ATTACHMENT A

ST. LUCIE UNIT 1

EXTRACTION STEAM PIPING

INSPECTION PROGRAM GUIDELINES

JANUARY 28, 1987

REVISION 1

EXTRACTION STEAM PIPING INSPECTION PROGRAM GUIDELINES

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* DRAWINGS ARE NOT INCLUDED BUT ARE AVAILABLE AT FPL.

EXTRACTION STEAM PIPING INSPECTION PROGRAM GUIDELINES

I. BACKGROUND/PURPOSE

A RUPTURE OF AN EXTRACTION STEAM LINE ON UNIT 1 DURING CYCLE 7 RESULTED IN FORCED OUTAGE AND A LOSS OF APPROXIMATELY 39 FULL POWER HOURS. AN EXAMINATION OF THE FAILED PIPE AND A FOLLOW-UP ENGINEERING EVALUATION CONCLUDED THAT EROSION/CORROSION WAS THE FAILURE MECHANISM. EROSION/CORROSION IS AN INDUSTRY WIDE PROBLEM THAT IS UNIQUE TO WET STEAM PIPING SYSTEMS. EROSION/CORROSION IS AN ACCELERATED FORM OF CORROSION INDUCED BY FLOW DUE TO THE BREAKDOWN OF A PROTECTIVE OXIDE FILM FROM THE MATERIAL'S SURFACE. DURING THE FORCED OUTAGE, THE PIPING DOWNSTREAM OF THE FAILED SECTION WAS ALSO INSPECTED AND FOUND TO BE ERODED. BECAUSE OF THE PIPE FAILURE OCCURENCE AND FOLLOW-UP INSPECTION RESULTS, THE NEED FOR AN INSPECTION AND REPAIR PROGRAM WAS DETERMINED TO EXIST.

THE PURPOSE OF THIS DOCUMENT IS TO PROVIDE SPECIFIC INSPECTION GUIDELINES AND ACCEPTANCE CRITERIA FOR UNIT 1 WET STEAM PIPING SYSTEMS TO ADDRESS EROSION/CORROSION CONCERNS.

ALSO, IN LIGHT OF THE RECENT SURREY PLANT PIPING FAILURE INCIDENT, REPRESENTATIVE FITTINGS AND PIPING FROM OTHER HIGH ENERGY SYSTEMS SUCH AS FEEDWATER, BLOWDOWN AND HEATER DRAIN ARE INCLUDED WITHIN THE SCOPE OF THESE INSPECTIONS. REV 1

II. INSPECTION SCOPE

BECAUSE OF THE SIGNIFICANT AMOUNT OF WET STEAM PIPING IN THE ST. LUCIE NUCLEAR POWER PLANT, A METHOD FOR PRIORITIZING THE INSPECTION POINTS WAS FIRST DEVELOPED. THIS METHOD REQUIRED THE CALCULATION OF EROSION RATES FOR REPRESENTATIVE PIPING CONFIGURATIONS AND CONDITIONS. THE RATE OF EROSION/CORROSION IN WET STEAM PIPING IS A FUNCTION OF A NUMBER OF FACTORS INCLUDING:

- PERCENT MOISTURE
- MATERIAL COMPOSITION
- pH AND WATER CHEMISTRY
- TEMPERATURE
- OXYGEN
- FLOW PATH GEOMETRY
- FLOW VELOCITY

HAVING DETERMINED THE EROSION RATES, THE PIPING MINIMUM WALL AND WEAR ALLOWANCES WERE THEN CALCULATED. FINALLY, A LIST PRIORITIZING THOSE PIPING CONFIGURATIONS WITH THE HIGHEST EROSION RATES AND SHORTEST PREDICTED TIME TO VIOLATE MINIMUM WALL

II. INSPECTION SCOPE (CONT'D)

THICKNESS REQUIREMENTS WAS GENERATED AND USED TO IDENTIFY REQUIRED INSPECTION POINTS. IN GENERAL, THE INSPECTION AREAS ARE AS FOLLOWS:

1. CROSSUNDER PIPING BRANCH CONNECTIONS TO THE 4A AND 4B FEEDWATER HEATERS

2. 4A AND 4B FEEDWATER HEATER EXTRACTION STEAM LINE TRAP BRANCHES

3. 4A AND 4B FEEDWATER HEATER EXTRACTION STEAM PIPING ELBOWS PLUS REPRESENTATIVE STRAIGHT PIPING

4. 5B FEEDWATER HEATER EXTRACTION STEAM LINE TRAP BRANCHES

5. MSR SSVC TEE CONNECTION TO THE NUMBER 5B FEEDWATER HEATER EXTRACTION STEAM LINE PLUS RESPECTIVE DOWNSTREAM ELBOW

6. REPRESENTATIVE 5B FEEDWATER HEATER EXTRACTION STEAM LINE ELBOW

7. 2A OR 2B FEEDWATER HEATER EXTRACTION STEAM FABRICATED ELBOW CONNECTION IN THE CONDENSER

8. STRAIGHT PIPING DOWNSTREAM OF THE 3A,5B AND 4A,4B FEEDWATER EXTRACTION STEAM LINE NON-RETURN VALVES

9. FEEDWATER RECIRCULATION PIPING AND ELBOWS DOWNSTREAM OF THE RECIRCULATION CONTROL VALVE

10. CONDENSATE PUMP FULL FLOW RECIRCULATION PIPING AND ELBOW DOWNSTREAM OF THE RECIRCULATION CONTROL VALVE

11. FEEDWATER PIPING AND BRANCH CONNECTION DOWNSTREAM OF THE FEEDWATER REGULATING VALVES

12. HEATER DRAIN TIE IN BRANCH CONNECTION TO THE CONDENSATE SYSTEM

13. MSR HEMI-HEAD DRAIN BRANCH CONNECTION

14. MSR SHELL SIDE DRAIN PIPING BRANCH CONNECTION

15. BLOWDOWN PIPING AND ELBOW DOWNSTREAM OF PRESSURE CONTROL VALVE

16. MAIN STEAM PIPING TEE CONNECTION

REV. 1

THE SPECIFIC REQUIRED INSPECTION POINTS ARE LISTED IN TABLE I ALONG WITH A UNIQUE DESIGNATION NUMBER AND DRAWING REFERENCE. THE ELEVEN PLANT DRAWINGS LISTED IN THE TABLE OF CONTENTS ARE ATTACHED AND HAVE BEEN MARKED-UP TO SHOW THE SPECIFIC FITTINGS AND PIPING TO BE INSPECTED.

III. METHOD OF INSPECTION

INSPECTION IS TO BE CONDUCTED USING AN ULTRASONIC DEVICE TO MEASURE WALL THICKNESS. GENERALLY, ONE ULTRASONIC WALL THICKNESS READING WILL BE REQUIRED FOR EVERY 2" X 2" AREA ON PIPING AND FITTINGS LARGER THAN 6" NOMINAL PIPE SIZE, AND FOR EVERY 1" X 1" AREA FOR PIPING AND FITTINGS 6" NOMINAL PIPE SIZE AND LESS.

FOR EACH INSPECTION POINT LISTED IN TABLE 1, AN "INSPECTION SCOPE" IS GIVEN. THE INSPECTION SCOPE FOR EACH GENERIC FITTING TYPE, I.E., 45 DEGREE ELBOWS, 90 DEGREE ELBOWS, TEES AND BRANCH CONNECTIONS, IS SHOWN IN DETAIL IN SKETCHES 1,2,3 AND 4. THESE SKETCHES INDICATE HOW EACH CONFIGURATION TYPE IS GENERALLY TO BE MAPPED. THE SKETCHES ALSO INDICATE APPROXIMATELY HOW THE INSPECTION REPORT MAPS SHOULD APPEAR.

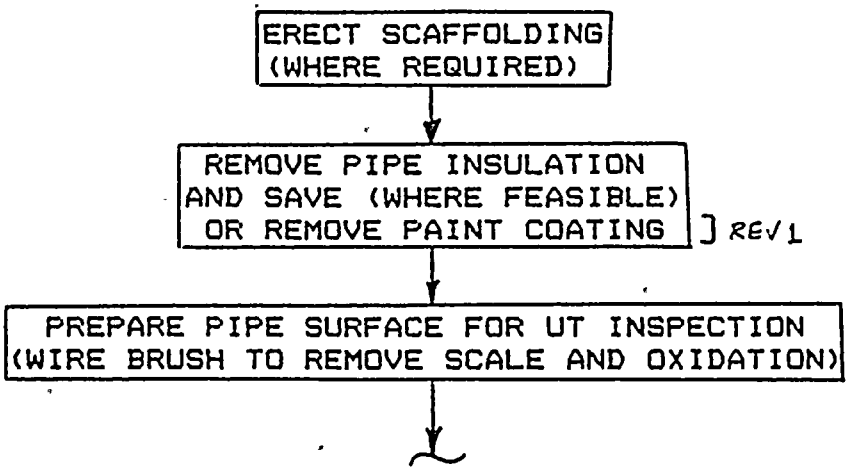
IV. SCREENING CRITERIA

TABLE 1 PROVIDES A WALL THICKNESS VALUE FOR EACH EXTRACTION STEAM FITTING OR PIPING SECTION TO BE INSPECTED. IF INSPECTION RESULTS INDICATE THAT ALL ULTRASONIC TEST READINGS ARE EQUAL TO OR GREATER THAN THE VALUE SPECIFIED, THEN NO REPAIR OR REPLACEMENT ACTIVITIES WILL BE REQUIRED. IF ANY ULTRASONIC TEST RESULT IS LESS THAN THE VALUE SPECIFIED, THEN AN NCR IS TO BE GENERATED WHICH INCLUDES THE INSPECTION REPORT FOR THE FITTING OR PIPING SECTION AND INDICATES THE SCREENING CRITERIA VALUE VIOLATED.

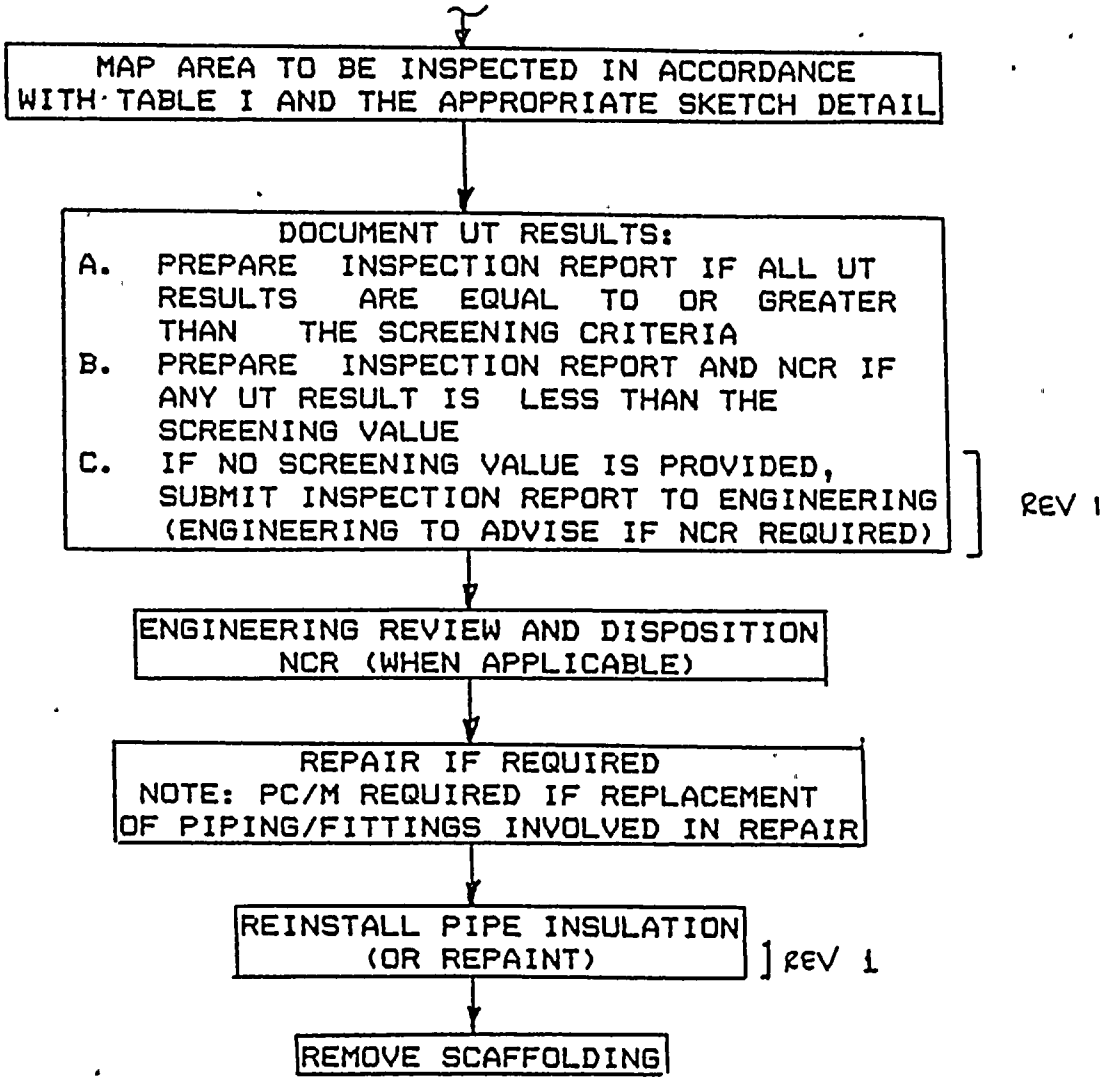
FOR OTHER HIGH ENERGY FLUID SYSTEMS, SCREENING CRITERIA IS NOT PROVIDED. FOR THESE CASES, THE INSPECTION REPORT PACKAGE SHALL BE REVIEWED BY ENGINEERING PRIOR TO REPLACING INSULATION OR REPAINTING.] REV. 1

