DE&S
Duke Engineering & Services

CERTIFICATION OF ENGINEERING CALCULATION

PROJECT: Containment Overpressure Required for Adequate NPSH for ECCS.
LOCATION: Monticello Nuclear Generating Station
TITLE OF CALCULATION: Determination of Containment Overpressure Required for Adequate NPSH of the Low Pressure ECCS Pumps.
CALCULATION NO.: V75100.NSP97.00501
ORIGINALLY CONSISTING OF:
PAGES _____ THROUGH _____
TOTAL ATTACHMENTS 5 (A, B, C, D, & E)
TOTAL MICROFICHE ATTACHMENTS NONE

THESE ENGINEERING CALCULATION COVER QA CONDITION 1 ITEMS. IN ACCORDANCE WITH ESTABLISHED PROCEDURES. THE QUALITY HAS BEEN ASSURED AND I CERTIFY THAT THE ABOVE CALCULATION HAS BEEN ORIGINATED, VERIFIED, AND APPROVED AS NOTED BELOW:

ORIGINATED BY: Joseph D. Spagnuolo DATE: 6/16/97
VERIFIED BY: Wayne C. Hodge DATE: 6/18/97
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ISSUED FOR QA RECORD STORAGE: _____ DATE: _____
RECEIVED FOR QA RECORD STORAGE: _____ DATE: _____

MICROFICHE ATTACHMENT LIST: ☐ YES ☐ NO SEE FORM DPR-3.2D

REV. NO.	CALCULATED PAGES (VOL)			ATTACHMENTS (VOL)			VOLUMES		ORIG	VER	APPR	ISSUE DATE
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PROJECT:	Required Containment Overpressure for NPSH	FILE NO:	V75100.NSP97.00501
LOCATION:	Monticello Nuclear Generating Station	CALC.NO	V75100.NSP97.00501

Calculation Verification Checklist

Calculation Title: Determination of Containment Overpressure Required for Adequate NPSH of the Low Pressure ECCS Pumps.

Revision: 0

1)	Were inputs correctly selected and incorporated ?	(Y) / N / NA
2)	Are assumptions adequately described and reasonable?	(Y) / N / NA
3)	Are the appropriate quality and quality assurance requirements specified?	(Y) / N / NA
4)	Are the applicable codes, standards and regulatory requirements identified and met?	(Y) / N / NA
5)	Have applicable construction and operating experience been considered?	Y / N / (NA)
6)	Have the design interface requirements been satisfied?	(Y) / N / NA
7)	Was an appropriate design method used?	(Y) / N / NA
8)	Is the output reasonable compared to inputs?	(Y) / N / NA
9)	Are specified parts, equipment, and processes suitable for the required application?	(Y) / N / NA
10)	Are the specified materials compatible with design environmental conditions?	Y / N / (NA)
11)	Have adequate maintenance features and requirements been specified?	Y / N / (NA)
12)	Are accessibility and other design provisions adequate?	Y / N / (NA)
13)	Has adequate accessibility been provided to perform the in-service inspection?	Y / N / (NA)
14)	Has the design properly considered radiation exposure?	Y / N / (NA)
15)	Are the acceptance criteria incorporated in the design documents sufficient to allow verification?	Y / N / (NA)
16)	Have adequate pre-operational and subsequent periodic test requirements been specified?	Y / N / (NA)
17)	Are adequate handling, storage, cleaning and shipping requirements specified?	Y / N / (NA)
18)	Are adequate identification requirements specified?	Y / N / (NA)
19)	Are requirements for record preparation review, approval, retention, etc., adequately specified?	Y / N / (NA)

Verified by/Date: Stg C. Hu 6/18/97 **Initials:** LH

Verifier

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PROJECT:	Required Containment Overpressure for NPSH	FILE NO:	V75100.NSP97.00501
LOCATION:	Monticello Nuclear Generating Station	CALC.NO	V75100.NSP97.00501

Design Verification Sheet

Client/Project Northern States Power - Monticello Nuclear Generating Station
Required Containment Overpressure for Adequate ECCS NPSH

Title of Calculation Determination of Containment Overpressure Required for Adequate NPSH of the Low Pressure ECCS Pumps.

Calculation No. V75100.NSP97.00501 **Rev. No.** 0

Design Verification Method:

- ☒ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

Results of Design Review ALL COMMENTS RESOLVED

Verifier

6/18/97
Date

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DE&S

Naperville, Illinois

PROJECT	Monticello Nuclear Station	File No:	V75100.NSP97.00501
OWNER	Northern States Power Co.	Calc No:	V75100.NSP97.00501
CLIENT	Monticello Nuclear Station		

REFERENCE

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List Of Attachments

A. NPSH AND OVER PRESSURE RESULTS FOR EACH CASE. page 16

B. FLO-SERIES MODEL PIPING AND NETWORK INPUT AND OUTPUT FOR CASE #1. page 25

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REFERENCE

1.0 OBJECTIVE

The purpose of this calculation is to determine the containment over pressure that would be required to achieve an adequate Net Positive Suction Head (NPSH) for the Core Spray (CS) and Residual Heat Removal (RHR) pumps during different phases and scenarios of the Design Basis Accident (DBA), Loss of Cooling Accident (LOCA).

2.0 QA REQUIREMENTS

This calculation covers QA condition 1 items (Nuclear Safety Related).

3.0 METHODOLOGY

3.1 Introduction

This analysis will use FLO-SERIES software, version 5.01, to run the model of the CS and RHR piping systems which was created in DE&S calculation V75100.NSP97.00500, "Low Pressure Emergency Core Cooling System (ECCS) Run Out Flows". Specific data, which is representative of particular Torus and plant conditions will be input into this model in order to achieve pump and system output data required for NPSH determinations. 8.4

3.2 FLO-SERIES modeling

3.2.1 The FLO-SERIES software methodology uses Bernoulli's equation in determining the system pressures at the node points. When performing the pressure calculation at a node in the system, the fluid velocity value is unknown at that node so it is not factored into the pressure calculation. FLO-SERIES explains this assumption by stating that the fluid velocities in a process system are designed to be fairly constant and therefore the velocity terms will cancel each other out in the equation.

This assumption can not be applied in this model. Regardless of changes in fluid velocities within the system, the pressures being calculated need to be corrected for velocity head. In order to determine the correct NPSHA for each pump, the correct pressure at that pump suction must be used. In order to obtain the correct suction pressure for each pump, a correction must be added which takes into account the effect of velocity head. This correction consists of adding a fixed resistance

		REFERENCE
	coefficient of 1. This resistance coefficient is used in calculating the head loss and is directly related to the velocity in the pipe. This head loss is equal the velocity term in Bernoulli's equation. The correction is placed in the model piping just upstream of each pump suction node and corrects the pressure at each pump suction node by taking velocity into account as a head loss. In the model, this correction for the velocity term in Bernoulli's equation is identified as, "Fixed K vel corctn". This methodology was used in DE&S calculation V609.000.00001 rev. 2, "Low Pressure Emergency Core Cooling Systems (ECCS) Net Positive Suction Head (NPSH)".	8.3
3.2.2	The "A" suction strainer was chosen to be modeled as the blocked strainer due to the results of the DE&S calculation V75100.NSP97.00500, "Determination of CS and RHR system run out flows", which shows that the "A" suction strainer passes the largest amount of flow.	8.4
3.2.3	To produce the CS and RHR pump flows specified by each case, a control valve was simulated in the model line ups. The control valve was set to the specific pump flow for each case. In order to produce the pump run out flows specified in case #1, the model line up does not contain any control valves, which allows the CS and RHR pumps to pump as much flow as the piping system and pump design will allow. These run out flows are less than the flows determined by DE&S calculation V75100.NSP97.00500, "Determination of CS and RHR system run out flows". The decrease in pump run out flows is due to the 15% increase in pipe friction loss due to aging of the piping as discussed in section 7.3.	8.4
3.3	FLO-SERIES results	
	The FLO-SERIES model of the Torus ring header and ECCS piping allows the specified initial Torus conditions, such as pressure and temperature, as well as pump flows, to be input into the model with the purpose of receiving the outputs needed for the NPSH calculations. The specific FLO-SERIES outputs required for the NPSH calculations are fluid velocity and pressure at the suction of the particular pump.	

REFERENCE

3.4 NPSH Calculations

Given the inputs of fluid velocity and pressure at the pump suction, the NPSH available to any of the RHR or CS loops (A or B) is calculated using the following equation.

$$NPSHA = Hb/\gamma - Hva/\gamma + Ps/\gamma + Z + Vs^2/2g$$ 8.7

where:

NPSHA = net positive suction head available, ft.
Hb = atmospheric pressure, 2053.44 lb/ft^2. 8.5
Hva = vapor pressure at the specified fluid temp, lb/ft^2.
Ps = pressure of the fluid at the suction of the pump, lb/ft^2.
γ = specific weight of fluid at pumping temperature, lb/ft^3 = (1/specific volume).
Vs = average velocity of the fluid at the suction of the pump, ft/s.
Z = vertical distance between center line of pump and indication of Ps, = 0.0 ft.
g = 32.2 ft/s^2.

3.5 NPSH Details

Attachment A contains spread sheets which details the NPSH calculations for the CS and RHR systems in each case. NPSHA is calculated for each operating pump, at the specified time interval and associated temperature, for each case. The pump suction pressure and velocity that is determined from the FLO-SERIES results is used in the above equation, along with the specific weight and vapor pressure for that specified temperature, to calculate the NPSHA. The NPSHA is then subtracted from the NPSHR, and that result is the required containment pressure that is needed to satisfy NPSHR.

4.0 APPLICABLE CODES AND STANDARDS

This calculation of NPSHA for the low pressure ECCS pumps does not reference any codes or standards.

REFERENCE

5.0 DESIGN INPUT

5.1 Case #1:

Short Term phase of the DBA LOCA - 0 to 600 sec (10 minutes). 8.6

- Double ended guillotine break of the "B" Reactor Recirculation discharge piping.
- Failure of the LPCI loop select logic.
- 100 % blockage of the "A" ECCS ring header suction strainer.
- Head loss of the remaining suction strainers is 1 ft @ 10,000 gpm.
- All CS and LPCI pumps running at run out flows.
- Suppression pool temperatures for the specific time intervals listed below, that are listed in Case 1 of reference 8.2.

PARAMETERS	VALUE	
Atmospheric Pressure	14.26 psia	8.6
Primary Containment Pressure	0 psig	8.6
Reactor Pressure	0 psig	8.6
Suppression Pool Water Level	908'-9.3"	8.6
"A" CS Pump Flow	run out	8.6
"B" CS Pump Flow	run out	8.6
"A" RHR Pump Flow	run out	8.6
"B" RHR Pump Flow	run out	8.6
"C" RHR Pump Flow	run out	8.6
"D" RHR Pump Flow	run out	8.6
CS NPSHR	33 ft	8.9
RHR NPSHR	27 ft	8.10

Time	Temperature	Specific Weight	Vapor Pressure	
86.3 sec	131.8 ^{o}F	61.5195 lb/ft^3	335.8368 lb/ft^2	8.6, 8.8
148.8 sec	137.9 ^{o}F	61.4119 lb/ft^3	394.0948 lb/ft^2	8.6, 8.8
212.2 sec	141.6 ^{o}F	61.3459 lb/ft^3	433.4947 lb/ft^2	8.6, 8.8
274.7 sec	143.5 ^{o}F	61.3121 lb/ft^3	454.9824 lb/ft^2	8.6, 8.8
337.2 sec	145.1 ^{o}F	61.2839 lb/ft^3	473.7556 lb/ft^2	8.6, 8.8
399.7 sec	146.4 ^{o}F	61.2482 lb/ft^3	489.5280 lb/ft^2	8.6, 8.8
462.2 sec	147.5 ^{o}F	61.2389 lb/ft^3	503.2008 lb/ft^2	8.6, 8.8
524.7 sec	148.3 ^{o}F	61.2239 lb/ft^3	513.3398 lb/ft^2	8.6, 8.8
587.2 sec	149.1 ^{o}F	61.2085 lb/ft^3	523.6430 lb/ft^2	8.6, 8.8
599.7 sec	149.3 ^{o}F	61.2040 lb/ft^3	526.2667 lb/ft^2	8.6, 8.8

REFERENCE

5.2 Case #2:

Long Term phase of the DBA LOCA - greater than 600 sec (10 minutes) . 8.6

- Double ended guillotine break of the "B" Reactor Recirculation discharge piping.
- Loss of off-site power.
- Failure of one Diesel Generator.
- 100 % blockage of the "A" ECCS ring header suction strainer.
- Head loss of the remaining suction strainers is 1 ft @ 10,000 gpm.
- Suppression pool temperatures for the specific time intervals listed below, that are listed in Case 2 of reference 8.1.

PARAMETERS	VALUE	REFERENCE
Atmospheric Pressure	14.26 psia	8.6
Primary Containment Pressure	0 psig	8.6
Reactor Pressure	0 psig	8.6
Suppression Pool Water Level	908'-9.3"	8.6
"A" CS Pump Flow	0 gpm	8.6
"B" CS Pump Flow	2800 gpm (delivered to the core)	8.6
"A" RHR Pump Flow	0 gpm	8.6
"B" RHR Pump Flow	4000 gpm	8.6
"C" RHR Pump Flow	0 gpm	8.6
"D" RHR Pump Flow	0 gpm	8.6
CS NPSHR	29 ft	8.9
RHR NPSHR	26 ft	8.10

Time	Temperature	Specific Weight	Vapor Pressure	
742.8 sec	152.7 ^{o}F	61.1378 lb/ft^3	572.3140 lb/ft^2	8.6, 8.8
2280.1 sec	164.0 ^{o}F	60.9125 lb/ft^3	750.5856 lb/ft^2	8.6, 8.8
6017.6 sec	176.0 ^{o}F	60.6575 lb/ft^3	989.1360 lb/ft^2	8.6, 8.8
15,039.1 sec	188.0 ^{o}F	60.3901 lb/ft^3	1288.3680 lb/ft^2	8.6, 8.8
21,538.3 sec	192.0 ^{o}F	60.2954 lb/ft^3	1403.5680 lb/ft^2	8.6, 8.8
30,035.6 sec	194.0 ^{o}F	60.2482 lb/ft^3	1464.1920 lb/ft^2	8.6, 8.8
33,534.8 sec	194.2 ^{o}F	60.2439 lb/ft^3	1470.4400 lb/ft^2	8.6, 8.8
46,528.1 sec	193.0 ^{o}F	60.2736 lb/ft^3	1433.6640 lb/ft^2	8.6, 8.8
52,027.3 sec	192.0 ^{o}F	60.2954 lb/ft^3	1403.5680 lb/ft^2	8.6, 8.8
71,151.1 sec	187.0 ^{o}F	60.4120 lb/ft^3	1260.8640 lb/ft^2	8.6, 8.8

REFERENCE

5.3 Case #3:
Long Term phase of the DBA LOCA - greater than 600 sec (10 minutes). 8.6

- Double ended guillotine break of the "B" Reactor Recirculation discharge piping.
- Failure of the LPCI injection valve.
- Loss of off-site power.
- 100 % blockage of the "A" ECCS ring header suction strainer.
- Head loss of the remaining suction strainers is 1 ft @ 10,000 gpm.
- Suppression pool temperatures for the specific time intervals listed below, that are listed in Case 2 of reference 8.2.

PARAMETERS	VALUE	
Atmospheric Pressure	14.26 psia	8.6
Primary Containment Pressure	0 psig	8.6
Reactor Pressure	0 psig	8.6
Suppression Pool Water Level	908'-9.3"	8.6
"A" CS Pump Flow	2800 gpm (delivered to the core)	8.6
"B" CS Pump Flow	2800 gpm (delivered to the core)	8.6
"A" RHR Pump Flow	0 gpm	8.6
"B" RHR Pump Flow	4000 gpm	8.6
"C" RHR Pump Flow	4000 gpm	8.6
"D" RHR Pump Flow	0 gpm	8.6
CS NPSHR	29 ft	8.9
RHR NPSHR	26 ft	8.10

Time	Temperature	Specific Weight	Vapor Pressure	
742.7 sec	150.2 °F	61.1845 lb/ft^3	537.6960 lb/ft^2	8.6, 8.8
2349.0 sec	159.8 °F	60.9979 lb/ft^3	679.5360 lb/ft^2	8.6, 8.8
4007.0 sec	164.5 °F	60.9013 lb/ft^3	759.4920 lb/ft^2	8.6, 8.8
5324.0 sec	167.1 °F	60.8472 lb/ft^3	807.0077 lb/ft^2	8.6, 8.8
6299.5 sec	168.0 °F	60.8273 lb/ft^3	824.0112 lb/ft^2	8.6, 8.8
7612.5 sec	168.4 °F	60.8199 lb/ft^3	831.7238 lb/ft^2	8.6, 8.8
8925.5 sec	168.7 °F	60.8143 lb/ft^3	837.5083 lb/ft^2	8.6, 8.8
14,579.2 sec	166.3 °F	60.8650 lb/ft^3	792.1354 lb/ft^2	8.6, 8.8
28,055.0 sec	158.4 °F	61.0262 lb/ft^3	657.1555 lb/ft^2	8.6, 8.8
41,793.7 sec	151.3 °F	61.1639 lb/ft^3	552.9499 lb/ft^2	8.6, 8.8

REFERENCE

5.4 Case #4:

Long Term phase of the DBA LOCA - greater than 600 sec (10 minutes) . 8.6

- Double ended guillotine break of the "B" Reactor Recirculation discharge piping.
- Failure of the LPCI injection valve.
- 100 % blockage of the "A" ECCS ring header suction strainer.
- Head loss of the remaining suction strainers is 1 ft @ 10,000 gpm.
- Suppression pool temperatures for the specific time intervals listed below, that are listed in Case 4 of reference 8.2.

PARAMETERS	VALUE	
Atmospheric Pressure	14.26 psia	8.6
Primary Containment Pressure	0 psig	8.6
Reactor Pressure	0 psig	8.6
Suppression Pool Water Level	908'-9.3"	8.6
"A" CS Pump Flow	2800 gpm (delivered to the core)	8.6
"B" CS Pump Flow	2800 gpm (delivered to the core)	8.6
"A" RHR Pump Flow	4000 gpm	8.6
"B" RHR Pump Flow	4000 gpm	8.6
"C" RHR Pump Flow	4000 gpm	8.6
"D" RHR Pump Flow	4000 gpm	8.6
CS NPSHR	29 ft	8.6, 8.9
RHR NPSHR	26 ft	8.6, 8.10

Time	Temperature	Specific Weight	Vapor Pressure	
724.0 sec	150.5 °F	61.1789 lb/ft^3	542.1456 lb/ft^2	8.6, 8.8
1647.3 sec	156.0 °F	61.0724 lb/ft^3	620.1792 lb/ft^2	8.6, 8.8
3213.8 sec	159.9 °F	60.9961 lb/ft^3	681.1488 lb/ft^2	8.6, 8.8
4621.6 sec	162.0 °F	60.9533 lb/ft^3	715.9968 lb/ft^2	8.6, 8.8
5094.8 sec	162.2 °F	60.9489 lb/ft^3	719.4211 lb/ft^2	8.6, 8.8
6475.3 sec	162.0 °F	60.9533 lb/ft^3	715.9968 lb/ft^2	8.6, 8.8
7894.8 sec	161.0 °F	60.9719 lb/ft^3	699.2064 lb/ft^2	8.6, 8.8
9618.6 sec	159.9 °F	60.9961 lb/ft^3	681.1488 lb/ft^2	8.6, 8.8
11,759.8 sec	157.7 °F	61.0407 lb/ft^3	646.1928 lb/ft^2	8.6, 8.8
21,124.8 sec	149.3 °F	61.2040 lb/ft^3	526.2667 lb/ft^2	8.6, 8.8

REFERENCE

6.0 APPLICABLE FSAR CRITERIA

UFSAR section 6.2, "Emergency Core Cooling Systems (ECCS)", contains the overall description of the CS and RHR systems.

7.0 ASSUMPTIONS

7.1 The head loss of the ECCS ring header suction strainers and the associated Ram's head was modeled as a 1 foot head loss at 10,000 gpm. The calculated head loss is shown in DE&S calculation V751.NSP97.00502 rev. 0, "Head Loss Through ECCS Suction Strainer Assembly". 8.5

7.2 CS and RHR system losses are not changed by the change in fluid temperature. The pump suction pressures which are used in calculating the NPSHAs for each case, do not change enough over the change in suppression pool temperature to significantly change the resultant NPSH, therefore the pump suction pressure used in the NPSHA calculations remains as a constant for each case. The pump suction pressure that is used in the calculation of the NPSHA, is taken at the lowest temperature for that case. As the suppression pool temperature increases, there will be less head losses in the piping system, and therefore a larger suction pressure will result. By using the pump suction pressure at the lowest temperature for that case, the result of the NPSHA will be conservative.

7.3 To model the effects that aging has on the friction factor of a pipe, the lengths of each pipe in the FLO-SERIES model were increased by 15%. The increase in pipe length by 15% will increase the head loss of the particular pipe by 15%, thus simulating a 15% increase of the pipe friction factor.

REFERENCE

8.0 REFERENCES

8.1 Letter GLN-97-019, from P. T. Tran of General Electric Company, to S. J. Hammer of Northern States Power Company, Monticello Nuclear Generating Station, dated May 9, 1997, subject: "Revised Analysis of Suppression Pool Temperature and Wetwell Pressure for Limiting Long-term LOCA event for NPSH (Task 6.0)."

8.2 Letter GLN-97-022, from P. T. Tran of General Electric Company, to S. J. Hammer of Northern States Power Company, Monticello Nuclear Generating Station, dated May 30, 1997, subject: "Additional Analysis of LOCA Suppression Pool Temperature and Wetwell Pressure for Evaluating NPSH (Task 6.0)."

8.3 DE&S calculation V609.000.00001 rev. 2, "Low Pressure Emergency Core Cooling Systems (ECCS) Net Positive Suction Head (NPSH)".

8.4 DE&S calculation V751.NSP97.00500 rev. 0, "Low Pressure Emergency Core Cooling Systems (ECCS) Run Out Flows".

8.5 DE&S calculation V751.NSP97.00502 rev. 0, "Head Loss Through ECCS Suction Strainer Assembly".

8.6 Fax from Pat Tobin of Norther States Power Company, to Joe Sparacino of DE&S, Subject: Inputs for Containment Pressurer/NPSH Evaluation Rev. 1, Dated June 15, 1997.

8.7 Pump Handbook, 2nd edition, 1986, Igor J. Karassik.

8.8 ASME Steam Tables, sixth edition, The American Society of Mechanical Engineers.

8.9 Monticello Station Drawing No. NX-7833-17, 18, 23, & 24, "CS Pump Curves and Data Tables".

8.10 Monticello Station Drawing No. NX-7905-51, 52, 53, 54, 55, 56, 58, & 59, "RHR Pump Curves and Data Tables".

9.0 STATEMENT OF SUITABILITY

This calculation does not involve any materials, parts, equipment, or processes which require a suitability review.

REFERENCE

10.0 CALCULATIONS

10.1 FLO-SERIES modeling

The nodal diagram, piping inputs and line up outputs for the low pressure ECCS piping model is contained in attachments B, C, D, and E. The resultant suction pressures and velocities for each pump, in each case defined in the Inputs section, 5.0, are listed in Table 10.1 below. In each of the model runs, the High Pressure Core Injection (HPCI) system, and Reactor Core Isolation Cooling (RCIC) system have been isolated from the ring header.

10.2 Table 10.1, shown below, lists the pressure and velocity at the suction of each pump for each case. These pressures and velocities are used to calculate the NPSHA as shown in attachment A.

	PUMP	PRESSURE	VELOCITY
Case #1	"A" CS	-1.153 psig	12.29 ft/sec
	"B" CS	-1.380 psig	12.05 ft/sec
	"A" RHR	-0.109 psig	9.956 ft/sec
	"B" RHR	-0.941 psig	10.07 ft/sec
	"C" RHR	-0.543 psig	10.08 ft/sec
	"D" RHR	-0.555 psig	10.11 ft/sec
Case #2	"B" CS	2.108 psig	8.688 ft/sec
	"B" RHR	2..399 psig	9.315 ft/sec
Case #3	"A" CS	1.938 psig	8.706 ft/sec
	"B" CS	1.857 psig	8.688 ft/sec
	"B" RHR	2.127 psig	9.315 ft/sec
	"C" RHR	2.222 psig	9.315 ft/sec
Case #4	"A" CS	1.511 psig	8.706 ft/sec
	"B" CS	1.177 psig	8.687 ft/sec
	"A" RHR	0.683 psig	9.279 ft/sec
	"B" RHR	0.047 psig	9.297 ft/sec
	"C" RHR	0.327 psig	9.351 ft/sec
	"D" RHR	0.376 psig	9.332 ft/sec

TABLE 10.1

REFERENCE

11.0 SUMMARY AND CONCLUSIONS

11.1 Results: The results of the FLO-SERIES model runs for each case are attached to this calculation in each of attachments B, C, D, and E. The pump suction pressure and velocity output results of the models are listed in Table 10.1 for each case. The required containment over pressure results for each pump, which is the difference between the NPSHR and the NPSHA, are listed in Attachment A for each case according to time (elapsed time after the break of the Reactor Recirculation line) and Suppression Pool temperature. The details of the NPSHA calculations for the different temperatures in each of the 4 cases are also shown in Attachment A.

11.2 Conclusion: The over all containment over pressure required for each case, and the pump that it is required for, is listed in Table 11.1 below. These pressures were determined by using the largest required containment pressure for each case.

CASE	REQUIRED OVER PRESSURE	SYSTEM PUMP
1	3.9161 psig	"B" CS
2	5.6801 psig	"B" CS
3	1.4887 psig	"B" CS
4	1.3689 psig	"B" CS

TABLE 11.1

REFERENCE

ATTACHMENT A

NPSH AND OVER PRESSURE RESULTS FOR EACH CASE.

CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE CORE SPRAY NPSH DURING THE SHORT TERM PHASE OF THE DBA LOCA

Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft³)	Vapor Pressure (Hva) (lb/ft²)	Hva/Sw (ft.)	Atmospheric Pressure (Hb) (lb/ft2)	Hb/Sw (ft.)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + V²/2(32.2)) (ft.)	NPSHA (ft.)	NPSHR (ft.)	System Pump	Required Containment Pressure (psig)
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-1.153	12.29	-0.3534	27.5662	33	"A" CS	2.3529
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-1.38	12.05	-0.9755	26.9441	33	"B" CS	2.6234
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-1.153	12.29	-0.3582	26.6618	33	"A" CS	2.7457
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-1.38	12.05	-0.9812	26.0388	33	"B" CS	3.0156
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-1.153	12.29	-0.3611	26.0456	33	"A" CS	3.0126
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-1.38	12.05	-0.9846	25.4221	33	"B" CS	3.2828
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.4[illegible]	-1.153	12.29	-0.3626	25.7083	33	"A" CS	3.1588
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.[illegible]31[illegible]	-1.38	12.05	-0.9864	25.0844	33	"B" CS	3.4290
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-1.153	12.29	-0.3638	25.4127	33	"A" CS	3.2868
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-1.38	12.05	-0.9879	24.7886	33	"B" CS	3.5572
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-1.153	12.29	-0.3654	25.1686	33	"A" CS	3.3926
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-1.38	12.05	-0.9898	24.5442	33	"B" CS	3.6631
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-1.153	12.29	-0.3658	24.9488	33	"A" CS	3.4878
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-1.38	12.05	-0.9903	24.3243	33	"B" CS	3.7583
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-1.153	12.29	-0.3665	24.7887	33	"A" CS	3.5571
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-1.38	12.05	-0.9911	24.1641	33	"B" CS	3.8277
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-1.153	12.29	-0.3672	24.6261	33	"A" CS	3.6276
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-1.38	12.05	-0.9919	24.0013	33	"B" CS	3.8982
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-1.153	12.29	-0.3674	24.5848	33	"A" CS	3.6455
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-1.38	12.05	-0.9921	23.9600	33	"B" CS	3.9161

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE RHR NPSH DURING THE SHORT TERM PHASE OF THE DBA LOCA

Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft³)	Vapor Pressure (Hva) (lb/ft²)	Hva/Sw (ft.)	Atmospherec Prassure (Hb) (lb/ft2)	Hb/Sw (ft.)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + V²/2(32.2)) (ft.)	NPSHA (ft.)	NPSHR (ft.)	System Pump	Required Containment Pressure (psig)
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-0.109	9.956	1.2840	29.2037	27	"A" RHR	-0.9546
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-0.9041	10.07	-0.5416	27.3780	27	"B" RHR	-0.1638
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-0.543	10.08	0.3067	28.2264	27	"C" RHR	-0.5313
86.3	131.8	61.5195	335.8368	5.4590	2053.44	33.3787	-0.555	10.11	0.2880	28.2077	27	"D" RHR	-0.5232
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-0.109	9.956	1.2836	28.3035	27	"A" RHR	-0.5647
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-0.9041	10.07	-0.5453	26.4746	27	"B" RHR	0.2276
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-0.543	10.08	0.3045	27.3244	27	"C" RHR	-0.1405
148.8	137.9	61.4119	394.0949	6.4172	2053.44	33.4372	-0.555	10.11	0.2858	27.3057	27	"D" RHR	-0.1324
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-0.109	9.956	1.2833	27.6900	27	"A" RHR	-0.2989
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-0.9041	10.07	-0.5476	25.8591	27	"B" RHR	0.4942
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-0.543	10.08	0.3031	26.7099	27	"C" RHR	0.1257
212.2	141.6	61.3459	433.4947	7.0664	2053.44	33.4731	-0.555	10.11	0.2844	26.6911	27	"D" RHR	0.1338
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.4916	-0.109	9.956	1.2832	27.3540	27	"A" RHR	-0.1534
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.4916	-0.9041	10.07	-0.5488	25.5220	27	"B" RHR	0.6402
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.4916	-0.543	10.08	0.3024	26.3733	27	"C" RHR	0.2715
274.7	143.5	61.3121	454.9824	7.4208	2053.44	33.4916	-0.555	10.11	0.2836	26.3545	27	"D" RHR	0.2796
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-0.109	9.956	1.2830	27.0595	27	"A" RHR	-0.0258
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-0.9041	10.07	-0.5498	25.2267	27	"B" RHR	0.7682
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-0.543	10.08	0.3018	26.0783	27	"C" RHR	0.3993
337.2	145.1	61.2839	473.7556	7.7305	2053.44	33.5070	-0.555	10.11	0.2830	26.0596	27	"D" RHR	0.4074
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-0.109	9.956	1.2829	26.8169	27	"A" RHR	0.0793
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-0.9041	10.07	-0.5510	24.9830	27	"B" RHR	0.8738
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-0.543	10.08	0.3011	25.8351	27	"C" RHR	0.5046
399.7	146.4	61.2482	489.5280	7.9925	2053.44	33.5265	-0.555	10.11	0.2823	25.8163	27	"D" RHR	0.5128
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-0.109	9.956	1.2829	26.5975	27	"A" RHR	0.1744
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-0.9041	10.07	-0.5513	24.7633	27	"B" RHR	0.9689
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-0.543	10.08	0.3009	25.6155	27	"C" RHR	0.5998
462.2	147.5	61.2389	503.2008	8.2170	2053.44	33.5316	-0.555	10.11	0.2821	25.5967	27	"D" RHR	0.6079
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-0.109	9.956	1.2828	26.4380	27	"A" RHR	0.2435
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-0.9041	10.07	-0.5519	24.6034	27	"B" RHR	1.0092
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-0.543	10.08	0.3006	25.4558	27	"C" RHR	0.6689
524.7	148.3	61.2239	513.3398	8.3846	2053.44	33.5399	-0.555	10.11	0.2818	25.4370	27	"D" RHR	0.6771
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-0.109	9.956	1.2827	26.2759	27	"A" RHR	0.3137
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-0.9041	10.07	-0.5524	24.4408	27	"B" RHR	1.1086
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-0.543	10.08	0.3003	25.2935	27	"C" RHR	0.7393
587.2	149.1	61.2085	523.6430	8.5551	2053.44	33.5483	-0.555	10.11	0.2814	25.2747	27	"D" RHR	0.7474
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-0.109	9.956	1.2827	26.2349	27	"A" RHR	0.3314
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-0.9041	10.07	-0.5525	24.3996	27	"B" RHR	1.1265
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-0.543	10.08	0.3002	25.2524	27	"C" RHR	0.7571
599.7	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	-0.555	10.11	0.2813	25.2335	27	"D" RHR	0.7652

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE CORE SPRAY NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA													
Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft)	Atmosphereic Pressure (Hb) (:b/ft2)	Hb/Sw (ft)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + V^2/2(32 2)) (ft)	NPSHA (ft)	NPSHR (ft)	System Pump	Required Containment Pressure (psig)
742 8	152 7	61 1378	572 3140	9 3611	2053 44	33 5871	2 108	8 688	6 1371	30 3632	29	"B" CS	-0 5905
2280 1	164	60 9125	750 5856	12 3224	2053 44	33 7113	2 108	8 688	6 1555	27 5444	29	"B" CS	0 6305
6017 6	176	60 6575	989 1360	16 3069	2053 44	33 8530	2 108	8 688	6 1764	23 7225	29	"B" CS	2 2862
15039 1	188	60 3901	1288 3680	21 3341	2053 44	34 0029	2 108	8 688	6 1986	18 8674	29	"B" CS	4 3894
21538 3	192	60 2954	1403 5680	23 2782	2053 44	34 0563	2 108	8 688	6 2065	16 9846	29	"B" CS	5 2051
30035 6	194	60 2482	1464 1920	24 3027	2053 44	34 0830	2 108	8 688	6 2104	15 9908	29	"B" CS	5 6356
33534 8	194 2	60 2439	1470 4400	24 4081	2053 44	34 0855	2 108	8 688	6 2108	15 8881	29	"B" CS	5 6801
46528 1	193	60 2736	1433 6640	23 7859	2053 44	34 0686	2 108	8 688	6 2083	16 4910	29	"B" CS	5 4189
52027 3	192	60 2954	1403 5680	23 2782	2053 44	34 0563	2 108	8 688	6 2065	16 9846	29	"B" CS	5 2051
71151 1	187	60 4120	1260 8640	20 8711	2053 44	33 9906	2 108	8 688	6 1968	19 3163	29	"B" CS	4 1950

