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RECIP.NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Responds to NRC Bulletin 88-004, "Potential Safety-Related Pump Loss."

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FPL

JULY 11 1988

L-88-293

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Re: St. Lucie Plant Unit Nos. 1 and 2
Docket Nos. 50-335 and 50-389
Response to NRC Bulletin 88-04
Potential Safety-Related Pump Loss

On May 5, 1988 the NRC issued NRC Bulletin 88-04 "Potential Safety-Related Pump Loss" which requested all licensees to investigate and address two miniflow design concerns. The first concern involved the potential for the dead-heading of one or more pumps in safety-related systems that have a miniflow line common to two or more pumps or other piping configurations that do not preclude pump-to-pump interaction during miniflow operation. A second concern was whether or not the installed miniflow capacity is adequate for even a single pump in operation. Action item 4 requested a response within 60 days of receipt of the bulletin.

Florida Power & Light Company (FPL) has completed the evaluation of the first concern and completed the first phase of the evaluation of the second concern. The next phase of the evaluation will be to interface with the appropriate pump suppliers and confirm the minimum acceptable recirculation flow rate for each pump. It is anticipated that within 90 days FPL will be able to provide a schedule for completion of the second concern.

IE11

The enclosed report provides a complete response to the first concern and a partial response to the second concern of the bulletin and is submitted under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended. Should there be any questions, please contact us.

Very truly yours,

W. F. Conway
Senior Vice President - Nuclear

WFC/GRM/gp

Enclosure

cc: Dr. J. Nelson Grace, Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, St. Lucie Plant

GRMNRC.BUL

STATE OF FLORIDA)
) ss.
COUNTY OF PALM BEACH)

W. F. Conway being first duly sworn, deposes and says:

That he is Senior Vice President - Nuclear, of Florida Power and Light Company, the Licensee herein;

That he has executed the foregoing document; that the statements made in this document are true and correct to the best of his knowledge, information and belief, and that he is authorized to execute the document on behalf of said Licensee.

W. F. Conway

Subscribed and sworn to before me this 11th day of July, 1988.

Roberta S Economy

NOTARY PUBLIC, in and for the County of Palm Beach, State of Florida

Notary Public, State of Florida
My Commission Expires June 1, 1989
Bonded Thru Troy Fain - Insurance, Inc.

My Commission expires

Re: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
L-88-293

ST. LUCIE PLANT UNITS 1 and 2
RESPONSE TO NRC BULLETIN NO. 88-04
POTENTIAL SAFETY-RELATED PUMP LOSS

ACTION ITEM 4A:

Summarize the problems and systems affected. Action Item 1 requested licensees to promptly determine whether or not their facilities have any safety-related system with a pump and piping system configuration that does not preclude pump-to-pump interaction during miniflow operation and could therefore result in dead-heading of one or more of the pumps.

Action Item 3 requested licensees to evaluate the adequacy of the minimum flow bypass lines for safety-related centrifugal pumps with respect to damage resulting from operation and testing in the minimum flow mode.

RESPONSE to ITEM 4A:

FPL has determined that the following pumps could potentially be affected by either one or both of the NRC's concerns: High Pressure Safety Injection, Low Pressure Safety Injection, Containment Spray, Auxiliary Feedwater and Boric Acid Makeup. Table 1 summarizes the affected safety related pumps, pump vendors, minimum flows, and configuration. An evaluation has been performed and the results are discussed below for each safety related centrifugal pump using a miniflow recirculation design at St. Lucie Plant.

A. Dead-Heading

The first concern regarding the potential for dead-heading a pump when more than one pump is operated through a common recirculation line is addressed below:

1) High Pressure Safety Injection (HPSI) Pumps, Low Pressure Safety Injection (LPSI) Pumps, and Containment Spray (CS) Pumps

o St. Lucie Unit 1 (PSL 1)

On Unit 1, all of the 2" HPSI, LPSI, and CS pump miniflow recirculation lines connect to a common 3" header, which expands to a 6" line to the Refueling Water Tank (RWT). See Figure 1. In a worst case scenario, (LOCA) a maximum of only 6 of the 7 pumps connected to the 3" header have the potential for supplying recirculation miniflow, since only 2 of the 3 HPSI pumps are actuated upon the Safety Injection Actuation Signal (SIAS).

