LIC-98-0140

Enclosure 2

Calculation FC05977
ABB-CE Evaluation of Containment Spray Pump Net Positive Suction Head
Accounting for Sump Subcooling

CALCULATION COVER SHEET

Calculation Preparation, Review and Approval
Form PED-QP-3.1 Form Page No. 1 of 2
Calculation Cover Sheet

* Short Term Calc: ☐ YES ☒ NO

CALCULATION NUMBER ° FC Ø 5977

Calc. Page No. 1

*TOTAL PAGES 128

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CALCULATION TITLE ABB-CE Evaluation of Containment Spray Pump Net Positive Suction Head Accounting for Sump Subcooling

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Rich Harsell 6/12/92	Robert Paakkonen, (see ABB-CE calc. sheet)		Ø	NA		✓

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CALCULATION COVER SHEET

Calculation Preparation, Review and Approval
Form PED-QP-3.1 Form Page No. 2 of 2
Calculation Cover Sheet

CALCULATION NUMBER: FC05977

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FACILITY/SYSTEM: FCS / SI

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CALCULATION PREPARATION, REVIEW AND APPROVAL
FORM PED-QP-3.2 Form Page No. 1 of 1

PRODUCTION ENGINEERING DIVISION
CALCULATION REVISION SHEET

CALCULATION NO.

FC#5977

REV. NO.	DESCRIPTION /REASON FOR CHANGE
0	Initial issue

Evaluation of Containment Spray Pump Net Positive Suction Head Accounting for Sump Sub-Cooling

Prepared for Omaha Public Power District, Fort Calhoun Station

Calculation No. : O-MECH-CALC-021 Rev. 00
Safety Related : Yes X No __
Total Pages : 21
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Prepared By: R. B. Harsell Richard Harsell

Reviewed By: R. F. Paakkonen

VERIFICATION STATUS: COMPLETE
The Safety-Related design information contained in this document has been verified to be correct by means of Design Review using Checklist(s) 2 of QAM-101.
R. Paakkonen R. Paakkonen 6/12/92
Independent Reviewer: Name/Signature/Date

Approved By: F. P. Ferraraccio, Supervisor F. P. Ferraraccio 6-12-92

Purpose: To investigate available Net Positive Suction Head (NPSH) of Fort Calhoun Station Containment Spray Pumps accounting for containment sump liquid sub-cooling.

Method and Results of Review : Independent design review. The results of the review were found to be acceptable and consistent with that of the calculation.

ABB Combustion Engineering Nuclear Services

RECORD OF REVISION

Revision	Date	Author	Reviewer	Approval	Extent of Rev.
00	6/12/92	R. Harsell	R. Paakkonen	F. Ferraraccio	Original issue

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1.0 INTRODUCTION

The purpose of this calculation is to document the evaluation of available NPSH ($NPSH_a$) of Fort Calhoun Station's Containment Spray Pumps. This calculation documents the investigative effort to identify additional $NPSH_a$ using the model of Reference 3.2 and accounting for containment sump sub-cooling. The minimum sump sub-cooling available is given in Reference 3.14. This results in an additional, but conservative, amount of $NPSH_a$.

2.0 SCOPE

This calculation applies to the Omaha Public Power District's Fort Calhoun Station Containment Spray System.

3.0 REFERENCES

FC05777

3.1 CE Calculation O-MPS-CALC-004 Rev. 01, "The Development of a Hydraulic Computer Model of the Containment Spray System at Fort Calhoun Station using the "As-Built" Piping Isometrics and "FLO-SERIES" Hydraulic Analysis Computer Code", dated 5/12/92.

FC05906

3.2 CE Calculation O-MECH-CALC-019 Rev. 01, " Evaluation of Containment Spray Pump Net Positive Suction Head", dated 4/27/92.

3.3 CE Letter O-MPS-91-120, "Containment Spray System Open Item Closure", dated 8/23/91.

3.4 CE Letter O-MPS-91-147, "Containment Spray System NPSH Investigation for DBD Open Item Number 42", dated 10/10/91.

3.5 FLO-SERIES Users Manual dated 1990.

3.6 Garay, Paul N., "Pump Application Desk Book", The Fairmont Press, Inc., 1990.

3.7 Safety Guide 1, "Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps", dated 11/2/70.

3.8 MISC-MPS-CALC-015 Revision 0, Quality Assurance Software Verification and Validation Report, dated 7-12-91 for PIPE-FLO version 3.91a and NET-FLO version 3.92a.

3.9 Crane Manual, Technical Paper No. 410, Twenty-Fourth printing, 1988.

3.10 Ft. Calhoun Station Unit No. 1, Surveillance Test ST-N2-1, "Containment Spray Nozzles", performed May 1987

3.11 OPPD OSAR 85-33, "Electrical Equipment Qualification Environment Determination", dated 3/21/86. Copy attached to Reference 3.2.

3.12 Facsimile from P. Kasztejna (Ingersoll-Rand) to D. Blanchard (ABB) concerning Containment Spray Pumps, received 3/19/92. Copy attached in Appendix D.

3.13 CE Calculation O-MPS-CALC-011 Rev. 00, "Calculation of Spray Initiation Time", dated 10/24/91.

3.14 ABB Inter-Office Correspondence OPS-92-0653, "Evaluation of the Pressure Margin Present Between the Saturation Pressure of the Containment Sump Water and the Containment Pressure - Post LOCA", dated 5/29/92. Copy attached in Appendix D.

3.15 ASME Steam Tables, dated 1979.

3.16 Ingersoll-Rand Company pump curves N-182A, N-171A, AND N-178A. Copy attached in Appendix D.

4.0 BASIC DATA AND ASSUMPTIONS

4.1 Assumptions 4.1 and 4.3 - 4.8 of Reference 3.1 apply. Those assumptions are:

4.1.1 The SIRWT water temperature is 90°F.
4.1.2 Pump elevation is 973.25 ft.
4.1.3 Spray headers "A" and "B" are at 1111.5 ft.
4.1.4 The same ring elevations are used.
4.1.5 The following pump curve data from Reference 3.16 was used to model the pumps:

Pump	Curve No.
SI-3A	N-178 A
SI-3B	N-182 A
SI-3C	N-171 A

4.2 Reference 3.11 allows the use of 6.0 feet of level in the containment sump for $NPSH_r$ determination. Its applicability was established in Reference 3.2.

4.3 The $NPSH_r$ curve in each of this calculation's Figures is based on Reference 3.12. This curve is the most recent curve of $NPSH_r$ and was, therefore, used in this calculation. Its applicability was established in Reference 3.2.

4.4 Properties of sump liquid are approximated as water and, as such, the properties of Reference 3.15 apply to the sump liquid.

5.0 METHOD OF ANALYSIS

This calculation is an expansion of Reference 3.2. References 3.1, 3.2, 3.3, and 3.4 have noted a possible condition resulting in inadequate NPSH for the Containment Spray Pumps (CSP) during the recirculation phase of safety injection. This calculation uses the model developed for Reference 3.2.

The objective of this calculation is to calculate the available NPSH and compare it against the required NPSH. To determine $NPSH_a$, various parameters were considered. The parameters of elevation difference, sump level, and CSP suction headloss were considered in Reference 3.2. This calculation, however, expands that calculation by accounting for sump sub-cooling. The sump sub-cooling arises due to the pressure in containment being greater than the vapor pressure of the sump liquid. The total $NPSH_a$ is plotted against $NPSH_r$ to determine the available NPSH margin.

This Section discusses the methodology in general terms, while Section 7 explains, in detail, the methods employed in this calculation.

5.1 MODEL DEVELOPMENT

The model used in this calculation was developed in Reference 3.2. This included using Reference 3.5. FLO-SERIES has been QA certified by Reference 3.8. The Code Certificates are included in Appendix D.

5.1.1 MODEL MODIFICATION

The model of Reference 3.2 was modified to use the manufacturer's pump curve data. A set of runs was performed using the modified model. These runs included the ring data of Reference 3.10. The ring data input to FLO-SERIES was taken from Reference 3.1. The K factors for rings A-F and H-L were taken from Reference 3.1, Appendix G while the K factor for ring G was taken from Appendix T of Reference 3.1. Appendix T accounts for the missing nozzle annotated in Reference 3.10. The Piping Project Report showing the respective rings and K factors is located in Appendix B.

5.2 $NPSH_a$ DETERMINATION

To determine the available NPSH, Equation 1 on page 200 of Reference 3.6 was used.

$$NPSH_a = \frac{(P_1 - P_v)(2.31)}{Specific\ Gravity} \pm Z - H_{fs} \qquad (1)$$

where $NPSH_a$ = available NPSH
P_1 = containment pressure
P_v = vapor pressure of the water at the pumping temperature; in this case, sump temperature
2.31 = conversion factor from psi to feet of head
Z = elevation difference between sump bottom and centerline of pump
H_{fs} = suction headloss

5.3 TEST CASE CONDITIONS

Runs were based on allowable CSP/CS header configurations that were developed in Reference 3.13. The configuration runs are listed in Table 1.

TABLE 1
CONTAINMENT SPRAY SYSTEM MAIN MODEL RUNS

RUN	CONFIGURATION	CSS PUMP	DISCHARGE HEADER
1	3P2H	SI-3A SI-3B SI-3C	HDR A HDR B
2	2P2H	SI-3B SI-3C	HDR A HDR B
3	3P1H	SI-3A SI-3B SI-3C	HDR B
4	2P1H	SI-3A SI-3B	HDR B
5	2P1H	SI-3A SI-3C	HDR B
6	1P1H	SI-3A	HDR B

NOTE: The designation xPyH determines the number of pumps (P) and headers (H). Results of these runs are found in Appendix C.

6.0 RESULTS

This calculation shows that crediting only 25% of the available sump liquid sub-cooling NPSH and accounting for a 6 foot level in the sump yields positive NPSH margins. Tables 4 and 5 and the Figures show the $NPSH_a$ versus $NPSH_r$ for various pump flow data points. Table 6 and the Figures show the $NPSH_a$ values for the flows determined by FLO-SERIES. The 3P1H configuration is not graphed.

Based on Table 6 and the Figures, OPPD CSPs have sufficient $NPSH_a$ providing credit is taken for sump liquid sub-cooling.

7.0 BODY OF THE CALCULATION

7.1 MODEL DEVELOPMENT AND VERIFICATION

The explanation of model development is included in Reference 3.1. The base model for this calculation comes from Reference 3.2. The base model, OPPDCS, was copied onto a working disk as OPPDCS1 and run using one set of conditions established in Reference 3.2. The verification run was documented in accordance with FLO-SERIES control procedures; the verification sheet is included in Appendix D. Once the working model was verified, it was modified as described in Section 7.1.1.

7.1.1 MODEL MODIFICATION

The working model was modified in accordance with Reference 3.4 by replacing the test pump data with the manufacturer's pump data. The pump replacement was accomplished by setting up new networks in NET-FLO Network Design & Configuration. The respective nodes were called up and the proper pump "installed" into the corresponding pipe. The Component Table Report of Appendix B includes the three pumps used. Components C, D, and E were placed into pipelines 74, 75, and 76, respectively. Additionally, for the runs involving only one header, Header A was blocked by the use of "phantom" check valves and 5000 psi for the fixed grade pressure. This check valve/high pressure combination resulted in zero flow through Header A. In this way, the system was modified and run in the configurations according to Table 1.

7.2 AVAILABLE NPSH DETERMINATION

As discussed in Section 5.2, $NPSH_a$ was determined using Equation 1. In order to calculate $NPSH_a$ the terms P_1, P_v, specific gravity, Z, and H_f are necessary. Reference 3.14 transmitted the data pertaining to the conditions in containment that would yield the least, i.e. most conservative, amount of sub-cooling available.

7.2.1 CONTAINMENT PRESSURE (P_1)

The values for containment pressure are located in various containment analysis calculations. The specific containment pressure relevant to this calculation is given in Reference 3.14 as 16.43 psia.

7.2.2 VAPOR PRESSURE AT SUMP TEMPERATURE (P_v)

The vapor pressure is the saturation pressure corresponding to the sump temperature. The sump temperature relevant to this calculation is given in Reference 3.14 as 100.3°F.

7.2.3 $P_1 - P_v$

Reference 3.14 transmitted the minimum delta P available. This delta P results due to sump sub-cooling and results in additional $NPSH_a$. This differential pressure is stated in Reference 3.14 as 15.47 psi.

7.2.4 SPECIFIC GRAVITY

The specific gravity, as applicable to this case, is defined as

$$SG = \frac{\rho_{water\ at\ sump\ temperature}}{\rho_{water\ at\ 60°F}} \quad (2)$$

where ρ (density at sump temperature of 100.3°F per Reference 3.14) is 61.996 lbm/ft^3 from Reference 3.15
ρ (density at 60°F) is 62.371 lbm/ft^3 from Reference 3.15

therefore,

$$SG = \frac{61.996}{62.371} = 0.994 \quad (3)$$

7.2.5 $NPSH_{SUBCOOLING}$

Sections 7.2.2 through 7.2.4 are used to calculate the additional NPSH available due to sump subcooling. The additional NPSH available is

$$NPSH_{SUBCOOLING} = \frac{15.47}{0.994} * 2.31 = 35.95\ feet \quad (4)$$

To maintain conservatism, only 25% , or 8.99 feet, of the $NPSH_{SUBCOOLING}$ will be accounted for in this calculation.

7.2.6 ELEVATION DIFFERENCE (Z)

The centerline of the CSPs are at 973.25 ft (Assumption 4.1.2) and the bottom of the containment sump is at 994 ft per Reference 3.1. This Z equals 20.75 ft but does not account for any level in the containment sump. There will, however, be water in the sump which will result in additional level. Reference 3.11 revealed that the height of water in the sump would be approximately 6.0 ft. This does not account for RCS volume but does account for SIT volume. The resultant Z is 26.75 ft. This calculation shows $NPSH_a$ values for both Z = 20.75 feet and Z = 26.75 feet.

$X - 973.25 = 26.75$
$X = 1000\ ft$

$X - 973.25 = 20.75$
$X = 994$

7.2.7 SUCTION HEADLOSS (H_{fs})

To determine the suction headloss equations for each pump, data for the respective piping sections of Reference 3.1 was used to calculate a Total K factor. FLO-SERIES computes two K factors, $K_{v\&f}$ and K_{flow}. PIPE-FLO calculates $K_{v\&f}$ based on the valves and fittings "installed" into each pipe section. This $K_{v\&f}$ is shown on the individual Pipeline Reports which are located in Appendix B. NET-FLO then computes K_{flow} using fL/D. The values for f, L (in feet), and D (in inches) are also shown on the Pipeline Reports in Appendix B. Equation 5 was used to calculate K_{total}. Table 2 compiles the data from the Pipeline Reports and computes a Total K for each pipe section. Equation 6, taken from Reference 3.9, calculates K in terms of different size pipes. Using Equation 6, an effective K for the suction side of the respective pump is calculated and is shown in Table 3.

$$K_{total} = K_{v+f} + K_{flow} \tag{5}$$

$$K_{smaller\ pipe} = K_{larger\ pipe}\left(\frac{d_{small}}{d_{large}}\right)^4 \tag{6}$$

Once an effective K factor was determined, Equation 7, taken from page 3-4 of Reference 3.9, was used to calculate the headloss at different flows.

$$H_{fs} = \frac{0.00259 K_{total} Q^2}{d_{small}^4} \tag{7}$$

7.2.8 SUCTION HEADLOSS (H_{fs}) FOR PUMPS SI-3B and SI-3C OPERATING IN PARALLEL

Runs 1-3 result in pumps SI-3B and SI-3C operating in parallel. Therefore, the flow in the common pipelines (108, 110, and 112) is essentially doubled. To account for this additional headloss, the resistance for those pipelines has been quadrupled when the CS system is operating in one of the applicable configurations. Equations 10 and 12 represent the headloss equations and Table 3 displays the results in spreadsheet format.

7.2.9 AVAILABLE NPSH EQUATION

Using Sections 7.2.1 through 7.2.8, the resultant $NPSH_a$ equations for each CSP are:

$$SI\text{-}3A \qquad NPSH_a = 8.99 + Z - 2.084*10^{-7}\ Q^2 \qquad (8)$$

$$SI\text{-}3B \qquad NPSH_a = 8.99 + Z - 2.657*10^{-7}\ Q^2 \qquad (9)$$

$$SI\text{-}3B\ (w/SI\text{-}3C) \qquad NPSH_a = 8.99 + Z - 3.899*10^{-7}\ Q^2 \qquad (10)$$

$$SI\text{-}3C \qquad NPSH_a = 8.99 + Z - 2.750*10^{-7}\ Q^2 \qquad (11)$$

$$SI\text{-}3C\ (w/SI\text{-}3B) \qquad NPSH_a = 8.99 + Z - 3.991*10^{-7}\ Q^2 \qquad (12)$$

The effective K factors and headloss equations are included in Table 3. $NPSH_a$ calculations for Equations 8 through 12 are in spreadsheet form in Tables 4 and 5.

7.3 FLO-SERIES INPUT AND OUTPUT

7.3.1 FLO-SERIES INPUT

The main CS System network was formed in References 3.1 and 3.2. The network was modified per Section 7.1 of this calculation. The input data consisted of containment sump pressure and pressure at the discharge of the containmnet spray nozzles. Since the nozzles are also in containment, the pressures are similar. The difference arises due to the 6 foot level in the sump, in accordance with Assumption 4.2. This results in an additional 2.6 psi of pressure at Nodes H69 and H70 using Equation 13.

$$P_{additional} = \frac{6\ ft * 62.12\ \frac{lbm}{ft^3}}{144\ \frac{inch^2}{ft^2}} \qquad (13)$$

where 62.12 lbm/ft^3 is the density at 90°F (Reference 3.15)
144 inch^2/ft^2 converts ft^2 to inch^2

The initial pressure input is not important in this application; the only rigid requirement is that the difference between sump and containment spray nozzle pressure be 2.6 psi to account for sump water level.

7.3.2 FLO-SERIES OUTPUT

The FLO-SERIES output is contained in Appendix C. The RUN 1 output contains a complete NET-FLO report. This includes a Network Summary Report, a Configured Complete Junction Node Report, and a Complete Pipeline Report. These allow the reviewer to verify the node connections and ensure the proper pump was used. For other runs, only the Network Summary Report and Complete Pipeline Report are submitted.

Table 6 list the flows computed by FLO-SERIES and the NPSH$_a$ for each run in a composite format.

Table 2

PIPELINE TOTAL K FACTORS

Total K's for CSP suction pipes. Data is taken from Pipeline Reports in Appendix B.

PIPE #	K v&f	f	L (ft)	D (in)	Total K
2	0.236	0.012	7.25	19.25	0.290
5	0.618	0.013	18.65	12.39	0.853
6	1.662	0.013	26.39	12.39	1.994
7	1.405	0.013	14.85	12.39	1.592
67	0.448	0.013	9.50	12.00	0.572
68	0.000	0.013	5.50	12.00	0.072
69	0.259	0.013	10.43	12.00	0.395
107	0.228	0.011	7.20	23.25	0.269
108	0.368	0.012	5.42	23.25	0.402
109	3.022	0.011	140.40	23.25	3.819
110	3.100	0.011	89.72	23.25	3.609
111	0.475	0.011	55.86	23.25	0.792
112	0.388	0.011	47.56	23.25	0.658

Table 3

HEADLOSS EQUATIONS FOR THE CONTAINMENT SPRAY PUMP

Pipe	Diameter	Total K	In terms of	New K
Headloss Equations for CSP SI-3A during Recirculation Total K factors are from Table 2				
5	12.39	0.853	12.00	0.750
67	12.00	0.572	12.00	0.572
107	23.25	0.269	12.00	0.019
109	23.25	3.819	12.00	0.271
111	23.25	0.792	12.00	0.056
			Effective K =	1.668
Suction Head Losses for CSP SI-3A HL = 0.00259 K Q^2/d^4 HL = 2.084E-07 Q^2				
Headloss Equations for CSP SI-3B during Recirculation Total K factors are from Table 2				
7	12.39	1.592	12.00	1.401
69	12.00	0.395	12.00	0.395
* 108	23.25	0.402	12.00	0.029
* 110	23.25	3.609	12.00	0.256
* 112	23.25	0.658	12.00	0.047
			Effective K =	2.127
			K' =	3.121
Suction Head Losses for CSP SI-3B HL = 0.00259 K Q^2/d^4 Single Pump: HL = 2.657E-07 Q^2 — Two Pump: 3.899E-07 Q^2				
Headloss Equations for CSP SI-3C during Recirculation Total K factors are from Table 2				
2	19.25	0.290	12.00	0.044
6	12.39	1.994	12.00	1.755
68	12.00	0.072	12.00	0.072
* 108	23.25	0.402	12.00	0.029
* 110	23.25	3.609	12.00	0.256
* 112	23.25	0.658	12.00	0.047
			Effective K =	2.201
			K' =	3.196
Suction Head Losses for CSP SI-3C HL = 0.00259 K Q^2/d^4 Single Pump: HL = 2.750E-07 Q^2 — Two Pump: 3.991E-07 Q^2				
* refers to those sections of suction pipe which are shared by pumps 3B and 3C. These values for "New K" are quadrupled to determine K' for input to the "H" equation for when CSPs 3B and 3C are operating.				

