PREPARATION, REVIEW AND APPROVAL OF CALCULATIONS

CALCULATION TITLE PAGE

ComEd

STATION Quad Cities Units 1 and 2

Calculation No: QDC-1000-M-0454

DESCRIPTION CODE: M10
DISCIPLINE CODE: M
SYSTEM CODE: RH

TITLE: Short Term RHR/Core Spray Pump NPSH Analysis - Design Basis LOCA

X **Safety Related** ____ **Augmented Quality** ____ **Non-Safety Related**

REFERENCE NUMBERS

Type	Number	Type	Number
~~CALC~~	~~QDC-1000-M-0291~~ D 9/28/98		
CALC	QDC-1000-M-0419		
~~CALC~~	~~DRE-97-0012~~ DFC 9/28/98		

A complete list of References can be found in Section 5 of this calculation.

COMPONENT EPN: / **DOCUMENT NUMBERS:**

EPN	Compt Type	Doc Type/SubType	Document Number
1(2)-1002A/B	Pumps		
1(2)-1002C/D	Pumps		
1(2)-1401A/B	Pumps		

REMARKS: This calculation supersedes Calc. No. QDC-1000-M-0291 in its entirety.

REV. NO.	REVISING ORGANIZATION	APPROVED PRINT/SIGN	DATE
0	COMED	STEVE BOLINE / [signature]	12/23/97
1	COMED	STEVE BOLINE / [signature]	9/29/98

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CALCULATION REVISION PAGE

CALCULATION NO. QDC-1000-M-0454 PAGE NO.: 2

REVISION SUMMARIES

REV: 0

REVISION SUMMARY:
Initial Issue

Electronic Calculation Data Files:
(Program Name, Version, File name ext/size/date/hour/: min)
SEE REV. 0.

Prepared by: Douglas F. Collins / SIGNATURE ON FILE 12/23/97
Print/Sign Date

Reviewed by: Roger H. Heyn / SIGNATURE ON FILE 12/23/97
Print/Sign Date

Type of Review
[X] Detailed [ ] Alternate [ ] Test

Supplemental Review Required [ ] Yes (NEP-12-05 documentation attached) [X] No
Supervisor N/A /

DO ANY ASSUMPTIONS IN THIS CALCULATION REQUIRE LATER VERIFICATION [X] YES [ ] NO
Tracked by: 2542519715701

REV: 1

REVISION SUMMARY:
This revision incorporates the results of the 1998 containment analysis, and provides time-dependent curves of the required containment pressure. Rev. 1 supersedes Rev. 0 in its entirety.

Electronic Calculation Data Files:
(Program Name, Version, File name ext/size/date/hour/: min)
PIPE-FLO. Ver. 4.11, SHORT.PLL / 36 KB / 09-25-98 / 10:03AM
LSL-3RHR.PLU/ 36 KB / 09-25-98 / 01:49PM
SF-DG.PLU / 36 KB / 09-25-98 / 01:50PM
SHRT-NEW.PLU / 36 KB / 09-25-98 / 01:51PM
LSL-FULL.PLU / 36 KB / 09-25-98 / 01:48PM
LSL-CAV.PLU / 36 KB / 09-25-98 / 01:49PM
SHRT-NEW.PLL / 135 KB / 09-25-98 / 10:07AM
LSL-FEW.PLL/ 36 KB / 09-29-98 / 07:24AM

Prepared by: Douglas F. Collins Douglas F Collins 09/28/98
Print/Sign Date

Reviewed by: Roger H. Heyn Roger H Heyn 9-28-98
Print/Sign Date

Type of Review
[X] Detailed [ ] Alternate [ ] Test

Supplemental Review Required [ ] Yes (NEP-12-05 documentation attached) [X] No
Supervisor [signature] / 9/28/98

DO ANY ASSUMPTIONS IN THIS CALCULATION REQUIRE LATER VERIFICATION [ ] YES [X] NO
Tracked by:

Exhibit D
NEP-12-02
Revision 6

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1. PURPOSE/OBJECTIVE

The purpose of this calculation is to determine if sufficient net positive suction head (NPSH) is available to the Residual Heat Removal (RHR) pumps and the Core Spray (CS) pumps following a Design Basis Loss of Coolant Accident (DBA-LOCA). This will be accomplished by developing a time-dependent set of curves comparing the available containment pressure to the pressure required to satisfy the RHR/CS pump NPSH requirements. This calculation is limited to the first 600 seconds of the accident, during which no credit is taken for operator action. The results of this calculation will be used to support a Quad Cities License Amendment request. Upon approval of this request, this calculation will represent a Design Basis Document.

2. METHODOLOGY AND ACCEPTANCE CRITERIA

This calculation will utilize a FLO-SERIES hydraulic model of the RHR and CS suction and discharge piping (Ref. 5.1) to develop a time-dependent set of curves comparing the available containment pressure to the pressure required to satisfy the RHR/CS pump NPSH requirements.

NPSH required (NPSHR) curves for the LPCI/CS pumps are provided on the original vendor pump curves (attached to Ref. 5.1). These curves represent the point at which a 3% reduction in pump developed head has occurred due to insufficient NPSH available (NPSHA). Cavitation tests were performed on this pump model by the vendor at various flow rates (Ref. 5.9). These tests demonstrate that the pumps can operate in cavitation for at least one hour without any damage to pump internals or any degradation of pump performance. These tests also demonstrate that the pump head remains stable for NPSHA values several feet below the NPSHR before the pump head collapses. For the purposes of this calculation, the pump head will conservatively be assumed to collapse when NPSHA is equal to NPSHR (Assumption 3.6).

Per Ref. 5.12, the two most limiting single failures with respect to Peak Clad Temperature (PCT) are:

1) <u>SF-LPCI: Failure of LPCI</u>
   This case results in only two CS pumps injecting into the reactor vessel.

2) <u>SF-DG: Failure of a Diesel Generator</u>
   This case results in one CS pump and two RHR pumps injecting into the reactor vessel.

For the LPCI failure, this calculation will use a failure of the LPCI loop select logic (SF-LSL), which causes all 4 RHR pumps to inject into the broken Reactor Recirculation loop. This flow case will yield the highest flow rates through the ECCS suction piping, and thus the bounding NPSH case for the CS pumps. The SF-DG case leads to the highest RHR flow rate per pump and, thus, is the bounding NPSH case for RHR.

For the SF-LSL case, due to the higher flow rates of the CS pumps in the short term, they will cavitate before the RHR pumps will. The flow through the CS pumps is also the main concern in the analysis of the SF-LSL case. All RHR pumps are assumed to discharge to the drywell through the broken Reactor Recirculation line, and the only cooling water to reach the reactor vessel is assumed to come from the CS system.

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RHR/CS pump flow requirements are as follows:

Failure 1: SF-LSL

- For the SF-LSL case, a two-pump CS flow of ≥11,300 gpm is required for approximately the first 180 seconds post-LOCA to maintain the PCT within acceptable limits. For the purposes of this calculation, a two-pump CS flow requirement of ≥11,300 gpm for the first 210 seconds will conservatively be used.

- After PCT has been achieved, a two-pump CS flow of ≥9,000 gpm (nominal flow) is required for reflooding purposes. Per Ref. 5.11, with 9,000 gpm of flow into the core, the core is reflooded at 7.5 minutes Following core reflood, a flow rate of 2,200 gpm is required into the core. For the purposes of this calculation, a two-pump flow rate of ≥9,000 gpm is required between 210 and 600 seconds.

Failure 2: SF-DG

- For the SF-DG case, a two-pump RHR flow of ≥9,000 gpm and a single CS pump flow of ≥5,650 gpm are required for approximately the first 180 seconds post-LOCA to maintain the PCT within acceptable limits. For the purposes of this calculation, a two-pump RHR flow requirement of ≥9,000 gpm and a single CS pump flow requirement of ≥5,650 gpm for the first 210 seconds will conservatively be used.

- After PCT has been achieved, the flow entering the core is needed only for reflood (level) purposes. Therefore, the SF-DG case has the same total ECCS flow requirement as the SF-LSL case above, which is a combined RHR/CS flow of ≥9,000 gpm between 210 and 600 seconds.

This calculation is conservative due to the use of the following inputs:

- Maximum suppression pool temperature response – Refs. 5.2 and 5.3 determine the maximum suppression pool temperatures post-LOCA, thus maximizing the vapor pressure and minimizing NPSH margin.

- Minimum suppression pool pressure response – the credited pool pressure response was developed based on a minimum pressure response generated by General Electric (GE) (Refs. 5.2 and 5.3). The GE pressure response utilizes inputs and assumptions that minimize suppression chamber pressures consistent with NRC Information Notice 96-55, thus minimizing overpressure credit and minimizing NPSH margin.

- Technical Specifications minimum suppression pool level including maximum drawdown, minimizing elevation head and minimizing NPSH margin.

- Maximum LPCI and CS pump flow conditions (unthrottled system, reactor/drywell differential pressure at 0 psid), maximizing suction piping friction losses and NPSH Required (NPSHR).

- Increased clean commercial steel suction pipe length by 20% to account for potential aging effects (Assumption 3.1 in Ref. 5.1), thus maximizing suction losses.

Per Equation 5.2 on page 66 of Ref 5.8, the equation for NPSHA is as follows:

$$NPSHA = h_{psa} + Z - h_f - h_{vpa} \qquad \text{(Eq. 1)}$$

Where:

h_{psa} = Suppression chamber pressure, feet absolute.
Z = Static head above pump, feet.
h_f = Suction friction losses, feet.
h_{vpa} = Vapor pressure, feet absolute.

This equation can be rewritten in terms of the suppression chamber pressure, and the minimum suppression chamber pressure required is that which will yield a value of NPSHA that is equal to the NPSHR. Thus:

$$h_{psa} = NPSHR - Z + h_f + h_{vpa} \qquad \text{(Eq. 2)}$$

Or this equation can be written to solve for the suppression chamber pressure in units of psia:

$$P_{min} = (NPSHR - Z + h_f + h_{vpa})/(144V) \qquad \text{(Eq. 3)}$$

Where:

P_{min} = Minimum Required Suppression Chamber Pressure, psia.
V = Specific volume, ft^3/lb.

The value of P_{min} for each flow case will be plotted as a function of time and compared to the Available and Credited Pressure in the Suppression Chamber (See Assumption 3.6).

3. ASSUMPTIONS/ENGINEERING JUDGEMENTS

3.1 RHR/CS pump suction losses were developed using a FLO-SERIES model of the Quad Cities ECCS ring header and pump suction piping (Ref. 5.1). This piping model was then run at the various RHR/CS pump combinations and flows required to support the cases evaluated in this calculation (Attachment A). The model was developed using clean commercial steel pipe. In order to compensate for the increased loss due to the potential effects of aging, the piping lengths of the suction lines were increased by 20%. This 20% addition is consistent with guidance on the GE Process Flow Diagrams. An example can be found in Note 2 of Ref. 5.17. Other assumptions in the model can be found in Ref. 5.1.

3.2 To account for strainer plugging, one of the four suction strainers inside the torus is assumed 100% blocked, while the remaining three strainers are assumed clean (Refs. 5.5 and 5.6). For each flow case, the strainer nearest the pump with the lowest differential between NPSHA and NPSHR will be considered blocked.

3.3 Per Ref. 5.1, the RHR/CS discharge piping is modeled such that the flow rate through these lines is maximized. This assumption is conservative since this assumption will lead to the maximum flow rates through the systems and will maximize NPSHR and minimize NPSHA.

3.4 The maximum allowable leakage from the CS nozzle safe end is 200 gpm (Ref. 5.16). This flow is modeled in the flow model exiting the CS nozzle and bypassing the CS sparger. This assumption is conservative since it leads to the highest flow rates through the CS pumps.

3.5 GE SIL 151 includes a case of all 4 RHR pumps injecting into both reactor recirculation loops simultaneously, with one loop broken. While it is expected that this case may result in slightly higher LPCI pump flow rates than the case being evaluated, a significant amount of water will be injected into the reactor through the intact loop. Therefore, any reduction in CS system flow due to cavitation below the minimum required flow will be made up by the LPCI flow injecting into the reactor. Therefore, it is expected that the PCT will not be challenged in this case and it will not be explored in this calculation.

3.6 The short term suppression chamber pressure responses from the containment analyses (Refs. 5.2 and 5.3) are contained in Figures 1 and 2 along with the assumed pressure response which is modeled as a time-dependent step function, consistent with the NRC-approved methodology from Dresden station. The assumed (credited) pressure response was determined in Design Input 4.2 such that it is conservatively bounded by the available pressure response from Refs. 5.2 and 5.3. The containment analyses incorporate assumptions to minimize containment overpressure that are consistent with NRC Information Notice 96-55. This data will predict the minimum available overpressure and will, therefore, be conservative.

3.7 Based on a review of Ref. 5.1, there is less resistance in the RHR injection line to loop A of Reactor Recirculation. This calculation will assume RHR injection into the A loop to maximize the flows through the RHR system. Ref. 5.3 is based on a Recirculation suction line break. The model assumes a discharge line break which will also serves to maximize flow rates.

4. DESIGN INPUT

4.1 This calculation uses an approved FLO-SERIES model of the ECCS piping generated by Calculation No. QDC-1000-M-0419 (Ref. 5.1)

4.2 Per the results of the containment analyses contained in Refs. 5.2 and 5.3, the available pressure response in the short term conservatively bounds the following values (see Figures 1 and 2):

Time (sec)	Credited Pressure (psig)
0 – 210	8.0
210 – 600	2.5

4.3 NPSHR values at various RHR/CS pump flow rates are taken from the NPSHR curves provided on the manufacturer's pump curves attached to Ref. 5.1. These values are summarized in the following table:

Pump Flow (gpm)	NPSHR (feet)
4000	25.0
5000	30.0
6012	40.9

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Quadratic interpolation of these three points yields a curve fit for the NPSHR versus flow rate (Q) of:

$NPSHR = (2.868\times10^{-6})Q^2 - (0.02081)Q + 62.35$ (Attachment C)

4.4 The pressure/temperature responses of containment predicted by Refs. 5.2 and 5.3 are contained in Tables 1A, 1B and 2 and Figures 1 and 2 on pages 11 - 15.

4.5 Saturation pressures and specific volumes at various temperatures are taken from Ref. 5.15 and are included in Tables 1A , 1B and 2.

4.6 The maximum drawdown of the suppression chamber water level post-LOCA is 2.1 ft (Ref 5.4). Applying this drawdown to the minimum water level allowed by Technical Specifications used in the model from Ref. 5.1 yields a water elevation of 568.5 ft.

4.7 The flow requirements for the RHR and CS pumps post-LOCA were determined from Refs. 5.11 - 5.14.

5. REFERENCES

5.1 Calculation No. QDC-1000-M-0419, Rev. 1, "Flow Model of Emergency Core Cooling System (ECCS) Suction Piping with Core Spray and Residual Heat Removal (RHR) Discharge Piping."

5.2 "Quad Cities Nuclear Power Station Units 1 and 2 Containment Analysis for Long-Term NPSH Evaluation with ANS 5.1-1979 + 2 Sigma Decay Heat," General Electric Nuclear Energy Report GE-NE-T2300750-00-02-R1, September 1998.

5.3 "Quad Cities Nuclear Power Station Units 1 and 2 Containment Analysis for Short-Term NPSH Evaluation with ANS 5.1-1979 + 2 Sigma Decay Heat," General Electric Nuclear Energy Report GE-NE-T2300750-00-03, September 1998.

5.4 GE Letter - S. Mintz to S. Eldridge dated September 24, 1992 (Attachment B).

5.5 UFSAR, Rev. 4, Section 6.2.2.3, "Containment Heat Removal Systems - Design Evaluation."

5.6 UFSAR, Rev. 4, Section 6.3, "Emergency Core Cooling System."

5.7 Calculation No. QDC-0010-M-0396, Rev. 0, "Quad Cities Unit 2 - ECCS Strainer Head Loss Estimate."

5.8 Calculation No. QDC-1600-M-0545, Rev. 0, "Quad Cities Unit 1 - ECCS Strainer Head Loss Estimate."

5.9 Cavitation Test Report - 12x14x14-1/2 CVDS Pump," Bingham Pump Co., May 22, 1969.

5.10 Durco Pump Engineering Manual - 4th Edition.

5.11 Nuclear Fuels Services NDIT No. 9800039, "ECCS Flow to Meet 10 CFR 50.46 Core Cooling Requirements of a DBA LOCA for Short Term and Long Term."

5.12 "LOCA Break Spectrum Analysis for Quad Cities Units 1 and 2," Siemens Document EMF-96-184(P) - Siemens Power Corporation, dated December 1996.

5.13 Principal LOCA Analysis Parameters for Quad Cities Units 1 and 2, EMF-95-165 - Siemens Power Corporation.

5.14 "Long Term Cooling of the Reactor Cores of the Dresden and Quad Cities Nuclear Plants Following Postulated Design Basis Accidents (DBA)." GE letter DRF:T23-685, to K. Ramsden (ComEd) from R. Muralidharan (GE), dated February 12, 1993.

5.15 Keenan, et. al. *Steam Tables*, Wiley: New York: 1969.

5.16 SESR Number 4-0496

5.17 Duke Engineering and Services Report No. TR-VQ1500-02, Rev. 0.

5.18 General Electric Process Flow Diagram No. 161F312, Rev. 1.

5.19 SESR Number 4-0496

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6. CALCULATIONS

The equation (Eq. 3) presented in Section 2.4 provides the minimum pool pressure required to meet pump NPSH requirements:

$$P_{min} = (NPSHR - Z + h_f + h_{vps})/(144V) \quad \text{(Eq. 3)}$$

Solving Eq. 3, the minimum suppression chamber pressure required to meet RHR and CS pump NPSH requirements for the SF-LSL case is calculated (Tables 1A and 1B). Similarly, the minimum chamber pressure required to meet RHR and CS pump NPSH requirements for the SF-DG case is calculated (Table 2). These results are plotted in Figures 1 and 2, along with the credited suppression chamber pressure. The GE available chamber pressure response for each case is also provided (Refs. 5.2 and 5.3).

It can be seen that for both cases, no cavitation is expected for the first 210 seconds post-LOCA. During this time, the RHR/CS pumps will deliver maximum flow. Since PCT occurs at time < 210 seconds, adequate flow will exist to ensure no impact on PCT. After 210 seconds, the RHR/CS pumps may cavitate, resulting in reduced flows.

