PDR

LILCO

LONG ISLAND LIGHTING COMPANY
SHOREHAM NUCLEAR POWER STATION
P.O. BOX 618, NORTH COUNTRY ROAD • WADING RIVER, N.Y. 11792

JOHN D. LEONARD, JR.
VICE PRESIDENT - NUCLEAR OPERATIONS

SEP 14 1987

SNRC-1370

Mr. William Russell
Regional Administrator
U.S. Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

NRC Bulletin 87-01
Thinning of Pipe Walls in Nuclear Power Plants
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Dear Mr. Russell:

The subject bulletin describes a failure of a main feedwater pipe at the Surry Power Station, and concludes that the failure was caused by thinning of the carbon steel pipe wall due to erosion/corrosion. This bulletin requests all licencees to submit a report concerning their programs for monitoring the wall thicknesses of all carbon steel pipes in both the safety related and non-safety related portions of the condensate, feedwater, steam and connected high-energy piping systems.

Attachment 1 contains our response (consisting of nine (9) pages of text, four (4) tables and four (4) exhibits) to each of the specific requests of the bulletin.

Please do not hesitate to call my office or members of my staff should you require additional information or clarification regarding this matter.

Very truly yours,

John D. Leonard, Jr.
Vice President - Nuclear Operations

TD/mo

Attachment

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cc: Document Control Desk
R. Lo
C.Warren

AFFIDAVIT

STATE OF NEW YORK)
: ss:
COUNTY OF SUFFOLK)

I, JOHN D. LEONARD, JR., being duly sworn, depose and say that I am the Vice President - Nuclear Operations for the Long Island Lighting Company. I am authorized on the part of said Company to sign and file with the U.S. Nuclear Regulatory Commission the enclosed letter (SNRC-1370) for the Shoreham Nuclear Power Station. This response was prepared under my supervision and direction; and the statements contained therein are true and correct to the best of my knowledge, information and belief.

John D. Leonard, Jr.

Sworn to before me this
14th day of September 1987

LINDA A. CRATTY
NOTARY PUBLIC, State of New York
No. 4816267
Qualified in Suffolk County
Commission Expires March 30, 1988

Linda A. Cratty

Attachment 1

1. Identify the codes or standards to which the piping was designed and fabricated.

Response

Shoreham's safety and non-safety related piping was designed and fabricated in accordance with ASME III (1971 Edition and all Addenda thereto including Winter Addenda of 12-31-72) and ANSI B31.1 (1967 Edition and all Addenda thereto including ANSI B31.1.0C dated 6-30-72) respectively.

2. Describe the scope and extent of your programs for ensuring that pipe wall thicknesses are not reduced below the minimum allowable thickness. Include in the description the criteria that you have established for:

   a. selecting points at which to make thickness measurements
   b. determining how frequently to make thickness measurements
   c. selecting the methods used to make thickness measurements
   d. making replacement/repair decisions.

Response

Shoreham's piping systems have been assessed for both single and two-phase Erosion/Corrosion (E/C). Systems determined to have susceptibility to E/C have been identified for detailed evaluation. Thus far, the Condensate/Feedwater (1N21/1B21) and Turbine Extraction Steam (1N36) systems have been evaluated in detail to select piping components for inspection. An inspection program consisting of the selected components within these two systems has been established to monitor the E/C rate via ultrasonic (UT) wall thickness measurements. To date, initial UT inspections are in progress to establish baseline wall thicknesses. The scope of the inspection program is anticipated to be increased following completion of detailed engineering evaluation of the Reactor Water Cleanup (RWCU) and Moisture Separator & Reheater Drain (MSR) systems which have been identified to be potentially susceptible to single-phase E/C.

The criteria for determination of inspection frequency and acceptance of nonconforming conditions is to be based on the acceptance criteria as delineated in the response to 2d below.

2a. Criteria For Selecting Points For Inspection

The method for selecting points for wall thickness inspection for single and two-phase E/C is described below.

Single-Phase Selection Criteria

Methods for single-phase E/C susceptibility evaluation on Shoreham's systems were based on the selection criteria as set forth in Section X of the "Surry Unit-2 Reactor Trip And Feedwater Pipe Failure Report, Rev. 0, dated 1-14-87".

All single-phase systems were considered for E/C evaluation. Any single-phase system with non-carbon steel piping, non-water service, low service temperature (<200°F) or that is infrequently used was eliminated from further consideration as is shown on Table-4. From this process of elimination, only three single-phase systems emerged as warranting further consideration. Namely, Condensate/Feedwater, Reactor Water Cleanup (RWCU), and the Moisture Separator & Reheater Drains (MSR).

Due to the limited number of operating hours of Shoreham's fluid systems which are potentially susceptible to E/C, there is no short or intermediate term concern for E/C at Shoreham. However, due to the feedwater pipe rupture experienced by Surry Power Station-Unit #2 on December 9, 1986, the Condensate/ Feedwater system was evaluated in detail for E/C susceptibility. The RWCU and MSR systems will be evaluated by December, 1988 using the same selection criteria.

Both trains A & B of the Condensate/Feedwater system were evaluated for E/C ratings. Each component was given an E/C rating which is a summation of it's corresponding temperature, velocity and geometry (see Exhibit-1 for rating schemes). Since the full flow condition fosters the most favorable environment for E/C growth, it was, therefore used as the basis for the temperature and velocity ratings. Small bore piping, and cross tie piping were generally not evaluated. However, since the condensate minimum recirculation lines have, in general, been known to experience cavitation problems at other plants, they were included in the evaluation. Of those components which exhibited high E/C ratings, a limited number of components representative of the 1N21/1B21 system have been selected for inspection.

Each of the selected components are within a section of piping containing several components having essentially equivalent susceptibility to E/C. If inspection results should prove to be unfavorable, based on the acceptance criteria provided below, then the number of components selected for inspection will be expanded such that a high confidence level of component integrity is obtained.

In evaluating the Condensate/Feedwater System, the following properties were considered: (1) piping material - carbon steel, (2) piping configuration, (3) water pH - neutral, (4) system temperature - 98 to 426°F, (5) fluid bulk velocity - 4 - 26 FT/SEC, (6) dissolved oxygen content - 20 to 200 ppb.

Temperature and velocity ratings for each line are tabulated on Table-3. Geometry and E/C ratings for all components evaluated are marked on a set of working isometric drawings.

Two-Phase Selection Criteria

Under contract to LILCO, Science Applications, Inc. (SAI performed an overall two-phase E/C susceptibility evaluation of Shoreham's piping systems and concluded that over an extended period of time, erosion could be anticipated in Shoreham's Extraction Steam piping (1N36) with high velocity wet steam.