FC 05977

Table 4

AVAILABLE NET POSITIVE SUCTION HEAD FOR THE CONTAINMENT SPRAY PUMPS

Based on NPSHsc= 8.99 ft
Z = 20.75 ft (no level in the sump)
HL = headloss based on appropriate equation from Table 3
NPSHa=NPSHsc + Z – HL = 8.99 + 20.75 – HL

Flow	2000	2200	2400	2600	2800	3000	3200
NPSHa SI-3A	28.906	28.731	28.539	28.331	28.106	27.864	27.606
NPSHa SI-3B	28.677	28.454	28.209	27.943	27.656	27.348	27.019
NPSHa SI-3C	28.640	28.409	28.156	27.881	27.584	27.265	26.924
NPSHr	14.8	16.5	18.3	20.2	22.5	24.5	27.0

Based on NPSHsc= 8.99 ft
Z = 26.75 ft (6 foot level in the sump per Reference 3.11)
HL = headloss based on appropriate equation from Table 3
NPSHa=NPSHsc + Z – HL = 8.99 + 26.75 – HL

Flow	2000	2200	2400	2600	2800	3000	3200
NPSHa SI-3A	34.906	34.731	34.539	34.331	34.106	33.864	33.606
NPSHa SI-3B	34.677	34.454	34.209	33.943	33.656	33.348	33.019
NPSHa SI-3C	34.640	34.409	34.156	33.881	33.584	33.265	32.924
NPSHr	14.8	16.5	18.3	20.2	22.5	24.5	27.0

NPSHr is taken from Reference 3.12

Table 5

AVAILABLE NET POSITIVE SUCTION HEAD FOR
SI-3B AND SI-3C OPERATING IN PARALLEL

Available Net Positive Suction Head for CSPs SI-3B & SI-3C
Based on NPSHsc= 8.99 ft
Z = 20.75 ft and Headloss based on appropriate equation from Table 3
NPSHa=NPSHsc + Z – HL = 8.99 + 20.75 – HL

Flow	2000	2200	2400	2600	2800	3000	3200
NPSHa SI-3B	28.18	27.85	27.49	27.10	26.68	26.23	25.75
NPSHa SI-3C	28.14	27.81	27.44	27.04	26.61	26.15	25.65
NPSHr	14.8	16.5	18.3	20.2	22.5	24.5	27.0

Based on NPSHsc= 8.99 ft
Z = 26.75 ft and Headloss based on appropriate equation from Table 3
NPSHa=NPSHsc + Z – HL = 8.99 + 26.75 – HL

Flow	2000	2200	2400	2600	2800	3000	3200
NPSHa SI-3B	34.18	33.85	33.49	33.10	32.68	32.23	31.75
NPSHa SI-3C	34.14	33.81	33.44	33.04	32.61	32.15	31.65
NPSHr	14.8	16.5	18.3	20.2	22.5	24.5	27.0

NPSHr is taken from Reference 3.12

Table 6

COMPOSITE FLOW vs. CONFIGURATION

NPSHa for CSP flows as computed by FLO-SERIES
Using manufacturer's pump curve data of Reference 3.16
NPSHsc = 8.99 ft

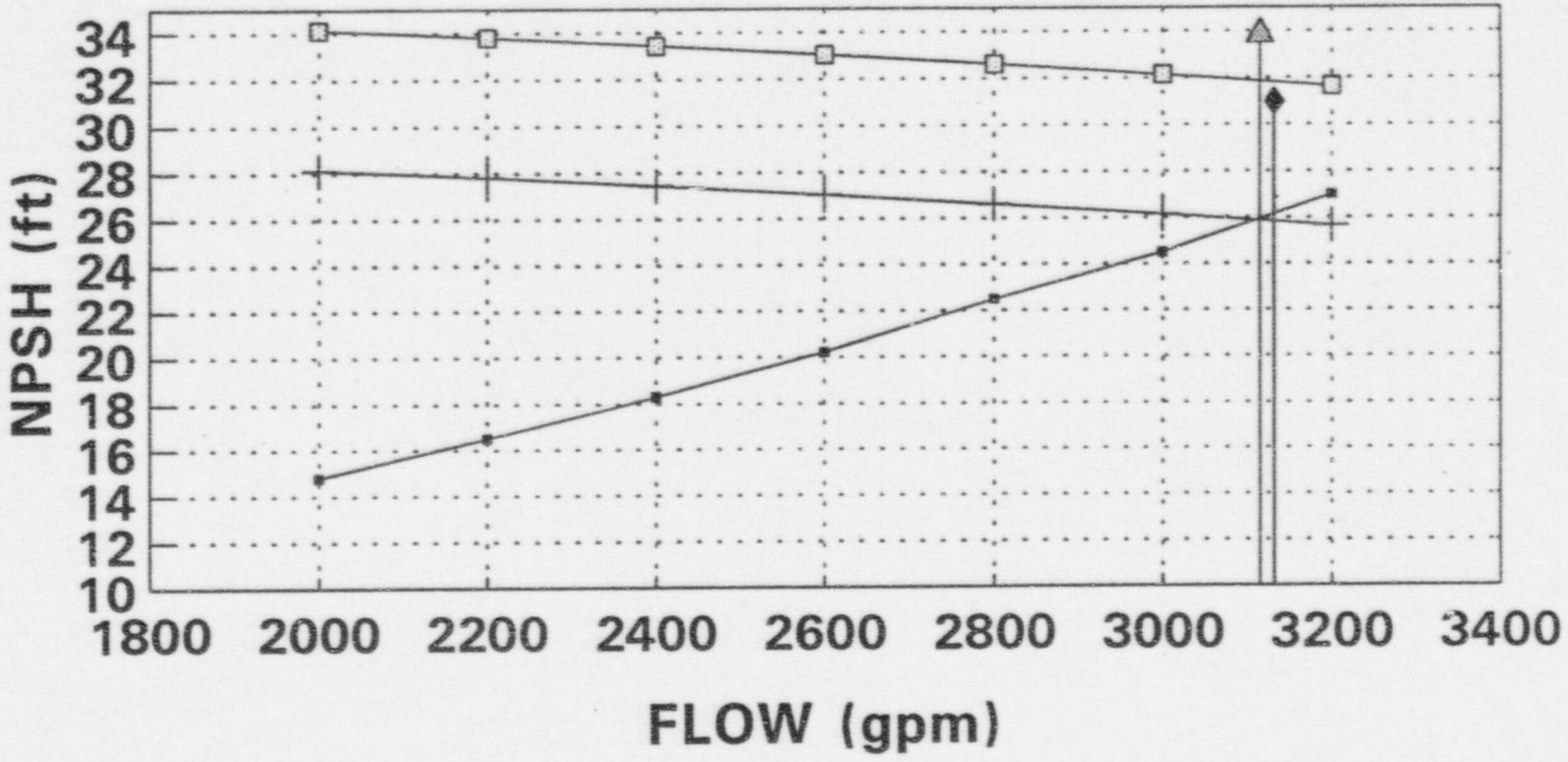
Pump	Configuration	Flow (gpm)	NPSHa (ft) (Z=0 ft)	NPSHa (ft) (Z=6.0 ft)	Suction Headloss (ft)
SI-3A	3P2H	2489	28.449	34.449	1.291
	3P1H	1535	29.249	35.249	0.491
	2P1H	2 21	28.803	34.803	0.937
	1P1H	3103	27.695	33.695	2.045
SI-3B	3P2H	2566	27.173	33.173	2.567
	2P2H	3132	25.916	31.916	3.824
	3P1H	1563	28.788	34.788	0.952
	2P1H	2192	28.463	34.463	1.277
SI-3C	3P2H	2549	27.147	33.147	2.593
	2P2H	3115	25.867	31.867	3.873
	3P1H	1530	28.806	34.806	0.934
	2P1H	2180	28.433	34.433	1.307

Note: Flows listed are the highest flows for the specific pump in the specific configuration.
The FLO-SERIES flow outputs are found in Appendix C.

Figure 1

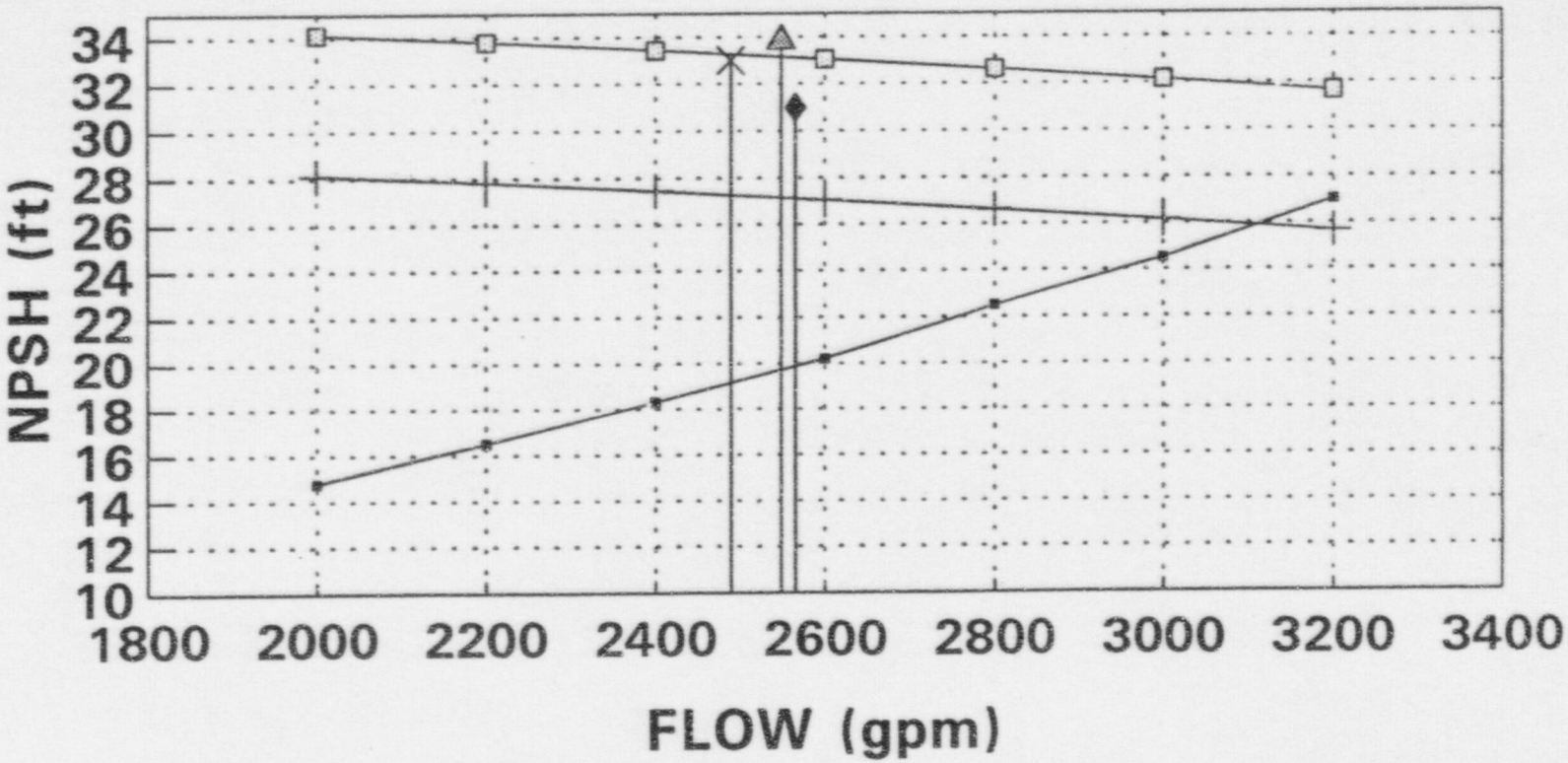
OPPD CSP NPSH w/ SUMP SUB-COOLING

2P2H Configuration



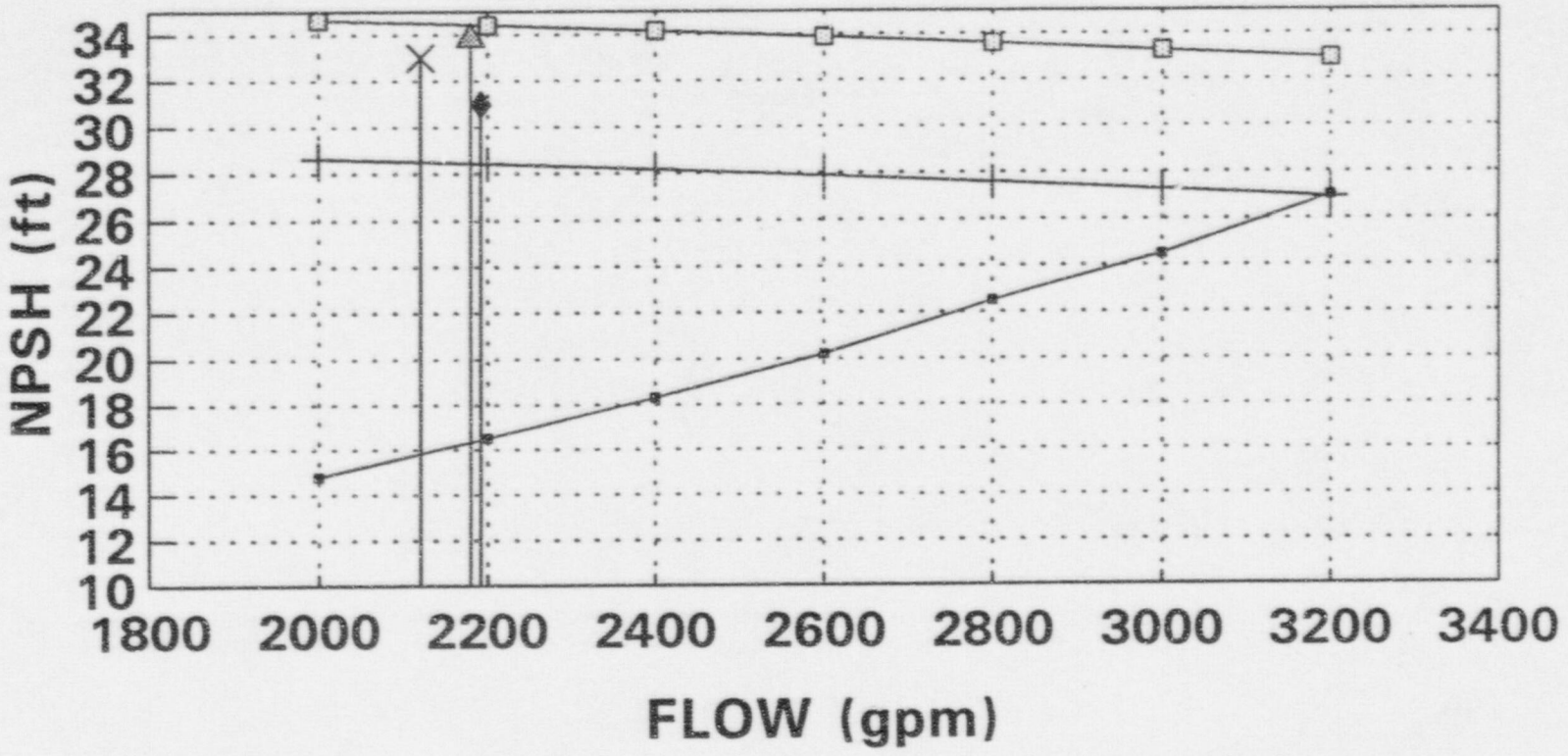
NPSHa taken from SI-3C of Table 5
Vertical lines represent pump flows
in 2P2H configuration.

Figure 2
OPPD CSP NPSH w/ SUMP SUB-COOLING
3P2H Configuration



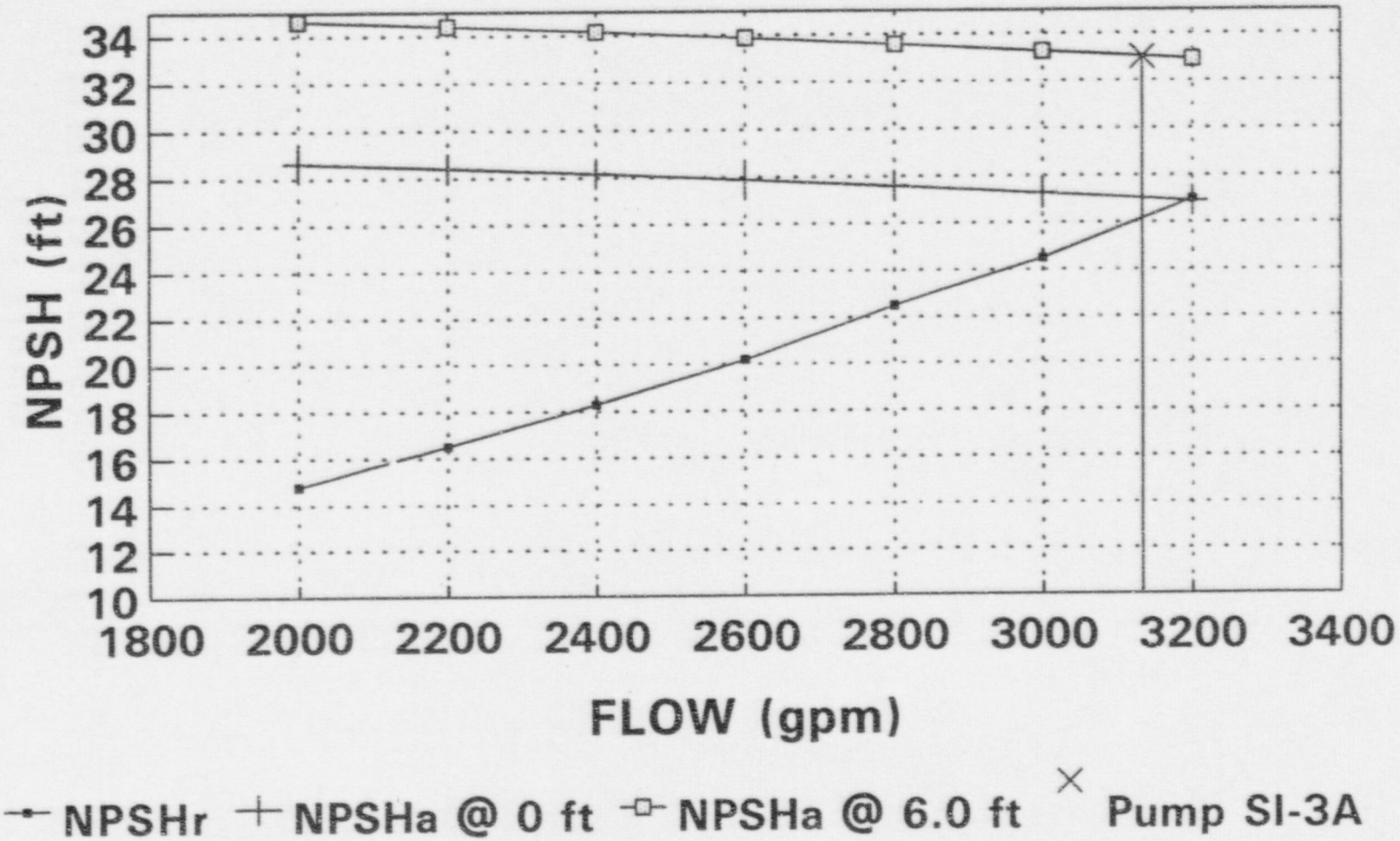
NPSHa taken from SI-3C of Table 5
Vertical lines represent pump flows in 3P2H configuration.

Figure 3
OPPD CSP NPSH w/ SUMP SUB-COOLING
2P1H Configuration



NPSHa taken from SI-3C of Table 4
Vertical lines represent pump flows in 2P1H configuration.

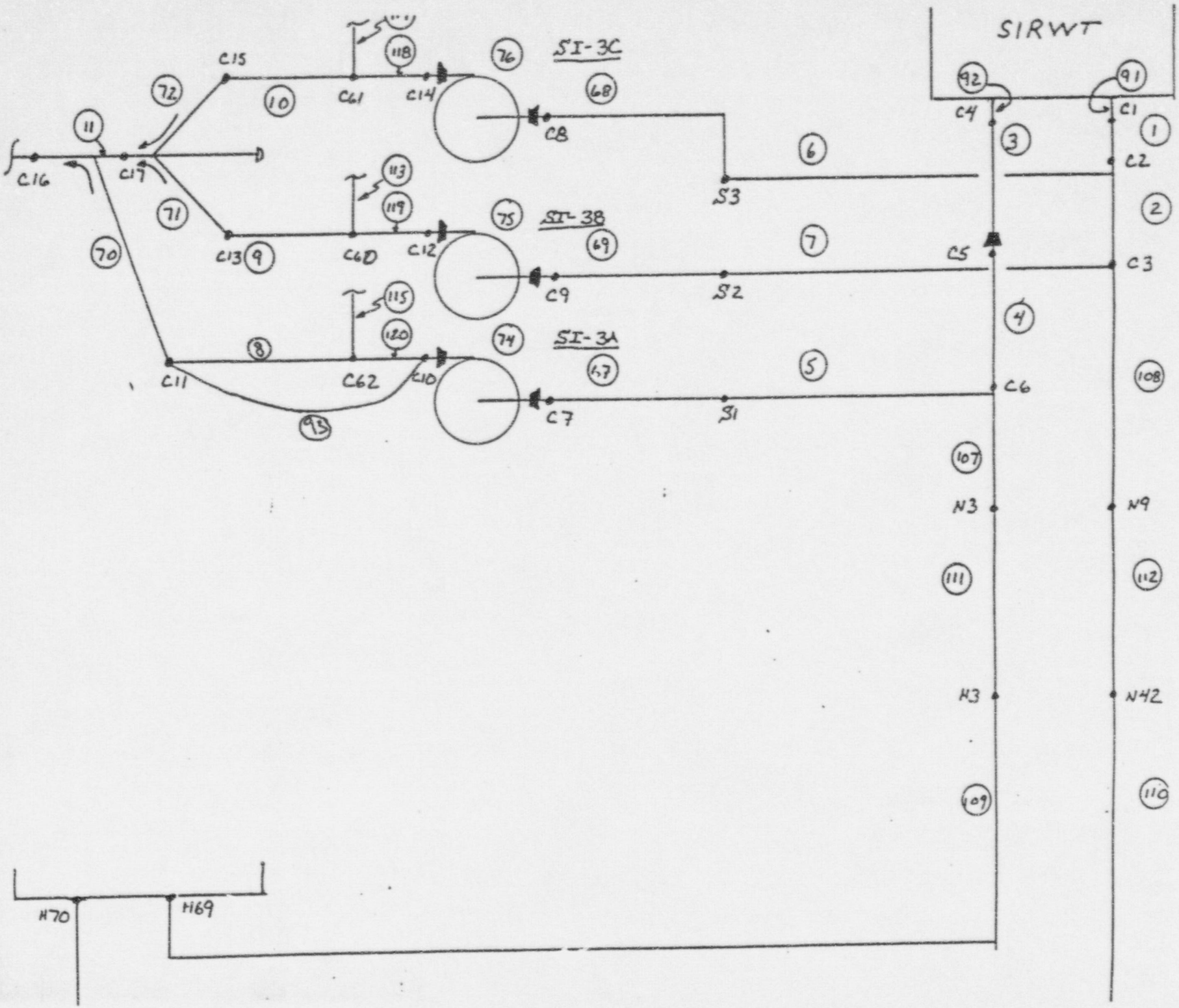
Figure 4
OPPD CSP NPSH w/ SUMP SUB-COOLING
1P1H Configuration



NPSHa taken from SI-3C of Table 4
Vertical lines represent pump flow
of SI-3A.

