

1. Calculation No. PM-925

UNIT(S) 2 1/3

7. ☒ Safety Related
☐ Non-Safety Related

Component: PIPING

[illegible]

BECHTEL CALC
33-

Computer program and version

9407120289 940706
PDR ADDCK 05000277
PDR
Q

CALCULATION REVIEW CHECKLIST

CALCULATION No.: PM-925Initiating Document (e.g., ECR, NCR, Mod No.): NCR No. PB 93-00809Calc. Rev. No.: 0

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MANUAL	COMPUTER	REVIEW CRITERIA	YES or N/A
<u>CALC.</u>	<u>CALC.</u>		
X	X	SOURCES OF DATA & FORMULAE WERE REVIEWED AND VERIFIED TO BE CORRECT & COMPLETE	<u>YES</u>
X	X	INPUT DATA FROM SOURCES IN ITEM 1 ABOVE IS CORRECT AND PROPERLY USED IN THE CALCULATION	<u>YES</u>
X		THE ANALYTICAL METHOD USED IN THE CALCULATION HAS BEEN CONSIDERED AND IS PROPER FOR THE INTENDED USE	<u>YES</u>
X		MATHEMATICAL ACCURACY HAS BEEN CHECKED AND IS CORRECT (INDICATE METHOD USED)	
		a) COMPLETE CHECK OF EACH COMPUTATION	<u>YES</u>
		b) SPOT-CHECK OF SELECTED COMPUTATIONS WHICH ARE INITIALED IN THE CALCULATION	<u>N/A</u>
		c) PERFORMANCE OF ALTERNATE OR APPROXIMATION CALCULATION (ATTACHED)	<u>N/A</u>
X	X	CALCULATION RESULTS WERE CHECKED AGAINST APPLICABLE DOCUMENTED DESIGN CRITERIA AND FOUND IN CONFORMANCE	<u>YES</u>
X	X	EXISTING CALCULATIONS REQUIRING REVISION AS A RESULT OF THIS CALCULATION HAVE BEEN IDENTIFIED	<u>N/A</u>
	X	THE ANALYTICAL METHOD DESCRIBED IN THE COMPUTER CALCULATION SUMMARY IS PROPER FOR THE INTENDED USE	<u>N/A</u>
X	X	ALL SYSTEMS AND TOPIC NUMBERS ASSOCIATED WITH THE CALCULATION HAVE BEEN LISTED	<u>YES</u>
	X	COMPUTATIONAL ACCURACY HAS BEEN CHECKED AND FOUND CORRECT (INDICATE THE METHOD USED)	
		a) CHECK SAMPLE CALCULATION USING DATA OTHER THAN THAT USED IN THE SAMPLE	<u>N/A</u>
		b) PERFORMANCE OF ALTERNATE OR APPROXIMATE CALCULATION (ATTACHED)	<u>N/A</u>
		c) DESCRIBE OTHER METHOD USED	

	X	PROGRAM USED IS APPROPRIATE, INPUT IS VALID, AND OUTPUT IS REASONABLE CONSIDERING THE INPUT	<u>N/A</u>
X	X	PIMS CODE OF CALCULATION BRANCH OWNER HAS BEEN LISTED IN BLOCK 4	<u>YES</u>
X	X	ASSUMPTIONS REQUIRING CONFIRMATION HAVE BEEN IDENTIFIED AND TRACKING A/R HAVE BEEN INITIATED	<u>N/A</u>

THE CRITERIA LISTED ABOVE ARE MINIMUM CRITERIA TO BE CONSIDERED AND ARE NOT INTENDED TO LIMIT THE INITIATIVE OF THE REVIEWER TO CONSIDER OTHER CRITERIA.

ATTRIBUTES APPLICABLE TO MANUAL AND COMPUTER CALCULATIONS ARE NOTED BY A "X" IN THE APPROPRIATE COLUMN. FOR CHECKING OF REVISIONS TO MANUAL CALCULATIONS, THE ATTRIBUTES MAY BE LIMITED TO ONLY REVISED PORTIONS OF THE CALCULATION.

LIST THE DOCUMENTS USED TO SUPPORT THE REVIEW:

ULTRASONIC EXAMINATION REPORTS IN ATTACHMENT 1 TO THIS CALC., NCR GENERIC

LETTER 90-05, BECHTEL STRESS CALC. 33-1 R/O, NCR No. PB 93-00809

AND REFERENCE DOCUMENTS LISTED IN SECTION VII:

REVIEWED BY: Naren Jom DATE: 4/29/94



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CALCULATION SHEET

CALC NO.: PM-725

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I. PURPOSE:

This calculation evaluates the structural integrity of the "A" and "B" ESW Booster Pump Suction piping. This evaluation is required due to flaws found in the pipe welds using ultrasonic examination (refer to NCR's PB 93-00809 and 94-00138). This calculation addresses the operability of the subject piping in its as-found condition.

Anyone in need of this calculation to support design or Station activities other than those explicitly specified in this Section should contact the owner of the calculation to ensure its appropriate use.

II. SUMMARY OF RESULTS:

The results of this calculation demonstrate that the subject piping and welds will be able to withstand all design loads in their as-found conditions. Since the "A" loop piping had more significant deterioration of the piping and welds than the "B" loop, the results of the "A" loop analysis envelope the "B" loop.

The "B" loop welds shall be reinspected within 6 months of the last inspection to monitor the acceptability/operability of the subject welds (an action evaluation will be created under A/R A0842408).

Corrosion rate of pipe = 0.0076 inches/year ("A" Loop)
0.0144 inches/year ("B" Loop)

Stress Intensity Factor, $K = 15.56 \text{ ksi}\sqrt{\text{in}}$

Burst pressure for pipe = 421 psi > 100 psi (system pressure)

Shear stress at thinnest wall = 0.036 ksi

Minimum Weld thickness required for circumferential weld:

"A" Loop = 0.004 inch

"B" Loop = 0.003 inch



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Pipe Stresses at $t_{min} = 0.118$ inch

		<u>Calculated</u>		<u>Allowable</u>		
Normal	=	14,951 psi	<	15,000 psi	∴	O.K.
Upset	=	17,600 psi	<	18,000 psi	∴	O.K.
Faulted	=	21,307 psi	<	35,000 psi	∴	O.K.

III. DESIGN INPUT / CRITERIA:

NRC Generic Letter 90-05, dated June 15, 1990

Specification M-300, Rev. 13, including Addenda 1 - 4

Bechtel Pipe Stress Calculation 33-1, Rev. 0

ANSI B31.1, 1973 Edition, including Summer Addenda 1973

NCR PB 93-00809, Revision 1

Ultrasonic Examination Records, dated 4/23/94 & 4/24/94

NCR PB 93-00809, Revision 0

Ultrasonic Examination Records, dated 11/16/93

Formulas for Stress and Strain, 5th Edition

IV. COMPUTER CALCULATION INFORMATION:

No computer calculation was performed for this calculation.

V. ASSUMPTIONS:

1. Minimum wall thickness at weld to be 0.245 inches for computing "A" Loop corrosion rate and 0.130 inches for computing "B" Loop corrosion rate.
2. Flaw diameter of 1/4" for flaw evaluation.



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3. Area of flaw at thinnest wall section is an ellipse for computing shear stress.
4. Thickness of existing circumferential weld to be 0.06 inch on ESW "A" Loop.

NOTE: These assumptions do not require verification.

VI. 50.59 DETERMINATION:

Refer to 50.59 review/safety evaluation performed for NCR PB 93-00809, Rev. 1 disposition.

VII. REFERENCES:

Drawing M-283, Rev. 17
HISO-3303, Sht. 1, Rev. 1
ISO 2-33-101, Rev. F-8
P&ID M-330, Sht. 1, Rev. 26
Also, refer to Section III of this calculation.