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE RHR NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA													
Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft)	Atmosphereic Pressure (Hb) (lb/ft2)	Hb/Sw (ft)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + V^2/2(32 2)) (ft)	NPSHA (ft)	NPSHR (ft)	System Pump	Required Containment Pressure (psig)
742 8	152 7	61 1378	572 3140	9 3611	2053 44	33 5871	2 399	9 315	6 9978	31 2238	26	"B" RHR	-2 2630
2280 1	164	60 9125	750 5856	12 3224	2053 44	33 7113	2 399	9 315	7 0187	28 4077	26	"B" RHR	-1 0430
6017 6	176	60 6575	989 1360	16 3069	2053 44	33 8530	2 399	9 315	7 0425	24 5887	26	"B" RHR	0 6114
15039 1	188	60 3901	1288 3680	21 3341	2053 44	34 0029	2 399	9 315	7 0678	19 7366	26	"B" RHR	2 7133
21538 3	192	60 2954	1403 5680	23 2782	2053 44	34 0563	2 399	9 315	7 0767	17 8549	26	"B" RHR	3 5285
30035 6	194	60 2482	1464 1920	24 3027	2053 44	34 0830	2 399	9 315	7 0812	16 8616	26	"B" RHR	3 9588
33534 8	194 2	60 2439	1470 4400	24 4081	2053 44	34 0855	2 399	9 315	7 0816	16 7590	26	"B" RHR	4 0032
46528 1	193	60 2736	1433 6640	23 7859	2053 44	34 0686	2 399	9 315	7 0788	17 3615	26	"B" RHR	3 7422
52027 3	192	60 2954	1403 5680	23 2782	2053 44	34 0563	2 399	9 315	7 0767	17 8549	26	"B" RHR	3 5285
71151 1	187	60 4120	1260 8640	20 8711	2053 44	33 9906	2 399	9 315	7 0657	20 1852	26	"B" RHR	2 5190

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE CORE SPRAY NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA													
Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft)	Atmosphereic Pressure (Hb) (lb/ft2)	Hb/Sw (ft)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + V^2/(32 2)) (ft)	NPSHA (ft)	NPSHR (ft)	System Pump	Required Containment Pressure (psig)
742 7	150 2	61 1845	537 6960	8 7881	2053 44	33 5614	1 938	8 706	5 7381	30 5114	29	"A" CS	-0 6547
742 7	150 2	61 1845	537 6960	8 7881	2053 44	33 5614	1 857	8 688	5 5426	30 3159	29	"B" CS	-0 5701
2349	159 8	60 9979	679 5360	11 1403	2053 44	33 6641	1 938	8 706	5 7520	28 2758	29	"A" CS	0 3137
2349	159 8	60 9979	679 5360	11 1403	2053 44	33 6641	1 857	8 688	5 5560	28 0797	29	"B" CS	0 3987
4007	164 5	60 9013	759 4920	12 4709	2053 44	33 7175	1 938	8 706	5 7592	27 0059	29	"A" CS	0 8638
4007	164 5	60 9013	759 4920	12 4709	2053 44	33 7175	1 857	8 688	5 5629	26 8095	29	"B" CS	0 9489
5324	167 1	60 8472	807 0077	13 2628	2053 44	33 7475	1 938	8 706	5 7634	26 2480	29	"A" CS	1 1922
5324	167 1	60 8472	807 0077	13 2628	2053 44	33 7475	1 857	8 688	5 5668	26 0514	29	"B" CS	1 2773
6299 5	168	60 8273	824 0112	13 5467	2053 44	33 7586	1 938	8 706	5 7649	25 9767	29	"A" CS	1 3097
6299 5	168	60 8273	824 0112	13 5467	2053 44	33 7586	1 857	8 688	5 5683	25 7801	29	"B" CS	1 3949
7612 5	168 4	60 8199	831 7238	13 6752	2053 44	33 7627	1 938	8 706	5 7654	25 8529	29	"A" CS	1 3633
7612 5	168 4	60 8199	831 7238	13 6752	2053 44	33 7627	1 857	8 688	5 5688	25 6562	29	"B" CS	1 4485
8925 5	168 7	60 8143	837 5083	13 7716	2053 44	33 7657	1 938	8 706	5 7659	25 7600	29	"A" CS	1 4036
8925 5	168 7	60 8143	837 5083	13 7716	2053 44	33 7657	1 857	8 688	5 5692	25 5634	29	"B" CS	1 4887
14579 2	166 3	60 8650	792 1354	13 0146	2053 44	33 7376	1 938	8 706	5 7620	26 4850	29	"A" CS	1 0895
14579 2	166 3	60 8650	792 1354	13 0146	2053 44	33 7376	1 857	8 688	5 5655	26 2885	29	"B" CS	1 1746
28055	158 4	61 0262	657 1555	10 7684	2053 44	33 6485	1 938	8 706	5 7499	28 6300	29	"A" CS	0 1603
28055	158 4	61 0262	657 1555	10 7684	2053 44	33 6485	1 857	8 688	5 5539	28 4340	29	"B" CS	0 2452
41793 7	151 3	61 1639	552 9499	9 0405	2053 44	33 5727	1 938	8 706	5 7396	30 2719	29	"A" CS	-0 5510
41793 7	151 3	61 1639	552 9499	9 0405	2053 44	33 5727	1 857	8 688	5 5441	30 0763	29	"B" CS	-0 4663

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE RHR NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA													
Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft.)	Atmosphereic Pressure (Hb) (lb/ft^2)	Hb/Sw (ft.)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + $V^2/2(32.2)$) (ft.)	NPSHA (ft.)	NPSHR (ft.)	System Pump	Required Containment Pressure (psig)
742.7	150.2	61.1845	537.6960	8.7881	2053.44	33.5614	2.127	9.315	6.3533	31.1266	26	"B" RHR	-2.2209
742.7	150.2	61.1845	537.6960	8.7881	2053.44	33.5614	2.222	9.315	6.5769	31.3502	26	"C" RHR	-2.3177
2349	159.8	60.9979	679.5360	11.1403	2053.44	33.6641	2.127	9.315	6.3686	28.8924	26	"B" RHR	-1.2530
2349	159.8	60.9979	679.5360	11.1403	2053.44	33.6641	2.222	9.315	6.5929	29.1167	26	"C" RHR	-1.3501
4007	164.5	60.9013	759.4920	12.4709	2053.44	33.7175	2.127	9.315	6.3766	27.6232	26	"B" RHR	-0.7032
4007	164.5	60.9013	759.4920	12.4709	2053.44	33.7175	2.222	9.315	6.6012	27.8478	26	"C" RHR	-0.8005
5324	167.1	60.8472	807.0077	13.2628	2053.44	33.7475	2.127	9.315	6.3811	26.8657	26	"B" RHR	-0.3750
5324	167.1	60.8472	807.0077	13.2628	2053.44	33.7475	2.222	9.315	6.6059	27.0905	26	"C" RHR	-0.4724
6299.5	168	60.8273	824.0112	13.5467	2053.44	33.7586	2.127	9.315	6.3827	26.5945	26	"B" RHR	-0.2576
6299.5	168	60.8273	824.0112	13.5467	2053.44	33.7586	2.222	9.315	6.6076	26.8194	26	"C" RHR	-0.3550
7612.5	168.4	60.8199	831.7238	13.6752	2053.44	33.7627	2.127	9.315	6.3833	26.4708	26	"B" RHR	-0.2039
7612.5	168.4	60.8199	831.7238	13.6752	2053.44	33.7627	2.222	9.315	6.6083	26.6957	26	"C" RHR	-0.3014
8925.5	168.7	60.8143	837.5083	13.7716	2053.44	33.7657	2.127	9.315	6.3838	26.3780	26	"B" RHR	-0.1637
8925.5	168.7	60.8143	837.5083	13.7716	2053.44	33.7657	2.222	9.315	6.6087	26.6029	26	"C" RHR	-0.2612
14579.2	166.3	60.8650	792.1354	13.0146	2053.44	33.7376	2.127	9.315	6.3796	27.1026	26	"B" RHR	-0.4776
14579.2	166.3	60.8650	792.1354	13.0146	2053.44	33.7376	2.222	9.315	6.6044	27.3273	26	"C" RHR	-0.5750
28055	158.4	61.0262	657.1555	10.7684	2053.44	33.6485	2.127	9.315	6.3663	29.2464	26	"B" RHR	-1.4063
28055	158.4	61.0262	657.1555	10.7684	2053.44	33.6485	2.222	9.315	6.5905	29.4705	26	"C" RHR	-1.5034
41793.7	151.3	61.1639	552.9499	9.0405	2053.44	33.5727	2.127	9.315	6.3550	30.8873	26	"B" RHR	-2.1172
41793.7	151.3	61.1639	552.9499	9.0405	2053.44	33.5727	2.222	9.315	6.5787	31.1109	26	"C" RHR	-2.2141

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE CORE SPRAY NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA

Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft.)	Atmosphereic Pressure (Hb) (lb/ft2)	Hb/Sw (ft.)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + $V^2/(32.2)$) (ft.)	NPSHA (ft.)	NPSHR (ft.)	System Pump	Required Containment Pressure (psig)
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	1.511	8.706	4.7335	29.4363	29	"A" CS	-0.1890
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	1.177	8.687	3.9422	28.6450	29	"B" CS	0.1538
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	1.511	8.706	4.7397	28.2079	29	"A" CS	0.3432
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	1.177	8.687	3.9470	27.4152	29	"B" CS	0.6865
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	1.511	8.706	4.7441	27.2421	29	"A" CS	0.7615
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	1.177	8.687	3.9505	26.4485	29	"B" CS	1.1053
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	1.511	8.706	4.7466	26.6887	29	"A" CS	1.0013
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	1.177	8.687	3.9524	25.8945	29	"B" CS	1.3453
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	1.511	8.706	4.7469	26.6344	29	"A" CS	1.0248
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	1.177	8.687	3.9526	25.8401	29	"B" CS	1.3689
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	1.511	8.706	4.7466	26.6887	29	"A" CS	1.0013
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	1.177	8.687	3.9524	25.8945	29	"B" CS	1.3453
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	1.511	8.706	4.7455	26.9563	29	"A" CS	0.8853
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	1.177	8.687	3.9516	26.1624	29	"B" CS	1.2293
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	1.511	8.706	4.7441	27.2421	29	"A" CS	0.7615
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	1.177	8.687	3.9505	26.4485	29	"B" CS	1.1053
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	1.511	8.706	4.7415	27.7957	29	"A" CS	0.5217
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	1.177	8.687	3.9484	27.0027	29	"B" CS	0.8652
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	1.511	8.706	4.7320	29.6842	29	"A" CS	-0.2964
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	1.177	8.687	3.9410	28.8932	29	"B" CS	0.0463

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CONTAINMENT PRESSURE REQUIRED FOR ADEQUATE RHR NPSH DURING THE LONG TERM PHASE OF THE DBA LOCA

Time (sec)	Temperature (°F)	Specific Weight (Sw) (lb/ft^3)	Vapor Pressure (Hva) (lb/ft^2)	Hva/Sw (ft)	Atmospheric Pressure (Hb) (lb/ft2)	Hb/Sw (ft)	Pump Suction Pressure (psig)	Velocity (ft/sec)	Constant (Ps/Sw + $V^2/2(32.2)$) (ft)	NPSHA (ft)	NPSHR (ft)	System Pump	Required Containment Pressure (psig)
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	0.688	9.279	2.9563	27.6592	26	"A" RHR	-0.7188
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	0.047	9.297	1.4528	26.1556	26	"B" RHR	-0.0674
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	0.327	9.351	2.1275	26.8303	26	"C" RHR	-0.3597
724	150.5	61.1789	542.1456	8.8616	2053.44	33.5645	0.376	9.332	2.2373	26.9401	26	"D" RHR	-0.4073
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	0.688	9.279	2.9592	26.4274	26	"A" RHR	-0.1851
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	0.047	9.297	1.4530	24.9212	26	"B" RHR	0.4673
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	0.327	9.351	2.1288	25.5970	26	"C" RHR	0.1746
1647.3	156.0	61.0724	620.1792	10.1548	2053.44	33.6230	0.376	9.332	2.2388	25.7070	26	"D" RHR	0.1269
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.688	9.279	2.9612	25.4592	26	"A" RHR	0.2343
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.047	9.297	1.4531	23.9511	26	"B" RHR	0.8876
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.327	9.351	2.1298	24.6278	26	"C" RHR	0.5944
3213.8	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.376	9.332	2.2399	24.7380	26	"D" RHR	0.5467
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.688	9.279	2.9623	24.9044	26	"A" RHR	0.4746
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.047	9.297	1.4532	23.3953	26	"B" RHR	1.1284
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.327	9.351	2.1303	24.0724	26	"C" RHR	0.8350
4621.6	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.376	9.332	2.2406	24.1827	26	"D" RHR	0.7873
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	0.688	9.279	2.9624	24.8500	26	"A" RHR	0.4982
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	0.047	9.297	1.4532	23.3407	26	"B" RHR	1.1520
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	0.327	9.351	2.1304	24.0179	26	"C" RHR	0.8587
5094.8	162.2	60.9489	719.4211	11.8037	2053.44	33.6912	0.376	9.332	2.2406	24.1281	26	"D" RHR	0.8109
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.688	9.279	2.9623	24.9044	26	"A" RHR	0.4746
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.047	9.297	1.4532	23.3953	26	"B" RHR	1.1284
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.327	9.351	2.1303	24.0724	26	"C" RHR	0.8350
6475.3	162.0	60.9533	715.9968	11.7466	2053.44	33.6887	0.376	9.332	2.2406	24.1827	26	"D" RHR	0.7873
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	0.688	9.279	2.9618	25.1726	26	"A" RHR	0.3584
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	0.047	9.297	1.4531	23.6639	26	"B" RHR	1.0120
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	0.327	9.351	2.1301	24.3409	26	"C" RHR	0.7187
7894.8	161.0	60.9719	699.2064	11.4677	2053.44	33.6785	0.376	9.332	2.2403	24.4511	26	"D" RHR	0.6710
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.688	9.279	2.9612	25.4592	26	"A" RHR	0.2343
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.047	9.297	1.4531	23.9511	26	"B" RHR	0.8876
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.327	9.351	2.1298	24.6278	26	"C" RHR	0.5944
9618.6	159.9	60.9961	681.1488	11.1671	2053.44	33.6651	0.376	9.332	2.2399	24.7380	26	"D" RHR	0.5467
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	0.688	9.279	2.9600	26.0142	26	"A" RHR	-0.0062
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	0.047	9.297	1.4530	24.5073	26	"B" RHR	0.6467
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	0.327	9.351	2.1292	25.1834	26	"C" RHR	0.3537
11749.8	157.7	61.0407	646.1928	10.5863	2053.44	33.6405	0.376	9.332	2.2393	25.2935	26	"D" RHR	0.3061
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	0.688	9.279	2.9557	27.9079	26	"A" RHR	-0.8265
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	0.047	9.297	1.4527	26.4049	26	"B" RHR	-0.1754
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	0.327	9.351	2.1271	27.0793	26	"C" RHR	-0.4676
21124.8	149.3	61.2040	526.2667	8.5986	2053.44	33.5507	0.376	9.332	2.2369	27.1891	26	"D" RHR	-0.5151

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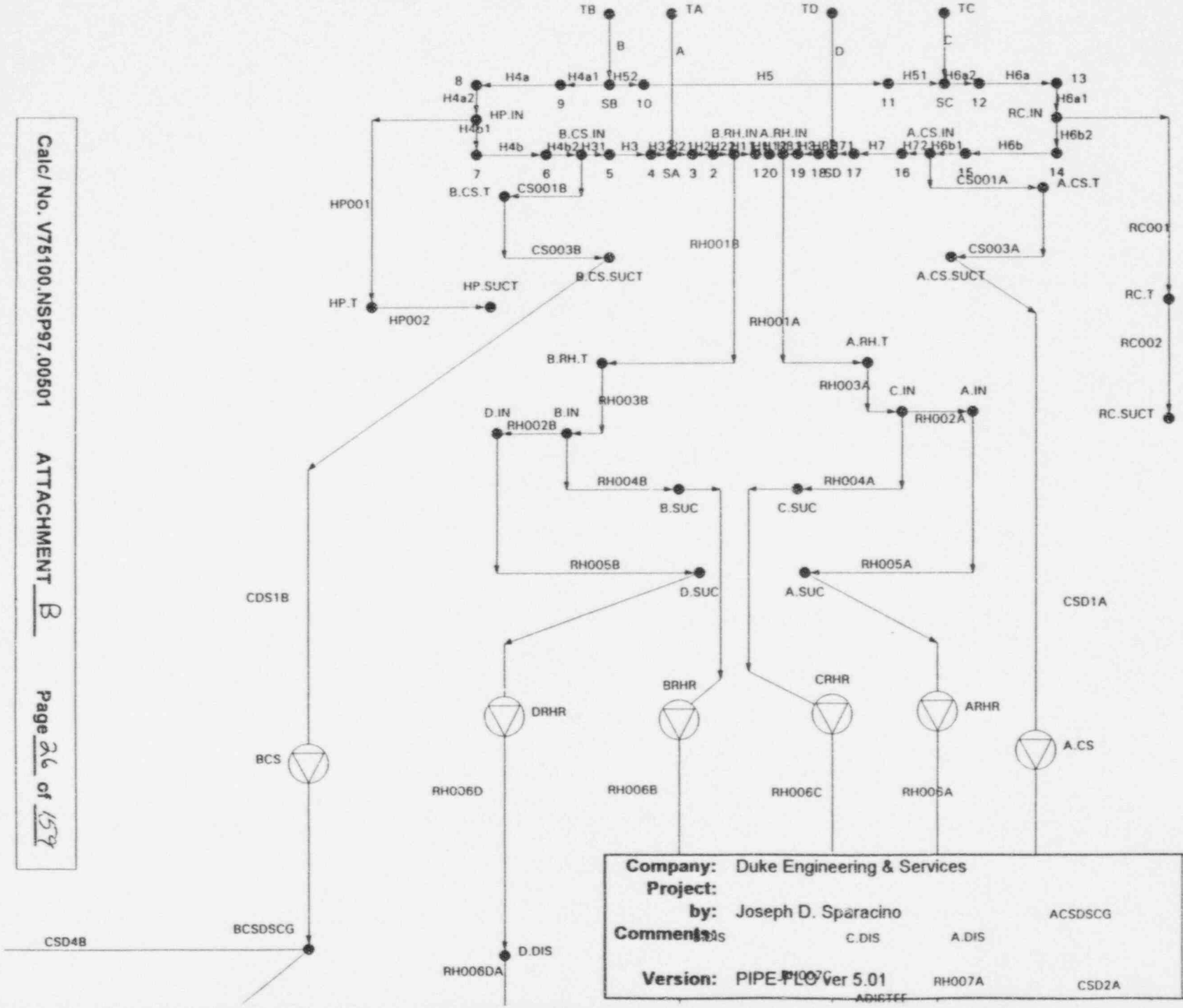
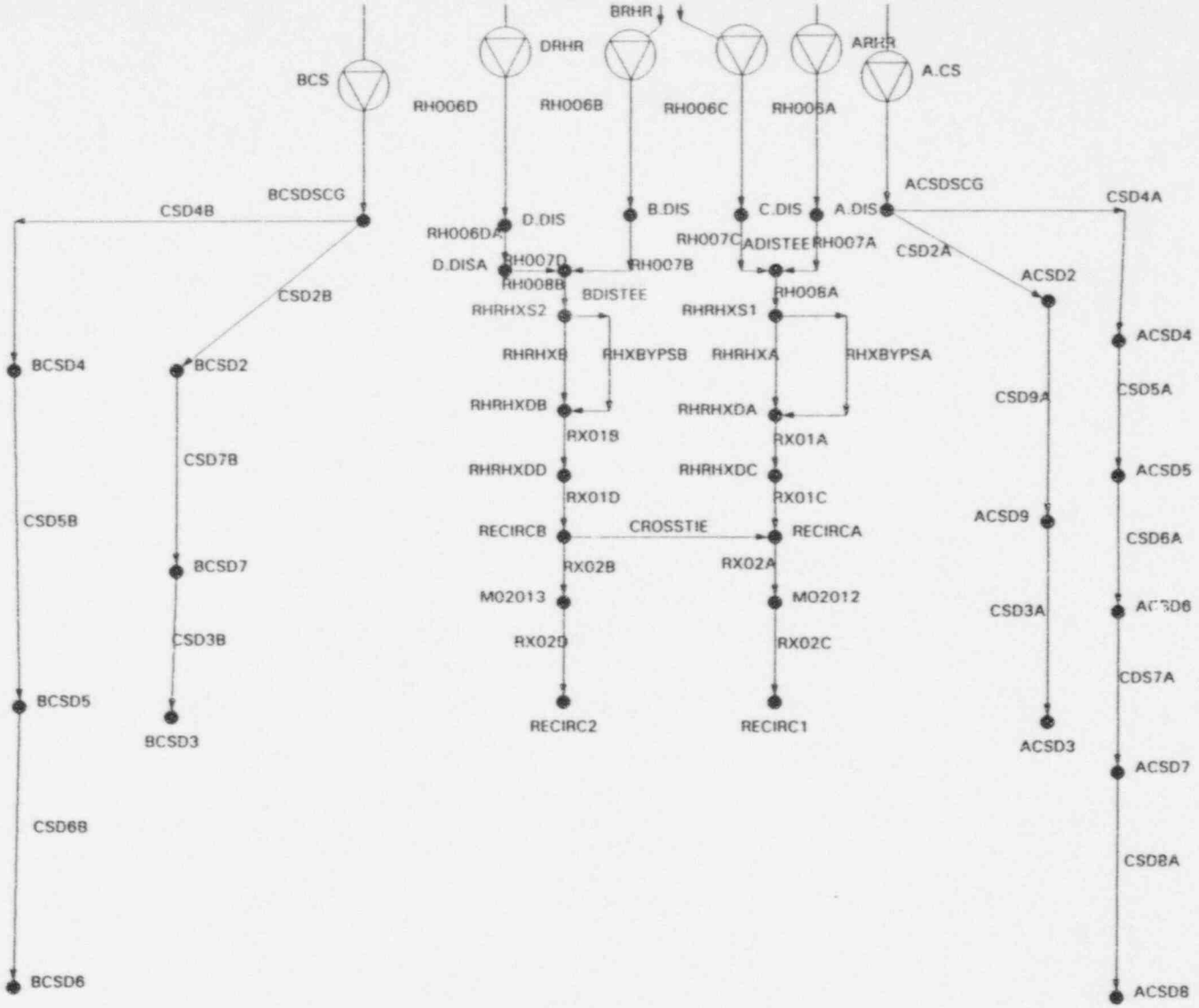
REFERENCE

ATTACHMENT B

FLO-SERIES MODEL PIPING AND NETWORK INPUT AND OUTPUT FOR CASE #1.



Company:	Duke Engineering & Services	06/11/97	4:56 pm
Project:		**Linelist:**	OVRPRES1
by:	Joseph D. Sparacino	**Lineup:**	
Comments:		**flow rate:**	gpm
		pressure:	psi_g
Version:	PIPE-FLO Ver 5.01	**level & grade:**	ft



Company:	Duke Engineering & Services	06/11/97	4:57 pm
Project:		**Linelist:**	OVRPRES1
by:	Joseph D. Sparacino	**Lineup:**	
Comments:		**flow rate:**	gpm
		pressure:	psig
Version:	PIPE-FLO ver 5.01	**level & grade:**	ft

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:17 am
System: OVRPRES1
rev: 06/12/97 8:16 am

SYSTEM REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 131.8°F. and 0 psig cont. press. Containment overpressure calcs.

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
1	902.25	H11	H1
10	902.25	H52	H5
11	902.25	H5	H51
12	902.25	H6a2	H6a
13	902.25	H6a	H6a1
14	902.25	H6b2	H6b
15	902.25	H6b	H6b1
16	902.25	H72	H7
17	902.25	H7	H71
18	902.25	H82	H8
19	902.25	H8	H81
2	902.25	H2	H22
20	902.25	H1	H12
3	902.25	H21	H2
4	902.25	H3	H32
5	902.25	H31	H3
6	902.25	H4b	H4b2
7	902.25	H4b1	H4b
8	902.25	H4a	H4a2
9	902.25	H4a1	H4a
A.CS.IN	902.25	H6b1	CS001A H72
A.CS.SUCT	897.833	CS003A	CSD1A
A.CS.T	899.916	CS001A	CS003A
A.DIS	897.833	RH006A	RH007A

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
A.IN	897.583	RH002A	RH005A
A.RH.IN	902.25	H12 H81	RH001A
A.RH.T	897.583	RH001A	RH003A
A.SUC	897.833	RH005A	RH006A
ACSD2	931.917	CSD2A	CSD9A
ACSD3	981.188	CSD3A	
ACSD4	900.156	CSD4A	CSD5A
ACSD5	900.74	CSD5A	CSD6A
ACSD6	925.875	CSD6A	CDS7A
ACSD7	928	CDS7A	CSD8A
ACSD8	927	CSD8A	
ACSD9	971.25	CSD9A	CSD3A
ACSDSCG	899.635	CSD1A	CSD2A CSD4A
ADISTEE	901.083	RH007A RH007C	RH008A
B.CS.IN	902.25	H4b2	CS001B H31
B.CS.SUCT	897.833	CS003B	CDS1B
B.CS.T	899.885	CS001B	CS003B
B.DIS	899.5	RH006B	RH007B
B.IN	897.583	RH003B	RH002B RH004B
B.RH.IN	902.25	H22	H11 RH001B
B.RH.T	897.583	RH001B	RH003B
B.SUC	897.833	RH004B	RH006B
BCSD2	927.833	CSD2B	CSD7B
BCSD3	980.38	CSD3B	
BCSD4	899.896	CSD4B	CSD5B
BCSD5	901.688	CSD5B	CSD6B
BCSD6	930.333	CSD6B	

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
BCSD7	978.5	CSD7B	CSD3B
BCSDSCG	899.583	CDS1B	CSD2B CSD4B
BDISTEE	908	RH007J RH007D	RH008B
C.DIS	897.833	RH006C	RH007C
C.IN	897.583	RH003A	RH002A RH004A
C.SUC	897.833	RH004A	RH006C
D.DIS	899.5	RH006D	RH006DA
D.DISA	908	RH006DA	RH007D
D.IN	897.583	RH002B	RH005B
D.SUC	897.833	RH005B	RH006D
HP.IN	902.25	H4a2	H4b1 HP001
HP.SUCT	901.615	HP002	
HP.T	901.615	HP001	HP002
M02013	940.91	RX02B	RX02D
MO2012	940.917	RX02A	RX02C
RC.IN	902.25	H6a1	H6b2 RC001
RC.SUCT	899.042	RC002	
RC.T	902.25	RC001	RC002
RECIRC1	951.75	RX02C	
RECIRC2	951.75	RX02D	
RECIRCA	930.168	CROSSTIE RX01C	RX02A
RECIRCB	930.167	RX01D	CROSSTIE RX02B
RHRHXDA	916.333	RHRHXA RHXBYPSA	RX01A
RHRHXDB	915.49	RHRHXB RHXBYPSB	RX01B
RHRHXDC	916.336	RX01A	RX01C

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
RHRHXDD	921.33	RX01B	RX01D
RHRHXS1	909.406	RH008A	RHRHXA RHXBYPSA
RHRHXS2	908	RH008B	RHRHXB RHXBYPSB
SA	902.25	A H32	H21
SB	902.25	B	H4a1 H52
SC	902.25	C H51	H6a2
SD	902.25	D H71	H82
TA	904.316		A
TB	904.316		B
TC	904.316		C
TD	904.316		D

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
A	31	TA	SA	
B	31	TB	SB	
C	31	TC	SC	
CDS1B	16	B.CS.SUCT	BCSDSCG	BCS
CDS7A	35	ACSD6	ACSD7	
CROSSTIE	21	RECIRCB	RECIRCA	
CS001A	16	A.CS.IN	A.CS.T	
CS001B	16	B.CS.IN	B.CS.T	
CS003A	16	A.CS.T	A.CS.SUCT	
CS003B	16	B.CS.T	B.CS.SUCT	
CSD1A	16	A.CS.SUCT	ACSDSCG	A.CS
CSD2A	16	ACSDSCG	ACSD2	
CSD2B	16	BCSDSCG	BCSD2	
CSD3A	35	ACSD9	ACSD3	
CSD3B	35	BCSD7	BCSD3	
CSD4A	16	ACSDSCG	ACSD4	
CSD4B	16	BCSDSCG	BCSD4	
CSD5A	35	ACSD4	ACSD5	
CSD5B	35	BCSD4	BCSD5	
CSD6A	16	ACSD5	ACSD6	
CSD6B	16	BCSD5	BCSD6	
CSD7B	16	BCSD2	BCSD7	
CSD8A	16	ACSD7	ACSD8	
CSD9A	16	ACSD2	ACSD9	
D	31	TD	SD	
H1	26	1	20	
H11	31	B.RH.IN	1	
H12	31	20	A.RH.IN	
H2	26	3	2	
H21	31	SA	3	
H22	31	2	B.RH.IN	
H3	26	5	4	
H31	31	B.CS.IN	5	
H32	31	4	SA	
H4a	26	9	8	
H4a1	31	SB	9	
H4a2	31	8	HP.IN	
H4b	26	7	6	
H4b1	31	HP.IN	7	
H4b2	31	6	B.CS.IN	
H5	26	10	11	
H51	31	11	SC	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
H52	31	SB	10	
H6a	26	12	13	
H6a1	31	13	RC.IN	
H6a2	31	SC	12	
H6b	26	14	15	
H6b1	31	15	A.CS.IN	
H6b2	31	RC.IN	14	
H7	26	16	17	
H71	31	17	SD	
H72	31	A.CS.IN	16	
H8	26	18	19	
H81	31	19	A.RH.IN	
H82	31	SD	18	
HP001	21	HP.IN	HP.T	
HP002	21	HP.T	HP.SUCT	
RC001	16	RC.IN	RC.T	
RC002	16	RC.T	RC.SUCT	
RH001A	26	A.RH.IN	A.RH.T	
RH001B	26	B.RH.IN	B.RH.T	
RH002A	26	C.IN	A.IN	
RH002B	26	B.IN	D.IN	
RH003A	26	A.RH.T	C.IN	
RH003B	26	B.RH.T	B.IN	
RH004A	21	C.IN	C.SUC	
RH004B	21	B.IN	B.SUC	
RH005A	21	A.IN	A.SUC	
RH005B	21	D.IN	D.SUC	
RH006A	16	A.SUC	A.DIS	ARHR
RH006B	16	B.SUC	B.DIS	BRHR
RH006C	16	C.SUC	C.DIS	CRHR
RH006D	16	D.SUC	D.DIS	DRHR
RH006DA	16	D.DIS	D.DISA	
RH007A	16	A.DIS	ADISTEE	
RH007B	16	B.DIS	BDISTEE	
RH007C	16	C.DIS	ADISTEE	
RH007D	21	D.DISA	BDISTEE	
RH008A	21	ADISTEE	RHRHXS1	
RH008B	21	BDISTEE	RHRHXS2	
RHRHXA	21	RHRHXS1	RHRHXDA	
RHRHXB	21	RHRHXS2	RHRHXDB	
RHXBYPSA	21	RHRHXS1	RHRHXDA	
RHXBYPSB	21	RHRHXS2	RHRHXDB	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
RX01A	21	RHRHXDA	RHRHXDC	
RX01B	21	RHRHXDB	RHRHXDD	
RX01C	21	RHRHXDC	RECIRCA	
RX01D	21	RHRHXDD	RECIRCB	
RX02A	21	RECIRCA	MO2012	
RX02B	21	RECIRCB	M02013	
RX02C	35	MO2012	RECIRC1	
RX02D	35	M02013	RECIRC2	
RXO1A	16	.	.	

PUMP/COMP	PERFORMANCE DATA					
A.CS	gpm:	0	2179	3990	5040	5755
	ft:	850.3	795.5	664	536.2	411.7
	eqn:	850.3 - 4.49715e-006 Q ^ 2.12033				
ARHR	gpm:	0	3365	4000	4250	4540
	ft:	810.3	498.9	350	280	171.8
	eqn:	810.3 - 1.3787e-006 Q ^ 2.36763				
BCS	gpm:	0	1948	3080	4875	5600
	ft:	844	770.1	719.4	535.2	418.1
	eqn:	844 - 0.000218414 Q ^ 1.66917				
BRHR	gpm:	0	3656	4000	4250	4408
	ft:	813.8	436	350	280	230
	eqn:	813.8 - 2.04305e-006 Q ^ 2.32005				
CRHR	gpm:	0	3540	4000	4250	4440
	ft:	763.9	461.1	360	290	235.4
	eqn:	763.9 - 5.58043e-007 Q ^ 2.46066				
DRHR	gpm:	0	3542	4000	4250	4425
	ft:	810.1	463	350	285	227
	eqn:	810.1 - 2.16007e-006 Q ^ 2.31196				

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:17 am
System: OVRPRES1
rev: 06/12/97 8:16 am

PIPELIST REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 131.8°F. and 0 psig cont. press. Containment overpressure calcs.