APPENDIX A
PIPING DIAGRAM

A2 Piping Diagram



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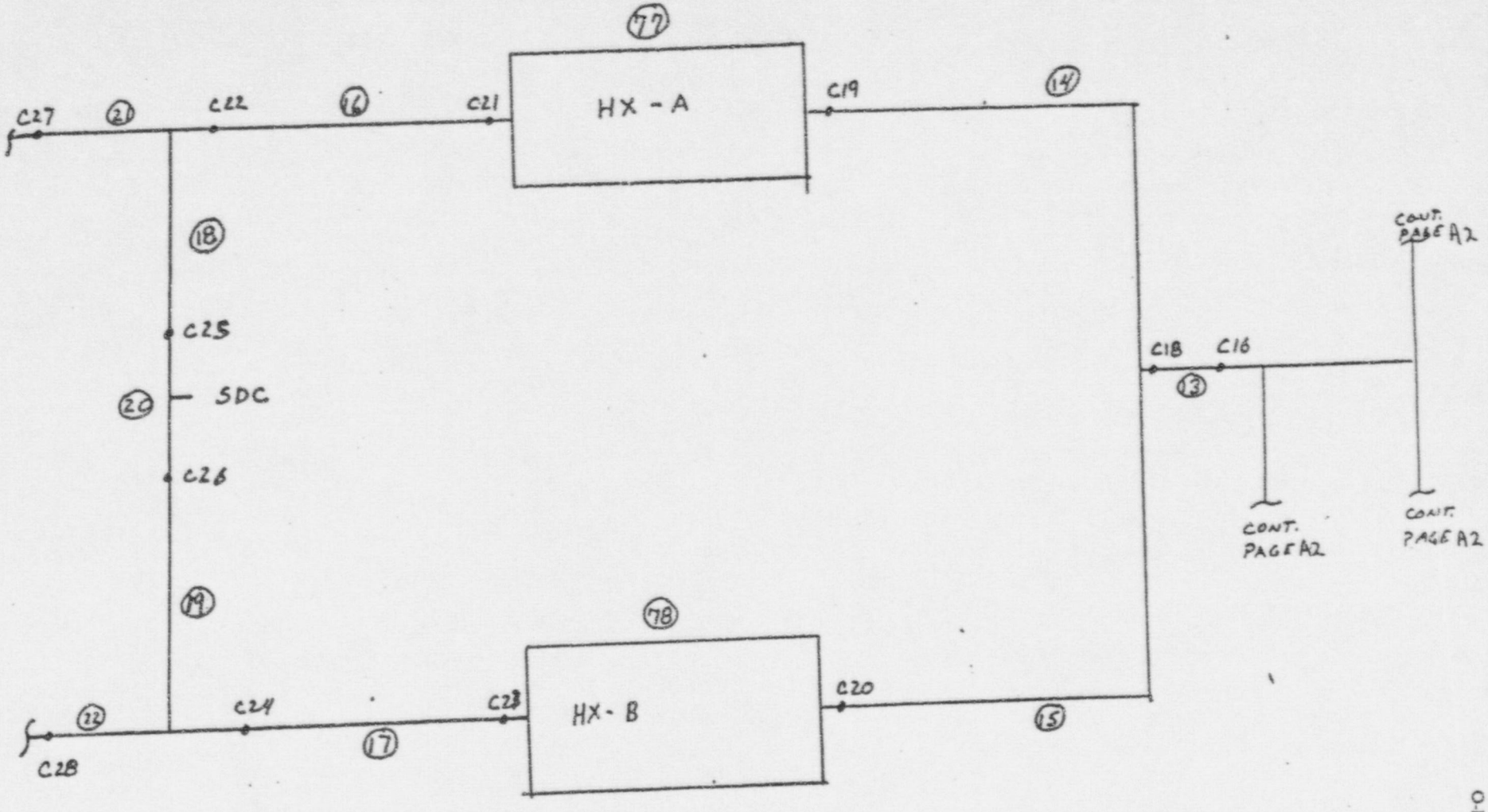
77
C27
21
C22
16
C21
HX - A
C19
14
18
C25
20
SDC
C26
19
78
22
C24
C23
HX - B
C20
17
15
C28
C18
C16
13
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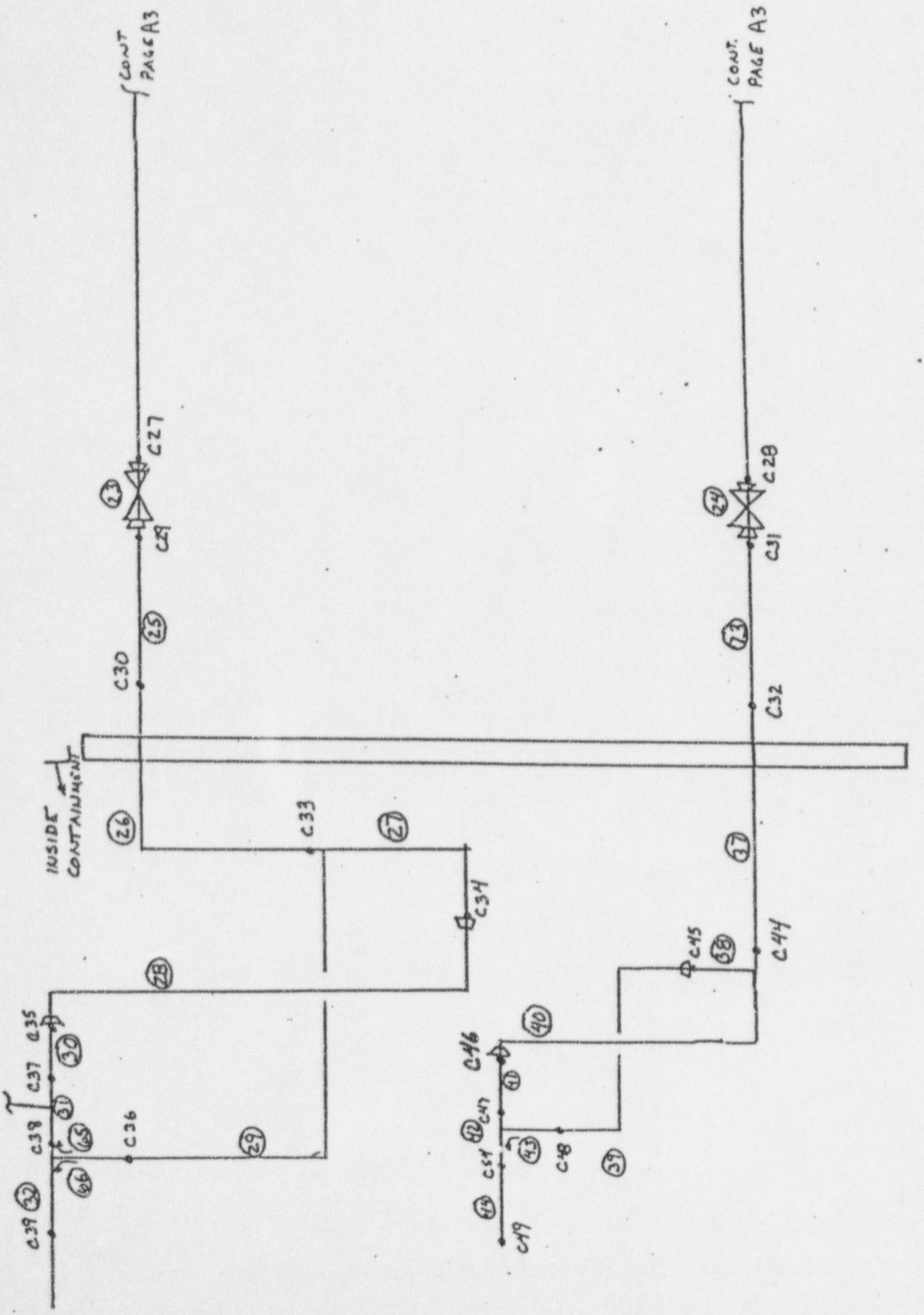
CONT. PAGE A2
CONT. PAGE A2


CONT PAGE A3
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INSIDE CONTAINMENT
C27
C29
C28
C31
C30
C32
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C34
C35
C37
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C36
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C46
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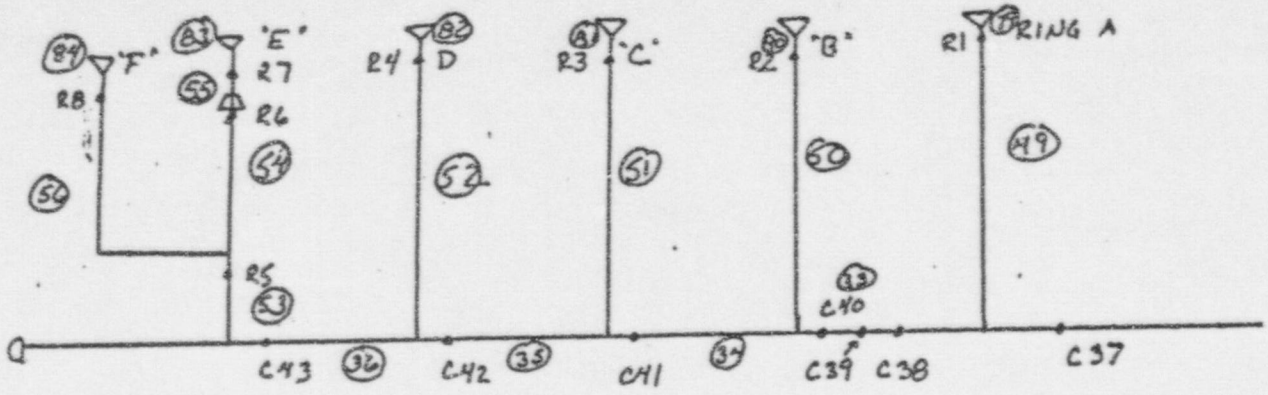
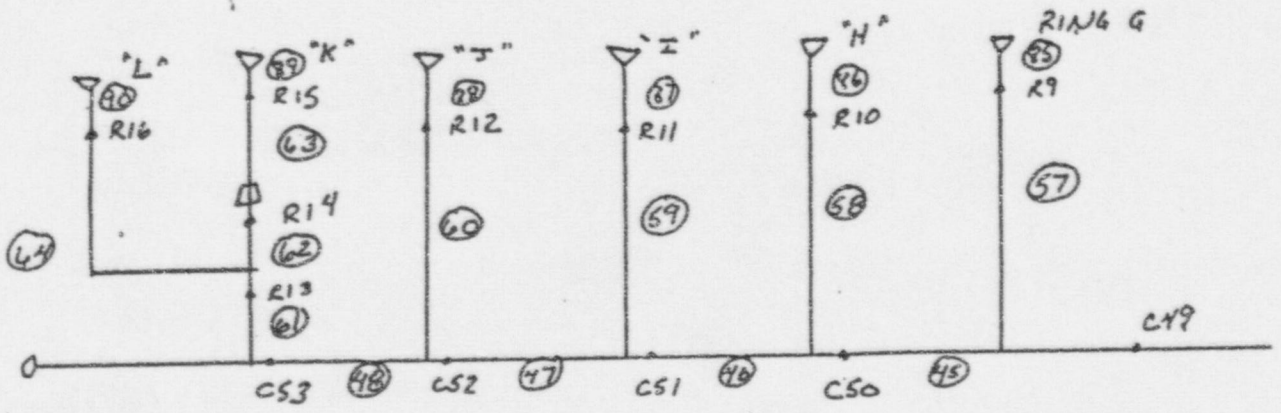
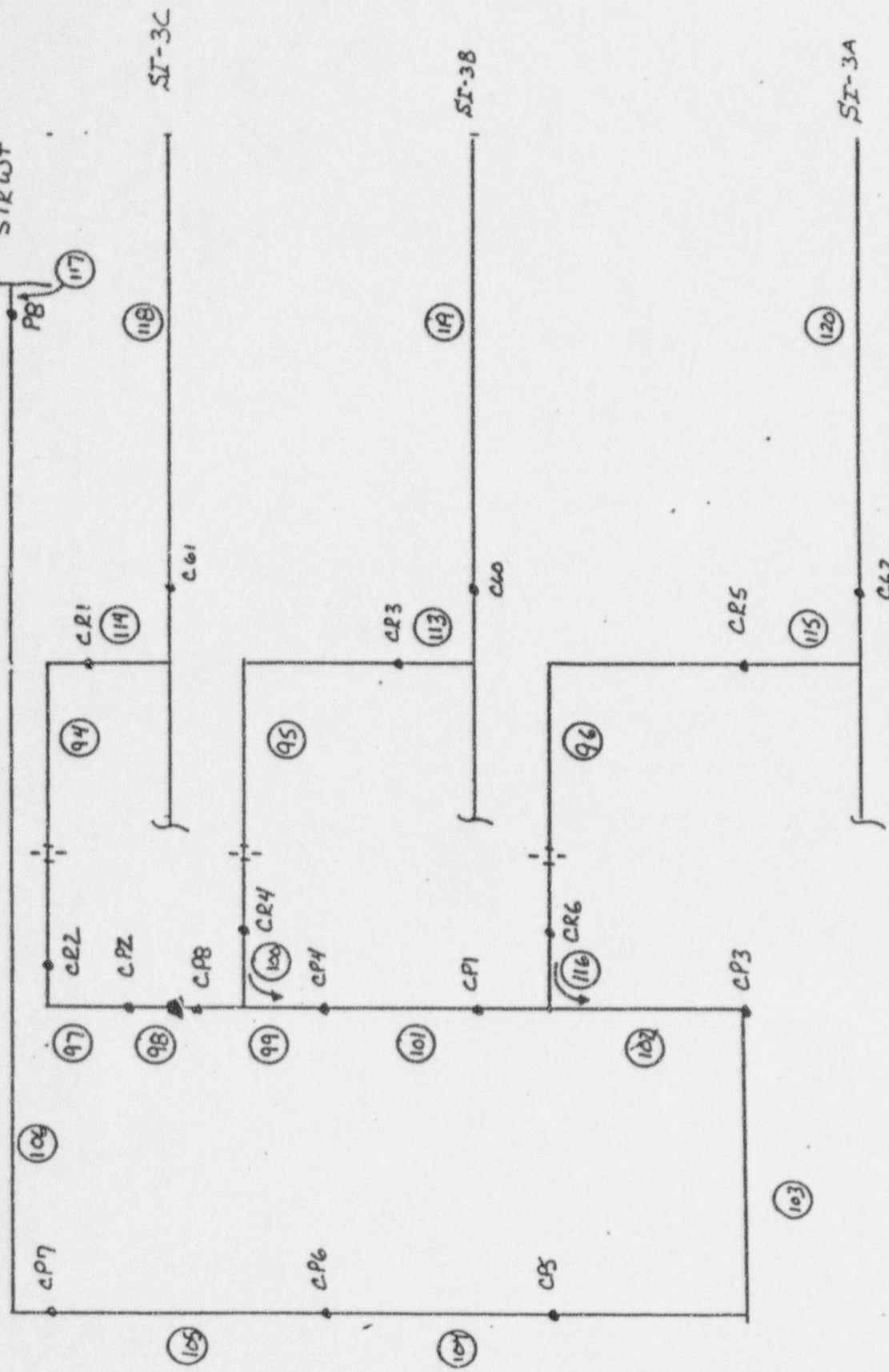






RECIRCULATION (MINI-FLOW) PIPING

APPENDIX B
PIPE-FLO OUTPUT

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

OPPD CONTAINMENT SPRAY SYSTEM
CSP NPSH EVALUATION W/ SUMP SUBCOOLING
O-MECH-CALC-021

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec
PRESSURE MIN: 0.00 MAX: 5000.00 PSI

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
1	SIRWT EXIT	STEEL 20 in/SCH 20	74.45	WATER 90 deg-F		2.593
2	SIRWT HEADER	STEEL 20 in/SCH 20	7.25	WATER 90 deg-F		0.236
3	SIRWT EXIT	STEEL 20 in/SCH 20	35.75	WATER 90 deg-F		1.884
4	SIRWT HEADER	STEEL 24 in/SCH 20	4	WATER 90 deg-F		12.521
5	SI-3A SUCTION	SSTEEL 12 in/SCH 10S	18.65	WATER 90 deg-F		0.618
6	SI-3C SUCTION	SSTEEL 12 in/SCH 10S	26.39	WATER 90 deg-F		1.662
7	SI-3B SUCTION	SSTEEL 12 in/SCH 10S	14.85	WATER 90 deg-F		1.405
8	SI-3A DISCHARGE	SSTEEL 8 in/SCH 40S	100.60	WATER 90 deg-F		4.062
9	SI-3B DISCHARGE	SSTEEL 8 in/SCH 40S	20.20	WATER 90 deg-F		2.937
10	SI-3C DISCHARGE	SSTEEL 8 in/SCH 40S	22.56	WATER 90 deg-F		3.218
11	DSCHRG HDR	SSTEEL 12 in/SCH 40S	2.11	WATER 90 deg-F		0.259
12	DSCHRG HDR	SSTEEL 12 in/SCH 40S	0.66	WATER 90 deg-F		0.580

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
13	DSCHRG HDR	SSTEEL 12 in/SCH 40S	173.70	WATER 90 deg-F		1.863
14	A HX INLET	SSTEEL 12 in/SCH 40S	23.16	WATER 90 deg-F		2.399
15	B HX INLET	SSTEEL 12 in/SCH 40S	32.16	WATER 90 deg-F		4.766
16	A HX OUTLET	SSTEEL 12 in/SCH 40S	15.44	WATER 90 deg-F		0.981
17	B HX OUTLET	SSTEEL 12 in/SCH 40S	14.19	WATER 90 deg-F		0.792
18	HX CROSS CONECT	SSTEEL 12 in/SCH 40S	12.63	WATER 90 deg-F		1.500
19	HX CROSS CONECT	SSTEEL 12 in/SCH 40S	12.27	WATER 90 deg-F		1.500
20	SDC DISCHARGE	SSTEEL 12 in/SCH 40S	1	WATER 90 deg-F		0.259
21	A HEADER	SSTEEL 12 in/SCH 40S	62.21	WATER 90 deg-F		2.435
22	B HEADER	SSTEEL 12 in/SCH 40S	66.47	WATER 90 deg-F		2.621
23	A HEADER	SSTEEL 8 in/SCH 40S	3.94	WATER 90 deg-F		1.430
24	B HEADER	SSTEEL 8 in/SCH 40S	3.94	WATER 90 deg-F		1.627
25	A HEADER	SSTEEL 12 in/SCH 40S	48.53	WATER 90 deg-F		1.345
26	A HEADER	SSTEEL 12 in/SCH 10S	52.95	WATER 90 deg-F		2.251

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Marsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
27	A HEADER	SSTEEL 12 in/SCH 10S	2.33	WATER 90 deg-F		0.514
28	A HEADER	SSTEEL 8 in/SCH 10S	47.35	WATER 90 deg-F		1.295
29	A HEADER	SSTEEL 8 in/SCH 10S	52.33	WATER 90 deg-F		1.578
30	A HEADER	SSTEEL 12 in/SCH 10S	6.20	WATER 90 deg-F		0.257
31	A HEADER	SSTEEL 12 in/SCH 10S	2.05	WATER 90 deg-F		0.257
32	A HEADER	SSTEEL 12 in/SCH 10S	1	WATER 90 deg-F		0.257
33	PIPE-33	SSTEEL 12 in/SCH 10S	2.05	WATER 90 deg-F		
34	A HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
35	A HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
36	A HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
37	B HEADER	SSTEEL 12 in/SCH 10S	53.38	WATER 90 deg-F		2.287
38	B HEADER	SSTEEL 12 in/SCH 10S	1	WATER 90 deg-F		0.257
39	B HEADER	SSTEEL 8 in/SCH 10S	55.32	WATER 90 deg-F		1.559
40	B HEADER	SSTEEL 8 in/SCH 10S	51.50	WATER 90 deg-F		2.088

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
41	B HEADER	SSTEEL 12 in/SCH 10S	4.12	WATER 90 deg-F		
42	B HEADER	SSTEEL 12 in/SCH 10S	1	WATER 90 deg-F		0.257
43	B HEADER	SSTEEL 12 in/SCH 10S	0.66	WATER 90 deg-F		2.913
44	B HEADER	SSTEEL 12 in/SCH 10S	3.75	WATER 90 deg-F		
45	B HEADER	SSTEEL 12. in/SCH 10S	4.11	WATER 90 deg-F		0.257
46	B HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
47	B HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
48	B HEADER	SSTEEL 12 in/SCH 10S	4.11	WATER 90 deg-F		0.257
49	RING A	SSTEEL 8 in/SCH 10S	9.18	WATER 90 deg-F		1.273
50	RING B	SSTEEL 8 in/SCH 10S	17.55	WATER 90 deg-F		1.280
51	RING C	SSTEEL 6 in/SCH 10S	25.48	WATER 90 deg-F		1.261
52	RING D	SSTEEL 6 in/SCH 10S	33.24	WATER 90 deg-F		1.272
53	RING E	SSTEEL 4 in/SCH 10S	36.63	WATER 90 deg-F		1.052
54	RING E2	SSTEEL 4 in/SCH 10S	0.33	WATER 90 deg-F		0.322

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
55	RING E3	SSTEEL 3 in/SCH 10S	11.50	WATER 90 deg-F		0.338
56	RING F	SSTEEL 4 in/SCH 10S	5.35	WATER 90 deg-F		1.593
57	RING G	SSTEEL 8 in/SCH 10S	4.98	WATER 90 deg-F		1.267
58	RING H	SSTEEL 8 in/SCH 10S	13.45	WATER 90 deg-F		1.046
59	RING I	SSTEEL 6 in/SCH 10S	21.56	WATER 90 deg-F		1.258
60	RING J	SSTEEL 6 in/SCH 10S	29.45	WATER 90 deg-F		1.269
61	RING K	SSTEEL 4 in/SCH 10S	32.80	WATER 90 deg-F		1.050
62	RING K2	SSTEEL 4 in/SCH 10S	0.33	WATER 90 deg-F		0.322
63	RING K3	SSTEEL 3 in/SCH 10S	12	WATER 90 deg-F		0.335
64	RING L	SSTEEL 4 in/SCH 10S	5.39	WATER 90 deg-F		1.587
65	SPRAY HDR A	SSTEEL 12 in/SCH 10S	0.33	WATER 90 deg-F		2.913
66	SPRAY HDR A	SSTEEL 12 in/SCH 10S	0.33	WATER 90 deg-F		2.913
67	SI-3A SUCTION	SSTEEL 12 in/SCH 40S	9.50	WATER 90 deg-F		0.448
68	SUCTION SI-3C	SSTEEL 12 in/SCH 40S	5.50	WATER 90 deg-F		

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
69	SUCTION SI-3B	SSTEEL 12 in/SCH 40S	10.43	WATER 90 deg-F		0.259
70	DISCHARGE HDR	SSTEEL 12 in/SCH 40S	0.66	WATER 90 deg-F		0.580
71	DISCHARGE HDR	SSTEEL 12 in/SCH 40S	0.66	WATER 90 deg-F		0.580
72	DISCHARGE HDR	SSTEEL 12 in/SCH 40S	0.66	WATER 90 deg-F		0.580
73	HEADER B	SSTEEL 12 in/SCH 40S	39.52	WATER 90 deg-F		0.518
74	PUMP SI-3A	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		0.333
75	PUMP SI-3B	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		0.333
76	PUMP SI-3C	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		0.371
77	HX-A	SSTEEL 12 in/SCH 40S	1	WATER 90 deg-F		
78	HX-B	SSTEEL 12 in/SCH 40S	1	WATER 90 deg-F		
79	RING A	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		65.909
80	RING B	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		99.196
81	RING C	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		150.980
82	RING D	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		284.020

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
83	RING E	SSTEEL 3 in/SCH 10S	1	WATER 90 deg-F		463.420
84	RING F	SSTEEL 4 in/SCH 10S	1	WATER 90 deg-F		138.920
85	RING G	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		58.820
86	RING H	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		107.060
87	RING I	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		174.330
88	RING J	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		300.980
89	RING K	SSTEEL 3 in/SCH 10S	1	WATER 90 deg-F		116.210
90	RING L	SSTEEL 4 in/SCH 10S	1	WATER 90 deg-F		128.500
91	SIRWT	STEEL 20 in/SCH 20	0.25	WATER 90 deg-F		0.500
92	SIRWT	STEEL 20 in/SCH 20	0.25	WATER 90 deg-F		0.500
93	PIPE-93	SSTEEL .5 in/SCH 80S	9,000	WATER 90 deg-F		% 5400000
94	CS RECIRC	SSTEEL 2 in/SCH 40S	23.54	WATER 90 deg-F		91.894
95	CS RECIRC	SSTEEL 2 in/SCH 40S	18	WATER 90 deg-F		89.961
96	CS RECIRC	SSTEEL 2 in/SCH 40S	8.46	WATER 90 deg-F		89.021