VIII. ATTACHMENTS:

1. Ultrasonic exam reports (9 pages)

ref: pm-925.doc



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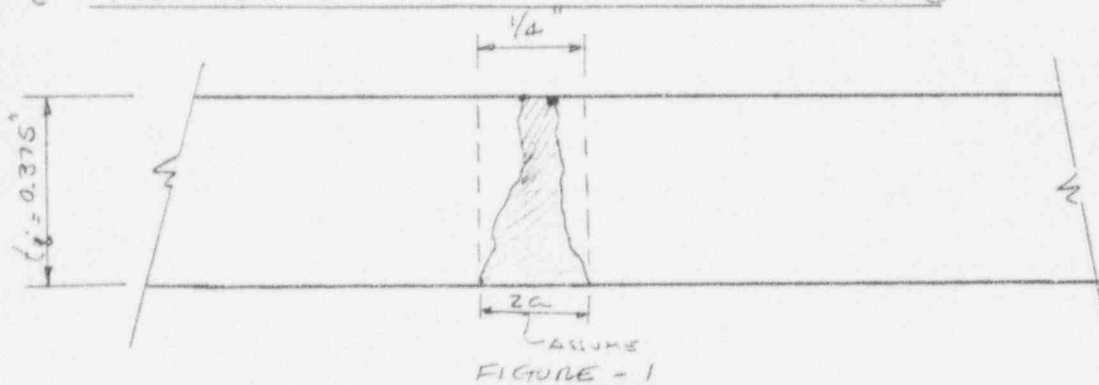
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DISPOSITION OF NCR P93-00809 Rev. 0

REF.



a) CALCULATE THE REQUIRED MINIMUM WALL THICKNESS (t_m) FOR INTERNAL PRESSURE.

- Assume $P = 100$ psi (CONSERVATIVE, ACTUAL $P \leq 15$ psi)

$$t_m = \frac{P(D_o)}{2(S_E + P_y)} + C \quad \text{where } S_E = 15 \text{ ksi} \\ P_y = 0.4(P)$$

$$t_{min} = \frac{100(20)}{2(15,000 + 0.4(100))} + C$$

$$t_{min} = 0.066" + C$$

b) FROM UT RESULTS DETERMINE CORROSION RATE

- FROM THE UT RESULTS, USE THE THINDEST AREA (t_t) AND DETERMINE THE CORROSION RATE BY THE FOLLOWING EQUATION.

$$C = \frac{t_i - t_t}{17}$$

$$C = \frac{0.375 - 0.245}{17}$$

$$C = 0.0076" / yr.$$

where t_i = INITIAL THICKNESS
 t_t = THINDEST PORTION
17 = YEARS OF SERVICE

UT RESULTS
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OF 10



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REF

$$t_{min} = 0.066 + 0.0076$$

$$t_{min} = \underline{\underline{0.0741''}}$$

c) Flow evaluation per 90-05

$$K = 1.4 \leq F (3.1416 a)^{0.5} \quad (1)$$

G.L.
90-05

WHERE THE GEOMETRY FACTOR "F" IS

$$F = 1 + A C^{1.5} + B C^{2.5} + C C^{3.5} \quad (2)$$

G.L.
90-05

WHENEVER $C = a / (3.1416 R)$

$R =$ MEAN PIPE RADIUS

$$a = 0.25''/2 \text{ (CONSERV.)}$$

$$C = \frac{0.125}{(3.1416)(9.963)}$$

$$a = 0.125''$$

$$R = (20 - 0.0741)/2$$

$$R = 9.963''$$

$$C = 0.0040$$

$$T = \frac{R}{t_{min}}$$

G.L. 90-05
EQ. (7)

$$T = \frac{9.963}{0.0741} \rightarrow 134.453$$

DETERMINE "A"

$$A = -3.26543 + 1.52784 T - 0.072698 T^2 + 0.0016011 T^3$$

G.L.
90-05
EQ. (4)

$$A = -3.26543 + 205.42335 - 1,314.21466 + 3891.65403$$

$$A = 2,779.59729$$



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DETERMINE B

$$B = 11.36322 - 3.91412 Y + 0.18619 Y^2 - 0.004099 Y^3$$

$$B = 11.36322 - 526.26690 + 3,365.89215 - 9963.08156$$

$$B = -7,112.09309$$

RET

GL
90-05
EQ. (5)DETERMINE C

$$C = -3.18609 + 3.84763 Y - 0.18304 Y^2 + 0.00403 Y^3$$

$$C = -3.18609 + 517.32709 - 3,308.94731 + 9,795.36928$$

$$C = 7,000.56297$$

GL
90-05
EQ. (6)FIND GEOMETRY FACTOR "F"

$$F = 1 + A C^{1.5} + B C^{2.5} + C C^{3.5}$$

$$F = 1 + (2,779.59729)(0.004)^{1.5} + (-7,112.09309)(0.004)^{2.5} + (7,000.56297)(0.004)^{3.5}$$

$$F = 1 + 0.70319 - 0.00720 + 0.00003$$

$$F = 1.69602$$

GL
90-05
EQ. (2)DETERMINE "K"

$$K = 1.4(10.458 \text{ ksi})(1.69602)(3.1416 \times 0.125)^{0.5}$$

Conserv.

$$K = 15.56053 \text{ ksi} \sqrt{\text{IN}} < 35 \text{ ksi} \sqrt{\text{IN}} \text{ (Conservative)}$$

GL
90-05

THEREFORE ACCEPTABLE - Code Repair to be provided.

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DISPOSITION OF NCR 93-00809 REV. 1

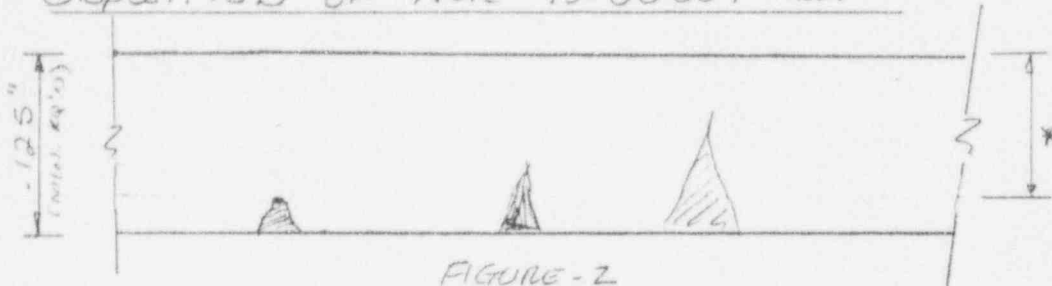


FIGURE-2

* FIND t_{NEW} TO ALLOWABLE STRESSES FOR
ALL CODE CONDITIONS

FROM STRESS CALC 33-01

SCALE
33-01

EQ. 8	=	4888 psi	(NORMAL CONDITION)
EQ 9B	=	5754 psi	(UPSET CONDITION)
EQ 9D	=	6966 psi	(FAULTED CONDITION)

$$\sigma = \frac{M}{S}$$

$$M = (\sigma)(S)$$

$$S = \text{PIPE SECTION MODULUS}$$

$$= 111.4 \text{ in}^3 \text{ FOR } 20" \phi$$

USE EQ 9D FOR CONTROLLING MOMENT.

