GPU Nuclear
P.O. Box 480
Middletown, Pennsylvania 17057
717-944-7621
Writer's Direct Dial Number:

August 6, 1982
4400-82-L-0116

TMI Program Office
Attn: Dr. B. J. Snyder, Program Director
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Update of the Standby Reactor Coolant Pressure Control System System Description

Enclosed is an update of the Standby Reactor Coolant Pressure Control System System Description which specifically deals with RCS drain down from the CRDM Quick Look. The added material appears on pages 12 and 37. Additionally, Table 5 on page 24 has been updated to provide additional information on the Borated Water Batching Tank. The enclosed revision should be added to your copy of the Unit 2 Recovery System Descriptions and Technical Evaluation Reports.

If you have any questions, please contact J. E. Larson.

Sincerely,

B. K. Kanga

B. K. Kanga
Director, TMI-2

BKK/JJB/jep

Attachment

CC: L. H. Barrett, Deputy Program Director - TMI Program Office

D009

THREE MILE ISLAND NUCLEAR STATION UNIT 2

RECOVERY PROGRAM

STANDBY REACTOR COOLANT PRESSURE CONTROL SYSTEM

SYSTEM DESCRIPTION

Revision 1

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FOR

STANDBY REACTOR COOLANT PRESSURE CONTROL SYSTEM

APPENDIX

TMI UNIT 2

SYSTEM DESCRIPTION

STANDBY REACTOR COOLANT PRESSURE CONTROL SYSTEM

1.0 INTRODUCTION

1.1 System Functions

The functions of the Standby Reactor Coolant Pressure Control System are to:

a. Maintain the Reactor Coolant System in a water-solid condition for long term reactor core natural circulation cooling by automatically compensating for coolant volumetric decreases in the Reactor Coolant System due to system leakage or thermal contraction.

b. Maintain the Reactor Coolant System pressure at 100 $\pm$ 10 psig with the Pressurizer solid and Pressurizer heaters out of service.

c. Provide adequate NPSH to the reactor coolant pumps if it becomes necessary to use one. This was an original design function of the system and is no longer required in the reduced pressure mode of operation.

NOTE: This system is designed to maintain pressure on the RC System, not relieve pressure. It is possible to have an RC system pressure higher than standby pressure control system pressure.

The Standby Reactor Coolant System Pressure Control System interfaces with the following systems:

a. Reactor Coolant Makeup and Purification.

b. Demineralized Water.

c. Instrument Air.

d. Balance of Plant Electrical MCC 2-32A, MCC 2-42A and USS 2-45.

1.2 Summary Description of the System

The Standby Reactor Coolant Pressure Control System is used to maintain the Reactor Coolant System pressure within ± 10% of a set value by maintaining the volume of the solid Reactor Coolant System. Borated water degassed to less than 15cc (STP)/kg and less than 100 ppb oxygen is added from the Standby Pressure Control Surge Tanks to the Reactor Coolant System through the MU-P-1C discharge lines. Three 900 gallon surge tanks are connected in series and pressurized with nitrogen at the desired reactor coolant pressure. Only the most remote tank from the Reactor Coolant System is normally directly pressurized with nitrogen to minimize the amount of nitrogen in solution, by keeping the water to gas interface to a minimum.

The Nitrogen Pressure Control System consists of 2 banks of 6 cylinders connected to a common header. Each cylinder contains 56 water cubic feet of nitrogen. One bank of N_2 Cylinders is in the operating mode with pressure maintained between 225 psig and 375 psig. The other bank of N_2 Cylinders is in the non-operating mode with pressure maintained greater than 400 psig but less than 800 psig and is used for periodic makeup to the operating cylinders. Pressure to the surge tanks is remotely set and maintained automatically by two 100% nitrogen regulators for normal and expected transient flow rates of nitrogen addition. Two additional regulators (100% each) are provided for manual control of system pressure and are normally isolated.

The surge tank levels are maintained by supplying makeup degasified borated water to the system through a Variable Charging Pump (VCP) or either of two redundant Charging Pumps. These pumps take suction from the Charging Water Storage Tank (SPC-T-4), and discharge to the outlet line from the surge tank nearest the Reactor Coolant System. Normally the VCP functions to add makeup water to the system at approximately the same rate as primary leakage, thus holding level and pressure in surge tank SPC-T-3 constant. Large volume additions into the system are met by the two Charging Pumps. If the Variable Charging Pump is not available one of the Charging Pumps would start on low level in SPC-T-3. The nitrogen in tank SPC-T-3 is compressed, raising the pressure of the Standby Pressure Control System and the RC System to the vent regulator setpoint. Nitrogen is automatically vented from the surge tank inlet line to preclude pressure from exceeding 10% of setpoint pressure as the water level rises to the high level setpoint. The Charging Pump is automatically tripped at the high level setpoint, and the vent regulator then closes, leaving the system at a pressure 10% or less above the original setpoint. As the system makes up for reactor coolant leakage, the level in surge tank SPC-T-3 drops, and the pressure decreases to the regulators' setpoints. The system will continue to cycle in this manner from the set pressure to +10% or less until the system pressure setpoints are

changed. Without the VCP operating to maintain a stable level, the lead charging pump will cycle on for 6 minutes and off for 60 minutes, based on the 4 gpm design leakage rate.

Makeup to the Charging Water Storage Tank is from the Borated Water Batching Tank. When level in the Charging Water Storage Tank (CWST) reaches the low end of the normal range, borated water at 3500-4500 ppm boron is mixed and transferred under manual control from the Borated Water Batching Tank until the Charging Water Storage Tank level is restored.

The surge tanks can be recirculated to the Charging Water Storage Tanks to ensure the boron solution remains homogeneous. Recirculation is accomplished by circulating water via SPC-P-1A, -1B, or -3 through SPC-T-1, SPC-T-2, SPC-T-3 and throttling the discharge to SPC-T-4 with either SPC-V-18B or SPC-V-12B to maintain level in SPC-T-3.

The Standby Reactor Coolant Pressure Control System components are located in the new fuel storage cell on the 331' level and at the 347' level of the Fuel Handling Building.

The Standby Reactor Coolant Pressure Control System is connected to the RC System through existing high pressure injection piping on the discharge of the Makeup Pump MU-P-1C. Locked-closed isolation valves are provided to ensure the makeup pumps do not discharge to the RC Pressure Control System.

1.3 System Design Requirements

The Standby Reactor Coolant Pressure Control System is operated to control the reactor coolant pressure at 100 $\pm$ 10 psig continuously. Operation of the SPC System with nitrogen gas pressures between 225-375 psig produces an 80 gpm injection rate into the RCS which is great enough to cover the design maximum shrink and which, concurrently, will not overpressurize the lower design pressure interconnected systems. Operation of the SPC at pressures higher than 400 psig could conceivably result in overpressurization assuming subsequent failures of the control valves coupled with failure of the SPC dump valve. To preclude this from occurring the gas pressure in the operating bank of nitrogen cylinders is reduced to 225-375 psig to allow SPC operation concurrently with DH-V1 or 171 opened and with a lower design pressure system exposed. This operating band will allow some margin between system operating pressure and the maximum pressure (400 psig) that system pressure relief can accommodate.

