Proposed Change No. 145

Telephone 617 366-9011

TWX
710-390-0739

Regulatory Docket File

YANKEE ATOMIC ELECTRIC COMPANY

WYR 77-1

YANKEE

20 Turnpike Road Westborough, Massachusetts 01581

January 6, 1977

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation

Subject: Yankee Rowe Proposed ECCS MOdification for Core XIII

References:
(a) License No. DPR-3 (Docket No. 50-29)
(b) Letter from W. P. Johnson to USNRC, WYR-76-119, (November 22, 1976)
(c) Meeting with NRC Staff on October 22, 1976, regarding Yankee Rowe ECCS/Accumulator Modification

Dear Sir:

Pursuant to Section 50:59 of the Commission's Rules and Regulations, Yankee Atomic Electric Company hereby proposes the following modification.

PROPOSED CHANGE: Yankee Atomic Electric Company proposes modifications to the Emergency Core Cooling System as described in the enclosed System Description.

REASON FOR CHANGE: This change is designed to improve performance of the Emergency Core Cooling System as detailed in the System Description.

SAFETY CONSIDERATIONS: A safety evaluation is included in the System Description. This submittal has been reviewed by the Nuclear Safety Audit and Review Committee.

SCHEDULE OF CHANGE: In accordance with the schedule proposed in Reference (b), as requested by Reference (c), we are forwarding the ECCS modifications which comprises a portion of Proposed Change No. 145 for Yankee Rowe Core XIII.

Technical Specification changes will be submitted by April 15, 1977.

An analysis of the 0.6 DECLG break size for Core XIII performed with assumptions consistent with the ECCS modification will be submitted informally as soon as possible while, the Yankee Rowe Core XIII Performance Analysis will be submitted formally to the Staff by April 15, 1977.

The proposed modification will be installed prior to the startup of Core XIII.

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Any further questions regarding the system modifications should be directed to Mr. Paul A. Rainey at our Engineering Office, 20 Turnpike Road, Westborough, Massachusetts 01581, (617) 366-9011 (extension 2862), while questions regarding the core analysis should be directed to Mr. William J. Szymczak (extension 2844).

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

W P Johnson

W. P. Johnson
Vice President

COMMONWEALTH OF MASSACHUSETTS)
)ss.
COUNTY OF WORCESTER)

Then personally appeared before me, W. P. Johnson, who, being duly sworn, did state that he is Vice President of Yankee Atomic Electric Company, that he is duly authorized to execute and file the foregoing request in the name and on the behalf of Yankee Atomic Electric Company, and that the statements therein are true to the best of his knowledge and belief.

Armand R Soucy

Armand R. Soucy Notary Public
My Commission Expires September 9, 1977

YANKEE ROWE ECCS MODIFICATION

SYSTEM DESCRIPTION

PROPOSED CHANGE NO. 145

REASON FOR CHANGE

The reason for this modification is to achieve lower peak clad temperatures following a LOCA. To achieve this objective, modifications to the accumulator portion of the Emergency Core Cooling System are herein proposed. The modifications proposed shorten the time required to recover the bottom of the core by increasing the accumulator flow rates through higher operating pressures and assure adequate accumulator inventory by utilizing its full volume and delaying its pressurization. Delaying the pressurization of the accumulator prevents the loss of inventory during the time the reactor coolant system depressurizes to a pressure equal to the operating pressure of the accumulator. The delay period extends about six seconds, beyond the equalization time, into the blowdown phase.

PROPOSED SYSTEM CHANGES

The present Emergency Core Cooling System is shown on Figure FM-83A and is described in the Yankee Rowe Hazards Summary. Yankee proposes to modify the accumulator and pressure regulating portion of the system. The changes proposed are summarized below:

1. The operating pressure is to be increased from 337 to 500 psig.

2. The accumulator operating volume will be increased from 800 ft^3 to approximately 850 ft^3 to provide the maximum accumulator inventory. A small expansion tank will be added to accommodate thermal expansion.

3. A third parallel 50% capacity nitrogen regulating valve is to be added.

4. The high pressure nitrogen storage is to be increased from 12 bottles to 18 bottles.

5. Additional valves will be added as indicated in Figure SK-1 to control pressurization and depressurization.

6. A third pilot operated safety valve will be added to accommodate the increased nitrogen capacity.

7. Instrumentation and controls will be provided to control and monitor the required functions.

SYSTEM OPERATION

The Emergency Core Cooling System is described in Section 212 of the Final Hazards Summary Report. This change modifies only those portions related to the pressurization/depressurization and inventory of the accumulator portion of the system. The accumulator portion of the system is shown schematically on Sketch 1. During normal power operation, the accumulator is maintained, filled and depressurized and the nitrogen storage tanks are filled in accordance with technical specifications.

In the unlikely event of a large loss of coolant accident, the accumulator will function as described below.