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123

UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
97	CS RECIRC	SSTEEL 3 in/SCH 40S	0.60	WATER 90 deg-F		
98	COMMON RECIRC	SSTEEL 3 in/SCH 40S	9.40	WATER 90 deg-F		0.505
99	COMMON RECIRC	SSTEEL 6 in/SCH 40S	0.66	WATER 90 deg-F		0.596
100	CS RECIRC	SSTEEL 6 in/SCH 40S	1	WATER 90 deg-F		
101	COMMON RECIRC	SSTEEL 6 in/SCH 40S	27.24	WATER 90 deg-F		0.894
102	COMMON RECIRC	SSTEEL 6 in/SCH 40S	5	WATER 90 deg-F		0.596
103	COMMON RECIRC	SSTEEL 6 in/SCH 40S	43.25	WATER 90 deg-F		2.235
104	COMMON RECIRC	SSTEEL 4 in/SCH 80S	6	WATER 90 deg-F		11.644
105	COMMON RECIRC	SSTEEL 6 in/SCH 10S	24.99	WATER 90 deg-F		2.158
106	COMMON RECIRC	SSTEEL 6 in/SCH 10S	21.01	WATER 90 deg-F		0.590
107	CS SUMP PIPE	STEEL 24 in/SCH 20	7.20	WATER 90 deg-F		0.228
108	CS SUMP PIPE	STEEL 20 in/SCH 20	5.42	WATER 90 deg-F		0.368
109	COMMON SUMP LIN	STEEL 24 in/SCH 20	140.40	WATER 90 deg-F		3.022
110	COMMON SUMP LIN	STEEL 24 in/SCH 20	89.72	WATER 90 deg-F		3.100

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPING PROJECT REPORT JUNE 8, 1992
R. Harsell

PROJECT : OPPDCS
PIPES : 123 UPDATED: JUNE 8, 1992

	IDENTIFIER	MATERIAL SIZE / SCH	LENGTH (ft)	FLUID NAME TEMP	DESIGN FLOW-RATE (gal/min)	TOTAL K
111	COMMON SUMP LIN	STEEL 24 in/SCH 20	55.86	WATER 90 deg-F		0.475
112	COMMON SUMP LIN	STEEL 24 in/SCH 20	47.56	WATER 90 deg-F		0.388
113	cs recirc 3b	SSTEEL 2 in/SCH 40S	0.66	WATER 90 deg-F		0.776
114	cs recirc 3c	SSTEEL 2 in/SCH 40S	0.66	WATER 90 deg-F		0.776
115	cs recirc 3a	SSTEEL 2 in/SCH 40S	0.66	WATER 90 deg-F		0.776
116	cs recirc	SSTEEL 2 in/SCH 40S	0.66	WATER 90 deg-F		0.560
117	common to sirwt	SSTEEL 6 in/SCH 10S	1	WATER 90 deg-F		1.000
118	SI-3C DISCHARGE	SSTEEL 8 in/SCH 40S	1	WATER 90 deg-F		
119	SI-3B DISCHARGE	SSTEEL 8 in/SCH 40S	1	WATER 90 deg-F		
120	SI-3A DISCHARGE	SSTEEL 8 in/SCH 40S	1	WATER 90 deg-F		
121	SUMP ENTRANCE	STEEL 24 in/SCH 20	0.25	WATER 90 deg-F		0.500
122	SUMP ENTRANCE	STEEL 24 in/SCH 20	0.25	WATER 90 deg-F		0.500
123	A1HEADER	SSTEEL 12 in/SCH 40S	25.28	WATER 90 deg-F		1.917

COMPONENT TABLE REPORT as of MAY 21, 1992

TABLE NAME: 6 COMPONENT ENTRIES

CSS COMPONENTS FOR OPPD CSP NPSH w/ SUBCOOLING

CODE	COMPONENT ID	POWER EQUATION
A	HX-A	HEAD LOSS = 1.54E-06 * Q ^ 2

DATA POINTS: 0 gal/min vs. 0 ft of fluid
DATA POINTS: 1500 gal/min vs. 3.476 ft of fluid
DATA POINTS: 4000 gal/min vs. 24.72 ft of fluid

B	FLOW VALVE	HEAD LOSS = 7.99E-07 * Q ^ 2

DATA POINTS: 0 gal/min vs. 0 ft of fluid
DATA POINTS: 2000 gal/min vs. 3.194 ft of fluid
DATA POINTS: 4000 gal/min vs. 12.776 ft of fluid

C	SI-3A (pump)	HEAD RISE = 500 - 1.01E-07 * Q ^ 2.642

DATA POINTS: 0 gal/min vs. 500 ft of fluid
DATA POINTS: 2800 gal/min vs. 370 ft of fluid
DATA POINTS: 3200 gal/min vs. 315 ft of fluid

D	SI-3B (pump)	HEAD RISE = 496 - 5.62E-08 * Q ^ 2.713

DATA POINTS: 0 gal/min vs. 496 ft of fluid
DATA POINTS: 2800 gal/min vs. 370 ft of fluid
DATA POINTS: 3200 gal/min vs. 315 ft of fluid

E	SI-3C (pump)	HEAD RISE = 494 - 4.14E-08 * Q ^ 2.749

DATA POINTS: 0 gal/min vs. 494 ft of fluid
DATA POINTS: 2800 gal/min vs. 370 ft of fluid
DATA POINTS: 3200 gal/min vs. 315 ft of fluid

F	flow meter	HEAD LOSS = 8.68E-07 * Q ^ 2

DATA POINTS: 0 gal/min vs. 0 ft of fluid
DATA POINTS: 2000 gal/min vs. 3.46 ft of fluid
DATA POINTS: 4500 gal/min vs. 17.51 ft of fluid

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SIRWT HEADER MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 2 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 20 in
inside diameter: 19.25 in
PIPE LENGTH: 7.25 ft
ELEVATION IN: 981.00 ft
OUT: 981.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT = 0.012	K - VALUE
1	TEE-RUN		0.236

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 0.236

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SI-3A SUCTION MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 5 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 10S
abs. roughness: 1.80E-03 in

NOMINAL SIZE: 12 in
inside diameter: 12.39 in
PIPE LENGTH: 18.65 ft
ELEVATION IN: 980.00 ft
OUT: 980.00 ft

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT - 0.013	K - VALUE
1	2 * ELBOW-S	90 deg	0.515
2	GATE		0.103

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 0.618

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SI-3C SUCTION MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS
PIPE NO : 6

DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 10S
abs. roughness: 1.80E-03 in

NOMINAL SIZE: 12 in
inside diameter: 12.39 in
PIPE LENGTH: 26.39 ft
ELEVATION IN: 981.00 ft
OUT: 978.00 ft

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO			FFT - 0.013		K - VALUE
1		FIX-K VALUE			0.787
2	3 *	ELBOW-S	90	deg	0.772
3		GATE			0.103

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 1.662

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SI-3B SUCTION MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 7 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 10S
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 12 in
inside diameter: 12.39 in
PIPE LENGTH: 14.85 ft
ELEVATION IN: 981.00 ft
OUT: 979.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO			FFT = 0.013		K - VALUE
1		FIX-K VALUE			0.787
2	2 *	ELBOW-S	90	deg	0.515
3		GATE			0.103

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 1.405

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SI-3A SUCTION MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 67 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 40S
abs. roughness: 1.80E-03 in

NOMINAL SIZE: 12 in
inside diameter: 12.00 in
PIPE LENGTH: 9.50 ft
ELEVATION IN: 980.00 ft
OUT: 973.00 ft

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT - 0.013		K - VALUE
1	ELBOW-S	45	deg	0.189
2	ELBOW-S	90	deg	0.259

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 0.448

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SUCTION SI-3C MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS
PIPE NO : 68

DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 40S
abs. roughness: 1.80E-03 in

NOMINAL SIZE: 12 in
inside diameter: 12.00 in
PIPE LENGTH: 5.50 ft
ELEVATION IN: 978.00 ft
OUT: 973.00 ft

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------
none

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : SUCTION SI-3B MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 69 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: SSTEEL
SCHEDULE: 40S
abs. roughness: 1.80E-03 in

NOMINAL SIZE: 12 in
inside diameter: 12.00 in
PIPE LENGTH: 10.43 ft
ELEVATION IN: 979.00 ft
OUT: 973.00 ft

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT - 0.013	K - VALUE
1	ELBOW-S	90 deg	0.259

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 0.259

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : CS SUMP PIPE MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 107 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 24 in
inside diameter: 23.25 in
PIPE LENGTH: 7.20 ft
ELEVATION IN: 980.00 ft
OUT: 980.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT = 0.011	K - VALUE
1	TEE-RUN		0.228

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 0.228

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : CS SUMP PIPE MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS
PIPE NO : 108

DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 20 in
inside diameter: 19.25 in
PIPE LENGTH: 5.42 ft
ELEVATION IN: 982.00 ft
OUT: 982.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT - 0.012		K - VALUE
1	TEE-RUN			0.236
2	REDUCER	seat: 23.25 , appr:	2.00	0.132

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 0.368

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : COMMON SUMP LIN MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 109 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 24 in
inside diameter: 23.25 in
PIPE LENGTH: 140.40 ft
ELEVATION IN: 994.00 ft
OUT: 982.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT = 0.011		K - VALUE
1	CK-SW-ANG			1.141
2	BUTTERFLY			0.285
3	2 * ELBOW-S	24	deg	0.276
4	2 * ELBOW-L	90	deg	0.320
5	EXIT			1.000

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 3.022

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : COMMON SUMP LIN MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS
PIPE NO : 110

DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 24 in
inside diameter: 23.25 in
PIPE LENGTH: 89.72 ft
ELEVATION IN: 994.00 ft
OUT: 982.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVE AND FITTINGS ----------

VALVE NO			FF1 = 0.011		K - VALUE
1		CK-SW-ANG			1.141
2		BUTTERFLY			0.285
3	2 *	ELBOW-L	30	deg	0.195
4	3 *	ELBOW-L	90	deg	0.479
5		EXIT			1.000

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 3.100

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : COMMON SUMP LIN MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PIPE NO : 111 ---------- PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 24 in
inside diameter: 23.25 in
PIPE LENGTH: 55.86 ft
ELEVATION IN: 982.00 ft
OUT: 980.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT = 0.011	K - VALUE
1	ELBOW-L	20 deg	0.087
2	ELBOW-L	90 deg	0.160
3	TEE-RUN		0.228

V&F HEAD LOSS = 0.000 ft V&F TOTAL K = 0.475

PIPE-FLO by Engineered Software

ABB Combustion Engineering

CLIENT : Omaha Public Power District

PIPELINE REPORT : COMMON SUMP LIN MAR 19, 1992
Petraske/ Harsell

PROJECT : OPPDCS
PIPE NO : 112

DESIGN RULES: VELOCITY MIN: MAX: 1000.00 ft/sec
PRESSURE MIN:0 MAX: 5000.00 PSI

---- PIPE CHARACTERISTICS ---------- FLUID PROPERTIES ----------

MATERIAL: STEEL
SCHEDULE: 20
abs. roughness: 1.80E-03 in

FLUID: WATER at 90.0 deg-F
density: 62.108 lbs/ft^3
viscosity: 0.7600 centipois

NOMINAL SIZE: 24 in
inside diameter: 23.25 in
PIPE LENGTH: 47.56 ft
ELEVATION IN: 992.00 ft
OUT: 992.00 ft

DESIGN FLOW RATE:
FLUID VELOCITY:
HEAD LOSS:
PRESSURE IN:
OUT:

---------- VALVES AND FITTINGS ----------

VALVE NO		FFT - 0.011	K - VALUE
1	ELBOW-L	90 deg	0.160
2	TEE-RUN		0.228

V&F HEAD LOSS - 0.000 ft V&F TOTAL K - 0.388

PIPE-FLO by Engineered Software

APPENDIX C
NET-FLO OUTPUT FOR CSS MAIN MODEL RUNS

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1 DATA FOR PIPES: OPPDCS
UPDATED : JUNE 8, 1992

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
3P2H:3A,3B,3C SUCTION FROM THE SUMP (6 ft)

0.01 % DEVIATION after 8 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	1,149.88	>>>	14.70 PSI
R2	>>>	80	RING B	>>>	926.30	>>>	14.70 PSI
R3	>>>	81	RING C	>>>	740.49	>>>	14.70 PSI
R4	>>>	82	RING D	>>>	537.40	>>>	14.70 PSI
R7	>>>	83	RING E	>>>	108.05	>>>	14.70 PSI
R8	>>>	84	RING F	>>>	336.13	>>>	14.70 PSI
R9	>>>	85	RING G	>>>	1,198.03	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	875.66	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	675.80	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	510.55	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	207.66	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	338.13	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	7,604.09	<<<	17.30 PSI

NET FLOWS IN: 0.01 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C1	0	989.00	1,032.58	18.80
PIPES IN:		PIPES OUT: 1 SIRWT EXIT		
C10	0	974.00	1,433.68	198.26
PIPES IN: 74 PUMP SI-3A X 93XPIPE-93		PIPES OUT: 120 SI-3A DISCHARGE		
C11	0	979.50	1,408.62	185.08
PIPES IN: 8 SI-3A DISCHARGE		PIPES OUT: 70 DISCHARGE HDR X 93XPIPE-93		
C12	0	974.00	1,423.93	194.06
PIPES IN: 75 PUMP SI-3B		PIPES OUT: 119 SI-3B DISCHARGE		
C13	0	979.50	1,409.60	185.50
PIPES IN: 9 SI-3B DISCHARGE		PIPES OUT: 71 DISCHARGE HDR		
C14	0	974.00	1,425.13	194.57
PIPES IN: 76 PUMP SI-3C		PIPES OUT: 118 SI-3C DISCHARGE		
C15	0	979.50	1,409.60	185.50
PIPES IN: 10 SI-3C DISCHARGE		PIPES OUT: 72 DISCHARGE HDR		
C16	0	979.50	1,408.16	184.88
PIPES IN: 11 DSCHRG HDR 70 DISCHARGE HDR		PIPES OUT: 13 DSCHRG HDR		

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C17	0	979.50	1,409.12	185.30
PIPES IN:	71 DISCHARGE HDR 72 DISCHARGE HDR	PIPES OUT:	11 DSCHRG HDR	
C18	0	997.66	1,377.73	163.93
PIPES IN:	13 DSCHRG HDR	PIPES OUT:	14 A HX INLET 15 B HX INLET	
C19	0	993.75	1,372.84	163.50
PIPES IN:	14 A HX INLET	PIPES OUT:	77 HX-A	
C2	0	981.50	1,032.58	22.03
PIPES IN:	1 SIRWT EXIT 2 SIRWT HEADER	PIPES OUT:	6 SI-3C SUCTION	
C20	0	993.75	1,368.32	161.55
PIPES IN:	15 B HX INLET	PIPES OUT:	78 HX-B	
C21	0	995.75	1,350.53	153.02
PIPES IN:	77 HX-A	PIPES OUT:	16 A HX OUTLET	
C22	0	996.75	1,348.37	151.66
PIPES IN:	16 A HX OUTLET	PIPES OUT:	18 HX CROSS CONECT 21 A HEADER	
C23	0	995.75	1,345.92	151.03
PIPES IN:	78 HX-B	PIPES OUT:	17 B HX OUTLET	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C24	0	996.75	1,344.13	149.83
PIPES IN:	17 B HX OUTLET	PIPES OUT:	19 HX CROSS CONECT 22 B HEADER	
C25	0	990.50	1,348.37	154.35
PIPES IN:	18 HX CROSS CONECT	PIPES OUT:	X 20XSDC DISCHARGE	
C26	0	990.50	1,344.13	152.52
PIPES IN:	19 HX CROSS CONECT	PIPES OUT:	X 20XSDC DISCHARGE	
C27	0	1,008.00	1,329.94	138.85
PIPES IN:	21 A HEADER	PIPES OUT:	23 A HEADER	
C28	0	1,009.00	1,325.18	136.37
PIPES IN:	22 B HEADER	PIPES OUT:	24 B HEADER	
C29	0	1,009.00	1,304.45	127.43
PIPES IN:	23 A HEADER	PIPES OUT:	25 A HEADER	
C3	0	981.50	1,032.62	22.05
PIPES IN:	108 CS SUMP PIPE	PIPES OUT:	2 SIRWT HEADER 7 SI-3B SUCTION	
C30	0	1,032.00	1,300.81	115.94
PIPES IN:	25 A HEADER	PIPES OUT:	26 A HEADER	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C31	0	1,009.00	1,297.76	124.54
PIPES IN:	24 B HEADER	PIPES OUT:	73 HEADER B	
C32	0	1,036.70	1,295.82	111.76
PIPES IN:	73 HEADER B	PIPES OUT:	37 B HEADER	
C33	0	1,074.00	1,296.11	95.80
PIPES IN:	26 A HEADER	PIPES OUT:	27 A HEADER 29 A HEADER	
C34	0	1,074.00	1,295.88	95.70
PIPES IN:	27 A HEADER	PIPES OUT:	28 A HEADER	
C35	0	1,111.50	1,291.10	77.46
PIPES IN:	28 A HEADER	PIPES OUT:	30 A HEADER	
C36	0	1,111.50	1,291.16	77.49
PIPES IN:	29 A HEADER	PIPES OUT:	65 SPRAY HDR A 66 SPRAY HDR A	
C37	0	1,111.50	1,290.95	77.40
PIPES IN:	30 A HEADER	PIPES OUT:	31 A HEADER 49 RING A	
C38	0	1,111.50	1,290.93	77.39
PIPES IN:	31 A HEADER 65 SPRAY HDR A	PIPES OUT:	32 A HEADER	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C39	0	1,111.50	1,290.85	77.35
PIPES IN:	32 A HEADER 66 SPRAY HDR A	PIPES OUT:	33 PIPE-33	
C4	0	989.00	1,033.56	19.22
PIPES IN:		PIPES OUT:	3 SIRWT EXIT	
C40	0	1,111.50	1,290.83	77.35
PIPES IN:	33 PIPE-33	PIPES OUT:	34 A HEADER 50 RING B	
C41	0	1,111.50	1,290.73	77.30
PIPES IN:	34 A HEADER	PIPES OUT:	35 A HEADER 51 RING C	
C42	0	1,111.50	1,290.69	77.29
PIPES IN:	35 A HEADER	PIPES OUT:	36 A HEADER 52 RING D	
C43	0	1,111.50	1,290.68	77.28
PIPES IN:	36 A HEADER	PIPES OUT:	53 RING E	
C44	0	1,074.00	1,291.03	93.61
PIPES IN:	37 B HEADER	PIPES OUT:	38 B HEADER 40 B HEADER	
C45	0	1,074.00	1,290.93	93.56
PIPES IN:	38 B HEADER	PIPES OUT:	39 B HEADER	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C46	0	1,111.50	1,284.66	74.68
PIPES IN:	40 B HEADER	PIPES OUT:	41 B HEADER	
C47	0	1,111.50	1,284.64	74.68
PIPES IN:	41 B HEADER	PIPES OUT:	42 B HEADER	
C48	0	1,111.50	1,285.67	75.12
PIPES IN:	39 B HEADER	PIPES OUT:	43 B HEADER	
C49	0	1,111.50	1,284.45	74.59
PIPES IN:	44 B HEADER	PIPES OUT:	45 B HEADER 57 RING G	
C5	0	980.00	1,033.56	23.10
PIPES IN:	3 SIRWT EXIT	PIPES OUT:	4 SIRWT HEADER	
C50	0	1,111.50	1,284.22	74.50
PIPES IN:	45 B HEADER	PIPES OUT:	46 B HEADER 58 RING H	
C51	0	1,111.50	1,284.11	74.45
PIPES IN:	46 B HEADER	PIPES OUT:	47 B HEADER 59 RING I	
C52	0	1,111.50	1,284.07	74.43
PIPES IN:	47 B HEADER	PIPES OUT:	48 B HEADER 60 RING J	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
C53	0	1,111.50	1,284.06	74.43
PIPES IN:	48 B HEADER	PIPES OUT:	61 RING K	
C54	0	1,111.50	1,284.53	74.63
PIPES IN:	42 B HEADER 43 B HEADER	PIPES OUT:	44 B HEADER	
C6	0	980.00	1,033.56	23.10
PIPES IN:	4 SIRWT HEADER 107 CS SUMP PIPE	PIPES OUT:	5 SI-3A SUCTION	
C60	0	975.00	1,423.84	193.59
PIPES IN:	119 SI-3B DISCHARGE	PIPES OUT:	9 SI-3B DISCHARGE	
C61	0	975.00	1,425.04	194.10
PIPES IN:	118 SI-3C DISCHARGE	PIPES OUT:	10 SI-3C DISCHARGE	
C62	0	975.00	1,433.59	197.79
PIPES IN:	120 SI-3A DISCHARGE	PIPES OUT:	8 SI-3A DISCHARGE	
C7	0	973.25	1,032.51	25.56
PIPES IN:	67 SI-3A SUCTION	PIPES OUT:	74 PUMP SI-3A	
C8	0	973.25	1,031.07	24.94
PIPES IN:	68 SUCTION SI-3C	PIPES OUT:	76 PUMP SI-3C	
C9	0	973.25	1,031.11	24.96
PIPES IN:	69 SUCTION SI-3B	PIPES OUT:	75 PUMP SI-3B	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
H3	0	982.00	1,033.63	22.27
PIPES IN:	109 COMMON SUMP LIN	PIPES OUT:	111 COMMON SUMP LIN	
H70	0	994.00	1,033.85	17.19
PIPES IN:	121 SUMP ENTRANCE	PIPES OUT:	109 COMMON SUMP LIN 110 COMMON SUMP LIN	
N3	0	980.00	1,033.58	23.11
PIPES IN:	111 COMMON SUMP LIN	PIPES OUT:	107 CS SUMP PIPE	
N42	0	---	1,032.99	---
PIPES IN:	110 COMMON SUMP LIN	PIPES OUT:	112 COMMON SUMP LIN	
N9	0	980.00	1,032.82	22.78
PIPES IN:	112 COMMON SUMP LIN	PIPES OUT:	108 CS SUMP PIPE	
R1	0	1,117.50	1,289.90	74.36
PIPES IN:	49 RING A	PIPES OUT:	79 RING A	
R10	0	1,119.30	1,283.66	70.89
PIPES IN:	58 RING H	PIPES OUT:	86 RING H	
R11	0	1,122.30	1,282.72	69.19
PIPES IN:	59 RING I	PIPES OUT:	87 RING I	
R12	0	1,124.60	1,283.16	68.39
PIPES IN:	60 RING J	PIPES OUT:	88 RING J	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
R13	0	1,124.50	1,277.87	66.15
PIPES IN:	61 RING K	PIPES OUT:	62 RING K2 64 RING L	
R14	0	1,124.50	1,277.76	66.10
PIPES IN:	62 RING K2	PIPES OUT:	63 RING K3	
R15	0	1,127.50	1,276.61	64.31
PIPES IN:	63 RING K3	PIPES OUT:	89 RING K	
R16	0	1,126.50	1,276.20	64.57
PIPES IN:	64 RING L	PIPES OUT:	90 RING L	
R2	0	1,120.90	1,290.05	72.96
PIPES IN:	50 RING B	PIPES OUT:	80 RING B	
R3	0	1,123.50	1,288.95	71.36
PIPES IN:	51 RING C	PIPES OUT:	81 RING C	
R4	0	1,125.40	1,289.63	70.83
PIPES IN:	52 RING D	PIPES OUT:	82 RING D	
R5	0	1,125.30	1,286.26	69.42
PIPES IN:	53 RING E	PIPES OUT:	54 RING E2 56 RING F	
R6	0	1,128.00	1,286.23	68.25
PIPES IN:	54 RING E2	PIPES OUT:	55 RING E3	