Redundant instrumentation and controls are provided for all essential active components to ensure system reliability. System piping, except for the nitrogen piping of the cylinder manifolds, is designed in accordance with ANSI B31.1. The nitrogen cylinder manifold piping is designed to the Compressed Gas Association Standards. All system liquid piping is compatible with water at 200°F and 4500 ppm boron. The design pressure is 600 psig for the liquid system up to the tie-in isolation check valves, and 1500 psig from the two check valves to the tie-in point on the high pressure injection line. The nitrogen piping through the regulator outlet stop valves is designed for 2500 psig. Downstream of the regulator outlet stop valves the nitrogen piping is designed for 600 psig.

Provision is made for the addition of chemicals to the system, and sampling points are provided at the CWST outlet and the surge tank outlets. Provision is also made to establish and maintain a low pressure nitrogen blanket in the CWST to reduce the dissolved oxygen gas concentration in the system to less than 100 ppb.

2.0 DETAILED DESCRIPTION OF SYSTEM

2.1 Components

2.1.1 Standby Pressure Control Surge Tanks, SPC-T-1 through T-3

Three Surge Tanks (Table 1) are arranged in series at elev. 331' in the new fuel storage cell to provide for ingurge to the RC System. The tanks have a capacity of 900 gallons each, and are rated at 2735 psig and 300°F. The tanks are ASME Section III, Class 2. Tank connections include a 6" inlet on the top, and a 6" bottom outlet. The inlet lines are provided with taps for two redundant level transmitters. Each tank is provided with nozzles (near the bottom) to accommodate the level transmitters.

2.1.2 Charging Pumps, SPC-P-1A, SPC-P-1B

Two 40 gpm positive displacement Charging Pumps (Table 2) take a suction on the Charging Water Storage Tank, and as selected, transfer either 40 or 80 gpm of degasified, 160°F water into the surge line downstream of Surge Tank SPC-T-1. Both pumps are located at elev. 331' in the Fuel Handling Building and are 480V, 3 Phase, 60 Hz, powered from MCC 2-32A (SPC-P-1A) and MCC 2-42A (SPC-P-1B).

Each pump is protected from the potential effects of an overpressure condition by a backpressure - compensated relief valve set at 600 psig on the discharge, and a thermal relief valve set at 80 psi on

the auction. The pump discharge relief valve relieves to the auction line and the auction relief valve relieves to a 55 gallon drum open to the atmosphere. This arrangement minimizes the potential for liquid discharge.

Each Charging Pump is also provided with a self-contained primary packing cooling system. A packing cooling pump (Table 3) supplies demineralized water from a tank to the zone between the high pressure and low pressure packing of the cylinders, and returns the water to the cooling tank.

2.1.3 Charging Water Storage Tank, SPC-T-4

The Charging Water Storage Tank (Table 4) is a 5100 gallon capacity tank located on the 347' elevation of the Fuel Handling Building. It serves as a holdup/degasification point from which the VCP and the 40 gpm Charging Pumps transfer borated water to the surge tanks. The tank is provided with external strip heaters totaling 113.4 KW that maintain tank water temperature at 160°F for degasification purposes. The heaters are powered from USS 2-45, and are 480V, 3 Phase, 60 Hz. Since the tank is at an elevated temperature, it is insulated with 2" of insulation.

The CWST is also provided with two pressure regulators in series to supply low pressure nitrogen (1 to 2.5 psig.) from the nitrogen storage cylinders. A vent line with a manual vent valve and flow meter is provided to purge air from the tank while makeup is supplied by the nitrogen regulators.

In addition to supplying a holdup volume serving the pumps, the tank has provision for a continuous spray from the combined charging pump discharge header so that spray may be actuated for degasification whenever a charging pump is operating. The recirculation line also provides for bypass flow to allow the VCP to operate continuously within its control band with RC leakage less than 2 gpm.

To further meet the overall system total dissolved gas criteria of 15 cc/kg and 100 ppb oxygen, a flow path may also be established from the outlet of the first surge tank (SPC-T-3), into the Charging Water Storage Tank such that a continuous discharge flow from the surge tank may be established to degas the surge tank water. To maximize the effectiveness of this operation, the level in SPC-T-3 is reduced to a minimum.

2.1.4 Borated Water Batching Tank, SPC-T-5

The Borated Water Batching Tank (Table 5) is located on the 347' level of the Fuel Handling Building. It provides for batch mixing of boric acid and demineralized water (500 gallon batches). Hydrazine is also batch mixed to scavenge oxygen.

The Borated Water Batching Tank is a 632 gallon, austenitic stainless steel tank with a hinged cover for boric acid addition. The maximum useful volume of the tank is 500 gallons. The tank has an internal level gauge with 10 gallon graduations up to 500 gallons. The tank is provided with three 15 KW heaters, powered from MCC 2-32A, which are manually energized to heat the water to aid in dissolving the boric acid and degasing the water. The tank is filled with demineralized water at approximately 20 gpm using hoses from the Cask Cleaning Station on the 347' level in the FHB. To enhance the batch mixing process, a motor operated mixer is provided. The mixer is powered from MCC 2-32A, and is 480V, 3 phase, 60 Hz.

2.1.5 Borated Water Transfer Pump, SPC-P-2

The Borated Water Transfer Pump (Table 6) is located on the 347' level of the Fuel Handling Building, and is used to transfer borated water from the batching tank to the Charging Water Storage Tank. The pump has a capacity of 50 gpm at a 35 foot discharge head. The Borated Water Transfer Pump motor is 480V, 3 phase, 60 Hz., and is powered from MCC 2-32A.

2.1.6 Nitrogen (N_2) Supply

The nitrogen supply subsystem of the Standby RC Pressure Control System is located on the 347' level of the FHB.

Nitrogen is supplied to the RC Pressure System from two racks of six N_2 cylinders each. The cylinders are arranged in a paralleled array with one rack aligned to provide N_2 to the RC Standby Pressure Control System at all times. Each bottle has a capacity of 56 water cubic feet at up to 2400 psig. One rack is sufficient to meet design transient requirements.

Each manifold is provided with overpressure protection in the form of two relief valves, set to relieve to the atmosphere at 2450 psig. Each cylinder is also protected against overpressure by a rupture disc set between 3307 and 3675 psi.

2.1.7 Nitrogen Reducing Station

The nitrogen reducing station consists of four control regulators, two of which are set by manually adjusting the loading regulators and two which may be controlled from the Unit 2 control room. Each regulator is sized to accomodate the design surge rate of the system. These valves are set such that they provide the desired N_2 pressure to Surge Tank SPC-T-3.