$$M = (6.966)(111.4) = 776.012 \text{ in-k}$$

FIND MIN. SECTION MODULUS

$$S = \frac{0.098175 (D^4 - d^4)}{D} \quad \text{TRY } t = 0.125"$$

$$S = 38.53 \text{ in}^3$$

$$\sigma_{NEW} = \frac{T(S)}{S_{NEW}}$$

EQ. 8

$$\sigma_{NEW} = 14.132 \text{ ksi} < 15.00 \text{ ksi ALLOW.}$$

EQ 9D

$$\sigma_{NEW} = 20.135 \text{ ksi} < 35.0 \text{ ksi ALLOW.}$$

EQ 9B

$$\sigma_{NEW} = 16.632 \text{ ksi} < 18.0 \text{ ksi ALLOW.}$$

OK

OK

OK



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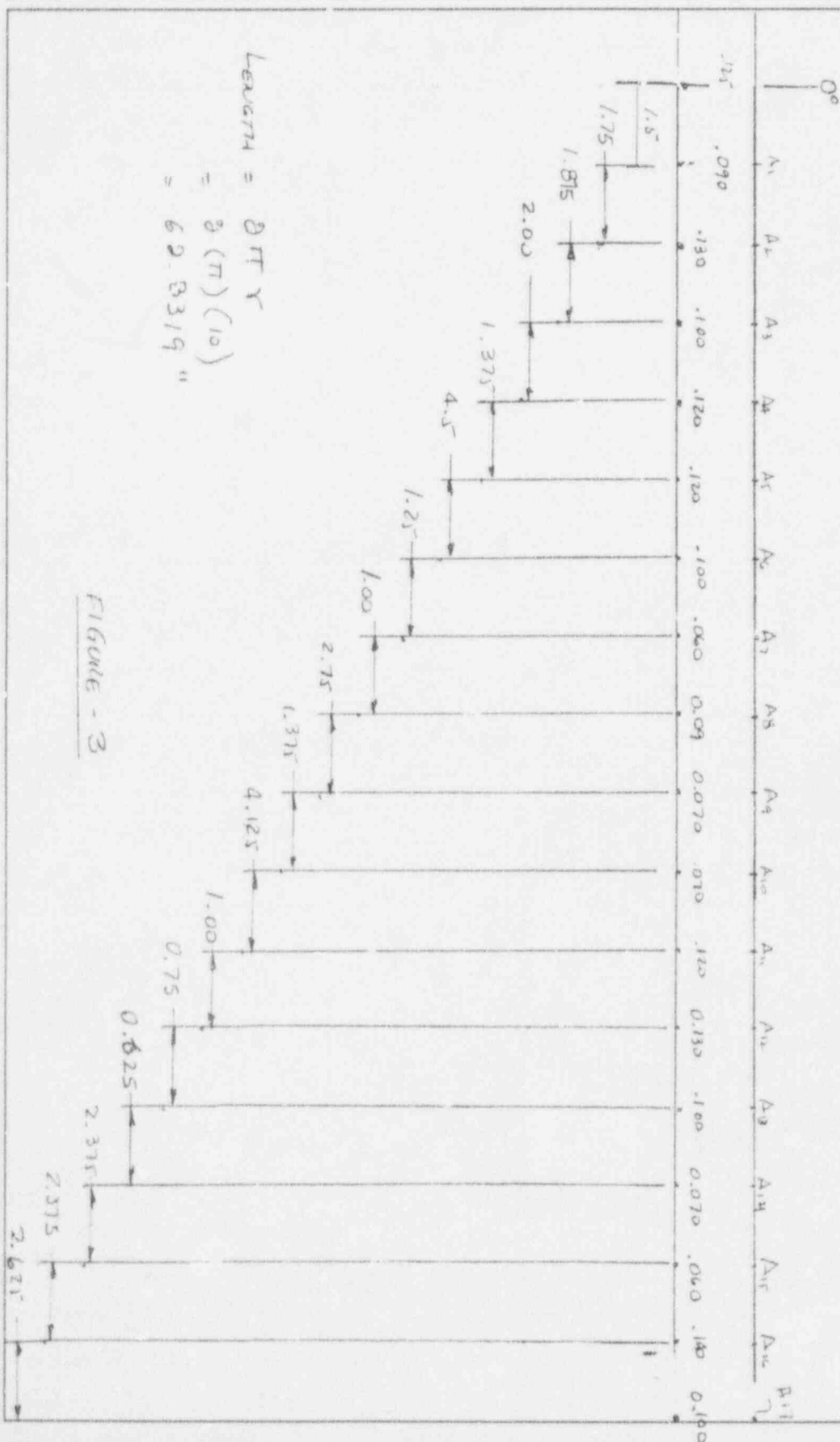
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FROM NDE RESULTS
 ASSUMING RADIUS OF FITTING = $\frac{1}{8}$ "

ELAWS LOCATIONS (Ft)



$$\begin{aligned}
 \text{LENGTH} &= 2\pi r \\
 &= 2(\pi)(10) \\
 &= 62.8319"
 \end{aligned}$$



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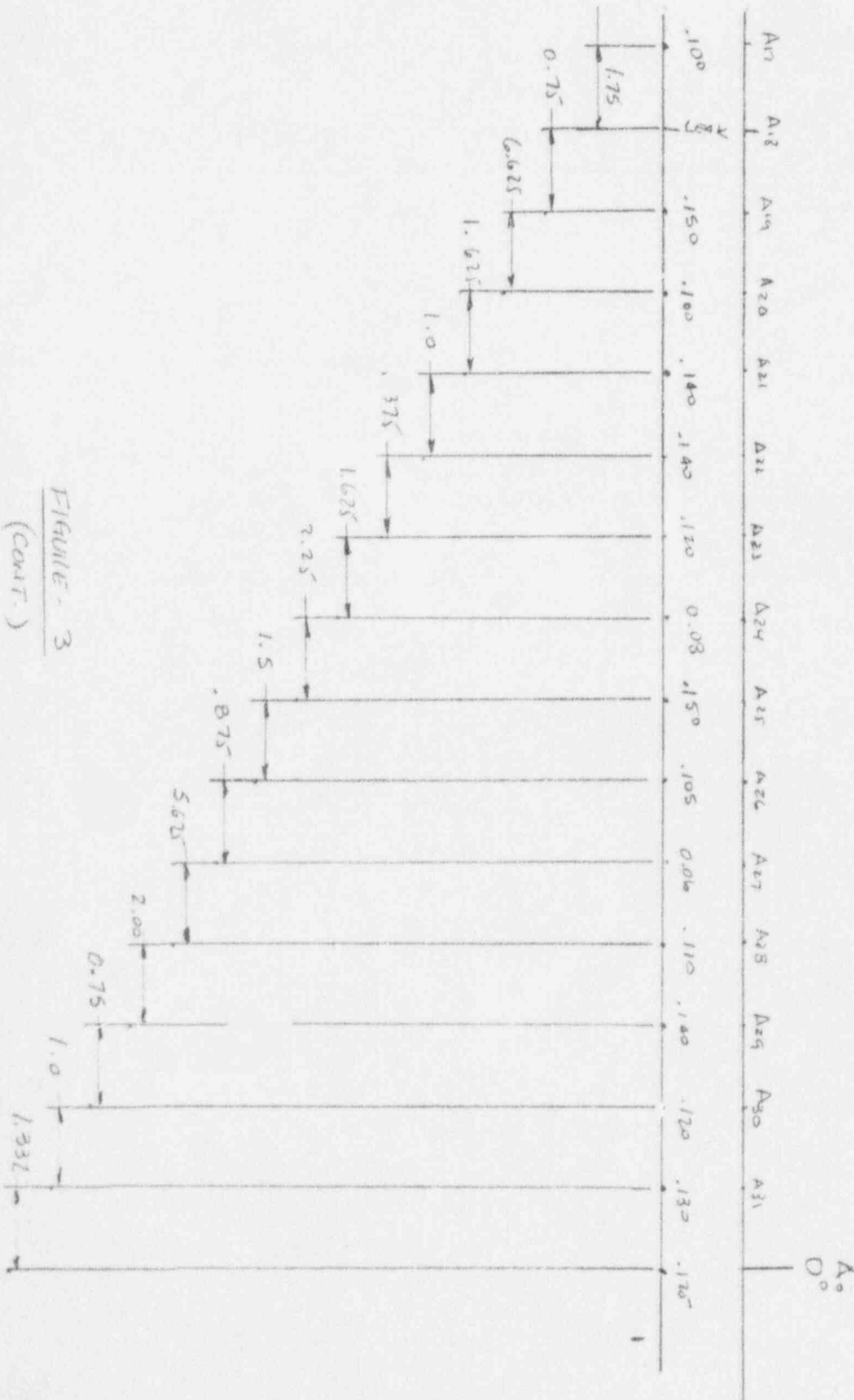
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FLAME LOCATION



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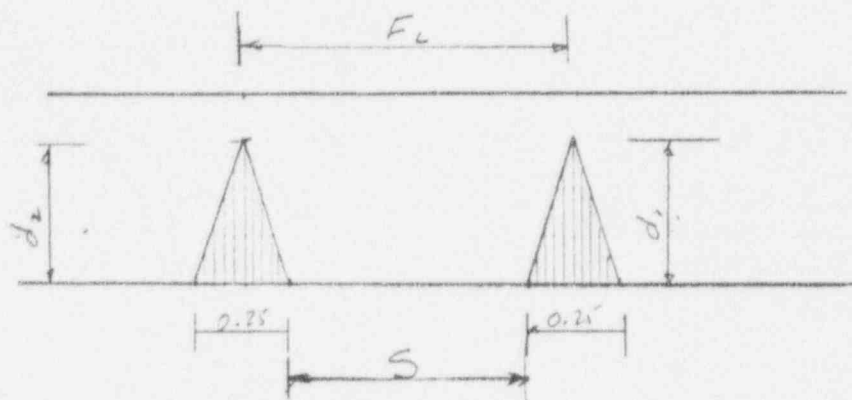