COMPLETE JUNCTION NODE REPORT JUNE 8, 1992

NODE COUNT: 81

DESIGN RULES: PRESSURE MIN: 0.00 MAX: 5000.00 PSI

JUNCTION NODE	DEMAND (gal/min)	ELEVATION (ft)	HYDRAULIC GRADE	PRESSURE (PSI)
R7	0	1,127.70	1,285.91	68.24
PIPES IN:	55 RING E3	PIPES OUT:	83 RING E	
R8	0	1,127.00	1,284.61	67.98
PIPES IN:	56 RING F	PIPES OUT:	84 RING F	
R9	0	1,115.30	1,283.39	72.50
PIPES IN:	57 RING G	PIPES OUT:	85 RING G	
S1	0	980.00	1,032.96	22.84
PIPES IN:	5 SI-3A SUCTION	PIPES OUT:	67 SI-3A SUCTION	
S2	0	979.00	1,031.45	22.62
PIPES IN:	7 SI-3B SUCTION	PIPES OUT:	69 SUCTION SI-3B	
S3	0	978.75	1,031.13	22.59
PIPES IN:	6 SI-3C SUCTION	PIPES OUT:	68 SUCTION SI-3C	

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE		TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1		C2	0.00	0.00	0.00
2	SIRWT HEADER	C3	*	C2	0.04	2.81	2,549.27
3	SIRWT EXIT	C4		C5	0.00	0.00	0.00
4	SIRWT HEADER	C5		C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6		S1	0.60	6.62	2,489.21
6	SI-3C SUCTION	C2		S3	1.45	6.78	2,549.27
7	SI-3B SUCTION	C3		S2	1.17	6.83	2,565.61
8	SI-3A DISCHARGE	C62		C11	24.97	15.96	2,489.21
9	SI-3B DISCHARGE	C60		C13	14.24	16.45	2,565.61
10	SI-3C DISCHARGE	C61		C15	15.44	16.34	2,549.27
11	DSCHRG HDR	C17		C16	0.94	14.51	5,114.88
13	DSCHRG HDR	C16		C18	30.43	21.57	7,604.09
14	A HX INLET	C18		C19	4.91	10.77	3,798.25
15	B HX INLET	C18		C20	9.44	10.79	3,805.84
16	A HX OUTLET	C21		C22	2.16	10.77	3,798.25
17	B HX OUTLET	C23		C24	1.79	10.79	3,805.84
18	HX CROSS CONECT	C22		C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24		C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25		C26	*** CLOSED ***		
21	A HEADER	C22		C27	18.43	10.77	3,798.25
	--- WITH COMPONENT F - flow meter						
22	B HEADER	C24		C28	18.95	10.79	3,803.84
	--- WITH COMPONENT F - flow meter						

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	25.49	24.35	3,798.25
	--- WITH COMPONENT B - FLOW VALVE					
24	B HEADER	C28	C31	27.42	24.40	3,805.84
	--- WITH COMPONENT B - FLOW VALVE					
25	A HEADER	C29	C30	3.64	10.77	3,798.25
26	A HEADER	C30	C33	4.70	10.10	3,798.25
27	A HEADER	C33	C34	0.23	5.21	1,957.71
28	A HEADER	C34	C35	4.78	11.52	1,957.71
29	A HEADER	C33	C36	4.94	10.84	1,840.55
30	A HEADER	C35	C37	0.15	5.21	1,957.71
31	A HEADER	C37	C38	0.02	2.15	807.83
32	A HEADER	C38	C39	0.08	4.41	1,658.60
33	PIPE-33	C39	C40	0.02	7.05	2,648.37
34	A HEADER	C40	C41	0.10	4.58	1,722.08
35	A HEADER	C41	C42	0.03	2.61	981.59
36	A HEADER	C42	C43	0.01	1.18	444.19
37	B HEADER	C32	C44	4.79	10.12	3,805.84
38	B HEADER	C44	C45	0.11	5.01	1,883.00
39	B HEADER	C45	C48	5.26	11.09	1,883.00
40	B HEADER	C44	C46	6.37	11.32	1,922.84
41	B HEADER	C46	C47	0.02	5.12	1,922.84
42	B HEADER	C47	C54	0.11	5.12	1,922.84
43	B HEADER	C48	C54	1.14	5.01	1,883.00

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.08	10.12	3,805.84
45	B HEADER	C49	C50	0.23	6.94	2,607.81
46	B HEADER	C50	C51	0.10	4.61	1,732.14
47	B HEADER	C51	C52	0.04	2.81	1,056.34
48	B HEADER	C52	C53	0.01	1.45	545.79
49	RING A	C37	R1	1.05	6.77	1,149.88
50	RING B	C40	R2	0.78	5.45	926.30
51	RING C	C41	R3	1.78	7.48	740.49
52	RING D	C42	R4	1.06	5.43	537.40
53	RING E	C43	R5	4.42	10.00	444.19
54	RING E2	R5	R6	0.03	2.43	108.05
55	RING E3	R6	R7	0.32	4.15	108.05
56	RING F	R5	R8	1.65	7.56	336.13
57	RING G	C49	R9	1.06	7.05	1,198.03
58	RING H	C50	R10	0.56	5.16	875.66
59	RING I	C51	R11	1.39	6.83	675.80
60	RING J	C52	R12	0.91	5.16	510.55
61	RING K	C53	R13	6.19	12.28	545.79
62	RING K2	R13	R14	0.12	4.67	207.66
63	RING K3	R14	R15	1.15	7.98	207.66
64	RING L	R13	R16	1.67	7.61	338.13
65	SPRAY HDR A	C36	C38	0.23	2.26	850.77

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C36	C39	0.31	2.63	989.77
67	SI-3A SUCTION	S1	C7	0.45	7.06	2,489.21
68	SUCTION SI-3C	S3	C8	0.06	7.23	2,549.27
69	SUCTION SI-3B	S2	C9	0.34	7.28	2,565.61
70	DISCHARGE HDR	C11	C16	0.46	7.06	2,489.21
71	DISCHARGE HDR	C13	C17	0.48	7.28	2,565.61
72	DISCHARGE HDR	C15	C17	0.48	7.23	2,549.27
73	HEADER B	C31	C32	1.94	10.79	3,805.84
74	PUMP SI-3A	C7	C10	(401.17)	25.16	2,489.21
	--- WITH COMPONENT C - SI-3A					
75	PUMP SI-3B	C9	C12	(392.82)	25.93	2,565.61
	--- WITH COMPONENT D - SI-3B					
76	PUMP SI-3C	C8	C14	(394.06)	25.76	2,549.27
	--- WITH COMPONENT E - SI-3C					
77	HX-A	C19	C21	22.31	10.77	3,798.25
	--- WITH COMPONENT A - HX-A					
78	HX-B	C20	C23	22.40	10.79	3,805.84
	--- WITH COMPONENT A - HX-A					
79	RING A	R1	FG	138.32	11.62	1,149.88
	--- WITH CHECK VALVE					
80	RING B	R2	FG	135.07	9.36	926.30
	--- WITH CHECK VALVE					
81	RING C	R3	FG	131.37	7.48	740.49
	--- WITH CHECK VALVE					
82	RING D	R4	FG	130.15	5.43	537.40
	--- WITH CHECK VALVE					
83	RING E	R7	FG	124.13	4.15	108.05
	--- WITH CHECK VALVE					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	123.53	7.56	336.13
	--- WITH CHECK VALVE					
85	RING G	R9	FG	134.01	12.11	1,198.03
86	RING H	R10	FG	130.28	8.85	875.66
87	RING I	R11	FG	126.34	6.83	675.80
88	RING J	R12	FG	124.48	5.16	510.55
89	RING K	R15	FG	115.03	7.98	207.66
90	RING L	R16	FG	115.62	7.61	338.13
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.02	1.88	2,489.21
108	CS SUMP PIPE	N9	C3	0.20	5.64	5,114.88
109	COMMON SUMP LIN	H70	H3	0.22	1.88	2,489.21
110	COMMON SUMP LIN	H70	N42	0.86	3.86	5,114.88
111	COMMON SUMP LIN	N3	N3	0.05	1.88	2,489.21
112	COMMON SUMP LIN	N42	N9	0.17	3.86	5,114.88
118	SI-3C DISCHARGE	C14	C61	0.09	16.34	2,549.27
119	SI-3B DISCHARGE	C12	C60	0.09	16.45	2,565.61
120	SI-3A DISCHARGE	C10	C62	0.09	15.96	2,489.21
121	SUMP ENTRANCE	FG	H70	0.26	5.74	7,604.09

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS

JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1
UPDATED : JUNE 8, 1992

DATA FOR PIPES: OPPDCS

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
2P2H: 3B & 3C SUCTION FROM THE SUMP (6 ft)

0.00 % DEVIATION after 9 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	951.05	>>>	14.70 PSI
R2	>>>	80	RING B	>>>	761.70	>>>	14.70 PSI
R3	>>>	81	RING C	>>>	606.04	>>>	14.70 PSI
R4	>>>	82	RING D	>>>	438.26	>>>	14.70 PSI
R7	>>>	83	RING E	>>>	87.71	>>>	14.70 PSI
R8	>>>	84	RING F	>>>	273.24	>>>	14.70 PSI
R9	>>>	85	RING G	>>>	994.00	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	721.50	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	553.71	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	416.44	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	168.32	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	274.69	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	6,246.65	<<<	17.30 PSI

NET FLOWS OUT: 0.01 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE		TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1		C2	0.00	0.00	0.00
2	SIRWT HEADER	C3	*	C2	0.05	3.43	3,115.12
3	SIRWT EXIT	C4		C5	0.00	0.00	0.00
4	SIRWT HEADER	C5		C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6		S1	0.00	0.00	0.00
6	SI-3C SUCTION	C2		S3	2.16	8.29	3,115.12
7	SI-3B SUCTION	C3		S2	1.73	8.33	3,131.52
8	SI-3A DISCHARGE	C62		C11	0.00	0.00	0.00
9	SI-3B DISCHARGE	C60		C13	21.19	20.08	3,131.52
10	SI-3C DISCHARGE	C61		C15	23.04	19.97	3,115.12
11	DSCHRG HDR	C17		C16	1.40	17.72	6,246.65
13	DSCHRG HDR	C16		C18	20.62	17.72	6,246.65
14	A HX INLET	C18		C19	3.31	8.84	3,117.99
15	B HX INLET	C18		C20	6.38	8.87	3,128.66
16	A HX OUTLET	C21		C22	1.46	8.84	3,117.99
17	B HX OUTLET	C23		C24	1.21	8.87	3,128.66
18	HX CROSS CONECT	C22		C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24		C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25		C26	*** CLOSED ***		
21	A HEADER	C22		C27	12.43	8.84	3,117.99
	--- WITH COMPONENT F - flow meter						
22	B HEADER	C24		C28	12.82	8.87	3,128.66
	--- WITH COMPONENT F - flow meter						

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	17.18	19.99	3,117.99
	--- WITH COMPONENT B - FLOW VALVE					
24	B HEADER	C28	C31	18.53	20.06	3,128.66
	--- WITH COMPONENT B - FLOW VALVE					
25	A HEADER	C29	C30	2.47	8.84	3,117.99
26	A HEADER	C30	C33	3.18	8.29	3,117.99
27	A HEADER	C33	C34	0.16	4.28	1,607.11
28	A HEADER	C34	C35	3.24	9.46	1,607.11
29	A HEADER	C33	C36	3.35	8.89	1,510.88
30	A HEADER	C35	C37	0.10	4.28	1,607.11
31	A HEADER	C37	C38	0.01	1.75	656.05
32	A HEADER	C38	C39	0.05	3.60	1,354.93
33	PIPE-33	C39	C40	0.01	5.76	2,166.94
34	A HEADER	C40	C41	0.07	3.74	1,405.24
35	A HEALER	C41	C42	0.02	2.13	799.20
36	A HEADER	C42	C43	0.00	0.96	360.94
37	B HEADER	C32	C44	3.24	8.32	3,128.66
38	B HEADER	C44	C45	0.07	4.12	1,547.90
39	B HEADER	C45	C48	3.57	9.11	1,547.90
40	B HEADER	C44	C46	4.32	9.31	1,580.76
41	B HEADER	C46	C47	0.02	4.21	1,580.76
42	B HEADER	C47	C54	0.07	4.21	1,580.76
43	B HEADER	C48	C54	0.77	4.12	1,547.90

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.06	8.32	3,128.66
45	B HEADER	C49	C50	0.16	5.68	2,134.66
46	B HEADER	C50	C51	0.07	3.76	1,413.16
47	B HEADER	C51	C52	0.03	2.29	859.45
48	B HEADER	C52	C53	0.01	1.18	443.01
49	RING A	C37	R1	0.72	5.60	951.05
50	RING B	C40	R2	0.53	4.48	761.70
51	RING C	C41	R3	1.20	6.12	606.04
52	RING D	C42	R4	0.71	4.43	438.26
53	RING E	C43	R5	2.95	8.12	360.94
54	RING E2	R5	R6	0.02	1.97	87.71
55	RING E3	R6	R7	0.21	3.37	87.71
56	RING F	R5	R8	1.10	6.15	273.24
57	RING G	C49	R9	0.73	5.85	994.00
58	RING H	C50	R10	0.38	4.25	721.50
59	RING I	C51	R11	0.94	5.60	553.71
60	RING J	C52	R12	0.61	4.21	416.44
61	RING K	C53	R13	4.11	9.97	443.01
62	RING K2	R13	R14	0.08	3.79	168.32
63	RING K3	R14	R15	0.77	6.47	168.32
64	RING L	R13	R16	1.10	6.18	274.69
65	SPRAY HDR A	C36	C38	0.16	1.86	698.88

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C36	C39	0.21	2.16	812.00
67	SI-3A SUCTION	S1	C7	0.00	0.00	0.00
68	SUCTION SI-3C	S3	C8	0.09	8.83	3,115.12
69	SUCTION SI-3B	S2	C9	0.50	8.88	3,131.52
70	DISCHARGE HDR	C11	C16	0.00	0.00	0.00
71	DISCHARGE HDR	C13	C17	0.72	8.88	3,131.52
72	DISCHARGE HDR	C15	C17	0.71	8.83	3,115.12
73	HEADER B	C31	C32	1.32	8.87	3,128.66
74	PUMP SI-3A	C7	C10	*** CLOSED ***		
	--- WITH COMPONENT C					
75	PUMP SI-3B	C9	C12	(319.68)	31.65	3,131.52
	--- WITH COMPONENT D - SI-3B					
76	PUMP SI-3C	C8	C14	(321.59)	31.48	3,115.12
	--- WITH COMPONENT E - SI-3C					
77	HX-A	C19	C21	15.04	8.84	3,117.99
	--- WITH COMPONENT A - HX-A					
78	HX-B	C20	C23	15.14	8.87	3,128.66
	--- WITH COMPONENT A - HX-A					
79	RING A	R1	FG	94.62	9.61	951.05
	--- WITH CHECK VALVE					
80	RING B	R2	FG	91.33	7.70	761.70
	--- WITH CHECK VALVE					
81	RING C	R3	FG	87.99	6.12	606.04
	--- WITH CHECK VALVE					
82	RING D	R4	FG	86.56	4.43	438.26
	--- WITH CHECK VALVE					
83	RING E	R7	FG	81.79	3.37	87.71
	--- WITH CHECK VALVE					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	81.62	6.15	273.24
	--- WITH CHECK VALVE					
85	RING G	R9	FG	92.25	10.05	994.00
86	RING H	R10	FG	88.44	7.29	721.50
87	RING I	R11	FG	84.81	5.60	553.71
88	RING J	R12	FG	82.82	4.21	416.44
89	RING K	R15	FG	75.57	6.47	168.32
90	RING L	R16	FG	76.31	6.18	274.69
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.00	0.00	0.00
108	CS SUMP PIPE	N9	C3	0.30	6.88	6,246.65
109	COMMON SUMP LIN	H70	H3	0.00	0.00	0.00
110	COMMON SUMP LIN	H70	N42	1.28	4.72	6,246.65
111	COMMON SUMP LIN	H3	N3	0.00	0.00	0.00
112	COMMON SUMP LIN	N42	N9	0.24	4.72	6,246.65
118	SI-3C DISCHARGE	C14	C61	0.14	19.97	3,115.12
119	SI-3B DISCHARGE	C12	C60	0.14	20.08	3,131.52
120	SI-3A DISCHARGE	C10	C62	0.00	0.00	0.00
121	SUMP ENTRANCE	FG	H70	0.17	4.72	6,246.65

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS

JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1
UPDATED : JUNE 8, 1992

DATA FOR PIPES: OPPDCS

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
3P1H:3A,3B,3C HDR B SUCTION FROM THE SUMP (6 ft)

0.01 % DEVIATION after 14 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	0.00	>>>	5,000.00 PSI
R2	>>>	80	RING B	>>>	0.00	>>>	5,000.00 PSI
R3	>>>	81	RING C	>>>	0.00	>>>	5,000.00 PSI
R4	>>>	82	RING D	>>>	0.00	>>>	5,000.00 PSI
R7	>>>	83	RING E	>>>	0.00	>>>	5,000.00 PSI
R8	>>>	84	RING F	>>>	0.00	>>>	5,000.00 PSI
R9	>>>	85	RING G	>>>	1,447.60	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	1,063.15	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	823.60	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	624.07	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	254.88	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	414.41	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	4,627.72	<<<	17.30 PSI

NET FLOWS IN: 0.01 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE		TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1		C2	0.00	0.00	0.00
2	SIRWT HEADER	C3	*	C2	0.01	1.69	1,530.20
3	SIRWT EXIT	C4		C5	0.00	0.00	0.00
4	SIRWT HEADER	C5		C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6		S1	0.23	4.08	1,534.64
6	SI-3C SUCTION	C2		S3	0.53	4.07	1,530.20
7	SI-3B SUCTION	C3		S2	0.43	4.16	1,562.89
8	SI-3A DISCHARGE	C62		C11	9.58	9.84	1,534.64
9	SI-3B DISCHARGE	C60		C13	5.30	10.02	1,562.89
10	SI-3C DISCHARGE	C61		C15	5.58	9.81	1,530.20
11	DSCHRG HDR	C17		C16	0.35	8.77	3,093.08
13	DSCHRG HDR	C16		C18	11.40	13.12	4,627.72
14	A HX INLET	C18		C19	0.00	0.00	0.00
15	B HX INLET	C18		C20	13.94	13.12	4,627.72
16	A HX OUTLET	C21		C22	0.00	0.00	0.00
17	B HX OUTLET	C23		C24	2.64	13.12	4,627.72
18	HX CROSS CONECT	C22		C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24		C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25		C26	*** CLOSED ***		
21	A HEADER	C22		C27	0.00	0.00	0.00
	--- WITH COMPONENT F - flow meter *** MODEL OUT OF RANGE ***						
22	B HEADER	C24		C28	27.99	13.12	4,627.72
	--- WITH COMPONENT F - flow meter *** MODEL OUT OF RANGE ***						

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	0.00	0.00	0.00
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
24	B HEADER	C28	C31	40.53	29.67	4,627.72
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
25	A HEADER	C29	C30	0.00	0.00	0.00
26	A HEADER	C30	C33	0.00	0.00	0.00
27	A HEADER	C33	C34	0.00	0.00	0.89
28	A HEADER	C34	C35	0.00	0.01	0.89
29	A HEADER	C36 *	C33	0.00	0.01	0.89
30	A HEADER	C35	C37	0.00	0.00	0.89
31	A HEADER	C37	C38	0.00	0.00	0.89
32	A HEADER	C38	C39	0.00	0.00	0.44
33	PIPE-33	C39	C40	0.00	0.00	0.00
34	A HEADER	C40	C41	0.00	0.00	0.00
35	A HEADER	C41	C42	0.00	0.00	0.00
36	A HEA..	C42	C43	0.00	0.00	0.00
37	B HEADER	C32	C44	7.06	12.31	4,627.72
38	B HEADER	C44	C45	0.16	6.09	2,289.70
39	B HEADER	C45	C48	7.74	13.48	2,289.70
40	B HEADER	C44	C46	9.38	13.76	2,338.02
41	B HEADER	C46	C47	0.03	6.22	2,338.02
42	B HEADER	C47	C54	0.16	6.22	2,338.02
43	B HEADER	C48	C54	1.68	6.09	2,289.70

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.12	12.31	4,627.72
45	B HEADER	C49	C50	0.35	8.46	3,180.12
46	B HEADER	C50	C51	0.16	5.63	2,116.96
47	B HEADER	C51	C52	0.06	3.44	1,293.36
48	B HEADER	C52	C53	0.02	1.78	669.29
49	RING A	C37	R1	0.00	0.00	0.00
50	RING B	C40	R2	0.00	0.00	0.00
51	RING C	C41	R3	0.00	0.00	0.00
52	RING D	C42	R4	0.00	0.00	0.00
53	RING E	C43	R5	0.00	0.00	0.00
54	RING E2	R5	R6	0.00	0.00	0.00
55	RING E3	R6	R7	0.00	0.00	0.00
56	RING F	R5	R8	0.00	0.00	0.00
57	RING G	C49	R9	1.55	8.52	1,447 50
58	RING H	C50	R10	0.82	6.26	1,063.15
59	RING I	C51	R11	2.06	8.32	823.60
60	RING J	C52	R12	1.35	6.31	624.07
61	RING K	C53	R13	9.25	15.06	669.29
62	RING K2	R13	R14	0.17	5.74	254.88
63	RING K3	R14	R15	1.72	9.79	254.88
64	RING L	R13	R16	2.50	9.33	414.41
65	SPRAY HDR A	C38 *	C36	0.00	0.00	0.45