The N_2 reducing station also provides overpressure protection for the pressure reducing valve manifold with a relief valve set at 600 psig.

Provision exists to automatically vent the N_2 inlet line to Surge Tank SPC-T-3 through a manually-adjustable backpressure regulating valve station located downstream of the N_2 manifold outlet check valve. The regulating valve is adjusted from the control room. This is the normal way to maintain SPC-T-3 pressure within 10% of the setpoint pressure during refill of SPC-T-3.

2.1.8 Variable Charging Pump, SPC-P-3

The Variable Charging Pump (Table 7) takes a suction on the Charging Water Storage Tank (SPC-T-4) and discharges into the surge line downstream of Surge Tank SPC-T-1. The pump is located at elev. 331' in the Fuel Handling Building and is powered from MCC 2-42A. Pump capacity is automatically adjusted from 2 to 10 GPM by a level signal from surge tank SPC-T-3.

The pump is protected from the potential effects of an overpressure condition by a discharge backpressure-compensated relief valve set at 600 psig and a suction (thermal) relief valve set at 80 psig. The suction relief valve relieves to a 55 gallon drum open to the atmosphere. The pump discharge relief valve relieves to the suction line and then via the suction (thermal) relief valve, if it's setpoint is exceeded, to a 55 gallon drum open to the atmosphere.

2.2 Instruments, Controls, Alarms, and Protective Devices

System instrumentation and controls are listed in Table 8, and panel mounted annuciators and computer inputs are listed in Table 9.

Three panels are provided for controls and indication. One panel, SPC-PNL-1, contains local controls near the surge tanks at elevation 331' in the fuel handling building. The second panel, SPC-PNL-2, contains local controls for the borated water batching tank and transfer pump at the 347' level. The third panel, SPC-PNL-3, is located in the control room, and contains the remote instrumentation, and controls.

Instrumentation and controls are summarized below by the equipment or function they serve.

2.2.1 Surge Tanks, SPC-T-1, 2, & 3

a) SPC-T-1

SPC-T-1 has two differential-pressure level transmitters (SPC-LIT-1A & B) each providing local and remote indication. In addition, one level transmitter (1B) provides local and remote low level alarms, and an interlock to close outlet valve SPC-V71 on low level. A conductivity type level element is also located at the low level setpoint to close outlet valve SPC-V71 and to actuate local and remote low level alarms.

b) SPC-T-2

SPC-T-2 has two level transmitters (SPC-LIT-2A & B) for local and remote indication only.

c) SPC-T-3

SPC-T-3 has two level transmitters, (SPC-LIT-3A & B) each of which provides local and remote indication, high level charging pump stop signal, local and remote high-high level alarm, low level charging pump start signal, and local and remote low-low level alarm and backup charging pump start signal. In addition, the "A" Instrument loop generates the proportional adjustable level control signal and the high and low level cycling control for the Variable Charging Pump SPC-P-3.

2.2.2 Variable Charging Pump SPC-P-3

The Variable Charging Pump flow rate is normally controlled by a proportional signal from SPC-LIC-3A. Should level decrease to the low level setpoint the pump would get a start signal from SPC-LSL-3A.

The pump also has start and stop pushbuttons and indicating lights on SPC-PNL-1 and 3. The pump shuts off automatically on high level in SPC-T-3 or low-low level in SPC-T-4, the Charging Water Storage Tank. The pump can be shut off using an "overide" control switch which is located and alarmed on SPC-PNL-3. The pump will restart automatically when the appropriate tank level has been reestablished and the level switch resets.

There is local suction and discharge pressure indication, and local and remote discharge flow indication.

2.2.3 Charging Pumps SPC-P-1A & B

The charging pumps are operated as lead and backup pumps in the event the variable pump cannot maintain the level in SPC-T-3. Selection of the lead pump is made at SPC-PNL-3, in the control room. The lead pump is started by a low level signal from the associated switch (SPC-LSL-3A or B) for SPC-T-3. The backup pump receives a start signal (from SPC-LSL-3A or B) if the level continues to fall to the low-low alarm point.

Each pump has start and stop pushbuttons with indicating lights on panels SPC-PNL-1 and SPC-PNL-3. The pumps shut off automatically on high level in SPC-T-3, or low-low level in SPC-T-4. In addition each pump can be shut off using an "overide" control switch which is located and alarmed on SPC-PNL-3.

There is local pressure indication at the discharge of either pump, and local and remote flow indication in the common line to the surge tanks. The pumps share a common suction pressure indication with the VCP.

The charging pumps each have an integral packing cooling system with a cooling pump, flow meter, pressure gage, and pressure switch. The cooling pump is started automatically when the charging pump starts. Since the charging pumps can run without cooling water for an extended period of time the cooling water pressure switch only provides a control room alarm on low pressure.

The packing cooling tank has provision for automatic filling, controlled by a level switch and solenoid valve. This feature is not used since leakage from the high pressure seals into the cooling system normally exceeds system losses thereby providing a constant overflow. Manual filling, if required, should be initiated at 1/4 full, refilling to the 3/4 mark. Cooling water flow is adjusted

manually to meet pump requirements. Heat is dissipated to the air, and no external cooling water is required.

2.2.4 Charging Water Storage Tank SPC-T-4

The storage tank has temperature instrumentation which provides local and remote indication and combined high/low temperature alarms. A temperature controller and a local on/off handswitch provide automatic control of the strip heaters mounted on the tank.

Level instrumentation provides local and remote indication, local and remote high and low level alarms, low level heater shutoff, and the interlocks to stop pumps SPC-P-1A, 1B, & 3 on low-low level, as described above.

The tank also has a local flow indicator in the vent line discharge path.

2.2.5 Borated Water Batching Tank, SPC-T-5 and Transfer Pump, SPC-P-2

All controls and indications associated with the Batching Tank and Transfer Pump are local. The control switches are mounted on panel SPC-P-2.

The Batching Tank is provided with a manually operated mixer and three manually operated 15 KW heaters. Temperature indication for the batching tank is provided locally. The tank also has an internal 0-500 gallon level indication.

The Borated Water Transfer Pump is manually operated. Indicating lights are provided on the local control panel. A discharge pressure gauge is provided.

2.2.6 Nitrogen Supply

Each N_2 supply header is provided with two pressure indicators, and two cylinders within each bank are provided with temperature indicators. In addition, a local pressure indicator and local and remote low pressure alarms are provided downstream of the header. A flow indicating switch with local and remote high flow alarms are also provided upstream of the regulators to alert the operator of a high flow condition. Pressure gages are provided for both intermediate and final nitrogen supply pressure to the CWST.