An evaluation of the calculations has determined that dead-heading of a pump will not occur when the pumps are operating at/on miniflow recirculation. The HPSI pump miniflow lines/orifices were sized for a flow of 30 GPM each, the LPSI pump miniflow lines/orifices were sized for a flow of 40 GPM each, and the CS pump miniflow lines/orifices were sized for a flow of 50 GPM each, for a total flow of 240 GPM in the 3" header. These flows represent the minimum flow rates specified by each respective manufacturer. In addition, the calculations evaluated show that:

- The pressure created by the subject pumps to the miniflow recirculation system is greater than the pressure losses (frictional, elevation) in the miniflow system, such that adequate recirculation flows are assured for all pumps.

- Miniflow recirculation piping/orifices are adequately sized to handle this flow.

- The pump performance head curves as seen from the downstream side of the orifices in the miniflow recirculation system are unique in range and amplitude. For each pump there is a distinctive curve which yields discrete values when system piping, configuration and resistances are taken into account.

o St. Lucie Unit 2 (PSL 2)

On Unit #2, there are two separate 3" headers and each 3" header has one HPSI, LPSI, and CS pump miniflow line connected to it. Both 3" headers then flow into a common 6" line to the RWT. See Figure 2. In the worst case scenario, with all 6 pumps on miniflow recirculation simultaneously, it has been determined by calculation that pump dead-heading will not occur. The HPSI pump

miniflow lines/orifices were sized for a flow of 30 GPM each, the LPSI pump miniflow lines/orifices were sized for a flow of 100 GPM each, and the CS pump miniflow lines/orifices were sized for a flow of 150 GPM each, for a total flow of 280 GPM in each 3" header. These flows represent the minimum flow rates specified by each respective manufacturer. The calculations evaluated show that:

- The pressure created by the subject pumps to the miniflow recirculation system is greater than the pressure losses (frictional, elevation) in the miniflow system, such that adequate recirculation flows are assured for all pumps.

- Miniflow recirculation piping/orifices are adequately sized to handle this flow.

- The pump performance head curves as seen from the downstream side of the orifices in the miniflow recirculation system are unique in range and amplitude. For each pump there is a distinctive curve which yields discrete values when system piping, configuration and resistances are taken into account.

2) <u>Auxiliary Feedwater (AFW) Pumps - PSL 1 and PSL 2</u>

Both units have similar piping configurations for the AFW pump miniflow recirculation lines. See Figures 1 and 2. Both units have 2" miniflow lines where the 2" recirculation piping from one pump merges with the 2" recirculation piping from another pump and then both merge into the 2" recirculation piping of the third pump and a common 2" line flows to the Condensate Storage Tank (CST). AFW pump 1A and 1B have restriction orifices sized for 75 GPM and 1C is sized for 100GPM for a total of 250 GPM. AFW pump 2A and 2B have restriction orifices sized for 50 GPM and 2C is sized for 70 GPM for a total of 170 GPM. These flows represent the minimum flow rates specified by each respective manufacturer. The calculations evaluated show that:

- The pressure supplied by the subject pumps to the miniflow recirculation system is greater than the pressure losses (frictional, elevation), in the miniflow system such that adequate recirculation flows are assured for all pumps.

- Miniflow recirculation piping/orifices are adequately sized to handle this flow.

- The pump performance head curves as seen from the downstream side of the orifices in the miniflow recirculation system are unique in range and amplitude. For each pump there is a distinctive curve which yields discrete values when system piping, configuration and resistances are taken into account.

3) Boric Acid Makeup Pumps (BAMU) - PSL 1 and PSL 2

Due to the configuration of the BAMU pumps miniflow recirculation piping for both PSL 1 and PSL 2, the concern for dead-heading is not applicable. This is based on each pump having its own separate miniflow recirculation line to its own individual BAMU Tank, which precludes the possibility of pump-to-pump interaction. See Attachments 1 and 2.

In summary, the calculations evaluated show that for the above discussed pumps dead-heading is not a concern. Graphing each individual miniflow recirculation system performance curve on a flow versus head axis reveals a resultant unique curve with no flat region where the miniflow of any one pump could "backup" on the miniflow of another pump and cause a dead-heading problem. Additionally, the miniflow recirculation system resistance heads are less than the pump heads for all of the interconnected miniflow lines, which precludes the possibility of dead-heading the pumps.

B. Hydraulic Instability

At present, FPL has reviewed maintenance and operating performance histories of all the safety related centrifugal pumps with miniflow recirculation, and has determined that no pump degradation has occurred that can be attributed to operation at mini-flow conditions (i.e., hydraulic instability or impeller recirculation). FPL has contacted all affected pump vendors (See Table 1) and has requested the vendors to review the supplied pumps. The vendors were requested to advise FPL if a potential problem regarding miniflow operation, as addressed in NRC Bulletin 88-04, exists.