SAI's evaluation of the Extraction Steam piping system's susceptibility to steam erosion was based on the following selection criteria as set forth by Duke Power:

i. High energy piping (pressure greater than 275 psia or temperature greater than 200°F) and
ii. Velocity greater than or equal to 150 ft/sec. or moisture content greater than or equal to 5%; and
iii. Unusual piping configuration (e.g. steam direction changed 180 degrees over a very short distance).

Based upon a review of the Extraction Steam piping system in accordance with the above criteria, SAI concluded that the Extraction Steam piping for the first, second, and fifth point heaters would be the most likely candidates susceptible to steam erosion. Since the moisture content and the piping configuration are the most severe for the second feed point heater piping, this line will probably have the highest susceptibility to steam erosion.

The material of the Extraction Steam piping is chrome-moly(*) with the exception of the final elbow in each feedpoint heater line. That elbow is carbon steel.

(*) Extraction Steam Piping Material Spec.

	2" and smaller	2.5" to 24"	26" and larger
-Pipe-	A335, P11	A335, P11	A155, 1 1/4 CR
-Fittings-	A182, F11	A234-WP11	A234-WP11 or WP11W

Utilizing the conclusions drawn by SAI, LILCo's engineering staff reviewed the first, second, and fifth point heater's piping layout for unusual piping configurations. Based on engineering judgement, four specific elbows (one of which is a carbon steel elbow) were selected by the engineering staff for UT inspection, specifically for wall thinning monitoring.

2b. Criteria For Determining Inspection Frequency

The inspection frequency for both single and two-phase components is initially established to be at each refueling outage (approximately 1 1/2 - 2 years) and adjusted thereafter depending on E/C rates in accordance with the acceptance criteria as delineated below.

2c. Criteria For Selecting Inspection Methods

For liquid-phase (single-phase) components selected for inspection, the specific points on each component where wall thicknesses are to be measured are in accordance with the recommendations of the Surry report (see Exhibit-2).

For two-phase components, a six inch square examination grid was used as shown on Exhibit-3 and as described below:

(1) The first inspection point is at the approximate midpoint of the long radius side of the elbow and lies on the elbow centerline (long radius side). Exhibit-3 illustrates this position. This measurement point is used as the reference for determining the locations for the other measurements in (2) below.

(2) Traversing longitudinally along the elbow, two additional measurements upstream and downstream of the reference point in (1) above were taken. These points lie on the elbow centerline and are approximately six inches apart (see Exhibit-3)

(3) Traversing circumferentially about each measurement points in (1) and (2) above, one additional measurement was taken on either side of the elbow. These measurements were taken approximately six inches from the centerline measurements in (1) and (2) above. A total of fifteen thickness measurements were taken at each selected elbow.

It is considered that the six inch square grid is presently adequate due to the fact that SNPS Extraction Steam piping is mostly chrome-moly(*) and has seen very limited operating hours. However, if inspection results are indicative of steam erosion's presence, then the grid spacing will be adjusted smaller for more detailed measurements.

2d. Criteria For Making Replacement/Repair Decision

Ultrasonic results of both single and two-phase component wall thicknesses are to be evaluated based on the acceptance criteria as delineated in Section X of the Surry report. Namely,

$$Tacc = Tn - \frac{y}{y+n} (Tn - Tm)$$

Where: Tacc = The acceptance criteria
- Tn = Maximum nominal wall thickness (nominal wall + manufacturing tolerance.)
- y = Actual operating time in years. (hours critical converted to years)
- n = Projected remaining operating time in years
- Tm = Calculated code minimum required wall thickness in inches

The above acceptance criteria assumes that the yearly wear varies linearly with time. This assumption is in agreement with experimental data, as is published in "Erosion-Corrosion In Nuclear Power Systems - An Overview, Paper No. 86, by G. Cragnolino of Brookhaven National Laboratory, dated 3/87". The "as found" wall thickness (Ta) is to be compared to the acceptance criteria (Tacc) which will then place the components into various acceptance categories as shown in Exhibit-4. This acceptance criteria provides guidance on determining if a component needs to be replaced immediately, projected to be replaced at some future time in its operating life, or will continue to be monitored by inspection during its operating life.

3. For liquid-phase systems, state specifically whether the following factors have been considered in establishing your criteria for selecting points at which to monitor piping thickness (Item 2a):

a. piping material (e.g. chromium content)

Response

Piping material was considered in determining its eligibility for E/C evaluation. Only carbon steel piping systems were considered for evaluation, all others were eliminated from further consideration. Shoreham's Condensate/Feedwater piping is carbon steel.

b. piping configuration (e.g., fittings less than 10 pipe diameters apart)

Response

For those piping systems that qualify for E/C evaluation, each component is assigned a geometry rating per Exhibit-1. This geometry rating is part of a total E/C rating assigned to that component which is used to determine its overall E/C susceptibility.

c. pH of water in the system (e.g., pH less than 10)

Response

It has been found that by increasing the water pH above 9.2 (measured @ room temperature), the E/C rate on carbon steel decreases. Since Shoreham's Condensate/ Feedwater system has a neutral pH, it was considered for E/C evaluation.

d. System Temperature (e.g., between 190 and 500°F)

Response

A system's service temperature was considered in determining its eligibility for E/C evaluation and in selecting individual components within system evaluation for inspection. Each component is assigned a temperature rating (see Exhibit-1 for rating scheme) which is one of the constituents of the overall rating of E/C susceptibility. Any system with a service temperature less than 200°F was eliminated from further consideration. Shoreham's Condensate/Feedwater system has a service temperature range of 98 to 426°F.

e. fluid bulk velocity (e.g., greater than 10 ft/s)

Response

High fluid velocities cause localized removal of a protective magnitite (Fe_3O_4) layer from the pipe wall, rendering the exposed surface vulnerable to E/C. For systems evaluated for E/C, each component is assigned a velocity rating (see Exhibit-1 for rating scheme) which is one of the constituents of the overall rating of E/C susceptibility. As an example, Shoreham's Condensate/ Feedwater system has a velocity range of 4 to 26 ft/s.

f. oxygen content in the system (e.g., oxygen content less than 50 ppb)

Response

A system's oxygen content was one of the factors used to determine its eligibility for E/C evaluation. However, high oxygen content alone would not eliminate a system from E/C evaluation consideration. As an example Shoreham's Condensate/Feedwater oxygen content is maintained in the range of 20 to 200 ppb.

4. Chronologically list and summarize the results of all inspections that have been performed, which were specifically conducted for the purpose of identifying pipe wall thinning, whether or not pipe wall thinning was discovered, and any other inspections where pipe wall thinning was discovered even though that was not the purpose of that inspection.

a. Briefly describe the inspection program and indicate whether it was specifically intended to measure wall thickness or whether wall thickness measurements were an incidental determination.