2.2.7 Nitrogen Reducing Station

Four pressure reducing valves, SPC-PHV-2A through 2D, are provided for N_2 pressure control. Regulators 2A and 2B are normally used since their setpoints can be controlled from the control room and regulatora 2C and 2D are isolated and reserved for backup operation.

The regulator valves are controlled by gas pressure on their operators. Each operator is supplied with nitrogen from the line upstream of the associated regulating valve. The line nitrogen pressure is reduced by a fixed-setpoint pressure reducing valve before it is supplied to the operator. The operators for regulating valves 2A and 2B also have an air supply from the Instrument Air System. Since the valve operators continuously bleed off the operating gas, the instrument air is normally used, and the nitrogen aupply is isolated.

Two pressure control channels are provided, one for each remotely controlled regulator. Instrument loop 16 controls regulator 2B, and loop 17 controls regulator 2A. Each instrument loop can be adjusted, at SPC-PIC-16 & 17 in the control room, to set desired SPC system pressure. The preferred loop is set to the desired pressure, and the backup loop is set slightly lower. A handswitch on SPC-PNL-3 is used to select the preferred loop setpoint for use in comparing actual pressure to set pressure, as described in 2.2.8.

Each regulator, 2A through 2D, has local pressure indication of the N supply to its actuator. Local and remote pressure indication is also provided for each regulator control loop, and local indication is provided at the control loop tie-in point.

2.2.8 RC and SPC Pressure and Differential Pressure

Local and remote RC pressure is available from the temporary nuclear sampling (SNS) system, and from the decay heat removal system between DH-V3 and the RB penetration. Local and remote SPC system pressure is available from downstream of SPC-V71.

Reactor coolant pressure at the DHR system is compared to SPC system pressure, and the differential pressure is displayed on SPC-PNL-3. Local and remote alarms are provided for high differential pressure in either direction.

The SPC actual system pressure is compared to the desired pressure set in either of the two pressure reducing control loops. A hand-switch on SPC-PNL-3 is used to select the operating control loop for this comparison. Local and remote alarms are provided for a high differential, in either direction, between desired and actual system pressure.

2.2.8.1 RCS Level Indication and SPC Operation During RCS Drain Down

During RCS drain down the SPC system will not be in operation as described by this system description. However, SPC instrumentation will be used as follows:

Level indication will be accomplished using SPC instrument string SPC-22 by changing range module SPC-PI-22-2 located on SPC-PNL-3 and retag to RC-LI-100A. Readout will change from "psig" to "inches of water". Recorder SPC-PR-22/SPC-PR-15 located on SPC-PNL-3 will be retagged to RC-LR-100/SPC-PR-15 and the multiplier will be on the "X6" scale. Indicator SPC-PI-22-1 located on SPC-PNL-1 will be retagged to RC-LI-100 and the indicator scale will read "0-600 inches of water". A reference leg exists from the pressure tap down stream of nitrogen system valve NM-V150 to RC-LI-100 and RC-LI-101 to subtract the nitrogen blanket pressure. The string can be restored to its original configuration by electrically reconnecting the SPC pressure transmitter.

2.2.9 Surge Tank Outlet Valve SPC-V71

The outlet valve is controlled by switches on panels SPC-PNL-1 and 3. The switches are three-position, open and close with spring return to mid-position. The valve normally travels to the fully open or shut position automatically. However, should the control relays fail, the valve can be operated by holding either control switch until valve travel is completed, as indicated by position lights on either panel.

The valve is interlocked, as described previously, with two low level signals from SPC-T-1, to close before the tank drains, to prevent nitrogen injection into the primary system. Should this occur, the valve can be opened by holding either control switch in the open position.

A limit switch on the valve provides local and remote alarms whenever the valve is in an abnormal position (i.e. not fully open). Note that if the valve is shut by a low level signal from SPC-T-1, this alarm is to be expected and does not indicate a fault.

2.2.10 Protective Devices

2.2.10.1 Nitrogen Supply System

Each nitrogen storage tank has its own rupture disk set between 3307 and 3675 psig. Isolatable sections of the tank header have individual relief valves, SPC-R5A, R5B, R6A, and R6B, set at 2450 psig.

A 50 psig relief, SPC-R13, is located between SPC-PRV-4 and SPC-PRV-5 in the N_2 supply line to SPC-T-4.

Relief valves SPC-R11A and B, set at 100 psig., protect the operators for regulating valves SPC-PRV-2A and B.

The N_2 supply to SPC-T-3 is protected by three relief valves. SPC-R4 is set at 600 psig., and SPC-R3 is set at 1000 psig. SPC-PCV-14 is an adjustable backpressure control valve, operated by gas pressure, similarly to regulating valves SPC-PRV-2A and 2B. It also has both nitrogen and instrument air supplies with instrument air preferred. The relief sepoint is selected on SPC-PNL-3 in the control room to be slightly higher than the system set pressure in the preferred regulator control loop. Relief valve SPC-R10 protects the operator of SPC-PCV-14 at 100 psig.

2.2.10.2 SPC Fluid System

The charging water storage tank is protected by relief SPC-R12, set at 75 psig. Charging pumps SPC-P-1A, 1B, & 3 are protected by 600 psig reliefs SPC-R1A, 1B and 8 on the discharge, and 80 psig thermal reliefs SPC-R2A, 2B, and 9 on the suction.

Two relief valves are located in the surge line to the reactor coolant system. Valve SPC-R7 is set at 600 psig for normal SPC system operation. Valve SPC-R14, set at 125 psig., is used when the mini decay heat removal system is in operation, by locking open the isolation valve SPC-V17.

3.0 PRINCIPLE MODES OF OPERATION

3.1 Startup

3.1.1 Initial Fill

Prerequisities to initial fill include the availability of approximately 6600 gallons of demineralized water and sufficient boric acid powder (1100 to 1400 pounds) to bring the demineralized water to a borated level of 3500 to 4500 ppm.

The demineralized water and boric acid are mixed in the Borated Water Batching Tank in 500 gallon, 3500-4500 ppm batches. Approximately 14 batches will be needed.

The batching tank is filled with water and heated before adding the boric acid, to reduce the dissolving time. The acid is added and mixed, and the solution is transferred to the CWST using the Borated Water Transfer Pump. The CWST is filled to approximately 3000 gallons. The CWST heaters are then energized, and filling continues to approximately 4500 gallons. The tank should be kept at operating temperature for at least one hour for degassification to less than 15 cc/kg total gas.

Air is then purged from the CWST gas space by establishing a one to two psig nitrogen supply to the CWST and then opening the vent line to purge 6 SCFM for one hour. The oxygen concentration of the water is then determined, and hydrazine is added and recirculated with a charging pump for approximately four hours until the oxygen concentration is below 100 ppb.