For the SF-LSL case, the maximum NPSH deficit of 11.29 feet occurs at the 600 second mark of the 4/2 case. In order to estimate the reduced flow at which the CS pumps will operate under these conditions, a flow estimate of 5400 gpm per CS pump is used in conjunction with Eq. 3:

CS Pump Flow (gpm)	Pool Temp. (°F)	$Z - h_f$ (feet)	Vapor Pressure (feet)	Specific Volume (ft3/lb)	CS Pump NPSHR (feet)	Required Torus Pressure (psig)	Credited Torus Pressure (psig)	Available Torus Pressure (psig)	CS NPSH Margin (feet)
6202	150.7	0.74	8.91	0.016347	43.60	7.29	2.50	3.40	-11.29
5400	150.7	2.34	8.91	0.016347	33.61	2.37	2.50	3.40	0.31

Since the NPSH margin at 5400 gpm is approximately 0 feet, it is at this flow that the NPSHA equals the vendor published NPSHR. Under this NPSH condition, the pump exhibits incipient cavitation but is not yet in the full cavitation stage. As full cavitation and total head collapse have not yet been achieved, pump flow will continue to increase, i.e. the pump is expected to operate above 5400 gpm. It is therefore conservative to use the flow at which NPSHA equals NPSHR to bound the minimum flow rate at which the CS pump will operate. Thus, under the most limiting scenario for NPSH, CS pump flow will reduce from ≥5,650 gpm per pump at time ≤ 210 seconds to a minimum flow of about 5400 gpm per pump at 600 seconds post-LOCA.

For the SF-DG case, the 2 RHR and 1 CS pumps must produce 9,000 gpm total, or 3,000 gpm per pump. Based on the NPSH deficiencies determined in Table 2, and the reduced flow calculation above, it is obvious that this flow requirement can easily be met.

New Strainer Design Basis

The current Quad Cities design basis for strainer blockage is one strainer blocked and 3 strainers clean (Assumption 3.2, Ref. 5.6). In response to NRC Bulletin 96-03, Quad Cities plans to revise this design basis to four partially clogged strainers, with the head loss associated with the new strainers (Ref. 5.17) and the debris loading as modeled in Ref. 5.7 – 5.8. (This model is attached as file SHRT_NEW.PLL) This possible, future design basis would increase the NPSH margin in the short term, as demonstrated in Attachment D. However, currently, one strainer completely blocked and three strainers clean is the Quad Cities strainer debris loading design basis.

Containment Pressure Required to Assure PCT

Attachment E provides a curve of the containment pressure required to ensure CS flow of 5650 gpm per pump during the first 210 seconds for the limiting single failure (SF-LSL). The maximum required pressure of 3.1 psig is well less than the 8 psig credited for the first 210 seconds post-LOCA.

7. SUMMARY AND CONCLUSIONS

This NPSH analysis was performed for the CS/RHR pumps under short-term design basis post-accident conditions. Specifically, two limiting single failures for the accident were modeled. A failure of LPCI loop select logic causing all RHR pumps to inject into the broken Reactor Recirculation loop was analyzed as well as a failure of a diesel generator. The analysis concludes that the pumps will supply the required flows for the first 210 seconds without cavitating. From 210 seconds to 600 seconds into the accident, the pumps may begin to cavitate, but they will be able to supply the required flow to the reactor. The total time that any of the pumps may cavitate is possibly 6.5 minutes, which is significantly less than the one hour allowed in section 2.0.

Therefore, there is sufficient NPSHA to ensure the ability of the RHR/CS pumps to perform their safety function under all accident scenarios.

Table 1A

SF-LSL: 4 RHR/2 CS Injection						RHR					CS				
Time (sec)	Available Pool Pressure (psig)	Credited Pool Pressure (psig)	Pool Temp (deg. F)	Specific Volume (ft^3/lb)	P_v (psia)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)
12	21.6	8.0	112.6	0.016175	1.376										
38	23.4	8.0	132.7	0.016260	2.391										
47	23.2	8.0	133.6	0.016263	2.448	5121	30.99	-3.60	2.52	12.84	6202	43.60	0.74	6.05	4.57
60	23.1	8.0	133.6	0.016263	2.448	5121	30.99	-3.60	2.52	12.84	6202	43.60	0.74	6.05	4.57
80	20.8	8.0	134.2	0.016266	2.487	5121	30.99	-3.60	2.55	12.75	6202	43.60	0.74	6.09	4.48
109	18.3	8.0	135.7	0.016274	2.587	5121	30.99	-3.60	2.65	12.54	6202	43.60	0.74	6.18	4.27
129	16.8	8.0	137.4	0.016281	2.704	5121	30.99	-3.50	2.76	12.29	6202	43.60	0.74	6.29	4.02
146	15.3	8.0	138.6	0.016287	2.789	5121	30.99	-3.60	2.84	12.11	6202	43.60	0.74	6.36	3.84
166	13.5	8.0	140.3	0.016295	2.915	5121	30.99	-3.60	2.96	11.84	6202	43.60	0.74	6.48	3.57
188	11.3	8.0	141.8	0.016302	3.029	5121	30.99	-3.60	3.06	11.59	6202	43.60	0.74	6.59	3.32
209	9.2	8.0	142.8	0.016307	3.106	5121	30.99	-3.60	3.14	11.42	6202	43.60	0.74	6.66	3.15
239	6.9	2.5	143.9	0.016313	3.195	5121	30.99	-3.60	3.22	-1.69	6202	43.60	0.74	6.74	-9.96
276	5.2	2.5	145.1	0.016319	3.293	5121	30.99	-3.60	3.31	-1.91	6202	43.60	0.74	6.83	-10.18
311	4.2	2.5	146.0	0.016323	3.368	5121	30.99	-3.60	3.38	-2.08	6202	43.60	0.74	6.90	-10.35
352	[illegible]	2.5	147.0	0.016328	3.454	5121	30.99	-3.60	3.47	-2.27	6202	43.60	0.74	6.98	-10.54
394	3.1	2.5	147.7	0.016332	3.515	5121	30.99	-3.60	3.52	-2.41	6202	43.60	0.74	7.04	-10.68
441	3.1	2.5	148.4	0.016335	3.577	5121	30.99	-3.60	3.58	-2.55	6202	43.60	0.74	7.10	-10.82
491	3.2	2.5	149.2	0.016339	3.648	5121	30.99	-3.60	3.65	-2.70	6202	43.60	0.74	7.16	-10.97
516	3.3	2.5	149.5	0.016341	3.676	5121	30.99	-3.60	3.68	-2.77	6202	43.60	0.74	7.19	-11.04
566	3.3	2.5	150.2	0.016344	3.741	5121	30.99	-3.60	3.74	-2.91	6202	43.60	0.74	7.25	-11.18
600	3.4	2.5	150.7	0.016347	3.787	5121	30.99	-3.60	3.78	-3.02	6202	43.60	0.74	7.29	-11.29

Table 1B

SF-LSL: 3 RHR/2 CS Injection						RHR					CS				
Time (sec)	Available Pool Pressure (psig)	Credited Pool Pressure (psig)	Pool Temp (deg. F)	Specific Volume (ft^3/lb)	P_V (psia)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)
12	21.6	8.0	112.6	0.016175	1.376										
38	23.4	8.0	132.7	0.016260	2.391										
47	23.2	8.0	133.6	0.016263	2.448	5508	34.74	-3.02	3.87	9.67	6212	43.75	2.62	5.31	6.30
60	23.1	8.0	133.6	0.016263	2.448	5508	34.74	-3.02	3.87	9.67	6212	43.75	2.62	5.31	6.30
80	20.8	8.0	134.2	0.016266	2.487	5508	34.74	-3.02	3.91	9.58	6212	43.75	2.62	5.35	6.21
109	18.3	8.0	135.7	0.016274	2.587	5508	34.74	-3.02	4.00	9.37	6212	43.75	2.62	5.44	6.00
129	16.8	8.0	137.4	0.016281	2.704	5508	34.74	-3.02	4.11	9.12	6212	43.75	2.62	5.55	5.75
146	15.3	8.0	138.6	0.016287	2.789	5508	34.74	-3.02	4.19	8.94	6212	43.75	2.62	5.63	5.57
166	13.5	8.0	140.3	0.016295	2.915	5508	34.74	-3.02	4.31	8.67	6212	43.75	2.62	5.74	5.30
188	11.3	8.0	141.8	0.016302	3.029	5508	34.74	-3.02	4.41	8.42	6212	43.75	2.62	5.85	5.05
209	9.2	8.0	142.8	0.016307	3.106	5508	34.74	-3.02	4.49	8.25	6212	43.75	2.62	5.92	4.88
239	6.9	2.5	143.9	0.016313	3.195	5508	34.74	-3.02	4.57	-4.86	6212	43.75	2.62	6.00	-8.23
276	5.2	2.5	145.1	0.016319	3.293	5508	34.74	-3.02	4.66	-5.08	6212	43.75	2.62	6.10	-8.45
311	4.2	2.5	146.0	0.016323	3.368	5508	34.74	-3.02	4.73	-5.25	6212	43.75	2.62	6.17	-8.62
352	3.4	2.5	147.0	0.016328	3.454	5508	34.74	-3.02	4.81	-5.44	6212	43.75	2.62	6.25	-8.81
394	3.1	2.5	147.7	0.016332	3.515	5508	34.74	-3.02	4.87	-5.58	6212	43.75	2.62	6.30	-8.95
441	3.1	2.5	148.4	0.016335	3.577	5508	34.74	-3.02	4.93	-5.72	6212	43.75	2.62	6.36	-9.09
491	3.2	2.5	149.2	0.016339	3.648	5508	34.74	-3.02	5.00	-5.87	6212	43.75	2.62	6.43	-9.24
516	3.3	2.5	149.5	0.016341	3.676	5508	34.74	-3.02	5.02	-5.94	6212	43.75	2.62	6.46	-9.31
566	3.3	2.5	150.2	0.016344	3.741	5508	34.74	-3.02	5.08	-6.08	6212	43.75	2.62	6.52	-9.45
600	3.4	2.5	150.7	0.016347	3.787	5508	34.74	-3.02	5.13	-6.19	6212	43.75	2.62	6.56	-9.56

Table 2

SF-DG: 2 RHR/1 CS Injection					RHR					CS				
Time (sec)	Credited Pool Pressure (psig)	Pool Temp (deg. F)	Specific Volume (ft^3/lb)	P_v (psia)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)
12	8.0	112.6	0.016175	1.376										
38	8.0	132.7	0.016260	2.391										
47	8.0	133.6	0.016263	2.448	5745	37.45	0.84	3.38	10.82	6229	44.00	6.98	3.56	10.41
60	8.0	133.6	0.016263	2.448	5745	37.45	0.84	3.38	10.82	6229	44.00	6.98	3.56	10.41
80	8.0	134.2	0.016266	2.487	5745	37.45	0.84	3.42	10.73	6229	44.00	6.98	3.59	10.32
109	8.0	135.7	0.016274	2.587	5745	37.45	0.84	3.51	10.52	6229	44.00	6.98	3.68	10.11
129	8.0	137.4	0.016281	2.704	5745	37.45	0.84	3.62	10.27	6229	44.00	6.98	3.79	9.86
146	8.0	138.6	0.016287	2.789	5745	37.45	0.84	3.70	10.09	6229	44.00	6.98	3.87	9.68
166	8.0	140.3	0.016295	2.915	5745	37.45	0.84	3.82	9.82	6229	44.00	6.98	3.99	9.41
188	8.0	141.8	0.016302	3.029	5745	37.45	0.84	3.92	9.57	6229	44.00	6.98	4.10	9.16
209	8.0	142.8	0.016307	3.106	5745	37.45	0.84	4.00	9.40	6229	44.00	6.98	4.17	8.99
239	2.5	143.9	0.016313	3.195	5745	37.45	0.84	4.08	-3.71	6229	44.00	6.98	4.25	-4.12
276	2.5	145.1	0.016319	3.293	5745	37.45	0.84	4.17	-3.93	6229	44.00	6.98	4.35	-4.34
311	2.5	146.0	0.016323	3.368	5745	37.45	0.84	4.24	-4.10	6229	44.00	6.98	4.42	-4.51
352	2.5	147.0	0.016328	3.454	5745	37.45	0.84	4.32	-4.29	6229	44.00	6.98	4.50	-4.70
394	2.5	147.7	0.016332	3.515	5745	37.45	0.84	4.38	-4.43	6229	44.00	6.98	4.56	-4.84
441	2.5	148.4	0.016335	3.577	5745	37.45	0.84	4.44	-4.57	6229	44.00	6.98	4.62	-4.98
491	2.5	149.2	0.016339	3.648	5745	37.45	0.84	4.51	-4.72	6229	44.00	6.98	4.68	-5.13
516	2.5	149.5	0.016341	3.676	5745	37.45	0.84	4.53	-4.79	6229	44.00	6.98	4.71	-5.20
566	2.5	150.2	0.016344	3.741	5745	37.45	0.84	4.60	-4.93	6229	44.00	6.98	4.77	-5.34
600	2.5	150.7	0.016347	3.787	5745	37.45	0.84	4.64	-5.04	6229	44.00	6.98	4.81	-5.45

Figure 1 - SF-LSL

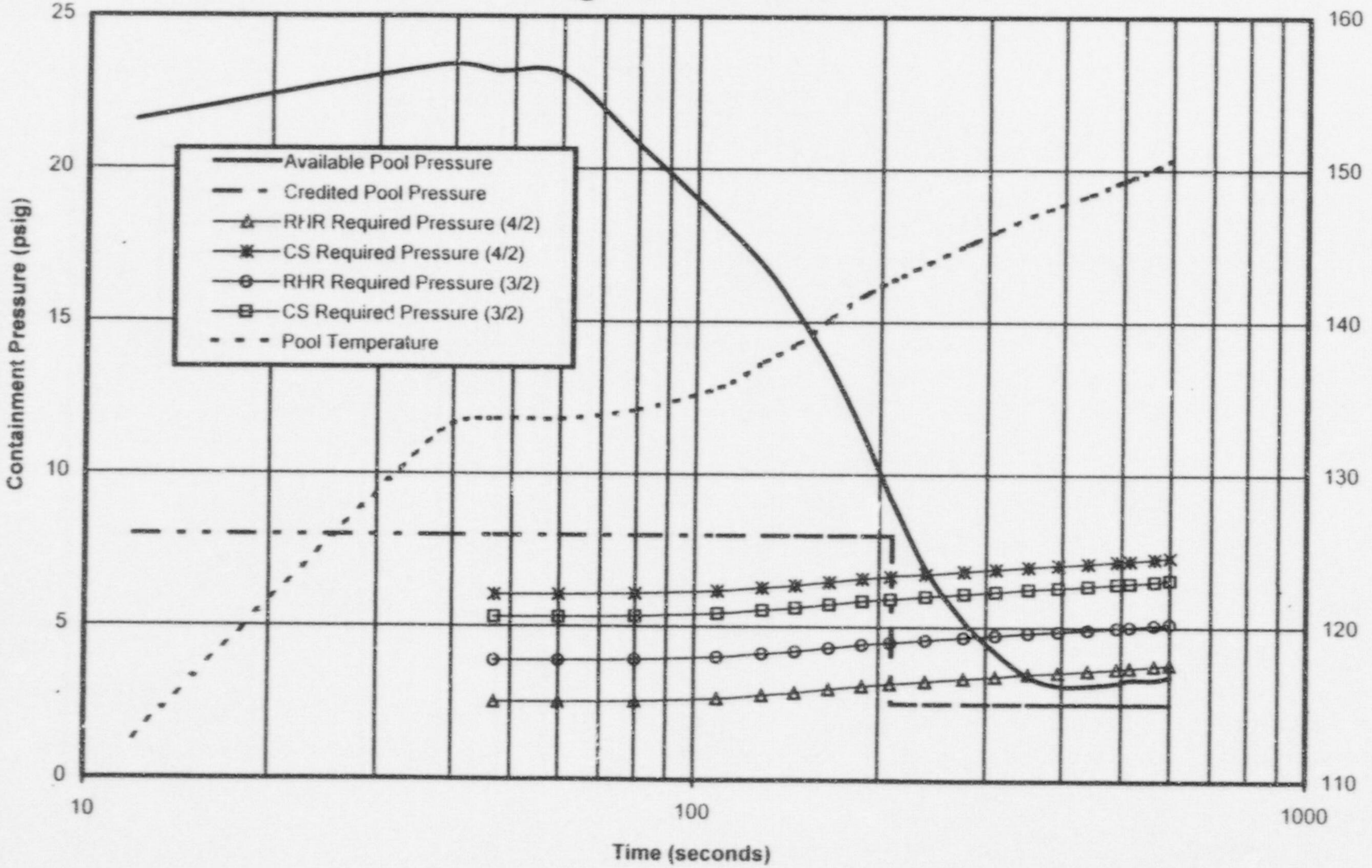
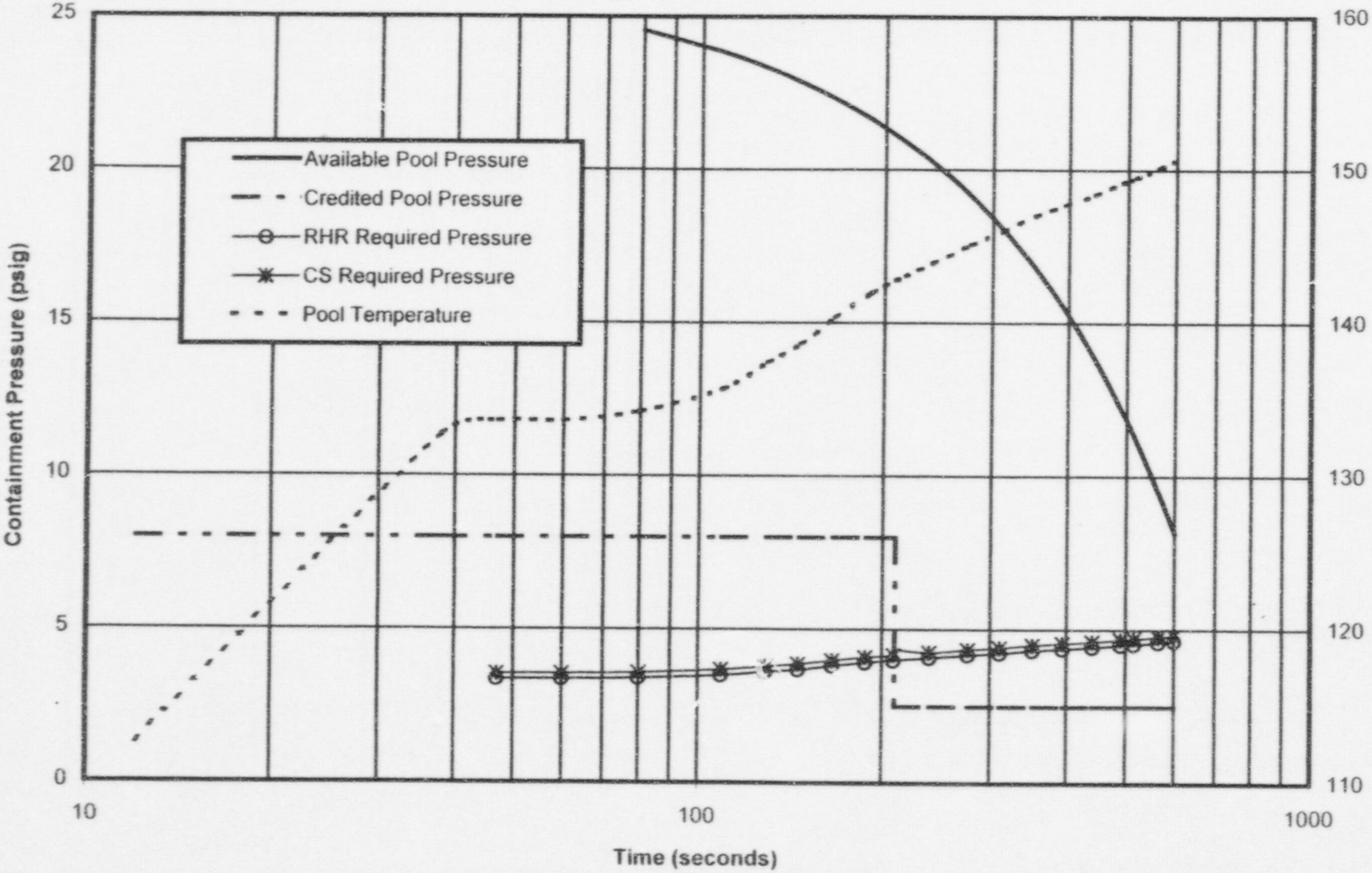