V. INSPECTION FLOW CHART

THE FOLLOWING IS A DESCRIPTION OF THE GENERAL PROCESS REQUIRED FOR THE INSPECTION OF EACH FITTING OR PIPING SECTION:



V. INSPECTION FLOWCHART (CONT'D)



VII. REQUIRED DOCUMENTATION

AN INSPECTION REPORT SHALL BE PREPARED FOR EACH INSPECTION POINT. THIS INSPECTION REPORT SHALL INCLUDE, AS A MINIMUM, THE FOLLOWING INFORMATION:

1. DRAWING NUMBER
2. PIPING/FITTING LABEL (AS LISTED IN TABLE I)
3. SCREENING CRITERIA
4. UT MAP(S) AS INDICATES BY TABLE I AND THE APPROPRIATE SKETCH DETAIL

5. NCR NUMBER (IF NCR REQUIRED)

6. ENGINEERING SIGN-OFF FOR INSPECTION REPORTS TO DOCUMENT WHETHER NCRS ARE OR ARE NOT REQUIRED

TABLE I

EXTRACTION STEAM PIPING INSPECTIONS - PIPING AND FITINGS

PIPING/FITTING LABEL	DWG. REFERENCE	SCOPE OF INSPECTION	SCREENING CRITERIA	NOTES
ES-3-B-1	8770-G-125 SH ES-B-1	AS PER MAP TYPE III (LESS SECTION C)	0.22"	
ES-3-E-1 ES-3-E-2 ES-3-E-3 ES-3-E-4 ES-3-E-5 ES-3-E-6 ES-3-E-7 ES-3-E-8 ES-3-E-9		AS PER MAP TYPE I ↓	0.26"	
ES-3-B-2 ES-3-B-3		AS PER MAP TYPE III ↓	RUN: 0.22" BRANCH: 0.16" ↓	
ES-3-SP-1 ES-3-SP-2		2"X2" GRID PATTERN, 3 FT. LONG ↓	0.22" ↓	
ES-4-B-1		ASPER MAP TYPE III (LESS SECTION C)	0.22"	
ES-4-B-2		AS PER MAP TYPE III	RUN: 0.22" BRANCH: 0.16"	
ES-4-SP-1		2"X2" GRID PATTERN BETWEEN VALVE AND ELBOW WELDS	0.22"	

BY _____ DATE 1/7/87
CHKD. BY _____ DATE _____
REV 1
SHEET NO. 1 OF 3
PROJECT NO. SLN-86-72

FORM 73 REV. 7

TABLE I

EXTRACTION STEAM PIPING INSPECTIONS - PIPING AND FITTINGS

PIPING/FITTING LABEL	DWG. REFERENCE	SCOPE OF INSPECTION	SCREENING CRITERIA	NOTES
ES-4-E-1	8770-G-125 ES-B-1	AS PER MAP TYPE III	0.26"	
ES-4-E-2		AS " " " I		
ES-4-E-3		I		
ES-4-E-4		II		
ES-4-E-5		II		
ES-4-E-6		I		
ES-4-E-7		I		
ES-4-E-8		I		
ES-4-E-9		II		
ES-4-E-10		II		
ES-4-E-11		II		
ES-4-E-12		II		
ES-4-E-13		I		
ES-4-E-14		I		
ES-4-E-16		I		
ES-5-E-1		AS PER MAP TYPE I	0.11"	
ES-5-B-1		AS PER MAP TYPE III		
ES-5-SP-1		2X2 GRID MAP BETWEEN VALVE AND ELBOW WELDS		
ES-2-T-1	8770-G-125 ES-B-2	AS PER MAP TYPE III	0.22"	
ES-2-B-1		III	RUN: 0.20" BRANCH 0.20"	
ES-2-SP-1		2X2 GRID BETWEEN VALVE AND ELBOW WELDS	0.20"	
ES-2-E-1		AS PER MAP TYPE I	0.25"	

BY _____ DATE 1/87
CHKD. BY _____ DATE _____

SHEET NO. 2 OF 3
PROJECT NO. SLN-86-72

FORM 73 REV. 7/74

TABLE I

EXTRACTION STEAM PIPING INSPECTIONS - PIPING AND FITINGS

PIPING/FITTING LABEL	DWG. REFERENCE	SCOPE OF INSPECTION	SCREENING CRITERIA	NOTES
ES-2-E-2	8770-G-125 ES-B-2	AS PER MAP TYPE I	0.25"	
ES-?-B-1	(W) 730J117 SH1 I/M 8770-4927	AS PER MAP TYPE III, SECTION C ONLY	0.18"	INSIDE CONDENSER AT #2 FW HTRS - EXACT LOCATION OF FITING TO BE INSPECTED TO BE BASED ON ACCESSIBILITY
HD-7-T-1	8770-G-125 SH HD-J-2	AS PER MAP TYPE IV NOTE: ALSO UT AND MAP TARGET PLATE.	NONE - REPORT RESULTS TO ENG. FOR EVAL.	ADDED PER REV 1
HD-11B-E-1	" " "	" " " " "		" " "
HD-1-T-1	SH. HD-J-1			
BF-18-E-1	" " " SH. BF-M-4	AS PER MAP TYPE I (COORDINATE W/ BF-18-T-1 BELOW)		" " "
BF-18-T-1	" " "	AS PER MAP TYPE IV		" " "
BF-22-T-1	8770-G-125 SH BF-M-5	" " " " " NOTE: ALSO UT AND MAP TARGET PLATE		" " "
MS-5-T-1	8770-G-125 SH MS-L-1	" " " " "		" " "
C-21-E-1	8770-G-125 SH C-E-10	AS PER MAP TYPE I		" " "
C-42-B-1	8770-G-125 SH C-E-2	AS PER MAP TYPE III		" " "
B-94-E-1	BLOWDOWN ISO B-44	AS PER MAP TYPE IV		" " "
B-94-T-1	" " "	AS PER MAP TYPE II		" " "