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
16 LB30 rev: 06/12/97 8:15 am	Steel Sch 40 0.0018 in Size for: 8 ft/sec	Water 131.8 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
21 LB31 rev: 06/12/97 8:15 am	Steel Sch 30 0.0018 in Size for: 8 ft/sec	Water 131.8 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
26 LB32 rev: 06/12/97 8:16 am	Steel Sch 20 0.0018 in Size for: 8 ft/sec	Water 131.8 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
31 LB34 rev: 06/12/97 8:16 am	Steel Sch 60 0.0018 in Size for: 8 ft/sec	Water 131.8 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
35 LB34a rev: 06/12/97 8:16 am	Steel Sch 80 0.0018 in Size for: 8 ft/sec	Water 131.8 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
A	31	Steel 20 in / 60	3.6777	Water 131.8 °F / 0 psi g	1.163
B	31	Steel 20 in / 60	3.6777	Water 131.8 °F / 0 psi g	0.4469
C	31	Steel 20 in / 60	3.6777	Water 131.8 °F / 0 psi g	1.163
CDS1B	16	Steel 10 in / 40	3.45	Water 131.8 °F / 0 psi g	0.2689
CDS7A	35	Steel 2 in / 80	7.73835	Water 131.8 °F / 0 psi g	0.478
CROSSTIE	21	Steel 14 in / 30	49.0188	Water 131.8 °F / 0 psi g	1.403
CS001A	16	Steel 12 in / 40	41.8129	Water 131.8 °F / 0 psi g	2.285
CS001B	16	Steel 12 in / 40	42.5259	Water 131.8 °F / 0 psi g	1.695
CS003A	16	Steel 12 in / 40	10.7215	Water 131.8 °F / 0 psi g	1.779
CS003B	16	Steel 12 in / 40	27.109	Water 131.8 °F / 0 psi g	2.018
CSD1A	16	Steel 10 in / 40	3.7973	Water 131.8 °F / 0 psi g	0.2689
CSD2A	16	Steel 10 in / 40	108.553	Water 131.8 °F / 0 psi g	60.59
CSD2B	16	Steel 10 in / 40	108.723	Water 131.8 °F / 0 psi g	59.14
CSD3A	35	Steel 8 in / 80	57.0055	Water 131.8 °F / 0 psi g	19.08
CSD3B	35	Steel 8 in / 80	55.4392	Water 131.8 °F / 0 psi g	19.08
CSD4A	16	Steel 2.5 in / 40	2.22525	Water 131.8 °F / 0 psi g	1.664
CSD4B	16	Steel 2.5 in / 40	2.7485	Water 131.8 °F / 0 psi g	1.93
CSD5A	35	Steel 2 in / 80	0.67045	Water 131.8 °F / 0 psi g	6.654
CSD5B	35	Steel 2 in / 80	2.0608	Water 131.8 °F / 0 psi g	6.654
CSD6A	16	Steel 2.5 in / 40	38.6803	Water 131.8 °F / 0 psi g	152.5
CSD6B	16	Steel 2.5 in / 40	101.051	Water 131.8 °F / 0 psi g	155.4
CSD7B	16	Steel 10 in / 40	97.3901	Water 131.8 °F / 0 psi g	1.995
CSD8A	16	Steel 2.5 in / 40	45.7585	Water 131.8 °F / 0 psi g	2.453
CSD9A	16	Steel 10 in / 40	75.8885	Water 131.8 °F / 0 psi g	1.53

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
D	31	Steel 20 in / 60	3.6777	Water 131.8 °F / 0 psi g	1.163
H1	26	Steel 20 in / 20	52.2054	Water 131.8 °F / 0 psi g	0.144
H11	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.2536
H12	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.00366
H2	26	Steel 20 in / 20	24.1868	Water 131.8 °F / 0 psi g	0.072
H21	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.00366
H22	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.01484
H3	26	Steel 20 in / 20	24.3777	Water 131.8 °F / 0 psi g	0.072
H31	31	Steel 20 in / 60	1.4375	Water 131.8 °F / 0 psi g	0.2425
H32	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.2536
H4a	26	Steel 20 in / 20	31.4675	Water 131.8 °F / 0 psi g	0.072
H4a1	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.7201
H4a2	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.01484
H4b	26	Steel 20 in / 20	45.6907	Water 131.8 °F / 0 psi g	0.144
H4b1	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.2425
H4b2	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.01484
H5	26	Steel 20 in / 20	108.244	Water 131.8 °F / 0 psi g	0.288
H51	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.2536
H52	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.7201
H6a	26	Steel 20 in / 20	15.1777	Water 131.8 °F / 0 psi g	0.072
H6a1	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.01484
H6a2	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.00366
H6b	26	Steel 20 in / 20	61.7884	Water 131.8 °F / 0 psi g	0.144
H6b1	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.01484

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
H6b2	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.2425
H7	26	Steel 20 in / 20	24.3777	Water 131.8 °F / 0 psi g	0.072
H71	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.2536
H72	31	Steel 20 in / 60	1.725	Water 131.8 °F / 0 psi g	0.2425
H8	26	Steel 20 in / 20	24.1868	Water 131.8 °F / 0 psi g	0.072
H81	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.01484
H82	31	Steel 20 in / 60	1.9171	Water 131.8 °F / 0 psi g	0.00366
HP001	21	Steel 14 in / 30	67.5027	Water 131.8 °F / 0 psi g	3.127
HP002	21	Steel 14 in / 30	9.3679	Water 131.8 °F / 0 psi g	1.356
RC001	16	Steel 6 in / 40	22.7965	Water 131.8 °F / 0 psi g	4.054
RC002	16	Steel 6 in / 40	56.5179	Water 131.8 °F / 0 psi g	1.298
RH001A	26	Steel 20 in / 20	62.1357	Water 131.8 °F / 0 psi g	2.161
RH001B	26	Steel 20 in / 20	55.6198	Water 131.8 °F / 0 psi g	2.09
RH002A	26	Steel 20 in / 20	5.75	Water 131.8 °F / 0 psi g	0.7101
RH002B	26	Steel 20 in / 20	5.3671	Water 131.8 °F / 0 psi g	0.7101
RH003A	26	Steel 20 in / 20	7.1093	Water 131.8 °F / 0 psi g	0.2367
RH003B	26	Steel 20 in / 20	7.6671	Water 131.8 °F / 0 psi g	0.7101
RH004A	21	Steel 14 in / 30	14.758	Water 131.8 °F / 0 psi g	2.63
RH004B	21	Steel 14 in / 30	14.95	Water 131.8 °F / 0 psi g	2.63
RH005A	21	Steel 14 in / 30	14.758	Water 131.8 °F / 0 psi g	1.867
RH005B	21	Steel 14 in / 30	14.95	Water 131.8 °F / 0 psi g	1.867
RH006A	16	Steel 12 in / 40	1.15	Water 131.8 °F / 0 psi g	0.2977
RH006B	16	Steel 12 in / 40	3.0671	Water 131.8 °F / 0 psi g	0.5573
RH006C	16	Steel 12 in / 40	1.15	Water 131.8 °F / 0 psi g	0.2977

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
RH006D	16	Steel 12 in / 40	3.06671	Water 131.8 °F / 0 psi g	0.5573
RH006DA	16	Steel 10 in / 40	20.7	Water 131.8 °F / 0 psi g	1.76
RH007A	16	Steel 10 in / 40	17.6094	Water 131.8 °F / 0 psi g	2.534
RH007B	16	Steel 10 in / 40	19.2625	Water 131.8 °F / 0 psi g	2.298
RH007C	16	Steel 10 in / 40	19.7656	Water 131.8 °F / 0 psi g	3.065
RH007D	21	Steel 14 in / 30	4.025	Water 131.8 °F / 0 psi g	0.2543
RH008A	21	Steel 14 in / 30	11.7875	Water 131.8 °F / 0 psi g	0.5086
RH008B	21	Steel 14 in / 30	2.875	Water 131.8 °F / 0 psi g	0.2543
RHRHXA	21	Steel 14 in / 30	28.4145	Water 131.8 °F / 0 psi g	5.436
RHRHXB	21	Steel 14 in / 30	54.8343	Water 131.8 °F / 0 psi g	6.316
RHXBYPSA	21	Steel 14 in / 30	29.4849	Water 131.8 °F / 0 psi g	5.85
RHXBYPSB	21	Steel 14 in / 30	15.4172	Water 131.8 °F / 0 psi g	5.341
RX01A	21	Steel 14 in / 30	6.3849	Water 131.8 °F / 0 psi g	0.763
RX01B	21	Steel 14 in / 30	20.748	Water 131.8 °F / 0 psi g	1.272
RX01C	21	Steel 14 in / 30	83.5906	Water 131.8 °F / 0 psi g	3.24
RX01D	21	Steel 14 in / 30	73.7917	Water 131.8 °F / 0 psi g	3.24
RX02A	21	Steel 16 in / 30	12.3625	Water 131.8 °F / 0 psi g	4.454
RX02B	21	Steel 16 in / 30	12.3625	Water 131.8 °F / 0 psi g	4.207
RX02C	35	Steel 16 in / 80	102.769	Water 131.8 °F / 0 psi g	3.252
RX02D	35	Steel 16 in / 80	97.9537	Water 131.8 °F / 0 psi g	3.184
RXO1A	16	Steel 14 in / 40	6.3849	Water 131.8 °F / 0 psi g	0.7645

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:17 am
System: OVRPRES1
rev: 06/12/97 8:16 am

MATERIALS REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 131.8°F. and 0 psig cont. press. Containment overpressure calcs.

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
A	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
B	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER
C	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER 1-Tee Flow Thru Branch
CDS1B	16	Steel 10 in / 40	3.45	1-Elbow Short - r/d 1 @ 90°
CDS7A	35	Steel 2 in / 80	7.73835	1-Elbow Short - r/d 1 @ 90° 1-Reducer Enlargement 2 X 2.5
CROSSTIE	21	Steel 14 in / 30	49.0188	3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Reducer Contraction 16 X 14 1-Reducer Enlargement 14 X 16 2-Gate Wedge Disc
CS001A	16	Steel 12 in / 40	41.8129	4-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
CS001B	16	Steel 12 in / 40	42.5259	1-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Branch
CS003A	16	Steel 12 in / 40	10.7215	3-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
CS003B	16	Steel 12 in / 40	27.109	1-Elbow Short - r/d 1 @ 90° 4-Elbow Short - r/d 1 @ 45° 1-Fixed K vel corctn
CSD1A	16	Steel 10 in / 40	3.7973	1-Elbow Short - r/d 1 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
CSD2A	16	Steel 10 in / 40	108.553	1-Tee Flow Thru Run 1-Swing Check Vertical 5-Elbow Short - r/d 1 @ 90° 8-Elbow Short - r/d 1 @ 45° 1-Fixed K Flow Element 1-Fixed K Res. Orifice
CSD2B	16	Steel 10 in / 40	108.723	4-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Fixed K Res. Orifice 1-Fixed K Flow Element
CSD3A	35	Steel 8 in / 80	57.0055	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Spargers
CSD3B	35	Steel 8 in / 80	55.4392	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Sparger
CSD4A	16	Steel 2.5 in / 40	2.22525	1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD4B	16	Steel 2.5 in / 40	2.7485	2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD5A	35	Steel 2 in / 80	0.67045	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD5B	35	Steel 2 in / 80	2.0608	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD6A	16	Steel 2.5 in / 40	38.6803	1-Elbow Short - r/d 1 @ 45° 2-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 2.5 X 2 1-Fixed K Orifice Min.
CSD6B	16	Steel 2.5 in / 40	101.051	10-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 1-Fixed K Orifice Min.
CSD7B	16	Steel 10 in / 40	97.3901	1-Reducer Contraction 10 X 8 4-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run
CSD8A	16	Steel 2.5 in / 40	45.7585	6-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°
CSD9A	16	Steel 10 in / 40	75.8885	1-Reducer Contraction 10 X 8 1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90°
D	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
H1	26	Steel 20 in / 20	52.2054	2-Fixed K 22.5 mitre
H11	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H12	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H2	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H21	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H22	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H3	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H31	31	Steel 20 in / 60	1.4375	1-Fixed K enlargement 1-Tee Flow Thru Run
H32	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H4a	26	Steel 20 in / 20	31.4675	1-Fixed K 22.5 mitre
H4a1	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement 1-Tee Flow Thru Branch
H4a2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H4b	26	Steel 20 in / 20	45.6907	2-Fixed K 22.5 mitre
H4b1	31	Steel	1.725	1-Fixed K enlargement

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
		20 in / 60		1-Tee Flow Thru Run
H4b2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H5	26	Steel 20 in / 20	108.244	4-Fixed K 22.5 mitre
H51	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H52	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Branch 1-Fixed K enlargement
H6a	26	Steel 20 in / 20	15.1777	1-Fixed K 22.5 mitre
H6a1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6a2	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H6b	26	Steel 20 in / 20	61.7884	2-Fixed K 22.5 mitre
H6b1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6b2	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H7	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H71	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H72	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H8	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H81	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H82	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
HP001	21	Steel 14 in / 30	67.5027	1-Elbow Long - r/d 1.5 @ 22.5° 2-Gate Wedge Disc 1-Swing Check Angled 3-Elbow Long - r/d 1.5 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run 1-Tee Flow Thru Branch
HP002	21	Steel 14 in / 30	9.3679	1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RC001	16	Steel 6 in / 40	22.7965	1-Elbow Long - r/d 1.5 @ 67.5° 1-Elbow Long - r/d 1.5 @ 45° 1-Elbow Long - r/d 1.5 @ 90° 2-Gate Wedge Disc 1-Swing Check Angled 2-Tee Flow Thru Branch
RC002	16	Steel 6 in / 40	56.5179	1-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH001A	26	Steel 20 in / 20	62.1357	2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH001B	26	Steel 20 in / 20	55.6198	1-Elbow Long - r/d 1.5 @ 90° 1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH002A	26	Steel 20 in / 20	5.75	1-Tee Flow Thru Branch
RH002B	26	Steel 20 in / 20	5.3671	1-Tee Flow Thru Branch
RH003A	26	Steel 20 in / 20	7.1093	1-Tee Flow Thru Run
RH003B	26	Steel 20 in / 20	7.6671	1-Tee Flow Thru Branch
RH004A	21	Steel 14 in / 30	14.758	1-Tee Flow Thru Branch 1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH004B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K vel corctn

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH005A	21	Steel 14 in / 30	14.758	1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH005B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RH006A	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006B	16	Steel 12 in / 40	3.0671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006C	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006D	16	Steel 12 in / 40	3.06671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006DA	16	Steel 10 in / 40	20.7	3-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Reducer Enlargement 10 X 14
RH007A	16	Steel 10 in / 40	17.6094	2-Elbow Short - r/d 1 @ 90° 1-Elbow Long - r/d 1.5 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Run 1-Reducer Enlargement 10 X 12 1-Swing Check Angled
RH007B	16	Steel 10 in / 40	19.2625	2-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Reducer Enlargement 10 X 14
RH007C	16	Steel 10 in / 40	19.7656	3-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Swing Check Angled
RH007D	21	Steel 14 in / 30	4.025	1-Tee Flow Thru Run
RH008A	21	Steel 14 in / 30	11.7875	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH008B	21	Steel 14 in / 30	2.875	1-Tee Flow Thru Run
RHRHXA	21	Steel 14 in / 30	28.4145	3-Elbow Short - r/d 1 @ 90° 2-Gate Wedge Disc 1-Tee Flow Thru Run 1-Fixed K RHR HX
RHRHXB	21	Steel 14 in / 30	54.8343	3-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 2-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K RHR HX
RHXBYPSA	21	Steel 14 in / 30	29.4849	1-Tee Flow Thru Branch 3-Elbow Short - r/d 1 @ 90° 1-Globe Valve
RHXBYPSB	21	Steel 14 in / 30	15.4172	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Globe Valve
RX01A	21	Steel 14 in / 30	6.3849	1-Tee Flow Thru Branch
RX01B	21	Steel 14 in / 30	20.748	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
RX01C	21	Steel 14 in / 30	83.5906	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX01D	21	Steel 14 in / 30	73.7917	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX02A	21	Steel 16 in / 30	12.3625	1-Globe Valve 1-Tee Flow Thru Run
RX02B	21	Steel 16 in / 30	12.3625	1-Globe Valve
RX02C	35	Steel 16 in / 80	102.769	7-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Reducer Enlargement 16 X 18

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RX02D	35	Steel 16 in / 80	97.9537	6-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Elbow Short - r/d 1 @ 45° 1-Reducer Enlargement 16 X 18
RXO1A	16	Steel 14 in / 40	6.3849	1-Tee Flow Thru Branch

PIPE SUMMARY 06/12/97 8:17 am

PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Steel	20	20 in	555.352 ft
Steel	30	14 in	516.659 ft
		16 in	24.725 ft
Steel	40	2.5 in	190.464 ft
		6 in	79.3144 ft
		10 in	475.139 ft
		12 in	130.603 ft
		14 in	6.3849 ft
Steel	60	20 in	51.2265 ft
Steel	80	2 in	10.4696 ft
		8 in	112.445 ft
		16 in	200.723 ft

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
16 LB30	Steel	40	
	Size: 2.5 in		7-Elbow Short - r/d 1 @ 45°
			2-Tee Flow Thru Branch
			3-Reducer Contraction 2.5 X 2
			18-Elbow Short - r/d 1 @ 90°
			2-Fixed K Orifice Min.
	Size: 6 in		1-Elbow Long - r/d 1.5 @ 67.5°
			1-Elbow Long - r/d 1.5 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°
			2-Gate Wedge Disc
			1-Swing Check Angled
			2-Tee Flow Thru Branch
			1-Elbow Short - r/d 1 @ 90°
			1-Fixed K vel corctn
	Size: 10 in		28-Elbow Short - r/d 1 @ 90°
			5-Tee Flow Thru Run
			4-Swing Check Vertical
			11-Elbow Short - r/d 1 @ 45°
			2-Fixed K Flow Element
			2-Fixed K Res. Orifice
			2-Reducer Contraction 10 X 8
			4-Gate Wedge Disc

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 10 in		2-Reducer Enlargement 10 X 14
			1-Elbow Long - r/d 1.5 @ 90°
			1-Reducer Enlargement 10 X 12
			2-Swing Check Angled
			2-Tee Flow Thru Branch
	Size: 12 in		11-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			2-Gate Double Disc
			2-Tee Flow Thru Run
			2-Tee Flow Thru Branch
			5-Elbow Short - r/d 1 @ 45°
			2-Fixed K vel corctn
			4-Reducer Contraction 12 X 10
	Size: 14 in		1-Tee Flow Thru Branch
21 LB31	Steel	30	
	Size: 14 in		30-Elbow Short - r/d 1 @ 90°
			9-Tee Flow Thru Run
			1-Reducer Contraction 16 X 14
			3-Reducer Enlargement 14 X 16
			13-Gate Wedge Disc
			1-Elbow Long - r/d 1.5 @ 22.5°
			1-Swing Check Angled
			3-Elbow Long - r/d 1.5 @ 90°
			10-Tee Flow Thru Branch
			5-Fixed K vel corctn
			4-Reducer Contraction 20 X 14
			2-Fixed K RHR HX
			2-Elbow Short - r/d 1 @ 45°
			2-Globe Valve
			2-Fixed K Flow Element
	Size: 16 in		2-Globe Valve
			1-Tee Flow Thru Run
26 LB32	Steel	20	
	Size: 20 in		16-Fixed K 22.5 mitre
			3-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			7-Tee Flow Thru Branch
			2-Elbow Short - r/d 1 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 20 in		1-Tee Flow Thru Run
31 LB34	Steel	60	
	Size: 20 in		2-Fixed K strainer
			5-Tee Flow Thru Branch
			2-Fixed K STRAINER
			10-Fixed K contraction
			8-Tee Flow Thru Run
			10-Fixed K enlargement
35 LB34a	Steel	80	
	Size: 2 in		1-Elbow Short - r/d 1 @ 90°
			3-Reducer Enlargement 2 X 2 5
			2-Globe Valve
	Size: 8 in		6-Gate Wedge Disc
			2-Swing Check Angled
			12-Elbow Short - r/d 1 @ 90°
			1-Fixed K Spargers
			1-Fixed K Sparger
	Size: 16 in		13-Elbow Short - r/d 1 @ 90°
			4-Gate Double Disc
			2-Swing Check Angled
			2-Reducer Enlargement 16 X 18
			1-Elbow Short - r/d 1 @ 45°

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:34 am
Lineup: CASE1
rev: 06/12/97 8:34 am

System: OVRPRES1
rev: 06/12/97 8:16 am

Deviation: 1.86e-005 %
after: 9 iterations

short term, all pumps runout, 0 cont. press., A strainer plugged, sp wtr lvl 908'-9.3"

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the first specification were used in this calculation.

LINEUP SUMMARIES

PIPELINE		FLOW gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
CSD3A	>>>	4070	ACSD3	0	0
CSD8A	>>>	213.4	ACSD8	0	0
CSD3B	>>>	3990	BCSD3	0	0
CSD6B	>>>	208.8	BCSD6	0	0
RX02D	>>>	17268	RECIRC2	0	0
B	<<<	9586	TB	0	4.459
C	<<<	6313	TC	0	4.459
D	<<<	9852	TD	0	4.459

Flows IN: 25751 gpm
Flows OUT: 25750 gpm

NET FLOWS IN: 1 gpm

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
1	902.25		1.112	904.9
10	902.25		2.348	907.7
11	902.25		2.329	907.7
12	902.25		2.313	907.7
13	902.25		2.223	907.5
14	902.25		2.06	907.1
15	902.25		1.762	906.4
16	902.25		1.717	906.3
17	902.25		1.692	906.2
18	902.25		1.629	906.1
19	902.25		1.265	905.2
2	902.25		1.061	904.7
20	902.25		1.21	905.1
3	902.25		1.096	904.8
4	902.25		1.142	904.9
5	902.25		1.178	905
6	902.25		1.238	905.1
7	902.25		1.513	905.8
8	902.25		1.701	906.2
9	902.25		1.875	906.6
A.CS.IN	902.25		1.745	906.3
A.CS.SUCT	897.833		-1.153 ***	895.1
A.CS.T	899.916		-0.116 ***	899.6
A.DIS	897.833		112.9	1162
A.IN	897.583		1.341	900.7
A.RH.IN	902.25		1.214	905.1
A.RH.T	897.583		1.627	901.4
A.SUC	897.833		-0.109 ***	897.6
ACSD2	931.917		136.7	1252
ACSD3	981.188		0 (source)	981.2
ACSD4	900.156		261.3 ***	1512
ACSD5	900.74		237.1 ***	1456
ACSD6	925.875		14.64	960.2
ACSD7	928		8.636	948.2
ACSD8	927		0 (source)	927
ACSD9	971.25		114.9	1240
ACSDSCG	899.635		264.1 ***	1518
ADISTEE	901.083		105.8	1149
B.CS.IN	902.25		1.219	905.1
B.CS.SUCT	897.833		-1.38 ***	894.6
B.CS.T	899.885		0.040	900

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
B.DIS	899.5		107.6	1151
B.IN	897.583		1.054	900.1
B.RH.IN	902.25		1.056	904.7
B.RH.T	897.583		1.52	901.1
B.SUC	897.833		-0.941 ***	895.6
BCSD2	927.833		134.9	1244
BCSD3	980.38		0 (source)	980.4
BCSD4	899.896		250.6 ***	1487
BCSD5	901.688		226.2 ***	1432
BCSD6	930.333		0 (source)	930.3
BCSD7	978.5		106.9	1229
BCSDSCG	899.583		253.5 ***	1493
BDISTEE	908		98.57	1139
C.DIS	897.833		114.2	1165
C.IN	897.583		1.453	901
C.SUC	897.833		-0.543 ***	896.6
D.DIS	899.5		106.8	1150
D.DISA	908		98.78	1139
D.IN	897.583		0.939	899.8
D.SUC	897.833		-0.555 ***	896.5
HP.IN	902.25		1.682	906.2
HP.T	901.615		1.953	906.2
M02013	940.91		37.94	1030
MO2012	940.917		69.64	1104
RC.IN	902.25		2.206	907.4
RC.T	902.25		2.206	907.4
RECIRC2	951.75		0 (source)	951.8
RECIRCA	930.168		74.23	1104
RECIRCB	930.167		68.95	1092
RHRHXDA	916.333		93.62	1136
RHRHXDB	915.49		90.42	1127
RHRHXDC	916.336		91.39	1130
RHRHXDD	921.33		83.83	1118
RHRHXS1	909.406		100.6	1145
RHRHXS2	908		97.79	1137
SA	902.25		1.1	904.8
SB	902.25		2.36	907.8
SC	902.25		2.324	907.7
SD	902.25		1.662	906.1
TB	904.316		1.904 (source)	908.8
TC	904.316		1.904 (source)	908.8

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
TD	904.316		1.904 (source)	908.8

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
A	TA		SA	closed	0	0	0
B	TB		SB	9586	11.61	(0.457)	0.997
C	TC		SC	6313	7.644	(0.420)	1.082
CDS1B	B.CS.SUCT		BCSDSCG	4199	* 17.1	(254.9)	(598.8)
—— BCS —— dP: (256.3) HL: (600.3)							
CDS7A	ACSD6		ACSD7	213.4	* 23.2	6.001	11.93
CROSSTIE	RECIRCA	<->	RECIRCB	8603	* 20.03	5.277	12.36
CS001A	A.CS.IN		A.CS.T	4284	* 12.29	1.861	6.693
CS001B	B.CS.IN		B.CS.T	4199	* 12.05	1.179	5.126
CS003A	A.CS.T		A.CS.SUCT	4284	* 12.29	1.037	4.511
CS003B	B.CS.T		B.CS.SUCT	4199	* 12.05	1.42	5.378
CSD1A	A.CS.SUCT		ACSDSCG	4284	* 17.44	(265.2)	(623)
—— A.CS —— dP: (266.7) HL: (624.6)							
CSD2A	ACSDSCG		ACSD2	4070	* 16.57	127.3	265.9
CSD2B	BCSDSCG		BCSD2	3990	* 16.25	118.7	249.6
CSD3A	ACSD9		ACSD3	4070	* 28.62	114.9	259.1
CSD3B	BCSD7		BCSD3	3990	* 28.06	106.9	248.5
CSD4A	ACSDSCG		ACSD4	213.4	* 14.31	2.758	5.939
CSD4B	BCSDSCG		BCSD4	208.8	* 14	2.971	6.644
CSD5A	ACSD4		ACSD5	213.4	* 23.2	24.27	56.25
CSD5B	BCSD4		BCSD5	208.8	* 22.71	24.35	55.24
CSD6A	ACSD5		ACSD6	213.4	* 14.31	222.4	495.8
CSD6B	BCSD5		BCSD6	208.8	* 14	226.2	501.2
CSD7B	BCSD2		BCSD7	3990	* 16.25	27.97	14.84
CSD8A	ACSD7		ACSD8	213.4	* 14.31	8.636	21.22
CSD9A	ACSD2		ACSD9	4070	* 16.57	21.89	11.92
D	TD		SD	9852	11.93	0.242	2.633
H1	20	<->	1	4624	5.102	0.098	0.229
H11	1	<->	B.RH.IN	4624	5.599	0.056	0.131
H12	A.RH.IN	<->	20	4624	5.599	0.004	0.010
H2	3		2	4041	4.459	0.036	0.083
H21	SA		3	4041	4.893	0.003	0.007
H22	2		B.RH.IN	4041	4.893	0.005	0.012
H3	5		4	4041	4.459	0.036	0.084
H31	B.CS.IN		5	4041	4.893	0.040	0.095
H32	4		SA	4041	4.893	0.043	0.100
H4a	9		8	8240	9.091	0.174	0.408
H4a1	SB		9	8240	9.977	0.485	1.136
H4a2	8		HP.IN	8240	9.977	0.019	0.045
H4b	7		6	8240	9.091	0.275	0.644
H4b1	HP.IN		7	8240	9.977	0.169	0.396
H4b2	6		B.CS.IN	8240	9.977	0.019	0.045

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
H5	10	11	1346	1.484	0.019	0.044
H51	11	SC	1346	1.629	0.005	0.011
H52	SB	10	1346	1.629	0.013	0.030
H6a	12	13	7659	8.45	0.090	0.212
H6a1	13	RC.IN	7659	9.273	0.017	0.039
H6a2	SC	12	7659	9.273	0.011	0.026
H6b	14	15	7659	8.45	0.298	0.698
H6b1	15	A.CS.IN	7659	9.273	0.017	0.039
H6b2	RC.IN	14	7659	9.273	0.146	0.342
H7	16	17	3375	3.724	0.025	0.059
H71	17	SD	3375	4.086	0.030	0.070
H72	A.CS.IN	16	3375	4.086	0.028	0.067
H8	18	19	13227	* 11.59	0.364	0.852
H81	19	A.RH.IN	13227	* 16.01	0.052	0.121
H82	SD	18	13227	* 16.01	0.033	0.076
HP001	HP.IN	HP.T	0	0	(0.271)	0
HP002	HP.T	HP.SUCT	closed	0	0	0
RC001	RC.IN	RC.T	0	0	0	0
RC002	RC.T	RC.SUCT	closed	0	0	0
RH001A	A.RH.IN	A.RH.T	8603	9.491	(0.414)	3.699
RH001B	B.RH.IN	B.RH.T	8666	9.561	(0.464)	3.58
RH002A	C.IN	A.IN	4276	4.717	0.112	0.261
RH002B	B.IN	D.IN	4343	4.791	0.115	0.268
RH003A	A.RH.T	C.IN	8603	9.491	0.174	0.408
RH003B	B.RH.T	B.IN	8666	9.561	0.466	1.092
RH004A	C.IN	C.SUC	4327	10.08	1.996	4.425
RH004B	B.IN	B.SUC	4323	10.07	1.994	4.421
RH005A	A.IN	A.SUC	4276	9.956	1.451	3.147
RH005B	D.IN	D.SUC	4343	10.11	1.495	3.25
RH006A	A.SUC	A.DIS	4276	* 12.27	(113)	(264.7)
—— ARHR —— dP: (113.3) HL: (265.4)						
RH006B	B.SUC	B.DIS	4323	* 12.4	(108.5)	(255.8)
—— BRHR —— dP: (109.8) HL: (257.2)						
RH006C	C.SUC	C.DIS	4327	* 12.41	(114.7)	(268.7)
—— CRHR —— dP: (115.1) HL: (269.5)						
RH006D	D.SUC	D.DIS	4343	* 12.46	(107.3)	(253)
—— DRHR —— dP: (108.6) HL: (254.5)						
RH006DA	D.DIS	D.DISA	4343	* 17.68	7.989	10.21
RH007A	A.DIS	ADISTEE	4276	* 17.41	7.065	13.3
RH007B	B.DIS	BDISTEE	4323	* 17.6	9.006	12.59
RH007C	C.DIS	ADISTEE	4327	* 17.62	8.368	16.35
RH007D	D.DISA	BDISTEE	4343	10.11	0.205	0.481

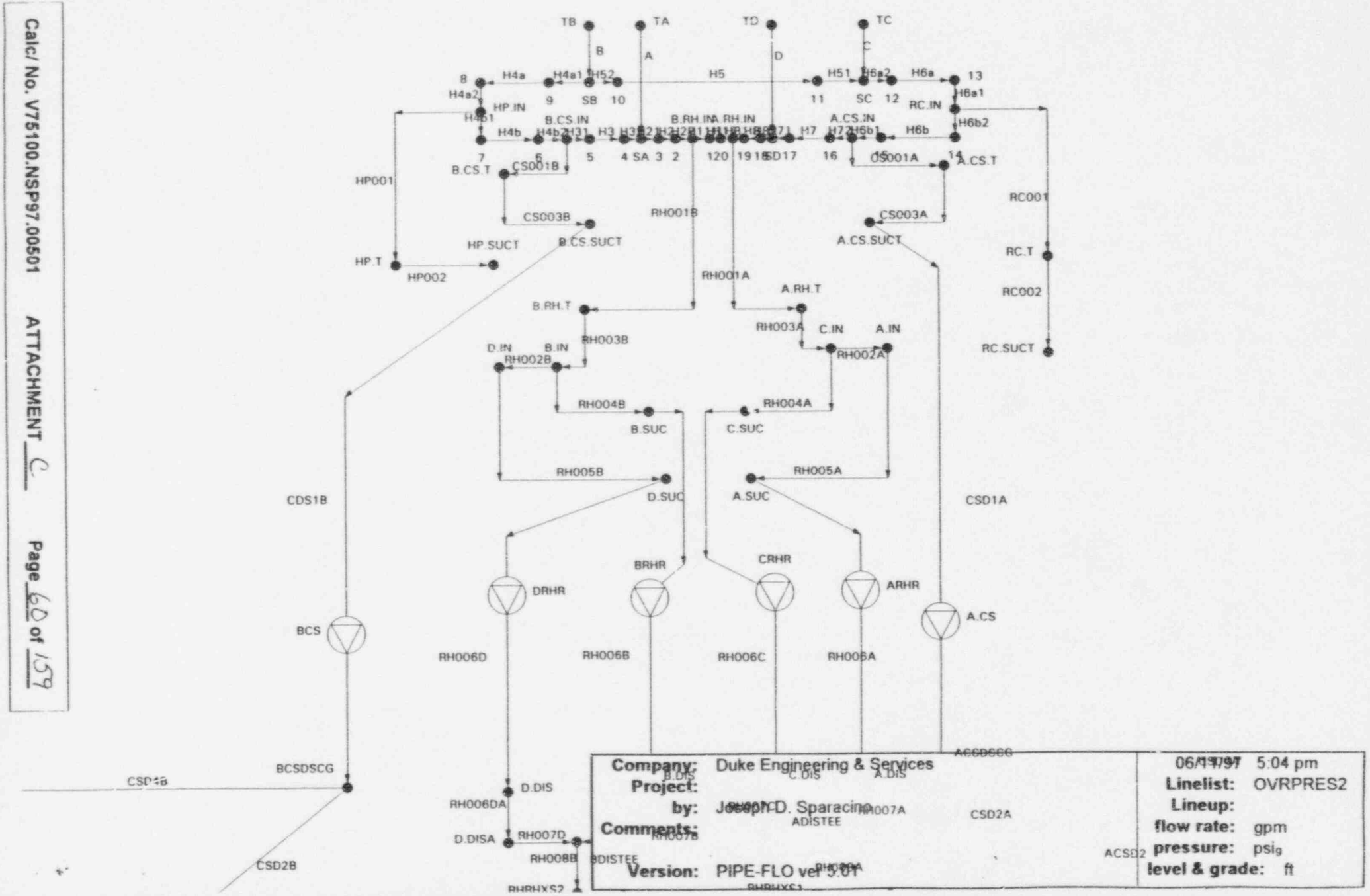
PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
RH008A	ADISTEE	RHRHXS1	8603	* 20.03	5.278	4.0 [illegible]
RH008B	BDISTEE	RHRHXS2	8666	* 20.18	0.778	[illegible]2
RHRHXA	RHRHXS1	RHRHXDA	4378	10.19	6.938	9.322
RHRHXB	RHRHXS2	RHRHXDB	4080	9.5	7.374	9.781
RHXBYPSA	RHRHXS1	RHRHXDA	4225	9.838	6.938	9.322
RHXBYPSB	RHRHXS2	RHRHXDB	4586	10.68	7.374	9.781
RX01A	RHRHXDA	RHRHXDC	8603	* 20.03	2.231	5.222
RX01B	RHRHXDB	RHRHXDD	8666	* 20.18	6.589	9.593
RX01C	RHRHXDC	RECIRCA	8603	* 20.03	17.16	26.35
RX01D	RHRHXDD	RECIRCB	8666	* 20.18	14.88	26.01
RX02A	RECIRCA	MO2012	0	0	4.59	0
RX02B	RECIRCB	M02013	17268	* 30.36	31.02	61.9
RX02C	MO2012	RECIRC1	closed	0	0	0
RX02D	M02013	RECIRC2	17268	* 34.47	37.94	78

PROJECT	Monticello Nuclear Station	File No:	V75100.NSP97.00501
OWNER	Northern States Power Co.	Calc No:	V75100.NSP97.00501
CLIENT	Monticello Nuclear Station		

REFERENCE

ATTACHMENT C

FLO-SERIES MODEL PIPING AND NETWORK INPUT AND OUTPUT FOR CASE #2.


