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U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 26, 1977

Mr. Edson G. Case, Acting Director
Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 374B/082977
PO&M/ALH:das
Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Attention: Mr. Robert W. Reid, Chief
Operating Reactors Branch 4

Dear Mr. Case:

We submitted a proposed design change which would allow the LHSI discharge valves to be remotely throttled from the control room. We have recently completed tests which provide information that will be helpful in your review. A complete description of the tests along with an evaluation of the results is provided in the attachment to this letter.

Very truly yours,

C. M. Stallings
C. M. Stallings
Vice President-Power Supply
and Production Operations

Attachment

cc: Mr. James P. O'Reilly

7727200 48

[illegible]	TEST SETUP
[illegible]	E-2-945
INSTRUMENT & CONTROL	

DATA TABLE

STEPPING CALIBRATION

FT-2-945		TY-2-945			FI-2-945								
[illegible]		DESIRED V	ACTUAL V	ERROR V	DESIRED GPM	ACTUAL GPM	ERROR GPM	DESIRED	ACTUAL	ERROR	DESIRED	ACTUAL	ERROR
0		1.000	1.002	+.002	0	0	—						
157		2.000	1.992	-.008	2500	2.450	-50						
314		3.000	2.988	-.012	2535	3.510	-25						
471		4.000	3.993	-.007	4330	4.390	+20						
628		5.000	4.998	-.002	5000	5000	—						
314		3.000	2.992	-.008	3535	3.510	35						
0		1.000	1.002	+.002	0	0	—						

TEST EQUIPMENT	MODEL NO.	SERIAL NO.	STEP NO.
MANOMETER			
GUAGE	Heise	Ser 162	
VOLTMETER	[illegible]	[illegible]	
DECADE BOX			
POWER SUPPLY			
RECORDER			

NOISE: NIL MV P/P AT — MA

TESTED BY [illegible] DATE 2-1-72

APPROVED BY [illegible] DATE 2-1-72

...ELECTRIC EQUIP Co.
... BASE STATION

...STRUMENT & CONTROL

DATA

TABLE

TEST SET UP

F-2-946

REFUELING CALIBRATION

REFUELING CALIBRATION

[illegible]-2-946		TP-2-946			FT-2-946								
[illegible]20		DESIRED V	ACTUAL V	ERROR V	DESIRED GPM	ACTUAL GPM	ERROR GPM	DESIRED	ACTUAL	ERROR	DESIRED	ACTUAL	ERROR
0		1.000	.996	-.004	0	0	—						
57		2.000	2.011	+.011	2500	2500	—						
[illegible]14		3.000	3.018	+.018	3535	3510	-25						
[illegible]71		4.000	4.015	+.015	4330	4350	+15						
[illegible]28		5.000	5.02[illegible]	+.02[illegible]	5000	5000	—						
314		3.000	3.017	+.017	3535	3510	-25						
0		1.000	.996	-.004	0	0	0						