BY: [illegible] DATE 1/7/87

CHKD. BY _____ DATE _____

SHEET NO. 3 OF 3

PROJECT NO. SLN-86-72

FORM 73 REV. 7/74

BY gf DATE 1/9/87

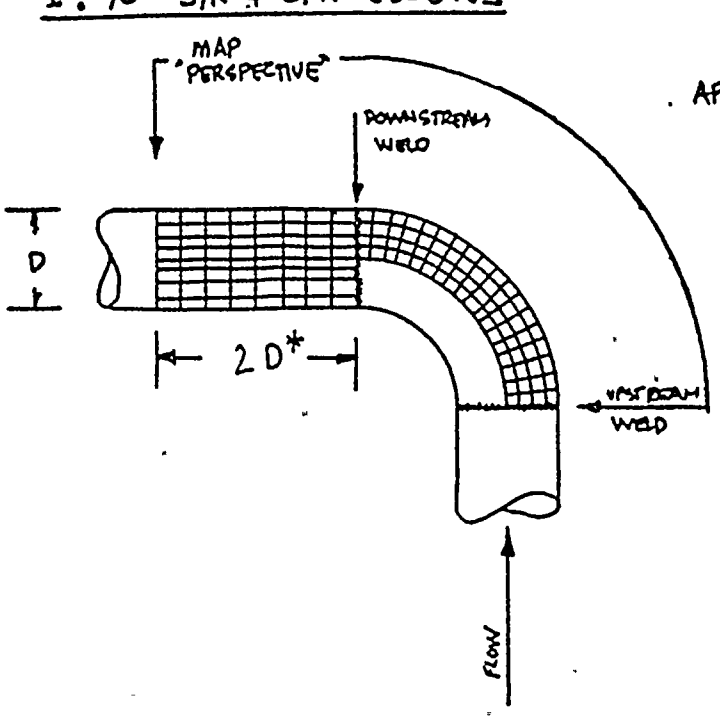
CHKD. BY _____ DATE _____

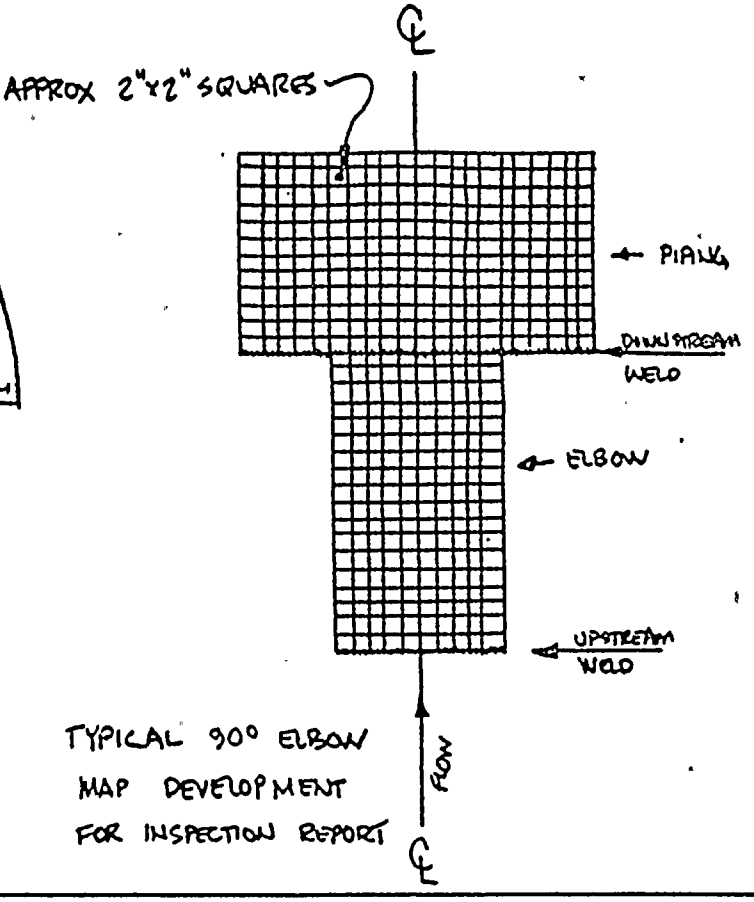
SHEET NO. 1 OF 1

PROJECT NO. SLN 86-72

REQUIRED MAPPING AREAS FOR PIPING AND FITTINGS

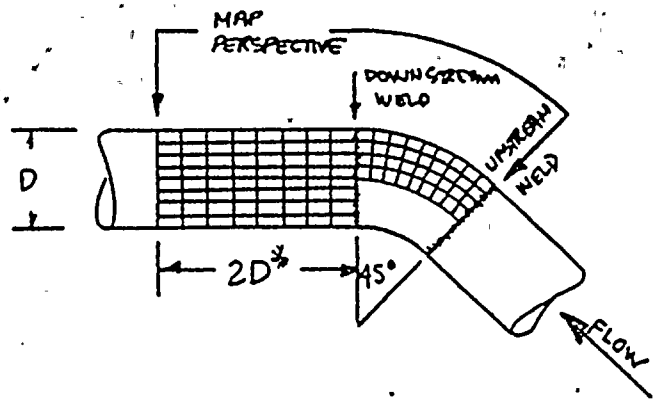
I. 90° S/R & L/R ELBOWS

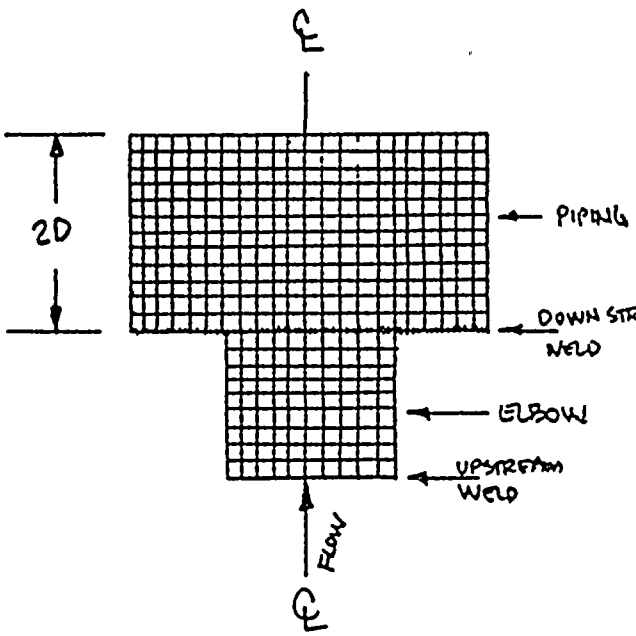




TYPICAL 90° ELBOW MAP DEVELOPMENT FOR INSPECTION REPORT

II. 45° S/R & L/R ELBOWS



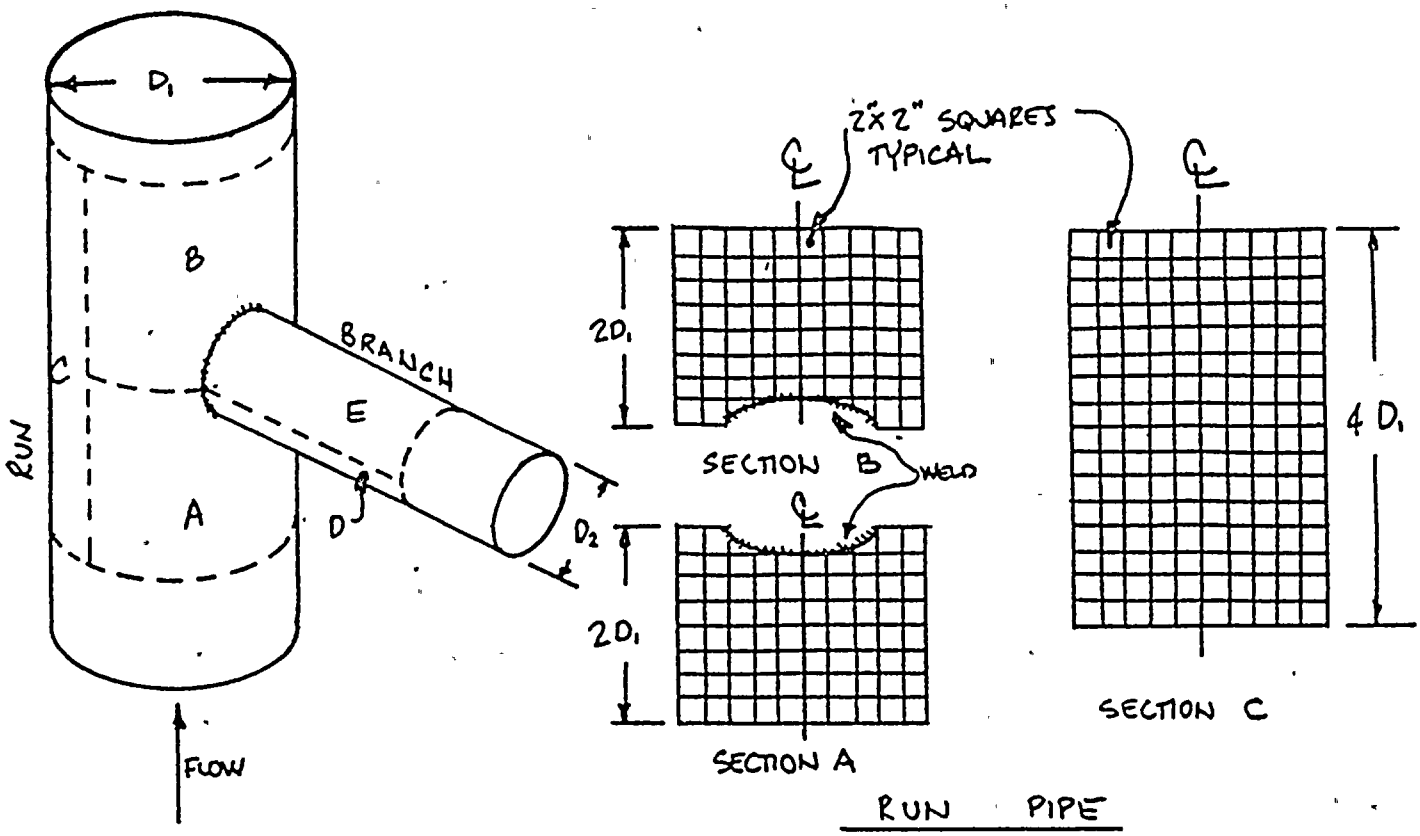


TYPICAL 45° ELBOW MAP DEVELOPMENT FOR INSPECTION REPORT

* MAP PIPING FOR LENGTH OF 2 PIPE DIAMETERS OR TO NEXT FITTING WELD IF LESS THAN 2D FROM DOWNSTREAM WELD

REQUIRED MAPPING AREAS FOR PIPING AND FITINGS

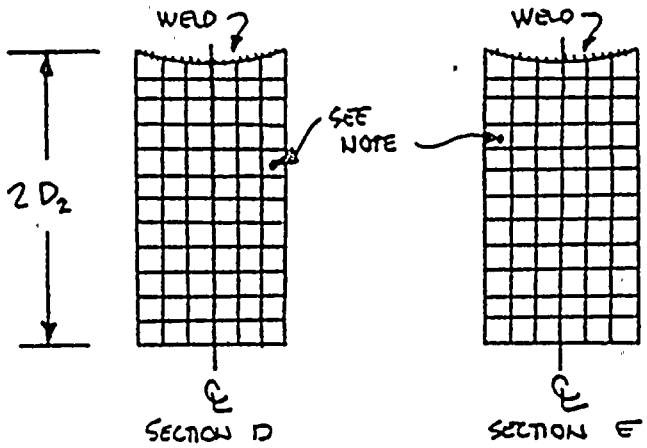
III. BRANCH CONNECTIONS (BRANCH PIPE SMALLER THAN RUN PIPE)



RUN PIPE

NOTE: - FOR BRANCH PIPING 6" O.D. AND LESS, USE 1"x 1" GRID SIZE

- FOR BRANCH PIPING 6" O.D AND GREATER USE 2"x2" GRID SIZE.

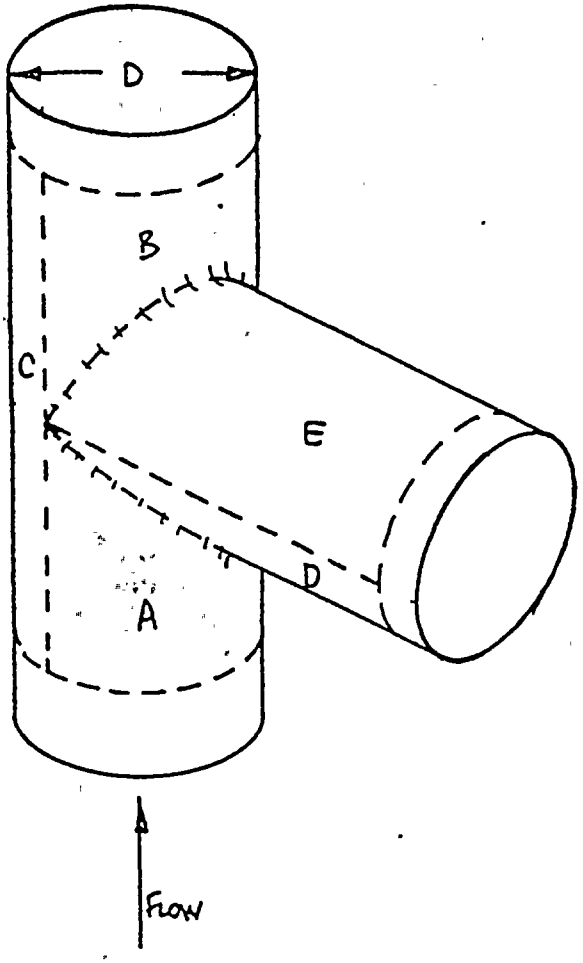


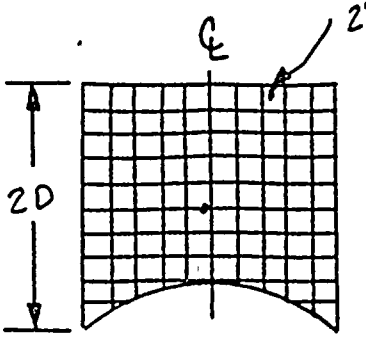
BRANCH PIPE

TYPICAL BRANCH CONNECTION MAP DEVELOPMENTS FOR INSPECTION REPORTS

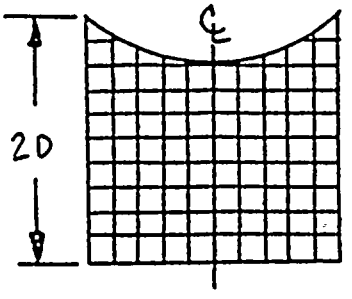
REQUIRED MAPPING AREAS FOR PIPING AND FITTINGS

IV TEES (RUN PIPE AND BRANCH PIPE SAME DIAMETER)