FIGURE 4

* Assume 1/8" radius of flaw.
IN ACCORDANCE WITH GL 90-05 FIG 3(a) DETERMINING
SINGLE VERSUS MULTIPLE FLAWS

$$0^{\circ}-A_1 \quad d_1 = 0.250" \quad d_1 < d_2 \text{ use } d_2$$

$$d_2 = 0.285$$

$$(2)(d_2) = 0.570 \text{ min required}$$

$$\text{ACTUAL} = 1.5 - 0.250 = 1.25" > 0.570" \therefore \text{OK}$$

SINGLE

$$A_1-A_2 = A_1 \text{ controls } \therefore 2d_2 = 0.570$$

$$\text{PROVIDED} = 1.50 > 0.570" \therefore \text{OK}$$

SINGLE

$$A_2-A_3 = \text{REQUIRED} = 0.550"$$

$$\text{PROVIDED} = 1.63 > 0.550" \quad \text{OK}$$

SINGLE

$$A_3-A_4 = \text{REQUIRED} = 0.550"$$

$$\text{PROVIDED} = 75" > 0.550" \quad \text{OK}$$

SINGLE

$$A_4-A_5 = \text{REQUIRED} = 0.510"$$

$$\text{PROVIDED} = 1.25" > 0.510 \quad \text{OK}$$

SINGLE

$$A_5-A_6 = \text{REQUIRED} = 0.550"$$

$$\text{PROVIDED} = 4.15" > 0.550" \quad \text{OK}$$

"

$$A_6-A_7 = \text{REQUIRED} = 0.630"$$

$$\text{PROVIDED} = 1.00" > 0.630" \quad \text{OK}$$

"

$$A_7-A_8 = \text{REQUIRED} = 0.630"$$

$$\text{PROVIDED} = 0.750" > 0.630" \quad \text{OK}$$

"



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				REF.
A ₈ - A ₉	Required = 0.610"			
	Provided = 2.50"	> 0.610"	OK	SINGLE
A ₉ - A ₁₀	Required = 0.610"			
	Provided = 1.125"	> 0.610"	OK	"
A ₁₀ - A ₁₁	Required = 0.610"			
	Provided = 3.875"	> 0.610"	OK	"
A ₁₁ - A ₁₂	Required = 0.510"			
	Provided = 0.75"	> 0.510"	OK	"
A ₁₂ - A ₁₃	Required = 0.550"			
	Provided = 0.500"	< 0.550"	OK	DOUBLE
A ₁₃ - A ₁₄	Required = 0.610"			
	Provided = 0.375"	< 0.610"	OK	DOUBLE
A ₁₄ - A ₁₅	Required = 0.630"			
	Provided = 2.125"	> 0.630"	OK	SINGLE
A ₁₅ - A ₁₆	Required = 0.630"			
	Provided = 2.125"	> 0.630"	OK	"
A ₁₆ - A ₁₇	Required = 0.550"			
	Provided = 2.375"	> 0.550"	OK	"
A ₁₇ - A ₁₈	Required = 0.750"			
	Provided = 1.500"	> 0.750"	OK	"
A ₁₈ - A ₁₉	Required = 0.750"			
	Provided = 0.500"	< 0.750"	OK	DOUBLE
A ₁₉ - A ₂₀	Required = 0.550"			
	Provided = 6.375"	> 0.550"	OK	SINGLE
A ₂₀ - A ₂₁	Required = 0.550"			
	Provided = 1.375"	> 0.550"	OK	"
A ₂₁ - A ₂₂	Required = 0.470"			
	Provided = 0.750"	> 0.470"	OK	"
A ₂₂ - A ₂₃	Required = 0.510"			
	Provided = 1.125"	> 0.510"	OK	"
A ₂₃ - A ₂₄	Required = 0.590"			
	Provided = 1.375"	> 0.590"	OK	"
A ₂₄ - A ₂₅	Required = 0.590"			
	Provided = 2.000"	> 0.590"	OK	"

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$A_{25} - A_{26}$	Required = 0.540"				REP
	Provided = 1.250"	> 0.540	OK		SINGLE
$A_{26} - A_{27}$	Required = 0.630"				
	Provided = 0.625"	< 0.630	OK		DOUBLE
$A_{27} - A_{28}$	Required = 0.630"				
	Provided = 5.375"	> 0.630	OK		SINGLE
$A_{29} - A_{29}$	Required = 0.530"				
	Provided = 1.750"	> 0.530	OK		"
$A_{29} - A_{30}$	Required = 0.510"				
	Provided = 0.500	< 0.510	OK		DOUBLE
$A_{30} - A_{31}$	Required = 0.510"				
	Provided = 0.750"	> 0.510	OK		SINGLE
$A_{31} - A_0$	Required = 0.500"				
	Provided = 1.082"	> 0.500	OK		"

$$A_{12} - A_{13} \quad A_{12} = 0.130 \quad A_{13} = 0.100$$

$$A_{13} - A_{14} \quad A_{13} = 0.100 \quad A_{14} = 0.070$$

$$A_{18} - A_{19} \quad A_{18} = 0 \quad A_{19} = 0.150 \quad \text{PIN HOLE} \quad \checkmark$$

$$A_{26} - A_{27} \quad A_{26} = 0.105 \quad A_{27} = 0.06$$

$$A_{29} - A_{30} \quad A_{29} = 0.140 \quad A_{30} = 0.120$$

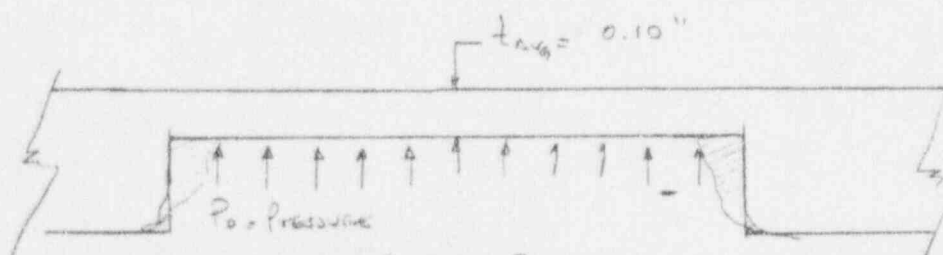
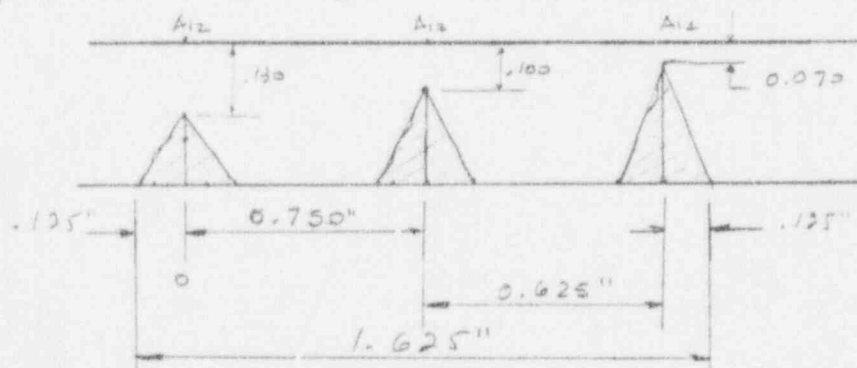
Analysis for $A_{12} - A_{13}$ AND $A_{13} - A_{14}$ 

FIGURE - 5



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d) DETERMINE BURST PRESSURE

where $T_u = T_{\text{max. TENSILE}}$

$$q_u = 2T_u \frac{a-b}{a+b}$$

$$a = 10 \text{ in}$$

$$b = 10 - 0.060 = 9.94$$

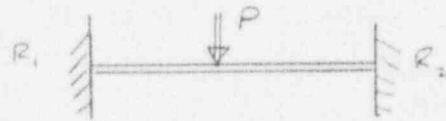
$$T_{\text{ty}} = 0.060"$$

$$q_u = 2(70) \frac{10.0 - 9.94}{10.0 + 9.94} \quad (1000 \text{ PSI/KSI})$$

FORMULA FOR STRESS STRAIN

$$q_u = 421 \text{ PSI} \rightarrow \text{SYSTEM PRESSURE (100 PSI)}$$

e) DETERMINE SHEAR STRESSES.