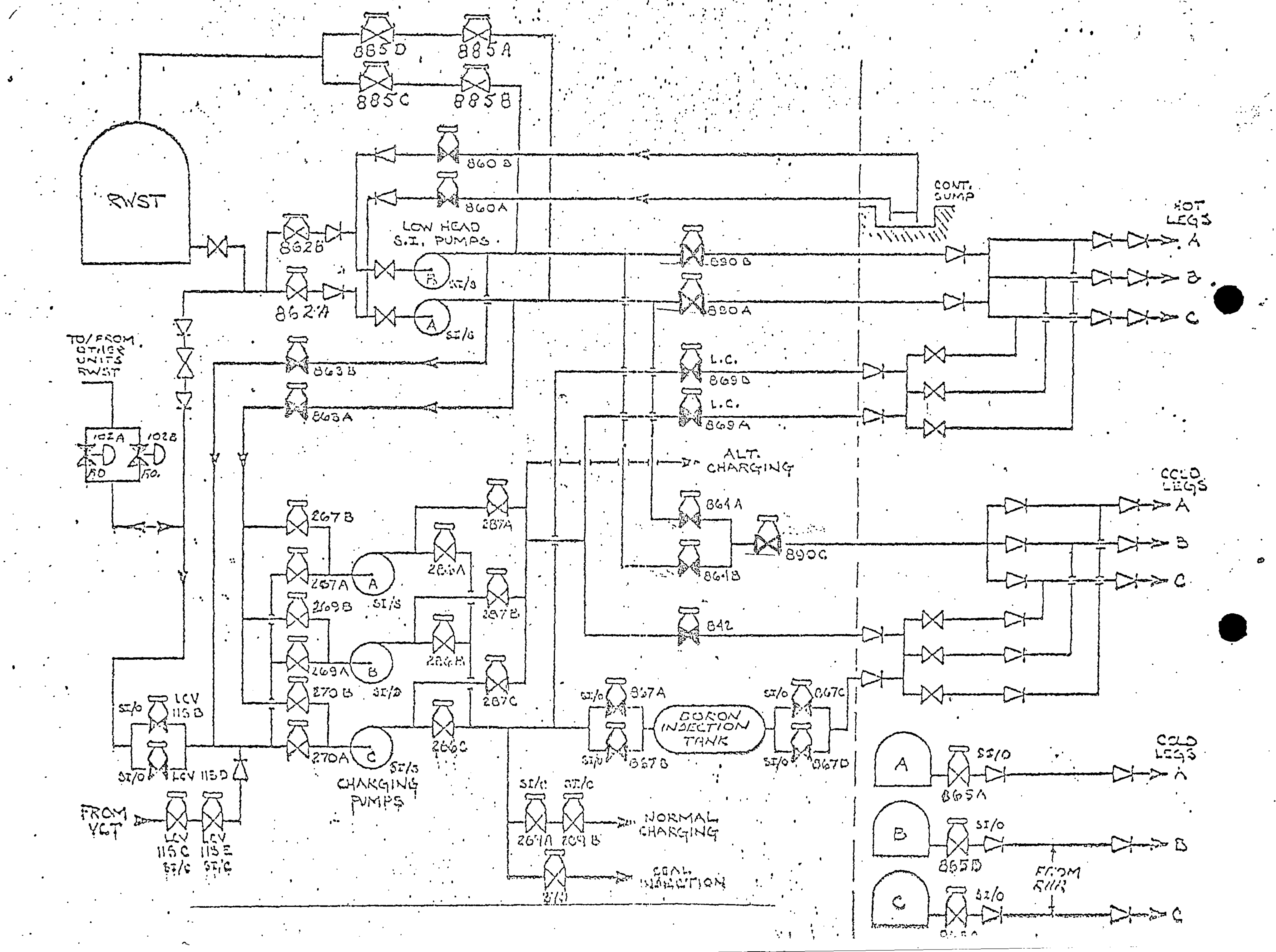
TEST EQUIPMENT	MODEL NO.	SERIAL NO.	STEP NO.
MANOMETER			
GUAGE	Heise	SN [illegible]69	
VOLTMETER	Fluke	SN [illegible]	
DECADE BOX			
POWER SUPPLY			
RECORDER			

NOISE: NA MV PIP AT NA MA

TESTED BY [illegible] DATE 7-1-[illegible]

APPROVED BY [illegible] DATE 7-[illegible]

SI FLOW DIAGRAM



SURRY POWER STATION

UNIT NOS. 1 & 2

LHSI FLOW CONTROL TEST

Purpose of Test

Excessive LHSI pump flow during the recirculation phase of long term cooling can result in inadequate NPSH. This may cause pump cavitation and possible damage. A test was performed to show that LHSI pump flow could be satisfactorily controlled by throttling the gate valves in the pump discharge flow path. The test was also intended to show that the valves could be satisfactorily positioned electrically and that personnel could manually operate the valves in a reasonable time period.

Test Description

For test purposes, the hot leg injection valves (MOV 890 A&B) were selected to control flow. The attached SI flow diagram shows the test line-up. The cold leg valves were not used for the following reasons: 1) During the test, the reactor vessel head was partially lifted and cold leg injection would subject core components to lift forces; 2) Cold leg injection would sweep crud deposits from core surfaces causing high levels of general area radiation and contamination to exist in the vicinity of the refueling cavity. Valve position during the test was controlled by manual operation of the valve handwheel and by electrically "jogging" the valve motor.

A "dry run" was performed prior to the flow test to simulate actual operator response during LOCA. This was to determine that sufficient time exists for an operator to manually position the injection valves between

the time an RWST low level alarm occurs and the time the minimum useable volume is reached.