SUMMARY OF OPERATIONS

1. Depressurization of the main coolant system and/or pressurization of the containment causes protective instrumentation to actuate a safety injection actuation signal (SIAS) at 1,700 psig in the main coolant system or at 5 psig in the vapor container.

2. In addition to the functions described in the Hazards Summary, the SIAS energizes two timers in each of the two protective channels. As each timer completes its run, it closes its contacts. When both sets of timer contacts close, the solenoid (NS-SOV-46 or 47) is energized, and the pressure is vented off the pneumatic operators causing the three pneumatic valves (SI-TV-604, 605 and 606) to open and pressurize the accumulator.

3. By this time, the reactor has proceeded into its blowdown phase and injection water from the accumulator flows to the reactor via the three intact loops. However, the blowdown analysis assumes that the injection water continues leaving the reactor via the broken loop until the end of reactor blowdown. At the end of bypass, credit for refilling the vessel is taken for all of the water entering the vessel. In the meantime, a portion of the injection flow is lost directly to the vapor container via the broken loop.

4. When the accumulator level descends to the 150 ft^3 level, the four accumulator level switches (LS-1, LS-2, LS-3 and LS-4), close and actuate their respective auxiliary relays (LSX-1, LSX-2, LSX-3 and LSX-4). Contacts from these auxiliary relays are used in the relief valve solenoid circuitry, in the MOV-1 circuitry, and the 4" pneumatic valve (SI-TV-608) solenoid circuitry. MOV-1 and the 4" pneumatic valve (SI-TV-608) close while the relief valves (SI-SV-1, 2 and 609) bleed off the accumulator pressure.

5. From this point on the ECCS functions as it does in the existing system as described in the Hazards Summary.

DETAILED OPERATING DESCRIPTION

Pressurization

Flow from the accumulator will be initiated by opening the three parallel pneumatically operated valves in the nitrogen supply piping. The regulators (SI-PR-58, 59 and 602) in series with the valves (SI-TV-604, 605 and 606) maintain the 500 psig accumulator pressure.

The valves are arranged in parallel so that the system will perform its intended safety function if one of the valves fails to operate. The valves are kept closed during normal operation by nitrogen pressure supplied to their pneumatic operators from either of the two full capacity bottles and regulators (NS-PR 41 and 42). A low pressure alarm is provided in the control room and a safety valve set at 120 psig provides overpressure protection. Valve operation is initiated by actuation of either of the two SIAS's. Each SIAS protective channel activates two timers to each of the two three way solenoid valves (NS-SOV-46 and 47) which are powered from separate batteries.

After a preset timer operation, the three way solenoid valves (NS-SOV-46 and 47) are energized. They simultaneously shut off the nitrogen supply and vent nitrogen from the valve actuator opening the valves (NS-TV-604, 605 and 606) by spring action. The solenoid valve cannot be actuated until both timers have completed their run and the solenoid valve is energized. A total of four timers are required for the two solenoid valves (2 per solenoid). Operation of either solenoid results in all three pneumatic valves opening. An accumulator high pressure alarm alerts the operator to improper valve position or a leaking valve.

Depressurization

Nitrogen is prevented from entering the reactor coolant system by closing either MOV-1 or the 4" pneumatic valve (SI-TV-608) and by opening the safety valves (SI-SV-1, 2 and 609).

Four level switches (LS-1, LS-2, LS-3, LS-4) are located on the accumulator at the low level setpoint. When the accumulator level descends to the low level setpoint, the four accumulator level switches close and actuate their respective auxiliary relays (LSX-1, LSX-2, LSX-3, LSX-4). Contacts from auxiliary relays LSX-1 and LSX-2 are used to energize solenoid valves NS-SOV-45 and SI-SV-56. Contacts from auxiliary relays LSX-3 and LSX-4 are used to energize solenoid valve SI-SV-57 and energize the closing coils of the dual motor starters for MOV-1.

The power for the control circuit of solenoid valves NS-SOV-45 and SI-SV-56, and for auxiliary relays LSX-1 and LSX-2 is from station battery no. 1. The power for the control circuit of solenoid valve SI-SV-57 and for auxiliary relays LSX-3 and LSX-4 is from station battery no. 3.

Safety Valves (See Elementary Diagram)

There are two solenoid valves (SI-SV-56 & 57) either of which can bleed the pressure off the safety valve dome causing all the valves to lift.

When accumulator level switches LS-1 and LS-2 close, they actuate their respective auxiliary relays LSX-1 and LSX-2. Contacts from these relays are used to energize solenoid valve SI-SV-56 which opens causing the safety valves to open. Both level switches and auxiliary relays must be actuated for the solenoid valve to be energized.

The operation of the control circuit for the other solenoid valve (SI-SV-57) is similar. When accumulator level switches LS-3 and LS-4 close, they actuate their respective auxiliary relays LSX-3 and LSX-4. Contacts from these relays are used to energize solenoid valve SI-SV-57, which opens, causing the safety valves to open. As before, both level switches and auxiliary relays must be actuated for the solenoid valve to be energized.