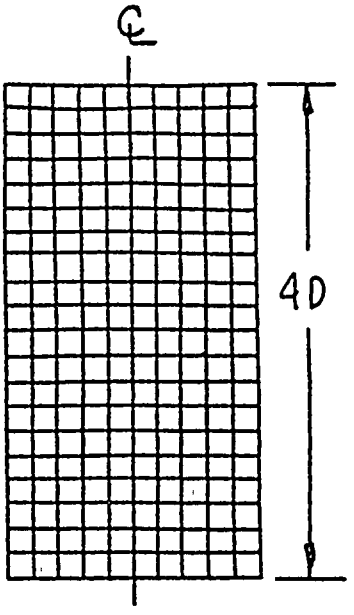




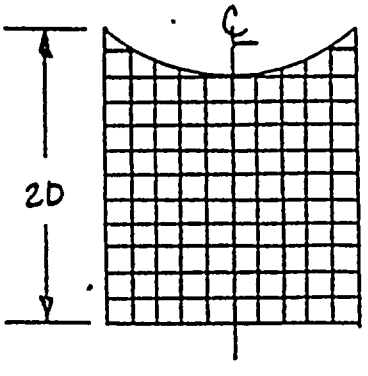
SECTION B



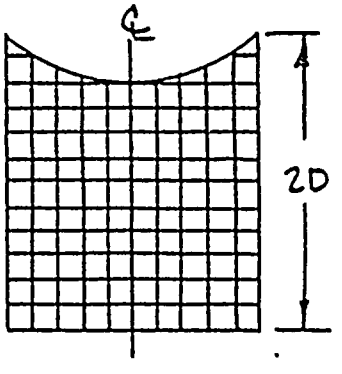
SECTION A



SECTION C



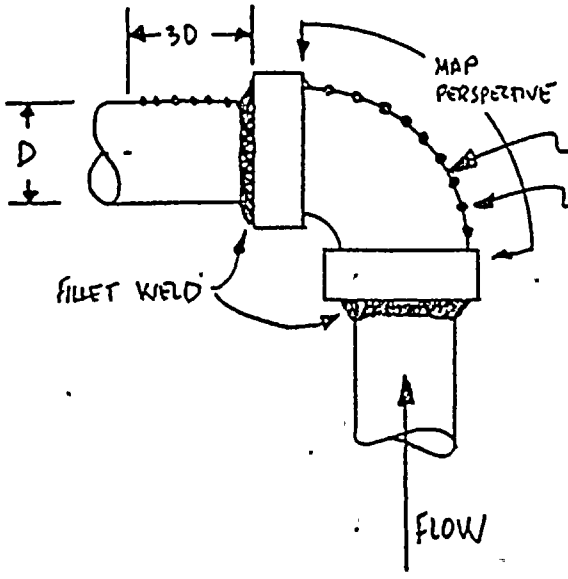
SECTION D



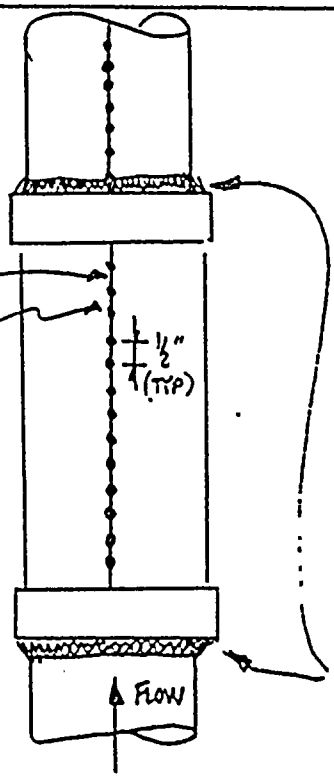
SECTION E

REQUIRED MAPPING AREAS FOR PIPING AND FITTINGS

V SOCKET WELDING ELBOWS

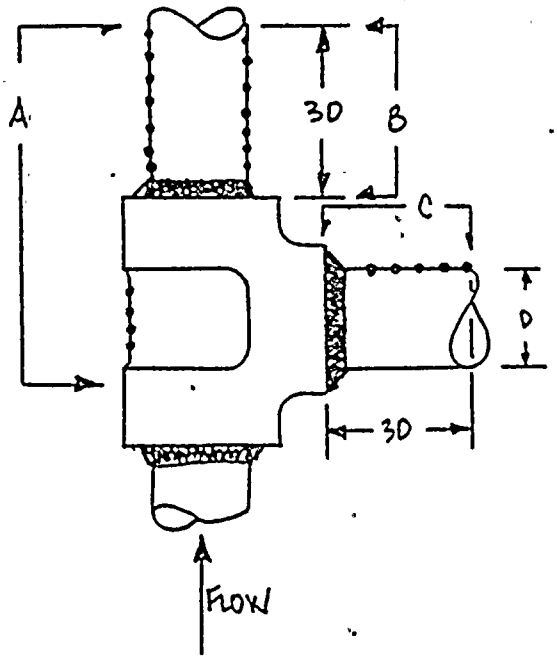


REPORT WALL THICKNESS ALONG ELBOW "EXTRADOS" LINE ONLY, ONE DATA POINT FOR EVERY 1/2"

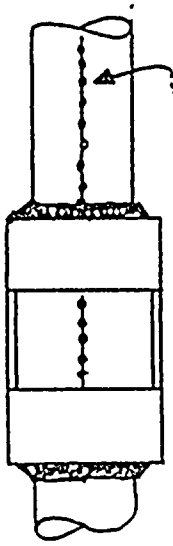


TYPICAL MAP DEVELOPMENT FOR INSPECTION REPORT

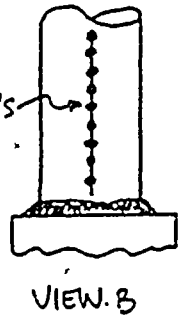
VI SOCKET WELDING TEES



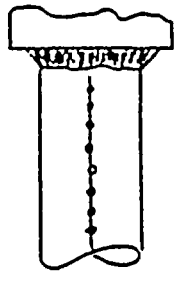
REPORT THICKNESS READINGS IN THE THREE AREAS SHOWN, READINGS SHOULD BE SPACED APPROXIMATELY 1/2" APART



VIEW A
MAP DEVELOPMENT



VIEW B



VIEW C

ATTACHMENT B

ST. LUCIE UNIT 1

INSPECTION PROGRAM RESULTS

SUMMARY

APRIL 28, 1987

Summary of Unit 1 Refueling Outage Piping Inspections and Activities

Attachment A provided the inspection program which was designed to detect erosion/corrosion degradation of piping in high energy systems. The systems included in the scope of the inspection program were extraction steam and main steam (to address the concerns of the subject REA), condensate, feedwater, blowdown and heater drain (to address concerns resulting from the Surry incident). The method of inspection involved ultrasonic mapping of the piping and fitting areas suspected of being susceptible to erosion/corrosion. The following summarizes our findings and corrective actions for each of the systems inspected:

- Blowdown: Seven fitting/piping locations were inspected. No signs of erosion/corrosion were evident.

- Feedwater: Three fitting/piping locations were inspected, including one similar in configuration to the failed section involved in the Surrey incident. No signs of erosion/corrosion were evident.

- Main Steam: One branch fitting at the main steam header was inspected. No signs of erosion/corrosion were evident.

- Extraction Steam Piping: These lines, as anticipated, were the only lines to show signs of erosion/corrosion. Portions of the extraction steam piping associated with the number 2 through number 5 feedwater heaters were inspected, and activities are summarized as follows:

    - Number 2 Feedwater Heaters: Two fabricated elbows (located in condenser) were inspected. Both elbows showed signs of erosion/corrosion damage. No corrective action was specified, since these fittings are expected to survive through Cycle 10 (i.e., given actual erosion rates, encroachment on code minimum wall thickness would not be expected until approximately Cycle 11).

    - Number 3 Feedwater Heaters: Three fittings/piping locations were examined. Some minor erosion/corrosion was detected, however, piping wall thicknesses are still within manufacturers tolerances.

    - Number 4 Feedwater Heaters: All elbows and several sections of straight piping were inspected (a total of 34 examination reports). These lines were expected to have sustained the most serious erosion/corrosion damage, and inspection results verified this expectation. As a result of inpsection data review, eight 20" elbows were replaced along with approximately 30' of associated piping. These fittings and piping were replaced since erosion had either encroached on code minimum wall thickness or would have resulted in violation of code minimum values within the next operating cycle. All fittings and piping were upgraded to chromium-molybdenum alloy steel which is expected to survive "life-of-plant" from the viewpoint of erosion/corrosion resistance (Reference PC/M 117-186).

Summary (cont'd)

- The balance of number 4 feedwater heater extraction steam line piping and fittings are in most cases severely eroded, and replacement of all remaining elbows and much of the piping is predicted within the next three to four cycles of operation.

- Number 5 Feedwater Heaters: Five fitting/piping locations were examined, and extensive erosion/corrosion was indicated by examination results. In the most severe cases, it was determined that, based upon actual erosion/corrosion rates, the fittings would survive an additional cycle of operation before code minimum wall thickness would be a concern. The number 5 feedwater heater extraction steam lines will make up the majority of the inspection program for the 1987 refueling outage, since 100% examination of fittings will be recommended. Also, based on the erosion/corrosion rates, new chromium-molybdenum piping and fittings should be purchased since replacement of some of the fittings is probable for the next refueling outage.

- Heater Drain: Three locations were examined. Erosion/corrosion was detected in the MSR shell side drains, however, no corrective action was specified, since the fittings should survive the next cycle of operation without encroaching on code minimum wall thickness.

The attached document is a database summary of inspection results and activities. The "piping/fitting labels" correspond to those listed in the Attachment A, which is the inspection program document.

SPE-PSE-87-1089

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING LABEL	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
B-01-E-01	BLOWDOWN	B-1	N/A	ELBOW	0.203/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
B-01-E-02	BLOWDOWN	B-1	N/A	ELBOW	0.215/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
B-01-E-03	BLOWDOWN	B-1	N/A	ELBOW	0.213/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
B-02-E-01	BLOWDOWN	B-2	N/A	ELBOW	0.228/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
J2-E-02	BLOWDOWN	B-2	N/A	ELBOW	0.212/1987			MPME DETECTED	REINSPECT IS 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
B-94-E-01	BLOWDOWN	B-42	N/A	ELBOW	0.362/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
B-94-T-01	BLOWDOWN	B-42	N/A	TEE	0.319/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
BF-18-E-01	8770-G-125	BF-M-4	N/A	ELBOW	1.76/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
BF-18-T-01	8770-G-125	BF-M-4	N/A	TEE	1.5/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
BF-22-T-01	8770-G-125	BF-M-5	N/A	TEE	1.0/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING ID	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
C-21-E-01	8770-G-125	C-E-10	N/A	ELBOW	NOMINAL			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
C-42-B-01	8770-G-125	C-E-2	N/A	BRANCH	0.525/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
ES-02-B-01	8770-G-125	ES-B-2		BRANCH	0.364/1987	0.422	0.179	0.0090		27
ES-02-E-01	8770-G-125	ES-B-2		ELBOW	0.220/1987	0.422	0.179	0.032		8
ES-02-E-01	8770-G-125	ES-B-2		PIPE DN ELBOW	0.391/1987	0.422	0.179	0.0048		51
02-E-02	8770-G-125	ES-B-2		ELBOW	0.370/1987	0.422	0.179	0.0081		30
ES-02-E-02	8770-G-125	ES-B-2		PIPE UP ELBOW	0.370/1987	0.422	0.179	0.0081		30
ES-02-SP-01	8770-G-125	ES-B-2		PIPE	0.360/1987	0.422	0.179	0.0096		25
ES-02-T-01	8770-G-125	ES-B-2		TEE	0.240/1987	0.422	0.179	0.028		9
ES-02A-B-01	W730J117I/M 8770-4427	SH 1		STOVE PIPE	0.265/1987	0.422	0.100	0.024		13
ES-02A-E-01	W730J117I/M 8770-4427	SH 1		MITRED ELBOWS	0.215/1987	0.422	0.100	0.032		10
ES-02A-E-02	W730J117I/M 8770-4427	SH 1		MITRED ELBOWS	0.215/1987	0.422	0.100	0.032		10
ES-03-B-01	8770-G-125	ES-B-1	1-036	BRANCH	0.160/1987	0.422	0.198	0.044	REPLACED	N/A
ES-03-B-01	8770-G-125	ES-B-1	1-036	ST. PIPE	0.230/1987	0.422	0.198	0.030	REPLACED	N/A
ES-03-B-02	8770-G-125	ES-B-1		ST. PIPE	0.285/1987	0.422	0.198	0.021		11

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING L..	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
ES-03-B-03	8770-G-125	ES-B-1		BRANCH	0.285/1987	0.422	0.198	0.021		11
ES-03-B-03	8770-G-125	ES-B-1		ST. PIPE	0.280/1987	0.422	0.198	0.022		10
F[illegible]3-E-01	8770-G-125	ES-B-1	1-036	ELBOW	0.235/1987	0.422	0.198	0.029	REPLACED	N/A
ES-03-E-01	8770-G-125	ES-B-1	1-036	PIPE	0.260/1987	0.422	0.198	0.025	REPLACED	N/A
ES-03-E-02	8770-G-125	ES-B-1	1-036	ELBOW	0.240/1987	0.422	0.198	0.028	REPLACED	N/A
ES-03-E-02	8770-G-125	ES-B-1	1-036	PIPE	0.310/1987	0.422	0.198	0.017	REPLACED	N/A
ES-03-E-03	8770-G-125	ES-B-1	1-038	ELBOW	0.210/1987	0.422	0.198	0.033	REPLACED	N/A
ES-03-E-03	8770-G-125	ES-B-1	1-038	PIPE	0.210/1987	0.422	0.198	0.033	REPLACED	N/A
ES-03-E-04	8770-G-125	ES-B-1	1-037	ELBOW	0.160/1987	0.422	0.198	0.042	REPLACED	N/A
ES-03-E-04	8770-G-125	ES-B-1	1-037	PIPE	0.225/1987	0.422	0.198	0.031	REPLACED	N/A
ES-03-E-05	8770-G-125	ES-B-1	1-033	ELBOW	0.190/1987	0.422	0.198	0.0362	REPLACED	N/A
[illegible]3-E-05	8770-G-125	ES-B-1	1-033	PIPE DN ELBOW	0.220/1987	0.422	0.198	0.0315	REPLACED	N/A
ES-03-E-06	8770-G-125	ES-B-1		ELBOW	0.280/1987	0.422	0.198	0.0221		10
ES-03-E-06	8770-G-125	ES-B-1		PIPE DN ELBOW	0.260/1987	0.422	0.198	0.0253		9
ES-03-E-07	8770-G-125	ES-B-1	1-039	ELBOW	0.310/1987	0.422	0.198	0.0175		13
[illegible]3-E-07	8770-G-125	ES-B-1	1-039	PIPE DN ELBOW	0.240/1987	0.422	0.198	0.0284		8