Figure 2 - SF-DG



Company: ComEd
Project:
by: Doug Collins

LSL-FULL
09/25/98

LINEUP REPORT rev: 09/25/98

LINELIST: SHORT
dated: 09/25/98

DEVIATION: 0.00012 %
after: 12 iterations

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

NODE		DEMAND gpm	NODE		DEMAND gpm
InletA	>>>	200	InletB	>>>	200

FLOWS IN: 0 gpm
FLOWS OUT: 400 gpm
NET FLOWS OUT: 400 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
Break-A	>>>	20084	>>>	Break-A	14.7
SpargerA	>>>	6002	>>>	CSOutA	14.7
SpargerB	>>>	5950	>>>	CSOutB	14.7
2-1079-1	>>>	298	>>>	Torus2	14.7
LB-1	<<<	11022	<<<	X-204B	14.7
LC-1	<<<	10863	<<<	X-204C	14.7
LD-1	<<<	10849	<<<	X-204D	14.7

FLOWS IN: 32734 gpm
FLOWS OUT: 32334 gpm
NET FLOWS IN: 400 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	14.67	593.6
B	559.5		*	14.67	593.6
Break-A	605.5		p	14.7	639.6
Break-B	605.5		*	135.2	919.2
C	559.5		*	14.7	593.6
CSOutA	647.5		p	14.7	681.6
CSOutB	647.5		p	14.7	681.6
D	559.5		*	14.71	593.6
Dis10A	555.58		*	158.2	922.8
Dis10B	555.58		*	158.2	922.8
Dis10C	555.58		*	162.8	933.6
Dis10D	555.58		*	162.9	933.6
Dis14A	555.63		*	185.7	986.7
Dis14B	555.63		*	189.3	995.1
E	559.5		*	14.71	593.6
F	559.5		*	14.62	593.4
G	559.5		*	14.62	593.4
H	559.5		*	14.62	593.4
HPCI2	556.08			16.17	593.6
I	559.5		*	14.63	593.5
InHXA	566.79		*	149.3	913.5
InHXB	566.79		*	154.1	924.5
InletA	647.5	> 200	*	96.89	872.4
InletB	647.5	> 200	*	95.48	869.1
J	559.5		*	14.81	593.9
K	559.5		*	14.82	593.9
L	559.5		*	14.82	593.9
M	559.5		*	14.83	593.9
N	559.5		*	14.83	593.9
Noz2C	623.25		*	127.5	919.2
Noz2D	623.25		*	127.5	919.2
Noz2E	623.25		*	127.5	919.2
Noz2F	623.25		*	127.5	919.2
Noz2G	623.25		*	127.5	919.2
O	559.5		*	14.83	593.9
OutHXA	584.5		*	139.9	909.2
OutHXB	584.5		*	144.8	920.5
P	559.5		*	14.83	593.9
Q	559.5		*	14.83	593.9

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
R	559.5		*	14.72	593.7
R1032C	563		*	27.56	627
Ram2C	634.23		*	122.8	919.2
Ram2D	634.23		*	122.8	919.2
Ram2E	634.23		*	122.8	919.2
Ram2F	634.23		*	122.8	919.2
Ram2G	634.23		*	122.8	919.2
RCIC2	556.83			15.98	593.9
RecircA	605.5		*	24.73	662.9
RecircB	605.5		*	135.2	919.2
Red1012A	581		*	119.6	858.6
Red1012B	580.67		*	145.9	919.2
Red10A	562.25		*	12.29	590.8
Red10B	562.25		*	12.32	590.8
Red13	561.46			13.98	593.9
Red14A	555.63			15.02	590.5
Red14B	555.63			15.1	590.7
Red23-1	562.25		*	13.51	593.6
Red23-2	556.08			16.17	593.6
RedCSA	636.5		*	115	903.5
RedCSB	642.25		*	112.5	903.5
S	559.5		*	14.69	593.6
Suc10A	555.58			13.74	587.5
Suc10B	555.58			13.15	586.1
Suc10C	555.58			13.13	586.1
Suc10D	555.58			14.09	588.3
Suc14A	555.63			15.02	590.5
Suc14B	555.63			15.09	590.7
T	559.5		*	14.67	593.6
T1006A	564		*	151	914.4
T1006B	564		*	151	914.4
T1006C	564		*	155.7	925.3
T1006D	564		*	155.7	925.3
T1008A	584.5		*	139.8	909
T1008B	584.5		*	144.7	920.3
T1010A	584.5		*	139.2	907.7
T1010B	584.5		*	144.2	919.2
T1032A	555.58		*	158.2	922.7
T1032B	555.58		*	158.1	922.7

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
T1032C	555.58		*	162.6	933
T1032D	555.58		*	162.6	933
T1079-1	563		*	27.41	626.6
T1079-2	588			6.299	602.6
Tee10A-1	562.25		*	12.43	591.1
Tee10A-2	557.08			14.11	589.8
Tee10B-1	562.25		*	12.46	591.2
Tee10B-2	556.75			13.62	588.4
Tee10C-2	556.79			13.52	588.2
Tee10D-2	556.92			14.43	590.4
Tee13	557.33			15.76	593.9
Tee14A	555.63			15.07	590.6
Tee14B	555.63			15.15	590.8
Tee23	562.67			13.33	593.6
Tee2C	610		*	133.2	919.2
Tee2D	610		*	133.2	919.2
Tee2E	610		*	133.2	919.2
Tee2F	610		*	133.2	919.2
Tee2G	610		*	133.2	919.2
Torus2	568.5		p	14.7	602.6
U	559.5		*	14.66	593.5
V	559.5		*	14.67	593.6
V24A	638.17		*	113.7	902.2
V28A	589.08		*	107.6	838.8
V28B	591.25		*	141.3	919.2
V29A	589.08		*	60.51	729.5
V29B	591.25		*	141.3	919.2
X-204A	568.5			10.79	593.6
X-204B	568.5		p	14.7	602.6
X-204C	568.5		p	14.7	602.6
X-204D	568.5		p	14.7	602.6
X-223A	559.5		*	14.61	593.4
X-223B	559.5		*	14.63	593.4
X-224A	559.5			14.66	593.5
X-224B	559.5			14.71	593.7
X-225	559.5		*	14.7	593.6
X-226	559.5			14.83	593.9
ZA	560.5		*	14.24	593.6
ZB	560.5		*	15.1	595.5

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
ZC	560.5		*	15.19	595.7
ZD	560.5		*	15.19	595.8

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA		Tee2L	closed		0	0	0
2-0201B-1	RecircB		Tee2F	0		0	0	0
2-0201B-2	Tee2F		Tee2G	0		0	0	0
2-0201B-3	Tee2F		Tee2E	0		0	0	0
2-0201B-4	Tee2E		Tee2D	0		0	0	0
2-0201B-5	Tee2D		Tee2C	0		0	0	0
2-0201C-1	Tee2C		Noz2C	0		0	0	0
2-0201C-2	Noz2C		Ram2C	0		0	0	0
2-0201D-1	Tee2D		Noz2D	0		0	0	0
2-0201D-2	Noz2D		Ram2D	0		0	0	0
2-0201E-1	Tee2E		Noz2E	0		0	0	0
2-0201E-2	Noz2E		Ram2E	0		0	0	0
2-0201F-1	Tee2F		Noz2F	0		0	0	0
2-0201F-2	Noz2F		Ram2F	0		0	0	0
2-0201G-1	Tee2G		Noz2G	0		0	0	0
2-0201G-2	Noz2G		Ram2G	0		0	0	0
2-1006A-1	Dis10A		T1032A	5128	*	14.56	0.044	0.101
2-1006A-2	T1032A		T1006A	5128	*	14.56	7.206	8.306
2-1006B-1	Dis10B		T1032B	5121	*	14.54	0.044	0.101
2-1006B-2	T1032B		T1006B	5121	*	14.54	7.195	8.282
2-1006C-1	Dis10C		T1032C	5060	*	14.37	0.269	0.624
2-1006C-2	T1032C		T1006C	4911	*	13.94	6.927	7.659
2-1006D-1	Dis10D		T1032D	5072	*	14.4	0.270	0.627
2-1006D-2	T1032D		T1006D	4924	*	13.98	6.946	7.702
2-1008A-1	T1006B		InHXA	4633		6.46	1.604	0.932
2-1008A-2	T1006B	<->	T1006A	487.6		0.680	0.001	0.002
2-1008A-3	T1006A		T1008A	5616		7.83	11.17	5.427
2-1008B-1	T1006D		T1008B	5361		7.475	10.99	5.013
2-1008B-2	T1006C		T1006D	436.9		0.609	0	0.002
2-1008B-3	T1006C		InHXB	4474		6.237	1.556	0.822
2-1009A-1	OutHXA		T1008A	4633		6.46	0.099	0.229
2-1009A-2	T1008A		T1010A	10249	*	14.29	0.535	1.241
2-1009A-3	T1010A		Red1012A	20084	*	28	19.67	49.16
2-1009B-1	OutHXB		T1008B	4474		6.237	0.092	0.215
2-1009B-2	T1008B		T1010B	9835	*	13.71	0.450	1.045
2-1009B-3	T1010B		Red1012B	0		0	0	0
2-1010	T1010B	<->	T1010A	9835	*	13.71	4.963	11.52
2-1012A-1	Red1012A		V28A	20084	*	35.31	11.99	19.75
2-1012A-2	V28A		V29A	20084	*	40.09	47.09	109.3
2-1012A-3	V29A		RecircA	20084	*	38.75	35.77	66.62

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1012B-1	Red1012B		V28B	0	0	0	0
2-1012B-2	V28B		V29B	0	0	0	0
2-1012B-3	V29B		RecircB	0	0	0	0
2-1015A-1	X-223A		Tee10A-1	10249	7.751	2.182	2.314
2-1015A-2	Tee10A-1		Red10A	5128	3.878	0.142	0.329
2-1015B-1	X-223B		Tee10B-1	10133	7.663	2.165	2.276
2-1015B-2	Tee10B-1		Red10B	5060	3.827	0.140	0.325
2-1016A-1	Red10A		Tee10A-2	5128	11.94	(1.819)	0.948
2-1016A-2	Tee10A-2		Suc10A	5128	11.94	0.365	2.347
2-1016B-1	Tee10A-1		Tee10B-2	5121	11.92	(1.185)	2.749
2-1016B-2	Tee10B-2		Suc10B	5121	11.92	0.464	2.247
2-1016C-1	Red10B		Tee10C-2	5060	11.78	(1.199)	2.677
2-1016C-2	Tee10C-2		Suc10C	5060	11.78	0.390	2.115
2-1016D-1	Tee10B-1		Tee10D-2	5072	11.81	(1.969)	0.760
2-1016D-2	Tee10D-2		Suc10D	5072	11.81	0.344	2.138
2-1025-1	B	<->	A	2656	2.122	0	0.001
2-1025-10	I	<->	X-223B	12016	9.598	0.007	0.017
2-1025-11	J	<->	I	12016	9.088	0.182	0.422
2-1025-12	K	<->	J	12016	9.598	0.008	0.019
2-1025-13	L	<->	K	1153	0.921	0.001	0.003
2-1025-14	M	<->	L	1153	0.872	0.005	0.011
2-1025-15	X-226	<->	M	1153	0.921	0	0
2-1025-16	N	<->	X-226	1153	0.921	0.001	0.003
2-1025-17	O	<->	N	1153	0.872	0.002	0.004
2-1025-18	P	<->	O	1153	0.921	0	0
2-1025-19	P		Q	9696	7.745	0.005	0.012
2-1025-2	C	<->	B	2656	2.009	0.033	0.076
2-1025-20	Q		R	9696	7.333	0.108	0.252
2-1025-21	R		X-224B	9696	7.745	0.005	0.011
2-1025-22	X-224B		X-225	3546	2.832	0.015	0.035
2-1025-23	X-225		S	3546	2.832	0.005	0.013
2-1025-24	S		T	3546	2.682	0.018	0.042
2-1025-25	T		X-224A	3546	2.832	0.013	0.030
2-1025-26	U	<->	X-224A	2656	2.122	0	0
2-1025-27	V	<->	U	2656	2.009	0.009	0.021
2-1025-28	A	<->	V	2656	2.122	0	0.001
2-1025-3	D	<->	C	2656	2.122	0.007	0.017
2-1025-4	D		E	8366	6.682	0.004	0.009
2-1025-5	E		F	8366	6.327	0.090	0.208
2-1025-6	F		X-223A	8366	6.682	0.004	0.008

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1025-7	G	<-> X-223A	1883	1.504	0.002	0.004
2-1025-8	H	<-> G	1883	1.424	0.004	0.008
2-1025-9	X-223B	<-> H	1883	1.504	0.005	0.012
2-1032A	T1032A	T1032-1	closed	0	0	0
2-1032B-1	T1032B	R1032B	closed	0	0	0
2-1032C-1	T1032C	R1032C	149.8	* 16.28	135	306
2-1032C-2	R1032C	T1079-1	149.8	6.504	0.155	0.360
2-1032D	T1032D	T1079-1	148.3	* 16.12	135.2	306.4
2-1079	T1079-1	T1079-2	298	* 12.94	21.11	24
2-1079-1	T1079-2	Torus2	298	1.213	(8.401)	0
2-1318-1	X-226	Red13	0	0	0	0
2-1318-2	Red13	Tee13	0	0	0	0
2-1318-3	Tee13	RCIC2	0	0	0	0
2-1401-1	X-224A	Tee14A	6202	8.522	(0.409)	2.92
2-1401-2	Tee14A	Red14A	6202	8.522	0.051	0.118
2-1401-3	Red14A	Suc14A	6202	10.9	0.005	0.012
2-1402-1	X-224B	Tee14B	6150	8.45	(0.437)	2.856
2-1402-2	Tee14B	Red14B	6150	8.45	0.049	0.113
2-1402-3	Red14B	Suc14B	6150	10.81	0.007	0.017
2-1403-1	Dis14A	RedCSA	6202	* 17.61	70.66	83.14
2-1403-2	RedCSA	V24A	6202	* 25.26	1.296	1.339
2-1403-3	V24A	InletA	6202	* 26.67	16.85	29.79
2-1404-1	Dis14B	RedCSB	6150	* 17.46	76.78	91.6
2-1404-2	RedCSB	InletB	6150	* 26.45	17.06	34.36
2-2302-1	X-225	Red23-1	0	0	0	0
2-2302-2	Red23-1	Tee23	C	0	0	0
2-2302-3	Tee23	Red23-2	0	0	0	0
2-2302-4	Red23-2	HPCI2	0	0	0	0
Break-A	RecircA	Break-A	20084	* 38.75	10.03	23.29
Break-B	RecircB	Break-B	0	0	0	0
HXA	InHXA	OutHXA	4633	6.366	9.468	4.267
HXB	InHXB	OutHXB	4474	6.146	9.344	3.979
LA-1	X-204A	ZA	0	0	0	0
--- strainer ---	dP:	--- Hl:				
LA-2	ZA	A	0	0	0	0
LB-1	X-204B	ZB	11022	* 13.34	(0.398)	7.076
--- strainer ---	dP: 3.036	--- Hl: 7.047				
LB-2	ZB	D	11022	* 12.16	0.386	1.896
LC-1	X-204C	ZC	10863	* 13.15	(0.485)	6.874
--- strainer ---	dP: 2.949	--- Hl: 6.845				
LC-2	ZC	K	10863	11.98	0.363	1.842

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a		Hl ft
LD-1	X-204D	ZD	10849	*	13.14	(0.493	)	6.856
--- strainer --- dP: 2.941 --- Hl: 6.827								
LD-2	ZD	P	10849		11.97	0.361		1.837
Pmp10A	Suc10A	Dis10A	5128	*	14.56	(144.5	)	(335.3)
--- RHR Pump --- dP: (144.5) --- Hl: (335.3)								
Pmp10B	Suc10B	Dis10B	5121	*	14.54	(145	)	(336.7)
--- RHR Pump --- dP: (145) --- Hl: (336.7)								
Pmp10C	Suc10C	Dis10C	5060	*	14.37	(149.7	)	(347.5)
--- RHR Pump --- dP: (149.7) --- Hl: (347.5)								
Pmp10D	Suc10D	Dis10D	5072	*	14.4	(148.8	)	(345.4)
--- RHR Pump --- dP: (148.8) --- Hl: (345.4)								
Pmp14A	Suc14A	Dis14A	6202	*	17.61	(170.7	)	(396.2)
--- CS Pump --- dP: (170.7) --- Hl: (396.2)								
Pmp14B	Suc14B	Dis14B	6150	*	17.46	(174.2	)	(404.4)
--- CS Pump --- dP: (174.2) --- Hl: (404.4)								
SpargerA	InletA	CSOutA	6002	*	25.81	82.19		190.8
SpargerB	InletB	CSOutB	5950	*	25.59	80.78		187.5

LINEUP REPORT rev: 09/25/98

LINELIST: SHORT
dated: 09/25/98

DEVIATION: 0.0001 %
after: 13 iterations

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

NODE		DEMAND gpm	NODE		DEMAND gpm
Suc14A	>>>	5400	Suc14B	>>>	5400

FLOWS IN: 0 gpm
FLOWS OUT: 10800 gpm
NET FLOWS OUT: 10800 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
Break-A	>>>	20095	>>>	Break-A	14.7
2-1079-1	>>>	298.1	>>>	Torus2	14.7
LB-1	<<<	10507	<<<	X-204B	14.7
LC-1	<<<	10355	<<<	X-204C	14.7
LD-1	<<<	10330	<<<	X-204D	14.7