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C39 *	C36	0.00	0.00	0.44
67	SI-3A SUCTION	S1	C7	0.17	4.35	1,534.64
68	SUCTION SI-3C	S3	C8	0.02	4.34	1,530.20
69	SUCTION SI-3B	S2	C9	0.13	4.43	1,562.89
70	DISCHARGE HDR	C11	C16	0.17	4.35	1,534.64
71	DISCHARGE HDR	C13	C17	0.18	4.43	1,562.89
72	DISCHARGE HDR	C15	C17	0.17	4.34	1,530.20
73	HEADER B	C31	C32	2.85	13.12	4,627.72
74	PUMP SI-3A	C7	C10	(472.10)	15.51	1,534.64
	--- WITH COMPONENT C - SI-3A					
75	PUMP SI-3B	C9	C12	(468.68)	15.79	1,562.89
	--- WITH COMPONENT D - SI-3B					
76	PUMP SI-3C	C8	C14	(468.96)	15.46	1,530.20
	--- WITH COMPONENT E - SI-3C					
77	HX-A	C19	C21	0.00	0.00	0.00
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
78	HX-B	C20	C23	33.13	13.12	4,627.72
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
79	RING A	R1	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
80	RING B	R2	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
81	RING C	R3	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
82	RING D	R4	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
83	RING E	R7	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
85	RING G	R9	FG	195.65	14.63	1,447.60
86	RING H	R10	FG	192.04	10.74	1,063.15
87	RING I	R11	FG	187.64	8.32	823.60
88	RING J	R12	FG	185.99	6.31	624.07
89	RING K	R15	FG	173.29	9.79	254.88
90	RING L	R16	FG	173.67	9.33	414.41
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.01	1.16	1,534.64
108	CS SUMP PIPE	N9	C3	0.07	3.41	3,093.08
109	COMMON SUMP LIN	H70	H3	0.09	1.16	1,534.64
110	COMMON SUMP LIN	H70	N42	0.32	2.34	3,093.08
111	COMMON SUMP LIN	H3	N3	0.02	1.16	1,534.64
112	COMMON SUMP LIN	N42	N9	0.06	2.34	3,093.08
118	SI-3C DISCHARGE	C14	C61	0.03	9.81	1,530.20
119	SI-3B DISCHARGE	C12	C60	0.04	10.02	1,562.89
120	SI-3A DISCHARGE	C10	C62	0.03	9.84	1,534.64
121	SUMP ENTRANCE	FG	H70	0.10	3.50	4,627.72

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS

JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1
UPDATED : JUNE 8, 1992

DATA FOR PIPES: OPPDCS

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
2P1H:3A & 3B HDR B SUCTION FROM THE SUMP (6 ft)

0.01 % DEVIATION after 14 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	0.00	>>>	5,000.00 PSI
R2	>>>	80	RING B	>>>	0.00	>>>	5,000.00 PSI
R3	>>>	81	RING C	>>>	0.00	>>>	5,000.00 PSI
R4	>>>	82	RING D	>>>	0.00	>>>	5,000.00 PSI
R7	>>>	83	RING E	>>>	0.00	>>>	5,000.00 PSI
R8	>>>	84	RING F	>>>	0.00	>>>	5,000.00 PSI
R9	>>>	85	RING G	>>>	1,349.79	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	989.77	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	765.82	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	579.73	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	236.46	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	384.63	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	4,306.21	<<<	17.30 PSI

NET FLOWS IN: 0.01 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1	C2	0.00	0.00	0.00
2	SIRWT HEADER	C2	C3	0.00	0.00	0.00
3	SIRWT EXIT	C4	C5	0.00	0.00	0.00
4	SIRWT HEADER	C5	C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6	S1	0.43	5.63	2,114.64
6	SI-3C SUCTION	C2	S3	0.00	0.00	0.00
7	SI-3B SUCTION	C3	S2	0.85	5.83	2,191.57
8	SI-3A DISCHARGE	C62	C11	18.07	13.56	2,114.64
9	SI-3B DISCHARGE	C60	C13	10.40	14.05	2,191.57
10	SI-3C DISCHARGE	C61	C15	0.00	0.00	0.00
11	DSCHRG HDR	C17	C16	0.17	6.22	2,191.57
13	DSCHRG HDR	C16	C18	9.89	12.21	4,306.21
14	A HX INLET	C18	C19	0.00	0.00	0.00
15	B HX INLET	C18	C20	12.08	12.21	4,306.21
16	A HX OUTLET	C21	C22	0.00	0.00	0.00
17	B HX OUTLET	C23	C24	2.29	12.21	4,306.21
18	HX CROSS CONECT	C22	C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24	C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25	C26	*** CLOSED ***		
21	A HEADER	C22	C27	0.00	0.00	0.00
	--- WITH COMPONENT F - flow meter *** MODEL OUT OF RANGE ***					
22	B HEADER	C24	C28	24.24	12.21	4,306.21
	--- WITH COMPONENT F - flow meter					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	0.00	0.00	0.00
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
24	B HEADER	C28	C31	35.10	27.61	4,306.21
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
25	A HEADER	C29	C30	0.00	0.00	0.00
26	A HEADER	C30	C33	0.00	0.00	0.00
27	A HEADER	C33	C34	0.00	0.00	0.90
28	A HEADER	C34	C35	0.00	0.01	0.90
29	A HEADER	C36 *	C33	0.00	0.01	0.90
30	A HEADER	C35	C37	0.00	0.00	0.90
31	A HEADER	C37	C38	0.00	0.00	0.90
32	A HEADER	C38	C39	0.00	0.00	0.45
33	PIPE-33	C39	C40	0.00	0.00	0.00
34	A HEADER	C40	C41	0.00	0.00	0.00
35	A HEADER	C41	C42	0.00	0.00	0.00
36	A HEADER	C42	C43	0.00	0.00	0.00
37	B HEADER	C32	C44	6.12	11.46	4,306.21
38	B HEADER	C44	C45	0.14	5.67	2,130.60
39	B HEADER	C45	C48	6.71	12.54	2,130.60
40	B HEADER	C44	C46	8.13	12.81	2,175.61
41	B HEADER	C46	C47	0.03	5.79	2,175.61
42	B HEADER	C47	C54	0.14	5.79	2,175.61
43	B HEADER	C48	C54	1.46	5.67	2,130.60

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.10	11.46	4,306.21
45	B HEADER	C49	C50	0.30	7.87	2,956.42
46	B HEADER	C50	C51	0.13	5.23	1,966.64
47	B HEADER	C51	C52	0.05	3.19	1,200.83
48	B HEADER	C52	C53	0.01	1.65	621.09
49	RING A	C37	R1	0.00	0.00	0.00
50	RING B	C40	R2	0.00	0.00	0.00
51	RING C	C41	R3	0.00	0.00	0.00
52	RING D	C42	R4	0.00	0.00	0.00
53	RING E	C43	R5	0.00	0.00	0.00
54	RING E2	R5	R6	0.00	0.00	0.00
55	RING E3	R6	R7	0.00	0.00	0.00
56	RING F	R5	R8	0.00	0.00	0.00
57	RING G	C49	R9	1.35	7.95	1,349.79
58	RING H	C50	R10	0.71	5.83	989.77
59	RING I	C51	R11	1.79	7.74	765.82
60	RING J	C52	R12	1.17	5.86	579.73
61	RING K	C53	R13	7.98	13.98	621.09
62	RING K2	R13	R14	0.15	5.32	236.46
63	RING K3	R14	R15	1.48	9.09	236.46
64	RING L	R13	R16	2.16	8.66	384.63
65	SPRAY HDR A	C38 *	C36	0.00	0.00	0.45

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C39 *	C36	0.00	0.00	0.45
67	SI-3A SUCTION	S1	C7	0.33	6.00	2,114.64
68	SUCTION SI-3C	S3	C8	0.00	0.00	0.00
69	SUCTION SI-3B	S2	C9	0.25	6.22	2,191.57
70	DISCHARGE HDR	C11	C16	0.33	6.00	2,114.64
71	DISCHARGE HDR	C13	C17	0.35	6.22	2,191.57
72	DISCHARGE HDR	C15	C17	0.00	0.00	0.00
73	HEADER B	C31	C32	2.47	12.21	4,306.21
74	PUMP SI-3A	C7	C10	(435.51)	21.37	2,114.64
	--- WITH COMPONENT C - SI-3A					
75	PUMP SI-3B	C9	C12	(428.41)	22.15	2,191.57
	--- WITH COMPONENT D - SI-3B					
76	PUMP SI-3C	C14	C8	*** CLOSED ***		
	--- WITH COMPONENT E -					
77	HX-A	C19	C21	0.00	0.00	0.00
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
78	HX-B	C20	C23	28.68	12.21	4,306.21
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
79	RING A	R1	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
80	RING B	R2	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
81	RING C	R3	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
82	RING D	R4	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
83	RING E	R7	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
85	RING G	R9	FG	170.10	13.64	1,349.79
86	RING H	R10	FG	166.44	10.00	989.77
87	RING I	R11	FG	162.23	7.74	765.82
88	RING J	R12	FG	160.50	5.86	579.73
89	RING K	R15	FG	149.14	9.09	236.46
90	RING L	R16	FG	149.62	8.66	384.63
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.01	1.60	2,114.64
108	CS SUMP PIPE	N9	C3	0.04	2.42	2,191.57
109	COMMON SUMP LIN	H70	H3	0.16	1.60	2,114.64
110	COMMON SUMP LIN	H70	N42	0.16	1.66	2,191.57
111	COMMON SUMP LIN	H3	N3	0.04	1.60	2,114.64
112	COMMON SUMP LIN	N42	N9	0.03	1.66	2,191.57
118	SI-3C DISCHARGE	C14	C61	0.00	0.00	0.00
119	SI-3B DISCHARGE	C12	C60	0.07	14.05	2,191.57
120	SI-3A DISCHARGE	C10	C62	0.06	13.56	2,114.64
121	SUMP ENTRANCE	FG	H70	0.08	3.25	4,306.21

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1 DATA FOR PIPES: OPPDCS
UPDATED : JUNE 8, 1992

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
2P1H:3A & 3C HDR B SUCTION FROM THE SUMP (6 ft)

0.01 % DEVIATION after 14 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	0.00	>>>	5,000.00 PSI
R2	>>>	80	RING B	>>>	0.00	>>>	5,000.00 PSI
R3	>>>	81	RING C	>>>	0.00	>>>	5,000.00 PSI
R4	>>>	82	RING D	>>>	0.00	>>>	5,000.00 PSI
R7	>>>	83	RING E	>>>	0.00	>>>	5,000.00 PSI
R8	>>>	84	RING F	>>>	0.00	>>>	5,000.00 PSI
R9	>>>	85	RING G	>>>	1,348.31	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	988.66	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	764.94	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	579.06	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	236.18	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	384.18	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	4,301.34	<<<	17.30 PSI

NET FLOWS IN: 0.01 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE		TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1		C2	0.00	0.00	0.00
2	SIRWT HEADER	C3	*	C2	0.03	2.40	2,179.91
3	SIRWT EXIT	C4		C5	0.00	0.00	0.00
4	SIRWT HEADER	C5		C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6		S1	0.44	5.64	2,121.43
6	SI-3C SUCTION	C2		S3	1.06	5.80	2,179.91
7	SI-3B SUCTION	C3		S2	0.00	0.00	0.00
8	SI-3A DISCHARGE	C62		C11	18	13.60	2,121.43
9	SI-3B DISCHARGE	C60		C13	0.00	0.00	0.00
10	SI-3C DISCHARGE	C61		C15	11.30	13.98	2,179.91
11	DSCHRG HDR	C17		C16	0.17	6.18	2,179.91
13	DSCHRG HDR	C16		C18	9.87	12.20	4,301.34
14	A HX INLET	C18		C19	0.00	0.00	0.00
15	B HX INLET	C18		C20	12.05	12.20	4,301.34
16	A HX OUTLET	C21		C22	0.00	0.00	0.00
17	B HX OUTLET	C23		C24	2.29	12.20	4,301.34
18	HX CROSS CONECT	C22		C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24		C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25		C26	*** CLOSED ***		
21	A HEADER	C22		C27	0.00	0.00	0.00
	--- WITH COMPONENT F - flow meter *** MODEL OUT OF RANGE ***						
22	B HEADER	C24		C28	24.19	12.20	4,301.34
	--- WITH COMPONENT F - flow meter						

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	0.00	0.00	0.00
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
24	B HEADER	C28	C31	35.02	27.58	4,301.34
	--- WITH COMPONENT B - FLOW VALVE			*** MODEL OUT OF RANGE ***		
25	A HEADER	C29	C30	0.00	0.00	0.00
26	A HEADER	C30	C33	0.00	0.00	0.00
27	A HEADER	C33	C34	0.00	0.00	0.90
28	A HEADER	C34	C35	0.00	0.01	0.90
29	A HEADER	C36 *	C33	0.00	0.01	0.90
30	A HEADER	C35	C37	0.00	0.00	0.90
31	A HEADER	C37	C38	0.00	0.00	0.90
32	A HEADER	C38	C39	0.00	0.00	0.45
33	PIPE-33	C39	C40	0.00	0.00	0.00
34	A HEADER	C40	C41	0.00	0.00	0.00
35	A HEADER	C41	C42	0.00	0.00	0.00
36	A HEADER	C42	C43	0.00	0.00	0.00
37	B HEADER	C32	C44	6.11	11.44	4,301.34
38	B HEADER	C44	C45	0.13	5.66	2,128.19
39	B HEADER	C45	C48	6.70	12.53	2,128.19
40	B HEADER	C44	C46	8.12	12.79	2,173.15
41	B HEADER	C46	C47	0.03	5.78	2,173.15
42	B HEADER	C47	C54	0.14	5.78	2,173.15
43	B HEADER	C48	C54	1.46	5.66	2,128.19

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.10	11.44	4,301.34
45	B HEADER	C49	C50	0.30	7.86	2,953.03
46	B HEADER	C50	C51	0.13	5.23	1,964.37
47	B HEADER	C51	C52	0.05	3.19	1,199.42
48	B HEADER	C52	C53	0.01	1.65	620.36
49	RING A	C37	R1	0.00	0.00	0.00
50	RING B	C40	R2	0.00	0.00	0.00
51	RING C	C41	R3	0.00	0.00	0.00
52	RING D	C42	R4	0.00	0.00	0.00
53	RING E	C43	R5	0.00	0.00	0.00
54	RING E2	R5	R6	0.00	0.00	0.00
55	RING E3	R6	R7	0.00	0.00	0.00
56	RING F	R5	R8	0.00	0.00	0.00
57	RING G	C49	R9	1.35	7.94	1,348.31
58	RING H	C50	R10	0.71	5.82	988.66
59	RING I	C51	R11	1.78	7.73	764.94
60	RING J	C52	R12	1.17	5.85	579.06
61	RING K	C53	R13	7.96	13.96	620.36
62	RING K2	R13	R14	0.15	5.31	236.18
63	RING K3	R14	R15	1.48	9.08	236.18
64	RING L	R13	R16	2.15	8.65	384.18
65	SPRAY HDR A	C38 *	C36	0.00	0.00	0.45

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C39 *	C36	0.00	0.00	0.45
67	SI-3A SUCTION	S1	C7	0.33	6.02	2,121.43
68	SUCTION SI-3C	S3	C8	0.05	6.18	2,179.91
69	SUCTION SI-3B	S2	C9	0.00	0.00	0.00
70	DISCHARGE HDR	C11	C16	0.33	6.02	2,121.43
71	DISCHARGE HDR	C13	C17	0.00	0.00	0.00
72	DISCHARGE HDR	C15	C17	0.35	6.18	2,179.91
73	HEADER B	C31	C32	2.46	12.20	4,301.34
74	PUMP SI-3A	C7	C10	(434.97)	21.44	2,121.43
	--- WITH COMPONENT C - SI-3A					
75	PUMP SI-3B	C9	C12	*** CLOSED ***		
	--- WITH COMPONENT D -					
76	PUMP SI-3C	C8	C14	(428.68)	22.03	2,179.91
	--- WITH COMPONENT E - SI-3C					
77	HX-A	C19	C21	0.00	0.00	0.00
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
78	HX-B	C20	C23	28.62	12.20	4,301.34
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
79	RING A	R1	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVFRSE FLOW ***					
80	RING B	R2	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
81	RING C	R3	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
82	RING D	R4	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
83	RING E	R7	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

PIPELINE NO	ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
85	RING G	R9	FG	169.73	13.63	1,348.31
86	RING H	R10	FG	166.07	9.99	988.66
87	RING I	R11	FG	161.86	7.73	764.94
88	RING J	R12	FG	160.13	5.85	579.06
89	RING K	R15	FG	148.79	9.08	236.18
90	RING L	R16	FG	149.26	8.65	384.18
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.01	1.60	2,121.43
108	CS SUMP PIPE	N9	C3	0.04	2.40	2,179.91
109	COMMON SUMP LIN	H70	H3	0.16	1.60	2,121.43
110	COMMON SUMP LIN	H70	N42	0.16	1.65	2,179.91
111	COMMON SUMP LIN	H3	N3	0.04	1.60	2,121.43
112	COMMON SUMP LIN	N42	N9	0.03	1.65	2,179.91
118	SI-3C DISCHARGE	C14	C61	0.07	13.98	2,179.91
119	SI-3B DISCHARGE	C12	C60	0.00	0.00	0.00
120	SI-3A DISCHARGE	C10	C62	0.06	13.60	2,121.43
121	SUMP ENTRANCE	FG	H70	0.08	3.25	4,301.34

ABB Combustion Engineering

CLIENT : Omaha Public Power District

NETWORK SUMMARY REPORTS JUNE 8, 1992
R. Harsell

NETWORK NAME : OPPDCS1 DATA FOR PIPES: OPPDCS
UPDATED : JUNE 8, 1992

OPPD CSP NPSH W/ SUMP SUBCOOLING
O-MECH-CALC-021
1P1H: 3A HDR B SUCTION FROM THE SUMP (6 ft)

0.01 % DEVIATION after 15 ITERATIONS

FIXED GRADE SUMMARY

NETWORK NODE		CONNECTION PIPELINE			FLOW-RATE (gal/min)		FIXED GRADE / PRESSURE SOURCE
R1	>>>	79	RING A	>>>	0.00	>>>	5,000.00 PSI
R2	>>>	80	RING B	>>>	0.00	>>>	5,000.00 PSI
R3	>>>	81	RING C	>>>	0.00	>>>	5,000.00 PSI
R4	>>>	82	RING D	>>>	0.00	>>>	5,000.00 PSI
R7	>>>	83	RING E	>>>	0.00	>>>	5,000.00 PSI
R8	>>>	84	RING F	>>>	0.00	>>>	5,000.00 PSI
R9	>>>	85	RING G	>>>	995.19	>>>	14.70 PSI
R10	>>>	86	RING H	>>>	722.41	>>>	14.70 PSI
R11	>>>	87	RING I	>>>	554.44	>>>	14.70 PSI
R12	>>>	88	RING J	>>>	416.99	>>>	14.70 PSI
R15	>>>	89	RING K	>>>	168.56	>>>	14.70 PSI
R16	>>>	90	RING L	>>>	275.07	>>>	14.70 PSI
H70	<<<	121	SUMP ENTRANCE	<<<	3,132.66	<<<	17.30 PSI

NET FLOWS IN: 0.00 gal/min

DEMAND SUMMARY

JUNCTION NODE	DEMAND (gal/min)	JUNCTION NODE	DEMAND (gal/min)

NET DEMAND IN: 0.00 gal/min

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
1	SIRWT EXIT	C1	C2	0.00	0.00	0.00
2	SIRWT HEADER	C2	C3	0.00	0.00	0.00
3	SIRWT EXIT	C4	C5	0.00	0.00	0.00
4	SIRWT HEADER	C5	C6	0.00	0.00	0.00
5	SI-3A SUCTION	C6	S1	0.94	8.33	3,132.66
6	SI-3C SUCTION	C2	S3	0.00	0.00	0.00
7	SI-3B SUCTION	C3	S2	0.00	0.00	0.00
8	SI-3A DISCHARGE	C62	C11	39.41	20.09	3,132.66
9	SI-3B DISCHARGE	C60	C13	0.00	0.00	0.00
10	SI-3C DISCHARGE	C61	C15	0.00	0.00	0.00
11	DSCHRG HDR	C17	C16	0.00	0.00	0.00
13	DSCHRG HDR	C16	C18	5.29	8.88	3,132.66
14	A HX INLET	C18	C19	0.00	0.00	0.00
15	B HX INLET	C18	C20	6.40	8.88	3,132.66
16	A HX OUTLET	C21	C22	0.00	0.00	0.00
17	B HX OUTLET	C23	C24	1.22	8.88	3,132.66
18	HX CROSS CONECT	C22	C25	0.00	0.00	0.00
19	HX CROSS CONECT	C24	C26	0.00	0.00	0.00
20	SDC DISCHARGE	C25	C26	*** CLOSED ***		
21	A HEADER	C22	C27	0.00	0.00	0.00
	--- WITH COMPONENT F - flow meter *** MODEL OUT OF RANGE ***					
22	B HEADER	C24	C28	12.85	8.88	3,132.66
	--- WITH COMPONENT F - flow meter					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
23	A HEADER	C27	C29	0.00	0.00	0.00
	--- WITH COMPONENT B - FLOW VALVE *** MODEL OUT OF RANGE ***					
24	B HEADER	C28	C31	18.58	20.09	3,132.66
	--- WITH COMPONENT B - FLOW VALVE					
25	A HEADER	C29	C30	0.00	0.00	0.00
26	A HEADER	C30	C33	0.00	0.00	0.00
27	A HEADER	C33	C34	0.00	0.00	0.66
28	A HEADER	C34	C35	0.00	0.00	0.66
29	A HEADER	C36 *	C33	0.00	0.00	0.66
30	A HEADER	C35	C37	0.00	0.00	0.66
31	A HEADER	C37	C38	0.00	0.00	0.66
32	A HEADER	C38	C39	0.00	0.00	0.33
33	PIPE-33	C39	C40	0.00	0.00	0.00
34	A HEADER	C40	C41	0.00	0.00	0 00
35	A HEADER	C41	C42	0.00	0.00	0.00
36	A HEADER	C42	C43	0.00	0.00	0.00
37	B HEADER	C32	C44	3.25	8.33	3,132.66
38	B HEADER	C44	C45	0.07	4.12	1,549.88
39	B HEADER	C45	C48	3.58	9.12	1,549.88
40	B HEADER	C44	C46	4.33	9.32	1,582.78
41	B HEADER	C46	C47	0.02	4.21	1,582.78
42	B HEADER	C47	C54	0.07	4.21	1,582.78
43	B HEADER	C48	C54	0.77	4.12	1,549.88

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
44	B HEADER	C54	C49	0.06	8.33	3,132.66
45	B HEADER	C49	C50	0.16	5.69	2,137.47
46	B HEADER	C50	C51	0.07	3.76	1,415.06
47	B HEADER	C51	C52	0.03	2.29	860.62
48	B HEADER	C52	C53	0.01	1.18	443.63
49	RING A	C37	R1	0.00	0.00	0.00
50	RING B	C40	R2	0.00	0.00	0.00
51	RING C	C41	R3	0.00	0.00	0.00
52	RING D	C42	R4	0.00	0.00	0.00
53	RING E	C43	R5	0.00	0.00	0.00
54	RING E2	R5	R6	0.00	0.00	0.00
55	RING E3	R6	R7	0.00	0.00	0.00
56	RING F	R5	R8	0.00	0.00	0.00
57	RING G	C49	R9	0.74	5.86	995.19
58	RING H	C50	R10	0.38	4.25	722.41
59	RING I	C51	R11	0.94	5.60	554.44
60	RING J	C52	R12	0.61	4.21	416.99
61	RING K	C53	R13	4.12	9.98	443.63
62	RING K2	R13	R14	0.08	3.79	168.56
63	RING K3	R14	R15	0.77	6.48	168.56
64	RING L	R13	R16	1.11	6.19	275.07
65	SPRAY HDR A	C38 *	C36	0.00	0.00	0.33

