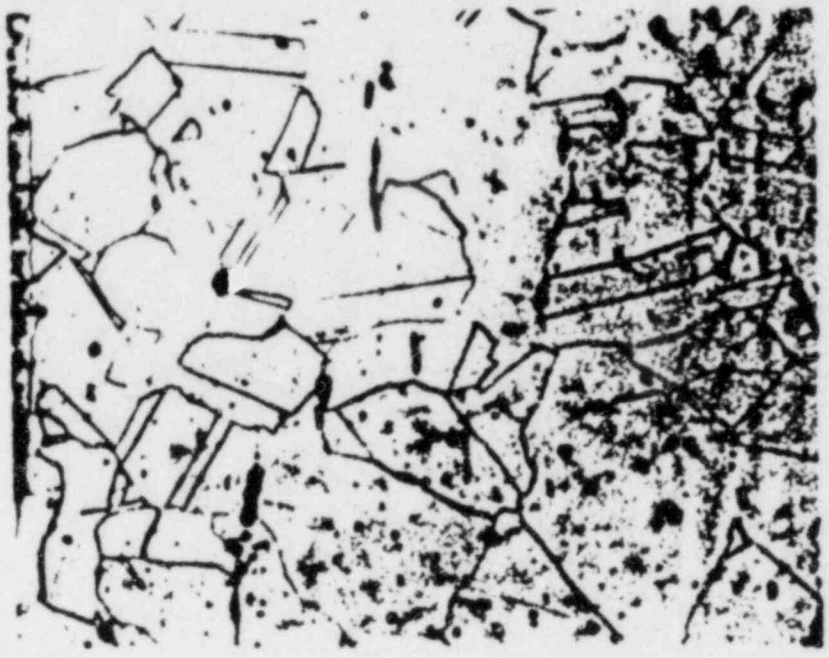
Approved by: _____ Reported by: _____

Copies to: F.A. Palmer
L.C. Bird
K. Kalivianakis
R. Bax
J.S. Abel
S. Schulte
W. Burkamper

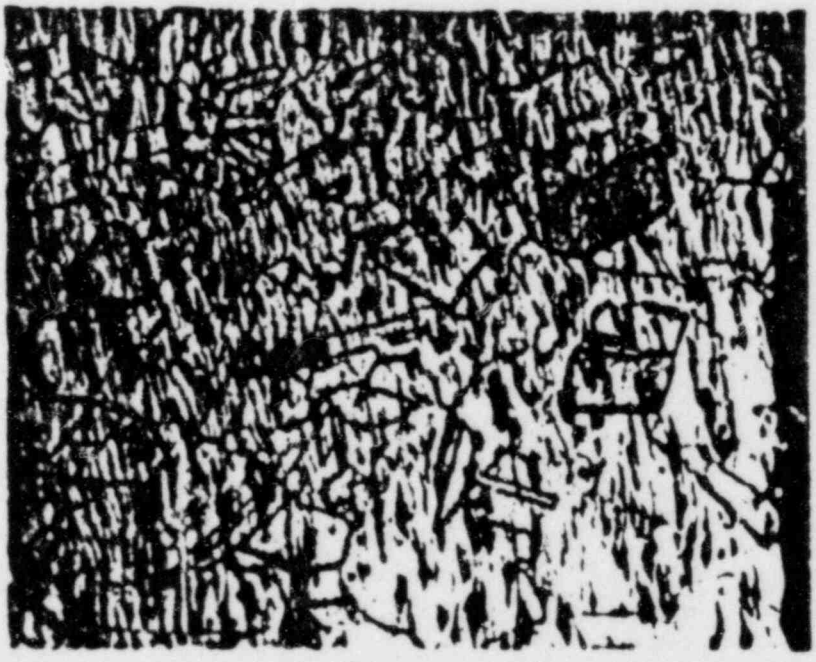
Figure 1

Schematic diagram depicting the approximate location of the cap weld.

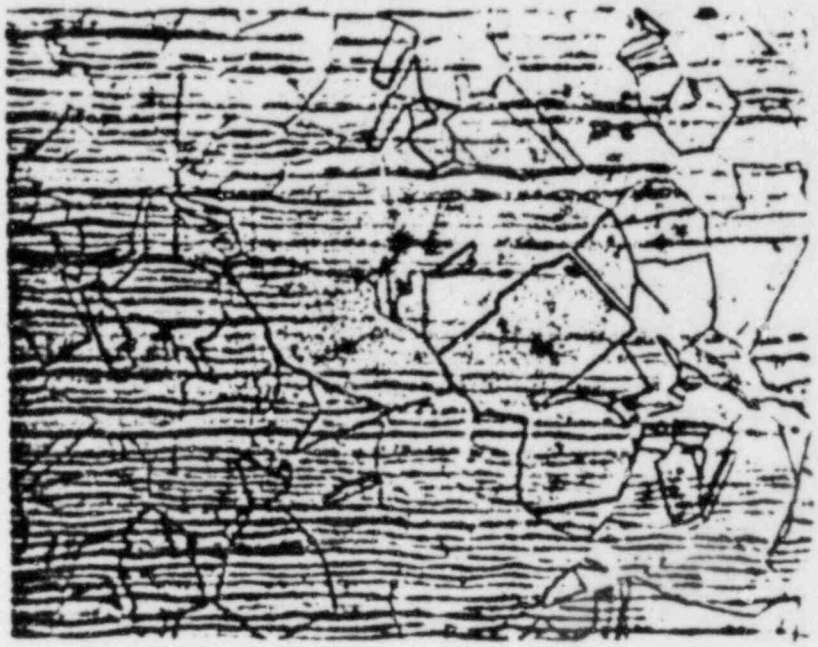




(200×) Figure 2 10% oxalic electrolytically
Photomicrograph taken adjacent to the fusion line on the pipe side of the spool piece. No evidence of sensitization can be seen (stepped structure).