FLOWS IN: 31192 gpm
FLOWS OUT: 20393 gpm
NET FLOWS IN: 10799 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	15.04	594.4
B	559.5		*	15.04	594.4
Break-A	605.5		p	14.7	639.6
Break-B	605.5		*	135.3	919.5
C	559.5		*	15.06	594.5
D	559.5		*	15.06	594.5
Dis10A	555.58		*	158.3	923.1
Dis10B	555.58		*	158.3	923.1
Dis10C	555.58		*	163	933.9
Dis10D	555.58		*	163	933.9
E	559.5		*	15.06	594.5
F	559.5		*	14.97	594.2
G	559.5		*	14.97	594.2
H	559.5		*	14.97	594.2
HPCI2	556.08			16.54	594.5
I	559.5		*	14.98	594.3
InHXA	566.79		*	149.5	913.8
InHXB	566.79		*	154.2	924.8
J	559.5		*	15.16	594.7
K	559.5		*	15.17	594.7
L	559.5		*	15.17	594.7
M	559.5		*	15.18	594.7
N	559.5		*	15.18	594.7
Noz2C	623.25		*	127.6	919.5
Noz2D	623.25		*	127.6	919.5
Noz2E	623.25		*	127.6	919.5
Noz2F	623.25		*	127.6	919.5
Noz2G	623.25		*	127.6	919.5
O	559.5		*	15.18	594.7
OutHXA	584.5		*	140	909.5
OutHXB	584.5		*	144.9	920.8
P	559.5		*	15.18	594.7
Q	559.5		*	15.18	594.7
R	559.5		*	15.09	594.5
R1032C	563		*	27.57	627
Ram2C	634.23		*	122.9	919.5
Ram2D	634.23		*	122.9	919.5
Ram2E	634.23		*	122.9	919.5
Ram2F	634.23		*	122.9	919.5

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
Ram2G	634.23		*	122.9	919.5
RCIC2	556.83			16.33	594.7
RecircA	605.5		*	24.75	662.9
RecircB	605.5		*	135.3	919.5
Red1012A	581		*	119.7	858.8
Red1012B	580.67		*	146	919.5
Red10A	562.25		*	12.64	591.6
Red10B	562.25		*	12.67	591.7
Red13	561.46			14.33	594.7
Red14A	555.63			15.71	592.1
Red14B	555.63			15.76	592.2
Red23-1	562.25		*	13.88	594.5
Red23-2	556.08			16.54	594.5
S	559.5		*	15.06	594.5
Suc10A	555.58			14.09	588.3
Suc10B	555.58			13.5	586.9
Suc10C	555.58			13.47	586.9
Suc10D	555.58			14.43	589.1
Suc14A	555.63	> 5400		15.71	592.1
Suc14B	555.63	> 5400		15.76	592.2
T	559.5		*	15.05	594.4
T1006A	564		*	151.1	914.7
T1006B	564		*	151.1	914.7
T1006C	564		*	155.8	925.6
T1006D	564		*	155.8	925.6
T1008A	584.5		*	139.9	909.3
T1008B	584.5		*	144.8	920.6
T1010A	584.5		*	139.4	908
T1010B	584.5		*	144.3	919.5
T1032A	555.58		*	158.3	923
T1032B	555.58		*	158.3	923
T1032C	555.58		*	162.7	933.3
T1032D	555.58		*	162.7	933.3
T1079-1	563		*	27.42	626.6
T1079-2	588			6.299	602.6
Tee10A-1	562.25		*	12.78	591.9
Tee10A-2	557.08			14.46	590.6
Tee10B-1	562.25		*	12.81	592
Tee10B-2	556.75			13.96	589.2

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
Tee10C-2	556.79			13.86	589
Tee10D-2	556.92			14.77	591.2
Tee13	557.33			16.11	594.7
Tee14A	555.63			15.75	592.2
Tee14B	555.63			15.8	592.3
Tee23	562.67			13.7	594.5
Tee2C	610		*	133.4	919.5
Tee2D	610		*	133.4	919.5
Tee2E	610		*	133.4	919.5
Tee2F	610		*	133.4	919.5
Tee2G	610		*	133.4	919.5
Torus2	568.5		p	14.7	602.6
U	559.5		*	15.04	594.4
V	559.5		*	15.04	594.4
V28A	589.08		*	107.7	839
V28B	591.25		*	141.4	919.5
V29A	589.08		*	60.55	729.6
V29B	591.25		*	141.4	919.5
X-204A	568.5			11.16	594.4
X-204B	568.5		p	14.7	602.6
X-204C	568.5		p	14.7	602.6
X-204D	568.5		p	14.7	602.6
X-223A	559.5		*	14.96	594.2
X-223B	559.5		*	14.97	594.3
X-224A	559.5			15.04	594.4
X-224B	559.5			15.08	594.5
X-225	559.5		*	15.07	594.5
X-226	559.5			15.18	594.7
ZA	560.5		*	14.61	594.4
ZB	560.5		*	15.38	596.2
ZC	560.5		*	15.46	596.4
ZD	560.5		*	15.47	596.4

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA		Tee2L	closed		0	0	0
2-0201B-1	RecircB		Tee2F	0		0	0	0
2-0201B-2	Tee2F		Tee2G	0		0	0	0
2-0201B-3	Tee2F		Tee2E	0		0	0	0
2-0201B-4	Tee2E		Tee2D	0		0	0	0
2-0201B-5	Tee2D		Tee2C	0		0	0	0
2-0201C-1	Tee2C		Noz2C	0		0	0	0
2-0201C-2	Noz2C		Ram2C	0		0	0	0
2-0201D-1	Tee2D		Noz2D	0		0	0	0
2-0201D-2	Noz2D		Ram2D	0		0	0	0
2-0201E-1	Tee2E		Noz2E	0		0	0	0
2-0201E-2	Noz2E		Ram2E	0		0	0	0
2-0201F-1	Tee2F		Noz2F	0		0	0	0
2-0201F-2	Noz2F		Ram2F	0		0	0	0
2-0201G-1	Tee2G		Noz2G	0		0	0	0
2-0201G-2	Noz2G		Ram2G	0		0	0	0
2-1006A-1	Dis10A		T1032A	5131	*	14.57	0.044	0.102
2-1006A-2	T1032A		T1006A	5131	*	14.57	7.21	8.315
2-1006B-1	Dis10B		T1032B	5124	*	14.55	0.044	0.101
2-1006B-2	T1032B		T1006B	5124	*	14.55	7.199	8.291
2-1006C-1	Dis10C		T1032C	5063	*	14.37	0.269	0.624
2-1006C-2	T1032C		T1006C	4913	*	13.95	6.931	7.668
2-1006D-1	Dis10D		T1032D	5075	*	14.41	0.270	0.627
2-1006D-2	T1032D		T1006D	4927	*	13.99	6.949	7.71
2-1008A-1	T1006B		InHXA	4636		6.463	1.604	0.933
2-1008A-2	T1006B	<->	T1006A	487.9		0.680	0.001	0.002
2-1008A-3	T1006A		T1008A	5619		7.834	11.17	5.433
2-1008B-1	T1006D		T1008B	5364		7.479	10.99	5.019
2-1008B-2	T1006C		T1006D	437.2		0.610	0	0.002
2-1008B-3	T1006C		InHXB	4476		6.24	1.557	0.823
2-1009A-1	OutHXA		T1008A	4636		6.463	0.099	0.230
2-1009A-2	T1008A		T1010A	10255	*	14.3	0.535	1.242
2-1009A-3	T1010A		Red1012A	20095	*	28.02	19.69	49.21
2-1009B-1	OutHXB		T1008B	4476		6.24	0.093	0.215
2-1009B-2	T1008B		T1010B	9840	*	13.72	0.451	1.046
2-1009B-3	T1010B		Red1012B	0		0	0	0
2-1010	T1010B	<->	T1010A	9840	*	13.72	4.968	11.53
2-1012A-1	Red1012A		V28A	20095	*	35.32	12	19.77
2-1012A-2	V28A		V29A	20095	*	40.11	47.14	109.4
2-1012A-3	V29A		RecircA	20095	*	38.77	35.8	66.69

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi a		Hl ft
2-1012B-1	Red1012B		V28B	0	0	0		0
2-1012B-2	V28B		V29B	0	0	0		0
2-1012B-3	V29B		RecircB	0	0	0		0
2-1015A-1	X-223A		Tee10A-1	10255	7.755	2.183		2.317
2-1015A-2	Tee10A-1		Red10A	5131	3.881	0.142		0.329
2-1015B-1	X-223B		Tee10B-1	10138	7.667	2.167		2.279
2-1015B-2	Tee10B-1		Red10B	5063	3.829	0.140		0.326
2-1016A-1	Red10A		Tee10A-2	5131	11.95	(1.818	)	0.949
2-1016A-2	Tee10A-2		Suc10A	5131	11.95	0.366		2.35
2-1016B-1	Tee10A-1		Tee10B-2	5124	11.93	(1.184	)	2.752
2-1016B-2	Tee10B-2		Suc10B	5124	11.93	0.465		2.25
2-1016C-1	Red10B		Tee10C-2	5063	11.79	(1.198	)	2.68
2-1016C-2	Tee10C-2		Suc10C	5063	11.79	0.391		2.117
2-1016D-1	Tee10B-1		Tee10D-2	5075	11.82	(1.969	)	0.761
2-1016D-2	Tee10D-2		Suc10D	5075	11.82	0.345		2.14
2-1025-1	B	<->	A	1990	1.59	0		0
2-1025-10	I	<->	X-223B	11876	9.485	0.007		0.017
2-1025-11	J	<->	I	11876	8.982	0.178		0.412
2-1025-12	K	<->	J	11876	9.485	0.008		0.018
2-1025-13	L	<->	K	[illegible]	1.215	0.002		0.006
2-1025-14	M	<->	L	1521	1.15	0.008		0.019
2-1025-15	X-226	<->	M	1521	1.215	0		0
2-1025-16	N	<->	X-226	1521	1.215	0.002		0.006
2-1025-17	O	<->	N	1521	1.15	0.003		0.007
2-1025-18	P	<->	O	1521	1.215	0		0
2-1025-19	P		Q	8810	7.036	0.004		0.010
2-1025-2	C	<->	B	1990	1.505	0.019		0.044
2-1025-20	Q		R	8810	6.663	0.090		0.209
2-1025-21	R		X-224B	8810	7.036	0.004		0.009
2-1025-22	X-224B		X-225	3410	2.723	0.014		0.032
2-1025-23	X-225		S	3410	2.723	0.005		0.012
2-1025-24	S		T	3410	2.579	0.017		0.039
2-1025-25	T		X-224A	3410	2.723	0.012		0.028
2-1025-26	U	<->	X-224A	1990	1.59	0		0
2-1025-27	V	<->	U	1990	1.505	0.005		0.012
2-1025-28	A	<->	V	1990	1.59	0		0
2-1025-3	D	<->	C	1990	1.59	0.004		0.010
2-1025-4	D		E	8517	6.803	0.004		0.010
2-1025-5	E		F	8517	6.441	0.093		0.216
2-1025-6	F		X-223A	8517	6.803	0.004		0.009

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a		Hl ft
2-1025-7	G	<->	X-223A	1738		1.388	0.002		0.004
2-1025-8	H	<->	G	1738		1.314	0.003		0.007
2-1025-9	X-223B	<->	H	1738		1.388	0.005		0.011
2-1032A	T1032A		T1032-1	closed		0	0		0
2-1032B-1	T1032B		R1032B	closed		0	0		0
2-1032C-1	T1032C		R1032C	149.8	*	16.29	135.1		306.3
2-1032C-2	R1032C		T1079-1	149.8		6.507	0.155		0.360
2-1032D	T1032D		T1079-1	148.3	*	16.13	135.3		306.7
2-1079	T1079-1		T1079-2	298.1	*	12.95	21.12		24.02
2-1079-1	T1079-2		Torus2	298.1		1.214	(8.401	)	0
2-1318-1	X-226		Red13	0		0	0		0
2-1318-2	Red13		Tee13	0		0	0		0
2-1318-3	Tee13		RCIC2	0		0	0		0
2-1401-1	X-224A		Tee14A	5400		7.419	(0.713	)	2.216
2-1401-2	Tee14A		Red14A	5400		7.419	0.039		0.090
2-1401-3	Red14A		Suc14A	5400		9.493	0.004		0.009
2-1402-1	X-224B		Tee14B	5400		7.419	(0.718	)	2.204
2-1402-2	Tee14B		Red14B	5400		7.419	0.038		0.087
2-1402-3	Red14B		Suc14B	5400		9.493	0.006		0.013
2-2302-1	X-225		Red23-1	0		0	0		0
2-2302-2	Red23-1		Tee23	0		0	0		0
2-2302-3	Tee23		Red23-2	0		0	0		0
2-2302-4	Red23-2		HPCI2	0		0	0		0
Break-A	RecircA		Break-A	20095	*	3 .77	10.05		23.32
Break-B	RecircB		Break-B	0		0	0		0
HXA	InHXA		OutHXA	4636		6.369	9.47		4.272
HXB	InHXB		OutHXB	4476		6.15	9.345		3.983
LA-1	X-204A		ZA	0		0	0		0
--- strainer --- dP: --- Hl:									
LA-2	ZA		A	0		0	0		0
LB-1	X-204B		ZB	10507	*	12.72	(0.676	)	6.431
--- strainer --- dP: 2.759 --- Hl: 6.404									
LB-2	ZB		D	10507		11.59	0.312		1.723
LC-1	X-204C		ZC	10355	*	12.54	(0.756	)	6.246
--- strainer --- dP: 2.679 --- Hl: 6.22									
LC-2	ZC		K	10355		11.42	0.290		1.674
LD-1	X-204D		ZD	10330	*	12.51	(0.763	)	6.216
--- strainer --- dP: 2.667 --- Hl: 6.19									
LD-2	ZD		P	10330		11.4	0.287		1.666
Pmp10A	Suc10A		Dis10A	5131	*	14.57	(144.2	)	(334.8)
--- RHR Pump --- dP: (144.2) --- Hl: (334.8)									

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
Pmp10B	Suc10B	Dis10B	5124	*	14.55	(144.8)	(336.2)
--- RHR Pump --- dP: (144.8) --- Hl: (336.2)							
Pmp10C	Suc10C	Dis10C	5063	*	14.37	(149.5)	(347.1)
--- RHR Pump --- dP: (149.5) --- Hl: (347.1)							
Pmp10D	Suc10D	Dis10D	5075	*	14.41	(148.6)	(344.9)
--- RHR Pump --- dP: (148.6) --- Hl: (344.9)							
Pmp14A	Suc14A	Dis14A	closed		0	0	0
--- CS Pump --- dP: --- Hl:							
Pmp14B	Suc14B	Dis14B	closed		0	0	0
--- CS Pump --- dP: --- Hl:							

LINEUP REPORT rev: 09/25/98

LINELIST: SHORT
dated: 09/25/98

DEVIATION: 5.59e-005 %
after: 13 iterations

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

NODE		DEMAND gpm	NODE		DEMAND gpm
InletA	>>>	200	InletB	>>>	200

FLOWS IN: 0 gpm
FLOWS OUT: 400 gpm
NET FLOWS OUT: 400 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
Break-A	>>>	16391	>>>	Break-A	14.7
SpargerA	>>>	6010	>>>	CSOutA	14.7
SpargerB	>>>	5958	>>>	CSOutB	14.7
2-1079-1	>>>	257.1	>>>	Torus2	14.7
LB-1	<<<	9753	<<<	X-204B	14.7
LC-1	<<<	9632	<<<	X-204C	14.7
LD-1	<<<	9630	<<<	X-204D	14.7

FLOWS IN: 29015 gpm
FLOWS OUT: 28616 gpm
NET FLOWS IN: 399 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	15.49	595.5
B	559.5		*	15.49	595.5
Break-A	605.5		p	14.7	639.6
Break-B	605.5		*	97.62	832.1
C	559.5		*	15.54	595.6
CSOutA	647.5		p	14.7	681.6
CSOutB	647.5		p	14.7	681.6
D	559.5		*	15.55	595.6
Dis10A	555.58		*	118.4	830.4
Dis10B	555.58		*	114	820.3
Dis10C	555.58		*	126.5	849.3
Dis10D	555.58		*	126.6	849.3
Dis14A	555.63		*	186	987.4
Dis14B	555.63		*	189.6	995.8
E	559.5		*	15.55	595.6
F	559.5		*	15.49	595.5
G	559.5		*	15.49	595.5
H	559.5		*	15.49	595.5
HPCI2	556.08			16.98	595.5
I	559.5		*	15.49	595.5
InHXA	566.79		*	109.1	820
InHXB	566.79		*	117	838.4
InletA	647.5	> 200	*	97.09	872.9
InletB	647.5	> 200	*	95.67	869.6
J	559.5		*	15.62	595.8
K	559.5		*	15.63	595.8
L	559.5		*	15.63	595.8
M	559.5		*	15.63	595.8
N	559.5		*	15.63	595.8
Noz2C	623.25		*	89.98	832.1
Noz2D	623.25		*	89.98	832.1
Noz2E	623.25		*	89.98	832.1
Noz2F	623.25		*	89.98	832.1
Noz2G	623.25		*	89.98	832.1
O	559.5		*	15.63	595.8
OutHXA	584.5		*	100.9	818.7
OutHXB	584.5		*	107.3	833.6
P	559.5		*	15.63	595.8
Q	559.5		*	15.62	595.8

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
R	559.5		*	15.52	595.5
R1032C	563		*	24.91	620.8
Ram2C	634.23		*	85.25	832.1
Ram2D	634.23		*	85.25	832.1
Ram2E	634.23		*	85.25	832.1
Ram2F	634.23		*	85.25	832.1
Ram2G	634.23		*	85.25	832.1
RCIC2	556.83			16.78	595.8
RecircA	605.5		*	21.38	655.1
RecircB	605.5		*	97.62	832.1
Red1012A	581		*	88.12	785.5
Red1012B	580.67		*	108.3	832.1
Red10A	562.25		*	13.83	594.4
Red10B	562.25		*	12.97	592.4
Red13	561.46			14.78	595.8
Red14A	555.63			15.84	592.4
Red14B	555.63			15.9	592.5
Red23-1	562.25		*	14.32	595.5
Red23-2	556.08			16.98	595.5
RedCSA	636.5		*	115.3	904.1
RedCSB	642.25		*	112.8	904
S	559.5		*	15.5	595.5
Suc10A	555.58			15	590.4
Suc10B	555.58			16.88	594.8
Suc10C	555.58			13.4	586.7
Suc10D	555.58			14.54	589.3
Suc14A	555.63			15.83	592.4
Suc14B	555.63			15.9	592.5
T	559.5		*	15.49	595.5
T1006A	564		*	110.4	820.3
T1006B	564		*	110.4	820.3
T1006C	564		*	118.6	839.4
T1006D	564		*	118.6	839.4
T1008A	584.5		*	100.9	818.7
T1008B	584.5		*	107.2	833.4
T1010A	584.5		*	100.7	818.3
T1010B	584.5		*	106.7	832.1
T1032A	555.58		*	118.4	830.3
T1032B	555.58		*	114	820.3