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
66	SPRAY HDR A	C39 *	C36	0.00	0.00	0.33
67	SI-3A SUCTION	S1	C7	0.71	8.88	3,132.66
68	SUCTION SI-3C	S3	C8	0.00	0.00	0.00
69	SUCTION SI-3B	S2	C9	0.00	0.00	0.00
70	DISCHARGE HDR	C11	C16	0.72	8.88	3,132.66
71	DISCHARGE HDR	C13	C17	0.00	0.00	0.00
72	DISCHARGE HDR	C15	C17	0.00	0.00	0.00
73	HEADER B	C31	C32	1.32	8.88	3,132.66
74	PUMP SI-3A	C7	C10	(319.4	31.66	3,132.66
	--- WITH COMPONENT C - SI-3A					
75	PUMP SI-3B	C9	C12	*** CLOSED ***		
	--- WITH COMPONENT D -					
76	PUMP SI-3C	C14	C8	*** CLOSED ***		
	--- WITH COMPONENT E -					
77	HX-A	C19	C21	0.00	0.00	0.00
	--- WITH COMPONENT A - HX-A *** MODEL OUT OF RANGE ***					
78	HX-B	C20	C23	15.18	8.88	3,132.66
	--- WITH COMPONENT A - HX-A					
79	RING A	R1	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
80	RING B	R2	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
81	RING C	R3	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
82	RING D	R4	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
83	RING E	R7	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					

COMPLETE PIPELINE REPORT JUNE 8, 1992

PIPELINE COUNT: 100

DESIGN RULES: VELOCITY MIN: 0.00 MAX: 1000.00 ft/sec

NO	PIPELINE ID	FROM NODE	TO NODE	HEAD-LOSS (GAIN)	VELOCITY (ft/sec)	FLOW-RATE (gal/min)
84	RING F	R8	FG	0.00	0.00	0.00
	--- WITH CHECK VALVE *** CLOSED BY REVERSE FLOW ***					
85	RING G	R9	FG	92.47	10.06	995.19
86	RING H	R10	FG	88.67	7.30	722.41
87	RING I	R11	FG	85.03	5.60	554.44
88	RING J	R12	FG	83.04	4.21	416.99
89	RING K	R15	FG	75.78	6.48	168.56
90	RING L	R16	FG	76.52	6.19	275.07
93	PIPE-93	C11	C10	*** CLOSED ***		
107	CS SUMP PIPE	N3	C6	0.02	2.37	3,132.66
108	CS SUMP PIPE	N9	C3	0.00	0.00	0.00
109	COMMON SUMP LIN	H70	H3	0.35	2.37	3,132.66
110	COMMON SUMP LIN	H70	N42	0.00	0.00	0.00
111	COMMON SUMP LIN	H3	N3	0.08	2.37	3,132.66
112	COMMON SUMP LIN	N42	N9	0.00	0.00	0.00
118	SI-3C DISCHARGE	C14	C61	0.00	0.00	0.00
119	SI-3B DISCHARGE	C12	C60	0.00	0.00	0.00
120	SI-3A DISCHARGE	C10	C62	0.14	20.09	3,132.66
121	SUMP ENTRANCE	FG	H70	0.04	2.37	3,132.66

APPENDIX D
SELECTED REFERENCES

D2	Reference 3.12
D5	Reference 3.14
D16	Reference 3.16
D19	FLO-SERIES Code Certificates
D21	Model Verification Checklist

I N G E R S O L L - R A N D

EPD ENGINEERING
942 MEMORIAL PARKWAY
PHILLIPSBURG, NEW JERSEY

DATE: 19 March 92

TO: Doug Blanchard

COMPANY LOCATION ABB. Comb. Engr

TELECOPIER NUMBER 203-285-4044

FROM Paul J. Kaszetejna

TELEPHONE (908) 859-8353

NUMBER OF PAGES BEING SENT _____ (INCLUDING COVER)

RE: 6UCL pps
S/N 0669-60, 61, 62
Containment Spray Pumps

With regard to page 3 of your 12MR92 fax to Kurt Schuman I have the following comments.
D.) I would project operating points of
2950 gpm basis 24' NPSHA and
2450 gpm basis 19' NPSHA
this is basis your figure 1 and actual test data that we have on this pump design. We have actual tests indicating @ 25' NPSHR @ 3000 gpm
C) Any type of orifice on control valve is

LOCATION: FOURTH FLOOR BENTLEY BUILDING

AUTOMATIC ANSWER NUMBER (908) 859-7322

(@ 24.5' actual)

Page 2
D. Blanchard.

possible to alter the system curve to reduce the potential of runout flow. An orifice within the pump would also achieve similar results by a steeper head/capacity curve causing less runout flow.

B) No ~~workable~~ alternate impeller designs are available that would produce better runout NPSH characteristics. We would have to study casing and impeller design to determine exactly what would be required. Right now looks like no easy solutions.

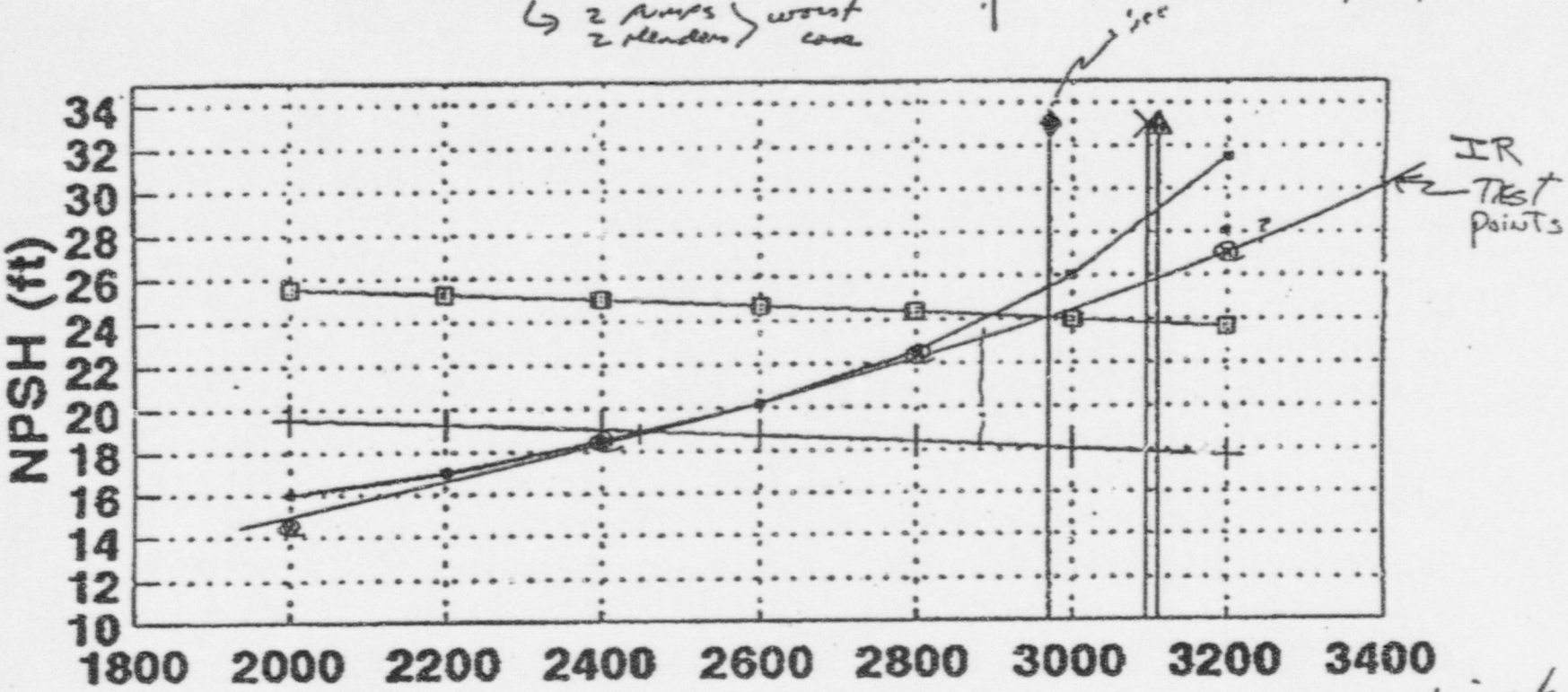
A) "In place" NPSH testing; I feel would be of questionable value. We would always have doubts if done accurately and question the results. We would have to accurately measure suction and discharge pressure as well as flow. this requires pipe taps in both suction and discharge and accessability to pipe for an ultra-sonic flow meter. NPSH tests are not easily done.

c 2
Phil Nagengast
Kurt Schuerman

Figure 1
OPPD CSP NPSH
2P2H Configuration

IR NPSHR Curve added 3/19/92

↳ 2 pumps 2 flanders > worst case



Ha taken from SI-3C (lowest)
Data uses pump with highest flow
2H configuration.

ABB
ASEA BROWN BOVERI

Inter-Office Correspondence

To: R. Harsell
F. P. Ferraraccio

From: M. Petraske
OPS-92-0653
May 29, 1992

xc: M. J. Gancarz
R. C. Whipple
J. J. Herbst
M. D. Michonski
QRC (2) - Permanent

References:
1) ABB CE Calculation No. 002-AS91-C-001 Rev.00, "OPPD Maximum Safeguards Hot Leg LOCA Containment Analysis", Dated 9-5-91.

2) ABB CE Calculation No. 002-NT90-C-012 Rev. 00. "Evaluation of LOCA Long Term Containment Response for Fort Calhoun Station", Dated 11-26-90.

3) Omaha Public Power District Fort Calhoun Station Updated Final Safety Analysis Report, R2, Dated 7-91.

Enclosure:
1) Graphs and Data Tables Developed from CONTRANS Case #AVQC, Case #OSNVBV97, and Case #AGTL.

Subject: EVALUATION OF THE PRESSURE MARGIN PRESENT BETWEEN THE SATURATION PRESSURE OF THE CONTAINMENT SUMP WATER AND THE CONTAINMENT PRESSURE - POST LOCA.

This memo is in response to your request to transmit the results of a review of Omaha Public Power District's Fort Calhoun Station containment transient analysis. This review was conducted to support the containment spray pump Net Positive Suction Head available (NPSHa) investigation.

The containment analysis runs are from the NRC approved code CONTRANS. This code simulates the pressure and temperature response in the containment following a design basis event. The output of this analysis code includes the containment pressure, sump water temperature, and various other containment parameters as a function of time during an event.

It is from this data, specifically the sump water temperature, that the saturation pressure of the sump water can be determined. The CONTRANS analysis runs chosen from References (1) and (2) are either the analysis of record, Case #AVQC (Reference 3), or provide a scenario where the sump temperature would be maximized and the containment pressure minimized, Case #AGTL and Case #OSNVBV97 (Reference 1 and 2).

Case #AVQC utilizes 1 spray header with spray water at 105°F and updated Shutdown Cooling Heat Exchanger data. Case #AGTL is the same as Case #AVQC except it has a revised decay heat input, a spray flow of 2510 GPM and 2 spray headers. Case #OSNVBV97 is a best estimate maximum safeguards case. It should be noted that all these cases are LOCA cases. The Main Steam Line Break cases of record in Reference (3) were not reviewed since the transient calculations are terminated prior to the time of the receipt of the Recirculation Actuation Signal (RAS). Since the MSLB case does not have any data post RAS it is impossible to predict the pressure response in containment. Note also that the cases reviewed were run to a maximum of 100,000 seconds, predictions of sub-cooling beyond that time were not possible.

The curves and tables developed in Enclosure (1) use the data taken directly from the CONTRANS case output and the ASME Steam Tables. The containment pressure is a direct output of the code while the saturation pressure of the sump water was developed using the temperature given by CONTRANS, and the corresponding saturation pressure from the ASME Steam Tables. This provided data for the containment pressure and the sump water saturation pressure. These two sets of data were then plotted and the minimum pressure differential determined.

The minimum differential pressure is being sought because it minimizes the amount of Net Positive Suction Pressure available to the containment spray pump during an event. This result is the goal of the evaluation this document is supporting.

In evaluating the curves and data tables in Enclosure (1) it can be seen that the minimum pressure differential between the containment sump saturation pressure and the total containment pressure, after the initiation of Recirculation Actuation Signal, is 15.47 psi. In each of the cases RAS is not achieved until after 1400 seconds into the transient. Therefore, any pressure differentials before this time are not considered in this evaluation. This occurs during the maximum safe guards case, Case #OSNVBV97, with all safety injection pumps running and two spray headers, with fan coolers. The minimum pressure differential occurs with the total containment pressure of 16.43 psia at 99650 seconds, and sump water at 100.3°F.

It should be noted that Case #OSNVBV97 never has sump water in excess of 212°F. In the three cases investigated, the sump temperature was maintained below 212°F except in Case #AVQC, between 18520 and 79520 seconds. In that case the sump water does reach the saturation point of water, at 14.7 psia, and 212°F, but the containment pressure in this range is maintained above 38.26 psia.

This provides a margin of over-pressure, from the containment pressure to the saturation pressure of the sump water, of 23 psi. This information is provided simply to illustrate that the water does exceed the saturation temperature at 14.7 psia, but there is sufficient over-pressure on the water to maintain it in a sub-cooled state.

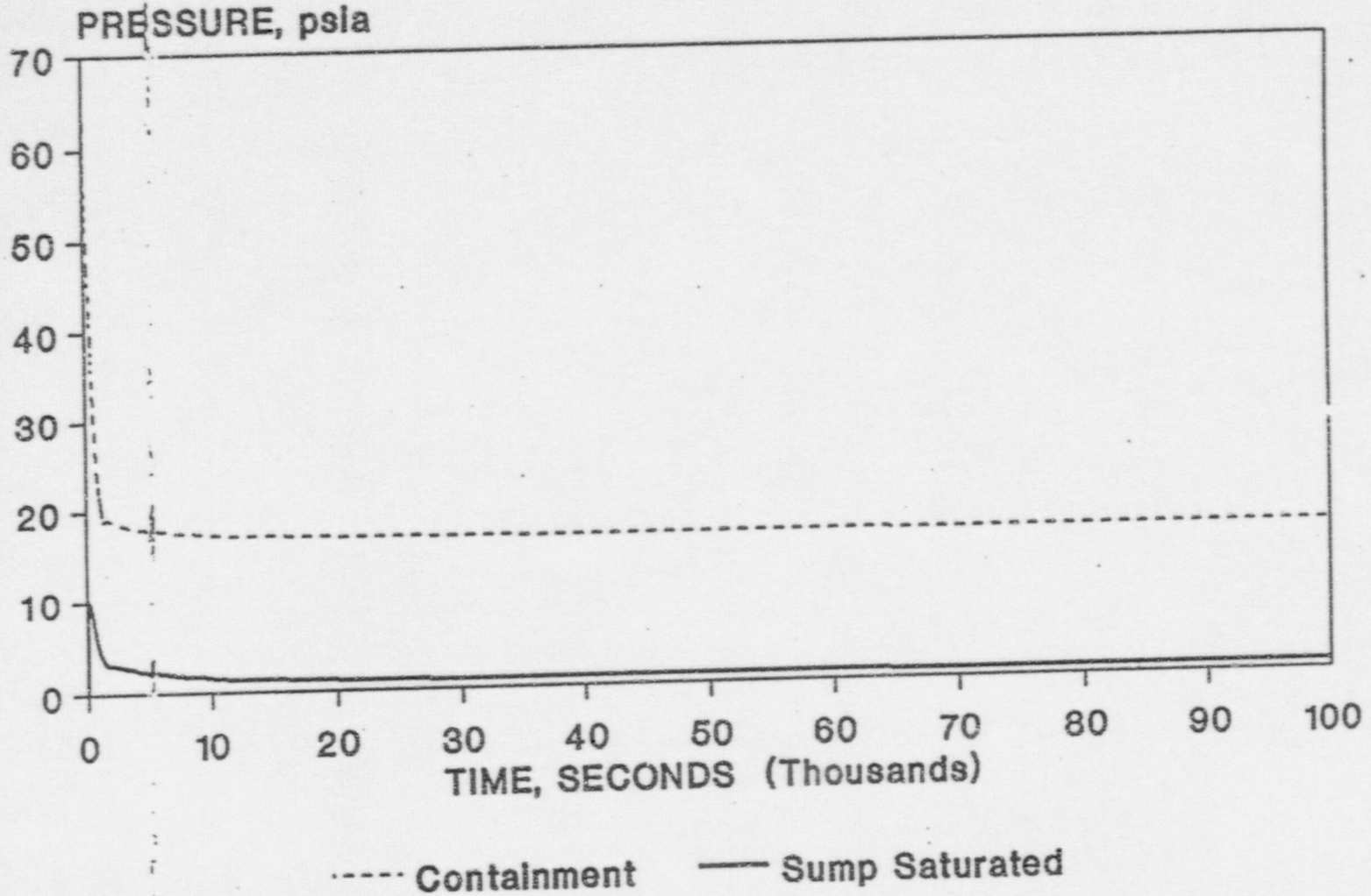
At all times in the three analyses there are large margins of containment pressure in excess of the saturation pressure of the sump water. Therefore the minimum differential pressure, 15.47, is achieved in Case #OSNVBV97, at 99650 seconds.

The enclosed data has been Quality Assured in accordance with the QAPM guidelines. Should you have any questions, please do not hesitate to contact myself at x5485, or Mike Gancarz at x4600.

QA Status: Verified
The safety related design information contained in this document has been reviewed and satisfies (where applicable) the items contained on check-list(s) 9, —, and — of the Quality Assurance Procedures Manual. This review is so certified.
Independent Reviewer R. D. Nichols
Date 6-1-92
Document Rev. No. -0-

OPPD LOCA CONTAINMENT PRESSURE vs TIME

Case # OSNVBV97

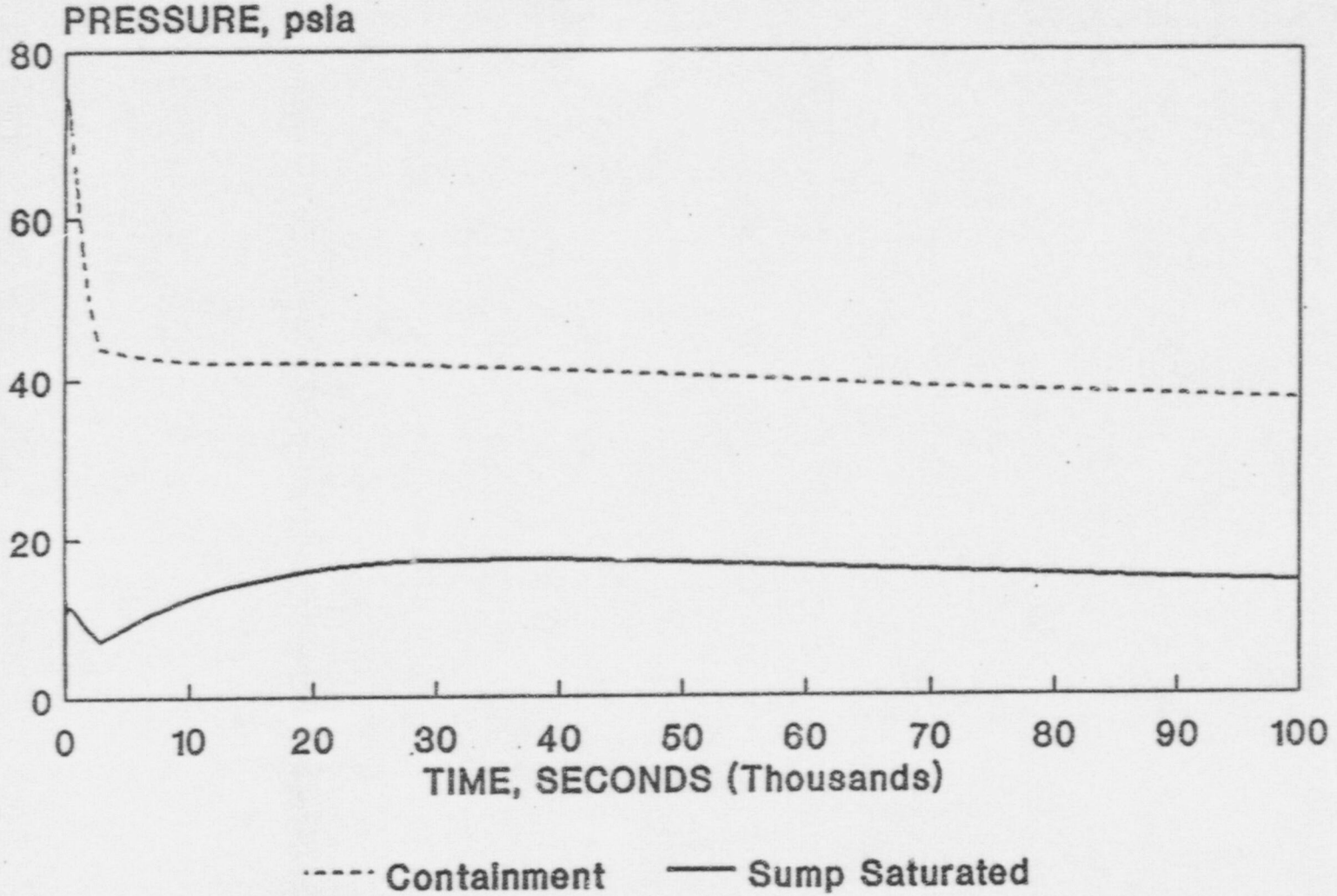


OPPD LOCA CONTAINMENT P/T vs TIME
Case # OSNVBV97

TIME,SEC	WATER, F	CONTAINMENT PRESS,PSIA	SUMP SAT. PRESS,PSIA	DELTA, P
0.0	90.0	14.70	0.69	14.01
0.2	90.5	16.78	0.71	16.07
0.4	93.4	19.23	0.78	18.45
1.3	111.8	28.03	1.34	26.69
2.8	135.1	38.00	2.54	35.46
3.8	148.0	43.49	3.54	39.95
4.8	159.9	48.54	4.73	43.81
5.8	169.9	53.02	5.98	47.04
7.8	183.9	59.86	8.18	51.68
8.8	188.0	62.10	8.95	53.15
10.8	192.7	64.69	9.89	54.8
12.8	194.3	66.07	10.23	55.84
18.8	194.0	65.85	10.17	55.68
20.8	193.7	65.72	10.10	55.62
28.8	192.6	65.28	9.87	55.41
38.8	191.1	64.91	9.56	55.35
68.8	190.5	62.74	9.44	53.3
88.8	192.0	60.87	9.75	51.12
98.8	192.6	60.03	9.87	50.16
112.8	193.1	58.77	9.97	48.8
122.8	193.2	57.92	9.99	47.93
132.8	193.4	57.11	10.04	47.07
152.8	193.6	55.60	10.08	45.52
172.8	193.5	54.20	10.06	44.14
192.8	193.3	52.91	10.02	42.89
210.8	193.0	51.81	9.95	41.86
248.8	192.1	49.42	9.75	39.67
288.8	190.8	46.89	9.50	37.39
308.8	190.0	45.71	9.34	36.37
338.8	188.6	43.93	9.06	34.87
368.8	187.1	42.20	8.77	33.43
388.8	186.1	41.13	8.58	32.55
428.8	184.0	38.95	8.20	30.75
448.8	183.0	37.92	8.02	29.9
468.8	181.9	37.03	7.83	29.2
488.8	180.9	35.99	7.66	28.33
530.0	178.7	34.13	7.29	26.84
730.0	169.2	27.56	5.88	21.68
830.0	165.0	25.17	5.34	19.83
930.0	161.0	23.40	4.85	18.55
1030.0	157.4	22.10	4.45	17.65
1180.0	152.5	20.77	3.95	16.82
1380.0	146.7	18.97	3.42	15.55
1530.0	145.4	18.99	3.29	15.7
1730.0	144.7	19.04	3.25	15.79
1930.0	144.1	18.97	3.21	15.76
2390.0	142.5	18.72	3.08	15.64
2840.0	140.9	18.50	2.96	15.54
3890.0	137.0	18.15	2.67	15.48