TB
TA
TD
TC
B
A
D
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8
H4a
H4a1
H52
H5
H51
H6a2
H6a
13
H4a2
9
SB
10
11
SC
12
H6a1
HP.IN
RC.IN
H4b1
B.CS.IN
B.RH.IN
A.RH.IN
A.CS.IN
H6b2
H4b
H4b2
H3
H7
H7a
H6b1
H6b
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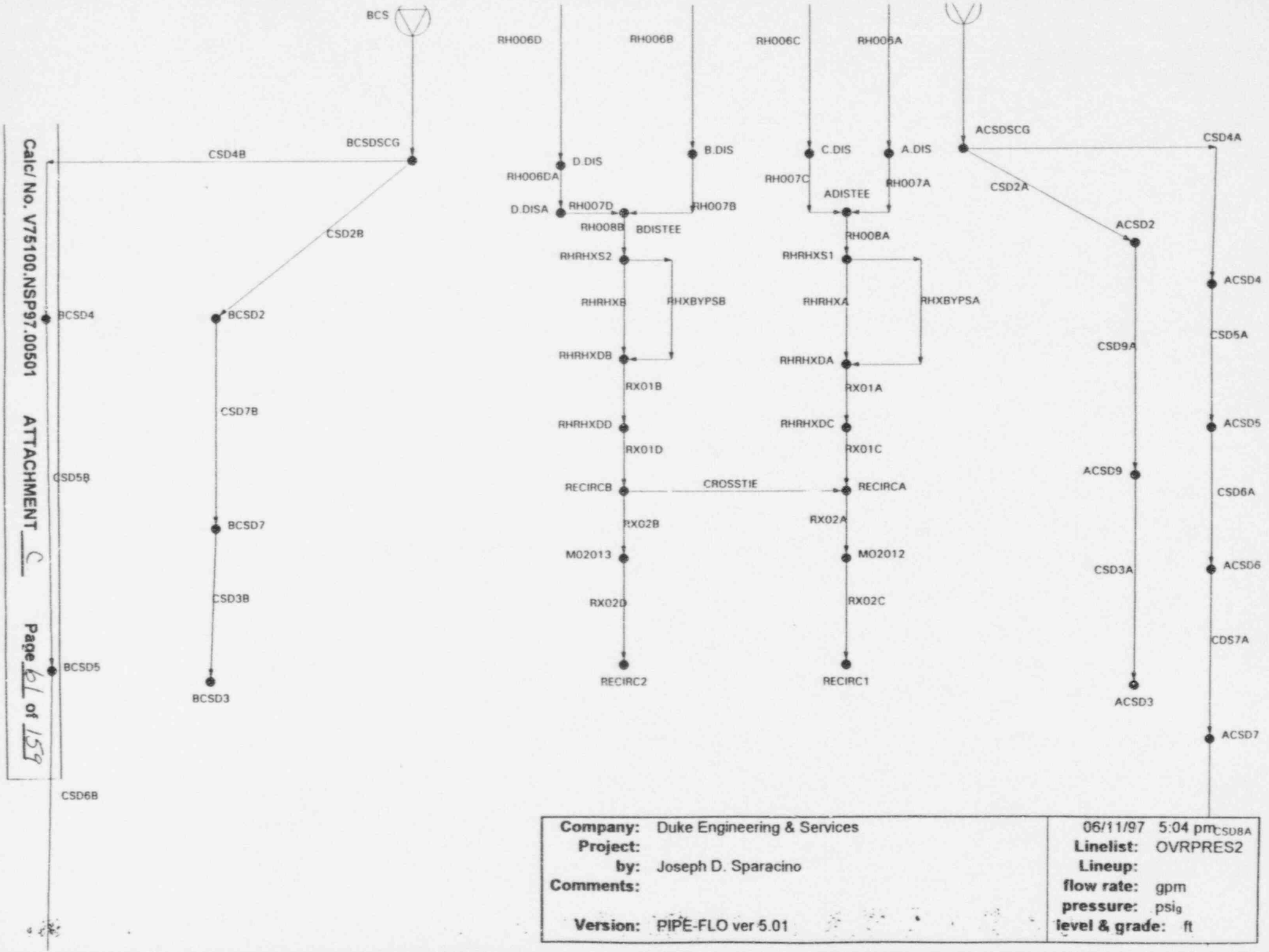
B.CS.T
CS001B
CS001A
A.CS.T
HP001
RC001
CS003B
RH001B
CS003A
HP.SUCT
B.CS.SUCT
A.CS.SUCT
HP.T
HP002
RH001A
RC.T
RC002
A.RH.T
B.RH.T
RH003A
C.IN
A.IN
RC.SUCT
D.IN
B.IN
RH003B
RH002B
RH002A
RH004B
RH004A
B.SUC
C.SUC
RH005B
RH005A
D.SUC
A.SUC
CDS1B
CSD1A
BRHR
CRHR
DRHR
ARHR
BCS
A.CS
RH006D
RH006B
RH006C
RH006A
BCSDSCG
D.DIS
RH006DA
D.DISA
RH007D
RH008B
CSD2B
ACSD2
CSD2A
RH007A
ADISTEE
RHRHXS2
Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino
Comments:
Version: PIPE-FLO vel 5.01
06/19/97 5:04 pm
Linelist: OVRPRES2
Lineup:
flow rate: gpm
pressure: psig
level & grade: ft



Calc/ No. V75100.NSP97.00501 ATTACHMENT C Page 61 of 159

Company:	Duke Engineering & Services	06/11/97	5:04 pm
Project:		**Linelist:**	OVRPRES2
by:	Joseph D. Sparacino	**Lineup:**	
Comments:		**flow rate:**	gpm
		pressure:	psig
Version:	PIPE-FLO ver 5.01	**level & grade:**	ft

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:19 am
System: OVRPRES2
rev: 06/12/97 8:19 am

SYSTEM REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 152.7°F. and 0 psig cont. press. Containment overpressure calcs.

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
1	902.25	H11	H1
10	902.25	H52	H5
11	902.25	H5	H51
12	902.25	H6a2	H6a
13	902.25	H6a	H6a1
14	902.25	H6b2	H6b
15	902.25	H6b	H6b1
16	902.25	H72	H7
17	902.25	H7	H71
18	902.25	H82	H8
19	902.25	H8	H81
2	902.25	H2	H22
20	902.25	H1	H12
3	902.25	H21	H2
4	902.25	H3	H32
5	902.25	H31	H3
6	902.25	H4b	H4b2
7	902.25	H4b1	H4b
8	902.25	H4a	H4a2
9	902.25	H4a1	H4a
A.CS.IN	902.25	H6b1	CS001A H72
A.CS.SUCT	897.833	CS003A	CSD1A
A.CS.T	899.916	CS001A	CS003A
A.DIS	897.833	RH006A	RH007A

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
A.IN	897.583	RH002A	RH005A
A.RH.IN	902.25	H12 H81	RH001A
A.RH.T	897.583	RH001A	RH003A
A.SUC	897.833	RH005A	RH006A
ACSD2	931.917	CSD2A	CSD9A
ACSD3	981.188	CSD3A	
ACSD4	900.156	CSD4A	CSD5A
ACSD5	900.74	CSD5A	CSD6A
ACSD6	925.875	CSD6A	CDS7A
ACSD7	928	CDS7A	CSD8A
ACSD8	927	CSD8A	
ACSD9	971.25	CSD9A	CSD3A
ACSDSCG	899.635	CSD1A	CSD2A CSD4A
ADISTEE	901.083	RH007A RH007C	RH008A
B.CS.IN	902.25	H4b2	CS001B H31
B.CS.SUCT	897.833	CS003B	CDS1B
B.CS.T	899.885	CS001B	CS003B
B.DIS	899.5	RH006B	RH007B
B.IN	897.583	RH003B	RH002B RH004B
B.RH.IN	902.25	H22	H11 RH001B
B.RH.T	897.583	RH001B	RH003B
B.SUC	897.833	RH004B	RH006B
BCSD2	927.833	CSD2B	CSD7B
BCSD3	980.38	CSD3B	
BCSD4	899.896	CSD4B	CSD5B
BCSD5	901.688	CSD5B	CSD6B
BCSD6	930.333	CSD6B	

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
BCSD7	978.5	CSD7B	CSD3B
BCSDSCG	899.583	CDS1B	CSD2B CSD4B
BDISTEE	908	RH007B RH007D	RH008B
C.DIS	897.833	RH006C	RH007C
C.IN	897.583	RH003A	RH002A RH004A
C.SUC	897.833	RH004A	RH006C
D.DIS	899.5	RH006D	RH006DA
D.DISA	908	RH006DA	RH007D
D.IN	897.583	RH002B	RH005B
D.SUC	897.833	RH005B	RH006D
HP.IN	902.25	H4a2	H4b1 HP001
HP.SUCT	901.615	HP002	
HP.T	901.615	HP001	HP002
M02013	940.91	RX02B	RX02D
MO2012	940.917	RX02A	RX02C
RC.IN	902.25	H6a1	H6b2 RC001
RC.SUCT	899.042	RC002	
RC.T	902.25	RC001	RC002
RECIRC1	951.75	RX02C	
RECIRC2	951.75	RX02D	
RECIRCA	930.168	CROSSTIE RX01C	RX02A
RECIRCB	930.167	RX01D	CROSSTIE RX02B
RHRHXDA	916.333	RHRHXA RHXBYPSA	RX01A
RHRHXDB	915.49	RHRHXB RHXBYPSB	RX01B
RHRHXDC	916.336	RX01A	RX01C

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
RHRHXDD	921.33	RX01B	RX01D
RHRHXS1	909.406	RH008A	RHRHXA RHXBYPSA
RHRHXS2	908	RH008B	RHRHXB RHXBYPSB
SA	902.25	A H32	H21
SB	902.25	B	H4a1 H52
SC	902.25	C H51	H6a2
SD	902.25	D H71	H82
TA	904.316		A
TB	904.316		B
TC	904.316		C
TD	904.316		D

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
A	31	TA	SA	
B	31	TB	SB	
C	31	TC	SC	
CDS1B	16	B.CS.SUCT	BCSDSCG	BCS
CDS7A	35	ACSD6	ACSD7	
CROSSTIE	21	RECIRCB	RECIRCA	
CS001A	16	A.CS.IN	A.CS.T	
CS001B	16	B.CS.IN	B.CS.T	
CS003A	16	A.CS.T	A.CS.SUCT	
CS003B	16	B.CS.T	B.CS.SUCT	
CSD1A	16	A.CS.SUCT	ACSDSCG	A.CS
CSD2A	16	ACSDSCG	ACSD2	
CSD2B	16	BCSDSCG	BCSD2	
CSD3A	35	ACSD9	ACSD3	
CSD3B	35	BCSD7	BCSD3	
CSD4A	16	ACSDSCG	ACSD4	
CSD4B	16	BCSDSCG	BCSD4	
CSD5A	35	ACSD4	ACSD5	
CSD5B	35	BCSD4	BCSD5	
CSD6A	16	ACSD5	ACSD6	
CSD6B	16	BCSD5	BCSD6	
CSD7B	16	BCSD2	BCSD7	
CSD8A	16	ACSD7	ACSD8	
CSD9A	16	ACSD2	ACSD9	
D	31	TD	SD	
H1	26	1	20	
H11	31	B.RH.IN	1	
H12	31	20	A.RH.IN	
H2	26	3	2	
H21	31	SA	3	
H22	31	2	B.RH.IN	
H3	26	5	4	
H31	31	B.CS.IN	5	
H32	31	4	SA	
H4a	26	9	8	
H4a1	31	SB	9	
H4a2	31	8	HP.IN	
H4b	26	7	6	
H4b1	31	HP.IN	7	
H4b2	31	6	B.CS.IN	
H5	26	10	11	
H51	31	11	SC	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
H52	31	SB	10	
H6a	26	12	13	
H6a1	31	13	RC.IN	
H6a2	31	SC	12	
H6b	26	14	15	
H6b1	31	15	A.CS.IN	
H6b2	31	RC.IN	14	
H7	26	16	17	
H71	31	17	SD	
H72	31	A.CS.IN	16	
H8	26	18	19	
H81	31	19	A.RH.IN	
H82	31	SD	18	
HP001	21	HP.IN	HP.T	
HP002	21	HP.T	HP.SUCT	
RC001	16	RC.IN	RC.T	
RC002	16	RC.T	RC.SUCT	
RH001A	26	A.RH.IN	A.RH.T	
RH001B	26	B.RH.IN	B.RH.T	
RH002A	26	C.IN	A.IN	
RH002B	26	B.IN	D.IN	
RH003A	26	A.RH.T	C.IN	
RH003B	26	B.RH.T	B.IN	
RH004A	21	C.IN	C.SUC	
RH004B	21	B.IN	B.SUC	
RH005A	21	A.IN	A.SUC	
RH005B	21	D.IN	D.SUC	
RH006A	16	A.SUC	A.DIS	ARHR
RH006B	16	B.SUC	B.DIS	BRHR
RH006C	16	C.SUC	C.DIS	CRHR
RH006D	16	D.SUC	D.DIS	DRHR
RH006DA	16	D.DIS	D.DISA	
RH007A	16	A.DIS	ADISTEE	
RH007B	16	B.DIS	BDISTEE	
RH007C	16	C.DIS	ADISTEE	
RH007D	21	D.DISA	BDISTEE	
RH008A	21	ADISTEE	RHRHXS1	
RH008B	21	BDISTEE	RHRHXS2	
RHRHXA	21	RHRHXS1	RHRHXDA	
RHRHXB	21	RHRHXS2	RHRHXDB	
RHXBYPSA	21	RHRHXS1	RHRHXDA	
RHXBYPSB	21	RHRHXS2	RHRHXDB	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
RX01A	21	RHRHXDA	RHRHXDC	
RX01B	21	RHRHXDB	RHRHXDD	
RX01C	21	RHRHXDC	RECIRCA	
RX01D	21	RHRHXDD	RECIRCB	
RX02A	21	RECIRCA	MO2012	
RX02B	21	RECIRCB	M02013	
RX02C	35	MO2012	RECIRC1	
RX02D	35	M02013	RECIRC2	
RXO1A	16	.	.	

PUMP/COMP	PERFORMANCE DATA					
A.CS	gpm:	0	2179	3990	5040	5755
	ft:	850.3	795.5	664	536.2	411.7
	eqn:	850.3 - 4.49715e-006 Q ^ 2.12033				
ARHR	gpm:	0	3365	4000	4250	4540
	ft:	810.3	498.9	350	280	171.8
	eqn:	810.3 - 1.3787e-006 Q ^ 2.36763				
BCS	gpm:	0	1948	3080	4875	5600
	ft:	844	770.1	719.4	535.2	418.1
	eqn:	844 - 0.000218414 Q ^ 1.66917				
BRHR	gpm:	0	3656	4000	4250	4408
	ft:	813.8	436	350	280	230
	eqn:	813.8 - 2.04305e-006 Q ^ 2.32005				
CRHR	gpm:	0	3540	4000	4250	4440
	ft:	763.9	461.1	360	290	235.4
	eqn:	763.9 - 5.58043e-007 Q ^ 2.46066				
DRHR	gpm:	0	3542	4000	4250	4425
	ft:	810.1	463	350	285	227
	eqn:	810.1 - 2.16007e-006 Q ^ 2.31196				

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/12/97 8:20 am
System: OVRPRES2
rev: 06/12/97 8:19 am

PIPELIST REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 152.7°F. and 0 psig cont. press. Containment overpressure calcs.

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
16 LB30 rev: 06/12/97 8:18 am	Steel Sch 40 0.0018 in Size for: 8 ft/sec	Water 152.7 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
21 LB31 rev: 06/12/97 8:18 am	Steel Sch 30 0.0018 in Size for: 8 ft/sec	Water 152.7 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
26 LB32 rev: 06/12/97 8:19 am	Steel Sch 20 0.0018 in Size for: 8 ft/sec	Water 152.7 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
31 LB34 rev: 06/12/97 8:19 am	Steel Sch 60 0.0018 in Size for: 8 ft/sec	Water 152.7 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
35 LB34a rev: 06/12/97 8:19 am	Steel Sch 80 0.0018 in Size for: 8 ft/sec	Water 152.7 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
A	31	Steel 20 in / 60	3.6777	Water 152.7 °F / 0 psi g	1.163
B	31	Steel 20 in / 60	3.6777	Water 152.7 °F / 0 psi g	0.4469
C	31	Steel 20 in / 60	3.6777	Water 152.7 °F / 0 psi g	1.163
CDS1B	16	Steel 10 in / 40	3.45	Water 152.7 °F / 0 psi g	0.2689
CDS7A	35	Steel 2 in / 80	7.73835	Water 152.7 °F / 0 psi g	0.478
CROSSTIE	21	Steel 14 in / 30	49.0188	Water 152.7 °F / 0 psi g	1.403
CS001A	16	Steel 12 in / 40	41.8129	Water 152.7 °F / 0 psi g	2.285
CS001B	16	Steel 12 in / 40	42.5259	Water 152.7 °F / 0 psi g	1.695
CS003A	16	Steel 12 in / 40	10.7215	Water 152.7 °F / 0 psi g	1.779
CS003B	16	Steel 12 in / 40	27.109	Water 152.7 °F / 0 psi g	2.018
CSD1A	16	Steel 10 in / 40	3.7973	Water 152.7 °F / 0 psi g	0.2689
CSD2A	16	Steel 10 in / 40	108.553	Water 152.7 °F / 0 psi g	60.59
CSD2B	16	Steel 10 in / 40	108.723	Water 152.7 °F / 0 psi g	59.14
CSD3A	35	Steel 8 in / 80	57.0055	Water 152.7 °F / 0 psi g	19.08
CSD3B	35	Steel 8 in / 80	55.4392	Water 152.7 °F / 0 psi g	19.08
CSD4A	16	Steel 2.5 in / 40	2.22525	Water 152.7 °F / 0 psi g	1.664
CSD4B	16	Steel 2.5 in / 40	2.7485	Water 152.7 °F / 0 psi g	1.93
CSD5A	35	Steel 2 in / 80	0.67045	Water 152.7 °F / 0 psi g	6.654
CSD5B	35	Steel 2 in / 80	2.0608	Water 152.7 °F / 0 psi g	6.654
CSD6A	16	Steel 2.5 in / 40	38.6803	Water 152.7 °F / 0 psi g	152.5
CSD6B	16	Steel 2.5 in / 40	101.051	Water 152.7 °F / 0 psi g	155.4
CSD7B	16	Steel 10 in / 40	97.3901	Water 152.7 °F / 0 psi g	1.995
CSD8A	16	Steel 2.5 in / 40	45.7585	Water 152.7 °F / 0 psi g	2.453
CSD9A	16	Steel 10 in / 40	75.8885	Water 152.7 °F / 0 psi g	1.53

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
D	31	Steel 20 in / 60	3.6777	Water 152.7 °F / 0 psi g	1.163
H1	26	Steel 20 in / 20	52.2054	Water 152.7 °F / 0 psi g	0.144
H11	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.2536
H12	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.00366
H2	26	Steel 20 in / 20	24.1868	Water 152.7 °F / 0 psi g	0.072
H21	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.00366
H22	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.01484
H3	26	Steel 20 in / 20	24.3777	Water 152.7 °F / 0 psi g	0.072
H31	31	Steel 20 in / 60	1.4375	Water 152.7 °F / 0 psi g	0.2425
H32	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.2536
H4a	26	Steel 20 in / 20	31.4675	Water 152.7 °F / 0 psi g	0.072
H4a1	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.7201
H4a2	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.01484
H4b	26	Steel 20 in / 20	45.6907	Water 152.7 °F / 0 psi g	0.144
H4b1	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.2425
H4b2	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.01484
H5	26	Steel 20 in / 20	108.244	Water 152.7 °F / 0 psi g	0.288
H51	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.2536
H52	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.7201
H6a	26	Steel 20 in / 20	15.1777	Water 152.7 °F / 0 psi g	0.072
H6a1	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.01484
H6a2	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.00366
H6b	26	Steel 20 in / 20	61.7884	Water 152.7 °F / 0 psi g	0.144
H6b1	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.01484

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
H6b2	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.2425
H7	26	Steel 20 in / 20	24.3777	Water 152.7 °F / 0 psi g	0.072
H71	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.2536
H72	31	Steel 20 in / 60	1.725	Water 152.7 °F / 0 psi g	0.2425
H8	26	Steel 20 in / 20	24.1868	Water 152.7 °F / 0 psi g	0.072
H81	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.01484
H82	31	Steel 20 in / 60	1.9171	Water 152.7 °F / 0 psi g	0.00366
HP001	21	Steel 14 in / 30	67.5027	Water 152.7 °F / 0 psi g	3.127
HP002	21	Steel 14 in / 30	9.3679	Water 152.7 °F / 0 psi g	1.356
RC001	16	Steel 6 in / 40	22.7965	Water 152.7 °F / 0 psi g	4.054
RC002	16	Steel 6 in / 40	56.5179	Water 152.7 °F / 0 psi g	1.298
RH001A	26	Steel 20 in / 20	62.1357	Water 152.7 °F / 0 psi g	2.161
RH001B	26	Steel 20 in / 20	55.6198	Water 152.7 °F / 0 psi g	2.09
RH002A	26	Steel 20 in / 20	5.75	Water 152.7 °F / 0 psi g	0.7101
RH002B	26	Steel 20 in / 20	5.3671	Water 152.7 °F / 0 psi g	0.7101
RH003A	26	Steel 20 in / 20	7.1093	Water 152.7 °F / 0 psi g	0.2367
RH003B	26	Steel 20 in / 20	7.6671	Water 152.7 °F / 0 psi g	0.7101
RH004A	21	Steel 14 in / 30	14.758	Water 152.7 °F / 0 psi g	2.63
RH004B	21	Steel 14 in / 30	14.95	Water 152.7 °F / 0 psi g	2.63
RH005A	21	Steel 14 in / 30	14.758	Water 152.7 °F / 0 psi g	1.867
RH005B	21	Steel 14 in / 30	14.95	Water 152.7 °F / 0 psi g	1.867
RH006A	16	Steel 12 in / 40	1.15	Water 152.7 °F / 0 psi g	0.2977
RH006B	16	Steel 12 in / 40	3.0671	Water 152.7 °F / 0 psi g	0.5573
RH006C	16	Steel 12 in / 40	1.15	Water 152.7 °F / 0 psi g	0.2977

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
RH006D	16	Steel 12 in / 40	3.06671	Water 152.7 °F / 0 psi g	0.5573
RH006DA	16	Steel 10 in / 40	20.7	Water 152.7 °F / 0 psi g	1.76
RH007A	16	Steel 10 in / 40	17.6094	Water 152.7 °F / 0 psi g	2.534
RH007B	16	Steel 10 in / 40	19.2625	Water 152.7 °F / 0 psi g	2.298
RH007C	16	Steel 10 in / 40	19.7656	Water 152.7 °F / 0 psi g	3.065
RH007D	21	Steel 14 in / 30	4.025	Water 152.7 °F / 0 psi g	0.2543
RH008A	21	Steel 14 in / 30	11.7875	Water 152.7 °F / 0 psi g	0.5086
RH008B	21	Steel 14 in / 30	2.875	Water 152.7 °F / 0 psi g	0.2543
RHRHXA	21	Steel 14 in / 30	28.4145	Water 152.7 °F / 0 psi g	5.436
RHRHXB	21	Steel 14 in / 30	54.8343	Water 152.7 °F / 0 psi g	6.316
RHXBYPSA	21	Steel 14 in / 30	29.4849	Water 152.7 °F / 0 psi g	5.85
RHXBYPSB	21	Steel 14 in / 30	15.4172	Water 152.7 °F / 0 psi g	5.341
RX01A	21	Steel 14 in / 30	6.3849	Water 152.7 °F / 0 psi g	0.763
RX01B	21	Steel 14 in / 30	20.748	Water 152.7 °F / 0 psi g	1.272
RX01C	21	Steel 14 in / 30	83.5906	Water 152.7 °F / 0 psi g	3.24
RX01D	21	Steel 14 in / 30	73.7917	Water 152.7 °F / 0 psi g	3.24
RX02A	21	Steel 16 in / 30	12.3625	Water 152.7 °F / 0 psi g	4.454
RX02B	21	Steel 16 in / 30	12.3625	Water 152.7 °F / 0 psi g	4.207
RX02C	35	Steel 16 in / 80	102.769	Water 152.7 °F / 0 psi g	3.252
RX02D	35	Steel 16 in / 80	97.9537	Water 152.7 °F / 0 psi g	3.184
RXO1A	16	Steel 14 in / 40	6.3849	Water 152.7 °F / 0 psi g	0.7645

MATERIALS REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 152.7°F. and 0 psig cont. press. Containment overpressure calcs.

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
A	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
B	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER
C	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER 1-Tee Flow Thru Branch
CDS1B	16	Steel 10 in / 40	3.45	1-Elbow Short - r/d 1 @ 90°
CDS7A	35	Steel 2 in / 80	7.73835	1-Elbow Short - r/d 1 @ 90° 1-Reducer Enlargement 2 X 2.5
CROSSTIE	21	Steel 14 in / 30	49.0188	3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Reducer Contraction 16 X 14 1-Reducer Enlargement 14 X 16 2-Gate Wedge Disc
CS001A	16	Steel 12 in / 40	41.8129	4-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
CS001B	16	Steel 12 in / 40	42.5259	1-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Branch
CS003A	16	Steel 12 in / 40	10.7215	3-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
CS003B	16	Steel 12 in / 40	27.109	1-Elbow Short - r/d 1 @ 90° 4-Elbow Short - r/d 1 @ 45° 1-Fixed K vel corctn
CSD1A	16	Steel 10 in / 40	3.7973	1-Elbow Short - r/d 1 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
CSD2A	16	Steel 10 in / 40	108.553	1-Tee Flow Thru Run 1-Swing Check Vertical 5-Elbow Short - r/d 1 @ 90° 8-Elbow Short - r/d 1 @ 45° 1-Fixed K Flow Element 1-Fixed K Res. Orifice
CSD2B	16	Steel 10 in / 40	108.723	4-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Fixed K Res. Orifice 1-Fixed K Flow Element
CSD3A	35	Steel 8 in / 80	57.0055	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Spargers
CSD3B	35	Steel 8 in / 80	55.4392	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Sparger
CSD4A	16	Steel 2.5 in / 40	2.22525	1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD4B	16	Steel 2.5 in / 40	2.7485	2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD5A	35	Steel 2 in / 80	0.67045	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD5B	35	Steel 2 in / 80	2.0608	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD6A	16	Steel 2.5 in / 40	38.6803	1-Elbow Short - r/d 1 @ 45° 2-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 2.5 X 2 1-Fixed K Orifice Min.
CSD6B	16	Steel 2.5 in / 40	101.051	10-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 1-Fixed K Orifice Min.
CSD7B	16	Steel 10 in / 40	97.3901	1-Reducer Contraction 10 X 8 4-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run
CSD8A	16	Steel 2.5 in / 40	45.7585	6-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°
CSD9A	16	Steel 10 in / 40	75.8885	1-Reducer Contraction 10 X 8 1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90°
D	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
H1	26	Steel 20 in / 20	52.2054	2-Fixed K 22.5 mitre
H11	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H12	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H2	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H21	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H22	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H3	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H31	31	Steel 20 in / 60	1.4375	1-Fixed K enlargement 1-Tee Flow Thru Run
H32	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H4a	26	Steel 20 in / 20	31.4675	1-Fixed K 22.5 mitre
H4a1	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement 1-Tee Flow Thru Branch
H4a2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H4b	26	Steel 20 in / 20	45.6907	2-Fixed K 22.5 mitre
H4b1	31	Steel	1.725	1-Fixed K enlargement

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
		20 in / 60		1-Tee Flow Thru Run
H4b2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H5	26	Steel 20 in / 20	108.244	4-Fixed K 22.5 mitre
H51	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H52	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Branch 1-Fixed K enlargement
H6a	26	Steel 20 in / 20	15.1777	1-Fixed K 22.5 mitre
H6a1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6a2	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H6b	26	Steel 20 in / 20	61.7884	2-Fixed K 22.5 mitre
H6b1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6b2	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H7	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H71	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H72	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H8	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H81	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H82	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
HP001	21	Steel 14 in / 30	67.5027	1-Elbow Long - r/d 1.5 @ 22.5° 2-Gate Wedge Disc 1-Swing Check Angled 3-Elbow Long - r/d 1.5 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run 1-Tee Flow Thru Branch
HP002	21	Steel 14 in / 30	9.3679	1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RC001	16	Steel 6 in / 40	22.7965	1-Elbow Long - r/d 1.5 @ 67.5° 1-Elbow Long - r/d 1.5 @ 45° 1-Elbow Long - r/d 1.5 @ 90° 2-Gate Wedge Disc 1-Swing Check Angled 2-Tee Flow Thru Branch
RC002	16	Steel 6 in / 40	56.5179	1-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH001A	26	Steel 20 in / 20	62.1357	2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH001B	26	Steel 20 in / 20	55.6198	1-Elbow Long - r/d 1.5 @ 90° 1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH002A	26	Steel 20 in / 20	5.75	1-Tee Flow Thru Branch
RH002B	26	Steel 20 in / 20	5.3671	1-Tee Flow Thru Branch
RH003A	26	Steel 20 in / 20	7.1093	1-Tee Flow Thru Run
RH003B	26	Steel 20 in / 20	7.6671	1-Tee Flow Thru Branch
RH004A	21	Steel 14 in / 30	14.758	1-Tee Flow Thru Branch 1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH004B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K vel corctn

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH005A	21	Steel 14 in / 30	14.758	1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH005B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RH006A	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006B	16	Steel 12 in / 40	3.0671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006C	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006D	16	Steel 12 in / 40	3.06671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006DA	16	Steel 10 in / 40	20.7	3-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Reducer Enlargement 10 X 14
RH007A	16	Steel 10 in / 40	17.6094	2-Elbow Short - r/d 1 @ 90° 1-Elbow Long - r/d 1.5 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Run 1-Reducer Enlargement 10 X 12 1-Swing Check Angled
RH007B	16	Steel 10 in / 40	19.2625	2-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Reducer Enlargement 10 X 14
RH007C	16	Steel 10 in / 40	19.7656	3-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Swing Check Angled
RH007D	21	Steel 14 in / 30	4.025	1-Tee Flow Thru Run
RH008A	21	Steel 14 in / 30	11.7875	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH008B	21	Steel 14 in / 30	2.875	1-Tee Flow Thru Run
RHRHXA	21	Steel 14 in / 30	28.4145	3-Elbow Short - r/d 1 @ 90° 2-Gate Wedge Disc 1-Tee Flow Thru Run 1-Fixed K RHR HX
RHRHXB	21	Steel 14 in / 30	54.8343	3-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 2-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K RHR HX
RHXBYPSA	21	Steel 14 in / 30	29.4849	1-Tee Flow Thru Branch 3-Elbow Short - r/d 1 @ 90° 1-Globe Valve
RHXBYPSB	21	Steel 14 in / 30	15.4172	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Globe Valve
RX01A	21	Steel 14 in / 30	6.3849	1-Tee Flow Thru Branch
RX01B	21	Steel 14 in / 30	20.748	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
RX01C	21	Steel 14 in / 30	83.5906	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX01D	21	Steel 14 in / 30	73.7917	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX02A	21	Steel 16 in / 30	12.3625	1-Globe Valve 1-Tee Flow Thru Run
RX02B	21	Steel 16 in / 30	12.3625	1-Globe Valve
RX02C	35	Steel 16 in / 80	102.769	7-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Reducer Enlargement 16 X 18

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RX02D	35	Steel 16 in / 80	97.9537	6-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Elbow Short - r/d 1 @ 45° 1-Reducer Enlargement 16 X 18
RXO1A	16	Steel 14 in / 40	6.3849	1-Tee Flow Thru Branch

PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Steel	20	20 in	555.352 ft
Steel	30	14 in	516.659 ft
		16 in	24.725 ft
Steel	40	2.5 in	190.464 ft
		6 in	79.3144 ft
		10 in	475.139 ft
		12 in	130.603 ft
		14 in	6.3849 ft
Steel	60	20 in	51.2285 ft
Steel	80	2 in	10.4696 ft
		8 in	112.445 ft
		16 in	200.723 ft

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
16 LB30	Steel	40	
	Size: 2.5 in		7-Elbow Short - r/d 1 @ 45°
			2-Tee Flow Thru Branch
			3-Reducer Contraction 2.5 X 2
			18-Elbow Short - r/d 1 @ 90°
			2-Fixed K Orifice Min.
	Size: 6 in		1-Elbow Long - r/d 1.5 @ 67.5°
			1-Elbow Long - r/d 1.5 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°
			2-Gate Wedge Disc
			1-Swing Check Angled
			2-Tee Flow Thru Branch
			1-Elbow Short - r/d 1 @ 90°
			1-Fixed K vel corctn
	Size: 10 in		28-Elbow Short - r/d 1 @ 90°
			5-Tee Flow Thru Run
			4-Swing Check Vertical
			11-Elbow Short - r/d 1 @ 45°
			2-Fixed K Flow Element
			2-Fixed K Res. Orifice
			2-Reducer Contraction 10 X 8
			4-Gate Wedge Disc

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 10 in		2-Reducer Enlargement 10 X 14
			1-Elbow Long - r/d 1.5 @ 90°
			1-Reducer Enlargement 10 X 12
			2-Swing Check Angled
			2-Tee Flow Thru Branch
	Size: 12 in		11-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			2-Gate Double Disc
			2-Tee Flow Thru Run
			2-Tee Flow Thru Branch
			5-Elbow Short - r/d 1 @ 45°
			2-Fixed K vel corctn
			4-Reducer Contraction 12 X 10
	Size: 14 in		1-Tee Flow Thru Branch
21 LB31	Steel	30	
	Size: 14 in		30-Elbow Short - r/d 1 @ 90°
			9-Tee Flow Thru Run
			1-Reducer Contraction 16 X 14
			3-Reducer Enlargement 14 X 16
			13-Gate Wedge Disc
			1-Elbow Long - r/d 1.5 @ 22.5°
			1-Swing Check Angled
			3-Elbow Long - r/d 1.5 @ 90°
			10-Tee Flow Thru Branch
			5-Fixed K vel corctn
			4-Reducer Contraction 20 X 14
			2-Fixed K RHR HX
			2-Elbow Short - r/d 1 @ 45°
			2-Globe Valve
			2-Fixed K Flow Element
	Size: 16 in		2-Globe Valve
			1-Tee Flow Thru Run
26 LB32	Steel	20	
	Size: 20 in		16-Fixed K 22.5 mitre
			3-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			7-Tee Flow Thru Branch
			2-Elbow Short - r/d 1 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 20 in		1-Tee Flow Thru Run
31 LB34	Steel	60	
	Size: 20 in		2-Fixed K strainer
			5-Tee Flow Thru Branch
			2-Fixed K STRAINER
			10-Fixed K contraction
			8-Tee Flow Thru Run
			10-Fixed K enlargement
35 LB34a	Steel	80	
	Size: 2 in		1-Elbow Short - r/d 1 @ 90°
			3-Reducer Enlargement 2 X 2.5
			2-Globe Valve
	Size: 8 in		6-Gate Wedge Disc
			2-Swing Check Angled
			12-Elbow Short - r/d 1 @ 90°
			1-Fixed K Spargers
			1-Fixed K Sparger
	Size: 16 in		13-Elbow Short - r/d 1 @ 90°
			4-Gate Double Disc
			2-Swing Check Angled
			2-Reducer Enlargement 16 X 18
			1-Elbow Short - r/d 1 @ 45°

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/17/97 8:25 pm
Lineup: CASE2
rev: 06/17/97 8:22 pm

System: OVRPRES2
rev: 06/12/97 8:19 am

Deviation: 0.00893 %
after: 12 iterations

long term, B RHR @4000 and B CS @ 2800gpm, 0 cont. pres., A strainer plugged, sp wtr lvl 908'-9.3".