With nitrogen pressure on the surge tanks set to a minimum, the charging pumps are filled and vented, and the surge tanks are filled through SPC-V71 by operation of one charging pump. Charging continues until SPC-T-3 is approximately 3/4 full. Nitrogen pressure is controlled at about 10 psig while the system is vented via SPC-PCV-14. The CWST is refilled with boric acid to approximately 4500 gallons. Manual venting of the CWST is required during filling. Sampling of, and hydrazine addition to, the CWST is repeated as necessary to bring the oxygen concentration below 100 ppb.

3.1.2 Startup

Prerequisites for startup include a filled, degassified system and a sufficient nitrogen supply to ensure that nitrogen pressure will not fall below 225 psig in the operating N_2 bank. In addition, prerequisities associated with the RC system concerning taking the plant solid shall have been satisfied. Makeup Pump MU-P-1C supply breaker must be racked out, MU-V144C, V147, V148, and V436 must be closed and locked. (See O.P. 2104-1.14 Section 4.1 for Additional Normal System Startup details.)

With the Reactor Plant solid and pressure below 550 psi, SPC-V5 is locked open, and MU-V16C & D, and SPC-V71 are opened. This provides a flow path for water from the Pressure Control System to insurge to the RC system as necessary to maintain pressure. When instructed by the Control Room, the plant is placed in the Standby Pressure Control mode by gradually increasing surge tank pressure by adjusting regulator SPC-PRV-2A and 2B setpoints until the RC system pressure responds to surge tank pressure.

Note: Pressure control, while in this mode, is limited to makeup from the Standby Pressure Control System into the RC system. Whenever RC pressure is higher than surge tank pressure, the SPC system is not controlling RC System pressure.

The N_2 supply system is placed in automatic operation by setting the preferred pressure regulator (SPC-PRV-2A or B) to desired RC pressure, the standby regulator (SPC-PRV-2B or A) to a slightly lower pressure, and the variable backpressure control valve SPC-PRV-14 to a slightly higher pressure. The preferred regulator setpoint is selected for input to the SPC actual vs SPC setpoint differential pressure alarm circuits.

In a similar manner the system can be started up under local manual control, using regulators SPC-PRV-2C and 2D. However, in this mode of operation the SPC actual vs. SPC setpoint differential pressure alarm does not receive the setpoint input from the regulator in use, and can therefore be misleading.

The charging system is placed in automatic operation by energizing the three pump control circuits, and selecting the lead charging pump, SPC-P-1A or B. All further pump operation is automatically controlled by level switches.

With charging recirculation valve SPC-V56 open, the Variable Charging Pump is started and operated near minimum capacity. Valve SPC-V56 is throttled until the pump discharge pressure is just below surge tank pressure, and the pump is placed in automatic proportional control. The pump will then supply makeup to the surge tanks as required without operating below its minimum flow rate. Periodic adjustment of SPC-V56 is required to maintain optimum performance.

The perferred mode of recirculation is accomplished by operating SPC-P-1A, -1B or -3 to circulate water through all three surge tanks and throttling the discharge to SPC-T-4 with SPC-V-18B or 12B to maintain level in SPC-T-3. For additional details see O.P. 2104-1.14 Section 4.9.

3.2 Normal Operation

Nitrogen gas flow to the surge tanks for maintaining system pressure is automatic. Operation of the VCP to maintain constant level minimizes the frequency for recharging the two racks of N_2 cylindera. Operation of the SPC System with nitrogen gas pressures between 225-375 psig produces an 80 gpm injection rate into the RCS which is great enough to cover the design maximum shrink and which, concurrently, will not overpressurize the lower design pressure interconnected systems.

Makeup water requirements are satisfied by the VCP to maintain surge tank level constant with minimum recirculation flow to the CWST as required to operate the VCP within its control range. Charging Water Storage Tank levels are maintained by the periodic transfer of water from the Borated Water Batching Tank. Sampling and hydrazine additions are periodically performed to maintain the oxygen concentration below 100 ppb.

System parameters must be continuously monitored to ensure continued safe system conditions. Operations at the design (not expected) leak rate of 4 gpm will require continuous boric acid mixing (i.e. 4 gpm is 5760 gallons per day or 11.5 batches per day, which allows 2 hours per batch).

3.3 Shutdown

If the system is to be shutdown, valves SPC-V71, MU-V16C and MC-V16D should be closed. If the shutdown is long term, the N_2 supply manifold should be isolated and pressure bled off from the first surge tank (SPC-T-3) via SPC-PCV-14 and the Charging Water Storage Tank heaters should be secured. The operating charging pump SPC-P-3 should be secured. Note that these steps should not be taken unless another means of maintaining a positive pressure on the RC System is available, or the RC System is to be totally depressurized.

3.4 Special or Infrequent Operation

The nitrogen cylinders are recharged from commercial nitrogen tube trailers connected to the tube trailer discharge station in the railroad bay of the Fuel Handling Building. One bank of nitrogen cylinders should remain lined up to the surge tanks during refilling operations.

The contents of surge tanks SPC-T-1 and 2 can be recirculated via the CWST for degassing by using a Charging Pump to feed water to the outlet of SPC-T-1, and throttling the return flow from SPC-T-3 to the CWST with valve SPC-V18B or SPC-V128. The level in SPC-T-3 should remain steady, preferably low, just above the minumum level required (400 gallons or 35%) for the design transient. Hydrazine can be added using the chemical addition flush in the pump discharge line.

3.5 Emergency

If a design transient occurs, the water level in SPC-T-3 will drop below the low level setpoints and one or both charging pumps will start. Normal pump operation will resume when the Charging Pumps overcome the transient and refill SPC-T-3 to the high level setpoints.

If the water level drops to the low level setpoint in SPC-T-1 the surge line outlet valve SPC-V71 will shut to prevent injecting nitrogen into RC system. The charging pumps would continue to run until the CWST low-low level is reached.

Should the RC System to SPC System high D/P alarm sound, immediate corrective action must be taken to ensure the primary side pressure does not increase to 600 psig. If the pressure does increase to 600 psi, the makeup isolation valves MU-V16C&D must be closed to ensure the Standby RC Pressure Control System is not overpressurized through check valve leakage. The D/P alarm can be due to high D/P in either direction. If the D/P is high from SPC to RCS, SPC-V71, SPC-V5, and MU-V16C and D must be verified open.

4.0 HAZARDS AND PRECAUTIONS

4.1 Do not operate for sustained periods of time with water level being maintained in a surge tank other than SPC-T-3.

4.2 There is no external level indication for the Borated Water Batching Tank. The water level must be determined visually so that the tank is not emptied with the heaters energized or the Borated Water Transfer Pump running.

4.3 Do not attempt to operate the Charging Pumps or the VCP with the suction or discharge valves closed.

4.4 Piping from the CWST to the Charging Pumps may be hot (due to heating in the CWST) and could present a burn hazard. (Piping from BWBT to CWST is insulated).