ASSUME ELLIPSE FOR

AREAS

$$A = 0.7854 D d$$

FIND P $P = \text{Pressure (Area)}$

$$P = 100 ((.7854)(1.625)(.25))$$

$$P = 31.906 \text{ Lbs}$$

$$R_1 = R_2 = \frac{P}{2} = 15.953 \text{ Lbs}$$

$$\text{SHEAR AREA} = \left(\pi \sqrt{2(A^2 + B^2)} \right) t_{\text{min}}$$

$$= 0.4383 \text{ IN}^2$$

$$\tau = \frac{V}{A}$$

$$\tau = \frac{15.953}{0.4383} = 36.40 \text{ PSI}$$

$$\tau = 0.036 \text{ KSI} < 14.0 \text{ KSI (TALLOW)} \text{ OK}$$

$$\begin{aligned} T_{\text{allow}} &= 0.4 S_y \\ &= 0.4(35) \\ &= 14.0 \text{ KSI} \end{aligned}$$

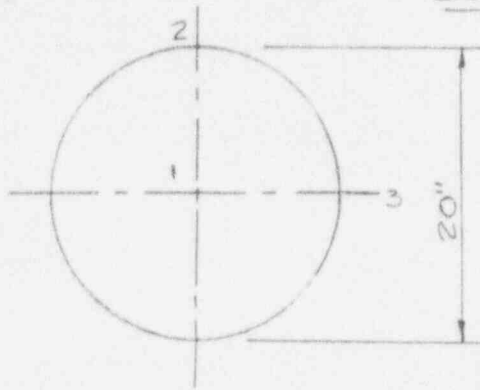
$\therefore$ FITTED AREAS WILL NOT SHEAR OFF AND WILL REMAIN IN PLACE



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DETERMINE REQUIRED WELD FOR
20" O.D PIPE

SECTION PROPERTIES

$$A_w = \pi d = \pi (20) \\ = 62.832 \text{ in}$$

$$S_w = \frac{\pi d^2}{4} = \frac{\pi (20)^2}{4} \\ = 314.159 \text{ in}^2$$

$$J_w = \frac{\pi d^3}{4} = \frac{\pi (20)^3}{4} \\ = 6283.185 \text{ in}^3$$

FIND RESULTANT FORCES AT AFFECTED NODE POINT
FOR "A" PIPING

$$F_x = \sqrt{2219^2 + 1600^2} = 2736 \text{ lbs}$$

$$F_y = \sqrt{943^2 + 556^2} = 1095 \text{ lbs}$$

$$F_z = \sqrt{147^2 + 87^2} = 171 \text{ lbs}$$

$$M_x = \sqrt{351^2 + 382^2} = 519 \text{ lbs}$$

$$M_y = \sqrt{679^2 + 289^2} = 738 \text{ lbs}$$

$$M_z = \sqrt{2709^2 + 2336^2} = 3577 \text{ lbs}$$

REF

STRESS
CALC.

33-01



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REF

$$f_1 = \frac{2736}{62.832} + \frac{\sqrt{738^2 + 3577^2}}{314.159} = 55.17$$

$$f_2 = \frac{\sqrt{1095^2 + 171^2}}{62.832} + \frac{519(10)}{6283.185} = 18.465$$

$$f_r = \sqrt{55.17^2 + 18.465^2} = 58.178$$

REQUIRED

$$\text{WELD SIZE} = \frac{58.178}{15,000} = 0.004 \text{ in} < 0.06 \text{ in } (*)$$

THEREFORE, STRUCTURAL INTEGRITY OF THE WELD
WILL BE MAINTAINED.

(*) ASSUMING 0.05" WELD THICKNESS ALL AROUND.
(CONSERVATIVE)



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EVALUATE "B" ESW BOOSTER PUMP SUCTION PIPING

DETERMINE MINIMUM WALL THICKNESS

FROM STRESS CALCULATION 33-01, FOR THE 48HB 20" PIPING, THE MAXIMUM STRESSES ARE AS FOLLOWS:

NORMAL	4888 PSI	15,000 PSI (ALLOWABLE)
UPSET	5754 PSI	18,000 PSI (ALLOWABLE)
FAULTED	6966 PSI	35,000 PSI (ALLOWABLE)

THE PROPERTIES OF THE PIPE ARE AS FOLLOWS:

O.D. =	20 IN
SECTION MODULUS =	111.4 IN ³
NOMINAL WALL THICKNESS =	0.375 IN

$$\sigma = \frac{M}{S} \rightarrow M = \sigma S$$

USE FAULTED CONDITION FOR CONTROLLING MOMENT

$$M = (6966)(111.4) = 776012 \text{ IN-LBS (776,012 IN-K)}$$

MIN SECTION MODULUS

$$S = \frac{0.098175 (D^4 - d^4)}{D}$$

$$\text{TRY } t = 0.118 \text{ IN}$$

$$d = D - 2t = 20 - 2(0.118) = 19.764 \text{ IN}$$



PECO ENERGY

NUCLEAR GROUP

CALCULATION SHEET

CALC NO.: PM-925

PAGE: 19

EVALUATE "B" ESW PIPING

$$S_{NEW} = \frac{0.098175(20^4 - 19.764^4)}{20}$$

$$S_{NEW} = 36.420 \text{ IN}^3$$

$$\sigma_{NEW} = \frac{\sigma(S)}{S_{NEW}}$$

$$\text{NORMAL } \sigma_{NEW} = 14,951 \text{ PSI} < 15,000 \text{ PSI}$$

$$\text{UPSET } \sigma_{NEW} = 17,600 \text{ PSI} < 18,000 \text{ PSI}$$

$$\text{FAULTED } \sigma_{NEW} = 21,307 \text{ PSI} < 35,000 \text{ PSI}$$

$$\text{THEREFORE } t_{min} = 0.118 \text{ IN}$$



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CALCULATION SHEET

CALC NO.: PM-925

PAGE: 20

EVALUATE B ESW PIPING:

DETERMINE CORROSION RATE

$$C = \frac{\text{NOMINAL WALL} - \text{MEASURED WALL}}{17 \text{ YRS}}$$

$$= \frac{0.375 \text{ IN} - 0.130}{17}$$

$$= 0.0144 \text{ IN/YR}$$

 UT
 RESULTS
 ATTACH
 PAGE 6
DETERMINE PREDICTED WALL THICKNESS

- AFTER 6 MONTHS

$$t_p = t_{\text{meas}} - C/2$$

$$= 0.130 - 0.0144/2$$

$$= 0.1228 \text{ IN}$$

- AFTER 1 YEAR

$$t_p = 0.130 - 0.0144$$

$$= 0.1156 \text{ IN}$$

SINCE t_p FOR 1 YEAR $> t_{\text{MIN}}$, PIPE WALL SHALL BE INSPECTED IN 6 MONTHS



PECO ENERGY

NUCLEAR GROUP

CALCULATION SHEET

CALC NO.: PM-925

PAGE: 21

DETERMINE REQUIRED WELD FOR "B" PIPE

$$F_x = \sqrt{1667^2 + 1103^2} = 1999 \text{ LB}$$

$$F_y = \sqrt{557^2 + 296^2} = 631 \text{ LB}$$

$$F_z = \sqrt{170^2 + 144^2} = 223 \text{ LB}$$

$$M_x = \sqrt{705^2 + 644^2} = 955 \text{ LB}$$

$$M_y = \sqrt{601^2 + 473^2} = 765 \text{ LB}$$

$$M_z = \sqrt{1631^2 + 1295^2} = 2083 \text{ LB}$$

STRESS
CALC
33-01

$$f_1 = \frac{1999}{62.832} + \frac{\sqrt{765^2 + 2083^2}}{314.159} = 39.88 \text{ LB/IN}$$

$$f_2 = \frac{\sqrt{631^2 + 223^2}}{62.832} + \frac{955(10)}{6283.185} = 12.17 \text{ LB/IN}$$

$$f_r = \sqrt{39.88^2 + 12.17^2} = 40.74 \text{ LB/IN}$$

$$\text{REQUIRED} = \frac{40.74}{15,000} = 0.003 \text{ IN} < 0.130 \text{ IN PER UT RESULTS}$$

THEREFORE, STRUCTURAL INTEGRITY OF THE WELD WILL
BE MAINTAINED

PECO NUCLEAR
MAINTENANCE
DIVISION

ULTRASONIC THICKNESS MEASUREMENT
WORK ORDER # Q 0149909

NDE
SUPPORT
GROUP

STATION: PEACH BOTTOM
UNIT: COMMON

DATE: APRIL 20, 1994
TIME: 22:00

DESCRIPTION/IDENTIFICATION OF AREA OR COMPONENT EXAMINED:

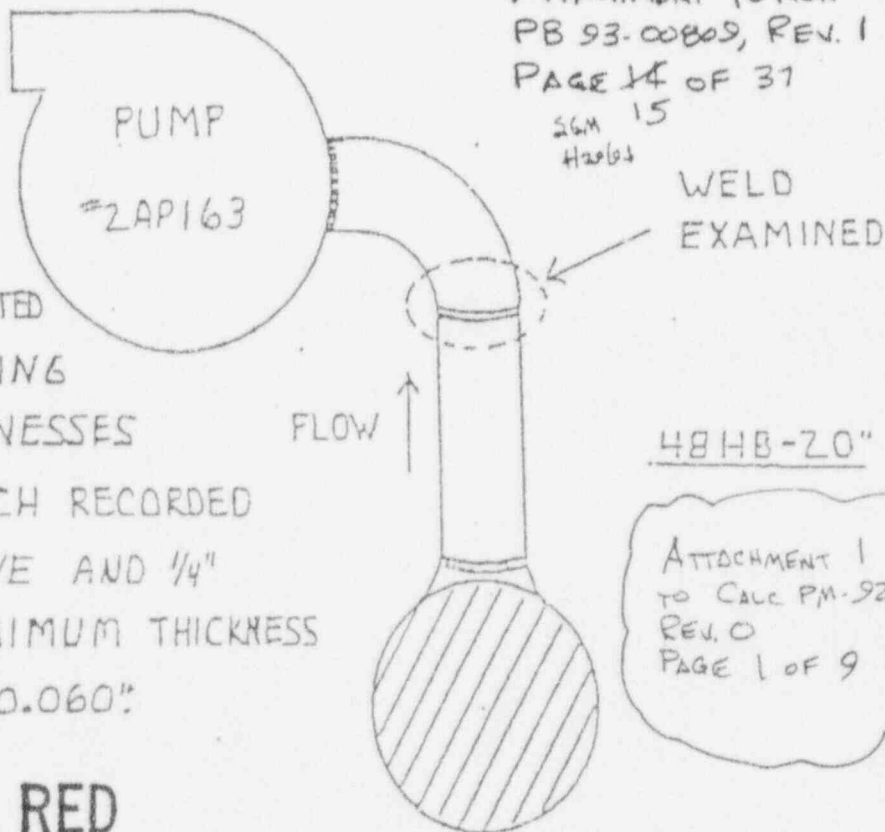
20" ESW PIPE TO ELBOW WELD IMMEDIATELY UPSTREAM
OF PUMP #2AP163

EXAM PROCEDURE: MAG-CG-412, REV. 0 ACCEPTANCE STANDARD: MEASUREMENT ONLY
FOR ENG. EVALU.

INSTRUMENT: MFR. STAVELY MODEL SONIC 136 S/N 36-6427
CALIBRATION DUE DATE 1-5-95
SEARCH UNIT: MFR. TECHNISONIC S/N T6760 TYPE DEP-0503-GP
SIZE 3/8" DIA. FREQUENCY 5 MHz
COUPLANT ULTRASEL II REFERENCE BLOCK C/S #16
CALIBRATION TIMES: INIT 19:30 FINAL 21:30 OTHER N/A

RESULTS

EXAMINED ENTIRE
CIRCUMFERENCE OF
INDICATED WELD.
RECORDED ANY
MEASUREMENT DETECTED
≤ .150" CORRESPONDING
BASE METAL THICKNESSES
WERE TAKEN AT EACH RECORDED
LOCATION 1/4" ABOVE AND 1/4"
BELOW WELD. MINIMUM THICKNESS
DETECTED WAS 0.060"



ORIGINAL IN RED

COMMENTS: ATTACHED SHEET DETAILS SPECIFIC MEASUREMENTS.

ATTACHMENT ☒

T. L. Anderson III / 4/21/94
NAME/LEVEL DATE

NAME/LEVEL DATE

Attachment to NCR 93-00809, Rev 1 Page 14 of 31
56M 15 H2063

STATION: PEACH BOTTOM UNIT: COMMON DATE: 4/20/94IDENTIFICATION OF AREA OR COMPONENT EXAMINED: 20" PIPE TO ELBOW
WELD ON SUCTION SIDE OF PUMP # 2API63EXAMINATION METHOD: U.T. PROCEDURE: MAG-CG-412, REV. 0NDE EXAMINER(S): T. L. ANDERSON JR. / V. GIAMPIETRO

ORIGINAL IN RED

THICKNESS

ATTACHMENT TO NCR PB 93-00809
Revision 1

PAGE 16 OF 37

Circumferential distance in inches from extrados of elbow	Base Metal 1/4" upstream from toe of weld (Pipe)	Weld	Base Metal 1/4" downstream from toe of weld (Elbow)
1/2"	.300"	.125"	.280"
2"	.310"	.090"	.300"
3 3/4"	.310"	.130"	.305"
5 5/8"	.305"	.100"	.300"
7 5/8"	.280"	.120"	.315"
9"	.310"	.120"	.290"
13 1/2"	.315"	.100"	.325"
14 3/4"	.300"	.060"	.280"
15 3/4"	.275"	.090"	.310"
18 1/2"	.290"	.070"	.310"
19 7/8"	.300"	.070"	.300"
24"	.320"	.120"	.310"
25"	.320"	.130"	.340"
26 3/4"	.300"	.100"	.300"
26 3/8"	.310"	.070"	.270"
28 3/4"	.310"	.060"	.270"
31 1/8"	.320"	.140"	.270"
33 3/4"	.290"	.100"	.280"
35" - 35 1/2"	.300"	LEAK	.300"
36 3/4"	.310"	.150"	.290"
42 3/8"	.270"	.100"	.300"
44"	.290"	.140"	.280"
45"	.290"	.140"	.280"
46 3/8"	.310"	.120"	.315"
48"	.280"	.080"	.320"
50 1/4"	.280"	.150"	.265"
51 3/4"	.310"	.105"	.290"
52 5/8"	.320"	.060"	.300"
58 1/4"	.310"	.110"	.310"
60 1/4"	.305"	.140"	.305"
61"	.320"	.120"	.330"
62"	.305"	.130"	.310"

ATTACHMENT 1 TO CALC PM-925
REV. 0 PAGE 2 OF 9

Page 2 of 2

ECO NUCLEAR
MAINTENANCE
DIVISION

SUPPLEMENTAL EXAMINATION WORKSHEET

NDE
SUPPORT
GROUPSTATION: PEACH BOTTOM UNIT: COMMON DATE: 4-24-94IDENTIFICATION OF AREA OR COMPONENT EXAMINED: ESW RETURN FROMU/2, U/3 TO 'A' & 'B' BOOSTER PUMPSEXAMINATION METHOD: ULTRASONIC PROCEDURE: MAG-CG-409NDE EXAMINER(S): SEE ATTACHED DATA SHEETS

THE ATTACHED DATA SHEETS CONTAIN THE MINIMUM WALL THICKNESS READINGS ON FIVE(5) SELECTED WELDS. THE GRIDS WERE LAYED OUT IN ACCORDANCE WITH THE REFERENCED PROCEDURE. EACH GRID WAS EXAMINED 100%. IF NO READING $\geq .150"$ OR BELOW WAS RECORDED, THAT VALUE WAS DOCUMENTED W/O EXACT LOCATION REFERENCE. IF READINGS OF $.150"$ OR BELOW WERE RECORDED A "L & W" MEASUREMENT WERE TAKEN TO LOCATE THE READING WITHIN THE GRID.

	GRID	READING	L + W
"A" PUMP TEE/PIPE	1B	.140	2.0 - 0
	1C	.150	.25 - .25
	2C	.100	.75 - .50
	5B	.110	2.25 - .25
"A" PUMP ELBOW/VALVE	6C	.120	2.25 - .75
	8C	.100	2.0 - .25
	3C	.130	.25 - .25

"B" PUMP PIPE/ELBOW - NO READINGS $.150"$ OR BELOW"B" PUMP ELBOW/VALVE - NO READINGS $.150"$ OR BELOW

ORIGINAL IN RED

NOTE:
ALL READINGS $.150"$ AND BELOW WERE VERIFIED VIA A SECOND 0° EXAMINATION AND CONFIRMED USING A 45° SHEAR W/ DEPTH CALIBRATION.