Response

An inspection program has been established at SNPS to specifically monitor for pipe wall thinning. This inspection program utilizes qualified inspection personnel, procedures and equipment. The inspection program is at the wall thickness baseline data acquisition stage and as such, a chronological list of inspection results is not yet available. Of the nineteen components selected for inspection, nine have been UT'd to date for baseline wall thicknesses. The remainder of the baseline wall thickness measurements will be completed as soon as the work can be scheduled.

b. Describe what piping was examined and how (e.g., describe the inspection instrument(s), test method, reference thickness, locations examined, means for locating measurement point(s) in subsequent inspections).

Response

Inspection components were selected from the Condensate/Feedwater and Extraction Steam piping systems and are tabulated on Table-1. The selected components are to be ultrasonically examined (Dual Element, Pitch and Catch Thickness Measurement) for wall thickness measurements. The specific points on each component where wall thicknesses are to be measured are shown on Exhibit-2 & 3 for single and two-phase components respectively.

The inspection instruments used for ultrasonic examinations on single-phase components were the Krautkramer "D" meters capable of measuring to 0.001" digitally. The reference thicknesses used were the Krautkramer carbon steel step blocks of various thicknesses. For the five components that have been examined to date, a magic marker was used to temporarily mark the points measured as a means for relocating measurement points in subsequent inspections. All measurement points (existing and future) will be permanently marked (e.g. Low Stress Punch Mark).

The inspection instrument used for ultrasonic examinations on two-phase components was the Krautkramer USL 38 Ultrasonic Unit. The reference thicknesses used were the Krautkramer carbon steel step blocks of various thicknesses. This type of carbon steel step block is satisfactory for instrument calibration in examining chrome-moly material because the acoustic velocities for these two materials are comparable to each other. Low stress punch marks were used as means for relocating measurement points in subsequent inspection.

c. Report thickness measurement results and note those that were identified as unacceptable and why.

<u>Response</u>

A total of nineteen components have been selected for wall thickness measurements of which nine have been examined to date. The wall thickness results are shown on Table-2. As expected, all of the components examined thus far exhibited wall thicknesses far above code minimum wall requirements.

d. Describe actions already taken or planned for piping that has been found to have a nonconforming wall thickness. If you have performed a failure analysis, include the results of that analysis. Indicate whether the actions involve repair or replacement, including any change of materials.

<u>Response</u>

For the components examined to date, no nonconforming wall thicknesses have been evidenced and thus no actions have been taken. If future inspections should yield nonconforming wall thicknesses, then the frequency and method of inspection will be adjusted accordingly to more closely monitor the affected components. Furthermore, consideration would be given to increase sample size in order that a high degree of confidence is obtained. Layout reconfiguration and material upgrade would also be considered if E/C rate are determined to be unacceptable.

5. Describe any plans either for revising the present or for developing new or additional programs for monitoring pipe wall thickness.

<u>Response</u>

EPRI, in it's report "Single-Phase erosion-corrosion of carbon steel piping" stated its intention to develop a standard for selection of components for inspection. This standard, a computer based model, is presently being considered for use by LILCO.

As indicated above, the RWCU and MSR Drain systems are to be completely evaluated in accordance with selection criteria described under response #2. Components selected for inspection in these systems will then be added to the inspection program.

The Nuclear Quality Assurance Department is evaluating alternative thickness measurement methods for possible use during future inspections.

Table - 1

List of Piping Components Selected for Ultrasonic Examination.

	Component	Applicable Isom. Dwg.	Line #	Location	Material Specification	Temp. Rating	Velocity Rating	Geom. Rating	C/E Rating
1.	24" x 20" 90 Degree Reducing Elbow (1N21)	IC-125	20"-C-83-301-4	Between 2nd Pt Htr Discharge &MOV-034B	Carbon Steel A234, WPB	3	3	50	56
2.	20" Tee (1N21)	IC-125	20"-C-20-301-4	Between MOV-034B & FW-8	Carbon Steel A234, WPB	3	3	50	56
3.	20" 90 Degree Elbow (1N21)	IC-125	20"-C-20-301-4	At FW-12 (Vent Connection)	Carbon Steel A234, WPB	3	3	50	56
4.	20" 90 Degree Elbow (1N21)	IC-232	20"-WFP-1-501-4	Between MOV-035B & PSA-489	Carbon Steel A234, WPB	3	3	48	54
5.	20" 90 Degree Elbow (1N21)	IC-122	20"-C-63-301-4	Between CBP "B" Discharge & 20"x10" Tee (Next to 20"x10" Tee)	Carbon Steel A234, WPB	0	2	42	44
6.	20" 90 Degree Elbow (1N21)	IC-122	20"-C-63-301-4	Between FW-4 & MOV-032B	Carbon Steel A234, WPB	0	2	42	44
7.	26"x20" Reducing Tee (1N21)	IC-334	26"-C-34-151-4	Between FW-3 & 26"x20" Conc. Reducer (Leading to 20"-C-60-151)	Carbon Steel A234, WPB	0	3	40	43
8.	Approx. 2' of Piping (1N21)	IC-334	20"-C-61-151-4	Immediately Downstream of FW-5	Carbon Steel A106 Gr.B or A53	0	2	40	42
9.	10" 90 Degree Elbow (1N21)	IC-437	10"-C-64-301-4	Between PSS-030 & FW-1	Carbon Steel A234, WPB	0	4	34	38
10.	10" 90 Degree Elbow (1N21)	IC-440	10"-C-65-301-4	Between FW-5 & PSR-785	Carbon Steel A234, WPB	0	4	34	38
11.	20" 90 Degree Elbow (1N21)	IC-120	20"-C-38-151-4	Between FW-7 & FW-8	Carbon Steel A234, WPB	0	1	34	35
12.	20" 90 Degree Elbow (1N21)	IC-124	20"-C-202-301-4	Between 30 Degree Elbow & RFP "A" Suction	Carbon Steel A234, WPB	3	3	27	33

<u>Table - 1</u> (Cont'd)

List of Piping Components Selected for Ultrasonic Examination.