SMAD Report on Reactor Water Clean-Up System, Quad Cities Unit 2



(200x) Figure 4 10% oxalic electrolytically
Photomicrograph taken of material unaffected by the heat input from welding. The structure can be classified as stepped (unsensitized).

SMAD Report on Reactor Water Clean-Up System, Quad Cities Unit 2

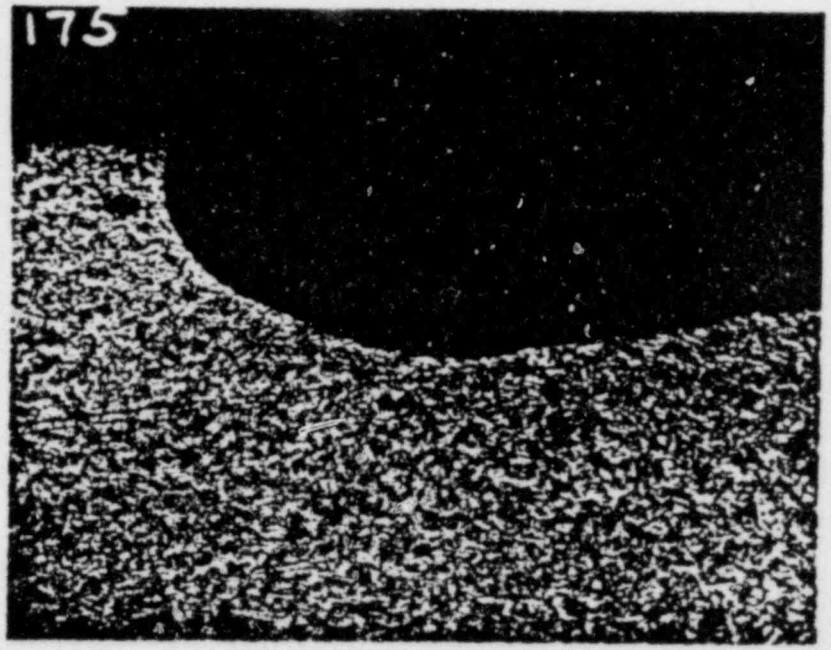
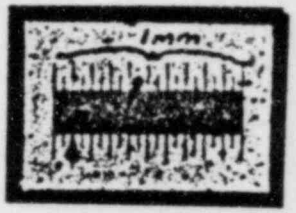


Figure 5



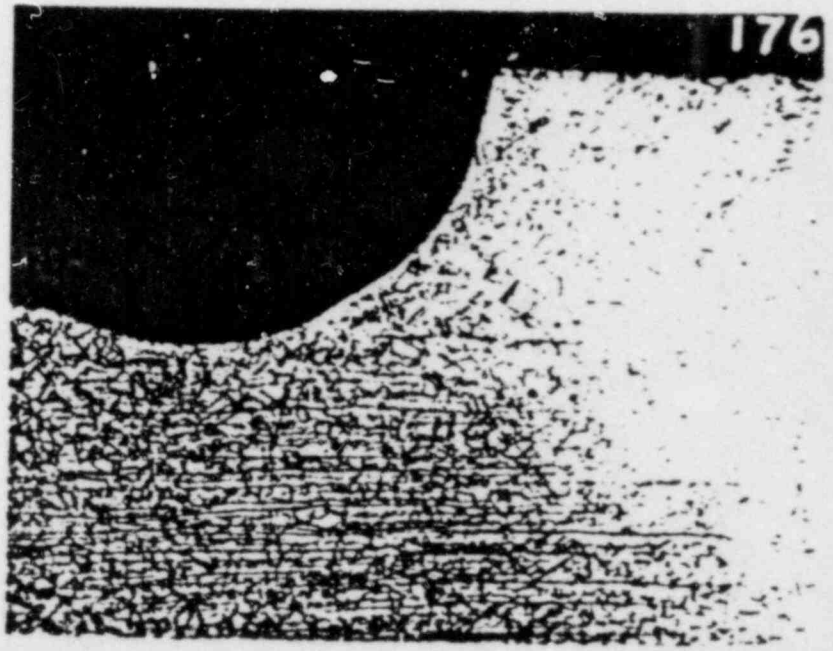


Figure 6

Both photomicrographs depict the depth of penetration. As can be seen, the pipe (fig. 5) and elbow (fig. 6) sides of the spool piece, average 0.050 inches.