Operation of either solenoid will cause the safety valves to relieve.

4" Pneumatic Valve (See Elementary Diagram)

When accumulator level switches LS-1 and LS-2 close, they actuate their respective auxiliary relays LSX-1 and LSX-2. Contact from these relays are used to energize solenoid valve NS-SOV-45. When the solenoid valve is energized, it opens and nitrogen is admitted to the operator which closes the 4" pneumatic valve (SI-TV-608).

Both level switches and auxiliary relays must be actuated for the solenoid valve to be energized; thus preventing a single failure or spurious signal from closing the valve.

Position indication is provided at the safety injection control panel in the control room, and at the valve itself.

MOV-1 (See Elementary Diagram)

During normal operation, MOV-1 is open. The closing coils in the dual motor starters are both deenergized. When the accumulator level descends to the 150 ft^3 level, level switches LS-3 and LS-4 close and actuate their respective auxiliary relays LSX-3 and LSX-4. Contacts from these auxiliary relays are used in the closing circuit of the dual motor starter. When the contact from auxiliary relay LSX-3 closes, the closing coil of the reversing motor starter is energized. This action permits the control circuit of the non-reversing contactor to receive power. Since the contact from auxiliary relay LSX-4 has previously been closed, the closing coil of the non-reversing contactor is energized, and MOV-1 closes.

Both level switches, auxiliary relays, and closing coils must be actuated for MOV-1 to close automatically; thus preventing a single failure or spurious signal from closing the valve.

MOV-1 can also be closed from the safety injection control panel in the control room by the operation of two control switches CS-1 and CS-2. Control switch CS-2 is keylocked in the open position.

Power for the control circuit of auxiliary relays LSX-3 and LSX-4 is from 125 volt dc station battery no. 3.

Position indication is provided at the safety injection control panel in the control room and manual position indication at the valve itself.

If either MOV-1 or the 4" pneumatic valve (SI-TV-608) close, flow is effectively terminated and nitrogen is not introduced into the reactor coolant system.

BOTTLES AND PIPING

The six additional nitrogen bottles will each have an isolation valve and a safety valve. The bottle outlets will be welded into a new two inch header. This new header and the existing header will join and a new 4" line will be run to the accumulator room. Once inside the room, the 4" line will divide into the three parallel three inch piping systems which each contain two isolation valves, a pressure regulator, and the normally closed pneumatic valves (SI-TV-604, 605 or 606).

The three parallel lines rejoin into a 4" line equipped with the pneumatically operated valve (SI-TV-608) and the pipe is welded to the accumulator nozzle which is equipped with a thermal sleeve.

NITROGEN SUPPLY TO PNEUMATIC OPERATORS

The three normally closed pneumatic valves (SI-TV-604, 605 & 606) are held closed by nitrogen supplied by 2 small nitrogen bottles. Each bottle is equipped with a regulator (NS-PR-41 & 42) which supplies 80-120 psig nitrogen.

On loss of nitrogen pressure, the valves will be forced open by spring force. As previously described, two normally de-energized three-way solenoid valves (NS-SOV-46 & 47) each of which is energized by a separate battery, provide the mechanism for venting the nitrogen to open the valves.

The 4" pneumatic valve No. SI-TV-608 is held open by spring force. As previously described, the valve is closed by energizing the three-way solenoid valve (NS-SOV-45) powered from the #1 battery. This admits nitrogen to the operator from the small bottles.

NITROGEN SUPPLY TO SAFETY VALVES

A third relief valve (SI-SV-609) is being provided for increased accumulator venting capability (SK-2). Line pressure act above and below the main piston of the safety valves. Since the area above the piston is greater than the area below the piston, the safety valves remain closed.

The tubing which connects the line pressure to the dome area above the piston has an orifice which limits nitrogen flow to the dome area.

Since the accumulator will be de-pressurized, any sudden increase in pressure would cause the valve to relieve since the orifice delays line pressure from reaching the dome, and creates a large differential pressure which causes the relief valve to open. This is prevented by a check valve (SI-V-610, 611 and 612) installed in the tubing which supplies line pressure to the dome. Two small full capacity bottles each equipped with full capacity regulators (SI-PR-613 & 614) which supply 500 psig gas will tie into the tubing between the check valve and the dome, thereby preventing the relief from lifting prematurely.

An orifice will be installed in the regulator outlet line so that the valve will relieve when pressure is bled off the dome.

Pressure can be bled off the dome by operation of the pilot valve when the overpressure setpoint is reached or by operation of either of the two solenoid valves (SI-SV-56 & 57) which are operated by the accumulator level switches. A pressure alarm will alert the operators to a low regulator pressure condition.

SYSTEM ADVANTAGES

1) Lower peak clad temperature.

2) System reliability is increased by the ability to monitor the downstream pressure of each regulator.

3) No operator action is required.

4) Protected against single failure and spurious valve operation.