ACTION ITEM 4B:

Provide a written response that identifies the short-term and long-term modifications to plant operating procedures or hardware that have been or are being implemented to ensure safe plant operations.

RESPONSE to ITEM 4B:

Based on the information currently available in FPL's Generation Equipment Management System (GEMS) Exception Report for the period of January 1, 1981 through June 27, 1988 and Inservice Testing (IST) Data for the period 1980 through 1988 for PSL 1 and 1983 through 1988 for PSL 2, and the discussions in the response to Item 4A of this evaluation, no modification to operating procedures or hardware are planned. However, dependent upon the results of the pump manufacturer's reviews concerning the "hydraulic instability" concern, plans for modifications, should any be required, will be addressed at that time.

ACTION ITEM 4C:

Provide a written response that identifies an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin.

RESPONSE:

Should any problem arise as a result of the pump manufacturer's evaluation of the hydraulic instability concern, the time necessary for resolution will be dependent on the severity of the problem. Currently, the pump manufacturers (See Table 1) have been requested to respond to this question by August 1, 1988. Within 60 days of the receipt of the manufacturers evaluation, a plan/schedule to resolve any problems will be provided.

ACTION ITEM 4D:

Provide a written response that provides justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 of the Code of Federal Regulations (10 CFR 50), "Emergency Core Cooling" and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors."

RESPONSE:

Justification for continued operation in regards to 10 CFR 50, Appendix A, Criterion 35 and to 10 CFR 50.46, is not required based on the following:

- The design flow configurations were evaluated and the calculations demonstrate that dead-heading is not a concern for continued operation.

- There are no observable trends demonstrating potential degradation of the subject safety related pumps that could be attributable to the hydraulic instability phenomenon.

- Both units have operated without an incident that could be attributed to hydraulic instability. Inservice tests have been conducted on both units monthly with test results conforming to procedure guidelines.

- Hydraulic instability is reported to occur in centrifugal pumps in a low flow condition. Pump operation under all the analyzed accident scenarios provides flow above this region.