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING LABEL	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
ES-03-E-08	8770-G-125	ES-B-1		ELBOW	0.300/1987	0.422	0.198	0.0190		12
ES-03-E-08	8770-G-125	ES-B-1		PIPE DN ELBOW	0.320/1987	0.422	0.198	0.0159		14
03-E-09	8770-G-125	ES-B-1		ELBOW	0.260/1987	0.422	0.198	0.0253		9
ES-03-E-09	8770-G-125	ES-B-1		REDUCER DN ELBOW	0.400/1987	0.422	0.198	0.0034		66
ES-03-SP-01	8770-G-125	ES-B-1		STR PIPE	0.280/1987	0.422	0.198	0.0221		10
ES-03-SP-02	8770-G-125	ES-B-1		STR PIPE	0.290/1987	0.422	0.198	0.0206		11
ES-04-B-01	8770-G-125	ES-B-1	1-016	BRANCH	0.280/1987	0.500	0.198	0.0343	REPLACED	N/A
ES-04-B-02	8770-G-125	ES-B-1		BRANCH	0.230/1987	0.422	0.198	0.300		8
ES-04-E-01	8770-G-125	ES-B-1	1-016	PIPE DN ELBOW	NOT MEASURED	0.422	0.198		REPLACED	N/A
ES-04-E-02	8770-G-125	ES-B-1	1-016	ELBOW	0.200/1987	0.422	0.198	0.0346	REPLACED	N/A
ES-04-E-03	8770-G-125	ES-B-1	1-025	ELBOW	0.245/1987	0.422	0.198	0.0276		8
04-E-03	8770-G-125	ES-B-1	1-025	PIPE DN ELBOW	0.290/1987	0.422	0.198	0.0206		11
ES-04-E-04	8770-G-125	ES-B-1		ELBOW	0.290/1987	0.422	0.198	0.0206		11
ES-04-E-04	8770-G-125	ES-B-1		PIPE DN ELBOW	0.340/1987	0.422	0.198	0.0128		12
ES-04-E-05	8770-G-125	ES-B-1		ELBOW	0.300/1987	0.422	0.198	0.0190		12
04-E-05	8770-G-125	ES-B-1		PIPE DN ELBOW	0.260/1987	0.422	0.198	0.0253		9

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
ES-04-E-06	8770-G-125	ES-B-1		ELBOW	0.280/1987	0.422	0.198	0.0221		10
ES-04-E-06	8770-G-125	ES-B-1		PIPE DN ELBOW	0.300/1987	0.422	0.198	0.0198		12
04-E-07	8770-G-125	ES-B-1	1-032	ELBOW	0.300/1987	0.422	0.198	0.0190	REPLACED	N/A
ES-04-E-07	8770-G-125	ES-B-1	1-032	PIPE DN ELBOW	0.135/1987	0.422	0.198	0.0447	REPLACED	N/A
ES-04-E-08	8770-G-125	ES-B-1	1-031	ELBOW	0.340/1987	0.422	0.198	0.0127		18
ES-04-E-08	8770-G-125	ES-B-1	1-031	PIPE DN ELBOW	0.160/1987	0.422	0.198	0.0408	REPLACED	N/A
ES-04-E-09	8770-G-125	ES-B-1		ELBOW	0.320/1987	0.422	0.198	0.0159		14
ES-04-E-09	8770-G-125	ES-B-1		PIPE DN ELBOW	0.300/1987	0.422	0.198	0.0190		12
ES-04-E-10	8770-G-125	ES-B-1		ELBOW	0.300/1987	0.422	0.198	0.0190		12
ES-04-E-10	8770-G-125	ES-B-1		PIPE DN ELBOW	0.256/1987	0.422	0.198	0.0259		9
ES-04-E-11	8770-G-125	ES-B-1		ELBOW	0.300/1987	0.422	0.198	0.0190		12
04-E-11	8770-G-125	ES-B-1		PIPE DN ELBOW	0.240/1987	0.422	0.198	0.0284		8
ES-04-E-12	8770-G-125	ES-B-1	1-020	ELBOW	0.280/1987	0.422	0.198	0.0221		10
ES-04-E-12	8770-G-125	ES-B-1	1-020	PIPE DN ELBOW	0.180/1987	0.422	0.198	0.0377	REPLACED	N/A
ES-04-E-13	8770-G-125	ES-B-1	1-017	ELBOW	0.340/1987	0.422	0.198	0.0128		18
04-E-13	8770-G-125	ES-B-1		PIPE DN ELBOW	0.255/1987	0.422	0.198	0.0260		9

SECONDARY STEAM/WATER PIPING INSPECTIONS

PIPING/ FITTING	DRAWING REFERENCE	SHEET	NCR NO.	COMPONENT	MIN. WALL (IN) MEASURED/ INSP. OUTAGE	NOMINAL WALL (IN)	CODE MIN. WALL REQMT.	ACTUAL EROSION RATE (IN/10^4 HRS)	DISPOSITION	PREDICTED REPLACEMENT OUTAGE
ES-04-E-14	8770-G-125	ES-B-1		ELBOW	0.256/1987	0.422	0.198	0.0259		9
ES-04-E-14	8770-G-125	ES-B-1		REDUCER DN ELBOW	0.350/1987	0.422	0.198	0.0112		8
ES-04-E-15	8770-G-125	ES-B-1		ELBOW	0.240/1987	0.422	0.198	0.0284		8
ES-04-SP-01	8770-G-125	ES-B-1	1-040	STRAIGHT PIPE	0.170/1987	0.422	0.198	0.0393	REPLACED	N/A
ES-05-B-01	8770-G-125	ES-B-1		BRANCH	0.341/1987	0.422	0.100	0.0126		26
ES-05-E-01	8770-G-125	ES-B-1		ELBOW	0.360/1987	0.422	0.100	0.0096		34
ES-05-E-01	8770-G-125	ES-B-1		PIPE DN ELBOW	0.350/1987	0.422	0.100	0.0112		29
ES-05-SP-01	8770-G-125	ES-B-1		ST. PIPE	0.329/1987	0.422	0.100	0.0145		22
HD-01-T-01	8770-G-125	HD-J-1		TEE	0.340/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
HD-07-T-01	8770-G-125	HD-J-2		TEE	0.400/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT
HD-118-E-01	8770-G-125	HD-J-1 ~~HD-J-2~~		ELBOW	0.200/1987	0.422		0.0346		REINSPECT NEXT OUTAGE
HD-118-E-01	8770-G-125	HD-J-2		PIPE DN ELBOW	0.260/1987	0.422		0.0253		REINSPECT NEXT OUTAGE
MS-05-T-01	8770-G-125	MS-L-1		TEE	3.2/1987			NONE DETECTED	REINSPECT IN 2-3 OUTAGES	REPLACEMENT NOT ANTICIPATED FOR LIFE OF PLANT

ATTACHMENT C

ST. LUCIE UNIT 2

PIPING INSPECTIONS FOR

EROSION/CORROSION

AUGUST 12, 1987

MCI1:5

HIGH ENERGY PIPING INSPECTION PROGRAM GUIDELINES

TABLE OF CONTENTS

* DRAWINGS ARE NOT INCLUDED BUT ARE AVAILABLE AT FPL.

HIGH ENERGY PIPING INSPECTION PROGRAM GUIDELINES

I. BACKGROUND/PURPOSE

A RUPTURE OF AN EXTRACTION STEAM LINE ON UNIT 1 DURING CYCLE 7 RESULTED IN FORCED OUTAGE AND A LOSS OF APPROXIMATELY 39 FULL POWER HOURS. AN EXAMINATION OF THE FAILED PIPE AND A FOLLOW-UP ENGINEERING EVALUATION CONCLUDED THAT EROSION/CORROSION WAS THE FAILURE MECHANISM. EROSION/CORROSION IS AN ACCELERATED FORM OF CORROSION INDUCED BY FLOW DUE TO THE BREAKDOWN OF A PROTECTIVE OXIDE FILM FROM THE MATERIAL'S SURFACE. BECAUSE OF THE PIPE FAILURE OCCURENCE AND FOLLOW-UP ANALYSIS AND INSPECTION RESULTS, THE NEED FOR AN INSPECTION AND REPAIR PROGRAM FOR BOTH ST. LUCIE UNITS WAS DETERMINED TO EXIST.

ALSO, IN LIGHT OF THE RECENT SURREY PLANT PIPING FAILURE INCIDENT, REPRESENTATIVE FITTINGS AND PIPING FROM SINGLE PHASE HIGH ENERGY SYSTEMS SUCH AS HEATER DRAIN, FEEDWATER AND CONDENSATE ARE INCLUDED. THE ADDITIONAL SINGLE PHASE LOCATIONS HAVE BEEN SELECTED IN ACCORDANCE WITH INPO SOER 87-3 GUIDANCE.

II. INSPECTION SCOPE

BECAUSE OF THE SIGNIFICANT AMOUNT OF HIGH ENERGY PIPING, A METHOD FOR PRIORITIZING THE INSPECTION POINTS WAS FIRST DEVELOPED. THIS METHOD REQUIRED THE CALCULATION OF EROSION RATES FOR REPRESENTATIVE PIPING CONFIGURATIONS AND CONDITIONS. THE RATE OF EROSION/CORROSION IS A FUNCTION OF A NUMBER OF FACTORS INCLUDING:

- PERCENT MOISTURE
- MATERIAL COMPOSITION
- pH AND WATER CHEMISTRY
- TEMPERATURE
- OXYGEN
- FLOW PATH GEOMETRY
- FLOW VELOCITY

BASED UPON REVIEW OF THE HIGH ENERGY PIPING SYSTEMS,THE GENERAL INSPECTION AREAS ARE AS FOLLOWS:

1. 4A AND 4B FEEDWATER HEATER EXTRACTION STEAM PIPING ELBOWS PLUS ASSOCIATED STRAIGHT PIPING
2. 5A FEEDWATER HEATER EXTRACTION STEAM LINE ELBOW AND ASSOCIATED PIPING
3. CONDENSATE PUMP FULL FLOW RECIRCULATION ELBOW AND PIPING DOWNSTREAM OF THE RECIRCULATION CONTROL VALVE

4. FEEDWATER PIPING AND ELBOW DOWNSTREAM OF THE FEEDWATER REGULATING VALVES .

5. HEATER DRAIN TIE IN BRANCH CONNECTION TO THE CONDENSATE SYSTEM

6. MSR SHELL SIDE DRAIN ELBOW AND ASSOCIATED PIPING

7. 3B EXTRACTION STEAM LINE ELBOW AND ASSOCIATED PIPING

THE SPECIFIC REQUIRED INSPECTION POINTS ARE LISTED IN TABLE I ALONG WITH A UNIQUE DESIGNATION NUMBER AND DRAWING REFERENCE. THE PLANT DRAWINGS LISTED IN THE TABLE OF CONTENTS ARE ATTACHED AND HAVE BEEN MARKED-UP TO SHOW THE SPECIFIC FITTINGS AND PIPING TO BE INSPECTED.

III. METHOD OF INSPECTION

INSPECTION IS TO BE CONDUCTED USING AN ULTRASONIC DEVICE TO MEASURE WALL THICKNESS. PIPING AND FITTINGS TO BE INSPECTED ARE TO BE MARKED OFF INTO "ZONE MAPS" AS SHOWN IN THE ATTACHED SKETCHES. GENERALLY, PIPING OVER 6" IN DIAMETER WILL HAVE 2" GRID SPACING, AND PIPING 6" IN DIAMETER OR LESS WILL HAVE 1" GRID SPACING.

FOR EACH INSPECTION POINT LISTED IN TABLE 1, AN "INSPECTION SCOPE" IS GIVEN. THE INSPECTION SCOPE FOR EACH GENERIC FITTING TYPE, I.E., 45 DEGREE ELBOWS, 90 DEGREE ELBOWS, TEES AND BRANCH CONNECTIONS, IS SHOWN IN DETAIL IN SKETCHES 1,2 AND 3. THESE SKETCHES INDICATE HOW EACH CONFIGURATION TYPE IS GENERALLY TO BE MAPPED. THE SKETCHES ALSO INDICATE APPROXIMATELY HOW THE INSPECTION REPORT MAPS SHOULD APPEAR.