5) Protected against single erroneous operator control manipulation during an accident.

TESTING

The individual components will be tested to insure that they perform as designed.

SAFETY EVALUATION

The Emergency Core Cooling System is a Safety Class 2 system and is designed to perform its safety function following a loss of coolant accident occurring simultaneously with a loss of offsite power and a single failure. The attached failure analysis table addresses that portion of the system within the scope of this modification.

This modification has given consideration to potential problems associated with water hammer, pipe whip, accumulator overpressurization, flooding and fire and YAEC believes that this change does not present significant hazards not described or implicit in the safety analysis report and does not involve an unreveiwed safety question as described in 10CFR50.59(a)(2).

CODES AND STANDARDS

All major equipment shall be designed and installed per the appropriate specifications of the Yankee Atomic Electric Company "Engineering Guideline Book", and shall be equal to or better than the original equipment. Piping will be designed in accordance with Stone & Webster Engineering Corporation specification YS-4652 dated July 28, 1970 entitled "Shop and Field Fabrication Nuclear Piping for Revised Arrangement of Safety Injection and Shield Tank Cavity Water Piping." This specification was approved by Yankee Atomic Electric Company Engineering. Materials of major components shall comply with ASME or ASTM specifications.

The following is a listing of the major equipment and the codes they will be designed to:

3" & 4" Valves

ASME Section III - Class NC - 1500#@100°F

4" x 6" Safety Valve

ASME Boiler and Pressure Vessel Code - Section VIII.

Piping

Carbon Steel - ANSI B36.10

Stainless Steel - ANSI B36.19

Fittings

2" and smaller - ANSI B16.11

greater than 2" - ANSI B16.9 or B16.5

Flanges - ANSI B16.5

Large Nitrogen Bottles

ASME Section VIII - Division 1

3" Regulator

600# ANSI B16.5

QUALITY ASSURANCE

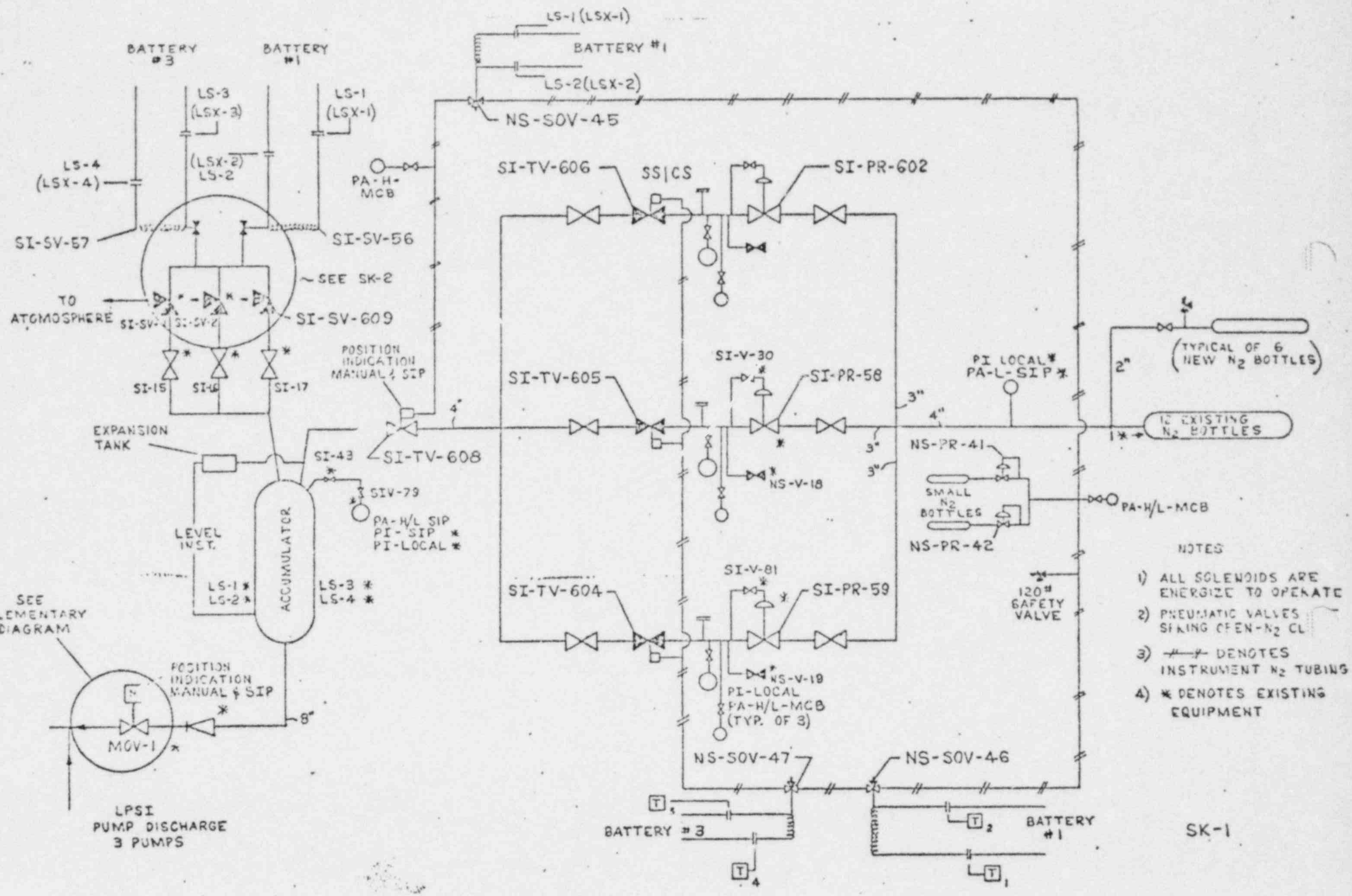
The design, procurement, inspection, assembly, fabrication and testing of this system modificati all be conducted in accordance with the appropriate approved p ures per the Yankee Atomic Electric Company, "Operations Guideline Bo".