Component	Applicable Iso. Dwg.	Line No.	Location	Material Specification	Temp. Rating	Velocity Rating	Geom. Rating	C/E Rating
13. 24"x20" Reducing Elbow (1N21)	IC-240	20"-WFP-2-901-4	Between MOV-045A & 1st Pt. Htr. Suction	Carbon Steel A234, WPB	3	3	25	31
14. 24"x20" Reducing Elbow (1N21)	IC-341	20"-C-79-301-4	@ 3rd Point Heater	Carbon Steel A234, WPB	5	2	12	19
15. 20" 180 Degree Elbow (1N21)	IC-129	20"-C-201-301-4	Between FW-11 & PSRH-050	Carbon Steel A234, WPB	3	3	10	16
16. 16" 90 Degree Elbow (1N36)	IC-110	16"-82B-7-301M-4	Final Suction Elbow of 1N21-E002B	Carbon Steel A234, WPB	—	—	—	—
17. 16" 90 Degree Elbow (1N36)	IC-110	16"-82B-7-301M-4	Between FW-15 & Carbon Steel Elbow	Chrome-Moly A234, WP11	—	—	—	—
18. 12" 90 Degree Elbow (1N36)	IC-108	12"-61E-1-301M-4	Between FW-8 & FW-17	Chrome-Moly A234, WP11	—	—	—	—
19. 20" 90 Degree Elbow (1N36)	IC-171	20"-63E-59-301M-4	Immediately upstream of FW-12	Chrome-Moly A234, WP11	—	—	—	—

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TABLE - 2

Component UT Wall Thickness Results

	Component	Applicable Isometric Dwg.	Line No.	Design Temp(°F)	Design Press(PSIG)	Code Min. Wall (In)	Lowest UT*** Reading (IN)
1.	24"x20" 90 Degree Reducing Elbow	IC-125	20"-C-83-301-4	383	683	0.577*	Not Available
2.	20" Tee	IC-125	20"-C-20-301-4	108	215	0.183*	Not Available
3.	20" 90 Degree Elbow	IC-125	20"-C-20-301-4	108	215	0.183*	Not Available
4.	20" 90 Degree Elbow	IC-232	20"-WFP-1-901-4	450	1340	0.903*	Not Available
5.	20" 90 Degree Elbow	IC-122	20"-C-63-301-4	110	683	0.488*	.685
6.	20" 90 Degree Elbow	IC-122	20"-C-63-301-4	110	683	0.488*	.555
7.	26"x20" Reducing Tee	IC-334	26"-C-34-151-4	111	215	0.226*	Not Available
8.	Approx. 2' of Piping	IC-334	20"-C-61-151-4	111	215	0.183*	Not Available
9.	10" 90 Degree Elbow	IC-437	10"-C-64-301-4	110	683	0.281*	0.355
10.	10" 90 Degree Elbow	IC-440	10"-C-65-301-4	110	683	0.281*	0.380
11.	20" 90 Degree Elbow	IC-120	20"-C-38-151-4	111	215	0.183*	0.375
12.	20" 90 Degree Elbow	IC-124	20"-C-202-301-4	382	683	0.488*	Not Available
13.	24"x20" Reducing Elbow	IC-240	20"-WFP-2-901-4	450	1340	1.076*	Not Available
14.	24"x20" Reducing Elbow	IC-341	20"-C-79-301-4	296	683	0.577*	Not Available
15.	20" 180 Degree Elbow	IC-129	20"-C-201-301-4	382	683	0.488*	Not Available

TABLE - 2 (Cont'd)

Component UT Wall Thickness Results

	Component	Applicable Isometric Dwg.	Line No.	Design Temp(°F)	Design Press(PSIG)	Code Min. Wall (In)	Lowest UT Reading (IN)
16.	16" 90 Degree Elbow	IC-110	16"-SZE-7-301M-4	390	200	0.277**	0.491
17.	16" 90 Degree Elbow	IC-110	16"-SZE-7-301M-4	390	200	0.277**	0.476
18.	12" 90 Degree Elbow	IC-108	12"-S1E 1-301M-4	443	376	0.279**	0.410
19.	20" 90 Degree Elbow	IC-171	20"-S5E 59-301M-4	237	7	0.125**	0.509

* Includes 0.04" of Corrosion Allowance.

** Includes 0.12" of Corrosion Allowance.

*** Given the current states that the base-line readings are still in the process of being taken, certain UT readings are not yet available.

NOTE: UT readings for, items 5 and 6 were taken during August 1987, items 8,9 and 11 were taken during March 1987 and items 16 through 19 were taken during January 1985.

TABLE - 3

Condensate/Feedwater System Piping Properties

Line No.	d (in)	m(#/hr)	T(^{o}F)	Den.(#/ft^3)	Vel.(ft/sec)	Temp. Rating	Vel. Rating
36"-C-1,2-151	35.250	5,515,808	98.25	62	4	0	0
36"-C-4,5-151	35.250	5,515,808	98.25	62	4	0	0
20"-C-7,12-151	19.250	5,515,808	98.40	62	13	0	2
20"-C-21,22-151	19.250	5,515,808	98.40	62	13	0	2
20"-C-24-151 (From 20"-C-23-151 to E-J-001A)	19.250	4,974,119	98.40	62	11	0	2
20"-C-25-151	19.250	4,974,119	99.49	62	11	0	2
20"-C-26-151	19.250	4,974,119	99.49	62	11	0	2
20"-C-27-151	19.250	4,974,119	99.49	62	11	0	2
20"-C-28-151	19.250	4,974,119	100.05	62	11	0	2
20"-C-23-151	19.250	541,689	98.40	62	1.2	0	0
20"-C-30-151	19.250	6,057,496	98.40	62	14	0	2
26"-C-29-151	25.250	11,031,615	100.05	62	15	0	3
26"-C-32-151 (From DE-002A to 20"-C-33-151)	25.250	11,031,615	100.05	62	15	0	3
26"-C-34-151 (From 20"-C-33-151 to 20"-C-60-151)	25.250	10,974,615	100.05	62	15	0	3
26"-C-34-151 (From 20"-C-60-151 to 26"x20" Red.)	25.250	5,487,308	100.05	62	7	0	1
20"-C-60,61-151	19.250	5,487,308	100.05	62	13	0	2
20"-C-62,63-301 (From P-072A,B to 10"-C-64,65-301)	18.812	5,487,308	100.70	62	13	0	2

TABLE - 3 (cont)

Condensate/Feedwater System Piping Properties

Line No.	d (in)	m(#/hr)	T(°F)	Den.(#/ft³)	Vel.(ft/sec)	Temp. Rating	Vel. Rating
20''-C-62,63-301 (Fr. 10''-C-64,65-301 to 20''-C-68,69-301)	18.812	5,482,111	100.70	62	13	0	2
20''-C-70,71-301	18.812	5,482,111	100.70	62	13	0	2
20''-C-72,73-301	18.812	5,454,225	121.95	61.7	13	0	2
20''-C-74,75-301	18.812	5,454,225	156.73	61	13	0	2
20''-C-76,77-301	18.812	5,454,225	219.03	59.6	14	2	2
20''-C-78,79-301	18.812	5,454,225	286.52	57.7	14	5	2
20''-C-80,81-301	18.812	5,454,225	322.58	56.5	14	4	2
20''-C-82,83-301	18.812	5,454,225	371.78	54.8	15	3	3
20''-C-201,202-301	18.812	5,454,225	371.78	54.8	15	3	3
20''-WFP-1,2-901	17.000	5,474,642	372.71	54.8	18	3	3
20''-WFP-3,[illegible]-901	17.000	5,474,642	425.13	52.5	19	1	3
26''-WFP-20-901	22.688	10,949,283	425.13	52.5	21	1	4
20''-WFP-21,22-901	17.000	5,474,642	425.13	52.5	19	1	3
20''-WFP-1,2-901B-1	17.438	5,474,642	425.13	52.5	18	1	3
18''-WFP-17,19-901B-1	15.688	5,474,642	425.13	32.5	22	1	4
12''-WFP-5,6-901B-1	11.062	2,737,321	425.13	52.5	22	1	4
12''-WFP-7,8-901B-1	11.062	2,737,321	425.13	52.5	22	1	4
18''-WFP-29,30-1501-1	14.438	5,474,642	425.13	52.5	26	1	5
10''-C-8,9-151	10.020	4,800 GPM	98.40	—	20	0	3
20''-C-33,38-151	19.250	5,000 GPM	100.05	—	6	0	1
10''-C-64,65-151	10.020	5,200 GPM	100.07	—	22	0	4