OPPD LOCA CONTAINMENT P/T vs TIME Case # OSNVBV97				
TIME,SEC	WATER, F	CONTAINMENT PRESS,PSIA	SUMP SAT. PRESS,PSIA	DELTA, P
4640.0	134.3	17.97	2.49	15.48
5240.0	132.3	17.85	2.36	15.49
6290.0	129.0	17.68	2.16	15.52
7640.0	125.3	17.51	1.96	15.55
8240.0	123.8	17.44	1.88	15.56
9290.0	121.5	17.34	1.76	15.58
10850.0	118.5	17.22	1.62	15.6
12650.0	115.7	17.12	1.50	15.62
13650.0	114.4	17.07	1.45	15.62
18650.0	109.9	16.91	1.27	15.64
21650.0	108.2	16.84	1.21	15.63
25650.0	106.6	16.78	1.15	15.63
29650.0	105.6	16.73	1.12	15.61
39650.0	103.9	16.64	1.06	15.58
49650.0	102.8	16.58	1.03	15.55
59650.0	102.0	16.54	1.00	15.54
69650.0	101.5	16.50	0.99	15.51
79650.0	101.0	16.47	0.98	15.49
89650.0	100.6	16.45	0.96	15.49
99650.0	100.3	16.43	0.96	15.47
100000.0	100.2	16.43	0.95	15.48

OPPD LOCA CONTAINMENT PRESSURE vs TIME
Case # AVQC



OPPD LOCA CONTAINMENT P/T vs TIME

Case # AVQC

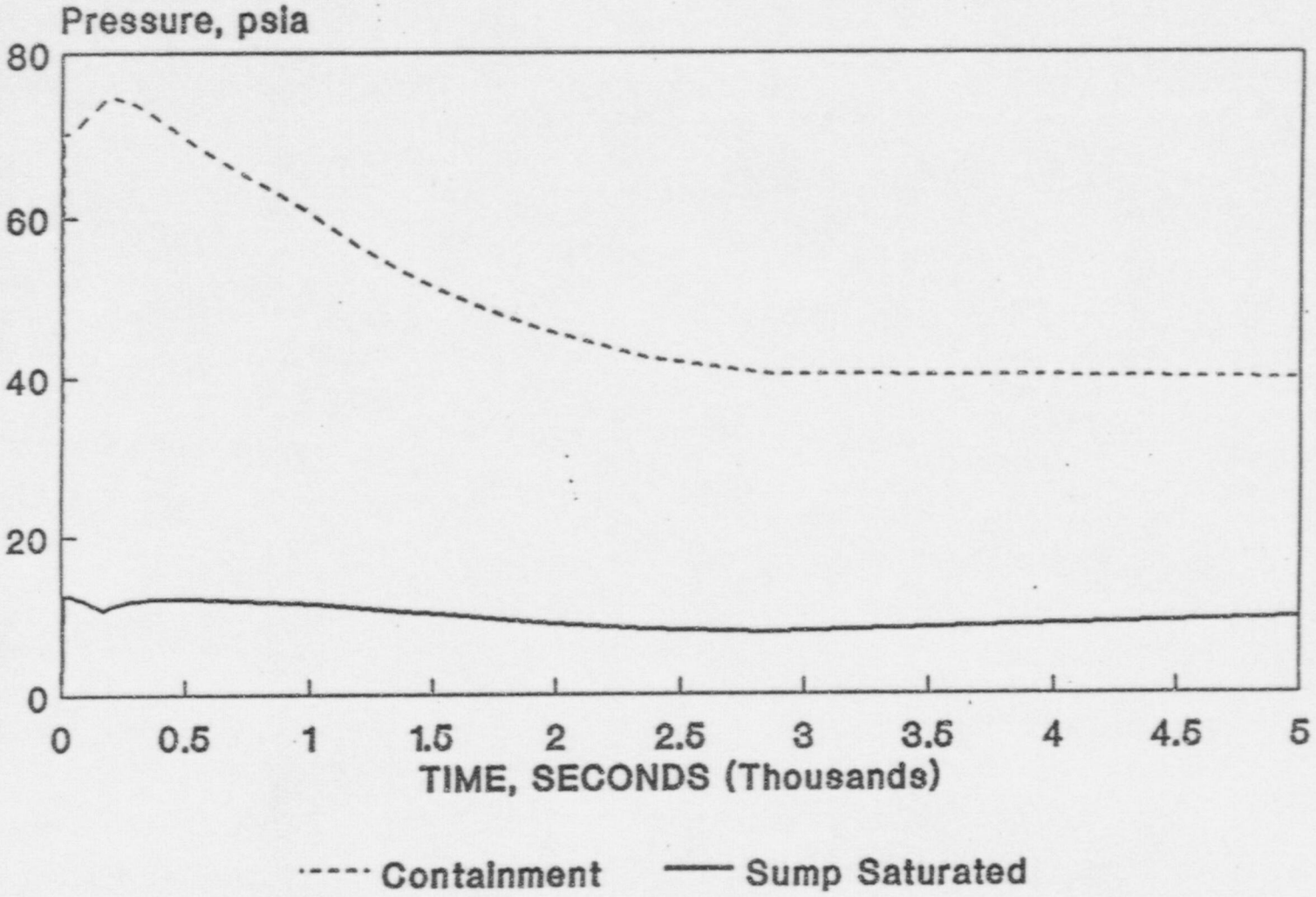
TIME,SEC	WATER, F	CONTAINMENT PRESS, PSIA	SUMP SAT. PRESS, PSIA	DELTA, P
0.0	120.0	17.70	1.69	16.01
0.2	119.9	19.39	1.69	17.70
0.4	121.4	21.79	1.76	20.03
1.3	134.5	30.66	2.50	28.16
2.8	153.2	40.80	4.02	36.78
3.8	164.0	46.42	5.21	41.21
4.8	174.1	51.61	6.58	45.03
5.8	182.7	56.23	7.97	48.26
7.8	194.9	63.35	10.36	52.99
8.8	198.5	65.74	11.17	54.57
10.8	202.6	68.60	12.16	56.44
12.8	203.9	70.17	12.49	57.68
18.8	204.1	70.35	12.54	57.81
20.8	204.1	70.34	12.54	57.80
28.8	204.0	70.37	12.51	57.86
38.8	203.8	70.52	12.46	58.06
68.8	202.5	71.19	12.14	59.05
88.8	201.4	71.82	11.86	59.96
98.8	200.8	72.13	11.72	60.41
112.8	199.9	72.49	11.50	60.99
122.8	199.3	72.77	11.36	61.41
132.8	198.6	73.07	11.20	61.87
152.8	197.3	73.71	10.90	62.81
172.8	197.4	74.06	10.92	63.14
192.8	198.1	74.25	11.08	63.17
210.8	198.7	74.43	11.22	63.21
248.8	199.4	74.35	11.38	62.97
288.8	199.9	74.18	11.50	62.68
308.8	200.0	73.94	11.53	62.41
338.8	200.2	73.60	11.57	62.03
368.8	200.2	73.08	11.57	61.51
388.8	200.1	72.72	11.55	61.17
428.8	199.9	72.03	11.50	60.53
448.8	199.9	71.68	11.50	60.18
468.8	199.7	71.33	11.45	59.88
488.8	199.6	71.00	11.43	59.57
530.0	199.3	70.34	11.36	58.98
730.0	197.9	67.17	11.03	56.14
830.0	197.1	65.70	10.85	54.85
930.0	196.3	64.33	10.67	53.66
1030.0	195.3	62.50	10.45	52.05
1180.0	193.9	59.87	10.15	49.72
1380.0	191.9	56.74	9.72	47.02
1530.0	190.4	54.69	9.41	45.28
1730.0	188.4	52.31	9.02	43.29
1930.0	186.3	50.30	8.62	41.68
2360.0	182.2	46.87	7.89	38.98
2860.0	178.0	43.92	7.18	36.74
3860.0	183.0	43.60	8.02	35.58

OPS-92-0653
Enclosure (1)
page 6 of 8

OPPD LC CA CONTAINMENT P/T vs TIME Case # AVQC				
TIME,SEC	WATER, F	CONTAINMENT PRESS, PSIA	SUMP SAT. PRESS, PSIA	DELTA, P
4260.0	184.9	43.48	8.37	35.11
5260.0	189.5	43.15	9.24	33.91
6260.0	193.4	42.89	10.04	32.85
7260.0	196.8	42.69	10.78	31.91
8260.0	199.4	42.52	11.38	31.14
9260.0	202.3	42.37	12.08	30.29
10320.0	204.6	42.23	12.66	29.57
12320.0	208.3	42.11	13.65	28.46
13520.0	210.0	42.08	14.12	27.96
18520.0	215.3	42.04	15.68	26.36
21520.0	217.2	42.00	16.27	25.73
25520.0	218.9	41.91	16.82	25.09
29520.0	219.8	41.75	17.12	24.63
39520.0	220.2	41.14	17.25	23.89
49520.0	219.1	40.39	16.89	23.50
59520.0	217.4	39.64	16.34	23.30
69520.0	215.5	38.92	15.75	23.17
79520.0	213.7	38.26	15.19	23.07
89520.0	211.9	37.66	14.66	23.00
99520.0	210.2	37.12	14.18	22.94
100000.0	210.1	37.09	14.15	22.94

OPPD LOCA CONTAINMENT PRESSURE vs TIME

Case # AGTL



OPS-92-0653
Enclosure (1)
page 8 of 8

OPPD LOCA CONTAINMENT P/T vs TIME Case # AGTL				
TIME,SEC	WATER, F	CONTAINMENT PRESS, PSIA	SUMP SAT. PRESS, PSIA	DELTA, P
0.00	120.0	17.70	1.69	16.01
0.17	119.9	19.39	1.69	17.702
0.37	121.4	21.79	1.76	20.03
1.30	134.5	30.66	2.50	28.16
2.80	153.2	40.80	4.02	36.78
3.80	164.0	46.42	5.22	41.2
4.80	174.1	51.61	6.58	45.03
5.80	182.7	56.23	7.97	48.26
7.80	194.9	63.35	10.36	52.99
8.80	198.5	65.74	11.17	54.57
10.80	202.6	68.60	12.16	56.44
12.80	203.9	70.17	12.48	57.69
18.80	204.1	70.35	12.54	57.81
20.80	204.1	70.34	12.54	57.8
28.80	204.0	70.37	12.51	57.86
38.80	203.8	70.52	12.46	58.06
68.80	202.5	71.19	12.13	59.06
88.80	201.4	71.82	11.86	59.96
98.80	200.8	72.13	11.71	60.42
112.80	199.9	72.49	11.50	60.99
122.80	199.3	72.77	11.36	61.41
132.80	198.6	73.07	11.19	61.88
152.80	197.3	73.70	10.89	62.81
172.80	196.2	74.34	10.65	63.69
192.80	197.4	74.41	10.92	63.49
210.80	198.4	74.51	11.15	63.36
248.80	199.8	74.23	11.48	62.75
288.80	200.9	73.87	11.74	62.13
308.80	201.3	73.54	11.84	61.7
338.80	201.7	73.06	11.94	61.12
368.80	202.0	72.42	12.01	60.41
388.80	202.1	71.98	12.03	59.95
428.80	202.2	71.13	12.06	59.07
448.80	202.3	70.70	12.08	58.62
468.80	202.3	70.27	12.08	58.19
488.80	202.3	69.86	12.08	57.78
530.00	202.2	69.05	12.06	56.99
730.00	201.3	65.22	11.84	53.38
830.00	200.6	63.46	11.67	51.79
930.00	199.9	61.83	11.50	50.33
1030.00	199.0	59.82	11.29	48.53
1180.00	197.5	56.71	10.94	45.77
1380.00	195.2	53.14	10.43	42.71
1530.00	193.4	50.88	10.04	40.84
1730.00	190.9	48.31	9.52	38.79
1930.00	188.4	46.14	9.02	37.12
2360.00	183.6	42.44	8.13	34.31
2860.00	181.2	40.29	7.71	32.58
3860.00	185.9	40.09	8.55	31.54
4260.00	187.6	39.94	8.87	31.07
5000.00	190.5	39.69	9.44	30.25

CURVE NO. N-18 A
DATE 1-14-72

CURVES ARE APPROXIMATE. PUMP GUARANTEED FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR, COLD, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT.

C.E.I. CONTRACT NUMBER 23866
C.E.I. PURCHASE ORDER 9900104
C.E.I. CUSTOMER: OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION UNIT 1
USE: CONTAINMENT SPRAY PUMPS

IMPELLER PATT. NO. 6 JC L3A DIA. 11"
DIFFUSOR PATT. NO.

B.H.P.

EST. PERFORMANCE
AT .005 INCREASED CLEARANCE

	CAPACITY	HEAD	EFF.	BHP
90	1200	470	60	237
	1500	460	68	256
	1700	452	72	269
80	2000	438	77	287
	2400	405	80	306

EFF.

HEAD

NPSH

TOTAL HEAD IN FEET

PER CENT EFFICIENCY

NPSH

GALLONS PER MINUTE

BRAKE HORSE POWER

THIS WILL CERTIFY THAT THIS CURVE IS BASED ON ACTUAL TEST PERFORMANCE.

A. Brkich
A. BRKICH FEB. 11, 1970

CHARACTERISTIC CURVE

NO. 6 TYPE UCL PUMP
3560 R. P. M.
PUMP NO. 068962 ORDER NO. 001-322

INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION

DATE 1-14-72 CURVE N-18E

O-MECH-CALC-021 Rev. 8
Page D 14

FC 05977

G-1226 7.500 8-62

CURVE NO. N 17 A
DATE 1-14-72

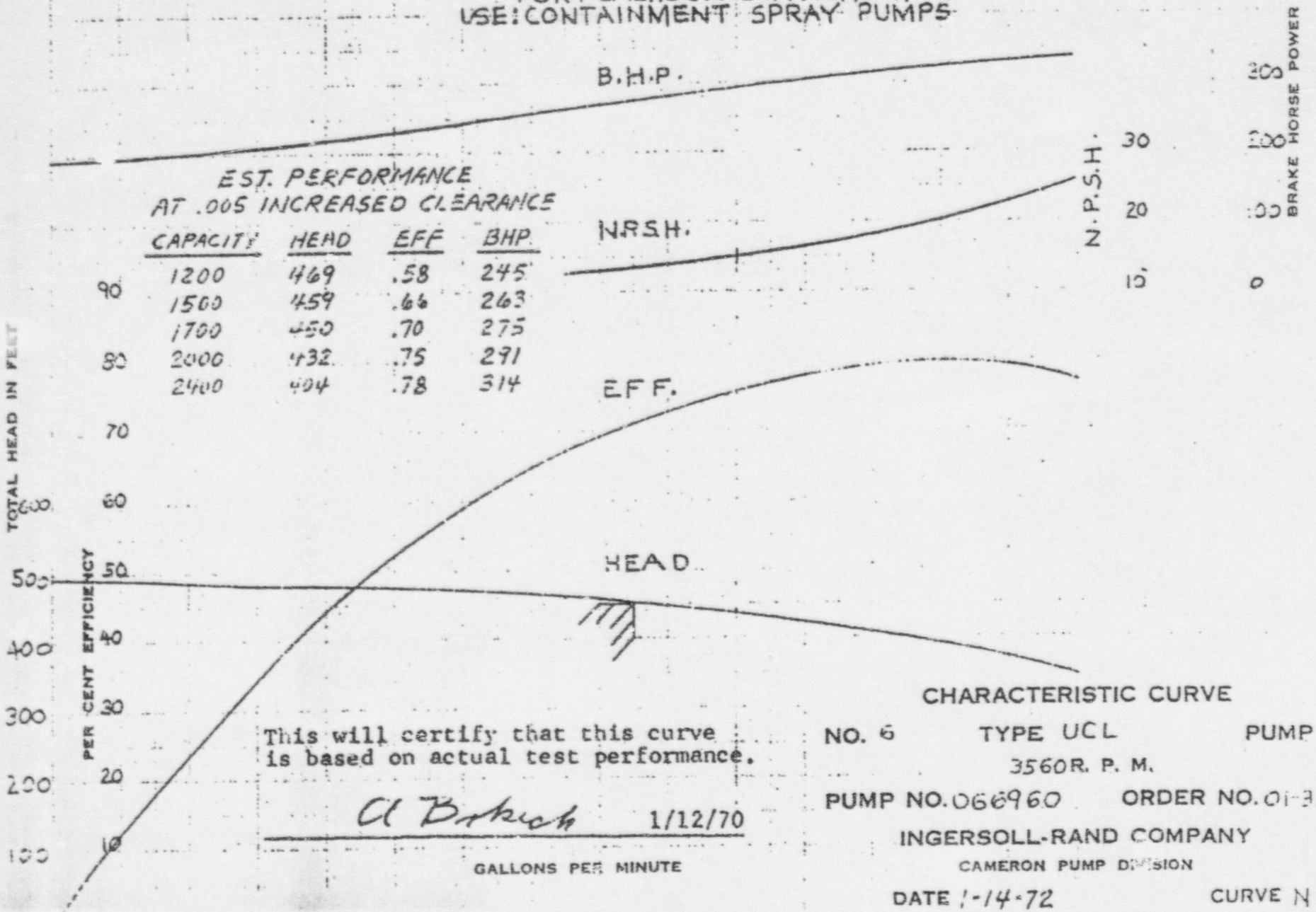
CURVES ARE APPROXIMATE. PUMP GUARANTEED FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR, COLD, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT.

CEI CONTRACT NUMBER 23866
CEI PURCHASE ORDER 9900104
CEI CUSTOMER:
OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION UNIT 1
USE: CONTAINMENT SPRAY PUMPS

IMPELLER PATT. NO. 6 JCL3A DIA. 11
DIFFUSOR PATT. NO.

EST. PERFORMANCE
AT .005 INCREASED CLEARANCE

CAPACITY	HEAD	EFF	BHP
1200	469	.58	245
1500	459	.66	263
1700	450	.70	275
2000	432	.75	291
2400	404	.78	314



This will certify that this curve is based on actual test performance.

C Bokich 1/12/70

CHARACTERISTIC CURVE

NO. 6 TYPE UCL PUMP

3560 R. P. M.

PUMP NO. 066960 ORDER NO. 01-3226

INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION

DATE 1-14-72 CURVE N 17 A

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FC 05977

G-1233 4M 10-6/

CURVE NO. N 178A
DATE 1-13-72

CURVES ARE APPROXIMATE. PUMP GUARANTEED FOR ONE SET OF CONDITIONS CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR, COLD, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT.

C.E.I. CONTRACT NUMBER 23865
C.E.I. PURCHASE ORDER 9900104
C.E.I. CUSTOMER:
OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION
UNIT 1

IMPELLER PATT. NO. 6UC13A DIA. 11
DIFFUSOR PATT. NO.

USE: CONTAINMENT SPRAY PUMPS

EST. PERFORMANCE
AT .005 INCREASED CLEARANCE

CAPACITY	HEAD	EFF	BHP
1200	470	59	242
1500	466	67	267
1700	454	71	276
2000	428	76	292
2495	408	79	313

BHP

EFF

HEAD

TOTAL HEAD IN FEET

PER CENT EFFICIENCY

GALLONS PER MINUTE

BRAKE HORSE POWER

This will certify that this curve is based on actual test data.

A. Strach 1/27/72

CHARACTERISTIC CURVE

NO. 6 TYPE 6UCL PUMP

R.P.M.

PUMP NO. 47181 ORDER NO.

INGERSOLL-RAND COMPANY
CAMDEN PUMP DIVISION

DATE 1-13-72 CURVE N-178A

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FC 05977

COMPUTER CODE CERTIFICATE

The following code, as noted by its name, version number and executable file identification, is approved for design use.

Code Name: PIPE-FLO

Version Number: 3.91a

Executable File Identification: PIPEFLO

Computer(s): IBM PC COMPATABLES

List any limitations on use, special hardware considerations, etc.

Verification and Validation Report Number: MISC-MPS-CALC-015

Program Manager: MARK PETRASKE

Date: 7/12/91

ABB Combustion Engineering Nuclear Power
Windsor, Connecticut

COMPUTER CODE CERTIFICATE

The following code, as noted by its name, version number and executable file identification, is approved for design use.

Code Name: NET-FLO

Version Number: 3.92a

Executable File Identification: * NETFLO.

Computer(s): IBM PC COMPATABLE

List any limitations on use, special hardware considerations, etc.

Verification and Validation Report Number: MISC-MPS-CALC-015

Program Manager: MARK PETRASKE

Date: 7/12/91

CHECKLIST FOR FLO-SERIES VERIFYING RUNS

Preparer	Reviewer	Task
~	RFP	Original Database Model OFFSETS
~	RFP	Taken from Calc O-MECH-CALC-019 Rev 01
~	RFP	Trial run of original database reproduces results of calc run.
~	RFP	Original database copied to file OFFSETS1
~	RFP	New file trial run reproduces results of calc run.
~	RFP	List of modifications to new file: Used auto pumps for Test pumps of Calc 019. New model used in Calc O-MECH-CALC-021 for OBE case with dummy junctions
~ In CALC-019	RFP	Piping project on file
~	RFP	Network summary report on file
~	RFP	Complete junction node report on file
~	RFP	Complete pipeline report on file
~	RFP	Piping diagram on file (In CALC-019 + CALC-021)
~	RFP	COMPTBL.SYS on file
N/A	—	USRVALV.SYS on file
~	RFP	Any other comments: FLO SERIES PRINTOUTS OF FILE W/ O-MECH-CALC-021 for OBE

Preparer: M Hyun

Reviewer: R. Pugh 6-10-92