FAILURE ANALYSIS TABLE

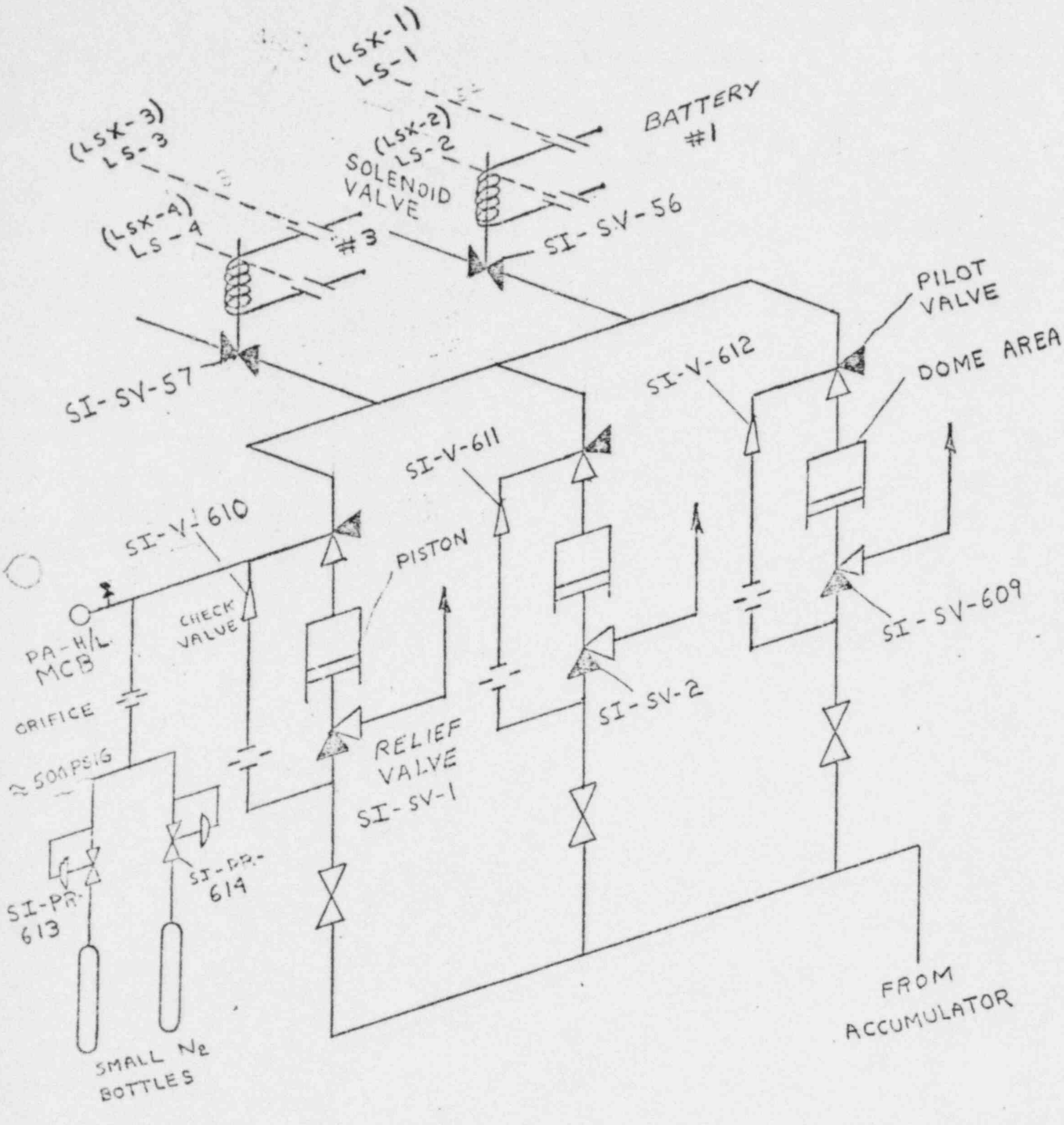
COMPONENT FAILED	NATURE OF FAILURE	COMPLETION OF SAFETY FUNCTION
Timers	a. Fails to open solenoid	a. Timers in redundant channel function.
	b. Premature closure	b. Circuit cannot be completed until the second timer closes solenoid valve contact precluding opening of solenoid valve.
Pneumatically Operated Valve	Fails to open	Redundant valve opens and permits flow from accumulator.
N_2 Regulator	Fails to open	The two redundant regulators will provide the required flow.
Level Switch (LS)	a. Contacts fail to close	a. The level switches in the redundant Protective Channel will function
	b. Premature closure of contacts	b. Circuit cannot be completed until the separate auxiliary relay contacts in series close precluding premature actuation.
Pilot Operated Safety Valve	Fails to open	The two redundant pilot operated safety valves will provide the required venting.
MOV-1	a. Fails to close	a. The 4" pneumatic valve secures nitrogen supply.
	b. Premature closure of contacts	b. Circuit cannot be completed until the separate auxiliary relay contacts in the dual motor starter close precluding premature closing.