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
T1032C	555.58		*	126.2	848.6
T1032D	555.58		*	126.2	848.6
T1079-1	563		*	24.8	620.6
T1079-2	588			6.299	602.6
Tee10A-1	562.25		*	14	594.8
Tee10A-2	557.08			15.57	593.2
Tee10B-1	562.25		*	13.14	592.8
Tee10B-2	556.75			16.37	594.8
Tee10C-2	556.79			13.96	589.2
Tee10D-2	556.92			15.05	591.9
Tee13	557.33			16.56	595.8
Tee14A	555.63			15.89	592.5
Tee14B	555.63			15.95	592.7
Tee23	562.67			14.14	595.5
Tee2C	610		*	95.68	832.1
Tee2D	610		*	95.68	832.1
Tee2E	610		*	95.68	832.1
Tee2F	610		*	95.68	832.1
Tee2G	610		*	95.68	832.1
Torus2	568.5		p	14.7	602.6
U	559.5		*	15.48	595.4
V	559.5		*	15.49	595.5
V24A	638.17		*	114	902.7
V28A	589.08		*	78.96	772.4
V28B	591.25		*	103.8	832.1
V29A	589.08		*	47.59	699.5
V29B	591.25		*	103.8	832.1
X-204A	568.5			11.62	595.5
X-204B	568.5		p	14.7	602.6
X-204C	568.5		p	14.7	602.6
X-204D	568.5		p	14.7	602.6
X-223A	559.5		*	15.49	595.5
X-223B	559.5		*	15.49	595.4
X-224A	559.5			15.48	595.4
X-224B	559.5			15.52	595.5
X-225	559.5		*	15.51	595.5
X-226	559.5			15.63	595.8
ZA	560.5		*	15.06	595.5
ZB	560.5		*	15.76	597.1

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
ZC	560.5		*	15.82	597.2
ZD	560.5		*	15.82	597.2

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA	Tee2L	closed	0	0	0
2-0201B-1	RecircB	Tee2F	0	0	0	0
2-0201B-2	Tee2F	Tee2G	0	0	0	0
2-0201B-3	Tee2F	Tee2E	0	0	0	0
2-0201B-4	Tee2E	Tee2D	0	0	0	0
2-0201B-5	Tee2D	Tee2C	0	0	0	0
2-0201C-1	Tee2C	Noz2C	0	0	0	0
2-0201C-2	Noz2C	Ram2C	0	0	0	0
2-0201D-1	Tee2D	Noz2D	0	0	0	0
2-0201D-2	Noz2D	Ram2D	0	0	0	0
2-0201E-1	Tee2E	Noz2E	0	0	0	0
2-0201E-2	Noz2E	Ram2E	0	0	0	0
2-0201F-1	Tee2F	Noz2F	0	0	0	0
2-0201F-2	Noz2F	Ram2F	0	0	0	0
2-0201G-1	Tee2G	Noz2G	0	0	0	0
2-0201G-2	Noz2G	Ram2G	0	0	0	0
2-1006A-1	Dis10A	T1032A	5619	* 15.95	0.052	0.121
2-1006A-2	T1032A	T1006A	5619	* 15.95	7.922	9.97
2-1006B-1	Dis10B	T1032B	0	0	0	0
2-1006B-2	T1032B	T1006B	0	0	0	0
2-1006C-1	Dis10C	T1032C	5508	* 15.64	0.318	0.738
2-1006C-2	T1032C	T1006C	5379	* 15.27	7.586	9.189
2-1006D-1	Dis10D	T1032D	5521	* 15.67	0.319	0.741
2-1006D-2	T1032D	T1006D	5393	* 15.31	7.607	9.237
2-1008A-1	T1006B	InHXA	2514	3.505	1.321	0.277
2-1008A-2	T1006A	T1006B	2514	3.505	0.027	0.062
2-1008A-3	T1006A	T1008A	3105	4.329	9.548	1.663
2-1008B-1	T1006D	T1008B	5872	8.187	11.42	6.013
2-1008B-2	T1006C	T1006D	479.2	0.668	0.001	0.002
2-1008B-3	T1006C	InHXB	4900	6.831	1.626	0.985
2-1009A-1	OutHXA	T1008A	2514	3.505	0.029	0.068
2-1009A-2	T1008A	T1010A	5619	7.834	0.161	0.375
2-1009A-3	T1010A	Red1012A	16391	* 22.85	12.6	32.76
2-1009B-1	OutHXB	T1008B	4900	6.831	0.111	0.257
2-1009B-2	T1008B	T1010B	10772	* 15.02	0.540	1.253
2-1009B-3	T1010B	Red1012B	0	0	0	0
2-1010	T1010B <->	T1010A	10772	* 15.02	5.948	13.81
2-1012A-1	Red1012A	V28A	16391	* 28.81	9.162	13.19
2-1012A-2	V28A	V29A	16391	* 32.71	31.37	72.81
2-1012A-3	V29A	RecircA	16391	* 31.63	26.21	44.41

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1012B-1	Red1012B		V28B	0	0	0	0
2-1012B-2	V28B		V29B	0	0	0	0
2-1012B-3	V29B		RecircB	0	0	0	0
2-1015A-1	X-223A		Tee10A-1	5619	4.249	1.486	0.699
2-1015A-2	Tee10A-1		Red10A	5619	4.249	0.170	0.395
2-1015B-1	X-223B		Tee10B-1	11029	8.341	2.346	2.695
2-1015B-2	Tee10B-1		Red10B	5508	4.166	0.166	0.385
2-1016A-1	Red10A		Tee10A-2	5619	* 13.08	(1.738)	1.136
2-1016A-2	Tee10A-2		Suc10A	5619	* 13.08	0.567	2.816
2-1016B-1	Tee10A-1		Tee10B-2	0	0	0	0
2-1016B-2	Tee10B-2		Suc10B	0	0	0	0
2-1016C-1	Red10B		Tee10C-2	5508	* 12.83	(0.986)	3.172
2-1016C-2	Tee10C-2		Suc10C	5508	* 12.83	0.557	2.504
2-1016D-1	Tee10B-1		Tee10D-2	5521	* 12.86	(1.909)	0.899
2-1016D-2	Tee10D-2		Suc10D	5521	* 12.86	0.513	2.53
2-1025-1	B	<->	A	3155	2.52	0	0.001
2-1025-10	I	<->	X-223B	10050	8.027	0.005	0.012
2-1025-11	J	<->	I	10050	7.601	0.128	0.298
2-1025-12	K	<->	J	10050	8.027	0.006	0.013
2-1025-13	L	<->	K	418	0.334	0	0
2-1025-14	M	<->	L	418	0.316	0	0.002
2-1025-15	X-226	<->	M	418	0.334	0	0
2-1025-16	N	<->	X-226	418	0.334	0	0
2-1025-17	O	<->	N	418	0.316	0	0
2-1025-18	P	<->	O	418	0.334	0	0
2-1025-19	P		Q	9212	7.358	0.005	0.011
2-1025-2	C	<->	B	3155	2.386	0.045	0.105
2-1025-20	Q		R	9212	6.967	0.098	0.228
2-1025-21	R		X-224B	9212	7.358	0.004	0.010
2-1025-22	X-224B		X-225	3054	2.44	0.011	0.026
2-1025-23	X-225		S	3054	2.44	0.004	0.009
2-1025-24	S		T	3054	2.31	0.014	0.032
2-1025-25	T		X-224A	3054	2.44	0.010	0.022
2-1025-26	U	<->	X-224A	3155	2.52	0	0.001
2-1025-27	V	<->	U	3155	2.386	0.012	0.029
2-1025-28	A	<->	V	3155	2.52	0	0.001
2-1025-3	D	<->	C	3155	2.52	0.010	0.024
2-1025-4	D		E	6598	5.27	0.003	0.006
2-1025-5	E		F	6598	4.99	0.057	0.131
2-1025-6	F		X-223A	6598	5.27	0.002	0.005

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1025-7	X-223A	G	979	0.782	0	0.001
2-1025-8	G	H	979	0.740	0.001	0.002
2-1025-9	H	X-223B	979	0.782	0.001	0.003
2-1032A	T1032A	T1032-1	closed	0	0	0
2-1032B-1	T1032B	R1032B	closed	0	0	0
2-1032C-1	T1032C	R1032C	129.2	* 14.05	101.3	227.7
2-1032C-2	R1032C	T1079-1	129.2	5.611	0.116	0.269
2-1032D	T1032D	T1079-1	127.9	* 13.91	101.4	228
2-1079	T1079-1	T1079-2	257.1	11.17	18.5	17.94
2-1079-1	T1079-2	Torus2	257.1	1.047	(8.401)	0
2-1318-1	X-226	Red13	0	0	0	0
2-1318-2	Red13	Tee13	0	0	0	0
2-1318-3	Tee13	RCIC2	0	0	0	0
2-1401-1	X-224A	Tee14A	6210	8.532	(0.406)	2.927
2-1401-2	Tee14A	Red14A	6210	8.532	0.051	0.119
2-1401-3	Red14A	Suc14A	6210	10.92	0.005	0.012
2-1402-1	X-224B	Tee14B	6158	8.46	(0.434)	2.863
2-1402-2	Tee14B	Red14B	6158	8.46	0.049	0.113
2-1402-3	Red14B	Suc14B	6158	10.82	0.007	0.017
2-1403-1	Dis14A	RedCSA	6210	* 17.63	70.74	83.33
2-1403-2	RedCSA	V24A	6210	* 25.29	1.298	1.342
2-1403-3	V24A	InletA	6210	* 26.71	16.88	29.86
2-1404-1	Dis14B	RedCSB	6158	* 17.48	76.87	91.81
2-1404-2	RedCSB	InletB	6158	* 26.48	17.1	34.44
2-2302-1	X-225	Red23-1	0	0	0	0
2-2302-2	Red23-1	Tee23	0	0	0	0
2-2302-3	Tee23	Red23-2	0	0	0	0
2-2302-4	Red23-2	HPCI2	0	0	0	0
Break-A	RecircA	Break-A	16391	* 31.63	6.684	15.51
Break-B	RecircB	Break-B	0	0	0	0
HXA	InHXA	OutHXA	2514	3.454	8.171	1.256
HXB	InHXB	OutHXB	4900	6.732	9.686	4.773
LA-1	X-204A	ZA	0	0	0	0
--- strainer --- dP: --- Hl:						
LA-2	ZA	A	0	0	0	0
LB-1	X-204B	ZB	9753	11.81	(1.059)	5.541
--- strainer --- dP: 2.377 --- Hl: 5.518						
LB-2	ZB	D	9753	10.76	0.209	1.485
LC-1	X-204C	ZC	9632	11.66	(1.118)	5.404
--- strainer --- dP: 2.318 --- Hl: 5.381						
LC-2	ZC	K	9632	10.63	0.193	1.448

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
LD-1	X-204D	ZD	9630		11.66	(1.119)	5.402
--- strainer --- dP: 2.317 --- Hl: 5.379							
LD-2	ZD	P	9630		10.62	0.193	1.447
Pmp10A	Suc10A	Dis10A	5619	*	15.95	(103.4)	(240)
--- RHR Pump --- dP: (103.4) --- Hl: (240)							
Pmp10B	Suc10B	Dis10B	closed		0	0	0
--- RHR Pump --- dP: --- Hl:							
Pmp10C	Suc10C	Dis10C	5508	*	15.64	(113.1)	(262.6)
--- RHR Pump --- dP: (113.1) --- Hl: (262.6)							
Pmp10D	Suc10D	Dis10D	5521	*	15.67	(112)	(260)
--- RHR Pump --- dP: (112) --- Hl: (260)							
Pmp14A	Suc14A	Dis14A	6210	*	17.63	(170.2)	(395)
--- CS Pump --- dP: (170.2) --- Hl: (395)							
Pmp14B	Suc14B	Dis14B	6158	*	17.48	(173.7)	(403.3)
--- CS Pump --- dP: (173.7) --- Hl: (403.3)							
SpargerA	InletA	CSOutA	6010	*	25.85	82.39	191.3
SpargerB	InletB	CSOutB	5958	*	25.62	80.97	188

Company: ComEd
Project:
by: Doug Collins

SF-DG
09/25/98

LINEUP REPORT rev: 09/25/98

LINELIST: SHORT
dated: 09/25/98

DEVIATION: 7.45e-005 %
after: 9 iterations

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

NODE		DEMAND gpm	NODE	DEMAND gpm
InletA	>>>	200		

FLOWS IN: 0 gpm
FLOWS OUT: 200 gpm
NET FLOWS OUT: 200 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
SpargerA	>>>	6026	>>>	CSOutA	14.7
2-0201H-2	>>>	2286	>>>	Ram2H	14.7
2-0201J-2	>>>	2287	>>>	Ram2J	14.7
2-0201K-2	>>>	2292	>>>	Ram2K	14.7
2-0201L-2	>>>	2321	>>>	Ram2L	14.7
2-0201M-2	>>>	2313	>>>	Ram2M	14.7
LB-1	<<<	6147	<<<	X-204B	14.7
LC-1	<<<	5792	<<<	X-204C	14.7
LD-1	<<<	5785	<<<	X-204D	14.7

FLOWS IN: 17724 gpm
FLOWS OUT: 17525 gpm
NET FLOWS IN: 199 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	17.37	599.8
B	559.5		*	17.37	599.8
Break-A	605.5		*	42.72	704.7
C	559.5		*	17.37	599.8
CSOutA	647.5		p	14.7	681.6
D	559.5		*	17.37	599.8
Dis10A	555.58		*	107	804
Dis10B	555.58		*	107	804
Dis14A	555.63		*	186.7	989.1
E	559.5		*	17.37	599.8
F	559.5		*	17.34	599.7
G	559.5		*	17.36	599.8
H	559.5		*	17.39	599.9
HPCI2	556.08			18.92	600
I	559.5		*	17.45	600
InHXA	566.79		*	97.14	792.3
InletA	647.5	> 200	*	97.55	873.9
J	559.5		*	17.51	600.1
K	559.5		*	17.51	600.1
L	559.5		*	17.51	600.1
M	559.5		*	17.51	600.1
N	559.5		*	17.51	600.1
Noz2H	623.25		*	32.31	698.3
Noz2J	623.25		*	32.33	698.3
Noz2K	623.25		*	32.38	698.4
Noz2L	623.25		*	32.72	699.2
Noz2M	623.25		*	32.62	699
O	559.5		*	17.51	600.1
OutHXA	584.5		*	87.2	786.9
P	559.5		*	17.51	600.1
Q	559.5		*	17.51	600.1
R	559.5		*	17.48	600.1
Ram2H	634.23		p	14.7	668.4
Ram2J	634.23		p	14.7	668.4
Ram2K	634.23		p	14.7	668.4
Ram2L	634.23		p	14.7	668.4
Ram2M	634.23		p	14.7	668.4
RCIC2	556.83			18.66	600.1
RecircA	605.5		*	42.72	704.7

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
Red1012A	581		*	80.96	768.9
Red10A	562.25		*	14.72	596.4
Red13	561.46			16.67	600.1
Red14A	555.63			17.71	596.7
Red23-1	562.25		*	16.26	600
Red23-2	556.08			18.92	600
RedCSA	636.5		*	115.8	905.3
S	559.5		*	17.43	600
Suc10A	555.58			15.81	592.3
Suc10B	555.58			15.06	590.5
Suc14A	555.63			17.71	596.7
T	559.5		*	17.39	599.9
T1006A	564		*	98.84	793.4
T1006B	564		*	98.85	793.4
T1008A	584.5		*	87.07	786.6
T1010A	584.5		*	86.4	785.1
T1032A	555.58		*	107	803.9
T1032B	555.58		*	107	803.9
Tee10A-1	562.25		*	14.9	596.8
Tee10A-2	557.08			16.43	595.2
Tee10B-2	556.75			15.78	593.4
Tee13	557.33			18.45	600.1
Tee14A	555.63			17.77	596.9
Tee23	562.67			16.08	600
Tee2H	610		*	38.61	699.6
Tee2J	610		*	38.63	699.7
Tee2K	610		*	38.69	699.8
Tee2L	610		*	39.04	700.6
Tee2M	610		*	39	700.5
U	559.5		*	17.37	599.8
V	559.5		*	17.37	599.8
V24A	638.17		*	114.5	904
V28A	589.08		*	74.66	762.4
V29A	589.08		*	59.22	726.6
X-204A	568.5			13.49	599.8
X-204B	568.5		p	14.7	602.6
X-204C	568.5		p	14.7	602.6
X-204D	568.5		p	14.7	602.6
X-223A	559.5		*	17.34	599.7

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
X-223B	559.5			17.45	600
X-224A	559.5			17.37	599.8
X-224B	559.5			17.48	600.1
X-225	559.5		*	17.44	600
X-226	559.5			17.51	600.1
ZA	560.5		*	16.94	599.8
ZB	560.5		*	17.2	600.4
ZC	560.5		*	17.3	600.7
ZD	560.5		*	17.31	600.7

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA		Tee2L	11498		7.248	3.676	4.033
2-0201A-2	Tee2L		Tee2M	2313		2.354	0.039	0.091
2-0201A-3	Tee2L		Tee2K	6864		6.986	0.353	0.820
2-0201A-4	Tee2K		Tee2J	4572		4.654	0.059	0.137
2-0201A-5	Tee2J		Tee2H	2286		2.326	0.015	0.034
2-0201H-1	Tee2H		Noz2H	2286		6.968	6.301	1.376
2-0201H-2	Noz2H		Ram2H	2286		9.307	17.61	29.9
2-0201J-1	Tee2J		Noz2J	2287		6.972	6.301	1.377
2-0201J-2	Noz2J		Ram2J	2287		9.312	17.63	29.93
2-0201K-1	Tee2K		Noz2K	2292		6.987	6.304	1.383
2-0201K-2	Noz2K		Ram2K	2292		9.332	17.68	30.06
2-0201L-1	Tee2L		Noz2L	2321		7.077	6.322	1.425
2-0201L-2	Noz2L		Ram2L	2321		9.452	18.02	30.84
2-0201M-1	Tee2M		Noz2M	2313		7.05	6.383	1.566
2-0201M-2	Noz2M		Ram2M	2313		9.416	17.92	30.61
2-1006A-1	Dis10A		T1032A	5753	*	16.33	0.055	0.127
2-1006A-2	T1032A		T1006A	5753	*	16.33	8.13	10.45
2-1006B-1	Dis10B		T1032B	5745	*	16.31	0.055	0.127
2-1006B-2	T1032B		T1006B	5745	*	16.31	8.117	10.42
2-1008A-1	T1006B		InHXA	5198		7.246	1.707	1.172
2-1008A-2	T1006B	<->	T1006A	547.5		0.763	0.001	0.003
2-1008A-3	T1006A		T1008A	6300		8.784	11.77	6.828
2-1009A-1	OutHXA		T1008A	5198		7.246	0.124	0.289
2-1009A-2	T1008A		T1010A	11498	*	16.03	0.672	1.561
2-1009A-3	T1010A		Red1012A	11498	*	16.03	5.443	16.13
2-1010	T1010A		T1010B	closed		0	0	0
2-1012A-1	Red1012A		V28A	11498	*	20.21	6.293	6.527
2-1012A-2	V28A		V29A	11498	*	22.95	15.44	35.84
2-1012A-3	V29A		RecircA	11498	*	22.19	16.51	21.9
2-1015A-1	X-223A		Tee10A-1	11498		8.696	2.439	2.91
2-1015A-2	Tee10A-1		Red10A	5753		4.351	0.178	0.414
2-1015B-1	X-223B		Tee10B-1	closed		0	0	0
2-1016A-1	Red10A		Tee10A-2	5753	*	13.4	(1.714)	1.191
2-1016A-2	Tee10A-2		Suc10A	5753	*	13.4	0.625	2.951
2-1016B-1	Tee10A-1		Tee10B-2	5745	*	13.38	(0.879)	3.459
2-1016B-2	Tee10B-2		Suc10B	5745	*	13.38	0.713	2.826
2-1025-1	B	<->	A	1019		0.814	0	0
2-1025-10	I	<->	X-223B	6369		5.087	0.002	0.005
2-1025-11	J	<->	I	6369		4.817	0.053	0.123
2-1025-12	K	<->	J	6369		5.087	0.002	0.006