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the first specification were used in this calculation.

LINEUP SUMMARIES

PIPELINE		FLOW gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
CSD3B	>>>	2800	BCSD3	0	0
CSD6B	>>>	228.6	BCSD6	0	0
RX02C	>>>	4000	RECIRC1	0	0
B	<<<	2854	TB	0	4.459
C	<<<	1736	TC	0	4.459
D	<<<	2439	TD	0	4.459

Flows IN: 7029 gpm
Flows OUT: 7029 gpm

NET FLOWS: 0 gpm

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
1	902.25		2.593	908.4
10	902.25		2.732	908.7
11	902.25		2.734	908.7
12	902.25		2.734	908.7
13	902.25		2.731	908.7
14	902.25		2.725	908.7
15	902.25		2.715	908.6
16	902.25		2.71	908.6
17	902.25		2.705	908.6
18	902.25		2.698	908.6
19	902.25		2.666	908.5
2	902.25		2.555	908.3
20	902.25		2.659	908.5
3	902.25		2.555	908.3
4	902.25		2.555	908.3
5	902.25		2.556	908.3
6	902.25		2.559	908.3
7	902.25		2.602	908.4
8	902.25		2.63	908.4
9	902.25		2.658	908.5
A.CS.IN	902.25		2.714	908.6
A.CS.SUCT	897.833		4.589	908.6
A.CS.T	899.916		3.705	908.6
A.DIS	897.833		4.536	908.5
A.IN	897.583		4.642	908.5
A.RH.IN	902.25		2.662	908.5
A.RH.T	897.583		4.642	908.5
A.SUC	897.833		4.536	908.5
ACSD2	931.917		-9.875 **	908.6
ACSD4	900.156		3.603	908.6
ACSD5	900.74		3.355	908.6
ACSD6	925.875		-7.311 ***	908.6
ACSD7	928		-8.213 ***	908.6
ACSD9	971.25		-26.57 ***	908.6
ACSDSCG	899.635		3.824	908.6
ADISTEE	901.083		24.84	959.6
B.CS.IN	902.25		2.556	908.3
B.CS.SUCT	897.833		2.108	902.8
B.CS.T	899.885		2.426	905.6
B.DIS	899.5		149.3	1251
B.IN	897.583		4.111	907.3

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
B.RH.IN	902.25		2.555	908.3
B.RH.T	897.583		4.21	907.5
B.SUC	897.833		2.399	903.5
BCSD2	927.833		77.35	1110
BCSD3	980.38		0 (source)	980.4
BCSD4	899.896		295.7 ***	1597
BCSD5	901.688		266.9 ***	1531
BCSD6	930.333		0 (source)	930.3
BCSD7	978.5		52.74	1103
BCSDSCG	899.583		299.3 ***	1605
BDISTEE	908		27.33	972.4
C.DIS	897.833		4.536	908.5
C.IN	897.583		4.642	908.5
C.SUC	897.833		4.536	908.5
D.DIS	899.5		3.298	907.3
D.DISA	908		27.33	972.4
D.IN	897.583		4.111	907.3
D.SUC	897.833		4.005	907.3
HP.IN	902.25		2.627	908.4
HP.T	901.615		2.897	908.4
M02013	940.91		9.077	962.3
MO2012	940.917		6.442	956.1
RC.IN	902.25		2.73	908.7
RC.T	902.25		2.73	908.7
RECIRC1	951.75		0 (source)	951.7
RECIRCA	930.168		12.49	959.6
RECIRCB	930.167		13.64	962.3
RHRHXDA	916.333		18.37	959.6
RHRHXDB	915.49		23.1	969.9
RHRHXDC	916.336		18.36	959.6
RHRHXDD	921.33		19.75	967.9
RHRHXS1	909.406		21.31	959.6
RHRHXS2	908		27.16	972
SA	902.25		2.555	908.3
SB	902.25		2.731	908.7
SC	902.25		2.734	908.7
SD	902.25		2.7	908.6
TB	904.316		1.892 (source)	908.8
TC	904.316		1.892 (source)	908.8
TD	904.316		1.892 (source)	908.8

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
A	TA		SA	closed	0	0	0
B	TB		SB	2854	3.455	(0.839)	0.089
C	TC		SC	1736	2.102	(0.842)	0.082
CDS1B	B.CS.SUCT		BCSDSCG	3029	* 12.33	(297.1)	(702)
—— BCS —— dP: (298.2) HL: (702.7)							
CDS7A	ACSD6		ACSD7	0	0	0.902	0
CROSSTIE	RECIRCB		RECIRCA	4000	9.315	1.141	2.688
CS001A	A.CS.IN		A.CS.T	0	0	(0.990)	0
CS001B	B.CS.IN		B.CS.T	3029	8.688	0.130	2.671
CS003A	A.CS.T		A.CS.SUCT	0	0	(0.884)	0
CS003B	B.CS.T		B.CS.SUCT	3029	8.688	0.318	2.8
CSD1A	A.CS.SUCT		ACSDSCG	0	0	0.765	0
—— A.CS —— dP: HL:							
CSD2A	ACSDSCG		ACSD2	0	0	13.7	0
CSD2B	BCSDSCG		BCSD2	2800	11.4	64.16	122.9
—— FCV@2800 —— dP: 157.7 HL: 371.7							
CSD3A	ACSD9		ACSD3	closed	0	0	0
CSD3B	BCSD7		BCSD3	2800	* 19.69	52.74	122.4
CSD4A	ACSDSCG		ACSD4	0	0	0.221	0
CSD4B	BCSDSCG		BCSD4	228.6	* 15.33	3.508	7.955
CSD5A	ACSD4		ACSD5	0	0	0.248	0
CSD5B	BCSD4		BCSD5	228.6	* 24.86	28.85	66.18
CSD6A	ACSD5		ACSD6	0	0	10.67	0
CSD6B	BCSD5		BCSD6	228.6	* 15.33	266.9	600.3
CSD7B	BCSD2		BCSD7	2800	11.4	24.61	7.326
CSD8A	ACSD7		ACSD8	closed	0	0	0
CSD9A	ACSD2		ACSD9	0	0	16.69	0
D	TD		SD	2439	2.953	(0.808)	0.162
H1	20	<->	1	3811	4.205	0.066	0.156
H11	1	<->	B.RH.IN	3811	4.615	0.038	0.089
H12	A.RH.IN	<->	20	3811	4.615	0.003	0.007
H2	3		2	188.5	0.208	0	0
H21	SA		3	188.5	0.228	0	0
H22	2		B.RH.IN	188.5	0.228	0	0
H3	5		4	188.5	0.208	0	0
H31	B.CS.IN		5	188.5	0.228	0	0
H32	4		SA	188.5	0.228	0	0
H4a	9		8	3217	3.549	0.027	0.065
H4a1	SB		9	3217	3.895	0.074	0.173
H4a2	8		HP.IN	3217	3.895	0.003	0.007
H4b	7		6	3217	3.549	0.043	0.102
H4b1	HP.IN		7	3217	3.895	0.026	0.061

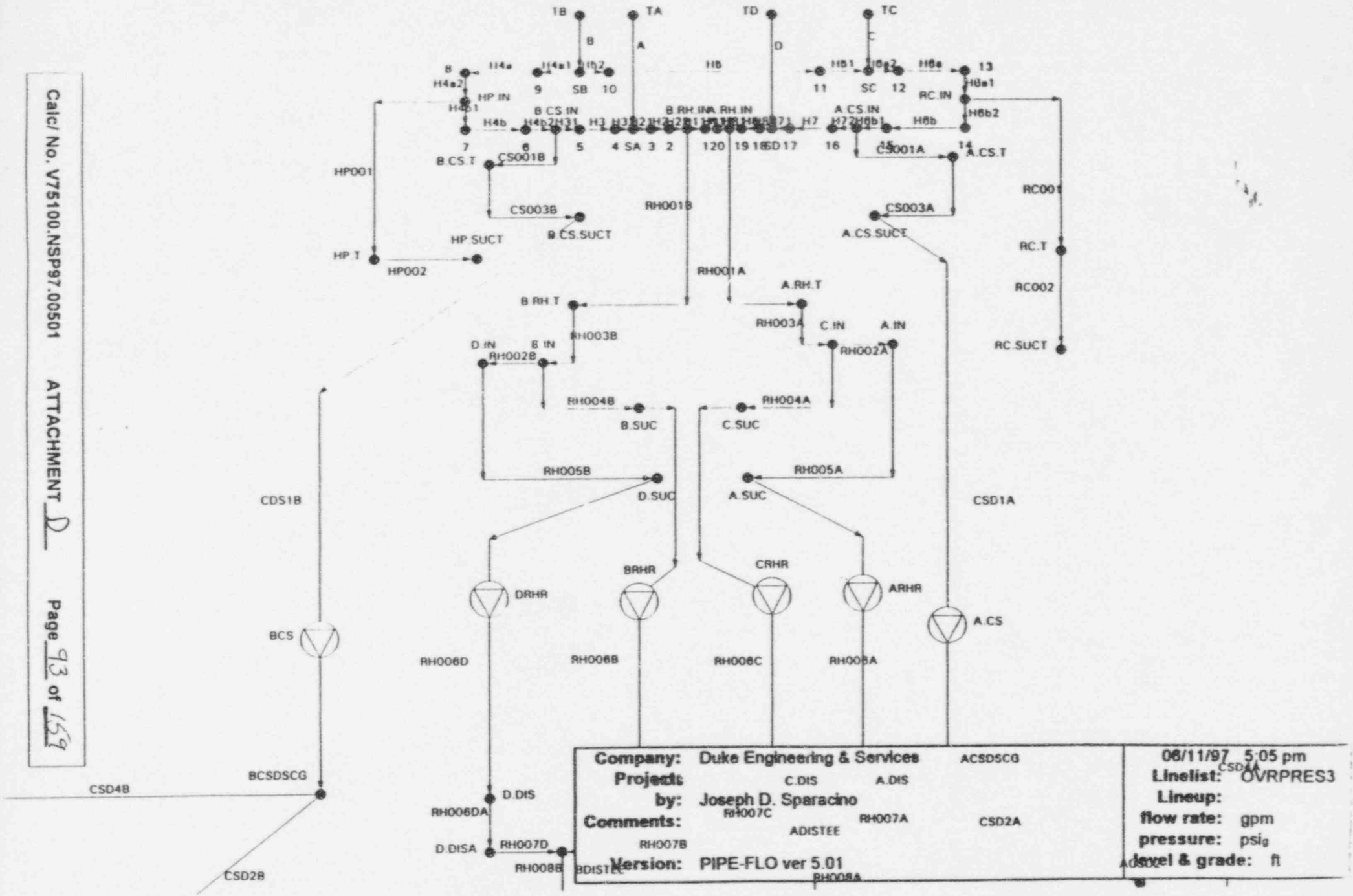
PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
H4b2	6		B.CS.IN	3217	3.895	0.003	0.007
H5	11	<->	10	363.5	0.401	0.002	0.004
H51	SC	<->	11	363.5	0.440	0	0
H52	10	<->	SB	363.5	0.440	0	0.002
H6a	12		13	1372	1.514	0.003	0.007
H6a1	13		RC.IN	1372	1.662	0	0.001
H6a2	SC		12	1372	1.662	0	0
H6b	14		15	1372	1.514	0.010	0.025
H6b1	15		A.CS.IN	1372	1.662	0	0.001
H6b2	RC.IN		14	1372	1.662	0.005	0.011
H7	16		17	1372	1.514	0.004	0.010
H71	17		SD	1372	1.662	0.005	0.012
H72	A.CS.IN		16	1372	1.662	0.005	0.011
H8	18		19	3811	4.205	0.031	0.074
H81	19		A.RH.IN	3811	4.615	0.004	0.010
H82	SD		18	3811	4.615	0.003	0.007
HP001	HP.IN		HP.T	0	0	(0.269)	0
HP002	HP.T		HP.SUCT	closed	0	0	0
RC001	RC.IN		RC.T	0	0	0	0
RC002	RC.T		RC.SUCT	closed	0	0	0
RH001A	A.RH.IN		A.RH.T	0	0	(1.981)	0
RH001B	B.RH.IN		B.RH.T	4000	4.413	(1.655)	0.767
RH002A	C.IN		A.IN	0	0	0	0
RH002B	B.IN		D.IN	0	0	0	0
RH003A	A.RH.T		C.IN	0	0	0	0
RH003B	B.RH.T		B.IN	4000	4.413	0.099	0.233
RH004A	C.IN		C.SUC	0	0	0.106	0
RH004B	B.IN		B.SUC	4000	9.315	1.712	3.784
RH005A	A.IN		A.SUC	0	0	0.106	0
RH005B	D.IN		D.SUC	0	0	0.106	0
RH006A	A.SUC		A.DIS	0	0	0	0
—— ARHR —— dP: HL:							
RH006B	B.SUC		B.DIS	4000	11.47	(146.9)	(347.8)
—— BRHR —— dP: (143.1) HL: (349)							
RH006C	C.SUC		C.DIS	0	0	0	0
—— CRHR —— dP: HL:							
RH006D	D.SUC		D.DIS	0	0	0.707	0
—— DRHR —— dP: HL:							
RH006DA	D.DIS		D.DISA	closed	0	0	0
RH007A	A.DIS		ADISTEE	closed	0	0	0
RH007B	B.DIS		BDISTEE	4000	* 16.29	8.18	10.78
—— FCV@4000 —— dP: 113.8 HL: 268.1							
RH007C	C.DIS		ADISTEE	closed	0	0	0

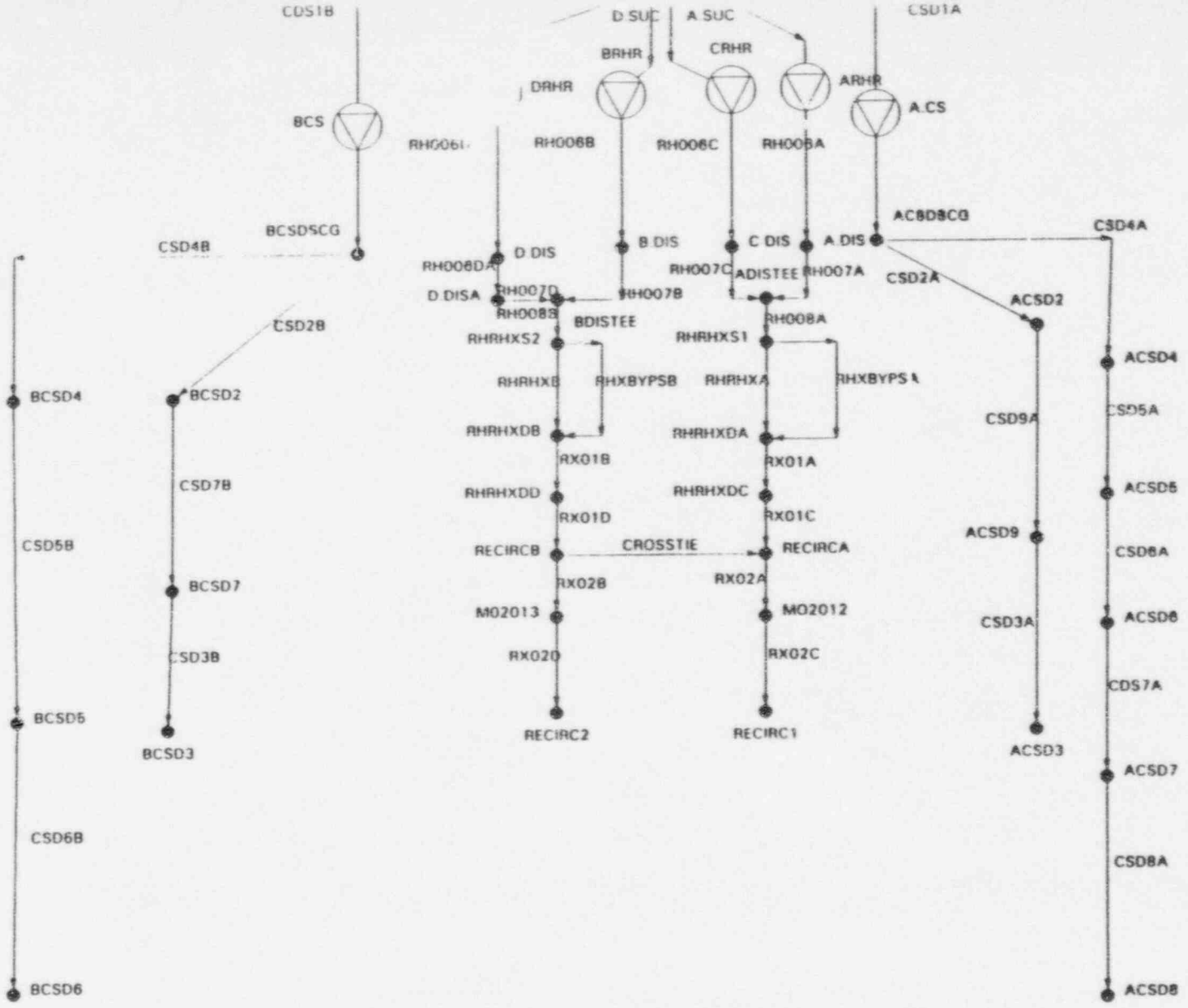
PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
RH007D	D.DISA		BDISTEE	0	0	0	0
RH008A	ADISTEE		RHRHXS1	0	0	3.532	0
RH008B	BDISTEE		RHRHXS2	4000	9.315	0.165	0.389
RHRHXA	RHRHXDA	<->	RHRHXS1	0.839	0.002	(2.94)	0
RHRHXB	RHRHXS2		RHRHXDB	1882	4.383	4.065	2.088
RHXBYPSA	RHRHXS1		RHRHXDA	0.839	0.002	2.94	0
RHXBYPSB	RHRHXS2		RHRHXDB	2118	4.932	4.065	2.088
RX01A	RHRHXDA		RHRHXDC	0	0	0.001	0
RX01B	RHRHXDB		RHRHXDD	4000	9.315	3.349	2.051
RX01C	RHRHXDC		RECIRCA	0	0	5.87	0
RX01D	RHRHXDD		RECIRCB	4000	9.315	6.112	5.565
RX02A	RECIRCA		MO2012	4000	7.032	6.053	3.515
RX02B	RECIRCB		M02013	0	0	4.559	0
RX02C	MO2012		RECIRC1	4000	7.984	6.442	4.347
RX02D	M02013		RECIRC2	closed	0	0	0

REFERENCE

ATTACHMENT D

FLO-SERIES MODEL PIPING AND NETWORK INPUT AND OUTPUT FOR CASE #3.


TB
TA
TD
TC
B
A
D
C
8
H4a
H4a1
H4a2
H4a1
H4b2
H5
H6a1
H6a2
H6a
13
H6a1
9
SB
10
11
SC
12
RC.IN
HP.IN
H4b1
B.CS.IN
B.RH.IN
A.RH.IN
A.CS.IN
H6b2
H4b
H4b2
H3
H7
H6b1
H6b
7
6
5
4
SA
3
2
120
19
18
SD
17
16
15
14
B.CS.T
CS001B
CS001A
A.CS.T
HP001
RC001
CS003B
RH001B
CS003A
B.CS.SUCT
A.CS.SUCT
HP.SUCT
HP.T
HP002
RC.T
RH001A
RC002
A.RH.T
B.RH.T
RH003A
C.IN
A.IN
RH003B
D.IN
B.IN
RH002A
RC.SUCT
RH002B
RH004B
RH004A
B.SUC
C.SUC
RH005B
RH005A
CDS1B
D.SUC
A.SUC
CSD1A
BRHR
CRHR
DRHR
ARHR
BCS
A.CS
RH006D
RH006B
RH006C
RH006A
BCSDSCG
CSD4B
D.DIS
RH006DA
D.DISA
RH007D
RH008B
CSD2B
Company: Duke Engineering & Services
Projects
by: Joseph D. Sparacino
Comments:
Version: PIPE-FLO ver 5.01
ACSDSCG
C.DIS
A.DIS
RH007C
RH007A
CSD2A
ADISTEE
RH007B
BDISTEE
RH008A
06/11/97 5:05 pm
Linelist: OVRPRES3
Lineup:
flow rate: gpm
pressure: psig
level & grade: ft



Company:	Duke Engineering & Services	06/11/97	5:06 pm
Project:		**Linelist:**	OVRPRES3
by:	Joseph D. Sparacino	**Lineup:**	
Comments:		**flow rate:**	gpm
		pressure:	psi_g
Version:	PIPE-FLO ver 5.01	**level & grade:**	ft

Calc/ No. V75100.NSP97.00501 ATTACHMENT 12 Page 94 of 159

SYSTEM REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.2°F. and 0 psig cont. press. Containment overpressure calcs.

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
1	902.25	H11	H1
10	902.25	H52	H5
11	902.25	H5	H51
12	902.25	H6a2	H6a
13	902.25	H6a	H6a1
14	902.25	H6b2	H6b
15	902.25	H6b	H6b1
16	902.25	H72	H7
17	902.25	H7	H71
18	902.25	H82	H8
19	902.25	H8	H81
2	902.25	H2	H22
20	902.25	H1	H12
3	902.25	H21	H2
4	902.25	H3	H32
5	902.25	H31	H3
6	902.25	H4b	H4b2
7	902.25	H4b1	H4b
8	902.25	H4a	H4a2
9	902.25	H4a1	H4a
A.CS.IN	902.25	H6b1	CS001A H72
A.CS.SUCT	897.833	CS003A	CSD1A
A.CS.T	899.916	CS001A	CS003A
A.DIS	897.833	RH006A	RH007A

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
A.IN	897.583	RH002A	RH005A
A.RH.IN	902.25	H12 H81	RH001A
A.RH.T	897.583	RH001A	RH003A
A.SUC	897.833	RH005A	RH006A
ACSD2	931.917	CSD2A	CSD9A
ACSD3	981.188	CSD3A	
ACSD4	900.156	CSD4A	CSD5A
ACSD5	900.74	CSD5A	CSD6A
ACSD6	925.875	CSD6A	CDS7A
ACSD7	928	CDS7A	CSD8A
ACSD8	927	CSD8A	
ACSD9	971.25	CSD9A	CSD3A
ACSDSCG	899.635	CSD1A	CSD2A CSD4A
ADISTEE	901.083	RH007A RH007C	RH008A
B.CS.IN	902.25	H4b2	CS001B H31
B.CS.SUCT	897.833	CS003B	CDS1B
B.CS.T	899.885	CS001B	CS003B
B.DIS	899.5	RH006B	RH007B
B.IN	897.583	RH003B	RH002B RH004B
B.RH.IN	902.25	H22	H11 RH001B
B.RH.T	897.583	RH001B	RH003B
B.SUC	897.833	RH004B	RH006B
BCSD2	927.833	CSD2B	CSD7B
BCSD3	980.38	CSD3B	
BCSD4	899.896	CSD4B	CSD5B
BCSD5	901.688	CSD5B	CSD6B
BCSD6	930.333	CSD6B	

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
BCSD7	978.5	CSD7B	CSD3B
BCSDSCG	899.583	CDS1B	CSD2B CSD4B
BDISTEE	908	RH007B RH007D	RH008B
C.DIS	897.833	RH006C	RH007C
C.IN	897.583	RH003A	RH002A RH004A
C.SUC	897.833	RH004A	RH006C
D.DIS	899.5	RH006D	RH006DA
D.DISA	908	RH006DA	RH007D
D.IN	897.583	RH002B	RH005B
D.SUC	897.833	RH005B	RH006D
HP.IN	902.25	H4a2	H4b1 HP001
HP.SUCT	901.615	HP002	
HP.T	901.615	HP001	HP002
M02013	940.91	RX02B	RX02D
MO2012	940.917	RX02A	RX02C
RC.IN	902.25	H6a1	H6b2 RC001
RC.SUCT	899.042	RC002	
RC.T	902.25	RC001	RC002
RECIRC1	951.75	RX02C	
RECIRC2	951.75	RX02D	
RECIRCA	930.168	CROSSTIE RX01C	RX02A
RECIRCB	930.167	RX01D	CROSSTIE RX02B
RHRHXDA	916.333	RHRHXA RHXBYPSA	RX01A
RHRHXDB	915.49	RHRHXB RHXBYPSB	RX01B
RHRHXDC	916.336	RX01A	RX01C

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
RHRHXDD	921.33	RX01B	RX01D
RHRHXS1	909.406	RH008A	RHRHXA RHXBYPSA
RHRHXS2	908	RH008B	RHRHXB RHXBYPSB
SA	902.25	A H32	H21
SB	902.25	B	H4a1 H52
SC	902.25	C H51	H6a2
SD	902.25	D H71	H82
TA	904.316		A
TB	904.316		B
TC	904.316		C
TD	904.316		D

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
A	31	TA	SA	
B	31	TB	SB	
C	31	TC	SC	
CDS1B	16	B.CS.SUCT	BCSDSCG	BCS
CDS7A	35	ACSD6	ACSD7	
CROSSTIE	21	RECIRCB	RECIRCA	
CS001A	16	A.CS.IN	A.CS.T	
CS001B	16	B.CS.IN	B.CS.T	
CS003A	16	A.CS.T	A.CS.SUCT	
CS003B	16	B.CS.T	B.CS.SUCT	
CSD1A	16	A.CS.SUCT	ACSDSCG	A.CS
CSD2A	16	ACSDSCG	ACSD2	
CSD2B	16	BCSDSCG	BCSD2	
CSD3A	35	ACSD9	ACSD3	
CSD3B	35	BCSD7	BCSD3	
CSD4A	16	ACSDSCG	ACSD4	
CSD4B	16	BCSDSCG	BCSD4	
CSD5A	35	ACSD4	ACSD5	
CSD5B	35	BCSD4	BCSD5	
CSD6A	16	ACSD5	ACSD6	
CSD6B	16	BCSD5	BCSD6	
CSD7B	16	BCSD2	BCSD7	
CSD8A	16	ACSD7	ACSD8	
CSD9A	16	ACSD2	ACSD9	
D	31	TD	SD	
H1	26	1	20	
H11	31	B.RH.IN	1	
H12	31	20	A.RH.IN	
H2	26	3	2	
H21	31	SA	3	
H22	31	2	B.RH.IN	
H3	26	5	4	
H31	31	B.CS.IN	5	
H32	31	4	SA	
H4a	26	9	8	
H4a1	31	SB	9	
H4a2	31	8	HP.IN	
H4b	26	7	6	
H4b1	31	HP.IN	7	
H4b2	31	6	B.CS.IN	
H5	26	10	11	
H51	31	11	SC	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
H52	31	SB	10	
H6a	26	12	13	
H6a1	31	13	RC.IN	
H6a2	31	SC	12	
H6b	26	14	15	
H6b1	31	15	A.CS.IN	
H6b2	31	RC.IN	14	
H7	26	16	17	
H71	31	17	SD	
H72	31	A.CS.IN	16	
H8	26	18	19	
H81	31	19	A.RH.IN	
H82	31	SD	18	
HP001	21	HP.IN	HP.T	
HP002	21	HP.T	HP.SUCT	
RC001	16	RC.IN	RC.T	
RC002	16	RC.T	RC.SUCT	
RH001A	26	A.RH.IN	A.RH.T	
RH001B	26	B.RH.IN	B.RH.T	
RH002A	26	C.IN	A.IN	
RH002B	26	B.IN	D.IN	
RH003A	26	A.RH.T	C.IN	
RH003B	26	B.RH.T	B.IN	
RH004A	21	C.IN	C.SUC	
RH004B	21	B.IN	B.SUC	
RH005A	21	A.IN	A.SUC	
RH005B	21	D.IN	D.SUC	
RH006A	16	A.SUC	A.DIS	ARHR
RH006B	16	B.SUC	B.DIS	BRHR
RH006C	16	C.SUC	C.DIS	CRHR
RH006D	16	D.SUC	D.DIS	DRHR
RH006DA	16	D.DIS	D.DISA	
RH007A	16	A.DIS	ADISTEE	
RH007B	16	B.DIS	BDISTEE	
RH007C	16	C.DIS	ADISTEE	
RH007D	21	D.DISA	BDISTEE	
RH008A	21	ADISTEE	RHRHXS1	
RH008B	21	BDISTEE	RHRHXS2	
RHRHXA	21	RHRHXS1	RHRHXDA	
RHRHXB	21	RHRHXS2	RHRHXDB	
RHXBYPSA	21	RHRHXS1	RHRHXDA	
RHXBYPSB	21	RHRHXS2	RHRHXDB	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
RX01A	21	RHRHXDA	RHRHXDC	
RX01B	21	RHRHXDB	RHRHXDD	
RX01C	21	RHRHXDC	RECIRCA	
RX01D	21	RHRHXDD	RECIRCB	
RX02A	21	RECIRCA	MO2012	
RX02B	21	RECIRCB	M02013	
RX02C	35	MO2012	RECIRC1	
RX02D	35	M02013	RECIRC2	
RXO1A	16			

PUMP/COMP	PERFORMANCE DATA					
A.CS	gpm:	0	2179	3990	5040	5755
	ft:	850.3	795.5	664	536.2	411.7
	eqn:	850.3 - 4.49715e-006 Q ^ 2.12033				
ARHR	gpm:	0	3365	4000	4250	4540
	ft:	810.3	498.9	350	280	171.8
	eqn:	810.3 - 1.3787e-006 Q ^ 2.36763				
BCS	gpm:	0	1948	3080	4875	5600
	ft:	844	770.1	719.4	535.2	418.1
	eqn:	844 - 0.000218414 Q ^ 1.66917				
BRHR	gpm:	0	3656	4000	4250	4408
	ft:	813.8	436	350	280	230
	eqn:	813.8 - 2.04305e-006 Q ^ 2.32005				
CRHR	gpm:	0	3540	4000	4250	4440
	ft:	763.9	461.1	360	290	235.4
	eqn:	763.9 - 5.58043e-007 Q ^ 2.46066				
DRHR	gpm:	0	3542	4000	4250	4425
	ft:	810.1	463	350	285	227
	eqn:	810.1 - 2.16007e-006 Q ^ 2.31196				

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:13 am
System: OVRPRES3
rev: 06/16/97 9:09 am

PIPELIST REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.2°F. and 0 psig cont. press. Containment overpressure calcs.