FAILURE ANALYSIS TABLE
(continued)

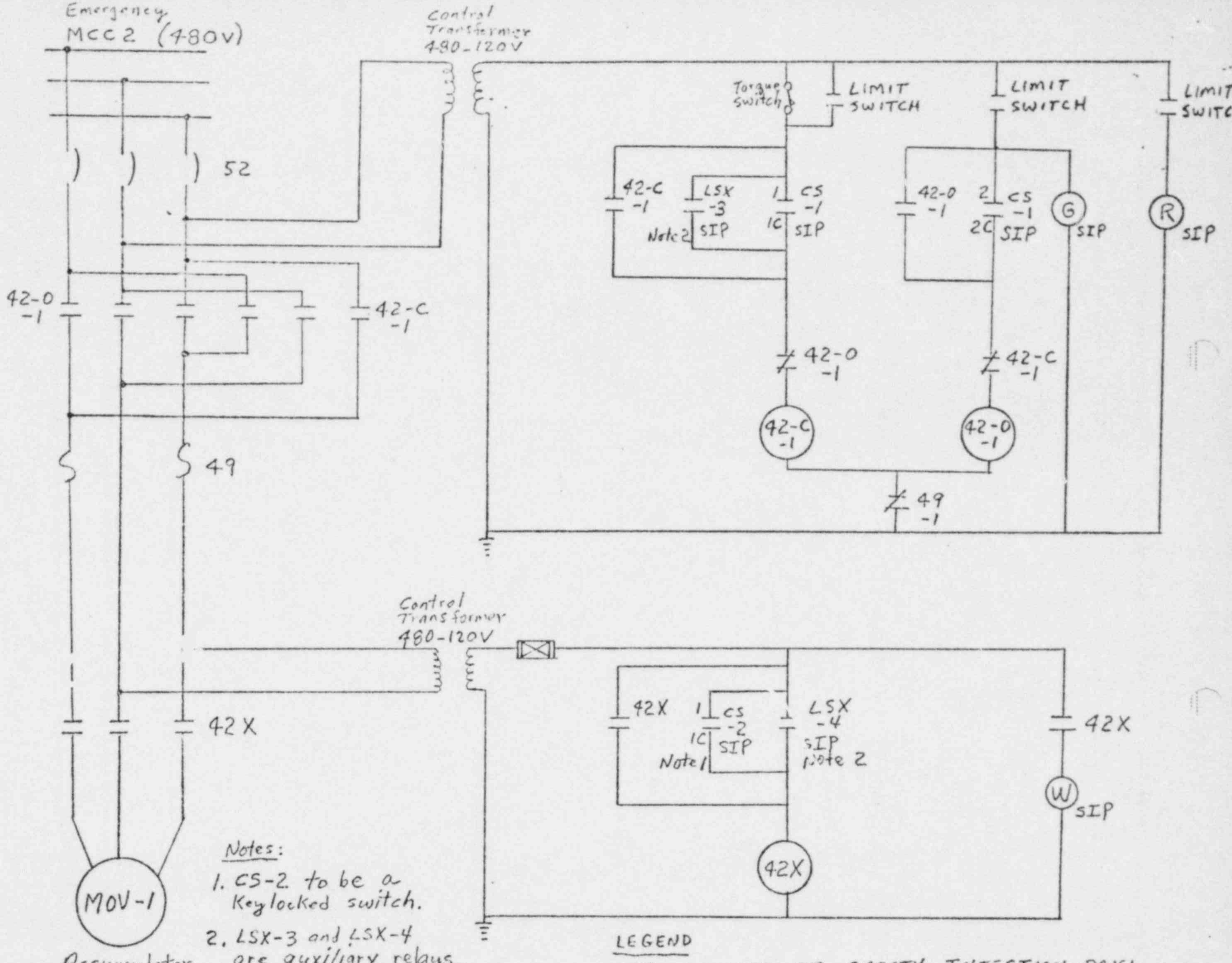
COMPONENT FAILED	NATURE OF FAILURE	COMPLETION OF SAFETY FUNCTION
4" Nitrogen Supply Valve	a. Fails to close	a. MOV-1 closes
	b. Premature closure of contacts	b. Circuit cannot be completed until the separate auxiliary relay contacts in series close precluding premature closing.