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1025-13	L	<->	K	577.3	0.461	0	0
2-1025-14	M	<->	L	577.3	0.437	0.001	0.003
2-1025-15	X-226	<->	M	577.3	0.461	0	0
2-1025-16	N	<->	X-226	577.3	0.461	0	0
2-1025-17	O	<->	N	577.3	0.437	0	0.001
2-1025-18	P	<->	O	577.3	0.461	0	0
2-1025-19	P		Q	5208	4.16	0.002	0.004
2-1025-2	C	<->	B	1019	0.770	0.005	0.012
2-1025-20	Q		R	5208	3.939	0.032	0.075
2-1025-21	R		X-224B	5208	4.16	0.001	0.003
2-1025-22	X-224B		X-225	5208	4.16	0.032	0.075
2-1025-23	X-225		S	5208	4.16	0.012	0.027
2-1025-24	S		T	5208	3.939	0.038	0.089
2-1025-25	T		X-224A	5208	4.16	0.028	0.065
2-1025-26	U	<->	X-224A	1019	0.814	0	0
2-1025-27	V	<->	U	1019	0.770	0.001	0.003
2-1025-28	A	<->	V	1019	0.814	0	0
2-1025-3	D	<->	C	1019	0.814	0.001	0.003
2-1025-4	D		E	5129	4.096	0.002	0.004
2-1025-5	E		F	5129	3.879	0.035	0.081
2-1025-6	F		X-223A	5129	4.096	0.001	0.003
2-1025-7	G	<->	X-223A	6369	5.087	0.020	0.046
2-1025-8	H	<->	G	6369	4.817	0.036	0.083
2-1025-9	X-223B	<->	H	6369	5.087	0.060	0.139
2-1032A	T1032A		T1032-1	closed	0	0	0
2-1032B-1	T1032B		R1032B	closed	0	0	0
2-1318-1	X-226		Red13	0	0	0	0
2-1318-2	Red13		Tee13	0	0	0	0
2-1318-3	Tee13		RCIC2	0	0	0	0
2-1401-1	X-224A		Tee14A	6226	8.555	(0.400)	2.943
2-1401-2	Tee14A		Red14A	6226	8.555	0.051	0.119
2-1401-3	Red14A		Suc14A	6226	10.95	0.005	0.012
2-1402-1	X-224B		Tee14B	closed	0	0	0
2-1403-1	Dis14A		RedCSA	6226	* 17.68	70.93	83.78
2-1403-2	RedCSA		V24A	6226	* 25.35	1.301	1.349
2-1403-3	V24A		InletA	6226	* 26.78	16.95	30.02
2-2302-1	X-225		Red23-1	0	0	0	0
2-2302-2	Red23-1		Tee23	0	0	0	0
2-2302-3	Tee23		Red23-2	0	0	0	0
2-2302-4	Red23-2		HPCI2	0	0	0	0

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
Break-A	RecircA	Break-A	0		0	0	0
HXA	InHXA	OutHXA	5198		7.141	9.943	5.37
LA-1	X-204A	ZA	0		0	0	0
--- strainer --- dP: --- Hl:							
LA-2	ZA	A	0		0	0	0
LB-1	X-204B	ZB	6147		7.443	(2.498)	2.201
--- strainer --- dP: 0.944 --- Hl: 2.192							
LB-2	ZB	D	6147		6.782	(0.177)	0.590
LC-1	X-204C	ZC	5792		7.012	(2.605)	1.954
--- strainer --- dP: 0.838 --- Hl: 1.946							
LC-2	ZC	K	5792		6.39	(0.205)	0.524
LD-1	X-204D	ZD	5785		7.004	(2.607)	1.95
--- strainer --- dP: 0.836 --- Hl: 1.941							
LD-2	ZD	P	5785		6.382	(0.206)	0.523
Pmp10A	Suc10A	Dis10A	5753	*	16.33	(91.22)	(211.7)
--- RHR Pump --- dP: (91.22) --- Hl: (211.7)							
Pmp10B	Suc10B	Dis10B	5745	*	16.31	(91.95)	(213.4)
--- RHR Pump --- dP: (91.95) --- Hl: (213.4)							
Pmp14A	Suc14A	Dis14A	6226	*	17.68	(169)	(392.4)
--- CS Pump --- dP: (169) --- Hl: (392.4)							
SpargerA	InletA	CSOutA	6026	*	25.92	82.85	192.3

LINEUP REPORT rev: 09/25/98

LINELIST: SHRT-NEW
dated: 09/25/98

DEVIATION: 0.0001 %
after: 12 iterations

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

NODE		DEMAND gpm	NODE		DEMAND gpm
InletA	>>>	200	InletB	>>>	200

FLOWS IN: 0 gpm
FLOWS OUT: 400 gpm
NET FLOWS OUT: 400 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
Break-A	>>>	20156	>>>	Break-A	14.7
SpargerA	>>>	6024	>>>	CSOutA	14.7
SpargerB	>>>	5971	>>>	CSOutB	14.7
2-1079-1	>>>	298.9	>>>	Torus2	14.7
LA-1	<<<	8161	<<<	X-204A	14.7
LB-1	<<<	8263	<<<	X-204B	14.7
LC-1	<<<	8270	<<<	X-204C	14.7
LD-1	<<<	8156	<<<	X-204D	14.7

FLOWS IN: 32850 gpm
FLOWS OUT: 32450 gpm
NET FLOWS IN: 400 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	17.11	599.2
B	559.5		*	17.11	599.2
Break-A	605.5		p	14.7	639.6
Break-B	605.5		*	136	921.2
C	559.5		*	17.09	599.2
CSOutA	647.5		p	14.7	681.6
CSOutB	647.5		p	14.7	681.6
D	559.5		*	17.09	599.2
Dis10A	555.58		*	159.1	924.8
Dis10B	555.58		*	159.1	924.8
Dis10C	555.58		*	163.8	935.7
Dis10D	555.58		*	163.8	935.7
Dis14A	555.63		*	186.6	988.8
Dis14B	555.63		*	190.2	997.2
E	559.5		*	17.08	599.2
F	559.5		*	16.95	598.8
G	559.5		*	16.95	598.8
H	559.5		*	16.95	598.8
HPCI2	556.08			18.54	599.1
I	559.5		*	16.95	598.8
InHXA	566.79		*	150.2	915.4
InHXB	566.79		*	155	926.5
InletA	647.5	> 200	*	97.48	873.8
InletB	647.5	> 200	*	96.04	870.4
J	559.5		*	17.08	599.2
K	559.5		*	17.09	599.2
L	559.5		*	17.09	599.2
M	559.5		*	17.11	599.2
N	559.5		*	17.11	599.2
Noz2C	623.25		*	128.4	921.2
Noz2D	623.25		*	128.4	921.2
Noz2E	623.25		*	128.4	921.2
Noz2F	623.25		*	128.4	921.2
Noz2G	623.25		*	128.4	921.2
O	559.5		*	17.11	599.2
OutHXA	584.5		*	140.7	911.1
OutHXB	584.5		*	145.6	922.5
P	559.5		*	17.12	599.2
Q	559.5		*	17.11	599.2

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
R	559.5		*	17.07	599.1
R1032C	563		*	27.63	627.1
Ram2C	634.23		*	123.7	921.2
Ram2D	634.23		*	123.7	921.2
Ram2E	634.23		*	123.7	921.2
Ram2F	634.23		*	123.7	921.2
Ram2G	634.23		*	123.7	921.2
RCIC2	556.83			18.26	599.2
RecircA	605.5		*	24.81	663.1
RecircB	605.5		*	136	921.2
Red1012A	581		*	120.3	860.1
Red1012B	580.67		*	146.7	921.2
Red10A	562.25		*	14.61	596.2
Red10B	562.25		*	14.63	596.2
Red13	561.46			16.26	599.2
Red14A	555.63			17.41	596.1
Red14B	555.63			17.44	596.1
Red23-1	562.25		*	15.88	599.1
Red23-2	556.08			18.54	599.1
RedCSA	636.5		*	115.7	905.1
RedCSB	642.25		*	113.2	905
S	559.5		*	17.06	599.1
Suc10A	555.58			16.06	592.9
Suc10B	555.58			15.46	591.5
Suc10C	555.58			15.43	591.4
Suc10D	555.58			16.39	593.6
Suc14A	555.63			17.41	596
Suc14B	555.63			17.44	596.1
T	559.5		*	17.06	599.1
T1006A	564		*	151.8	916.4
T1006B	564		*	151.8	916.4
T1006C	564		*	156.5	927.4
T1006D	564		*	156.5	927.4
T1008A	584.5		*	140.6	910.9
T1008B	584.5		*	145.5	922.3
T1010A	584.5		*	140.1	909.6
T1010B	584.5		*	145.1	921.2
T1032A	555.58		*	159	924.7
T1032B	555.58		*	159	924.7

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
T1032C	555.58		*	163.5	935.1
T1032D	555.58		*	163.5	935.1
T1079-1	563		*	27.47	626.8
T1079-2	588			6.299	602.6
Tee10A-1	562.25		*	14.76	596.5
Tee10A-2	557.08			16.43	595.2
Tee10B-1	562.25		*	14.77	596.5
Tee10B-2	556.75			15.93	593.7
Tee10C-2	556.79			15.82	593.5
Tee10D-2	556.92			16.74	595.8
Tee13	557.33			18.04	599.2
Tee14A	555.63			17.47	596.2
Tee14B	555.63			17.49	596.2
Tee23	562.67			15.7	599.1
Tee2C	610		*	134.1	921.2
Tee2D	610		*	134.1	921.2
Tee2E	610		*	134.1	921.2
Tee2F	610		*	134.1	921.2
Tee2G	610		*	134.1	921.2
Torus2	568.5		p	14.7	602.6
U	559.5		*	17.07	599.1
V	559.5		*	17.11	599.2
V24A	638.17		*	114.4	903.8
V28A	589.08		*	108.2	840.3
V28B	591.25		*	142.2	921.2
V29A	589.08		*	60.78	730.2
V29B	591.25		*	142.2	921.2
X-204A	567.5		p	14.7	601.6
X-204B	567.5		p	14.7	601.6
X-204C	567.5		p	14.7	601.6
X-204D	567.5		p	14.7	601.6
X-223A	559.5		*	16.95	598.8
X-223B	559.5		*	16.95	598.8
X-224A	559.5			17.06	599.1
X-224B	559.5			17.06	599.1
X-225	559.5		*	17.06	599.1
X-226	559.5			17.11	599.2
ZA	560.5		*	17.13	600.3
ZB	560.5		*	17.12	600.2

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
ZC	560.5		*	17.12	600.2
ZD	560.5		*	17.13	600.3

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA		Tee2L	closed		0	0	0
2-0201B-1	RecircB		Tee2F	0		0	0	0
2-0201B-2	Tee2F		Tee2G	0		0	0	0
2-0201B-3	Tee2F		Tee2E	0		0	0	0
2-0201B-4	Tee2E		Tee2D	0		0	0	0
2-0201B-5	Tee2D		Tee2C	0		0	0	0
2-0201C-1	Tee2C		Noz2C	0		0	0	0
2-0201C-2	Noz2C		Ram2C	0		0	0	0
2-0201D-1	Tee2D		Noz2D	0		0	0	0
2-0201D-2	Noz2D		Ram2D	0		0	0	0
2-0201E-1	Tee2E		Noz2E	0		0	0	0
2-0201E-2	Noz2E		Ram2E	0		0	0	0
2-0201F-1	Tee2F		Noz2F	0		0	0	0
2-0201F-2	Noz2F		Ram2F	0		0	0	0
2-0201G-1	Tee2G		Noz2G	0		0	0	0
2-0201G-2	Noz2G		Ram2G	0		0	0	0
2-1006A-1	Dis10A		T1032A	5147	*	14.61	0.044	0.102
2-1006A-2	T1032A		T1006A	5147	*	14.61	7.231	8.365
2-1006B-1	Dis10B		T1032B	5139	*	14.59	0.044	0.102
2-1006B-2	T1032B		T1006B	5139	*	14.59	7.221	8.341
2-1006C-1	Dis10C		T1032C	5078	*	14.42	0.271	0.628
2-1006C-2	T1032C		T1006C	4928	*	13.99	6.951	7.714
2-1006D-1	Dis10D		T1032D	5091	*	14.45	0.272	0.631
2-1006D-2	T1032D		T1006D	4942	*	14.03	6.969	7.757
2-1008A-1	T1006B		InHXA	4650		6.483	1.607	0.939
2-1008A-2	T1006B	<->	T1006A	489.4		0.682	0.001	0.002
2-1008A-3	T1006A		T1008A	5636		7.858	11.19	5.466
2-1008B-1	T1006D		T1008B	5380		7.501	11.01	5.049
2-1008B-2	T1006C		T1006D	438.5		0.611	0	0.002
2-1008B-3	T1006C		InHXB	4490		6.259	1.559	0.828
2-1009A-1	OutHXA		T1008A	4650		6.483	0.100	0.231
2-1009A-2	T1008A		T1010A	10286	*	14.34	0.538	1.25
2-1009A-3	T1010A		Red1012A	20156	*	28.1	19.82	49.51
2-1009B-1	OutHXB		T1008B	4490		6.259	0.093	0.216
2-1009B-2	T1008B		T1010B	9870	*	13.76	0.453	1.052
2-1009B-3	T1010B		Red1012B	0		0	0	0
2-1010	T1010B	<->	T1010A	9870	*	13.76	4.999	11.6
2-1012A-1	Red1012A		V28A	20156	*	35.43	12.05	19.89
2-1012A-2	V28A		V29A	20156	*	40.23	47.42	110.1
2-1012A-3	V29A		RecircA	20156	*	38.89	35.98	67.09

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1012B-1	Red1012B	V28B	0	0	0	0
2-1012B-2	V28B	V29B	0	0	0	0
2-1012B-3	V29B	RecircB	0	0	0	0
2-1015A-1	X-223A	Tee10A-1	10286	7.779	2.189	2.331
2-1015A-2	Tee10A-1	Red10A	5147	[illegible].892	0.143	0.331
2-1015B-1	X-223B	Tee10B-1	10169	7.691	2.172	2.293
2-1015B-2	Tee10B-1	Red10B	5078	3.841	0.141	0.328
2-1016A-1	Red10A	Tee10A-2	5147	11.98	(1.816)	0.955
2-1016A-2	Tee10A-2	Suc10A	5147	11.98	0.372	2.364
2-1016B-1	Tee10A-1	Tee10B-2	5139	11.97	(1.177)	2.768
2-1016B-2	Tee10B-2	Suc10B	5139	11.97	0.471	2.263
2-1016C-1	Red10B	Tee10C-2	5078	11.83	(1.19)	2.697
2-1016C-2	Tee10C-2	Suc10C	5078	11.83	0.396	2.13
2-1016D-1	Tee10B-1	Tee10D-2	5091	11.85	(1.967)	0.765
2-1016D-2	Tee10D-2	Suc10D	5091	11.85	0.350	2.153
2-1025-1	A	B	1993	1.592	0	0
2-1025-10	I	<-> X-223B	10199	8.146	0.005	0.012
2-1025-11	J	<-> I	10199	7.713	0.132	0.306
2-1025-12	K	<-> J	10199	8.146	0.006	0.014
2-1025-13	L	<-> K	1929	1.541	0.004	0.009
2-1025-14	M	<-> L	1929	1.459	0.013	0.030
2-1025-15	X-226	<-> M	1929	1.541	0	0
2-1025-16	N	<-> X-226	1929	1.541	0.004	0.009
2-1025-17	O	<-> N	1929	1.459	0.005	0.011
2-1025-18	P	<-> O	1929	1.541	0	0
2-1025-19	P	Q	6227	4.974	0.002	0.005
2-1025-2	B	C	1993	1.507	0.019	0.044
2-1025-20	Q	R	6227	4.71	0.046	0.106
2-1025-21	R	X-224B	6227	4.974	0.002	0.005
2-1025-22	X-224B	X-225	56.31	0.045	0	0
2-1025-23	X-225	S	56.31	0.045	0	0
2-1025-24	S	T	56.31	0.043	0	0
2-1025-25	T	X-224A	56.31	0.045	0	0
2-1025-26	U	<-> X-224A	6167	4.926	0.002	0.005
2-1025-27	V	<-> U	6167	4.664	0.045	0.104
2-1025-28	A	<-> V	6167	4.926	0.002	0.005
2-1025-3	C	D	1993	1.592	0.004	0.010
2-1025-4	D	E	10256	8.192	0.006	0.014
2-1025-5	E	F	10256	7.757	0.133	0.310
2-1025-6	F	X-223A	10256	8.192	0.005	0.012

PIPELINE	FROM	TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1025-7	G	<-> X-223A	29.69	0.024	0	0
2-1025-8	H	<-> G	29.69	0.022	0	0
2-1025-9	X-223B	<-> H	29.69	0.024	0	0
2-1032A	T1032A	T1032-1	closed	0	0	0
2-1032B-1	T1032B	R1032B	closed	0	0	0
2-1032C-1	T1032C	R1032C	150.2	* 16.34	135.9	307.9
2-1032C-2	R1032C	T1079-1	150.2	6.525	0.156	0.362
2-1032D	T1032D	T1079-1	148.7	* 16.17	136	308.3
2-1079	T1079-1	T1079-2	298.9	* 12.98	21.17	24.15
2-1079-1	T1079-2	Torus2	298.9	1.217	(8.401)	0
2-1318-1	X-226	Red13	0	0	0	0
2-1318-2	Red13	Tee13	0	0	0	0
2-1318-3	Tee13	RCIC2	0	0	0	0
2-1401-1	X-224A	Tee14A	6224	8.551	(0.401)	2.94
2-1401-2	Tee14A	Red14A	6224	8.551	0.051	0.119
2-1401-3	Red14A	Suc14A	6224	10.94	0.005	0.012
2-1402-1	X-224B	Tee14B	6171	8.479	(0.429)	2.875
2-1402-2	Tee14B	Red14B	6171	8.479	0.049	0.114
2-1402-3	Red14B	Suc14B	6171	10.85	0.007	0.017
2-1403-1	Dis14A	RedCSA	6224	* 17.67	70.9	83.71
2-1403-2	RedCSA	V24A	6224	* 25.34	1.3	1.348
2-1403-3	V24A	InletA	6224	* 26.77	16.94	29.99
2-1404-1	Dis14B	RedCSB	6171	* 17.52	77.04	92.21
2-1404-2	RedCSB	InletB	6171	* 26.54	17.16	34.59
2-2302-1	X-225	Red23-1	0	0	0	0
2-2302-2	Red23-1	Tee23	0	0	0	0
2-2302-3	Tee23	Red23-2	0	0	0	0
2-2302-4	Red23-2	HPCI2	0	0	0	0
Break-A	RecircA	Break-A	20156	* 38.89	10.11	23.46
Break-B	RecircB	Break-B	0	0	0	0
HXA	InHXA	OutHXA	4650	6.388	9.481	4.298
HXB	InHXB	OutHXB	4490	6.168	9.356	4.007
LA-1	X-204A	ZA	8161	9.88	(2.431)	1.357
--- strainer --- dP: 0.577 --- Hl: 1.34						
LA-2	ZA	A	8161	9.003	0.017	1.04
LB-1	X-204B	ZB	8263	10	(2.419)	1.385
--- strainer --- dP: 0.589 --- Hl: 1.368						
LB-2	ZB	D	8263	9.116	0.028	1.066
LC-1	X-204C	ZC	8270	10.01	(2.418)	1.387
--- strainer --- dP: 0.590 --- Hl: 1.37						
LC-2	ZC	K	8270	9.124	0.029	1.068