4.5 Do not allow non-operating N_2 bank pressure to fall below 400 psig and operating nitrogen bank below 225 psig.

4.6 In the event of a transient causing low level alarms in SPC-T-3 or SPC-T-1, verify proper automatic operation of SPC-P-1A & B and SPC-V71, respectively, or take manual control.

4.7 Deleted.

4.8 Makeup pump MU-P-1C must have its breaker racked out and discharge valves MU-V144C, 147, 148 and 436 closed at all times to ensure the system is not inadvertently pressurized due to Makeup Pump operation.

4.9 Do not run the Variable Charging Pump over 1200 rmp.

4.10 Do not permit the level in surge tank SPC-T-3 to fall below the minimum level (400 gallons or 35%) required for the design transient, while recirculating to the CWST during degasification.

4.11 The CWST must be manually vented, and transfer flow verified when operating the borated water transfer pump to avoid running the pump at shutoff head.

4.12 SPC-V-17 must be open to SPC-R14 during Mini-Decay Heat Removal Mode of Operation.

4.13 The non-operating nitrogen bank pressure shall be equal to or less than 600 psig during Submerged Demineralizer Cask Transfer.

TABLE 1

STANDBY PRESSURE CONTROL SURGE TANKS

Identification	SPC-T-1, SPC-T-2, SPC-T-3
Number Inatalled	Three
Manufacturer	Southwest Fabrication Co.
Capacity, gallons	900
Installation	Vertical
Outside Diameter & Height	54.17" x 166.55"
Shell Material	Stainless Steel
Design Temperature, °F	300
Design Pressure, psig	2735
Corrosion Allowance, in.	None
Design Code	ASME III, Class 2
Code Stamp required	"N"
Material Thickness	3-1/8"

TABLE 2

CHARGING PUMPS

Pump Details

Identification	SPC-P-1A, SPC-P-1B
Number Inatalled	Two
Manufacturer	Gaulin Corp.
Model No.	WP18
Type	Triplex Poaitive Displacement
Rated Speed, RPM	180
Rated Capacity, GPM	40 GPM
Rate Total Dynamic Head, psig	3010
NPSH Required, psia	4.1 psia
Design Pressure, Caaing, psig	4700
Design Temperature, °F	250
Lubricant/Coolant	Oil/Water (for seals)

Motor Details

Manufacturer	Louis Allis (Pacemaker)
Type	Induction (C0G4C9)
Enclosure	Open Drip Proof
Rate HP	100
Speed, RPM	1775
Lubricant, Coolant	Grease/Air
Power Requirementa	480V, 3 Phase, 60 Hz, 118 Ampa (full load)
Power Source	SPC-P-1A, MCC 2-32A SPC-P-1B, MCC 2-42A

TABLE 3

CHARGING PUMP PACKING COOLING SUMP PUMP

Pump Details

Number Installed	Two (one per unit)
Manufacturer	Eastern
Model No.	SD-11 Type 103 & 104
Type	Stainless Steel Centrifugal
Rated Speed, RPM	3450
Rated Capacity, GPM	6 GPM (max. at 7 psi head)
Rated Pressure, psig	20 psi (Max. at shutoff)

Motor Details

Manufacturer	Ohio Electric
Type	Split Phase Induction
Enclosure	Totally Enclosed
Rate HP	0.20
Rated Speed, RPM	3450
Lubricant/Coolant	Grease/Air
Power Requirements	115V, 1 Phase, 60 Hz, 3.2 Amps (full load)
Power Source	LPF-4C (Pump 1A) LPF-4D (Pump 1B)

TABLE 4

CHARGING WATER STORAGE TANK

Identification	SPC-T-4
Manufacturer	Progress Equipment Co., Inc.
Capacity, gallons	5110 total, (4185 Max. operating cap)
Installation	Vertical
Outside Diameter & Height	8' O.D. & 18' High
Shell Material	SA-240
Design Temperature, °F	250
Design Pressure, psig	75
Corrosion Allowance, in.	None
Design Code	ASME Section III, Class 2
Code Stamp required	"N"
Material Thickness, in.	0.4375

Heater Details

Capacity, KW	113.4
Type	Strip
Power Requirements	480V, 3 phase, 60 Hz
Power Supply	USS 2-45

TABLE 5

BORATED WATER BATCHING TANK

Identification	SPC-T-5
Manufacturer	CE Air Preheater
Capacity, gallons	632
Installation	Vertical
Outside Diameter & Height	60" O.D. & 72" High
Shell Material	Stainless Steel
Design Temperature, °F	200
Design Pressure, psig	Atmospheric
Corrosion Allowance, in.	None
Design Code	None
Material Thickness, in.	3/16

Heater Details

Number Installed	Three
Manufacturer	Emerson
Model Number	NTS-3150
Type	Immersion
Capacity, KW, per heater	15
Power Requirements	480V, 3 Phase, 60 Hz, Amps (full load) 15 KW
Power Source	MCC 2-32A

Mixer Details

Manufacturer	LFE Corporation
Model No.	RS-3
Type	Clamp on

Motor Details

Manufacturer	Duty Master
Type	P
Enclosure	Totally enclosed
Rated HP	1/2
Speed, RPM	1140
Power Requirements	480V, 3 Phase, 60 Hz
Code	L
Power Source	MCC 2-32A

TABLE 6

BORATED WATER TRANSFER PUMP

Identification	SPC-P-2
Number Installed	One
Manufacturer	Ingersoll Rand
Type	40C
Rated Speed, RPM	1745
Rated Capacity, GPM	50
Rated Total Dynamic Head, ft.	35
NPSH, ft.	3
Design Pressure, Casing, psig	525
Design Temperature, °F	350
Lubricant/Coolant	Oil/Air
Min. flow Requirements, GPM	22

Motor Details

Manufacturer	Gould
Type	SC
Enclosure	Open Drip Proof
Rated HP	1.5
Speed, RPM	1745
Lubricant/Coolant	Sealed bearings/Air
Power Requirements	480V, 3 Phase, 60 Hz
Power Source	MCC 2-32A

TABLE 7

VARIABLE CHARGING PUMP

Identification	SPC-P-3
Number Installed	One
Manufacturer	Cat Pumps
Model No.	820
Type	Positive Displacement
Max. Allowable Speed, RPM	1200
Rated speed, RPM	190 to 940
Rated Capacity, GPM	2 to 10
Rated Total Dynamic Head, ft.	1000
Required Inlet Pressure, psig	-8.5 at 140°F, 0 at 160°F, +5 at 165°F
Design Pressure, Casing, psig	1000
Design Temperature, °F	180
Lubricant/Coolant	Oil/Air

Motor Details

Manufacturer	US Motors
Type	VEV-1-TF-GD
Rated HP	7.5
Speed, RPM	190 to 1575
Lubricant/Coolant	Oil/Air
Power Requirements	480V, 3 Phase, 60 Hz
Power Source	MCC 2-42A