TABLE -4

Single Phase Systems Eliminated From Inspection

System	Reason For Elimination: High Oxygen	Low Temp	Not Carbon Steel	Not Water
Standby Liquid Control		X	X	
Reactor Water Recirculation			X	
Control Rod Drive		X		
Sample System		X		
Circulating Water	X	X	X	
TBCLCW	X	X		
Vacuum Priming & Air Removal		X		
Compressed Air				X
Neutron Monitoring			X	X
Diesel Aux. Service & Instrument Air				X
Diesel Air Start				X
Diesel Lube Oil				X
Diesel Jacket Water Cooling	X	X		
Service Water	X	X		
Gen. Hydrogen & CO Purge				X
Sealing Water		X		
Primary Cont. Atmospheric Control		X		
Reactor Recirc Lube Oil				X
Demin. Wtr. to Refuel Service Boxes		X		
Drywell Floor Seal Pressure Monitoring				X

TABLE -4 (Cont'd.)

Liquid Phase Systems Eliminated From Inspection

System	Reason For Elimination			
	High Oxygen	Low Temp	Not Carbon Steel	Not Water
Low Conductivity & Salty Water Drains		X		
Process Radiation Monitoring				X
Primary Cont. Integr. Leak Test				X
Primary Containment Inerting				X
Primary Containment Cooling	X	X		
Chilled Water	X	X		
Reactor Bldg. Prim. Cont. Purge Air		X		
Fire Protection	X	X		
RBCLCW	X	X		
Radwaste Solids Handling & Radwaste			X(1)	
Fuel Pool Cooling and Cleanup		X		
Chlorination		X	X	
Condensate Demineralizer		X		
Condensate Transfer		X		
Demin. & Makeup Water		X		
Fuel Oil				X
Lubricating Oil				X
Domestic Water	X	X		
Sanitary Sewage	X	X		
Glycol Heating		X		

TABLE -4 (Cont'd.)

Liquid Phase Systems Eliminated From Inspection

System	Reason For Elimination: High Oxygen	Low Temp	Not Carbon Steel	Not Water
Hot Water Heating	X(2)			
Radwaste Bldg. Ventilation		X		
Radwaste Off-Gas				X
Reactor Core Isol. Cooling (2)				
High Press Cool Injection (2)				
Post Accident Sampling (2)				
Core Spray (2)				
Heater Relief and Vent Lines (2)				
MSIV Leakage Control (2)				
Aux. Boiler (2)				
Residual Heat Removal (2)				
Reheat (3)				
Misc. Drains Secondary Plant (2,4) (Liquid Portion)				

Notes: (1) Only Water & Slurry @ Low Temp. Is of Carbon Steel.
(2) Eliminated Due to Infrequent Or Intermittent Use.
(3) Eliminated Due To Superheated Condition.
(4) Low Velocity (approximately 2 Ft/Sec).

EXHIBIT-1. (PG. 1 of 2)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT.

TABLE X-3
INSPECTION POINT RATING SCHEME

1. Temperature Factor

	Temperature (°F)	Rating
a.	265-320	5
b.	245-265 & 320-350	4
c.	230-245 & 350-380	3
d.	210-230 & 380-410	2
e.	193-210 & 410-440	1
f.	< 193 & > 440	0

NOTE: For lines which operate at or near (within 5°F) saturation, add 3 to the rating given above.

2. Velocity Factor

	Velocity (FPS)	Rating
a.	25-30	5
b.	20-25	4
c.	15-20	3
d.	10-15	2
e.	5-10	1
f.	< 5	0

EXHIBIT-1. (PG. 2 of 2)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT.

TABLE X-3 (Cont'd)

3. Geometry Factor

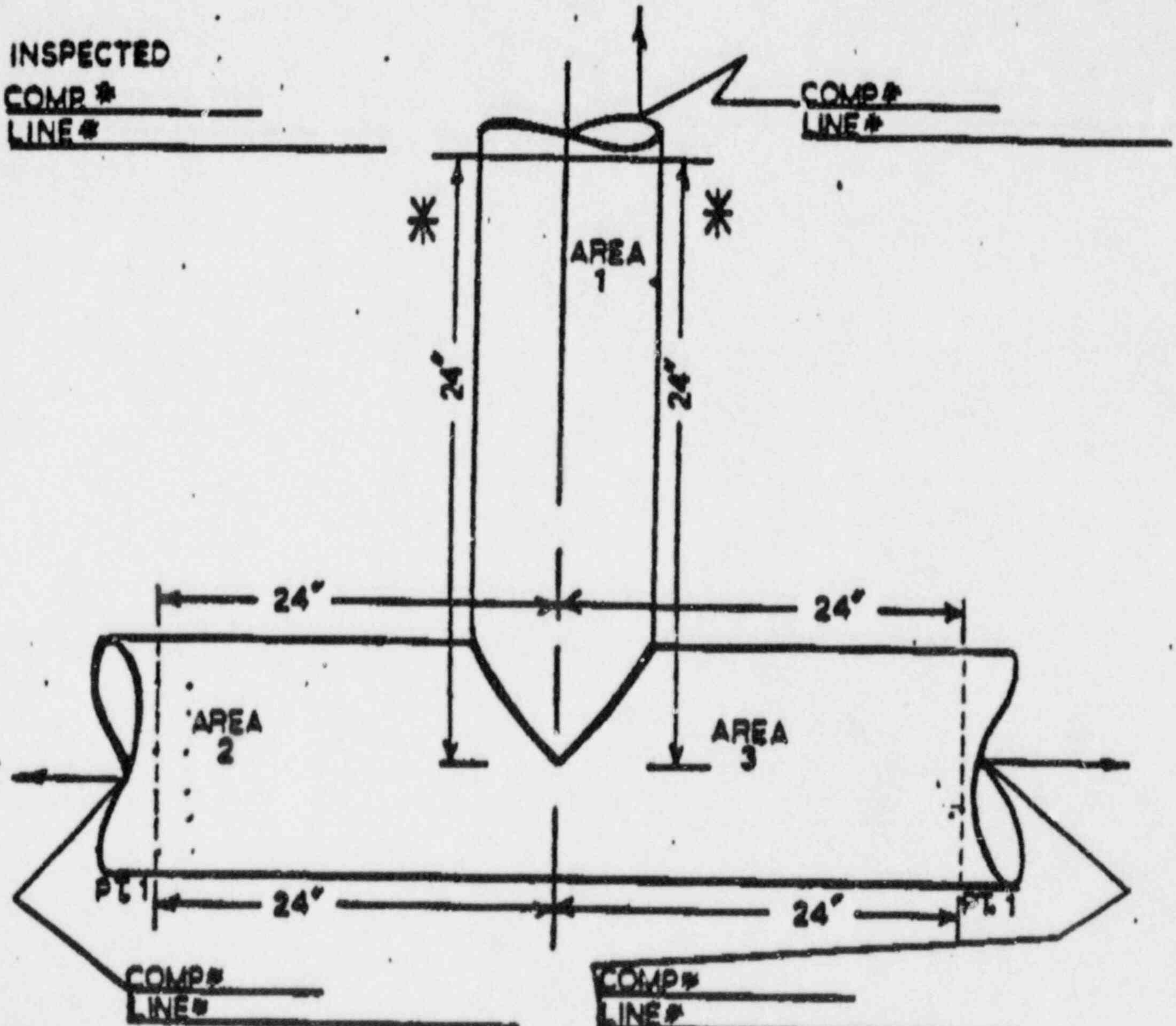
Geometry & Flow Disturbances	Rating
a. Control valve, tee (splitting), 180° bend	10
b. Check valve, globe valve, tee, flow orifices, components listed in c through f below separated by between 3 and 10 pipe diameters	8
c. 90° bend, elbow, reducing elbow	6
d. Butterfly valve, instrument tap, reducer	4
e. Gate valves, welds in straight pipe	2
f. Straight pipe	0