BATTERY #3
BATTERY #1
LS-3 (LSX-3)
LS-1 (LSX-1)
LS-4 (LSX-4)
(LSX-2) LS-2
SI-SV-57
SI-SV-56
~SEE SK-2
TO ATMOSPHERE
SI-SV-609
SI-15
SI-16
SI-17
EXPANSION TANK
LEVEL INST.
LS-1 *
LS-2 *
ACCUMULATOR
LS-3 *
LS-4 *
SI-43
SIV-79
PA-H/L SIP
PI-SIP *
PI-LOCAL *
POSITION INDICATION MANUAL & SIP
SI-TV-608
PA-H-MCB
LS-1 (LSX-1)
BATTERY #1
LS-2 (LSX-2)
NS-SOV-45
SI-TV-606
SS|CS
SI-PR-602
SI-TV-605
SI-V-30
SI-PR-58
NS-V-18
SI-TV-604
SI-V-81
SI-PR-59
NS-V-19
PI-LOCAL
PA-H/L-MCB
(TYP. OF 3)
NS-SOV-47
NS-SOV-46
BATTERY #3
BATTERY #1
PI LOCAL *
PA-L-SIP *
NS-PR-41
SMALL N_2 BOTTLES
NS-PR-42
PA-H/L-MCB
120# SAFETY VALVE
(TYPICAL OF 6 NEW N_2 BOTTLES)
12 EXISTING N_2 BOTTLES
SEE ELEMENTARY DIAGRAM
POSITION INDICATION MANUAL & SIP
MOV-1
LPSI PUMP DISCHARGE 3 PUMPS
NOTES
1) ALL SOLENOIDS ARE ENERGIZE TO OPERATE
2) PNEUMATIC VALVES SEEKING OPEN-N_2 CL
3) —//— DENOTES INSTRUMENT N_2 TUBING
4) * DENOTES EXISTING EQUIPMENT

SK-1


(LSX-1)
LS-1
BATTERY
#1
(LSX-2)
LS-2
(LSX-3)
LS-3
SOLENOID
VALVE
#3
(LSX-4)
LS-4
SI-SV-56
SI-SV-57
PILOT
VALVE
SI-V-612
DOME AREA
SI-V-611
SI-V-610
PISTON
CHECK
VALVE
PA-H/L
MCB
SI-SV-609
SI-SV-2
ORIFICE
RELIEF
VALVE
SI-SV-1
≈ 500 PSIG
SI-PR-
614
SI-PR-
613
SMALL N2
BOTTLES
FROM
ACCUMULATOR

SK-2



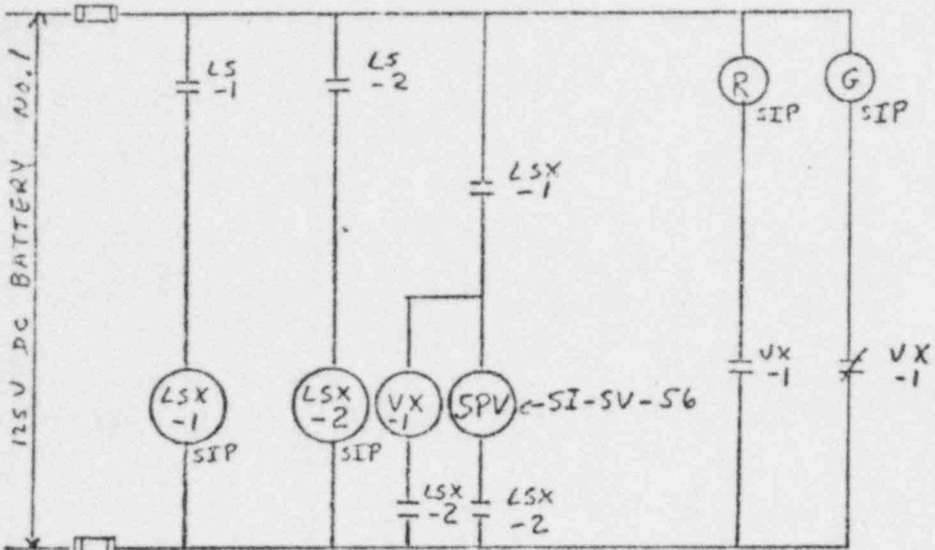
Notes:

1. CS-2 to be a Keylocked switch.
2. LSX-3 and LSX-4 are auxiliary relays.

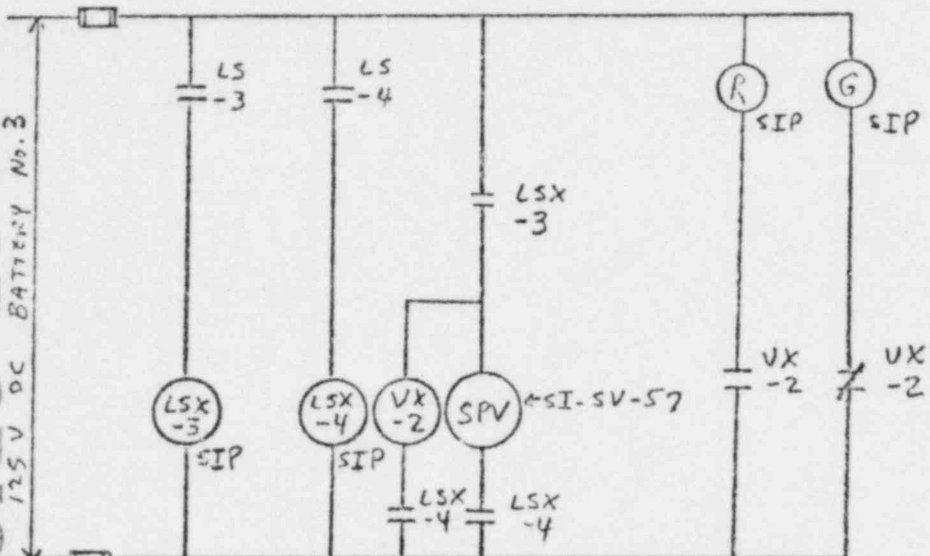
LEGEND

SIP - LOCATED AT SAFETY INJECTION PANEL

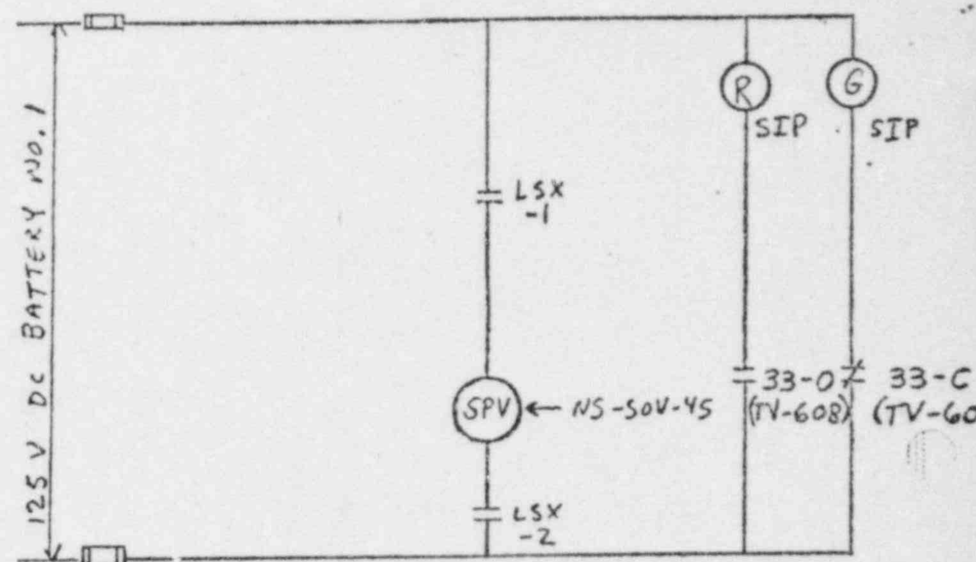
ELEMENTARY DIAGRAM FOR MOV-1



LP TANK RELIEF VALVE NO. 1



LP TANK RELIEF VALVE NO. 2



4" PNEUMATIC VALVE (SI-TV-608)

LEGEND

SIP - LOCATED AT SAFETY INJECTION PANEL
LS - LEVEL SWITCH

ELEMENTARY DIAGRAM FOR RELIEF VALVES AND 4" PNEUMATIC VALVE

NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

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Westborough, Mass
W P Johnson

DATE OF DOCUMENT: 1-6-77

DATE RECEIVED: 1-10-77

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DESCRIPTION

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2 p

PLANT NAME: Yankee Rowe

ENCLOSURE

Amdt to OL/Change to Tech Specs #145: Consisting of revisions to Appendix A with regard to modifications to the ECCS system.....(40 cys encl rec'd)

22 p

DO NOT REMOVE

ACKNOWLEDGED

SAFETY	FOR ACTION/INFORMATION	ENVIRO	1-11-77 ehf
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	CASE	KNIGHT				BALLARD
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	HARLESS	PAWLICKI		STELLO		
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	MELTZ		/	GRIMES		VOLLMER
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NRC FORM 195 (2-76)