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
LD-1	X-204D	ZD	8156		9.875	(2.432)	1.356
--- strainer --- dP: 0.577 --- Hl: 1.339							
LD-2	ZD	P	8156		8.999	0.017	1.039
Pmp10A	Suc10A	Dis10A	5147	*	14.61	(143)	(332)
--- RHR Pump --- dP: (143) --- Hl: (332)							
Pmp10B	Suc10B	Dis10B	5139	*	14.59	(143.6)	(333.3)
--- RHR Pump --- dP: (143.6) --- Hl: (333.3)							
Pmp10C	Suc10C	Dis10C	5078	*	14.42	(148.3)	(344.3)
--- RHR Pump --- dP: (148.3) --- Hl: (344.3)							
Pmp10D	Suc10D	Dis10D	5091	*	14.45	(147.4)	(342.1)
--- RHR Pump --- dP: (147.4) --- Hl: (342.1)							
Pmp14A	Suc14A	Dis14A	6224	*	17.67	(169.2)	(392.8)
--- CS Pump --- dP: (169.2) --- Hl: (392.8)							
Pmp14B	Suc14B	Dis14B	6171	*	17.52	(172.8)	(401.1)
--- CS Pump --- dP: (172.8) --- Hl: (401.1)							
SpargerA	InletA	CSOutA	6024	*	25.91	82.78	192.2
SpargerB	InletB	CSOutB	5971	*	25.68	81.34	188.8

Company: ComEd
Project:
by: Doug Collins

LSL-FEW
09/28/98

LINEUP REPORT rev: 09/28/98

LINELIST: SHORT
dated: 09/25/98

DEVIATION: 9.1e-005 %
after: 13 iterations

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

NODE		DEMAND gpm	NODE		DEMAND gpm
Suc14A	>>>	5650	Suc14B	>>>	5650

FLOWS IN: 0 gpm
FLOWS OUT: 11300 gpm
NET FLOWS OUT: 11300 gpm

PIPELINE		FLOW gpm		PRESSURE SOURCE	SET psia
Break-A	>>>	20091	>>>	Break-A	14.7
2-1079-1	>>>	298.1	>>>	Torus2	14.7
LB-1	<<<	10673	<<<	X-204B	14.7
LC-1	<<<	10519	<<<	X-204C	14.7
LD-1	<<<	10498	<<<	X-204D	14.7

FLOWS IN: 31690 gpm
FLOWS OUT: 20389 gpm
NET FLOWS IN: 11301 gpm

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
A	559.5		*	14.92	594.1
B	559.5		*	14.92	594.1
Break-A	605.5		p	14.7	639.6
Break-B	605.5		*	135.3	919.5
C	559.5		*	14.95	594.2
D	559.5		*	14.95	594.2
Dis10A	555.58		*	158.3	923
Dis10B	555.58		*	158.3	923
Dis10C	555.58		*	162.9	933.8
Dis10D	555.58		*	163	933.8
E	559.5		*	14.95	594.2
F	559.5		*	14.86	594
G	559.5		*	14.85	594
H	559.5		*	14.86	594
HPCI2	556.08			16.43	594.2
I	559.5		*	14.87	594
InHXA	566.79		*	149.4	913.7
InHXB	566.79		*	154.2	924.7
J	559.5		*	15.05	594.4
K	559.5		*	15.06	594.5
L	559.5		*	15.06	594.5
M	559.5		*	15.07	594.5
N	559.5		*	15.07	594.5
Noz2C	623.25		*	127.6	919.5
Noz2D	623.25		*	127.6	919.5
Noz2E	623.25		*	127.6	919.5
Noz2F	623.25		*	127.6	919.5
Noz2G	623.25		*	127.6	919.5
O	559.5		*	15.07	594.5
OutHXA	584.5		*	140	909.4
OutHXB	584.5		*	144.8	920.7
P	559.5		*	15.07	594.5
Q	559.5		*	15.07	594.5
R	559.5		*	14.97	594.3
R1032C	563		*	27.57	627
Ram2C	634.23		*	122.9	919.5
Ram2D	634.23		*	122.9	919.5
Ram2E	634.23		*	122.9	919.5
Ram2F	634.23		*	122.9	919.5

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
Ram2G	634.23		*	122.9	919.5
RCIC2	556.83			16.22	594.5
RecircA	605.5		*	24.74	662.9
RecircB	605.5		*	135.3	919.5
Red1012A	581		*	119.6	858.7
Red1012B	580.67		*	145.9	919.5
Red10A	562.25		*	12.53	591.3
Red10B	562.25		*	12.56	591.4
Red13	561.46			14.22	594.5
Red14A	555.63			15.5	591.6
Red14B	555.63			15.55	591.7
Red23-1	562.25		*	13.77	594.2
Red23-2	556.08			16.43	594.2
S	559.5		*	14.95	594.2
Suc10A	555.58			13.98	588
Suc10B	555.58			13.39	586.7
Suc10C	555.58			13.36	586.6
Suc10D	555.58			14.32	588.8
Suc14A	555.63	> 5650		15.49	591.6
Suc14B	555.63	> 5650		15.55	591.7
T	559.5		*	14.93	594.2
T1006A	564		*	151	914.6
T1006B	564		*	151	914.6
T1006C	564		*	155.7	925.5
T1006D	564		*	155.7	925.5
T1008A	584.5		*	139.9	909.2
T1008B	584.5		*	144.8	920.5
T1010A	584.5		*	139.3	907.9
T1010B	584.5		*	144.3	919.5
T1032A	555.58		*	158.2	922.9
T1032B	555.58		*	158.2	922.9
T1032C	555.58		*	162.7	933.2
T1032D	555.58		*	162.7	933.2
T1079-1	563		*	27.42	626.6
T1079-2	588			6.299	602.6
Tee10A-1	562.25		*	12.67	591.7
Tee10A-2	557.08			14.35	590.4
Tee10B-1	562.25		*	12.7	591.7
Tee10B-2	556.75			13.86	588.9

NODE	ELEVATION ft	DEMAND gpm		PRESSURE psi a	H GRADE ft
Tee10C-2	556.79			13.75	588.7
Tee10D-2	556.92			14.67	591
Tee13	557.33			16	594.5
Tee14A	555.63			15.54	591.7
Tee14B	555.63			15.59	591.8
Tee23	562.67			13.59	594.2
Tee2C	610		*	133.3	919.5
Tee2D	610		*	133.3	919.5
Tee2E	610		*	133.3	919.5
Tee2F	610		*	133.3	919.5
Tee2G	610		*	133.3	919.5
Torus2	568.5		p	14.7	602.6
U	559.5		*	14.92	594.1
V	559.5		*	14.92	594.1
V28A	589.08		*	107.7	839
V28B	591.25		*	141.4	919.5
V29A	589.08		*	60.54	729.6
V29B	591.25		*	141.4	919.5
X-204A	568.5			11.05	594.1
X-204B	568.5		p	14.7	602.6
X-204C	568.5		p	14.7	602.6
X-204D	568.5		p	14.7	602.6
X-223A	559.5		*	14.85	594
X-223B	559.5		*	14.86	594
X-224A	559.5			14.92	594.1
X-224B	559.5			14.97	594.2
X-225	559.5		*	14.95	594.2
X-226	559.5			15.07	594.5
ZA	560.5		*	14.49	594.1
ZB	560.5		*	15.29	596
ZC	560.5		*	15.37	596.2
ZD	560.5		*	15.38	596.2

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-0201A-1	RecircA		Tee2L	closed		0	0	0
2-0201B-1	RecircB		Tee2F	0		0	0	0
2-0201B-2	Tee2F		Tee2G	0		0	0	0
2-0201B-3	Tee2F		Tee2E	0		0	0	0
2-0201B-4	Tee2E		Tee2D	0		0	0	0
2-0201B-5	Tee2D		Tee2C	0		0	0	0
2-0201C-1	Tee2C		Noz2C	0		0	0	0
2-0201C-2	Noz2C		Ram2C	0		0	0	0
2-0201D-1	Tee2D		Noz2D	0		0	0	0
2-0201D-2	Noz2D		Ram2D	0		0	0	0
2-0201E-1	Tee2E		Noz2E	0		0	0	0
2-0201E-2	Noz2E		Ram2E	0		0	0	0
2-0201F-1	Tee2F		Noz2F	0		0	0	0
2-0201F-2	Noz2F		Ram2F	0		0	0	0
2-0201G-1	Tee2G		Noz2G	0		0	0	0
2-0201G-2	Noz2G		Ram2G	0		0	0	0
2-1006A-1	Dis10A		T1032A	5130	*	14.56	0.044	0.102
2-1006A-2	T1032A		T1006A	5130	*	14.56	7.208	8.312
2-1006B-1	Dis10B		T1032B	5123	*	14.54	0.044	0.101
2-1006B-2	T1032B		T1006B	5123	*	14.54	7.198	8.288
2-1006C-1	Dis10C		T1032C	5062	*	14.37	0.269	0.624
2-1006C-2	T1032C		T1006C	4912	*	13.95	6.93	7.665
2-1006D-1	Dis10D		T1032D	5074	*	14.41	0.270	0.627
2-1006D-2	T1032D		T1006D	4926	*	13.99	6.948	7.708
2-1008A-1	T1006B		InHXA	4635		6.462	1.604	0.933
2-1008A-2	T1006B	<->	T1006A	487.8		0.680	0.001	0.002
2-1008A-3	T1006A		T1008A	5618		7.833	11.17	5.431
2-1008B-1	T1006D		T1008B	5363		7.477	10.99	5.017
2-1008B-2	T1006C		T1006D	437.1		0.609	0	0.002
2-1008B-3	T1006C		InHXB	4475		6.239	1.556	0.823
2-1009A-1	OutHXA		T1008A	4635		6.462	0.099	0.230
2-1009A-2	T1008A		T1010A	10253	*	14.29	0.535	1.242
2-1009A-3	T1010A		Red1012A	20091	*	28.01	19.68	49.19
2-1009B-1	OutHXB		T1008B	4475		6.239	0.093	0.215
2-1009B-2	T1008B		T1010B	9838	*	13.72	0.450	1.046
2-1009B-3	T1010B		Red1012B	0		0	0	0
2-1010	T1010B	<->	T1010A	9838	*	13.72	4.967	11.53
2-1012A-1	Red1012A		V28A	20091	*	35.32	11.99	19.76
2-1012A-2	V28A		V29A	20091	*	40.1	47.12	109.4
2-1012A-3	V29A		RecircA	20091	*	38.77	35.79	66.66

PIPELINE	FROM		TO	FLOW gpm	VEL ft/sec	dP psi a	Hl ft
2-1012B-1	Red1012B		V28B	0	0	0	0
2-1012B-2	V28B		V29B	0	0	0	0
2-1012B-3	V29B		RecircB	0	0	0	0
2-1015A-1	X-223A		Tee10A-1	10253	7.754	2.183	2.316
2-1015A-2	Tee10A-1		Red10A	5130	3.88	0.142	0.329
2-1015B-1	X-223B		Tee10B-1	10136	7.666	2.166	2.278
2-1015B-2	Tee10B-1		Red10B	5062	3.828	0.140	0.326
2-1016A-1	Red10A		Tee10A-2	5130	11.95	(1.819)	0.949
2-1016A-2	Tee10A-2		Suc10A	5130	11.95	0.366	2.349
2-1016B-1	Tee10A-1		Tee10B-2	5123	11.93	(1.184)	2.751
2-1016B-2	Tee10B-2		Suc10B	5123	11.93	0.465	2.249
2-1016C-1	Red10B		Tee10C-2	5062	11.79	(1.198)	2.679
2-1016C-2	Tee10C-2		Suc10C	5062	11.79	0.390	2.116
2-1016D-1	Tee10B-1		Tee10D-2	5074	11.82	(1.969)	0.760
2-1016D-2	Tee10D-2		Suc10D	5074	11.82	0.344	2.139
2-1025-1	B	<->	A	2207	1.763	0	0
2-1025-10	I	<->	X-223B	11923	9.523	0.007	0.017
2-1025-11	J	<->	I	11923	9.017	0.179	0.416
2-1025-12	K	<->	J	11923	9.523	0.008	0.018
2-1025-13	L	<->	K	1405	1.122	0.002	0.005
2-1025-14	M	<->	L	1405	1.062	0.007	0.016
2-1025-15	X-226	<->	M	1405	1.122	0	0
2-1025-16	N	<->	X-226	1405	1.122	0.002	0.005
2-1025-17	O	<->	N	1405	1.062	0.003	0.006
2-1025-18	P	<->	O	1405	1.122	0	0
2-1025-19	P		Q	9093	7.263	0.005	0.011
2-1025-2	C	<->	B	2207	1.669	0.023	0.053
2-1025-20	Q		R	9093	6.877	0.096	0.222
2-1025-21	R		X-224B	9093	7.263	0.004	0.010
2-1025-22	X-224B		X-225	3443	2.75	0.014	0.033
2-1025-23	X-225		S	3443	2.75	0.005	0.012
2-1025-24	S		T	3443	2.604	0.017	0.040
2-1025-25	T		X-224A	3443	2.75	0.012	0.028
2-1025-26	U	<->	X-224A	2207	1.763	0	0
2-1025-27	V	<->	U	2207	1.669	0.006	0.015
2-1025-28	A	<->	V	2207	1.763	0	0
2-1025-3	D	<->	C	2207	1.763	0.005	0.012
2-1025-4	D		E	8466	6.762	0.004	0.010
2-1025-5	E		F	8466	6.403	0.092	0.213
2-1025-6	F		X-223A	8466	6.762	0.004	0.009

LINEUP PIPELINES

LSL-FEW
09/28/98

PIPELINE	FROM		TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
2-1025-7	G	<->	X-223A	1787		1.427	0.002	0.004
2-1025-8	H	<->	G	1787		1.351	0.003	0.007
2-1025-9	X-223B	<->	H	1787		1.427	0.005	0.011
2-1032A	T1032A		T1032-1	closed		0	0	0
2-1032B-1	T1032B		R1032B	closed		0	0	0
2-1032C-1	T1032C		R1032C	149.8	*	16.29	135.1	306.2
2-1032C-2	R1032C		T1079-1	149.8		6.506	0.155	0.360
2-1032D	T1032D		T1079-1	148.3	*	16.13	135.3	306.6
2-1079	T1079-1		T1079-2	298.1	*	12.95	21.12	24.01
2-1079-1	T1079-2		Torus2	298.1		1.214	(8.401)	0
2-1318-1	X-226		Red13	0		0	0	0
2-1318-2	Red13		Tee13	0		0	0	0
2-1318-3	Tee13		RCIC2	0		0	0	0
2-1401-1	X-224A		Tee14A	5650		7.763	(0.623)	2.425
2-1401-2	Tee14A		Red14A	5650		7.763	0.042	0.098
2-1401-3	Red14A		Suc14A	5650		9.932	0.004	0.010
2-1402-1	X-224B		Tee14B	5650		7.763	(0.628)	2.412
2-1402-2	Tee14B		Red14B	5650		7.763	0.041	0.096
2-1402-3	Red14B		Suc14B	5650		9.932	0.006	0.014
2-2302-1	X-225		Red23-1	0		0	0	0
2-2302-2	Red23-1		Tee23	0		0	0	0
2-2302-3	Tee23		Red23-2	0		0	0	0
2-2302-4	Red23-2		HPCI2	0		0	0	0
Break-A	RecircA		Break-A	20091	*	38.77	10.04	23.31
Break-B	RecircB		Break-B	0		0	0	0
HXA	InHXA		OutHXA	4635		6.368	9.469	4.271
HXB	InHXB		OutHXB	4475		6.149	9.345	3.981
LA-1	X-204A		ZA	0		0	0	0
--- strainer --- dP: --- Hl:								
LA-2	ZA		A	0		0	0	0
LB-1	X-204B		ZB	10673	*	12.92	(0.588)	6.635
--- strainer --- dP: 2.847 --- Hl: 6.608								
LB-2	ZB		D	10673		11.78	0.335	1.778
LC-1	X-204C		ZC	10519	*	12.73	(0.670)	6.445
--- strainer --- dP: 2.765 --- Hl: 6.417								
LC-2	ZC		K	10519		11.6	0.313	1.727
LD-1	X-204D		ZD	10498	*	12.71	(0.681)	6.419
--- strainer --- dP: 2.754 --- Hl: 6.392								
LD-2	ZD		P	10498		11.58	0.310	1.72
Pmp10A	Suc10A		Dis10A	5130	*	14.56	(144.3)	(335)
--- RHR Pump --- dP: (144.3) --- Hl: (335)								

PIPELINE	FROM	TO	FLOW gpm		VEL ft/sec	dP psi a	Hl ft
Pmp10B	Suc10B	Dis10B	5123	*	14.54	(144.9)	(336.3)
--- RHR Pump --- dP: (144.9) --- Hl: (336.3)							
Pmp10C	Suc10C	Dis10C	5062	*	14.37	(149.6)	(347.2)
--- RHR Pump --- dP: (149.6) --- Hl: (347.2)							
Pmp10D	Suc10D	Dis10D	5074	*	14.41	(148.6)	(345)
--- RHR Pump --- dP: (148.6) --- Hl: (345)							
Pmp14A	Suc14A	Dis14A	closed		0	0	0
--- CS Pump --- dP: --- Hl:							
Pmp14B	Suc14B	Dis14B	closed		0	0	0
--- CS Pump --- dP: --- Hl:							

Calc. No. QDC-1000-M-0454, Rev. 1 Attachment B

September 24, 1992

Ms. Sharon Eldridge
Commonwealth Edison Company
Rural Route # 1
Dresden Nuclear Power Station
Morris, IL 60450

Subject: Dresden Units 2 & 3 - Post LOCA Pool Drawdown

References: 1) Telecopy, J.C. Elliott to S. Mintz, "Small Job Authorization," September 21, 1992. (Small Job Task Number DR127)

Dear Ms. Eldridge:

In response to your request and per Reference 1, this letter provides an estimate of the maximum reduction in the Dresden suppression pool level following a loss-of-coolant accident (LOCA). The maximum suppression pool level decrease during a LOCA for Dresden is estimated to be 2.1 feet. This pool level decrease is the same as the value estimated for Quad Cities previously. A comparison of the key parameters between Quad Cities and Dresden confirmed that these plants are essentially identical and therefore allows application of the Quad Cities pool level decrease estimate to Dresden. This pool level decrease can be used together with the lower Technical Specification limit on pool level to determine the minimum post-LOCA pool level.