ST. LUCIE UNIT 1 PUMP CONFIGURATIONS

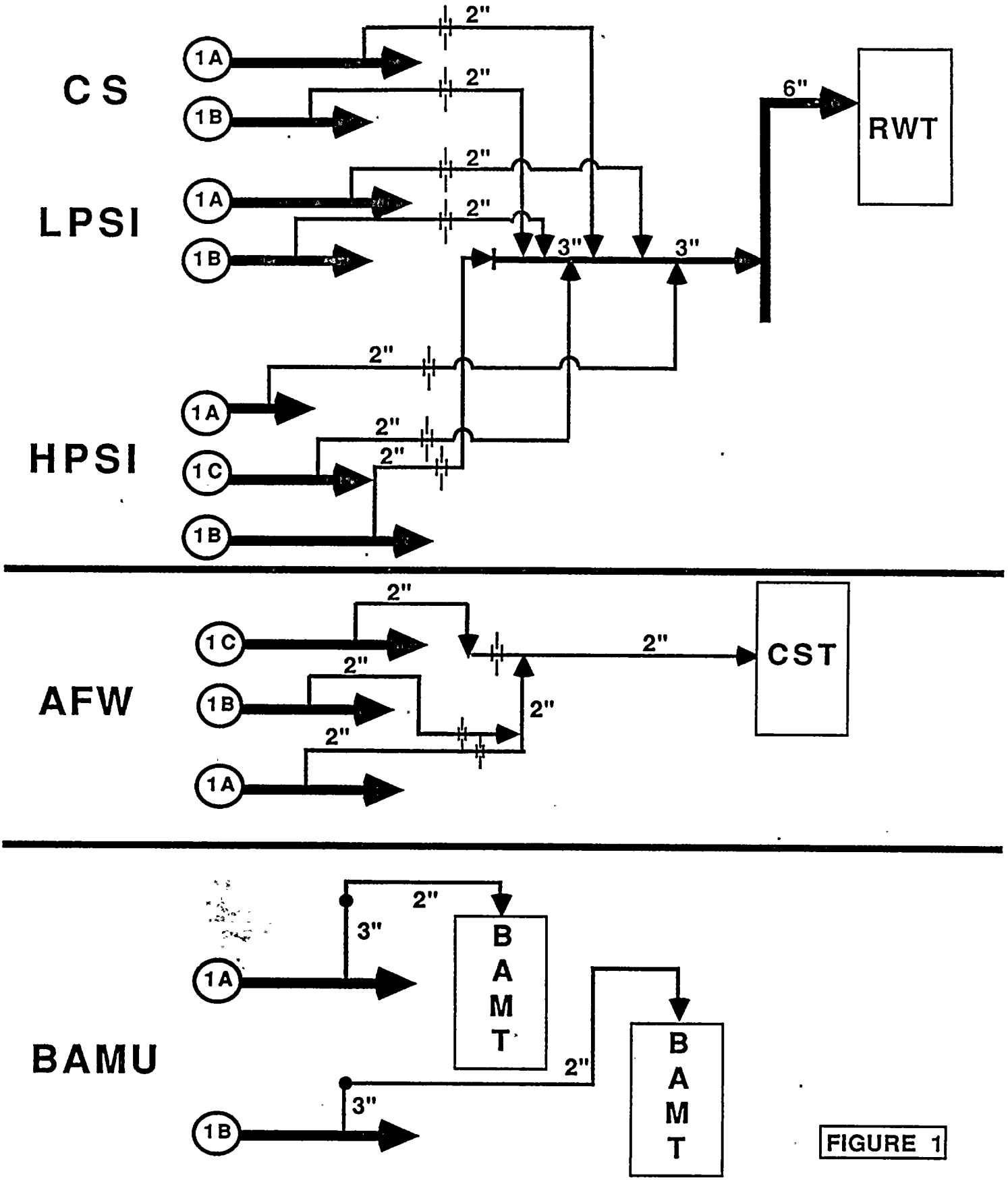
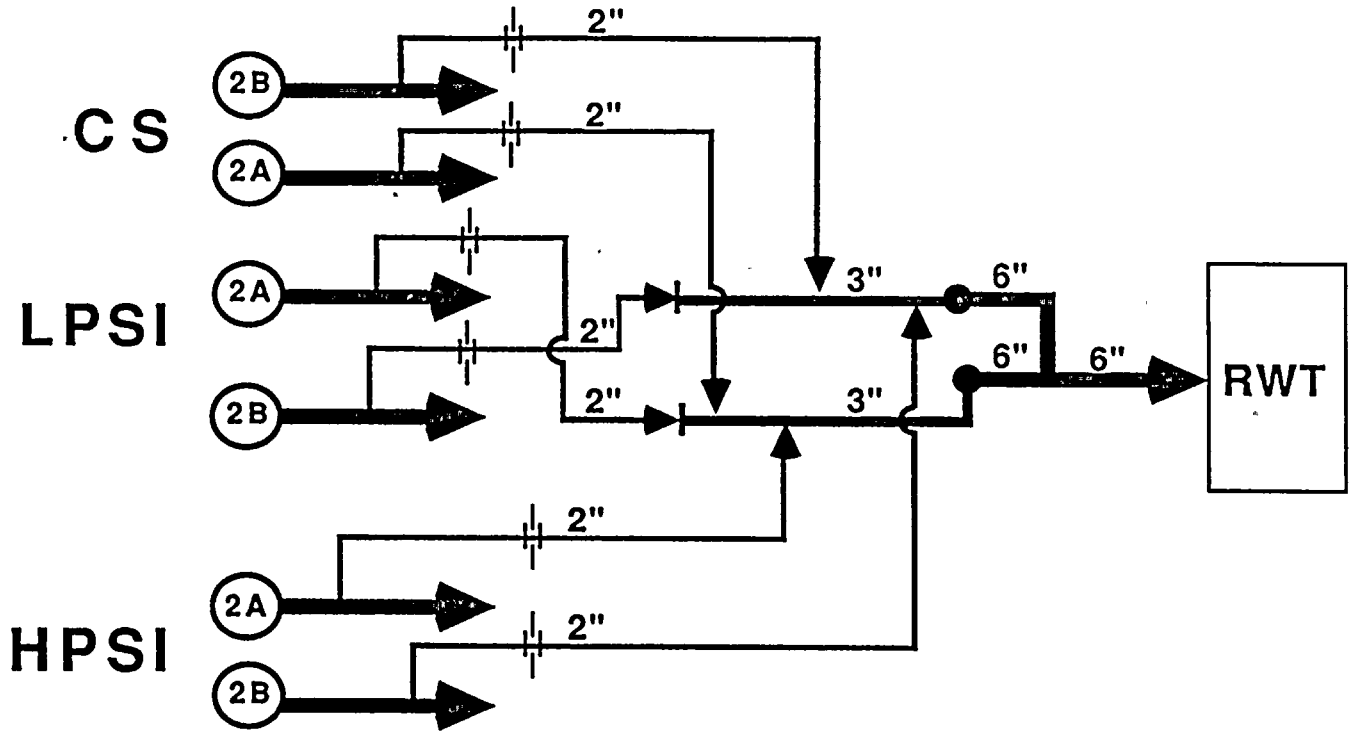
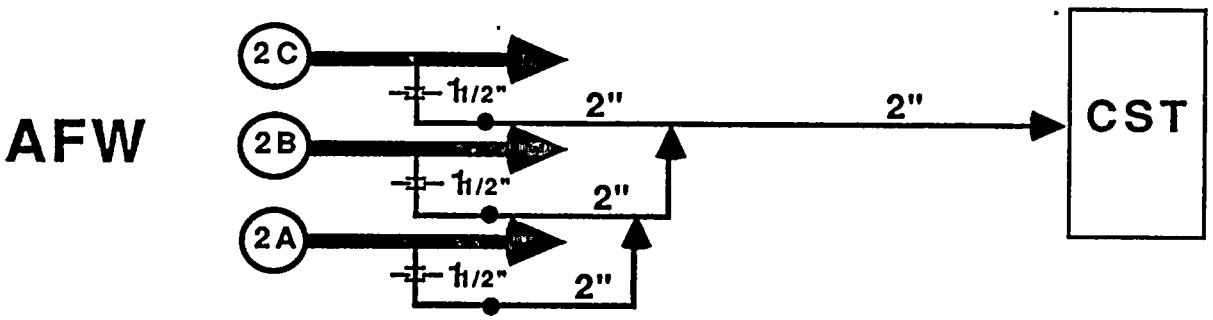