NOTE: For close coupled geometry (components separated by less than 3 pipe diameters) add the indicated values of each of the components and assign the result to each of the components.

4. Use of Factors

For a given component, sum the three factors (temperature + velocity + geometry) above. The sum obtained can be used to identify the susceptibility to C/E and to establish an inspection priority, with a larger value indicating a greater susceptibility.

EXHIBIT -2. (PG. 1 OF 5)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT.



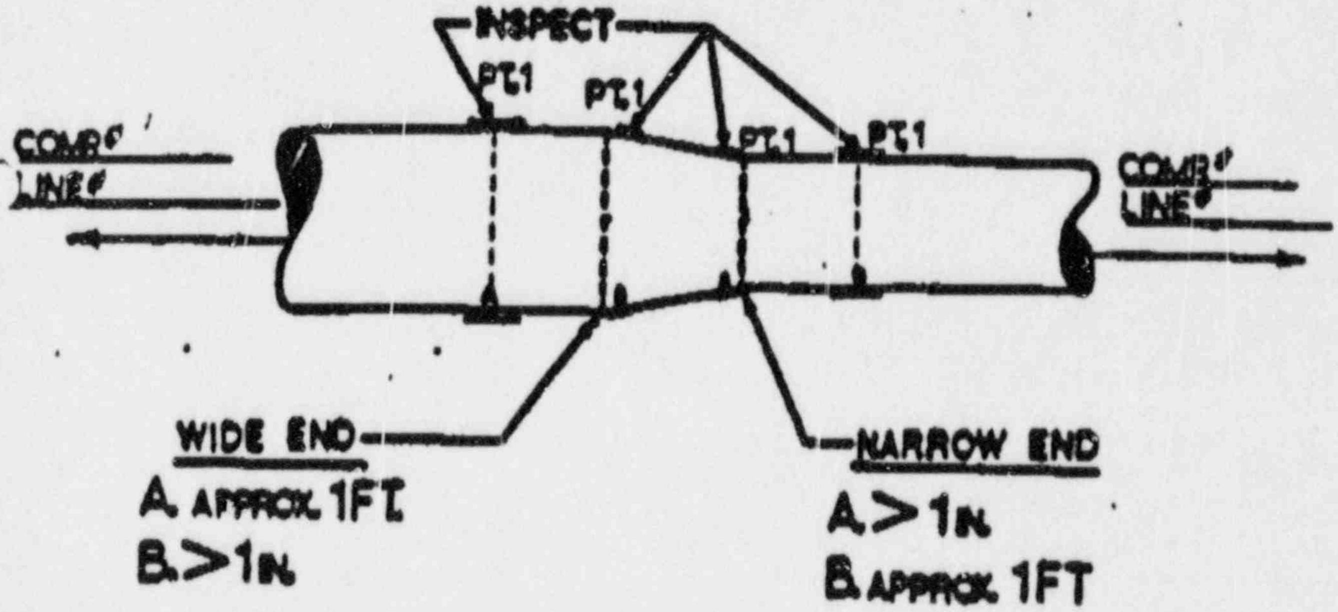
NOTE: READING TO BE TAKEN USING 2" x 4" MATRIX (360°)

* = REFERENCE START POINT TO BE DECIDED BY INSPECTOR. INSPECTOR IS TO PROVIDE DISCRIPTION AS TO WHAT REFERENCE WAS USED.

FIGURE X-1 - Tee Section Inspection Points

EXHIBIT -2. (PG. 2 OF 6)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT.