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
16 LB30 rev: 06/16/97 9:08 am	Steel Sch 40 0.0018 in Size for: 8 ft/sec	Water 150.2 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
21 LB31 rev: 06/16/97 9:08 am	Steel Sch 30 0.0018 in Size for: 8 ft/sec	Water 150.2 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
26 LB32 rev: 06/16/97 9:08 am	Steel Sch 20 0.0018 in Size for: 8 ft/sec	Water 150.2 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
31 LB34 rev: 06/16/97 9:08 am	Steel Sch 60 0.0018 in Size for: 8 ft/sec	Water 150.2 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
35 LB34a rev: 06/16/97 9:09 am	Steel Sch 80 0.0018 in Size for: 8 ft/sec	Water 150.2 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
A	31	Steel 20 in / 60	3.6777	Water 150.2 °F / 0 psi g	1.163
B	31	Steel 20 in / 60	3.6777	Water 150.2 °F / 0 psi g	0.4469
C	31	Steel 20 in / 60	3.6777	Water 150.2 °F / 0 psi g	1.163
CDS1B	16	Steel 10 in / 40	3.45	Water 150.2 °F / 0 psi g	0.2689
CDS7A	35	Steel 2 in / 80	7.73835	Water 150.2 °F / 0 psi g	0.478
CROSSTIE	21	Steel 14 in / 30	49.0188	Water 150.2 °F / 0 psi g	1.403
CS001A	16	Steel 12 in / 40	41.8129	Water 150.2 °F / 0 psi g	2.285
CS001B	16	Steel 12 in / 40	42.5259	Water 150.2 °F / 0 psi g	1.695
CS003A	16	Steel 12 in / 40	10.7215	Water 150.2 °F / 0 psi g	1.779
CS003B	16	Steel 12 in / 40	27.109	Water 150.2 °F / 0 psi g	2.018
CSD1A	16	Steel 10 in / 40	3.7973	Water 150.2 °F / 0 psi g	0.2689
CSD2A	16	Steel 10 in / 40	108.553	Water 150.2 °F / 0 psi g	60.59
CSD2B	16	Steel 10 in / 40	108.723	Water 150.2 °F / 0 psi g	59.14
CSD3A	35	Steel 8 in / 80	57.0055	Water 150.2 °F / 0 psi g	19.08
CSD3B	35	Steel 8 in / 80	55.4392	Water 150.2 °F / 0 psi g	19.08
CSD4A	16	Steel 2.5 in / 40	2.22525	Water 150.2 °F / 0 psi g	1.664
CSD4B	16	Steel 2.5 in / 40	2.7485	Water 150.2 °F / 0 psi g	1.93
CSD5A	35	Steel 2 in / 80	0.67045	Water 150.2 °F / 0 psi g	6.654
CSD5B	35	Steel 2 in / 80	2.0608	Water 150.2 °F / 0 psi g	6.654
CSD6A	16	Steel 2.5 in / 40	38.6803	Water 150.2 °F / 0 psi g	152.5
CSD6B	16	Steel 2.5 in / 40	101.051	Water 150.2 °F / 0 psi g	155.4
CSD7B	16	Steel 10 in / 40	97.3901	Water 150.2 °F / 0 psi g	1.995
CSD8A	16	Steel 2.5 in / 40	45.7585	Water 150.2 °F / 0 psi g	2.453
CSD9A	16	Steel 10 in / 40	75.8885	Water 150.2 °F / 0 psi g	1.53

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
D	31	Steel 20 in / 60	3.6777	Water 150.2 °F / 0 psi g	1.163
H1	26	Steel 20 in / 20	52.2054	Water 150.2 °F / 0 psi g	0.144
H11	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.2536
H12	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.00366
H2	26	Steel 20 in / 20	24.1868	Water 150.2 °F / 0 psi g	0.072
H21	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.00366
H22	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.01484
H3	26	Steel 20 in / 20	24.3777	Water 150.2 °F / 0 psi g	0.072
H31	31	Steel 20 in / 60	1.4375	Water 150.2 °F / 0 psi g	0.2425
H32	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.2536
H4a	26	Steel 20 in / 20	31.4675	Water 150.2 °F / 0 psi g	0.072
H4a1	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.7201
H4a2	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.01484
H4b	26	Steel 20 in / 20	45.6907	Water 150.2 °F / 0 psi g	0.144
H4b1	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.2425
H4b2	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.01484
H5	26	Steel 20 in / 20	108.244	Water 150.2 °F / 0 psi g	0.288
H51	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.2536
H52	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.7201
H6a	26	Steel 20 in / 20	15.1777	Water 150.2 °F / 0 psi g	0.072
H6a1	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.01484
H6a2	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.00366
H6b	26	Steel 20 in / 20	61.7884	Water 150.2 °F / 0 psi g	0.144
H6b1	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.01484

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
H6b2	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.2425
H7	26	Steel 20 in / 20	24.3777	Water 150.2 °F / 0 psi g	0.072
H71	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.2536
H72	31	Steel 20 in / 60	1.725	Water 150.2 °F / 0 psi g	0.2425
H8	26	Steel 20 in / 20	24.1868	Water 150.2 °F / 0 psi g	0.072
H81	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.01484
H82	31	Steel 20 in / 60	1.9171	Water 150.2 °F / 0 psi g	0.00366
HP001	21	Steel 14 in / 30	67.5027	Water 150.2 °F / 0 psi g	3.127
HP002	21	Steel 14 in / 30	9.3679	Water 150.2 °F / 0 psi g	1.356
RC001	16	Steel 6 in / 40	22.7965	Water 150.2 °F / 0 psi g	4.054
RC002	16	Steel 6 in / 40	56.5179	Water 150.2 °F / 0 psi g	1.298
RH001A	26	Steel 20 in / 20	62.1357	Water 150.2 °F / 0 psi g	2.161
RH001B	26	Steel 20 in / 20	55.6198	Water 150.2 °F / 0 psi g	2.09
RH002A	26	Steel 20 in / 20	5.75	Water 150.2 °F / 0 psi g	0.7101
RH002B	26	Steel 20 in / 20	5.3671	Water 150.2 °F / 0 psi g	0.7101
RH003A	26	Steel 20 in / 20	7.1093	Water 150.2 °F / 0 psi g	0.2367
RH003B	26	Steel 20 in / 20	7.6671	Water 150.2 °F / 0 psi g	0.7101
RH004A	21	Steel 14 in / 30	14.758	Water 150.2 °F / 0 psi g	2.63
RH004B	21	Steel 14 in / 30	14.95	Water 150.2 °F / 0 psi g	2.63
RH005A	21	Steel 14 in / 30	14.758	Water 150.2 °F / 0 psi g	1.867
RH005B	21	Steel 14 in / 30	14.95	Water 150.2 °F / 0 psi g	1.867
RH006A	16	Steel 12 in / 40	1.15	Water 150.2 °F / 0 psi g	0.2977
RH006B	16	Steel 12 in / 40	3.0671	Water 150.2 °F / 0 psi g	0.5573
RH006C	16	Steel 12 in / 40	1.15	Water 150.2 °F / 0 psi g	0.2977

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
RH006D	16	Steel 12 in / 40	3.06671	Water 150.2 °F / 0 psi g	0.5573
RH006DA	16	Steel 10 in / 40	20.7	Water 150.2 °F / 0 psi g	1.76
RH007A	16	Steel 10 in / 40	17.6094	Water 150.2 °F / 0 psi g	2.534
RH007B	16	Steel 10 in / 40	19.2625	Water 150.2 °F / 0 psi g	2.298
RH007C	16	Steel 10 in / 40	19.7656	Water 150.2 °F / 0 psi g	3.065
RH007D	21	Steel 14 in / 30	4.025	Water 150.2 °F / 0 psi g	0.2543
RH008A	21	Steel 14 in / 30	11.7875	Water 150.2 °F / 0 psi g	0.5086
RH008B	21	Steel 14 in / 30	2.875	Water 150.2 °F / 0 psi g	0.2543
RHRHXA	21	Steel 14 in / 30	28.4145	Water 150.2 °F / 0 psi g	5.436
RHRHXB	21	Steel 14 in / 30	54.8343	Water 150.2 °F / 0 psi g	6.316
RHXBYPSA	21	Steel 14 in / 30	29.4849	Water 150.2 °F / 0 psi g	5.85
RHXBYPSB	21	Steel 14 in / 30	15.4172	Water 150.2 °F / 0 psi g	5.341
RX01A	21	Steel 14 in / 30	6.3849	Water 150.2 °F / 0 psi g	0.763
RX01B	21	Steel 14 in / 30	20.748	Water 150.2 °F / 0 psi g	1.272
RX01C	21	Steel 14 in / 30	83.5906	Water 150.2 °F / 0 psi g	3.24
RX01D	21	Steel 14 in / 30	73.7917	Water 150.2 °F / 0 psi g	3.24
RX02A	21	Steel 16 in / 30	12.3625	Water 150.2 °F / 0 psi g	4.454
RX02B	21	Steel 16 in / 30	12.3625	Water 150.2 °F / 0 psi g	4.207
RX02C	35	Steel 16 in / 80	102.769	Water 150.2 °F / 0 psi g	3.252
RX02D	35	Steel 16 in / 80	97.9537	Water 150.2 °F / 0 psi g	3.184
RXO1A	16	Steel 14 in / 40	6.3849	Water 150.2 °F / 0 psi g	0.7645

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:14 am
System: OVRPRES3
rev: 06/16/97 9:09 am

MATERIALS REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.2°F. and 0 psig cont. press. Containment overpressure calcs.

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
A	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
B	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER
C	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER 1-Tee Flow Thru Branch
CDS1B	16	Steel 10 in / 40	3.45	1-Elbow Short - r/d 1 @ 90°
CDS7A	35	Steel 2 in / 80	7.73835	1-Elbow Short - r/d 1 @ 90° 1-Reducer Enlargement 2 X 2.5
CROSSTIE	21	Steel 14 in / 30	49.0188	3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Reducer Contraction 16 X 14 1-Reducer Enlargement 14 X 16 2-Gate Wedge Disc
CS001A	16	Steel 12 in / 40	41.8129	4-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
CS001B	16	Steel 12 in / 40	42.5259	1-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Branch
CS003A	16	Steel 12 in / 40	10.7215	3-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
CS003B	16	Steel 12 in / 40	27.109	1-Elbow Short - r/d 1 @ 90° 4-Elbow Short - r/d 1 @ 45° 1-Fixed K vel corctn
CSD1A	16	Steel 10 in / 40	3.7973	1-Elbow Short - r/d 1 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
CSD2A	16	Steel 10 in / 40	108.553	1-Tee Flow Thru Run 1-Swing Check Vertical 5-Elbow Short - r/d 1 @ 90° 8-Elbow Short - r/d 1 @ 45° 1-Fixed K Flow Element 1-Fixed K Res. Orifice
CSD2B	16	Steel 10 in / 40	108.723	4-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Fixed K Res. Orifice 1-Fixed K Flow Element
CSD3A	35	Steel 8 in / 80	57.0055	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Spargers
CSD3B	35	Steel 8 in / 80	55.4392	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Sparger
CSD4A	16	Steel 2.5 in / 40	2.22525	1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD4B	16	Steel 2.5 in / 40	2.7485	2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD5A	35	Steel 2 in / 80	0.67045	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD5B	35	Steel 2 in / 80	2.0608	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD6A	16	Steel 2.5 in / 40	38.6803	1-Elbow Short - r/d 1 @ 45° 2-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 2.5 X 2 1-Fixed K Orifice Min.
CSD6B	16	Steel 2.5 in / 40	101.051	10-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 1-Fixed K Orifice Min.
CSD7B	16	Steel 10 in / 40	97.3901	1-Reducer Contraction 10 X 8 4-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run
CSD8A	16	Steel 2.5 in / 40	45.7585	6-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°
CSD9A	16	Steel 10 in / 40	75.8885	1-Reducer Contraction 10 X 8 1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90°
D	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
H1	26	Steel 20 in / 20	52.2054	2-Fixed K 22.5 mitre
H11	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H12	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H2	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H21	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H22	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H3	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H31	31	Steel 20 in / 60	1.4375	1-Fixed K enlargement 1-Tee Flow Thru Run
H32	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H4a	26	Steel 20 in / 20	31.4675	1-Fixed K 22.5 mitre
H4a1	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement 1-Tee Flow Thru Branch
H4a2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H4b	26	Steel 20 in / 20	45.6907	2-Fixed K 22.5 mitre
H4b1	31	Steel	1.725	1-Fixed K enlargement

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
		20 in / 60		1-Tee Flow Thru Run
H4b2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H5	26	Steel 20 in / 20	108.244	4-Fixed K 22.5 mitre
H51	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H52	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Branch 1-Fixed K enlargement
H6a	26	Steel 20 in / 20	15.1777	1-Fixed K 22.5 mitre
H6a1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6a2	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H6b	26	Steel 20 in / 20	61.7884	2-Fixed K 22.5 mitre
H6b1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6b2	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H7	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H71	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H72	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H8	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H81	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H82	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
HP001	21	Steel 14 in / 30	67.5027	1-Elbow Long - r/d 1.5 @ 22.5° 2-Gate Wedge Disc 1-Swing Check Angled 3-Elbow Long - r/d 1.5 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run 1-Tee Flow Thru Branch
HP002	21	Steel 14 in / 30	9.3679	1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RC001	16	Steel 6 in / 40	22.7965	1-Elbow Long - r/d 1.5 @ 67.5° 1-Elbow Long - r/d 1.5 @ 45° 1-Elbow Long - r/d 1.5 @ 90° 2-Gate Wedge Disc 1-Swing Check Angled 2-Tee Flow Thru Branch
RC002	16	Steel 6 in / 40	56.5179	1-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH001A	26	Steel 20 in / 20	62.1357	2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH001B	26	Steel 20 in / 20	55.6198	1-Elbow Long - r/d 1.5 @ 90° 1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH002A	26	Steel 20 in / 20	5.75	1-Tee Flow Thru Branch
RH002B	26	Steel 20 in / 20	5.3671	1-Tee Flow Thru Branch
RH003A	26	Steel 20 in / 20	7.1093	1-Tee Flow Thru Run
RH003B	26	Steel 20 in / 20	7.6671	1-Tee Flow Thru Branch
RH004A	21	Steel 14 in / 30	14.758	1-Tee Flow Thru Branch 1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH004B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K vel corctn

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH005A	21	Steel 14 in / 30	14.758	1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH005B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RH006A	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006B	16	Steel 12 in / 40	3.0671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006C	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006D	16	Steel 12 in / 40	3.06671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006DA	16	Steel 10 in / 40	20.7	3-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Reducer Enlargement 10 X 14
RH007A	16	Steel 10 in / 40	17.6094	2-Elbow Short - r/d 1 @ 90° 1-Elbow Long - r/d 1.5 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Run 1-Reducer Enlargement 10 X 12 1-Swing Check Angled
RH007B	16	Steel 10 in / 40	19.2625	2-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Reducer Enlargement 10 X 14
RH007C	16	Steel 10 in / 40	19.7656	3-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Swing Check Angled
RH007D	21	Steel 14 in / 30	4.025	1-Tee Flow Thru Run
RH008A	21	Steel 14 in / 30	11.7875	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH008B	21	Steel 14 in / 30	2.875	1-Tee Flow Thru Run
RHRHXA	21	Steel 14 in / 30	28.4145	3-Elbow Short - r/d 1 @ 90° 2-Gate Wedge Disc 1-Tee Flow Thru Run 1-Fixed K RHR HX
RHRHXB	21	Steel 14 in / 30	54.8343	3-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 2-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K RHR HX
RHXBYPSA	21	Steel 14 in / 30	29.4849	1-Tee Flow Thru Branch 3-Elbow Short - r/d 1 @ 90° 1-Globe Valve
RHXBYPSB	21	Steel 14 in / 30	15.4172	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Globe Valve
RX01A	21	Steel 14 in / 30	6.3849	1-Tee Flow Thru Branch
RX01B	21	Steel 14 in / 30	20.748	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
RX01C	21	Steel 14 in / 30	83.5906	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX01D	21	Steel 14 in / 30	73.7917	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX02A	21	Steel 16 in / 30	12.3625	1-Globe Valve 1-Tee Flow Thru Run
RX02B	21	Steel 16 in / 30	12.3625	1-Globe Valve
RX02C	35	Steel 16 in / 80	102.769	7-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Reducer Enlargement 16 X 18

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RX02D	35	Steel 16 in / 80	97.9537	6-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Elbow Short - r/d 1 @ 45° 1-Reducer Enlargement 16 X 18
RXO1A	16	Steel 14 in / 40	6.3849	1-Tee Flow Thru Branch

PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Steel	20	20 in	555.352 ft
Steel	30	14 in	516.659 ft
		16 in	24.725 ft
Steel	40	2.5 in	190.464 ft
		6 in	79.3144 ft
		10 in	475.139 ft
		12 in	130.603 ft
		14 in	6.3849 ft
Steel	60	20 in	51.2285 ft
Steel	80	2 in	10.4696 ft
		8 in	112.445 ft
		16 in	200.723 ft

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
16 LB30	Steel	40	
	Size: 2.5 in		7-Elbow Short - r/d 1 @ 45°
			2-Tee Flow Thru Branch
			3-Reducer Contraction 2.5 X 2
			18-Elbow Short - r/d 1 @ 90°
			2-Fixed K Orifice Min.
	Size: 6 in		1-Elbow Long - r/d 1.5 @ 67.5°
			1-Elbow Long - r/d 1.5 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°
			2-Gate Wedge Disc
			1-Swing Check Angled
			2-Tee Flow Thru Branch
			1-Elbow Short - r/d 1 @ 90°
			1-Fixed K vel corctn
	Size: 10 in		28-Elbow Short - r/d 1 @ 90°
			5-Tee Flow Thru Run
			4-Swing Check Vertical
			11-Elbow Short - r/d 1 @ 45°
			2-Fixed K Flow Element
			2-Fixed K Res. Orifice
			2-Reducer Contraction 10 X 8
			4-Gate Wedge Disc

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 10 in		2-Reducer Enlargement 10 X 14
			1-Elbow Long - r/d 1.5 @ 90°
			1-Reducer Enlargement 10 X 12
			2-Swing Check Angled
			2-Tee Flow Thru Branch
	Size: 12 in		11-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			2-Gate Double Disc
			2-Tee Flow Thru Run
			2-Tee Flow Thru Branch
			5-Elbow Short - r/d 1 @ 45°
			2-Fixed K vel corctn
			4-Reducer Contraction 12 X 10
	Size: 14 in		1-Tee Flow Thru Branch
21 LB31	Steel	30	
	Size: 14 in		30-Elbow Short - r/d 1 @ 90°
			9-Tee Flow Thru Run
			1-Reducer Contraction 16 X 14
			3-Reducer Enlargement 14 X 16
			13-Gate Wedge Disc
			1-Elbow Long - r/d 1.5 @ 22.5°
			1-Swing Check Angled
			3-Elbow Long - r/d 1.5 @ 90°
			10-Tee Flow Thru Branch
			5-Fixed K vel corctn
			4-Reducer Contraction 20 X 14
			2-Fixed K RHR HX
			2-Elbow Short - r/d 1 @ 45°
			2-Globe Valve
			2-Fixed K Flow Element
	Size: 16 in		2-Globe Valve
			1-Tee Flow Thru Run
26 LB32	Steel	20	
	Size: 20 in		16-Fixed K 22.5 mitre
			3-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			7-Tee Flow Thru Branch
			2-Elbow Short - r/d 1 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 20 in		1-Tee Flow Thru Run
31 LB34	Steel	60	
	Size: 20 in		2-Fixed K strainer
			5-Tee Flow Thru Branch
			2-Fixed K STRAINER
			10-Fixed K contraction
			8-Tee Flow Thru Run
			10-Fixed K enlargement
35 LB34a	Steel	80	
	Size: 2 in		1-Elbow Short - r/d 1 @ 90°
			3-Reducer Enlargement 2 X 2.5
			2-Globe Valve
	Size: 8 in		6-Gate Wedge Disc
			2-Swing Check Angled
			12-Elbow Short - r/d 1 @ 90°
			1-Fixed K Spargers
			1-Fixed K Sparger
	Size: 16 in		13-Elbow Short - r/d 1 @ 90°
			4-Gate Double Disc
			2-Swing Check Angled
			2-Reducer Enlargement 16 X 18
			1-Elbow Short - r/d 1 @ 45°

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:17 am
Lineup: CASE3
rev: 06/16/97 9:17 am

System: OVRPRES3
rev: 06/16/97 9:09 am

Deviation: 0.000203 %
after: 9 iterations

long term, B &C RHR 4000 ea & A&B CS 2800gpm, A strainer plugged, 0 cont. press., sp wtr lvl 908'-9.3"

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the first specification were used in this calculation.

LINEUP SUMMARIES

PIPELINE		FLOW gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
CSD3A	>>>	2800	ACSD3	0	0
CSD8A	>>>	234.9	ACSD8	0	0
CSD3B	>>>	2800	BCSD3	0	0
CSD6B	>>>	228.5	BCSD6	0	0
RX02D	>>>	8000	RECIRC2	0	0
B	<<<	5250	TB	0	4.459
C	<<<	3473	TC	0	4.459
D	<<<	5341	TD	0	4.459

Flows IN: 14064 gpm
Flows OUT: 14063 gpm

NET FLOWS IN: 1 gpm

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
1	902.25		2.3	907.7
10	902.25		2.64	908.5
11	902.25		2.634	908.5
12	902.25		2.629	908.4
13	902.25		2.601	908.4
14	902.25		2.551	908.3
15	902.25		2.458	908
16	902.25		2.45	908
17	902.25		2.446	908
18	902.25		2.434	908
19	902.25		2.344	907.8
2	902.25		2.284	907.6
20	902.25		2.33	907.7
3	902.25		2.289	907.6
4	902.25		2.295	907.7
5	902.25		2.3	907.7
6	902.25		2.311	907.7
7	902.25		2.393	907.9
8	902.25		2.449	908
9	902.25		2.501	908.1
A.CS.IN	902.25		2.453	908
A.CS.SUCT	897.833		1.938	902.4
A.CS.T	899.916		2.015	904.7
A.DIS	897.833		3.828	906.8
A.IN	897.583		3.934	906.8
A.RH.IN	902.25		2.332	907.7
A.RH.T	897.583		3.972	906.9
A.SUC	897.833		3.828	906.8
ACSD2	931.917		75.41	1109
ACSD3	981.188		0 (source)	981.2
ACSD4	900.156		312.5 ***	1636
ACSD5	900.74		283.3 ***	1568
ACSD6	925.875		17.47	967
ACSD7	928		10.45	952.6
ACSD8	927		0 (source)	927
ACSD9	971.25		56.3	1104
ACSDSCG	899.635		315.8 ***	1643
ADISTEE	901.083		39.58	994.3
B.CS.IN	902.25		2.305	907.7
B.CS.SUCT	897.833		1.857	902.2
B.CS.T	899.885		2.175	905

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
B.DIS	899.5		149.1	1251
B.IN	897.583		3.84	906.6
B.RH.IN	902.25		2.283	907.6
B.RH.T	897.583		3.939	906.9
B.SUC	897.833		2.127	902.8
BCSD2	927.833		77.42	1110
BCSD3	980.38		0 (source)	980.4
BCSD4	899.896		295.7 ***	1596
BCSD5	901.688		266.9 ***	1530
BCSD6	930.333		0 (source)	930.3
BCSD7	978.5		52.78	1103
BCSDSCG	899.583		299.2 ***	1604
BDISTEE	908		35.65	991.9
C.DIS	897.833		153.3	1259
C.IN	897.583		3.934	906.8
C.SUC	897.833		2.222	903.1
D.DIS	899.5		3.026	906.6
D.DISA	908		35.65	991.9
D.IN	897.583		3.84	906.6
D.SUC	897.833		3.734	906.6
HP.IN	902.25		2.443	908
HP.T	901.615		2.713	908
M02013	940.91		11.74	968.6
MO2012	940.917		18.52	984.5
RC.IN	902.25		2.595	908.4
RC.T	902.25		2.595	908.4
RECIRC2	951.75		0 (source)	951.7
RECIRCA	930.168		23.09	984.5
RECIRCB	930.167		21.95	981.8
RHRHXDA	916.333		31.88	991.4
RHRHXDB	915.49		31.41	989.5
RHRHXDC	916.336		31.39	990.3
RHRHXDD	921.33		28.06	987.4
RHRHXS1	909.406		35.68	993.4
RHRHXS2	908		35.48	991.5
SA	902.25		2.289	907.6
SB	902.25		2.644	908.5
SC	902.25		2.632	908.4
SD	902.25		2.442	908
TB	904.316		1.894 (source)	908.8
TC	904.316		1.894 (source)	908.8

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
TD	904.316		1.894 (source)	908.8

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
A	TA		SA	closed	0	0	0
B	TB		SB	5250	6.356	(0.750)	0.299
C	TC		SC	3473	4.205	(0.738)	0.328
CDS1B	B.CS.SUCT		BCSDSCG	3028	* 12.33	(297.4)	(702)
—— BCS —— dP: (298.5) HL: (702.7)							
CDS7A	ACSD6		ACSD7	234.9	* 25.54	7.021	14.41
CROSSTIE	RECIRCA	<->	RECIRCB	4000	9.315	1.142	2.689
CS001A	A.CS.IN		A.CS.T	3035	8.706	0.438	3.365
CS001B	B.CS.IN		B.CS.T	3028	8.688	0.130	2.571
CS003A	A.CS.T		A.CS.SUCT	3035	8.706	0.078	2.266
CS003B	B.CS.T		B.CS.SUCT	3028	8.688	0.318	2.801
CSD1A	A.CS.SUCT		ACSDSCG	3035	* 12.36	(313.9)	(740.8)
—— A.CS —— dP: (315) HL: (741.6)							
CSD2A	ACSDSCG		ACSD2	2800	11.4	67.17	125.9
—— FCV@2800 —— dP: 173.2 HL: 407.9							
CSD2B	BCSDSCG		BCSD2	2800	11.4	64.21	123
—— FCV@2800 —— dP: 157.6 HL: 371.1							
CSD3A	ACSD9		ACSD3	2800	* 19.69	56.3	122.6
CSD3B	BCSD7		BCSD3	2800	* 19.69	52.78	122.4
CSD4A	ACSDSCG		ACSD4	234.9	* 15.75	3.276	7.192
CSD4B	BCSDSCG		BCSD4	228.5	* 15.32	3.508	7.948
CSD5A	ACSD4		ACSD5	234.9	* 25.54	29.2	68.18
CSD5B	BCSD4		BCSD5	228.5	* 24.84	28.84	66.12
CSD6A	ACSD5		ACSD6	234.9	* 15.75	265.8	600.8
CSD6B	BCSD5		BCSD6	228.5	* 15.32	266.9	599.8
CSD7B	BCSD2		BCSD7	2800	11.4	24.63	7.329
CSD8A	ACSD7		ACSD8	234.9	* 15.75	10.45	25.6
CSD9A	ACSD2		ACSD9	2800	11.4	19.11	5.661
D	TD		SD	5341	6.466	(0.549)	0.774
H1	20	<->	1	2544	2.807	0.030	0.071
H11	1	<->	B.RH.IN	2544	3.08	0.017	0.040
H12	A.RH.IN	<->	20	2544	3.08	0.001	0.003
H2	3		2	1456	1.606	0.005	0.011
H21	SA		3	1456	1.763	0	0.001
H22	2		B.RH.IN	1456	1.763	0	0.002
H3	5		4	1456	1.606	0.005	0.012
H31	B.CS.IN		5	1456	1.763	0.005	0.012
H32	4		SA	1456	1.763	0.006	0.013
H4a	9		8	4485	4.948	0.052	0.123
H4a1	SB		9	4485	5.429	0.143	0.337
H4a2	8		HP.IN	4485	5.429	0.006	0.013
H4b	7		6	4485	4.948	0.082	0.194

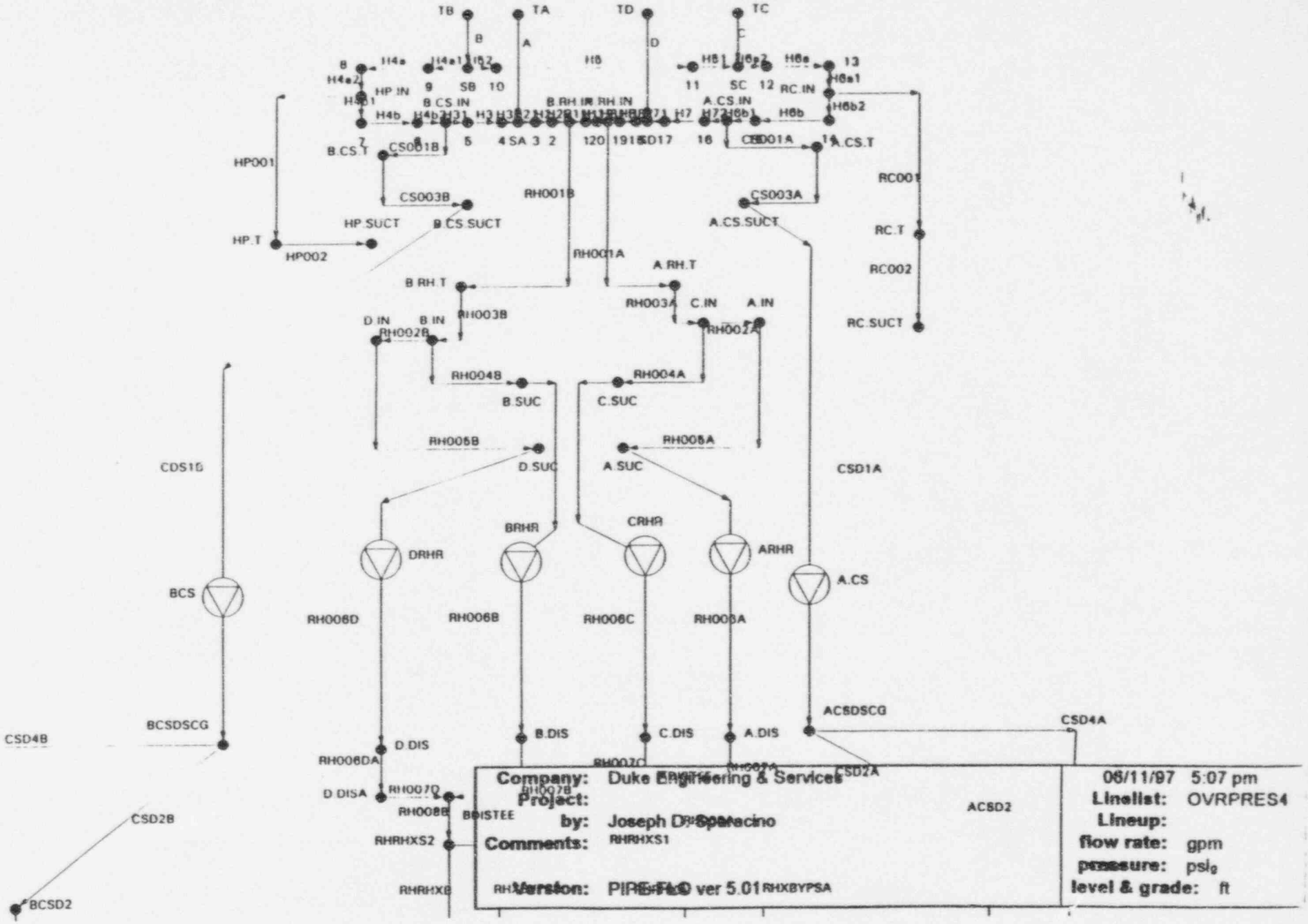
PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
H4b1	HP.IN	7	4485	5.429	0.050	0.118
H4b2	6	B.CS.IN	4485	5.429	0.006	0.013
H5	10	11	765.5	0.845	0.006	0.015
H51	11	SC	765.5	0.927	0.002	0.004
H52	SB	10	765.5	0.927	0.004	0.010
H6a	12	13	4238	4.676	0.028	0.066
H6a1	13	RC.IN	4238	5.131	0.005	0.012
H6a2	SC	12	4238	5.131	0.003	0.008
H6b	14	15	4238	4.676	0.093	0.218
H6b1	15	A.CS.IN	4238	5.131	0.005	0.012
H6b2	RC.IN	14	4238	5.131	0.045	0.105
H7	16	17	1203	1.328	0.003	0.008
H71	17	SD	1203	1.457	0.004	0.009
H72	A.CS.IN	16	1203	1.457	0.004	0.009
H8	18	19	6544	7.22	0.090	0.212
H81	19	A.RH.IN	6544	7.923	0.013	0.030
H82	SD	18	6544	7.923	0.008	0.019
HP001	HP.IN	HP.T	0	0	(0.270)	0
HP002	HP.T	HP.SUCT	closed	0	0	0
RC001	RC.IN	RC.T	0	0	0	0
RC002	RC.T	RC.SUCT	closed	0	0	0
RH001A	A.RH.IN	A.RH.T	4000	4.413	(1.64)	0.805
RH001B	B.RH.IN	B.RH.T	4000	4.413	(1.656)	0.768
RH002A	C.IN	A.IN	0	0	0	0
RH002B	B.IN	D.IN	0	0	0	0
RH003A	A.RH.T	C.IN	4000	4.413	0.038	0.089
RH003B	B.RH.T	B.IN	4000	4.413	0.099	0.233
RH004A	C.IN	C.SUC	4000	9.315	1.712	3.781
RH004B	B.IN	B.SUC	4000	9.315	1.713	3.784
RH005A	A.IN	A.SUC	0	0	0.106	0
RH005B	D.IN	D.SUC	0	0	0.106	0
RH006A	A.SUC	A.DIS	0	0	0	0
---- ARHR ---- dP: HL:						
RH006B	B.SUC	B.DIS	4000	11.47	(147)	(347.8)
---- BRHR ---- dP: (148.2) HL: (349)						
RH006C	C.SUC	C.DIS	4000	11.47	(151.1)	(355.8)
---- CRHR ---- dP: (151.4) HL: (356.4)						
RH006D	D.SUC	D.DIS	0	0	0.708	0
---- DRHR ---- dP: HL:						
RH006DA	D.DIS	D.DISA	closed	0	0	0
RH007A	A.DIS	ADISTEE	closed	0	0	0
RH007B	B.DIS	BDISTEE	4000	* 16.29	8.187	10.78
---- FCV@4000 ---- dP: 105.3 HL: 247.9						

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
RH007C	C.DIS	ADISTEE	4000	* 16.29	7.312	13.97
---- FCV@4000 ---- dP: 106.4 HL: 250.6						
RH007D	C.DISA	BDISTEE	0	0	0	0
RH008A	ADISTEE	RHRHXS1	4000	9.315	3.907	0.877
RH008B	BDISTEE	RHRHXS2	4000	9.315	0.165	0.389
RHRHXA	RHRHXS1	RHRHXDA	2036	4.74	3.8	2.02
RHRHXB	RHRHXS2	RHRHXDB	1882	4.382	4.068	2.089
RHXBYPSA	RHRHXS1	RHRHXDA	1964	4.574	3.8	2.02
RHXBYPSB	RHRHXS2	RHRHXDB	2118	4.932	4.068	2.089
RX01A	RHRHXDA	RHRHXDC	4000	9.315	0.482	1.131
RX01B	RHRHXDB	RHRHXDD	4000	9.315	3.351	2.051
RX01C	RHRHXDC	RECIRCA	4000	9.315	8.306	5.726
RX01D	RHRHXDD	RECIRCB	4000	9.315	6.117	5.566
RX02A	RECIRCA	MO2012	0	0	4.565	0
RX02B	RECIRCB	M02013	8000	* 14.06	10.21	13.29
RX02C	MO2012	RECIRC1	closed	0	0	0
RX02D	M02013	RECIRC2	8000	* 15.97	11.74	16.8

REFERENCE

ATTACHMENT E

FLO-SERIES MODEL PIPING AND NETWORK INPUT AND OUTPUT FOR CASE #4.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TA
TD
TC
B
A
D
C
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H4a1
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H5
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H6a1
H6b
H6b1
H6b2
HP IN
B.CS IN
B.RH IN
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9
SB
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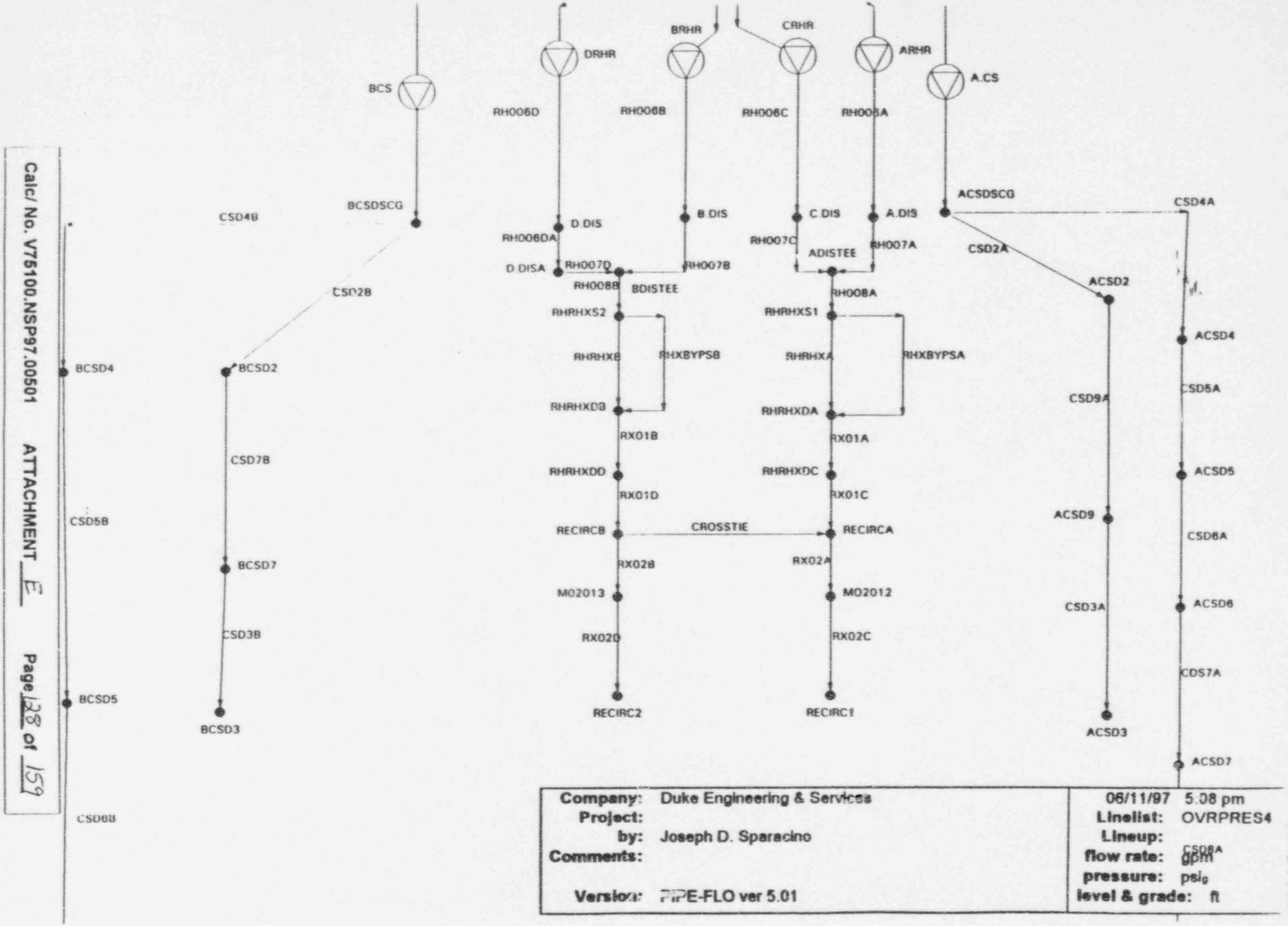
18
SD
17
16
B.CS.T
CS001B
CS001A
A.CS.T
HP001
RC001
CS003B
CS003A
RH001B
HP.SUCT
B.CS.SUCT
A.CS.SUCT
HP.T
HP002
RH001A
RC.T
RC002
A.RH.T
B.RH.T
RH003A
C.IN
A.IN
RH003B
D.IN
B.IN
RH002B
RH002A
RC.SUCT
RH004B
RH004A
B.SUC
C.SUC
RH005B
RH005A
CDS1B
D.SUC
A.SUC
CSD1A
BRHR
CRHR
DRHR
ARHR
A.CS
BCS
RH006D
RH006B
RH006C
RH006A
ACSDSCG
CSD4A
BCSDSCG
CSD4B
B.DIS
C.DIS
A.DIS
D.DIS
RH006DA
RH007C
RH007A
CSD2A
D.DISA
RH007D
RH007B
RH008B
BDISTEE
ACSD2
CSD2B
RHRHXS2
RHRHXS1
RHXBYPSA
RHRHXB
BCSD2
SD4
Company: Duke Engineering & Services
Project:
by: Joseph D. Spaccino
Comments:
Version: PIPE-FLO ver 5.01
06/11/97 5:07 pm
Linelist: OVRPRES4
Lineup:
flow rate: gpm
pressure: psig
level & grade: ft



Company:	Duke Engineering & Services		06/11/97 5:08 pm
Project:		**Linelist:**	OVRPRES4
by:	Joseph D. Sparacino	**Lineup:**	
Comments:		**flow rate:**	gpm
		pressure:	psi_g
Version:	PIPE-FLO ver 5.01	**level & grade:**	ft

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:26 am
System: OVRPRES4
rev: 06/16/97 9:24 am

SYSTEM REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.5°F. and 0 psig cont. press. Containment overpressure calcs.