FIGURE 1

ST. LUCIE UNIT 2 PUMP CONFIGURATIONS





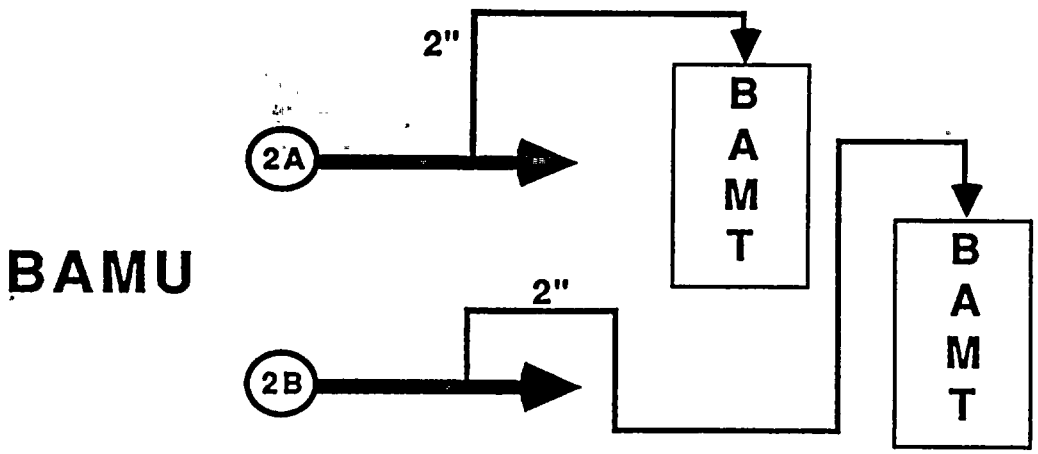


FIGURE 2

Attachment # 3 to
JPE-PSL-SEMJ-88-033
Rev. C

MINIFLOW VALUES AND PUMP MANUFACTURERS

PSL-1

System	Pump	Miniflow (GPM)	Vendor	Common Header?	Return to:
SI	(HPSI) 1A 1B 1C	30	Bingham-Willamette	Yes, one 3"	RWT
	(LPSI) 1A 1B	40	Ingersol-Rand		
CS	1A 1B	50	Byron Jackson		
AFW	1A 1B	75	Byron Jackson	Yes, 2"	CST
	1C	100			
BAMU	1A 1B	10	Goulds	No, 2"Recirc.	BAMT

PSL-2

System	Pump	Miniflow (GPM)	Vendor	Common Header?	Return to:
SI	(HPSI) 2A 2B	30	Bingham-Williamette	Yes, 3"	RWT
	(LPSI) 2A 2B	100	Ingersol-Rand		
CS	2A 2B	150	Ingersol Rand		
AFW	2A 2B	50	Ingersol Rand	Yes, 2"	CST
	2C	70			
BAMU	2A 2B	10	Goulds	No, 2"Recirc	BAMT

TABLE 1