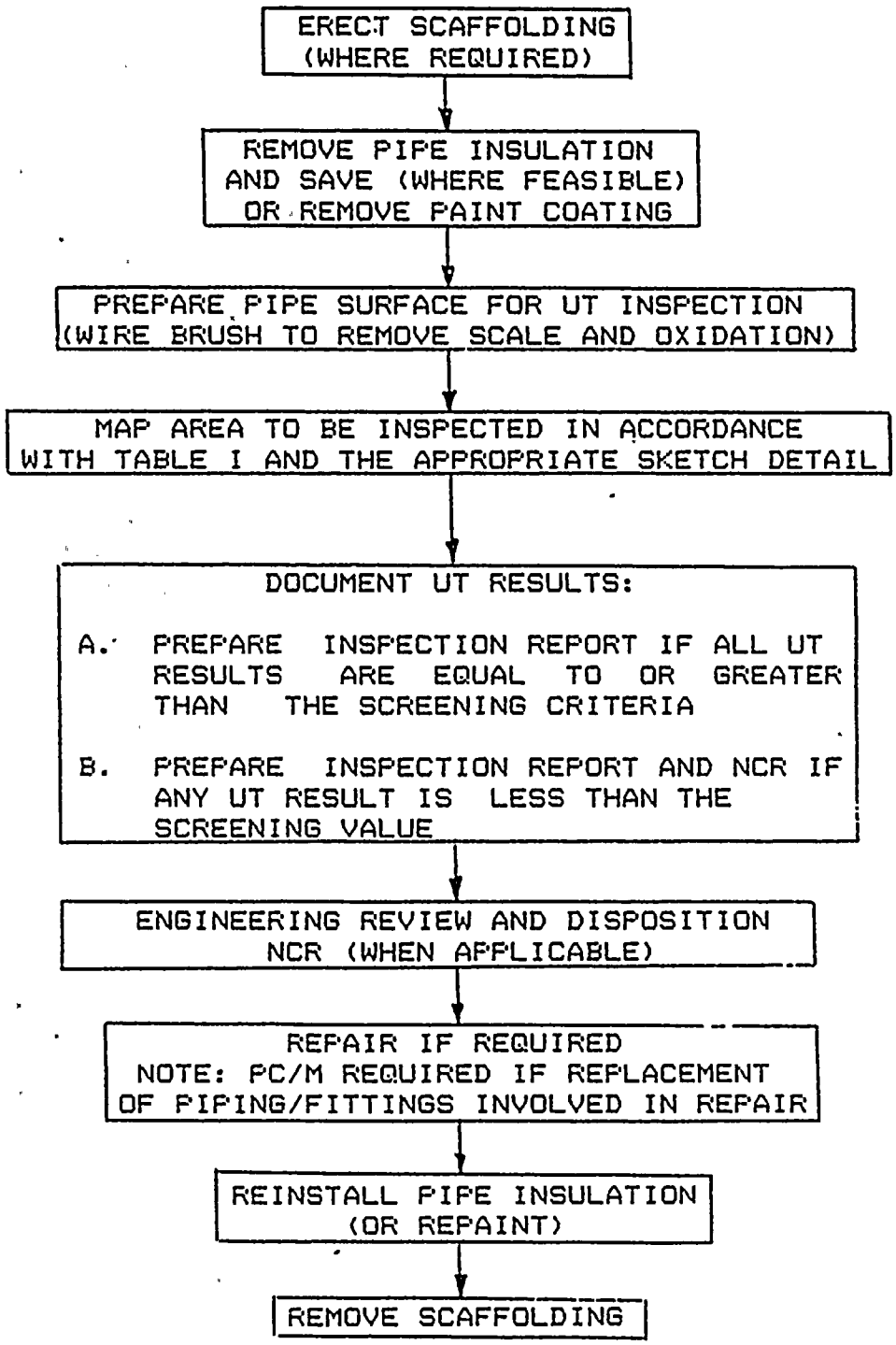
IV. SCREENING CRITERIA

TABLE 1 PROVIDES A WALL THICKNESS VALUE FOR EACH FITTING OR PIPING SECTION TO BE INSPECTED. IF INSPECTION RESULTS INDICATE THAT ALL ULTRASONIC TEST READINGS ARE EQUAL TO OR GREATER THAN THE VALUE SPECIFIED, THEN NO REPAIR OR REPLACEMENT ACTIVITIES WILL BE REQUIRED. IF ANY ULTRASONIC TEST RESULT IS LESS THAN THE VALUE SPECIFIED, THEN AN NCR IS TO BE GENERATED WHICH INCLUDES THE INSPECTION REPORT FOR THE FITTING OR PIPING SECTION AND INDICATES THE SCREENING CRITERIA VALUE VIOLATED.

ALL INSPECTION DATA ARE TO BE TURNED OVER TO POWER PLANT ENGINEERING FOR REVIEW UPON COMPLETION.

V. INSPECTION FLOW CHART

THE FOLLOWING IS A DESCRIPTION OF THE GENERAL PROCESS REQUIRED FOR THE INSPECTION OF EACH FITTING OR PIPING SECTION:



VII. REQUIRED DOCUMENTATION

AN INSPECTION REPORT SHALL BE PREPARED FOR EACH INSPECTION POINT. THIS INSPECTION REPORT SHALL INCLUDE, AS A MINIMUM, THE FOLLOWING INFORMATION:

1. DRAWING NUMBER
2. PIPING/FITTING LABEL (AS LISTED IN TABLE I)
3. SCREENING CRITERIA
4. UT MAP(S) AS INDICATED BY TABLE I AND THE APPROPRIATE SKETCH DETAIL
5. NCR NUMBER (IF NCR REQUIRED)

TABLE I
ST. LUCIE UNIT 2 EROSION/CORROSION INSPECTION PROGRAM - 1987

PIPING/ FITTING LABEL	DRAWING REFERENCE	ZONE MAP TYPE	SCREENING CRITERIA	NOTES
2BF-13-E-01	BF-M-3	SKETCH 1 -TYPE I	0.90"	FEEDWATER REG STATION
2C-21-E-01	C-E-16	SKETCH 1 -TYPE I	0.330"	CONDENSATE FULL FLOW RECIRC
2C-35-T-01	C-E-11	SKETCH 3 -TYPE III	0.370"	2-3A HTR TO 2-A DRAIN COOLER
2C-37-B-01	C-E-15	SKETCH 2 -TYPE III	0.385"	HTR DRAIN TO CONDENSATE
2ES-01-E-01	ES-B-1	SKETCH 1 -TYPE I	0.250"	EXTRACTION STEAM TO 2-5A HTR
2ES-01-E-02	ES-B-1	SKETCH 1 -TYPE I	0.250"	EXTRACTION STEAM TO 2-5A HTR
2ES-03-E-01	ES-B-3	SKETCH 1 -TYPE I	0.256"	EXTRACTION STEAM TO 2-4A HTR
2ES-03-E-02	ES-B-3	SKETCH 1 -TYPE I	0.256"	EXTRACTION STEAM TO 2-4A HTR
2ES-03-E-03	ES-B-3	SKETCH 1 -TYPE I	0.256"	EXTRACTION STEAM TO 2-4A HTR
2ES-04-E-01	ES-B-3	SKETCH 1 -TYPE II	0.256"	EXTRACTION STEAM TO 2-4B HTR
2ES-06-E-01	ES-B-1	SKETCH 1 -TYPE I	0.10"	EXTRACTION STEAM TO 2-3B HTR
2HD-118-E-01	HD-J-2	SKETCH 1 -TYPE I	0.150"	2B MSR SHELL DRAIN TO 2-4B HTR