TABLE 8

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-HS-1A-01,02	Hand Switch	On/Off control for SPC-P-1A	SPC-Panel 1	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-1A-03,04	Hand Switch	On/Off control for SPC-P-1A	SPC-Panel 3	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-1B-01,02	Hand Switch	On/Off control for SPC-P-1B	SPC-Panel 1	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-1B-03,04	Hand Switch	On/Off control for SPC-P-1B	SPC-Panel 3	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-3-01,02	Hand Switch	On/Off control for SPC-P-3	SPC-Panel 1	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-3-03,04	Hand Switch	On/Off control for SPC-P-3	SPC-Panel 3	Two Pushbuttons	N/A	N/A	N/A
SPC-PI-1A	Pressure Indicator	Indicates SPC-P-1A discharge pressure	Local	Bourdon	0-1000 psig	0-1000 psig	N/A
SPC-PI-1B	Pressure Indicator	Indicates SPC-P-1B discharge pressure	Local	Bourdon	0-1000 psig	0-1000 psig	N/A
SPC-PI-1C	Pressure Indicator	Indicates SPC-P-3 discharge pressure	Local	Bourdon	0-1000 psig	0-1000 psig	N/A
SPC-PIT-1	Pressure Indicator Transmitter	Indicates charging pumps suction pressure & transmits signal to SPC-PI-1	Local	Bellows	0 to 30 psig	10 to 50 madc	N/A
SPC-PI-1	Pressure Indicator	Indicates charging pump's suction pressure	SPC-Panel 1	Milliammeter	10 to 50 madc	0 to 30 psig	N/A
SPC-HS-1	Hand Switch	Select SPC-P-1A or 1B as the lead charging pump	SPC-Panel 3	Selector	N/A	N/A	N/A
SPC-LIT-1A	Level Indicator Transmitter	Level Indication of SPC-T-1, and input to SPC-LI-1A	Local	Twin Diaphragm	0 to 111 in. WC	10 to 50 madc 0-100%	N/A
SPC-LI-1A	Level Indicator	Indicates SPC-T-1 level	SPC-Panel 3	Milliammeter	10-50 madc	0-100%	N/A
SPC-LIT-1B	Level Indicator Transmitter	Level Indication of SPC-T-1 and input to SPC-LI-1B	Local	Twin Diaphragm	0 to 111 in. WC	10 to 50 madc 0-100%	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-LI-1B	Level Indicator	Indicates SPC-T-1 level	SPC-Panel 3	Milliammeter	10-50 madc	0-100%	N/A
SPC-LSL-1B	Level Switch	Actuates alarms SPC-LAL-1B-1 and 1B-2, and shuts SPC-V71	SPC-Panel 1	Solid state	10-50 madc	N/A	21%
SPC-LE-1C	Level Element	Provides SPC-T-1 low level input to SPC-LSL-1C	Local	Electrode	N/A	N/A	25 in.
SPC-LSL-1C	Level Switch	Actuates alarms SPC-LAL-1C1 & 1C2 on low level in SPC-T-1 & closes SPC-V71	SPC-Panel 1	Induction Relay	N/A	N/A	N/A
SPC-LIT-2A	Level Indicator Transmitter	Level indication of SPC-T-2 and input to SPC-LI-2A	Local	Twin Diaphragm	0-111 in.WC	10 to 50 madc 0-100%	N/A
SPC-LI-2A	Level Indicator	Indicates SPC-T-2 level	SPC-Panel 3	Milliammeter	10 to 50 madc	0-100%	
SPC-LIT-2B	Level Indicator Transmitter	Level Indication of SPC-T-2	Local	Twin Diaphragm	0-111 in.WC	10 to 50 madc 0-100%	N/A
SPC-LI-2B	Level Indicator	Indicates SPC-T-2 level	SPC-Panel 3	Milliammeter	10 to 50 madc	0-100%	N/A
SPC-LIT-3A	Level Indicator Transmitter	Level Indication of SPC-T-3 and input to SPC-LIC, LI, LSHH, LSH, LSLL, & LSL-3A	Local	Twin Diaphragm	0 to 111 in. WC	10 to 50 madc 0-100%	N/A
SPC-LIC-3A	Level Indicator Controller	Provide proportional control signal to SPC-P-3	SPC-Panel 3	PAI Controller	10 to 50 madc	10-50 madc 0-100%	Variable
SPC-LI-3A	Level Indicator	Level Indication of SPC-T-3	SPC-Panel 3	Milliammeter	10 to 50 madc	0-100%	N/A
SPC-LSL-3A	Low Level Switch	Starts SPC-P-1A (if lead pump) and SPC-P3 on low level in SPC-T-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	62%
SPC-LSH-3A	High Level Switch	Stops SPC-P-1A on high level in SPC-T-3. Cycles SPC-P-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	74%

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-LR-4,3B	2 Pen Strip Chart Recorder	Provide record of levels in SPC-T-3 and SPC-T-4	SPC-Panel 3	Waterline Angus	10 to 50 madc	0-100%	N/A
SPC-LSLL-3A	Low-Low Level Switch	Starts SPC-P-1A (if backup pump) on low-low level in SPC-T-3, and actuates alarms SPC-LAL-3A1 & 3A2	SPC-Panel 1	Foxboro	10 to 50 madc	N/A	57%
SPC-LSHH-3A	High High Level Switch	Actuates alarm SPC-LAHH-3A1 & 3A2 on high high level in SPC-T-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	78%
SPC-LIT-3B	Level Indicator Transmitter	Level Indication of SPC-T-3 and input to SPC-LI, LSHH, LSH, LSLL & LSL-3B	Local	Twin Diaphragm	0 to 111 in. WG	10 to 50 madc 0-100%	N/A
SPC-LI-3B	Level Indicator	Level Indication of SPC-T-3	SPC-Panel 3	Milliammeter	10 to 50 madc	0-100%	N/A
SPC-LSL-3B	Low Level Switch	Starts SPC-P-1B (if lead pump) on low level in SPC-T-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	62%
SPC-LSH-3B	High Level Switch	Stops SPC-P-1B on high level in SPC-T-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	74%
SPC-LSLL-3B	Low-Low Level Switch	Starts SPC-P-1B (if backup pump) on low-low level in SPC-T3, and actuates alarms SPC-LAL-3B1 & 3B2	SPC-Panel 1	Foxboro	10 to 50 madc	N/A	57%
SPC-LSHH-3B	High High Level Switch	Actuates alarm SPC-LAHH-3B1 & 3B2 on high high level in SPC-T-3	SPC-Panel 1	Solid State	10 to 50 madc	N/A	78%
SPC-HS-3-1/2	Hand Switch	Start/stop control for SPC-P-3	SPC-Panel 1	Two Pushbuttons	N/A	N/A	N/A
SPC-HS-3-3/4	Hand Switch	Start/stop control for SPC-P-3	SPC-Panel 3	Two Pushbuttons	N/A	N/A	N/A
SPC-LIT-4	Level Indicating Transmitter	Level Indication for SPC-T-4 and input to SPC-LI-4, LSHL-4, and LSLL-4A	Local	Twin Diaphragm	0-139"	10 to 50 madc	N/A
SPC-LI-4	Level Indicator	Level Indication for SPC-T-4	SPC-Panel 3	Milliammeter	10 to 50 madc	0-100%	N/A