INSPECTED
COMP# __________
LINE# __________

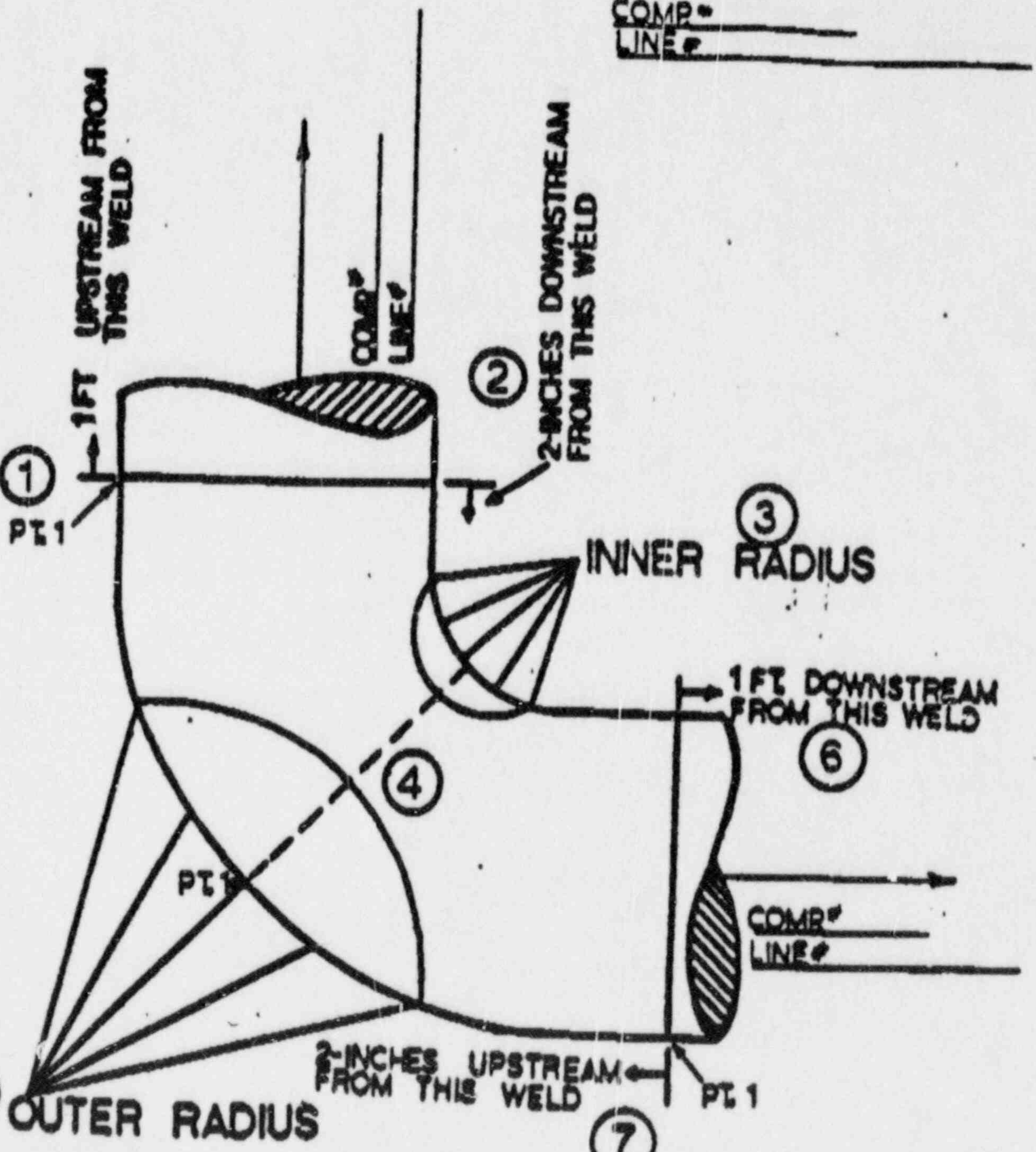


NOTE: READINGS TO BE TAKEN EVERY 2 INCHES (360°), POINT 1 WILL BE TOP DEAD CENTER WITH IDENTIFICATION MOVING CLOCKWISE AS ONE FACES THE DIRECTION OF FLOW.

FIGURE X-2 - Reducer Inspection Points

EXHIBIT -2 (Pg 3 of 6)
REF: SURRY UNIT-2 REACTOR TRIP AND FEEDWATER PIPE FAILURE REPORT

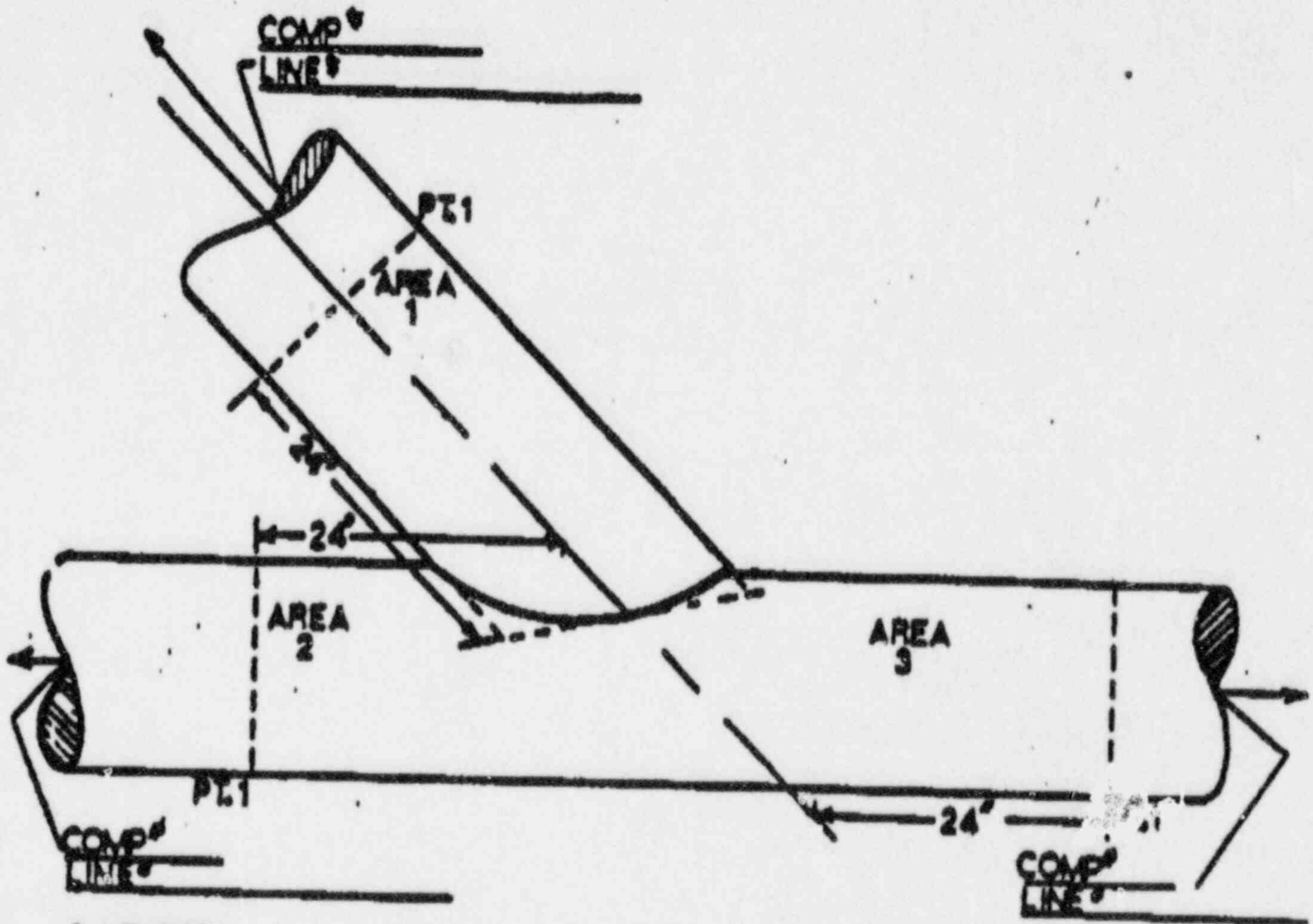
INSPECTED
COMP#
LINE#



NOTE: POINT 1 WILL BE OUTER RADIUS OF ELBOW. IDENTIFICATION MOVING CLOCKWISE AS ONE FACES DIRECTION OF FLOW.