SYSTEM NODES

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
1	902.25	H11	H1
10	902.25	H52	H5
11	902.25	H5	H51
12	902.25	H6a2	H6a
13	902.25	H6a	H6a1
14	902.25	H6b2	H6b
15	902.25	H6b	H6b1
16	902.25	H72	H7
17	902.25	H7	H71
18	902.25	H82	H8
19	902.25	H8	H81
2	902.25	H2	H22
20	902.25	H1	H12
3	902.25	H21	H2
4	902.25	H3	H32
5	902.25	H31	H3
6	902.25	H4b	H4b2
7	902.25	H4b1	H4b
8	902.25	H4a	H4a2
9	902.25	H4a1	H4a
A.CS.IN	902.25	H6b1	CS001A H72
A.CS.SUCT	897.833	CS003A	CSD1A
A.CS.T	899.916	CS001A	CS003A
A.DIS	897.833	RH006A	RH007A

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
A.IN	897.583	RH002A	RH005A
A.RH.IN	902.25	H12 H81	RH001A
A.RH.T	897.583	RH001A	RH003A
A.SUC	897.833	RH005A	RH006A
ACSD2	931.917	CSD2A	CSD9A
ACSD3	981.188	CSD3A	
ACSD4	900.156	CSD4A	CSD5A
ACSD5	900.74	CSD5A	CSD6A
ACSD6	925.875	CSD6A	CDS7A
ACSD7	928	CDS7A	CSD8A
ACSD8	927	CSD8A	
ACSD9	971.25	CSD9A	CSD3A
ACSDSCG	899.635	CSD1A	CSD2A CSD4A
ADISTEE	901.083	RH007A RH007C	RH008A
B.CS.IN	902.25	H4b2	CS001B H31
B.CS.SUCT	897.833	CS003B	CDS1B
B.CS.T	899.885	CS001B	CS003B
B.DIS	899.5	RH006B	RH007B
B.IN	897.583	RH003B	RH002B RH004B
B.RH.IN	902.25	H22	H11 RH001B
B.RH.T	897.583	RH001B	RH003B
B.SUC	897.833	RH004B	RH006B
BCSD2	927.833	CSD2B	CSD7B
BCSD3	980.38	CSD3B	
BCSD4	899.896	CSD4B	CSD5B
BCSD5	901.688	CSD5B	CSD6B
BCSD6	930.333	CSD6B	

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
BCSD7	978.5	CSD7B	CSD3B
BCSDSCG	899.583	CDS1B	CSD2B CSD4B
BDISTEE	908	RH007B RH007D	RH008B
C.DIS	897.833	RH006C	RH007C
C.IN	897.583	RH003A	RH002A RH004A
C.SUC	897.833	RH004A	RH006C
D.DIS	899.5	RH006D	RH006DA
D.DISA	908	RH006DA	RH007D
D.IN	897.583	RH002B	RH005B
D.SUC	897.833	RH005B	RH006D
HP.IN	902.25	H4a2	H4b1 HP001
HP.SUCT	901.615	HP002	
HP.T	901.615	HP001	HP002
M02013	940.91	RX02B	RX02D
MO2012	940.917	RX02A	RX02C
RC.IN	902.25	H6a1	H6b2 RC001
RC.SUCT	899.042	RC002	
RC.T	902.25	RC001	RC002
RECIRC1	951.75	RX02C	
RECIRC2	951.75	RX02D	
RECIRCA	930.168	CROSSTIE RX01C	RX02A
RECIRCB	930.167	RX01D	CROSSTIE RX02B
RHRHXDA	916.333	RHRHXA RHXBYPSA	RX01A
RHRHXDB	915.49	RHRHXB RHXBYPSB	RX01B
RHRHXDC	916.336	RX01A	RX01C

NODE	ELEVATION ft	PIPELINES IN	PIPELINES OUT
RHRHXDD	921.33	RX01B	RX01D
RHRHXS1	909.406	RH008A	RHRHXA RHXBYPSA
RHRHXS2	908	RH008B	RHRHXB RHXBYPSB
SA	902.25	A H32	H21
SB	902.25	B	H4a1 H52
SC	902.25	C H51	H6a2
SD	902.25	D H71	H82
TA	904.316		A
TB	904.316		B
TC	904.316		C
TD	904.316		D

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
A	31	TA	SA	
B	31	TB	SB	
C	31	TC	SC	
CDS1B	16	B.CS.SUCT	BCSDSCG	BCS
CDS7A	35	ACSD6	ACSD7	
CROSSTIE	21	RECIRCB	RECIRCA	
CS001A	16	A.CS.IN	A.CS.T	
CS001B	16	B.CS.IN	B.CS.T	
CS003A	16	A.CS.T	A.CS.SUCT	
CS003B	16	B.CS.T	B.CS.SUCT	
CSD1A	16	A.CS.SUCT	ACSDSCG	A.CS
CSD2A	16	ACSDSCG	ACSD2	
CSD2B	16	BCSDSCG	BCSD2	
CSD3A	35	ACSD9	ACSD3	
CSD3B	35	BCSD7	BCSD3	
CSD4A	16	ACSDSCG	ACSD4	
CSD4B	16	BCSDSCG	BCSD4	
CSD5A	35	ACSD4	ACSD5	
CSD5B	35	BCSD4	BCSD5	
CSD6A	16	ACSD5	ACSD6	
CSD6B	16	BCSD5	BCSD6	
CSD7B	16	BCSD2	BCSD7	
CSD8A	16	ACSD7	ACSD8	
CSD9A	16	ACSD2	ACSD9	
D	31	TD	SD	
H1	26	1	20	
H11	31	B.RH.IN	1	
H12	31	20	A.RH.IN	
H2	26	3	2	
H21	31	SA	3	
H22	31	2	B.RH.IN	
H3	26	5	4	
H31	31	B.CS.IN	5	
H32	31	4	SA	
H4a	26	9	8	
H4a1	31	SB	9	
H4a2	31	8	HP.IN	
H4b	26	7	6	
H4b1	31	HP.IN	7	
H4b2	31	6	B.CS.IN	
H5	26	10	11	
H51	31	11	SC	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
H52	31	SB	10	
H6a	26	12	13	
H6a1	31	13	RC.IN	
H6a2	31	SC	12	
H6b	26	14	15	
H6b1	31	15	A.CS.IN	
H6b2	31	RC.IN	14	
H7	26	16	17	
H71	31	17	SD	
H72	31	A.CS.IN	16	
H8	26	18	19	
H81	31	19	A.RH.IN	
H82	31	SD	18	
HP001	21	HP.IN	HP.T	
HP002	21	HP.T	HP.SUCT	
RC001	16	RC.IN	RC.T	
RC002	16	RC.T	RC.SUCT	
RH001A	26	A.RH.IN	A.RH.T	
RH001B	26	B.RH.IN	B.RH.T	
RH002A	26	C.IN	A.IN	
RH002B	26	B.IN	D.IN	
RH003A	26	A.RH.T	C.IN	
RH003B	26	B.RH.T	B.IN	
RH004A	21	C.IN	C.SUC	
RH004B	21	B.IN	B.SUC	
RH005A	21	A.IN	A.SUC	
RH005B	21	D.IN	D.SUC	
RH006A	16	A.SUC	A.DIS	ARHR
RH006B	16	B.SUC	B.DIS	BRHR
RH006C	16	C.SUC	C.DIS	CRHR
RH006D	16	D.SUC	D.DIS	DRHR
RH006DA	16	D.DIS	D.DISA	
RH007A	16	A.DIS	ADISTEE	
RH007B	16	B.DIS	BDISTEE	
RH007C	16	C.DIS	ADISTEE	
RH007D	21	D.DISA	BDISTEE	
RH008A	21	ADISTEE	RHRHXS1	
RH008B	21	BDISTEE	RHRHXS2	
RHRHXA	21	RHRHXS1	RHRHXDA	
RHRHXB	21	RHRHXS2	RHRHXDB	
RHXBYPSA	21	RHRHXS1	RHRHXDA	
RHXBYPSB	21	RHRHXS2	RHRHXDB	

PIPELINE	SPEC	FROM_NODE	TO_NODE	PUMP/COMP
RX01A	21	RHRHXDA	RHRHXDC	
RX01B	21	RHRHXDB	RHRHXDD	
RX01C	21	RHRHXDC	RECIRCA	
RX01D	21	RHRHXDD	RECIRCB	
RX02A	21	RECIRCA	MO2012	
RX02B	21	RECIRCB	M02013	
RX02C	35	MO2012	RECIRC1	
RX02D	35	M02013	RECIRC2	
RXO1A	16	.	.	

PUMP/COMP	PERFORMANCE DATA					
A.CS	gpm:	0	2179	3990	5040	5755
	ft:	850.3	795.5	664	536.2	411.7
	eqn:	850.3 - 4.49715e-006 Q ^ 2.12033				
ARHR	gpm:	0	3365	4000	4250	4540
	ft:	810.3	498.9	350	280	171.8
	eqn:	810.3 - 1.3787e-006 Q ^ 2.36763				
BCS	gpm:	0	1948	3080	4875	5600
	ft:	844	770.1	719.4	535.2	418.1
	eqn:	844 - 0.000218414 Q ^ 1.66917				
BRHR	gpm:	0	3656	4000	4250	4408
	ft:	813.8	436	350	280	230
	eqn:	813.8 - 2.04305e-006 Q ^ 2.32005				
CRHR	gpm:	0	3540	4000	4250	4440
	ft:	763.9	461.1	360	290	235.4
	eqn:	763.9 - 5.58043e-007 Q ^ 2.46066				
DRHR	gpm:	0	3542	4000	4250	4425
	ft:	810.1	463	350	285	227
	eqn:	810.1 - 2.16007e-006 Q ^ 2.31196				

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:26 am
System: OVRPRES4
rev: 06/16/97 9:24 am

PIPELIST REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.5°F. and 0 psig cont. press. Containment overpressure calcs.

SPECIFICATIONS

SPECIFICATION	PIPE MATERIAL Sch / Roughness	FLUID Temp / Pres	VALVE TABLE	DESIGN LIMITS Vel / Pres
16 LB30 rev: 06/16/97 9:23 am	Steel Sch 40 0.0018 in Size for: 8 ft/sec	Water 150.5 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
21 LB31 rev: 06/16/97 9:23 am	Steel Sch 30 0.0018 in Size for: 8 ft/sec	Water 150.5 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
26 LB32 rev: 06/16/97 9:24 am	Steel Sch 20 0.0018 in Size for: 8 ft/sec	Water 150.5 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
31 LB34 rev: 06/16/97 9:24 am	Steel Sch 60 0.0018 in Size for: 8 ft/sec	Water 150.5 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g
35 LB34d rev: 06/16/97 9:24 am	Steel Sch 80 0.0018 in Size for: 8 ft/sec	Water 150.5 °F 0 psi g	Standard	0 - 12 ft/sec 0 - 200 psi g

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
A	31	Steel 20 in / 60	3.6777	Water 150.5 °F / 0 psi g	1.163
B	31	Steel 20 in / 60	3.6777	Water 150.5 °F / 0 psi g	0.4469
C	31	Steel 20 in / 60	3.6777	Water 150.5 °F / 0 psi g	1.163
CDS1B	16	Steel 10 in / 40	3.45	Water 150.5 °F / 0 psi g	0.2689
CDS7A	35	Steel 2 in / 80	7.73835	Water 150.5 °F / 0 psi g	0.478
CROSSTIE	21	Steel 14 in / 30	49.0188	Water 150.5 °F / 0 psi g	1.403
CS001A	16	Steel 12 in / 40	41.8129	Water 150.5 °F / 0 psi g	2.285
CS001B	16	Steel 12 in / 40	42.5259	Water 150.5 °F / 0 psi g	1.695
CS003A	16	Steel 12 in / 40	10.7215	Water 150.5 °F / 0 psi g	1.779
CS003B	16	Steel 12 in / 40	27.109	Water 150.5 °F / 0 psi g	2.018
CSD1A	16	Steel 10 in / 40	3.7973	Water 150.5 °F / 0 psi g	0.2689
CSD2A	16	Steel 10 in / 40	108.553	Water 150.5 °F / 0 psi g	60.59
CSD2B	16	Steel 10 in / 40	108.723	Water 150.5 °F / 0 psi g	59.14
CSD3A	35	Steel 8 in / 80	57.0055	Water 150.5 °F / 0 psi g	19.08
CSD3B	35	Steel 8 in / 80	55.4392	Water 150.5 °F / 0 psi g	19.08
CSD4A	16	Steel 2.5 in / 40	2.22525	Water 150.5 °F / 0 psi g	1.664
CSD4B	16	Steel 2.5 in / 40	2.7485	Water 150.5 °F / 0 psi g	1.93
CSD5A	35	Steel 2 in / 80	0.67045	Water 150.5 °F / 0 psi g	6.654
CSD5B	35	Steel 2 in / 80	2.0608	Water 150.5 °F / 0 psi g	6.654
CSD6A	16	Steel 2.5 in / 40	38.6803	Water 150.5 °F / 0 psi g	152.5
CSD6B	16	Steel 2.5 in / 40	101.051	Water 150.5 °F / 0 psi g	155.4
CSD7B	16	Steel 10 in / 40	97.3901	Water 150.5 °F / 0 psi g	1.995
CSD8A	16	Steel 2.5 in / 40	45.7585	Water 150.5 °F / 0 psi g	2.453
CSD9A	16	Steel 10 in / 40	75.8885	Water 150.5 °F / 0 psi g	1.53

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
D	31	Steel 20 in / 60	3.6777	Water 150.5 °F / 0 psi g	1.163
H1	26	Steel 20 in / 20	52.2054	Water 150.5 °F / 0 psi g	0.144
H11	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.2536
H12	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.00366
H2	26	Steel 20 in / 20	24.1868	Water 150.5 °F / 0 psi g	0.072
H21	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.00366
H22	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.01484
H3	26	Steel 20 in / 20	24.3777	Water 150.5 °F / 0 psi g	0.072
H31	31	Steel 20 in / 60	1.4375	Water 150.5 °F / 0 psi g	0.2425
H32	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.2536
H4a	26	Steel 20 in / 20	31.4675	Water 150.5 °F / 0 psi g	0.072
H4a1	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.7201
H4a2	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.01484
H4b	26	Steel 20 in / 20	45.6907	Water 150.5 °F / 0 psi g	0.144
H4b1	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.2425
H4b2	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.01484
H5	26	Steel 20 in / 20	108.244	Water 150.5 °F / 0 psi g	0.288
H51	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.2536
H52	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.7201
H6a	26	Steel 20 in / 20	15.1777	Water 150.5 °F / 0 psi g	0.072
H6a1	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.01484
H6a2	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.00366
H6b	26	Steel 20 in / 20	61.7884	Water 150.5 °F / 0 psi g	0.144
H6b1	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.01484

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
H6b2	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.2425
H7	26	Steel 20 in / 20	24.3777	Water 150.5 °F / 0 psi g	0.072
H71	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.2536
H72	31	Steel 20 in / 60	1.725	Water 150.5 °F / 0 psi g	0.2425
H8	26	Steel 20 in / 20	24.1868	Water 150.5 °F / 0 psi g	0.072
H81	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.01484
H82	31	Steel 20 in / 60	1.9171	Water 150.5 °F / 0 psi g	0.00366
HP001	21	Steel 14 in / 30	67.5027	Water 150.5 °F / 0 psi g	3.127
HP002	21	Steel 14 in / 30	9.3679	Water 150.5 °F / 0 psi g	1.356
RC001	16	Steel 6 in / 40	22.7965	Water 150.5 °F / 0 psi g	4.054
RC002	16	Steel 6 in / 40	56.5179	Water 150.5 °F / 0 psi g	1.298
RH001A	26	Steel 20 in / 20	62.1357	Water 150.5 °F / 0 psi g	2.161
RH001B	26	Steel 20 in / 20	55.6198	Water 150.5 °F / 0 psi g	2.09
RH002A	26	Steel 20 in / 20	5.75	Water 150.5 °F / 0 psi g	0.7101
RH002B	26	Steel 20 in / 20	5.3671	Water 150.5 °F / 0 psi g	0.7101
RH003A	26	Steel 20 in / 20	7.1093	Water 150.5 °F / 0 psi g	0.2367
RH003B	26	Steel 20 in / 20	7.6671	Water 150.5 °F / 0 psi g	0.7101
RH004A	21	Steel 14 in / 30	14.758	Water 150.5 °F / 0 psi g	2.63
RH004B	21	Steel 14 in / 30	14.95	Water 150.5 °F / 0 psi g	2.63
RH005A	21	Steel 14 in / 30	14.758	Water 150.5 °F / 0 psi g	1.867
RH005B	21	Steel 14 in / 30	14.95	Water 150.5 °F / 0 psi g	1.867
RH006A	16	Steel 12 in / 40	1.15	Water 150.5 °F / 0 psi g	0.2977
RH006B	16	Steel 12 in / 40	3.0671	Water 150.5 °F / 0 psi g	0.5573
RH006C	16	Steel 12 in / 40	1.15	Water 150.5 °F / 0 psi g	0.2977

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	FLUID Temp / Pres	VALVES Total-K
RH006D	16	Steel 12 in / 40	3.06671	Water 150.5 °F / 0 psi g	0.5573
RH006DA	16	Steel 10 in / 40	20.7	Water 150.5 °F / 0 psi g	1.76
RH007A	16	Steel 10 in / 40	17.6094	Water 150.5 °F / 0 psi g	2.534
RH007B	16	Steel 10 in / 40	19.2625	Water 150.5 °F / 0 psi g	2.298
RH007C	16	Steel 10 in / 40	19.7656	Water 150.5 °F / 0 psi g	3.065
RH007D	21	Steel 14 in / 30	4.025	Water 150.5 °F / 0 psi g	0.2543
RH008A	21	Steel 14 in / 30	11.7875	Water 150.5 °F / 0 psi g	0.5086
RH008B	21	Steel 14 in / 30	2.875	Water 150.5 °F / 0 psi g	0.2543
RHRHXA	21	Steel 14 in / 30	28.4145	Water 150.5 °F / 0 psi g	5.436
RHRHXB	21	Steel 14 in / 30	54.8343	Water 150.5 °F / 0 psi g	6.316
RHXBYPSA	21	Steel 14 in / 30	29.4849	Water 150.5 °F / 0 psi g	5.85
RHXBYPSB	21	Steel 14 in / 30	15.4172	Water 150.5 °F / 0 psi g	5.341
RX01A	21	Steel 14 in / 30	6.3849	Water 150.5 °F / 0 psi g	0.763
RX01B	21	Steel 14 in / 30	20.748	Water 150.5 °F / 0 psi g	1.272
RX01C	21	Steel 14 in / 30	83.5906	Water 150.5 °F / 0 psi g	3.24
RX01D	21	Steel 14 in / 30	73.7917	Water 150.5 °F / 0 psi g	3.24
RX02A	21	Steel 16 in / 30	12.3625	Water 150.5 °F / 0 psi g	4.454
RX02B	21	Steel 16 in / 30	12.3625	Water 150.5 °F / 0 psi g	4.207
RX02C	35	Steel 16 in / 80	102.769	Water 150.5 °F / 0 psi g	3.252
RX02D	35	Steel 16 in / 80	97.9537	Water 150.5 °F / 0 psi g	3.184
RXO1A	16	Steel 14 in / 40	6.3849	Water 150.5 °F / 0 psi g	0.7645

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:26 am
System: OVRPRES4
rev: 06/16/97 9:24 am

MATERIALS REPORT

Created: 11/04/96 11:56 am
Design file:
Pipe Specs: 5

Pipes: 93
Nodes: 87
Pumps/Comps: 6

NSP RHR and CS piping model, SP Temp. 150.5°F. and 0 psig cont. press. Containment overpressure calcs.

PIPE MATERIALS LIST

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
A	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
B	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER
C	31	Steel 20 in / 60	3.6777	1-Fixed K STRAINER 1-Tee Flow Thru Branch
CDS1B	16	Steel 10 in / 40	3.45	1-Elbow Short - r/d 1 @ 90°
CDS7A	35	Steel 2 in / 80	7.73835	1-Elbow Short - r/d 1 @ 90° 1-Reducer Enlargement 2 X 2.5
CROSSTIE	21	Steel 14 in / 30	49.0188	3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Reducer Contraction 16 X 14 1-Reducer Enlargement 14 X 16 2-Gate Wedge Disc
CS001A	16	Steel 12 in / 40	41.8129	4-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
CS001B	16	Steel 12 in / 40	42.5259	1-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Gate Wedge Disc 1-Gate Double Disc 1-Tee Flow Thru Branch
CS003A	16	Steel 12 in / 40	10.7215	3-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
CS003B	16	Steel 12 in / 40	27.109	1-Elbow Short - r/d 1 @ 90° 4-Elbow Short - r/d 1 @ 45° 1-Fixed K vel corctn
CSD1A	16	Steel 10 in / 40	3.7973	1-Elbow Short - r/d 1 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
CSD2A	16	Steel 10 in / 40	108.553	1-Tee Flow Thru Run 1-Swing Check Vertical 5-Elbow Short - r/d 1 @ 90° 8-Elbow Short - r/d 1 @ 45° 1-Fixed K Flow Element 1-Fixed K Res. Orifice
CSD2B	16	Steel 10 in / 40	108.723	4-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Run 1-Fixed K Res. Orifice 1-Fixed K Flow Element
CSD3A	35	Steel 8 in / 80	57.0055	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Spargers
CSD3B	35	Steel 8 in / 80	55.4392	3-Gate Wedge Disc 1-Swing Check Angled 6-Elbow Short - r/d 1 @ 90° 1-Fixed K Sparger
CSD4A	16	Steel 2.5 in / 40	2.22525	1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD4B	16	Steel 2.5 in / 40	2.7485	2-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch 1-Reducer Contraction 2.5 X 2
CSD5A	35	Steel 2 in / 80	0.67045	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD5B	35	Steel 2 in / 80	2.0608	1-Globe Valve 1-Reducer Enlargement 2 X 2.5
CSD6A	16	Steel 2.5 in / 40	38.6803	1-Elbow Short - r/d 1 @ 45° 2-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 2.5 X 2 1-Fixed K Orifice Min.
CSD6B	16	Steel 2.5 in / 40	101.051	10-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 1-Fixed K Orifice Min.
CSD7B	16	Steel 10 in / 40	97.3901	1-Reducer Contraction 10 X 8 4-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run
CSD8A	16	Steel 2.5 in / 40	45.7585	6-Elbow Short - r/d 1 @ 90° 1-Elbow Short - r/d 1 @ 45°
CSD9A	16	Steel 10 in / 40	75.8885	1-Reducer Contraction 10 X 8 1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90°
D	31	Steel 20 in / 60	3.6777	1-Fixed K strainer 1-Tee Flow Thru Branch
H1	26	Steel 20 in / 20	52.2054	2-Fixed K 22.5 mitre
H11	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H12	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H2	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H21	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H22	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H3	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H31	31	Steel 20 in / 60	1.4375	1-Fixed K enlargement 1-Tee Flow Thru Run
H32	31	Steel 20 in / 60	1.9171	1-Fixed K contraction 1-Tee Flow Thru Run
H4a	26	Steel 20 in / 20	31.4675	1-Fixed K 22.5 mitre
H4a1	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement 1-Tee Flow Thru Branch
H4a2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H4b	26	Steel 20 in / 20	45.6907	2-Fixed K 22.5 mitre
H4b1	31	Steel	1.725	1-Fixed K enlargement

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
		20 in / 60		1-Tee Flow Thru Run
H4b2	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H5	26	Steel 20 in / 20	108.244	4-Fixed K 22.5 mitre
H51	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H52	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Branch 1-Fixed K enlargement
H6a	26	Steel 20 in / 20	15.1777	1-Fixed K 22.5 mitre
H6a1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6a2	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
H6b	26	Steel 20 in / 20	61.7884	2-Fixed K 22.5 mitre
H6b1	31	Steel 20 in / 60	1.725	1-Fixed K contraction
H6b2	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H7	26	Steel 20 in / 20	24.3777	1-Fixed K 22.5 mitre
H71	31	Steel 20 in / 60	1.9171	1-Tee Flow Thru Run 1-Fixed K contraction
H72	31	Steel 20 in / 60	1.725	1-Fixed K enlargement 1-Tee Flow Thru Run
H8	26	Steel 20 in / 20	24.1868	1-Fixed K 22.5 mitre
H81	31	Steel 20 in / 60	1.9171	1-Fixed K contraction
H82	31	Steel 20 in / 60	1.9171	1-Fixed K enlargement
HP001	21	Steel 14 in / 30	67.5027	1-Elbow Long - r/d 1.5 @ 22.5° 2-Gate Wedge Disc 1-Swing Check Angled 3-Elbow Long - r/d 1.5 @ 90°

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
				1-Tee Flow Thru Run 1-Tee Flow Thru Branch
HP002	21	Steel 14 in / 30	9.3679	1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RC001	16	Steel 6 in / 40	22.7965	1-Elbow Long - r/d 1.5 @ 67.5° 1-Elbow Long - r/d 1.5 @ 45° 1-Elbow Long - r/d 1.5 @ 90° 2-Gate Wedge Disc 1-Swing Check Angled 2-Tee Flow Thru Branch
RC002	16	Steel 6 in / 40	56.5179	1-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH001A	26	Steel 20 in / 20	62.1357	2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH001B	26	Steel 20 in / 20	55.6198	1-Elbow Long - r/d 1.5 @ 90° 1-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Elbow Short - r/d 1 @ 45° 1-Tee Flow Thru Branch
RH002A	26	Steel 20 in / 20	5.75	1-Tee Flow Thru Branch
RH002B	26	Steel 20 in / 20	5.3671	1-Tee Flow Thru Branch
RH003A	26	Steel 20 in / 20	7.1093	1-Tee Flow Thru Run
RH003B	26	Steel 20 in / 20	7.6671	1-Tee Flow Thru Branch
RH004A	21	Steel 14 in / 30	14.758	1-Tee Flow Thru Branch 1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH004B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K vel corctn

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH005A	21	Steel 14 in / 30	14.758	1-Reducer Contraction 20 X 14 1-Gate Wedge Disc 2-Elbow Short - r/d 1 @ 90° 1-Fixed K vel corctn
RH005B	21	Steel 14 in / 30	14.95	1-Reducer Contraction 20 X 14 2-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Fixed K vel corctn
RH006A	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006B	16	Steel 12 in / 40	3.0671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006C	16	Steel 12 in / 40	1.15	1-Reducer Contraction 12 X 10
RH006D	16	Steel 12 in / 40	3.06671	1-Elbow Short - r/d 1 @ 90° 1-Reducer Contraction 12 X 10
RH006DA	16	Steel 10 in / 40	20.7	3-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Reducer Enlargement 10 X 14
RH007A	16	Steel 10 in / 40	17.6094	2-Elbow Short - r/d 1 @ 90° 1-Elbow Long - r/d 1.5 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Run 1-Reducer Enlargement 10 X 12 1-Swing Check Angled
RH007B	16	Steel 10 in / 40	19.2625	2-Elbow Short - r/d 1 @ 90° 1-Swing Check Vertical 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Reducer Enlargement 10 X 14
RH007C	16	Steel 10 in / 40	19.7656	3-Elbow Short - r/d 1 @ 90° 1-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Swing Check Angled
RH007D	21	Steel 14 in / 30	4.025	1-Tee Flow Thru Run
RH008A	21	Steel 14 in / 30	11.7875	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RH008B	21	Steel 14 in / 30	2.875	1-Tee Flow Thru Run
RHRHXA	21	Steel 14 in / 30	28.4145	3-Elbow Short - r/d 1 @ 90° 2-Gate Wedge Disc 1-Tee Flow Thru Run 1-Fixed K RHR HX
RHRHXB	21	Steel 14 in / 30	54.8343	3-Elbow Short - r/d 1 @ 90° 2-Elbow Short - r/d 1 @ 45° 2-Gate Wedge Disc 1-Tee Flow Thru Branch 1-Fixed K RHR HX
RHXBYPSA	21	Steel 14 in / 30	29.4849	1-Tee Flow Thru Branch 3-Elbow Short - r/d 1 @ 90° 1-Globe Valve
RHXBYPSB	21	Steel 14 in / 30	15.4172	3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Globe Valve
RX01A	21	Steel 14 in / 30	6.3849	1-Tee Flow Thru Branch
RX01B	21	Steel 14 in / 30	20.748	1-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Run 1-Tee Flow Thru Branch
RX01C	21	Steel 14 in / 30	83.5906	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX01D	21	Steel 14 in / 30	73.7917	1-Tee Flow Thru Run 3-Elbow Short - r/d 1 @ 90° 1-Tee Flow Thru Branch 1-Reducer Enlargement 14 X 16 1-Fixed K Flow Element
RX02A	21	Steel 16 in / 30	12.3625	1-Globe Valve 1-Tee Flow Thru Run
RX02B	21	Steel 16 in / 30	12.3625	1-Globe Valve
RX02C	35	Steel 16 in / 80	102.769	7-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Reducer Enlargement 16 X 18

PIPELINE	SPEC	MATERIAL Size / Sch	LENGTH ft	VALVES & FITTINGS
RX02D	35	Steel 16 in / 80	97.9537	6-Elbow Short - r/d 1 @ 90° 2-Gate Double Disc 1-Swing Check Angled 1-Elbow Short - r/d 1 @ 45° 1-Reducer Enlargement 16 X 18
RXO1A	16	Steel 14 in / 40	6.3849	1-Tee Flow Thru Branch

PIPE SUMMARY 06/16/97 9:26 am

PIPE MATERIAL	SCHEDULE	SIZE	LENGTH
Steel	20	20 in	555.352 ft
Steel	30	14 in	516.659 ft
		16 in	24.725 ft
Steel	40	2.5 in	190.464 ft
		6 in	79.3144 ft
		10 in	475.139 ft
		12 in	130.603 ft
		14 in	6.3849 ft
Steel	60	20 in	51.2285 ft
Steel	80	2 in	10.4696 ft
		8 in	112.445 ft
		16 in	200.723 ft

VALVE & FITTING SUMMARY

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
16 LB30	Steel	40	
	Size: 2.5 in		7-Elbow Short - r/d 1 @ 45°
			2-Tee Flow Thru Branch
			3-Reducer Contraction 2.5 X 2
			18-Elbow Short - r/d 1 @ 90°
			2-Fixed K Orifice Min.
	Size: 6 in		1-Elbow Long - r/d 1.5 @ 67.5°
			1-Elbow Long - r/d 1.5 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°
			2-Gate Wedge Disc
			1-Swing Check Angled
			2-Tee Flow Thru Branch
			1-Elbow Short - r/d 1 @ 90°
			1-Fixed K vel corctn
	Size: 10 in		28-Elbow Short - r/d 1 @ 90°
			5-Tee Flow Thru Run
			4-Swing Check Vertical
			11-Elbow Short - r/d 1 @ 45°
			2-Fixed K Flow Element
			2-Fixed K Res. Orifice
			2-Reducer Contraction 10 X 8
			4-Gate Wedge Disc

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 10 in		2-Reducer Enlargement 10 X 14
			1-Elbow Long - r/d 1.5 @ 90°
			1-Reducer Enlargement 10 X 12
			2-Swing Check Angled
			2-Tee Flow Thru Branch
	Size: 12 in		11-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			2-Gate Double Disc
			2-Tee Flow Thru Run
			2-Tee Flow Thru Branch
			5-Elbow Short - r/d 1 @ 45°
			2-Fixed K vel corctn
			4-Reducer Contraction 12 X 10
	Size: 14 in		1-Tee Flow Thru Branch
21 LB31	Steel	30	
	Size: 14 in		30-Elbow Short - r/d 1 @ 90°
			9-Tee Flow Thru Run
			1-Reducer Contraction 16 X 14
			3-Reducer Enlargement 14 X 16
			13-Gate Wedge Disc
			1-Elbow Long - r/d 1.5 @ 22.5°
			1-Swing Check Angled
			3-Elbow Long - r/d 1.5 @ 90°
			10-Tee Flow Thru Branch
			5-Fixed K vel corctn
			4-Reducer Contraction 20 X 14
			2-Fixed K RHR HX
			2-Elbow Short - r/d 1 @ 45°
			2-Globe Valve
			2-Fixed K Flow Element
	Size: 16 in		2-Globe Valve
			1-Tee Flow Thru Run
26 LB32	Steel	20	
	Size: 20 in		16-Fixed K 22.5 mitre
			3-Elbow Short - r/d 1 @ 90°
			2-Gate Wedge Disc
			7-Tee Flow Thru Branch
			2-Elbow Short - r/d 1 @ 45°
			1-Elbow Long - r/d 1.5 @ 90°

SPECIFICATION	MATERIAL	SCHEDULE	VALVES & FITTINGS
	Size: 20 in		1-Tee Flow Thru Run
31 LB34	Steel	60	
	Size: 20 in		2-Fixed K strainer
			5-Tee Flow Thru Branch
			2-Fixed K STRAINER
			10-Fixed K contraction
			8-Tee Flow Thru Run
			10-Fixed K enlargement
35 LB34a	Steel	80	
	Size: 2 in		1-Elbow Short - r/d 1 @ 90°
			3-Reducer Enlargement 2 X 2.5
			2-Globe Valve
	Size: 8 in		6-Gate Wedge Disc
			2-Swing Check Angled
			12-Elbow Short - r/d 1 @ 90°
			1-Fixed K Spargers
			1-Fixed K Sparger
	Size: 16 in		13-Elbow Short - r/d 1 @ 90°
			4-Gate Double Disc
			2-Swing Check Angled
			2-Reducer Enlargement 16 X 18
			1-Elbow Short - r/d 1 @ 45°

Company: Duke Engineering & Services
Project:
by: Joseph D. Sparacino

06/16/97 9:34 am
Lineup: CASE4
rev: 06/16/97 9:34 am

System: OVRPRES4
rev: 06/16/97 9:24 am

Deviation: 7.98e-005 %
after: 9 iterations

long term, 4 RHR 8000gpm per division, A&B CS 2800gpm, 0 cont press., A strnr plugged, sp wtr lvl 908'-9.3

Volumetric flow rates require constant fluid properties in all pipelines. Fluid properties in the first specification were used in this calculation.