ATTACHMENT 1 TO CALC PM-925
REV. 0 PAGE 3 OF 9

PECO NUCLEAR MAINTENANCE DIVISION	RAW WATER PIPING SYSTEMS FOR CORROSION EXAMINATION REPORT FORM WORK ORDER # <u>CO149904</u>	NDE SUPPORT GROUP
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ATTACHMENT 1 TO CALC PM-925, REV. 0 PAGE 4 OF 9

STATION/UNIT: <u>Rec-13, Item U/23</u> CAM LOCATION ID: <u>"A" Pump Tee to Pipe</u>		EXAM AREA (X - ONE)	WELD ☒	STRAIGHT ☐	MEASUREMENT/RESULTS			
PIPE NOMINAL WALL : <u>.375</u>	EXAM POSITION	HORIZ.	VERTICAL	GRID	BAND A	BAND B	BAND C	
PIPE MINIMUM WALL : <u>.150</u>	(X - ONE)	☒	<u>60°</u>	1	.440	<u>.140</u>	<u>.150</u>	
PIPE DIAMETER : <u>20"</u>	ELEVATION : <u>132'</u>	AREA : <u>7/16-2</u>	ROOM # : <u>D/B-2</u>	2	.420	.240	<u>.100</u>	
INSTRUMENT: MFG. <u>Sonic</u> MODEL <u>136</u> S/N <u>136-7531</u>				3	.500	.250	.40	
CALIBRATION DUE DATE <u>8-10-94</u>				4	.500	.230	.400	
SEARCH UNIT: MFG. <u>HARISONIC</u> S/N <u>DIO5CH</u> TYPE <u>DUAL</u>				5	.480	<u>.110</u>	.320	
SIZE <u>.25"</u> FREQUENCY <u>5MHZ</u>				6	.460	.250	.280	
COUPLANT <u>ULTRAGEL</u> REFERENCE BLOCK				7	.480	.220	.240	
CALIBRATION TIMES: INIT <u>0730</u> FINAL <u>1410</u> OTHER <u>0930 1300</u>				8	.440	.270	.160	
DRAWING (IF APPLICABLE)				9	.360	.230	.190	
				10	.420	.280	.220	
				11	.350	.310	.350	
				12	.460	.200	.240	
				13	.460	.220	.180	
				14	.500	.290	.330	
				15	.500	.340	.160	
				16	.540	.320	.220	
				17	.530	.300	.310	
				18	.540	.250	.280	
				19	.500	.260	.200	
				20	.480	.310	.190	
				21				
				22				
				23				
24								
25								
26								
27								
28								
29								
30								

COMMENTS: ESW RETURN FROM U/25 U3 TO "A"
BOOSTER PUMP
- GRID #1 AT ELBOW EXTRADOS MEASURED
CW WITH FLOW

John M. Grider L-II
NAME/LEVEL DATE 4-24-94

NAME/LEVEL DATE

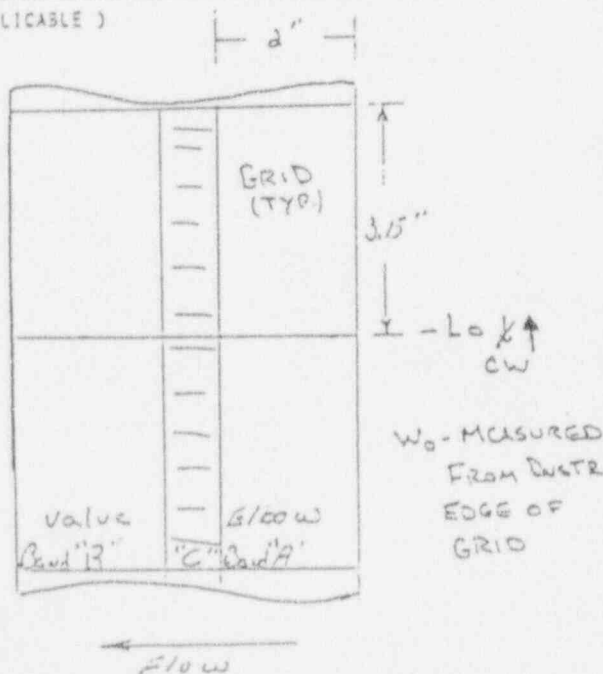
PECO NUCLEAR MAINTENANCE DIVISION	RAW WATER PIPING SYSTEMS FOR CORROSION EXAMINATION REPORT FORM WORK ORDER # C0149904	NDE SUPPORT GROUP
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ATTACHMENT 1 TO CALC PM-925, REV. 2 PAGE 5 OF 9

LOCATION/UNIT: <u>Pump Bottom U/S</u> M LOCATION ID # <u>"A" Pump Elbow to Valve</u>	EXAM AREA (X - ONE)	WELD (X)	STRAIGHT ()	MEASUREMENT/RESULTS			
IS NOMINAL WALL : <u>.375</u>	EXAM POSITION	HORIZ.	VERTICAL	GRID	BAND A	BAND B	BAND C
IS MINIMUM WALL : <u>.150</u>	(X - ONE)	<u>1/2</u>	<u>1X</u>	1	<u>.260</u>	Valve Body <u>N/A</u>	<u>.320</u>
IS DIAMETER : <u>20"</u>	ELEVATION : <u>135'</u>	AREA : <u>1/6.2</u>	ROOM # : <u>4/6.2</u>	2	<u>.260</u>		<u>.360</u>
INSTRUMENT: MFG. <u>SONIC</u>	MODEL <u>176</u>	S/N <u>136-7531</u>		3	<u>.310</u>		<u>.400</u>
CALIBRATION DUE DATE <u>8-10-94</u>				4	<u>.300</u>		<u>.440</u>
W/CH UNIT: MFG. <u>HARISONIC</u>	S/N <u>D10504</u>	TYPE <u>DUAL</u>		5	<u>.280</u>		<u>.390</u>
SIZE <u>.25"</u>	FREQUENCY <u>5MHz</u>			6	<u>.290</u>		<u>.120</u>
PLANT <u>ULTRAGE</u>	REFERENCE BLOCK <u>CAL-STEP-024/048</u>			7	<u>.290</u>		<u>.160</u>
LIBRATION TIMES: INIT <u>0755</u>	FINAL <u>0945</u>	OTHER		8	<u>.300</u>		<u>.100</u>

DRAWING (IF APPLICABLE)

ORIGINAL IN RED



GRID	BAND A	BAND B	BAND C
1	.260	Valve Body N/A	.320
2	.260		.360
3	.310		.400
4	.300		.440
5	.280		.390
6	.290		.120
7	.290		.160
8	.300		.100
9	.280		.400
10	.320		.300
11	.300		.180
12	.310		.180
13	.280		.450
14	.340		.380
15	.340		.420
16	.330		.420
17	.310		.200
18	.340		.420
19	.330		.300
20	.320	Y	.340
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

COMMENTS: E'SW RETURN FROM U/2C U/3 TO "A"
BOOSTER PUMP

NO READINGS ON BAND "B" DUE TO DOWSTREAM
VALVE CONFIGURATION

- GRID #1 @ TDC MEASURED CW WITH FLOW

Judd M. Ginder L-II
NAME/LEVEL DATE
4-24-94

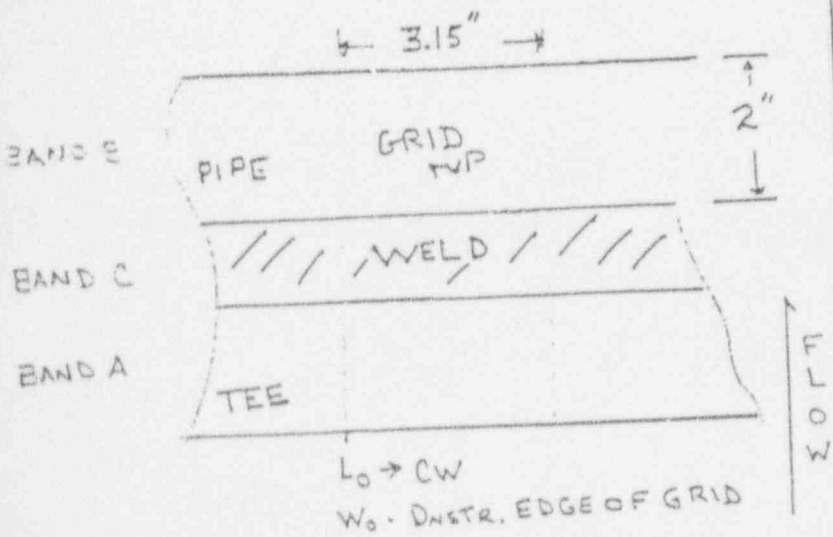
NAME/LEVEL DATE

LE) ATTACHMENT 1 TO CALC PM-925, REV. 0, PAGE 6 OF 9

ECO NUCLEAR MAINTENANCE DIVISION	RAW WATER PIPING SYSTEMS FOR CORROSION EXAMINATION REPORT FORM WORK ORDER # <u>CO153251</u>	NDE SUPPORT GROUP