BY GP DATE 5/2/87

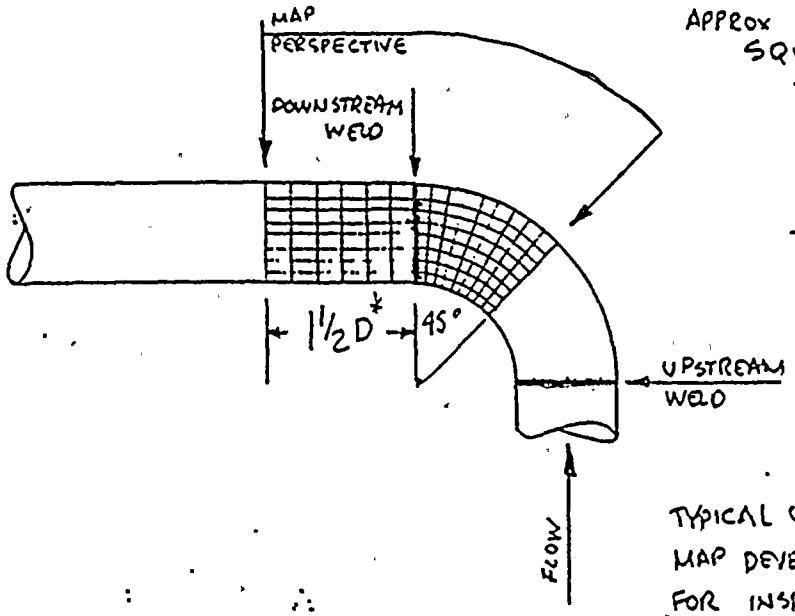
CHKD. BY ____ DATE ____

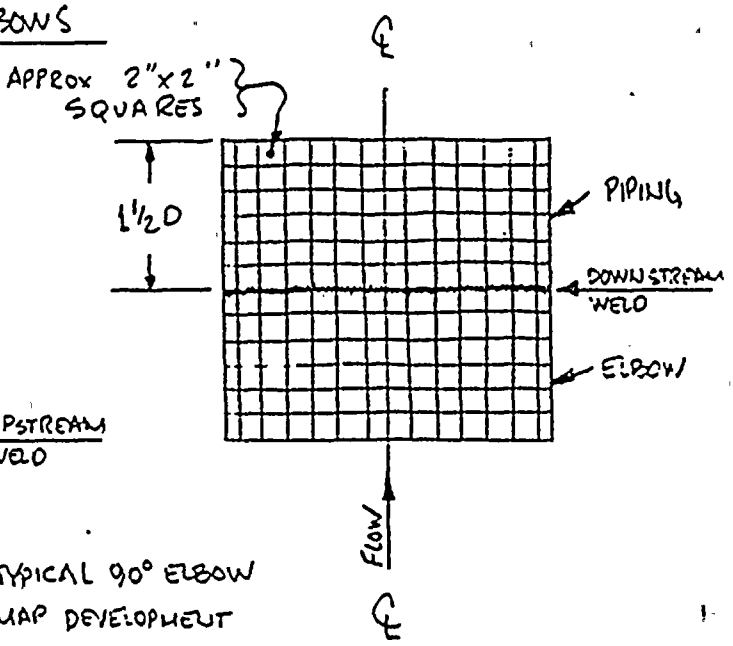
SHEET NO. 1 OF 1

PROJECT NO. SLN 86-72

REQUIRED: MAPPING AREAS FOR PIPING AND FITTINGS

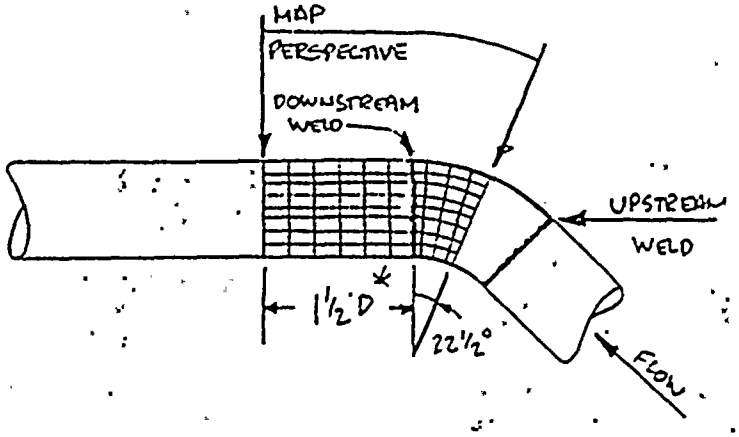
I. 90° SHORT OR LONG RADIUS ELBOWS

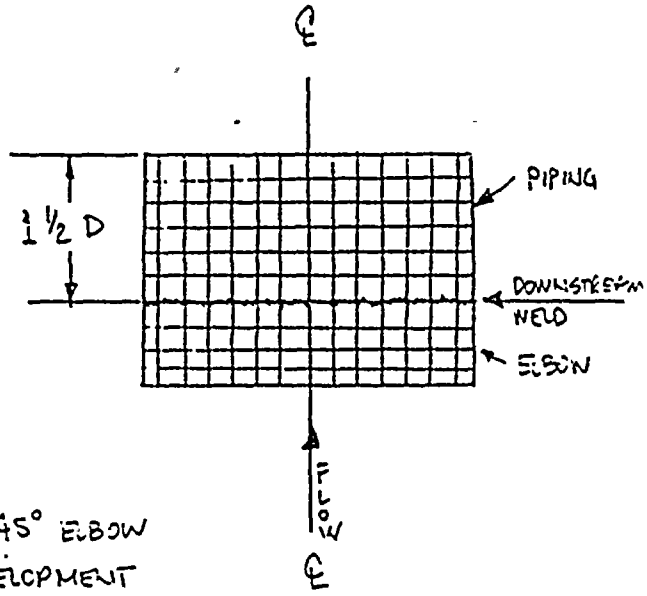




TYPICAL 90° ELBOW MAP DEVELOPMENT FOR INSPECTION REPORT

II. 45° SHORT OR LONG RADIUS ELBOWS



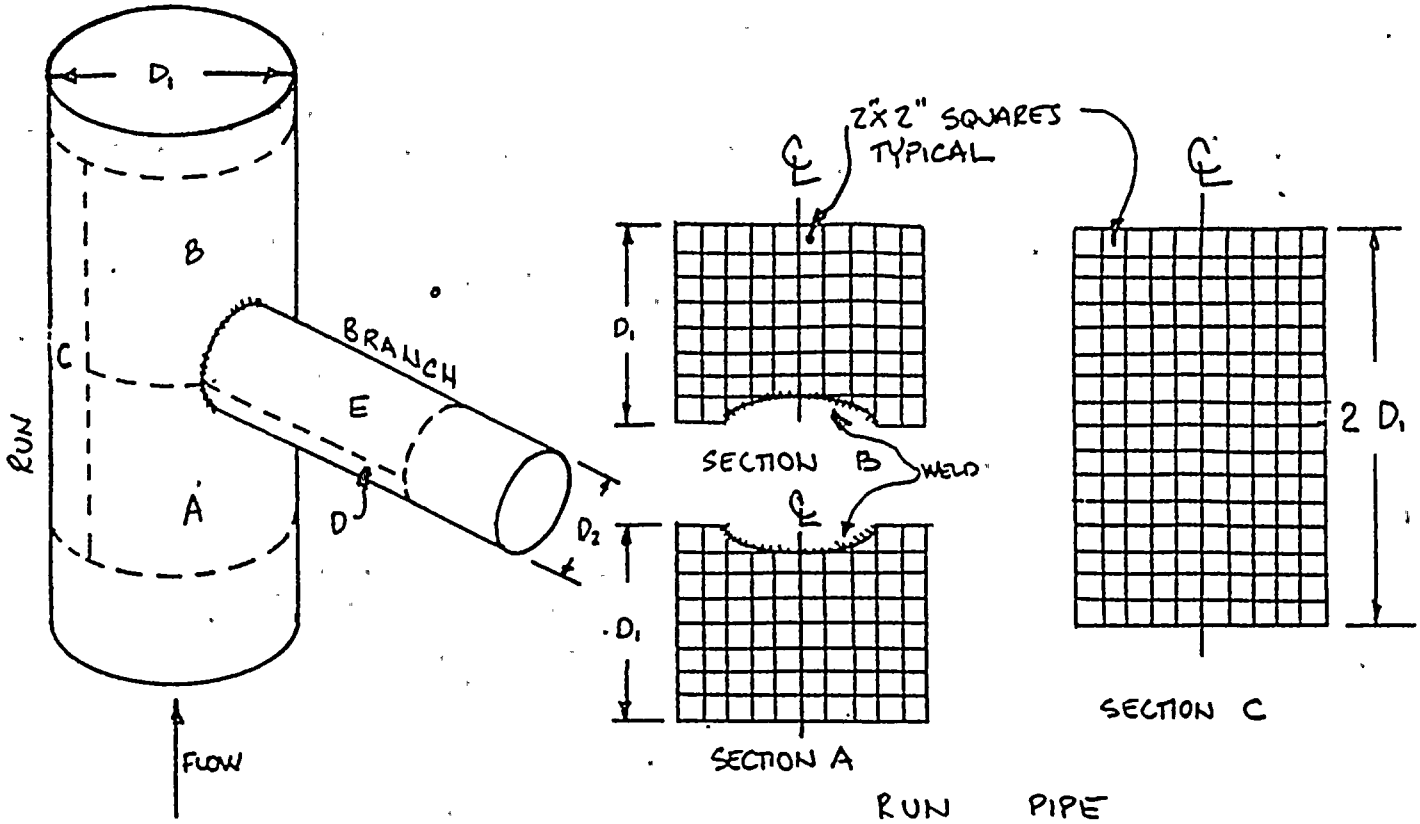


TYPICAL 45° ELBOW MAP DEVELOPMENT FOR INSPECTION REPORT

* MAP PIPING FOR LENGTH OF 1½ PIPE DIAMETERS OR TO NEXT FITTING WELD IF LESS THAN 1½ D FROM DOWNSTREAM WELD

REQUIRED MAPPING AREAS FOR PIPING AND FITINGS

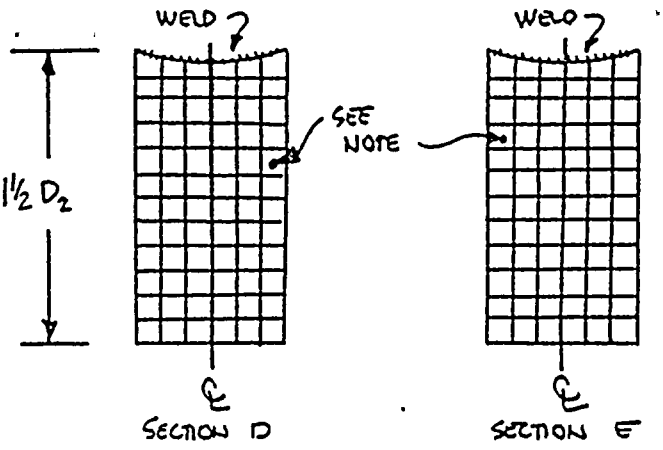
III. BRANCH CONNECTIONS (BRANCH PIPE SMALLER THAN RUN PIPE)



RUN PIPE

NOTE: - FOR BRANCH PIPING 6" O.D. AND LESS, USE 1"x1" GRID SIZE

- FOR BRANCH PIPING 6" O.D AND GREATER USE 2"x2" GRID SIZE

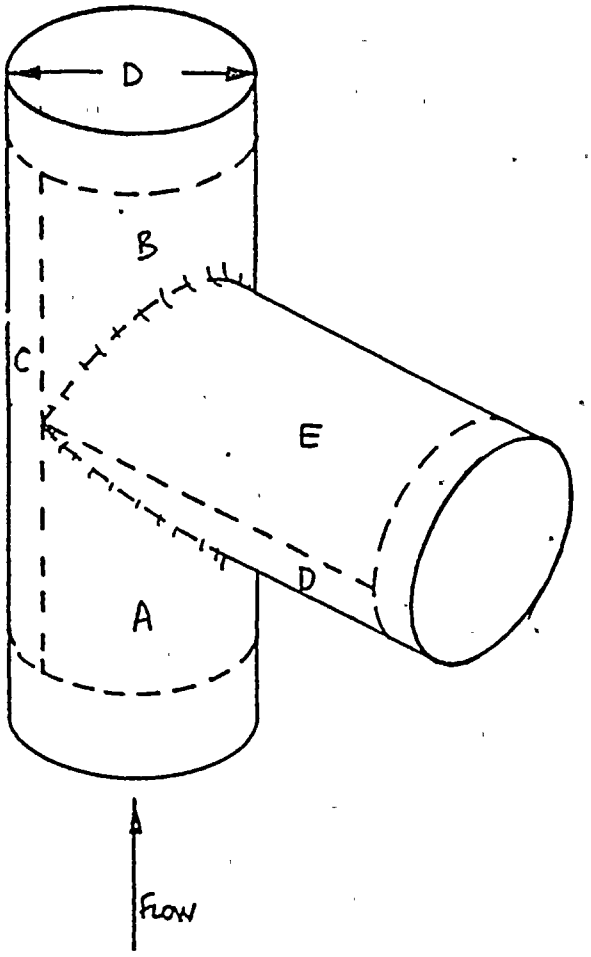


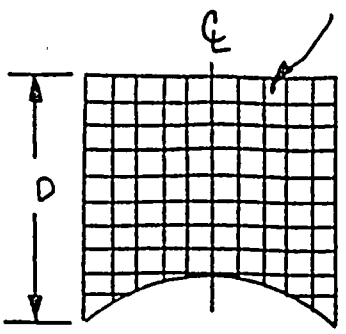
BRANCH PIPE

TYPICAL BRANCH CONNECTION MAP DEVELOPMENTS FOR INSPECTION REPORTS

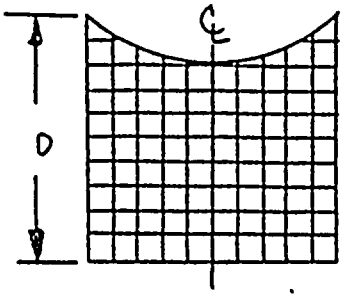
REQUIRED MAPPING AREAS FOR PIPING AND FITTINGS

IV TEES (RUN PIPE AND BRANCH PIPE SAME DIAMETER)

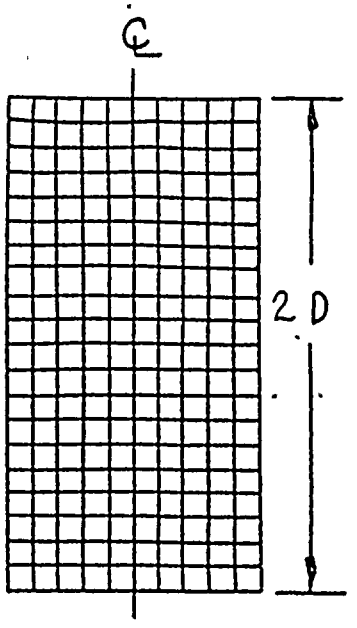




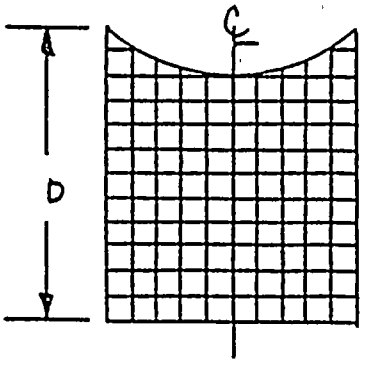
SECTION B



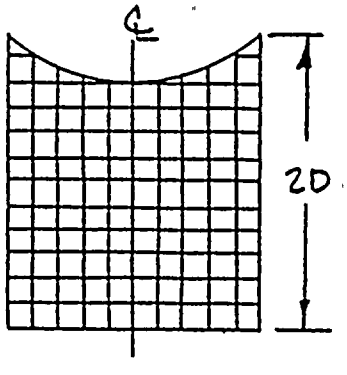
SECTION A



SECTION C



SECTION D



SECTION E

ATTACHMENT D

ST. LUCIE UNIT 1 TURBINE

CROSS UNDER PIPE INSPECTION

1983 REFUELING OUTAGE

1.0 PURPOSE

The purpose of this report is to provide Power Plant Engineerings inspection results and details of the various repairs that were performed on the St. Lucie Unit #1 turbine cross under piping during the 1983 refueling outage. Also included are recommendations for future inspections and repairs.

2.0 SCOPE

The scope of this report is applicable to the following:

2.1 Components Inspected

a. Pipe wall
b. Backing rings
c. Turning vanes
d. Turning vane supports
e. Expansion joints
f. Manways

2.2 Component Repairs

a. Turning vane supports
b. Manways
c. Backing rings

2.3 Recommendations

a. Future repairs
b. Periodic inspections

3.0 SYSTEM DESCRIPTION

The turbine cross under piping consists of four (4) 36 inch lines connecting the HP turbine exhaust to the four (4) moisture separator reheaters. The pipes are equipped with turning vanes at each bend to prevent pipe wall erosion. Each pipe section has six (6) manways located between the turning vanes to allow for access (see the attached Fig. 1 for piping layout).

4.0 COMPONENTS INSPECTED

The following manways were opened to allow for both manway repairs and internal pipe inspections: 1A1, 1A2, 1A6, 1B4, 1C2, 1C4, 1C5, 1D1, 1D2, 1D3, 1D5, and 1D6. Listed below are the results of the inspections.

4.1 Pipe Wall

The cross under piping itself showed no signs of significant erosion. The findings in this inspection were very similar to those found in Ref. 7.1. The majority of the piping has a magnetite coating which has protected the pipe from erosion.

4.2 Backing Rings

All of the backing rings that were inspected had eroded considerably. A few backing rings had been completely cut through in spots. Also, some of the backing rings had created turbulence which in turn caused minor downstream pipe wall erosion.

4.3 Turning Vanes

All the turning vanes inspected showed no signs of erosion or damage. The welds attaching the vanes to the pipe wall also appear to be in good shape.

4.4 Turning Vane Supports

The turning vane supports, in all cases, have experienced significant erosion. Erosion patterns are similar to the details provided in Ref. 7.1.