Test Procedure and Results

Initial conditions were established as follows: 1) Adequate RWST inventory and chemistry were verified; 2) Required electrical systems were verified operable; 3) Reactor cavity was made ready for flooding; 4) LHSI pump flow instrument calibration records (attached) were checked; 5) Valve lineups were made to assure proper suction and discharge flow paths; 6) Reactor cavity was flooded to a one foot level to verify reactor cavity seal tightness.

Both LHSI pumps were started and flow established at 2100 ±50 GPM per pump by manually positioning MOV 890 A&B. Valve position was then varied to assure that flow could be changed in 100 GPM increments. During this phase of the test the operator did not experience any difficulty moving the valve even though high differential forces existed across the valve disc. There was no evidence of valve vibration or excessive flow noise during this test. Each valve was approximately 2 inches open with 2100 ±50 GPM flow through each LHSI pump. The recirculation valves (MOV 885 A, B, C, D) were momentarily shut to verify that no measurable flow change would occur. As predicted the measured flow did not change noticeably. This is due to the fact that recirculation line resistance is approximately 1000 times greater than injection line resistance. This is further verified by the monthly LHSI flow test where actual recirculation flow is measured at $\sim$300 GPM with all other flow paths isolated. The recirculation valves were opened for the remainder of the testing.

The purpose of throttling flow to $\leq$2100 GPM for two pump operation

is to assure that loss of one LHSI pump doesn't result in excessive "run out" flow on the remaining pump. Therefore, one LHSI pump was tripped to determine the effect on flow. When this occurred the flow on the operating pump increased only by about 150 GPM. This seemed inconsistent with our predictions at first, but after examining the differences between cold and hot leg injection piping it became obvious as to why such a small flow change occurred. The cold leg injection piping is such that pump back pressure provides a significant portion of total system resistance in the two pump configuration. The pump discharge piping is joined together very near to the pumps. This would result in larger flow increases when one LSHI pump trips during cold leg injection. The hot leg injection piping is essentially two separate paths until it gets into the coolant loops and thus, pump backpressure would not be a significant factor in total system resistance. Tripping one LHSI pump during hot leg injection should not result in a significant increase of flow through the remaining pump.

In the single LHSI pump test configuration, flow was manually varied between 2100 GPM, and 3200 GPM to demonstrate flow control. Again the operator had no difficulty operating the valve. As flow increased, it was noted that the instrumentation oscillated more widely until at 3200 GPM the variation was ±150 GPM. The valve was approximately 2.75 inches open at 3200±150 GPM. No noticeable vibration or excessive flow noise existed in this condition.

The tests described above were then repeated and flow controlled by "jogging" the valve motor operator electrically. With two LHSI pumps running flow was controled at 2100±50 GPM with no difficulty. The operator was able to change flow in 100 GPM increments with no difficulty. With one

pump running the operator varied flow from 2100±50 GPM to 3200±150 GPM with no difficulty. The time required to change flow from 2100±50 GPM to 3200± 150 GPM by valve "jogging" was less than one minute.

The flow test was concluded by opening MOV 890 A&B fully and running both LHSI pumps to fill the reactor cavity in preparation for refueling.

The "dry run" tests were performed by directing an operator to shut the fully open MOV 864 valves using the manual handwheels. Operator action was completed in less than six minutes for both valves. The LOCA procedure requires that LHSI flow be throttled to 2100 GPM for each pump commencing at the time an RWST low level alarm occurs (54,000 useable gallons remaining). If it is assumed that each LHSI pumps is operating at 4000 GPM until its valve is in its final position and that two HHSI are operating at 600 GPM each continuously, the operator would complete the valve operation with at least 4,500 useable gallons remaining in the RWST.

Conclusions

The tests demonstrated that LHSI pump flow can be controlled by throttling the hot leg injection gate valves. Although flow testing through the cold leg injection valves was not performed, similar performance is expected due to valve similarity. The loss of one LHSI pump will not result in pump cavitation due to excessive flow "runout". No unusual or excessive forces are required to operate the valves even with high differential pressures across the discs. No excessive flow induced valve vibration will occur as a result of throttling. Electrical "jogging" of the valves was not difficult from the standpoint of positioning accuracy and it proved to be a very expeditious method of valve operation.

It is concluded that manual valve throttling is a satisfactory method

of controlling LHSI pump flow during LOCA, but electrical "jogging" is much more appropriate since it can be done safely and quickly from the control room with minor electrical modifications.