LINEUP SUMMARIES

PIPELINE		FLOW gpm	PRESSURE SOURCE	SET psi g	LEVEL ft
CSD3A	>>>	2800	ACSD3	0	0
CSD8A	>>>	234.7	ACSD8	0	0
CSD3B	>>>	2800	BCSD3	0	0
CSD6B	>>>	228.2	BCSD6	0	0
RX02D	>>>	16000	RECIRC2	0	0
B	<<<	8172	TB	0	4.459
C	<<<	5397	TC	0	4.469
D	<<<	8494	TD	0	4.459

Flows IN: 22063 gpm
Flows OUT: 22063 gpm

NET FLOWS: 0 gpm

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
1	902.25		1.503	905.8
10	902.25		2.455	908
11	902.25		2.443	908
12	902.25		2.431	908
13	902.25		2.367	907.8
14	902.25		2.251	907.6
15	902.25		2.038	907
16	902.25		1.997	907
17	902.25		1.971	906.9
18	902.25		1.913	906.8
19	902.25		1.619	906.1
2	902.25		1.467	905.7
20	902.25		1.574	906
3	902.25		1.503	905.8
4	902.25		1.549	905.9
5	902.25		1.584	906
6	902.25		1.63[illegible]	906.1
7	902.25		1.84	906.6
8	902.25		1.979	906.9
9	902.25		2.107	907.2
A.CS.IN	902.25		2.026	907
A.CS.SUCT	897.833		1.511	901.4
A.CS.T	899.916		1.589	903.7
A.DIS	897.833		148.7	1248
A.IN	897.583		1.955	902.2
A.RH.IN	902.25		1.577	906
A.RH.T	897.583		2.201	902.8
A.SUC	897.833		0.688	899.5
ACSD2	931.917		75.4	1109
ACSD3	981.188		0 (source)	981.2
ACSD4	900.156		312.1 ***	1635
ACSD5	900.74		282.9 ***	1567
ACSD6	925.875		17.44	966.9
ACSD7	928		10.43	952.6
ACSD8	927		0 (source)	927
ACSD9	971.25		56.29	1104
ACSDSCG	899.635		315.3 ***	1642
ADISTEE	901.083		142.4	1236
B.CS.IN	902.25		1.624	906.1
B.CS.SUCT	897.833		1.177	900.6
B.CS.T	899.885		1.495	903.4

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
B.DIS	899.5		147.9	1248
B.IN	897.583		1.754	901.7
B.RH.IN	902.25		1.462	905.7
B.RH.T	897.583		2.149	902.6
B.SUC	897.833		0.047	897.9
BCSD2	927.833		77.41	1110
BCSD3	980.38		0 (source)	980.4
BCSD4	899.696		295 ***	1595
BCSD5	901.688		266.3 ***	1529
BCSD6	930.333		0 (source)	930.3
BCSD7	978.5		52.78	1103
BCSDSCG	899.583		298.5 ***	1603
BDISTEE	908		139.7	1237
C.DIS	897.833		149.8	1251
C.IN	897.583		2.051	902.4
C.SUC	897.833		0.327	898.6
D.DIS	899.5		147.2	1246
D.DISA	908		139.9	1237
D.IN	897.583		1.657	901.5
D.SUC	897.833		0.376	898.7
HP.IN	902.25		1.965	906.9
HP.T	901.615		2.234	906.9
M02013	940.91		33.03	1019
MO2012	940.917		60.13	1083
RC.IN	902.25		2.355	907.8
RC.T	902.25		2.355	907.8
RECIRC2	951.75		0 (source)	951.8
RECIRCA	930.168		64.7	1083
RECIRCB	930.167		60.16	1072
RHRHXDA	916.333		82.16	1110
RHRHXDB	915.49		79.27	1102
RHRHXDC	916.336		80.24	1105
RHRHXDD	921.33		73.32	1094
RHRHXS1	909.406		88.53	1118
RHRHXS2	908		85.99	1110
SA	902.25		1.506	905.8
SB	902.25		2.463	908.1
SC	902.25		2.439	908
SD	902.25		1.94	906.8
TB	904.316		1.894 (source)	908.8
TC	904.316		1.898 (source)	908.8

NODE	ELEVATION ft	DEMAND gpm	PRESSURE psi g	H GRADE ft
TD	904.316		1.894 (source)	908.8

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
A	TA		SA	closed	0	0	0
B	TB		SB	8172	9.894	(0.570)	0.724
C	TC		SC	5397	6.534	(0.542)	0.791
CDS1B	B.CS.SUCT		BCSDSCG	3028	* 12.33	(297.4)	(702)
—— BCS —— dP: (298.4) HL: (702.8)							
CDS7A	ACSD6		ACSD7	234.7	* 25.53	7.012	14.39
CROSSTIE	RECIRCA	<->	RECIRCB	8000	* 18.63	4.536	10.68
CS001A	A.CS.IN		A.CS.T	3035	8.706	0.438	3.364
CS001B	B.CS.IN		B.CS.T	3028	8.687	0.130	2.671
CS003A	A.CS.T		A.CS.SUCT	3035	8.706	0.077	2.265
CS003B	B.CS.T		B.CS.SUCT	3028	8.687	0.318	2.8
CSD1A	A.CS.SUCT		ACSDSCG	3035	* 12.36	(313.8)	(740.8)
—— A.CS —— dP: (314.9) HL: (741.6)							
CSD2A	ACSDSCG		ACSD2	2800	11.4	67.16	125.9
—— FCV@2800 —— dP: 172.8 HL: 406.9							
CSD2B	BCSDSCG		BCSD2	2800	11.4	64.21	123
—— FCV@2800 —— dP: 156.9 HL: 369.5							
CSD3A	ACSD9		ACSD3	2800	* 19.69	56.29	122.6
CSD3B	BCSD7		BCSD3	2800	* 19.69	52.78	122.4
CSD4A	ACSDSCG		ACSD4	234.7	* 15.74	3.271	7.182
CSD4B	BCSDSCG		BCSD4	228.2	* 15.3	3.5	7.929
CSD5A	ACSD4		ACSD5	234.7	* 25.53	29.16	68.09
CSD5B	BCSD4		BCSD5	228.2	* 24.81	28.78	65.97
CSD6A	ACSD5		ACSD6	234.7	* 15.74	265.5	600
CSD6B	BCSD5		BCSD6	228.2	* 15.3	266.3	598.4
CSD7B	BCSD2		BCSD7	2800	11.4	24.63	7.328
CSD8A	ACSD7		ACSD8	234.7	* 15.74	10.43	25.56
CSD9A	ACSD2		ACSD9	2800	11.4	19.11	5.661
D	TD		SD	8494	10.28	(0.046)	1.957
H1	20	<->	1	3946	4.354	0.071	0.167
H11	1	<->	B.RH.IN	3946	4.778	0.041	0.096
H12	A.RH.IN	<->	20	3946	4.778	0.003	0.007
H2	3		2	4054	4.472	0.035	0.083
H21	SA		3	4054	4.908	0.003	0.007
H22	2		B.RH.IN	4054	4.908	0.005	0.012
H3	5		4	4054	4.472	0.035	0.084
H31	B.CS.IN		5	4054	4.908	0.040	0.095
H32	4		SA	4054	4.908	0.043	0.101
H4a	9		8	7082	7.813	0.128	0.302
H4a1	SB		9	7082	8.574	0.356	0.839
H4a2	8		HP.IN	7082	8.574	0.014	0.033
H4b	7		6	7082	7.813	0.202	0.475

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
H4b1	HP.IN	7	7082	8.574	0.124	0.293
H4b2	6	B.CS.IN	7082	8.574	0.014	0.033
H5	10	11	1090	1.203	0.012	0.029
H51	11	SC	1090	1.32	0.003	0.007
H52	SB	10	1090	1.32	0.008	0.020
H6a	12	13	6487	7.157	0.065	0.152
H6a1	13	RC.IN	6487	7.854	0.012	0.028
H6a2	SC	12	6487	7.854	0.008	0.019
H6b	14	15	6487	7.157	0.213	0.501
H6b1	15	A.CS.IN	6487	7.854	0.012	0.028
H6b2	RC.IN	14	6487	7.854	0.104	0.246
H7	16	17	3452	3.809	0.026	0.061
H71	17	SD	3452	4.179	0.031	0.073
H72	A.CS.IN	16	3452	4.179	0.030	0.070
H8	18	19	11946	* 13.18	0.295	0.694
H81	19	A.RH.IN	11946	* 14.46	0.042	0.098
H82	SD	18	11946	* 14.46	0.026	0.062
HP001	HP.IN	HP.T	0	0	(0.270)	0
HP002	HP.T	HP.SUCT	closed	0	0	0
RC001	RC.IN	RC.T	0	0	0	0
RC002	RC.T	RC.SUCT	closed	0	0	0
RH001A	A.RH.IN	A.RH.T	8000	8.826	(0.624)	3.196
RH001B	B.RH.IN	B.RH.T	8000	8.826	(0.687)	3.049
RH002A	C.IN	A.IN	3985	4.396	0.096	0.227
RH002B	B.IN	D.IN	4007	4.421	0.097	0.229
RH003A	A.RH.T	C.IN	8000	8.826	0.150	0.353
RH003B	B.RH.T	B.IN	8000	8.826	0.395	0.930
RH004A	C.IN	C.SUC	4015	9.351	1.724	3.81
RH004B	B.IN	B.SUC	3993	9.297	1.707	3.77
RH005A	A.IN	A.SUC	3985	9.279	1.267	2.733
RH005B	D.IN	D.SUC	4007	9.332	1.281	2.767
RH006A	A.SUC	A.DIS	3985	11.43	(148)	(348.5)
---- ARHR ---- dP: (148.3) HL: (349.2)						
RH006B	B.SUC	B.DIS	3993	11.45	(147.8)	(349.8)
---- BRHR ---- dP: (149.1) HL: (351)						
RH006C	C.SUC	C.DIS	4015	11.52	(149.4)	(351.9)
---- CRHR ---- dP: (149.7) HL: (352.5)						
RH006D	D.SUC	D.DIS	4007	11.5	(146.8)	(347.4)
---- DRHR ---- dP: (148.1) HL: (348.6)						
RH006DA	D.DIS	D.DISA	4007	* 16.32	7.301	8.692
RH007A	A.DIS	ADISTEE	3985	* 16.22	6.283	11.54
RH007B	B.DIS	BDISTEE	3993	* 16.26	8.169	10.74

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi g	HL ft
RH007C	C.DIS	ADISTEE	4015	* 16.35	7.357	14.08
RH007D	D.DISA	BDISTEE	4007	9.332	0.174	0.410
RH008A	ADISTEE	RHRHXS1	8000	* 18.63	5.017	3.491
---- FCV@8000 ---- dP: 48.86 HL: 115.1						
RH008B	BDISTEE	RHRHXS2	8000	* 18.63	0.659	1.553
---- FCV@8000 ---- dP: 53.07 HL: 125						
RHRHXA	RHRHXS1	RHRHXDA	4071	9.481	6.365	8.06
RHRHXB	RHRHXS2	RHRHXDB	3767	8.771	6.72	8.334
RHXBYPSA	RHRHXS1	RHRHXDA	3929	9.149	6.365	8.06
RHXBYPSB	RHRHXS2	RHRHXDB	4233	9.858	6.72	8.334
RX01A	RHRHXDA	RHRHXDC	8000	* 18.63	1.919	4.515
RX01B	RHRHXDB	RHRHXDD	8000	* 18.63	5.951	8.173
RX01C	RHRHXDC	RECIRCA	8000	* 18.63	15.55	22.78
RX01D	RHRHXDD	RECIRCB	8000	* 18.63	13.16	22.15
RX02A	RECIRCA	MO2012	0	0	4.565	0
RX02B	RECIRCB	M02013	16000	* 28.13	27.13	53.14
RX02C	MO2012	RECIRC1	closed	0	0	0
RX02D	M02013	RECIRC2	16000	* 31.93	33.03	66.94

CORRECTED CONTAINMENT PRESSURE REQUIRED for NPSH for CORE SPRAY PUMPs UNDER RUN OUT CONDITION.

Time (sec)	Req'd Cont. Press. (psig) Po	Specific Weight (lb/ft3) SW	Corrected Press. (psig) Pc
86.3	2.3539	61.5195	-0.2094
86.3	2.6234	61.5195	0.0601
148.8	2.7457	61.4119	0.1869
148.8	3.0156	61.4119	0.4568
212.2	3.0126	61.3459	0.4565
212.2	3.2828	61.3459	0.7267
274.7	3.1588	61.3121	0.6041
274.7	3.429	61.3121	0.8743
337.2	3.2868	61.2839	0.7333
337.2	3.5572	61.2839	1.0037
399.7	3.3926	61.2482	0.8406
399.7	3.6631	61.2482	1.1111
462.2	3.4878	61.2389	0.9362
462.2	3.7583	61.2389	1.2067
524.7	3.5571	61.2239	1.0061
524.7	3.8277	61.2239	1.2767
587.2	3.6276	61.2085	1.0772
587.2	3.8982	61.2085	1.3478
599.7	3.6455	61.2040	1.0953
599.7	3.9161	61.2040	1.3659

Telefax

SULZER PUMPS
Division of Sulzer Roteq

Sulzer Bingham Pumps Inc.
Field Engineering
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Manager
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Tel. (503) 226-5243
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Date: 18 June, 1997

To: Dave Pennington
NORTHERN STATES POWER
Monticello Nuclear Power Plant

Fax: 612-295-1017
Phone: 612-295-1354

Pages: 2 (including this one)

Subject: NPSH of Sulzer Bingham Pumps S/N 270417/418
Core Spray Pumps 10 x 12 x 14.5 CVDS
F-97-10626

Dear Dave:

We hope to send out report by June 23, 1997. However in the interim period, we confirm that the NPSH test on 270417 (Monticello: 10 x 12 x 14.5 CVDS) is identical to 270425 (Quad City 12 x 14 x 14.5 CVDS) between the **4000 to 5300 GPM flow range**. Attached is SBPI curve #26895.

Regards,

Kenny Thomson

Title

cc: D. Eddy - Hydraulics
T. Richfield - Field Services

Exhibit F

Monticello Nuclear Generating Plant

Revision No. 2 to License Amendment Request Dated January 23, 1997

"Torus Attached Piping Evaluation," Monticello Nuclear Generating Plant, Revised June, 1997

Torus attached piping has been conservatively analyzed for 195 °F by Duke Engineering and Services. The results of this analysis are summarized below.

Acceptance Criteria

In accordance with Section 12.2.2.12.2 of the Updated Safety Analysis Report (USAR), Torus attached piping is analyzed to withstand loss of coolant accident (LOCA) related loads and safety relief valve (SRV) discharge-related loads postulated to occur during a LOCA or a SRV discharge event defined by Nuclear Regulatory Commission (NRC) Safety Evaluation Report NUREG-0661. NUREG-0661 requires compliance with the American Society of Mechanical Engineers (ASME) Code, Section III, 1977 Edition, Summer 1977 Addenda, to evaluate the acceptability of torus attached piping designs.

Analysis Assumptions

Torus attached piping was previously analyzed for a peak suppression pool temperature of 184 °F in March, 1995, following an update of the Monticello design basis accident containment pressure and temperature response analysis reported in NEDO-32418.

General Electric has reanalyzed the LOCA containment pressure and temperature response for Monticello in a more conservative manner at a reactor power level of 1880 Mwt. The results of this analysis are contained in Report GE-NE-T2300731-2, "Monticello Nuclear Generating Plant LOCA Containment Analysis for Use in Evaluation of NPSH for the RHR and Core Spray Pumps," June, 1997. Worst case suppression pool temperature increases in this analysis to 194.2 °F with RHRSW temperature at the upper limit of 90 °F specified in Section 6.2.3.2.4.c of the USAR.

For conservatism, the piping was reanalyzed for a suppression pool temperature of 195 °F.

Methodology

The postulated Mark I containment hydrodynamic loads for operation at 1880 MWt do not change since there is no change in reactor operating pressure. There will be no increase in piping stresses, support loads, and stresses in the torus penetrations.

The SRV discharge line dynamic loads are influenced by parameters such as SRV discharge line geometry, torus geometry, water leg length, and SRV flow rate which is linearly proportional to the SRV opening pressure.

The SRV opening setpoint pressures will not be changed since the reactor pressure remains unchanged. Therefore, the SRV discharge dynamic loads will remain within the original SRV load definition. There will be no increase in piping stresses, support loads and stresses in the torus penetrations due to the SRV discharge line dynamic loads

Torus attached piping was designed for the suppression pool design pressure of 56 psig. The suppression pool pressure under rerate conditions will still be bounded by the current suppression pool design pressure.

Based on the above, it is concluded that the impact of power rerate on torus attached piping will be limited to the impact of higher peak suppression pool temperature. The affected torus attached lines which require evaluation include large bore and small bore lines of the following systems.

- SRV Discharge Lines
- Residual Heat Removal
- Reactor Core Isolation Cooling offgas line (steam side)
- Primary Containment & Atmospheric Control
- Core Spray
- High Pressure Coolant Injection (water side)
- Reactor Core Isolation Cooling (water side)
- Primary Containment Nitrogen Control
- Miscellaneous torus attached piping (instrument lines, construction drains, and cantilevered lines)

Results

The torus attached piping has been evaluated for the peak suppression pool temperature of 195 °F and concurrent Mark I containment hydrodynamic loads. Evaluations concluded that all pipe stresses, pipe supports, and torus penetrations are in compliance with the requirements of NUREG-0661 and the ASME Code.

This evaluation is conservative since Mark I containment hydrodynamic loads will terminate before the design peak suppression pool temperature of 195 °F is reached. Termination of DBA Mark I containment hydrodynamic loads will occur at a suppression pool temperature of about 134 °F for the design basis loss of coolant accident and 170 °F for the small break loss of coolant accident

No physical changes to piping or associated supports is required to support this change in design temperature.

The detailed torus attached piping calculations are currently being transferred from the contractor to the site. They will be available on site for inspection.

Exhibit G

Monticello Nuclear Generating Plant

Revision No. 2 to License Amendment Request Dated January 23, 1997

"Evaluation of RHR Room Temperature During DBA LOCA," Monticello Nuclear Generating Plant, Revised June, 1997

Maximum RHR room temperature under long-term design basis accident loss of coolant accident (LOCA) conditions was determined in Calculations CA-96-113, CA-97-074, and CA-97-157. The results of these calculations are summarized below.

Acceptance Criteria

Maximum long-term ambient temperature in the Residual Heat Removal (RHR) pump rooms is specified as 140 °F in Section 6.2.2.2.1 of the Updated Safety Analysis Report (USAR).

Analysis Assumptions

Calculations were performed for three scenarios:

Case 1 - One RHR pump and one RHR service water (RHRSW) pump are running in suppression pool cooling mode. One Core Spray pump is running for reactor makeup. Suppression pool temperature is maximized at 194.2 °F. This is the peak long-term suppression pool temperature at a conservative bounding reactor operating power level of 1880 MWt. RHRSW (Mississippi River) temperature was assumed to be at the maximum analyzed value of 90 °F for the entire period.

Case 2 - Two RHR pumps and two RHRSW pumps are running in suppression pool cooling mode. One Core Spray pump is running for reactor makeup. Heat added to the RHR room from motor losses is maximized. Peak suppression pool temperature is 178.9 °F for this combination of RHR and RHRSW pumps. RHRSW temperature was assumed to be at the maximum analyzed value of 90 °F for the entire period.

Case 3 - Same as Case #2 except RHRSW temperature was assumed to be 89 °F for the entire period.

Summer time steady state room temperatures were assumed before the LOCA.

At the time the LOCA is initiated, loss of all normal air conditioning and ventilation is assumed.

Ground water temperature was determined to be 48 °F for purposes of this analysis.

All sources of heat input to the room were modeled. Significant sources included:

- Core Spray and RHR piping
- RHR Heat Exchanger
- Electrical cables, lighting, and misc electrical loads
- Core Spray and RHR pump motors

Heat input to the room from the core spray and RHR pump motors was conservatively assumed to be based on rated pump brake horsepower of 800 HP for core spray and 600 HP for RHR. Actual motor loads would be expected to be substantially less than this.

Concrete and steel heat sinks were conservatively modeled. Heat removal by room coolers and heat transfer to the building structure and adjacent soil and ground water was conservatively modeled.

While both A and B pump rooms are similar, RHR pump room B was chosen for modeling. Because of the layout of the plant, RHR pump room B requires longer pipe runs for cooling water. Tests have shown that the A pump room receives approximately 30% more cooling water flow.

Methodology

A lumped parameter model was used to calculate the average bulk air temperature in the RHR pump room following initiation of the LOCA and loss of normal ventilation and air conditioning equipment. If possible, the computation was carried on long enough until room temperature peaks and begins trending down with time. Equations were formulated on a Lotus 123 spreadsheet.

Maximum RHRSW temperature was assumed for piping temperature upstream of heat exchangers. Classic heat exchanger formulas were used for temperature of piping downstream of heat exchangers.

Convective surface to air and radiation surface to surface heat transfer was modeled for all significant heat transfer surfaces. For conservatism, all nominal convective heat transfer coefficients were reduced by 25% . The extra dampening capacity of steel and reinforcing bar buried in concrete walls was conservatively ignored.

Results

The maximum RHR pump room temperatures during a design basis LOCA were determined to be:

Case	Assumptions	Maximum RHR Pump Room Temperature (°F)
1	Suppression Pool Temperature Maximized With RHRSW at 90 °F	130.84
2	Heat Added to RHR Pump Room From Motor Losses Maximized With RHRSW at 90 °F	140*
3	Heat Added to RHR Pump Room From Motor Losses Maximized With RHRSW at 89 °F	139.86**

* RHR room temperature at 25.7 hours after the beginning of the accident. Only one RHR pump and one core spray pump would be running at this point in the accident since this is well after the time of the peak suppression pool temperature for this scenario.

** RHR room temperature at 10^6 seconds (about 11.5 days) after the beginning of the accident. Only one RHR pump would be running at this point in the accident.

Details of the RHR pump room heatup calculations are available on site for inspection.

Exhibit H

Monticello Nuclear Generating Plant

"Evaluation of Environmental Qualification Bounding Conditions," Monticello Nuclear Generating Plant, June, 1997

Equipment required to be environmentally qualified per 10CFR50.49 are qualified to the worst case bounding conditions. The bounding accident temperature conditions in the drywell used for Environmental Qualification is based on the small break accident. The bounding accident pressure conditions in the drywell occur during the DBA LOCA. The humidity for accident scenarios is assumed to be 100% at the start of the accident. The Monticello Environmental Qualification central file references General Electric report AE-083-0983, "Extended Drywell Temperature Analysis", as containing the drywell accident enveloping temperatures. The central file references General Electric report NEDO-30485, "Monticello Design Basis Accident Containment Pressure and Temperature Response for FSAR Update," as containing the bounding drywell accident pressure profile. General Electric report NEDO-30477, "Safety Analysis of the RHR Intertie Line Monticello Nuclear Generating Plant" analyzed for the peak short-term (30 second) containment response. This analysis reported a peak drywell pressure of 42.3 psig at 1.2 seconds. The environmentally qualified equipment inside containment was verified to be qualified to the peak drywell pressure of 42.3 psig. The postulated normal and post accident containment radiation doses will remain unchanged. Normal radiation dose assumes no accident and post accident radiation dose assumes core damage.

The bounding conditions used for environmental qualification, 42.3 psig and 335 °F, will not be changed by the reanalysis of long term suppression pool temperature.

RATED POWER LEVEL	DBA-LOCA DRYWELL PEAK TEMP	SHORT-TERM PEAK LOCA DW PRESS	SBA-LOCA DRYWELL PEAK TEMP
1670 MW	282°F (1)	42.3 PSIG (2)	335°F (3)

Evaluations completed at 102% of the rated power level.

Note 1- From NEDO - 30485, Table 1; Code HXSIZ with May-Witt decay heat.
Note 2 - From NEDO - 30477, Table 3-3 ; Code CPT with May-Witt decay heat.
Note 3 - From AE-083-0983, Table , Code HEX with May-Witt decay heat.

References

1) General Electric report AE-083-0983, "Extended Drywell Temperature Analysis", Dated: October 1983.
2) General Electric report NEDO-30485, "Monticello Design Basis Accident Containment Pressure and Temperature Response for FSAR Update", Dated: December, 1983.
3) General Electric report NEDO-30477, "Safety Analysis of the RHR Intertie Line Monticello Nuclear Generating Plant", Dated: June 1984.

Exhibit I

Monticello Nuclear Generating Plant

Revision No. 2 to License Amendment Request Dated January 23, 1997

Response to NRC Request for Additional Information (RAI) dated March 12, 1997

1. Which Code is used in the decay heat analyses? Was this code used in the previous analyses? If not, then justify its use.

2. List and justify the changes in input parameters used in the ANS 5.1 versus those used previously in the May Witt Analyses.

3. Provide and justify the values for the following ANS 5.1 input parameters:

    1. Q (total recoverable energy) = (MeV/fission)
    2. δQ (net recoverable energy) = (MeV/fission)
    3. P (total power from fissioning of one nuclide) = (MeV/sec)
    4. δP (new power from fissioning of nuclide) = (MeV/sec)
    5. Fractional fission product power for: U235, U238, Pu239, and Pu241
    6. R-factor (the actinide production multiplier)
    7. G-factor (a decay heat multiplier to account for the effect of neutron capture in fission products)
    8. Si (a multiplier applied to the G-factor equation

4. Provide the value used for estimating the length of time of full power operation before shutdown.

5. Justify that your use of the ANS 5.1 analyses is conservative by showing that at least two standard deviations of confidence in your analyses results is provided.

6. Were the contributions to the decay heat from U-239 and Np-239 calculated in accordance with Branch Technical Position ASB 9-2? If not, provide the equation used to calculate them.

Response

1. The ANS 5.1-1979 decay heat model, with no adders, was used by General Electric in the containment pressure and temperature analysis originally submitted by NSP on January 23, 1997. Previous analyses used the May-Witt decay heat model.

A new analysis has been completed by General Electric which includes the appropriate baseline and benchmark analyses for the new computer codes and decay heat model used. The reanalysis is contained in General Electric Report GE-NE-T2300731-2, "Monticello Nuclear

Generating Plant LOCA Containment Analysis for Use in Evaluation of NPSH for the RHR and Core Spray Pumps," June, 1997. This report is included as Exhibit D.
Refer to Exhibit D.

2 - 6. In response to NRC concerns related to the sensitivity of ANS 5.1-1979 to input parameters and the confidence level of the results, the containment pressure and temperature analysis has been revised. The analysis was performed at a power level of 1880 Mwt to provide assurance that the results are conservative with respect to selection of input parameters and confidence level. Refer to Exhibit D.

This approach was discussed with the NRC Staff during a telephone conference call on May 22, 1997. The analysis performed at 1880 Mwt bounds an analysis performed at the current license power level of 1670 Mwt plus two sigma.

Exhibit J

Monticello Nuclear Generating Plant

Revision No. 2 to License Amendment Request Dated January 23, 1997

Response to NRC Request for Additional Information dated May 13, 1997

1. Please specify the amount of containment overpressure necessary to meet both short- and long-term NPSH (net positive suction head) requirements for all four cases provided in the March 4, 1997 submittal.

2. Provide the minimum containment pressure analyses that support the amount of containment overpressure assumed in the NPSH calculations. If new code is used for the containment pressure analyses, then the new code should be benchmarked against a code that has been approved by the staff. Results from such benchmarking studies should be provided for staff review.

3. Has the operation of containment sprays been factored into the assumption of containment overpressure?

4. How much of an impact will the higher than rated pump flow have on the brake horsepower requirements for the core spray and LPCI (low pressure core injection) pump motors?

Response

1 - 3. Refer to the two new attached reports related to analysis of containment pressure and temperature response and ECCS pump NPSH requirements:

Exhibit D - General Electric Report GE-NE-T2300731-2, "Monticello Nuclear Generating Plant LOCA Containment Analysis For Use in Evaluation of NPSH for the RHR and Core Spray Pumps," June, 1997

Exhibit E - Duke Engineering & Services Calculation Package V75100.NSP97.00501, "Determination of Containment Overpressure Required for Adequate NPSH of the Low Pressure ECCS Pumps," June 18, 1997

4. Per the pump curves for the ECCS pumps, it is evident that the higher than rated pump flows result in brake horsepower requirements which are equal to or slightly less than the rated horsepower of the motors. Furthermore, the electrical input power to the motors of these pumps when pumping the specified higher than rated pump flows is less than the values analyzed for in Table 8.4-2 of the USAR for Standby Diesel -Generator System Emergency Loads for these pumps.

Data Summary

Pump	Limiting Flow Rate	BHP	Efficiency	Electrical Input Power (kw)	USAR 8.4-2 Electrical Input Power (kw)
11 RHR	4292 gpm	575 hp	0.93	462 kw	497 kw
12 RHR	4289 gpm	575 hp	0.93	462 kw	497 kw
13 RHR	4344 gpm	600 hp	0.95	472 kw	497 kw
14 RHR	4308 gpm	575 hp	0.945	454 kw	497 kw
11 CS	4298 gpm	800 hp	0.95	629 kw	663 kw
12 CS	4218 gpm	800 hp	0.94	636 kw	663 kw

Inputs

1. Limiting flow rates in Calculation CA-97-163 were applied to the pump curves for the specific pumps to determine brake horsepower requirements under the high flow rate conditions. Limiting flow rates are the flow rates which require the highest brake horsepower. In some cases, lower flow rates which require more brake horsepower were used.

2. Brake horsepower requirements are from the pump curves for the subject pumps.

3. Efficiencies utilized are in agreement with those determined in Condition Report 96001901, "Clarification of ECCS Motor operating horsepower."

4. Electrical Input Power (kw) = (BHP/efficiency) X 0.7459 kw/hp.