4.5 Expansion Joints

In most cases, the expansion joints and links did not exhibit any signs of erosion or damage. At one expansion joint (in the 1C2 portion of pipe), upstream pipe wall erosion was present in front of the upper and lower link. This erosion pattern is detailed in Ref. 7.2.

4.6 Manways

The majority of the manways that were removed were significantly damaged because they had been seal welded to eliminate steam leakage. Several manways also showed signs of warpage and steam cuts. Manway gasket materials were not consistent.

5.0 COMPONENT REPAIRS

The following repairs had been performed during the 1983 outage:

5.1 Turning Vane Supports

Three test repair procedures for the turning vane supports were provided within PC/M 82-82. Times required to perform each repair were documented for the sake of comparison to determine which approach was most cost effective.

The first repair consisted of complete removal of the existing supports and replacing them with new stainless steel bars as recommended by Westinghouse. The leading edge supports between manways 1D1 and 1D2 had been replaced. It was originally requested that Bechtel replace the trailing edge supports at this turning vane also, but Bechtel had inadvertently removed and replaced the leading edge support between manways 1A1 and 1A2. The total number of manhours required to repair these four (4) supports was 272 manhours.

r estimate provided via Ref. [redacted] (worst case) assumed 160 hours to repair four (4) supports.

The second repair consisted of welding a stainless steel strip to only the face of the existing carbon steel support. This repair was performed to the leading edge support of the turning vane located between manways 1D2 and 1D3. This repair to only two (2) supports took approximately 108 manhours to complete.

The third repair consisted of welding a bead of metal on the upstream, outer face of both a leading and trailing edge support. One leading edge support located between manways 1A2 and 1A3 plus one trailing edge support located between manways 1C4 and 1C5 received the weld bead repair. The other supports were left alone for the sake of comparison (see Fig. 2 for details).. The time required to repair one (1) support in this manner was 20 manhours.

Please note that the remaining supports within the cross under piping received no repairs.

5.2 Manways

The affected manway covers were removed and shipped off site to be machined flat. No more than 1/8" of metal was to be removed from the manway covers. The manway bosses were machined on site by Bechtel. After machining and pipe repairs had been completed, the manway covers were replaced. Flat, rubber impregnated asbestos gaskets were utilized and the bolts torqued to 240 ft. lbs. The entire portion of the cross under piping is now accessible by the presence of bolted manways.

5.3 Backing Rings

Because of the findings while inspecting the backing rings, it was recommended that all accessible backing rings be removed and the pipe wall repaired as necessary using the details provided in PC/M 82-82. This recommendation is also in accordance with Ref. 7.2. In most cases, backing ring removal was relatively easy and the follow-up pipe repair not significant.

6.0 RECOMMENDATIONS

6.1 Future Repairs

a. Power Plant Engineering recommends that the remaining backing rings be removed and the pipe wall restored when the remaining portions of pipe are made accessible. This should be done within the next 3 - 4 years to help minimize the amount of pipe wall erosion caused by the backing rings.

b. The turning vane support repairs should be inspected within the next 3 years. Engineering would then assist the plant in determining which of the test repair(s) should be utilized based on cost and support life. Power Plant Engineering, based on discussions with Westinghouse has established that the supports are necessary to maintain turning vane integrity. As portions of the cross under piping become accessible, turning vane support repairs should take place as deemed necessary by inspections.

c. Expansion joints should also be periodically inspected to determine the necessity of repairs. Ref. 7.2 provides the details to repair the pipe wall.

6.2 Periodic Inspections

Power Plant Engineering recommends that the turning vane support repairs performed during the 1983 refueling outage be inspected within the next 3 years. This can be done by removing manways 1A1 or 1D1, 1D2, 1A2 and 1C5.

The remaining manways should be removed within the next 3 - 4 years for backing ring removal. This includes the 1A3, 1A4, 1A5, 1B1, 1B2, 1B3, 1B5, 1B6, 1C1, 1C3, 1C6 and 1D4 manways. Turning vane support repairs should be performed within this portion of pipe where necessary using the methods selected. These repairs should be documented because of the unlikelyhood that these sections will need to be inspected in the immediate future.

Power Plant Engineering does not feel that compliance with Westinghouse's recommendation of inspecting the cross under piping during all refueling outages (see Ref. 7.2) is necessary. Following the next piping inspection, Power Plant Engineering will aid in outlining a continuous inspection procedure taking into consideration all of the repairs that have been performed.

7.0 REFERENCES

7.1 Ebasco letter SL-BF-82-117, "Turbine Cross Under Pipe Inspection", dated March 31, 1982.

7.2 Westinghouse letter, W.F. Caperton to W.B. Derrickson, dated May 16, 1983.

7.3 IOC, C.S. Kent to D.K. James, dated August 25, 1982.

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FLORIDA POWER & LIGHT COMPANY

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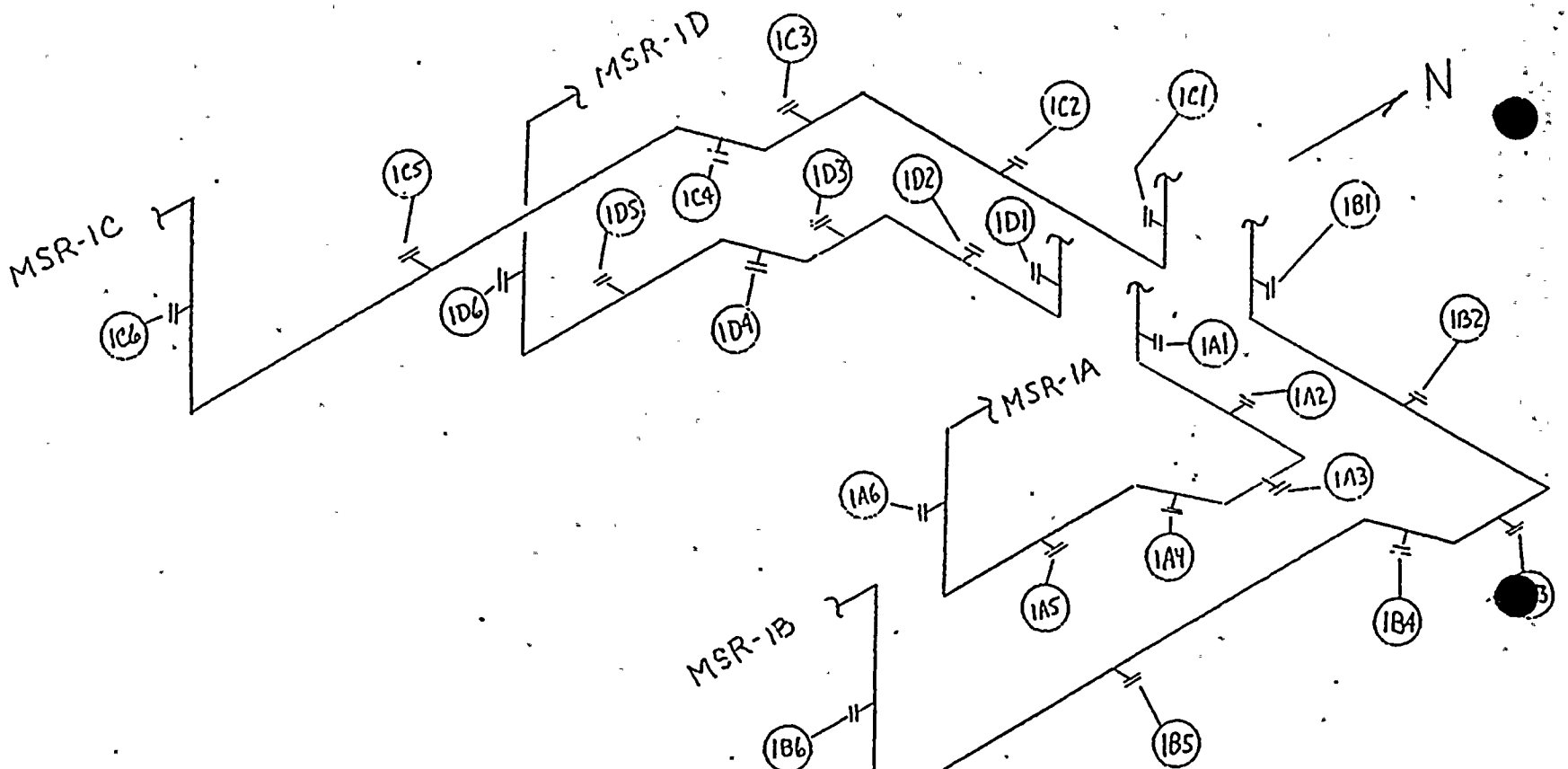

FIG. 1

PSL 1 - TURBINE CROSS UNDER PIPING LAYOUT

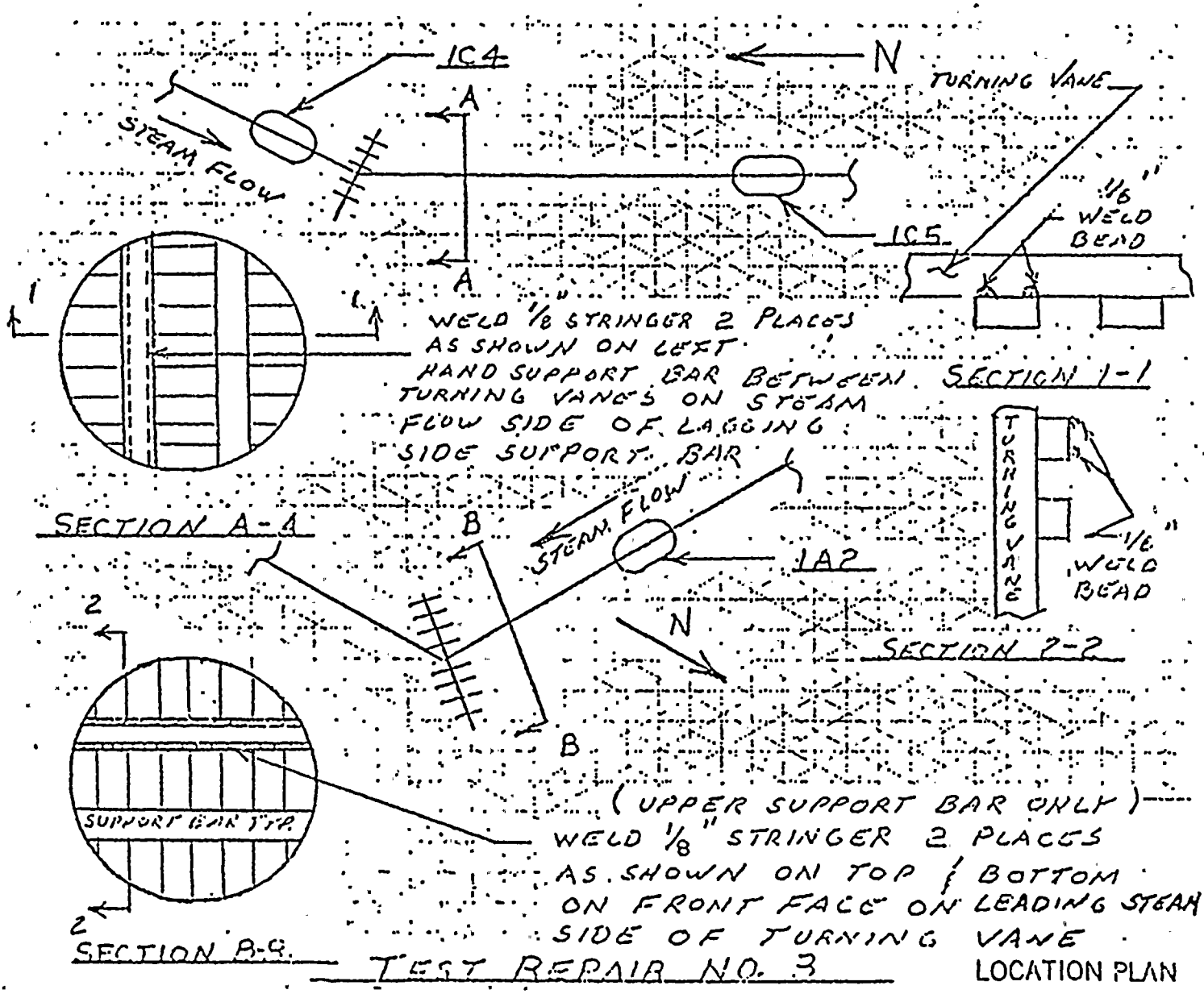

FIG. 2

APPROVED:

DIVISION ENGINEER

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