EXHIBIT -2. (PG. 4 OF 5)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT

INSPECTED
COMP#
LINE#



NOTE:

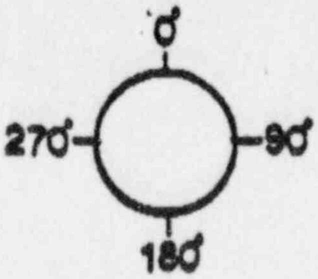
READING TO BE TAKEN USING 2"x4" MATRIX.
POINT ONE WILL BE TOP DEAD CENTER ON EXTERIOR WALL, AS SHOWN ABOVE. IDENTIFICATION SHALL MOVE CLOCKWISE AS ONE FACES THE DIRECTION OF FLOW.

FIGURE X-4 - Lateral (45°) Inspection Points

EXHIBIT - 2. (Pg 6 of 6)
REF: SURRY UNIT-2
REACTOR TRIP AND
FEEDWATER PIPE
FAILURE REPORT.

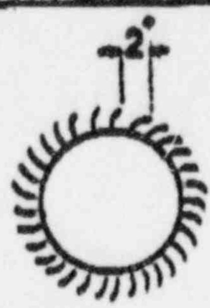
FIGURE ONE
REQUESTED READINGS

Points #1 and #6



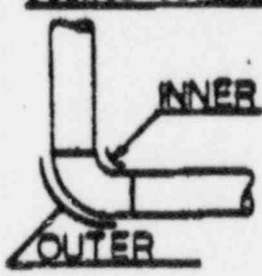
: Take reading one foot from the weld.
Request four readings at 90° apart.

Points #2 and #7



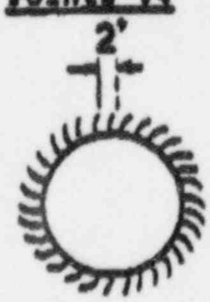
: Take reading two inches from the weld.
Request reading every two inches (360°).

Points #3 and #5



: Take reading on inner and outer radius.
Request scanning area and record lowest reading and highest reading.

Points #4



: Take reading from inner radius center to outer.
Request reading every two inches (360°).

FIGURE X-5 - Pipe Inspection Requested Readings

EXHIBIT - 3 (PG. 1 OF 1)
REF: LILCO MEMO FROM R.A. KASCSAK TO R. GUTMANN, DATED JANUARY 25, 1984

PC-179-83

PREPARED BY______________

DATE__________ LONG ISLAND LIGHTING COMPANY

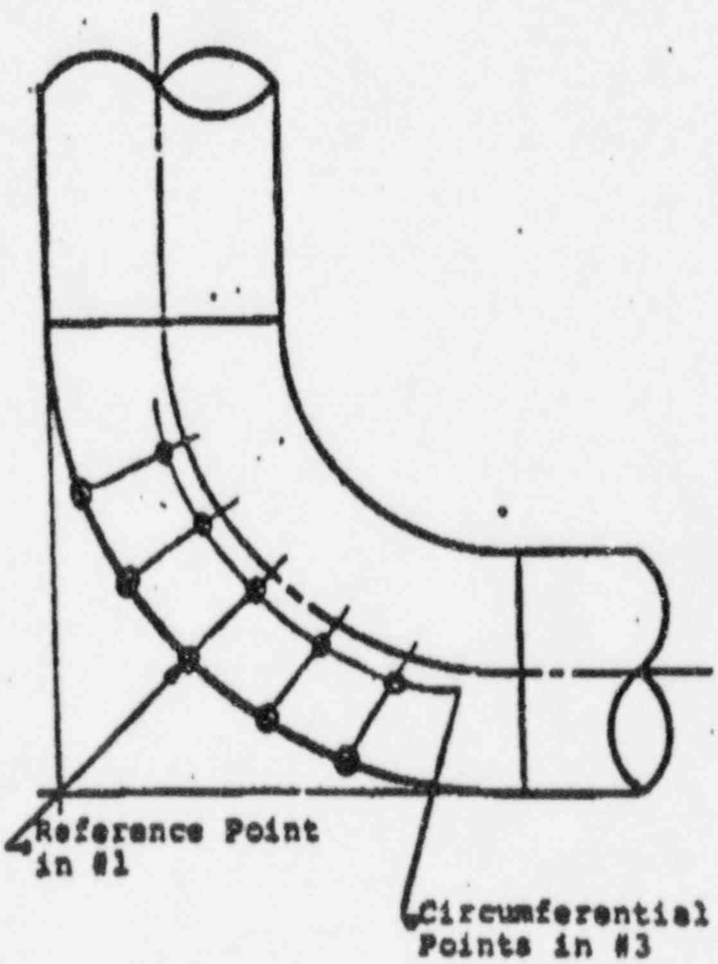
SUBJECT Steam Erosion Inspection Program

EWR No. RN83-017

PC.______

W. O. NO.______

ACCT. NO.______



Note: Identify inspection points with 4 low stress punch marks for ease of identification during future inspections, i.e.,

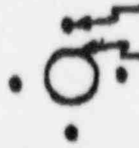


EXHIBIT -4 (PG. 1 OF 1)
REF: SURRY UNIT-2 REACTOR TRIP AND FEEDWATER PIPE FAILURE REPORT.

TABLE X - 4

ACCEPTANCE CATEGORIES

Acceptance Category	Criteria	Remarks
1. Immediate Replacement of Component	$Ta \le Tm$ or $Ta \le 0.100$	
2. Engineering Evaluation of Component	$Tm \le Ta < Tacc/n{=}t_1$	t_1 = time to next outage + 1/2 year. As a result of the engineering evaluation, each component in this category must be put in Category 1 or Category 3.
3. Potential Next Outage Replacement of Component	$Tacc/n{=}t_1 < Ta < Tacc/n{=}t_2$	t_2 = time to next 2 outages + 1/2 year. Component will be inspected at the next outage to verify the wear rate in order to confirm the need for replacement.
4. Each Outage Inspection of Component	$Tacc/n{=}t_2 \le Ta < Tacc/n{=}t_3$	t_3 = time to next 3 outages + 1 year. If no wear is determined by reinspection during the next three outages, put the component into Category 5.
5. Place Component in Station's Inspection Program	$Ta \ge Tacc/n{=}t_3$	