IN/UNIT: PBAPS/COMMON LOCATION ID # TEE/PIPE	EXAM AREA (X - ONE) <u>WELD</u> STRAIGHT <u>[]</u>	MEASUREMENT/RESULTS			
NOMINAL WALL : <u>.375</u>	EXAM POSITION HORIZ. VERTICAL	GRID	BAND A	BAND B	BAND C
MINIMUM WALL : <u>.150</u>	(X - ONE) <u>∞</u> <u>[]</u>	1	.500	.310	.170
DIAMETER : <u>20"</u>	ELEVATION : <u>135</u> AREA : <u>D/G</u> ROOM # : <u>D/G</u>	2	.540	.250	.175
UMENT: MFR. <u>SONIC</u> MODEL <u>136</u> S/N <u>36-6427</u>	CALIBRATION DUE DATE <u>1-5-95</u>	3	.170	.280	<u>.130</u>
IN UNIT: MFR. <u>HARISONIC</u> S/N <u>B</u> TYPE <u>DUAL</u>	SIZE <u>.25</u> FREQUENCY <u>5MHZ</u>	4	.530	.270	.200
ANT <u>ULTRAGEL</u> REFERENCE BLOCK <u>CS-16</u>	GRATION TIMES: INIT <u>0800</u> FINAL <u>0945</u> OTHER	5	.560	.250	.160
		6	.560	.280	.250
		7	.560	.330	.250
		8	.520	.300	.310
		9	.540	.320	.310
		10	.550	.300	.230
		11	.510	.280	.240
		12	.540 *	.280	.350
		13	.540	.310	.200
		14	.530	.320	.200
		15	.540	.340	.300
		16	.560	.310	.200
		17	.520	.320	.180
		18	.540	.340	.210
		19	.520 *	.340	.380
		20	.500	.300	.260
		21			
		22			
		23			
		24			
		25			
		26			
		27			
		28			
		29			
		30			

DRAWING (IF APPLICABLE)



* HIGH AMP 0° SIGNALS @ .090 W/ LOSS OF BACKWALL, UNABLE TO CONFIRM W/ 45° SIGNAL.

COMMENTS: ESW RETURN FROM U/2 & U/3 TO "B"
BOOSTER PUMP

- GRID #1 AT ELBOW EXTRADOES MEASURED
CW WITH FLOW

Ka07.70 / 4-23-94
NAME/LEVEL DATE

ORIGINAL IN RED

AMPLE)

ATTACHMENT 1 TO CALC PM-925, REV. 0 Page 7 of 9

PECO NUCLEAR MAINTENANCE DIVISION	RAW WATER PIPING SYSTEMS FOR CORROSION EXAMINATION REPORT FORM WORK ORDER # <u>C0153251</u>	NDE SUPPORT GROUP
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LOCATION/UNIT: PBAPS / COMMON AN LOCATION ID # <u>PIPE/ELBOW</u>		EXAM AREA (X - ONE)	WELD (X)	STRAIGHT ()	MEASUREMENT/RESULTS			
PE NOMINAL WALL : <u>.375</u>	EXAM POSITION HORIZ. VERTICAL	GRID	BAND A	BAND B	BAND C			
PE MINIMUM WALL : <u>.150</u>	(X - ONE) (X) ()	1	.300	.320 *	.300 *			
PE DIAMETER : <u>20"</u>	ELEVATION : <u>135</u> AREA : <u>D/G</u> ROOF # : <u>D/G</u>	2	.280	.320 *	.310 *			
INSTRUMENT: MFR. <u>SONIC</u> MODEL <u>136</u> S/N <u>36-6427</u>		3	.170	.320	.360			
CALIBRATION DUE DATE <u>1-5-95</u>		4	.260	.330	.180			
ARCH UNIT: MFR. <u>HARISONIC</u> S/N <u>B3363</u> TYPE <u>DUAL</u>		5	.250	.300	.380			
SIZE <u>.25</u> FREQUENCY <u>5 MHE</u>		6	.280	.300	.390			
UPPLANT <u>ULTRAGEL</u> REFERENCE BLOCK <u>CS-16</u>		7	.300	.350	.390			
LIBRATION TIMES: INIT <u>1100</u> FINAL <u>1400</u> OTHER <u>1140 - 1250</u>		8	.230	.290	.390			
DRAWING (IF APPLICABLE)		9	.230	.380 *	.400			
TYPICAL		10	.220	.310 *	.360			
		11	.300	.350	.300 *			
		12	.265	.360	.380			
		13	.240	.320	.360			
		14	.250	.300	.320			
		15	.320	.300	.200			
		16	.320	.300	.320			
		17	.240	.280	.320			
		18	.250	.280	.200			
		19	.320	.330	.230			
		20	.300	.300	.400 *			
		21						
		22						
		23						
COMMENTS: ESW RETURN FROM U/24 U/3 TO "B"		24						
BOOSTER PUMP		25						
* LIMITED EXAMINATION - CONDUIT OBSTRUCTION		26						
- GRID #1 AT ELBOW EXTRADOES MEASURED		27						
CW WITH FLOW		28						
		29						
		30						

ORIGINAL IN RED

4-23-94 K. O. J. 4-23-94
NAME/LEVEL DATE NAME/LEVEL DATE

ATTACHMENT 1 TO CALC PM-925, REV. 0 PAGE 8 OF 9

PECO NUCLEAR MAINTENANCE DIVISION	RAW WATER PIPING SYSTEMS FOR CORROSION EXAMINATION REPORT FORM WORK ORDER # <u>C0153251</u>	NDE SUPPORT GROUP
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FROM/UNIT: PBAPS/COMMON		EXAM AREA	WELD	STRAIGHT	MEASUREMENT/RESULTS			
LOCATION ID # ELBOW/VALVE		(X - ONE)	(X)	()	GRID	BAND A	BAND B	BAND C
NOMINAL WALL : .375	EXAM POSITION	HORIZ.	VERTICAL					
MINIMUM WALL : .150	(X - ONE)	()	(X)		1	.340	N/A	.440
DIAMETER : 20"	ELEVATION : 135	AREA : D/G	ROOM # : D/G		2	.350		.410
INSTRUMENT: MFG. SONIC	MCOEL 136	S/N 36-6427			3	.310		.410
CALIBRATION DUE DATE 1-5-95					4	.300		.400
ARCH UNIT: MFG. HARRISONIC	S/N B3363	TYPE DUAL			5	.330		.380
SIZE .25	FREQUENCY 5 MHz				6	.300		.360
PLANT ULTRAGEL	REFERENCE BLOCK CS-16				7	.320		.170
LIBRATION TIMES: INIT 0800	FINAL 0935	OTHER			8	.330		.440
					9	.320		.410
					10	.310		.400
					11	.320		.220
					12	.310		.230
					13	.340		.430
					14	.330		.390
					15	.330		.340
					16	.310		.160
					17	.330		.410
					18	.320		.440
					19	.310		.410
					20	.330		.410
					21			
					22			
					23			
					24			
					25			
					26			
					27			
					28			
					29			
					30			

DRAWING (IF APPLICABLE)

A
BAND

C
BAND

TYPICAL VALVE

ORIGINAL IN RED

COMMENTS: ESW RETURN FROM U/2F U/3 TO 'B'

BOOSTER PUMP.

- NO READINGS ON BAND 'B' DUE TO DNSTREAM VALVE CONFIGURATION.

- GRID #1 @ TDC MEASURED CW WITH FLOW

Ka077ul / 10 / 4-24-94

NAME/LEVEL DATE

NAME/LEVEL DATE

MRF/REFERENCE # A0795247

STATION: Peach Bottom
UNIT: #2

DATE: 11/16/93
TIME: 1600

DESCRIPTION/IDENTIFICATION OF AREA OR COMPONENT EXAMINED: System # 48
'A' ESW Booster Pump Suction Line # 48-HB-20"
Loc. Diesel Bldg Cardex Room (Below Grating)
E. Information only

EXAM PROCEDURE: *Ultrasonic*

ACCEPTANCE STANDARD: NDE-12 Rev. -1

INSTRUMENT: MFGR. Harisonic MODEL 26 DL S/N 36-6773
SEARCH UNIT: MFGR. Panometrics S/N 39197 TYPE Dual
SIZE .375" FREQUENCY 5 MHz
COUPLANT Ultragel REFERENCE BLOCK Step Wedge
CALIBRATION TIMES: INIT 1615 FINAL 1630 OTHER 1" CS Step Wedge FCC-15

RESULTS

ATTACHMENT 1
TO CALC P.M.-925
REV. 0
PAGE 9 OF 9

MEASUREMENT

[illegible]

COMMENTS: Recorded UT Thickness Readings around Leak in Pipe Weld Nominal Wall .375"
1 Grid = 1 Transducer Diameter of .375". ATTACHMENT ()

Exhibit II / 11-18-93

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ORIGINAL IN RED

ATTACHMENT TO
NCR PB 93-00809
REVISION 0
PAGE 2 OF 13