This estimate of 2.1 feet pool level reduction post-LOCA is based on a conservative analysis of another BWR with a 251 inch ID reactor pressure vessel and a Mark I containment. This analysis considered the water which may be transferred to the reactor pressure vessel, drywell and drywell-to-wetwell vent system from the suppression pool during a LOCA. A more detailed calculation could be performed with the Dresden specific geometry, but it is not expected that the results would change significantly.

Documentation and evidence of verification of this letter is included in the GE design record file, DRF-T23-00692.

Sincerely,

S. Mintz

cc: GE
J. E. Torbeck
C. T. Young
J. E. Nash

Page B1 / Final

The three points listed in Design Input 4.4 for NPSHR versus flow can be plotted and curve fit (See page J2). This quadratic interpolation of these three points was determined as follows:

The NPSHR was defined as a quadratic function:

$$NPSHR = AQ^2 + BQ + C$$

Where Q is the flow rate (gpm) and A, B and C are unknown constants.

The following 3 points are defined in Design Input 4.4:

1. Q=4000 and NPSHR = 25.0
2. Q=5000 and NPSHR = 30.0
3. Q=6012 and NPSHR = 40.9

Substituting these values into the equation listed above will yield a system of equations:

4. $A(4000)^2 + B(4000) + C = 25.0$
5. $A(5000)^2 + B(5000) + C = 30.0$
6. $A(6012)^2 + B(6012) + C = 40.9$

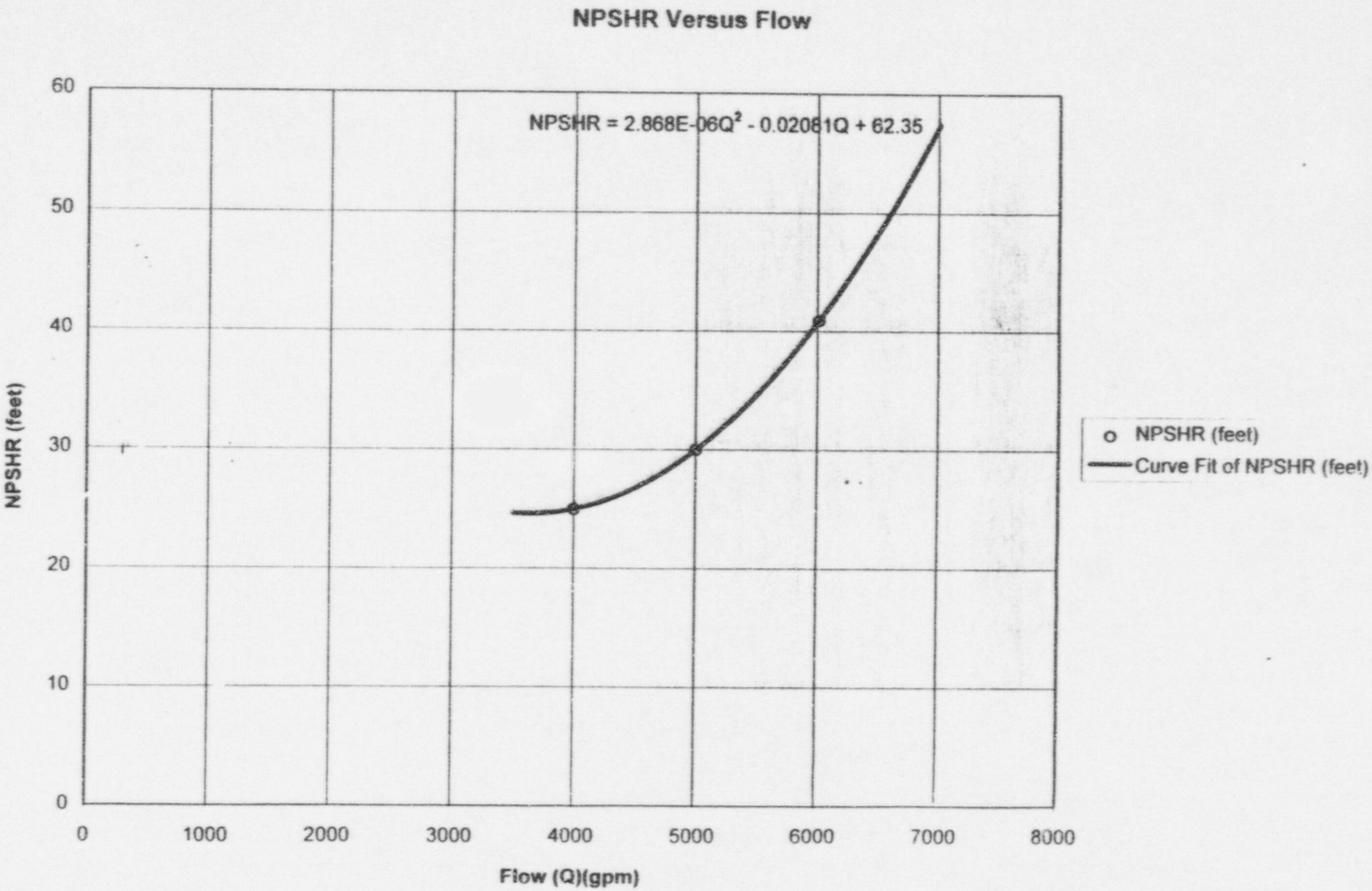
This system of equations can be solved for the values of A, B and C:

$$A = 2.868 \times 10^{-6}$$
$$B = -0.02081$$
$$C = 62.35$$

Substituting these values back into the equation from above yields the quadratic interpolation of NPSHR versus flow:

$$NPSHR = (2.868 \times 10^{-6})Q^2 - (0.02081)Q + 62.35$$

This curve along with the three data points from Design Input 4.4 are shown in the plot on the next page.



Calc. No. QDC-1000-M-0454, Rev. 1

Attachment C
Page C2 (Final)

Table D

SF-LSL: 4 RHR/2 CS Injection						CS (New Design Basis)					CS (Old Design Basis)				
Time (sec)	Available Pool Pressure (psig)	Credited Pool Pressure (psig)	Pool Temp (deg. F)	Specific Volume (ft^3/lb)	P_v (psia)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)
12	21.6	8.0	112.6	0.016175	1.376										
38	23.4	8.0	132.7	0.016260	2.391										
47	23.2	8.0	133.6	0.016263	2.448	6224	43.93	6.29	3.82	9.79	6202	43.60	0.74	6.05	4.57
60	23.1	8.0	133.6	0.016263	2.448	6224	43.93	6.29	3.82	9.79	6202	43.60	0.74	6.05	4.57
80	20.8	8.0	134.2	0.016266	2.487	6224	43.93	6.29	3.86	9.70	6202	43.60	0.74	6.09	4.48
109	18.3	8.0	135.7	0.016274	2.587	6224	43.93	6.29	3.95	9.49	6202	43.60	0.74	6.18	4.27
129	16.8	8.0	137.4	0.016281	2.704	6224	43.93	6.29	4.06	9.24	6202	43.60	0.74	6.29	4.02
146	15.3	8.0	138.6	0.016287	2.789	6224	43.93	6.29	4.14	9.06	6202	43.60	0.74	6.36	3.84
166	13.5	8.0	140.3	0.016295	2.915	6224	43.93	6.29	4.26	8.79	6202	43.60	0.74	6.48	3.57
188	11.3	8.0	141.8	0.016302	3.029	6224	43.93	6.29	4.36	8.54	6202	43.60	0.74	6.59	3.32
209	9.2	8.0	142.8	0.016307	3.106	6224	43.93	6.29	4.44	8.37	6202	43.60	0.74	6.66	3.15
239	6.9	2.5	143.9	0.016313	3.195	6224	43.93	6.29	4.52	-4.74	6202	43.60	0.74	6.74	-9.96
276	5.2	2.5	145.1	0.016319	3.293	6224	43.93	6.29	4.61	-4.96	6202	43.60	0.74	6.83	-10.18
311	4.2	2.5	146.0	0.016323	3.368	6224	43.93	6.29	4.68	-5.13	6202	43.60	0.74	6.90	-10.35
352	3.4	2.5	147.0	0.016328	3.454	6224	43.93	6.29	4.76	-5.32	6202	43.60	0.74	6.98	-10.54
394	3.1	2.5	147.7	0.016332	3.515	6224	43.93	6.29	4.82	-5.46	6202	43.60	0.74	7.04	-10.68
441	3.1	2.5	148.4	0.016335	3.577	6224	43.93	6.29	4.88	-5.60	6202	43.60	0.74	7.10	-10.82
491	3.2	2.5	149.2	0.016339	3.648	6224	43.93	6.29	4.95	-5.75	6202	43.60	0.74	7.16	-10.97
516	3.3	2.5	149.5	0.016341	3.676	6224	43.93	6.29	4.97	-5.82	6202	43.60	0.74	7.19	-11.04
566	3.3	2.5	150.2	0.016344	3.741	6224	43.93	6.29	5.03	-5.96	6202	43.60	0.74	7.25	-11.18
600	3.4	2.5	150.7	0.016347	3.787	6224	43.93	6.29	5.08	-6.07	6202	43.60	0.74	7.29	-11.29

Old Strainer Design Basis vs. New Design Basis (NRC Bulletin 96-03)

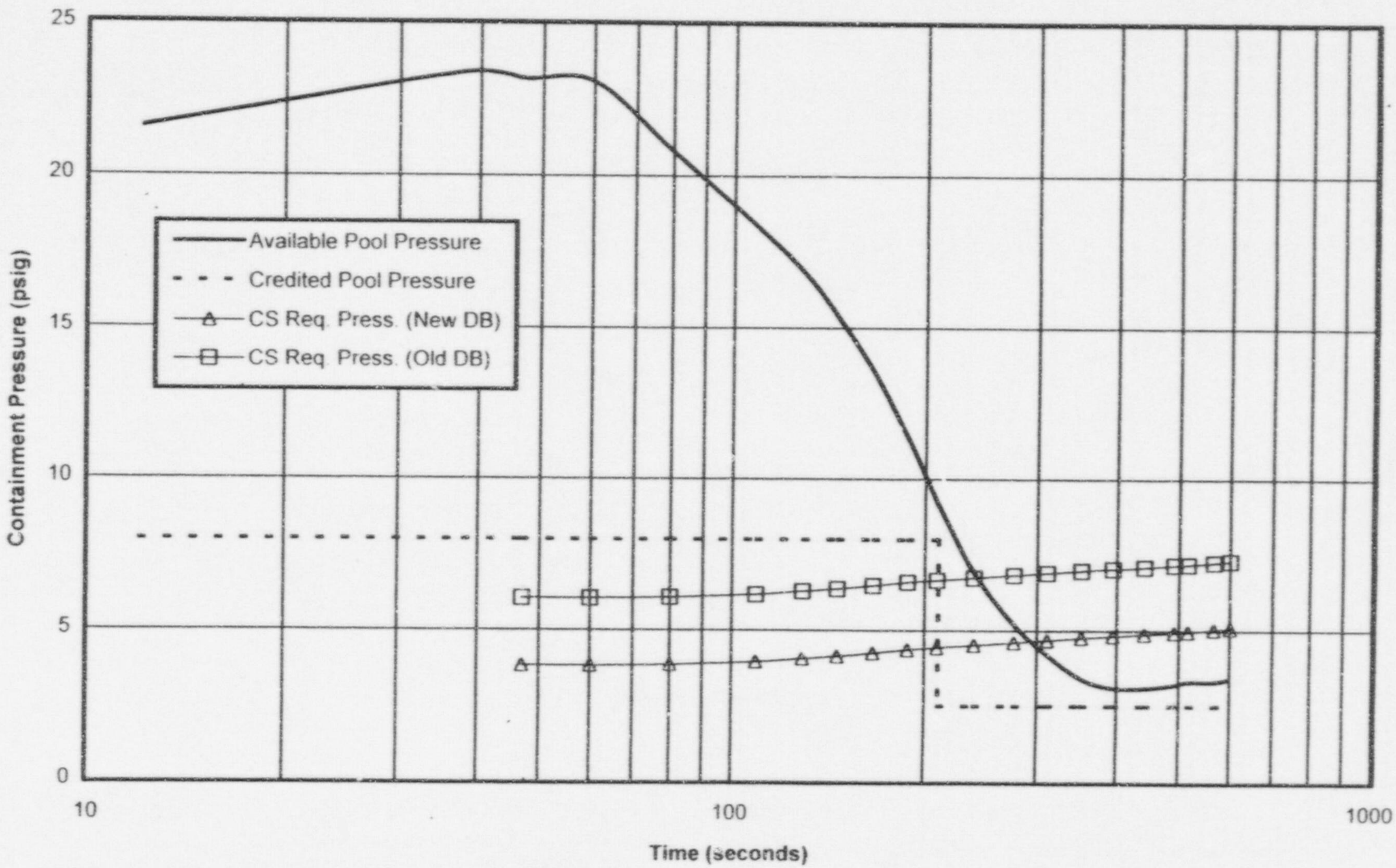
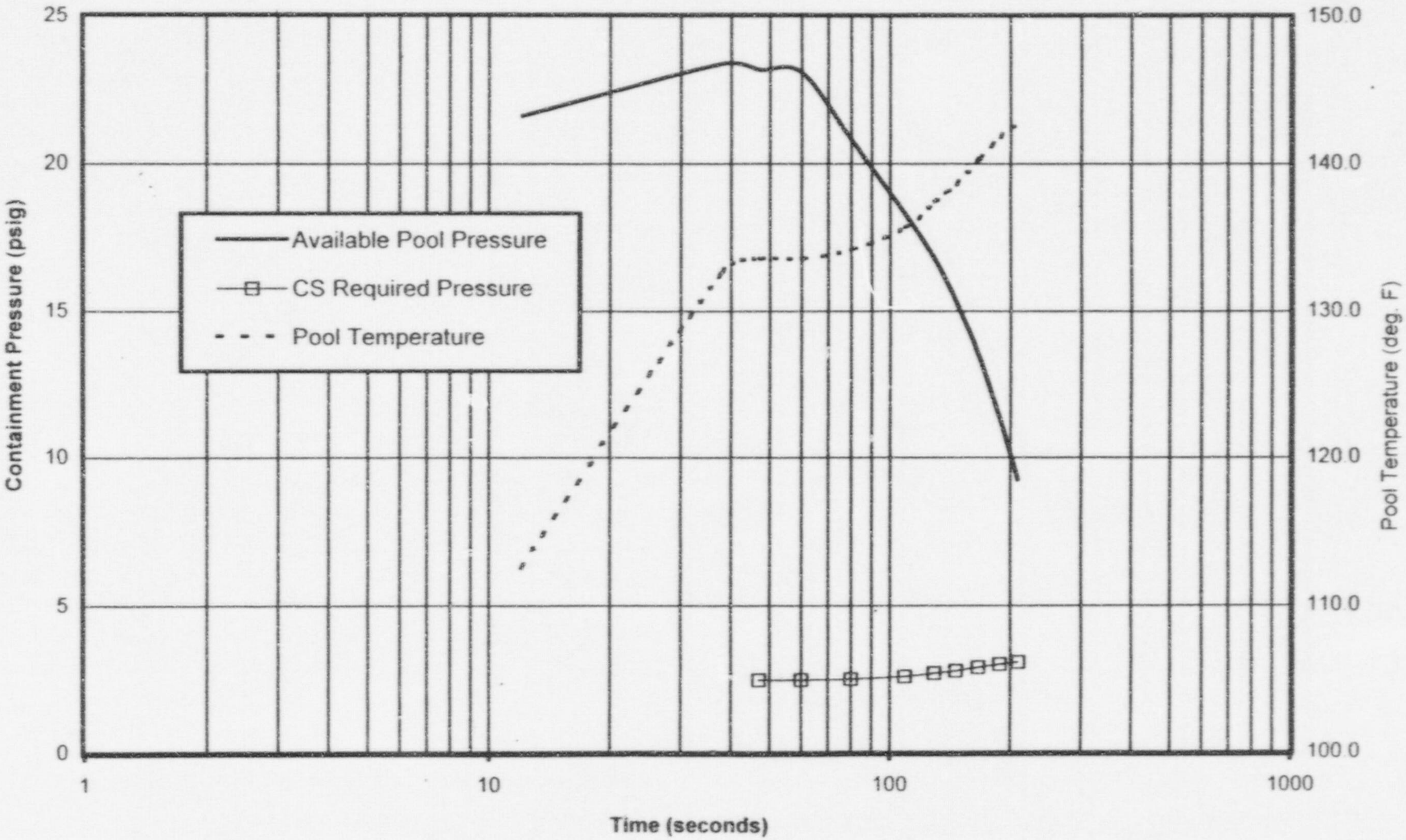


Table E

SF-LSL: 4 RHR/2 CS Injection					CS				
Time (sec)	Available Pool Pressure (psig)	Pool Temp (deg. F)	Specific Volume (ft^3/lb)	P_v (psia)	Flow (gpm)	NPSHR (feet)	$Z - h_f$ (feet)	Required Pressure (psig)	Margin (feet)
12	21.6	112.6	0.016175	1.376					
38	23.4	132.7	0.016260	2.391					
47	23.2	133.6	0.016263	2.448	5650	36.33	1.83	2.48	48.52
60	23.1	133.6	0.016263	2.448	5650	36.33	1.83	2.48	48.29
80	20.8	134.2	0.016266	2.487	5650	36.33	1.83	2.52	42.83
109	18.3	135.7	0.016274	2.587	5650	36.33	1.83	2.61	36.77
129	16.8	137.4	0.016281	2.704	5650	36.33	1.83	2.72	33.01
146	15.3	138.6	0.016287	2.789	5650	36.33	1.83	2.80	29.32
166	13.5	140.3	0.016295	2.915	5650	36.33	1.83	2.92	24.83
188	11.3	141.8	0.016302	3.029	5650	36.33	1.83	3.03	19.42
209	9.2	142.8	0.016307	3.106	5650	36.33	1.83	3.10	14.33

Figure E


Available Pool Pressure
CS Required Pressure
Pool Temperature
Containment Pressure (psig)
Pool Temperature (deg. F)
Time (seconds)
25
20
15
10
5
0
150.0
140.0
130.0
120.0
110.0
100.0
1
10
100
1000

ATTACHMENT C

SVP 98-316

GE Report, GENE-637-022-0893, DRF T23-00711, September, 1993, Quad Cities Nuclear Power Station, Units 1 and 2, "Evaluation of the Minimum Post-LOCA Heat Removal Requirements to Assure Adequate NPSH for the Core Spray and LPCI/Containment Cooling Pumps"