TABLE 6 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-LSHL-4	Level Switch High, Low	SPC-T-4 low level heater shut off and high low level alarms	SPC-Panel-1	Solid State	10 to 50 madc	N/A	96% Inc. 57% dec.
SPC-LSLL-4A	Low Low Level Switch	Stops pumps SPC-P-1A & 3 on SPC-T-4 low level	SPC-Panel-1	Solid State	10 to 50 madc	N/A	3%
SPC-LSLL-4B	Low Low Level Switch	Stops pump SPC-P-1B on SPC-T-4 low level	Local	Diaphragm	2.5 to 45" WC	N/A	24" WC
SPC-TE-4	Temperature Element	Measures temp. of water in SPC-T-4 for input to SPC-TIC-4-1 and TT-4	Local	Dual T/C	0 to 300°F	MVDC	N/A
SPC-TIC-4-1	Temperature Indicator Controller	Controls heater for SPC-T-4	SPC-Panel 1	On/Off	MVDC	N/A	160°F
SPC-TI-4-2	Temperature Indicator	Indicates SPC-T-4 temperature	SPC-Panel 3	Milliammeter	10 to 50 madc	0-300°F	N/A
SPC-TSH-4	High Temperature Switch	Signal for SPC-T-4 High temp. alarm TAHL-4	SPC-Panel 1	Solid State	10 to 50 madc	N/A	170°F
SPC-TSL-4	Low Temperature Switch	Signal for SPC-T-4 low temp. alarm TAHL-4	SPC-Panel 1	Solid State	10 to 50 madc	N/A	150°F
SPC-TY-4	Converter	Converts SPC-T-4 temperature signal for input to SPC-TI-4-2, TSH-4 and TSL-4	SPC-Panel 1	E/I	MVDC	10 to 50 madc	N/A
SPC-HS-4	Hand Switch	On/Off control for Heater for SPC-T-4	SPC-Panel 1	2 Position (Maintained) with Indicating lights	N/A	N/A	N/A
SPC-FE-5	Flow Element	Develops differential press. for charging pumps Discharge Flow Measurement for input to SPC-FIT-5	Local	Orifice	0 to 100 GPM	0-312.5"WC	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-PIT-5	Flow Indicating Transmitter	Indicates charging pumps Discharge Flow & Transmits Signal to SPC-FY-5	Local	Twin Diaphragm	0-312.5"WG	10-50madc 0-100%	N/A
SPC-FY-5	Flow Converter	Converts flow signal for input to SPC-FI-5	SPC-Panel 1	Square Root	10 to 50 madc	10 to 50 madc	N/A
SPC-FI-5	Flow Indicator	Indicates charging pumps Discharge Flow	SPC-Panel 3	Millivmeter	10 to 50 madc	0 to 100 GPM	N/A
SPC-HS-6	Hand Switch	On/Off control for SPC-T-5 Mixer	SPC-Panel 2	2 Position (Maintained) with Indicating lights	N/A	N/A	N/A
SPC-HS-7	Hand Switch	On/Off control for SPC-T-5 heater	SPC-Panel 2	2 Position (Maintained) with Indicating lights	N/A	N/A	N/A
SPC-HS-8	Hand Switch	On/Off control for SPC-P-2	SPC-Panel 2	2 Position (Maintained) with Indicating lights	N/A	N/A	N/A
SPC-TI-9	Temperature Indicator	Indicates temp. of mixture in SPC-T-5	Local	Every Angle	0 to 200°F	0 to 200°F	N/A
SPC-PIT-10	Pressure Indication Transmitter	Provides Indication of standby R.C. Press. Cont. SYS. pressure & signal to SPC-DPS-10A & B, PI-10-1 & 2 and DPI-10	Local	Bellows	0 to 1000 psig	10 to 50 MA 0-100%	N/A
SPC-DFY-10	Converter	Convert SPC-PIT-10 & FI-15 signals into SPC/RC differential pressure signal to SPC-DPI-10	SPC-Panel 1	Summing Amplifier	10-50 madc 10-50 madc	10-50 madc	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-DPI-10	Differential Pressure Indicator	Indicate SPC/RC differential pressure	SPC-Panel 3	Milliammeter	10-50 madc	100-0-100 psid	N/A
SPC-PI-10-1	Pressure Indicator	Indicates SPC system pressure	SPC-Panel 1	Milliammeter	10-50 madc	0-1000 psig	N/A
SPC-PI-10-2	Pressure Indicator	Indicates SPC system pressure	SPC-Panel 3	Milliammeter	10-50 madc	0-1000 psig	N/A
SPC-DPS-10A	Differential Pressure Switch	SPC/RC pressure difference alarm to SPC-DPA-10A-1&2	SPC-Panel 1	Solid State	10-50 madc	N/A	± 25 psid
SPC-DPS-10B	Differential Pressure Switch	SPC pressure/setpoint difference alarm to SPC-DPA-10B-1&2	SPC-Panel 1	Solid State	10-50 madc	N/A	± 25 psid
SPC-PI-11	Pressure Indicator	Indicates SPC nitrogen pressure	Local	Bourdon Tube	0-500 psig	0-500 psig	N/A
SPC-PS-11	Pressure Switch	Actuates SPC low nitrogen alarm SPC-PAL-11-1&2	Local	Diaphragm	50-375 psig	N/A	225 psig
SPC-FE-12	Flow Element	Develops D/P for variable charging pump SPC-P-3 flow, and provides input to SPC-FIT-12	Local	Orifice	0-15 gpm	0-100"WC	N/A
SPC-FIT-12	Flow Indicating Transmitter	Indicates Variable Charging Pump Disch. Flow & Transmits Signals to SPC-FI-12	Local	Twin Diaphragm	0-100"WC	10-50 madc	N/A
SPC-FI-12	Flow Converter	Convert flow signal for input to SPC-FI-12	SPC-Panel 1	Square Root	10-50 madc	10-50 madc	N/A
SPC-FI-12	Flow Indicator	Indicates Variable Charging Pump Discharge Flow	SPC-Panel 3	Milliammeter	10-50 madc	0-100 GPM	N/A
SPC-PI-13	Pressure Indicator	Indicates Borated Water Transfer Pump SPC-P-2 Discharge Pressure	Local	Bourdon Tube	0-30 psig	0-30 psig	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-PI-14	Pressure Indicator	Indicates nitrogen pressure to SPC-T-3	Local	Bourdon Tube	0-500 psig	0-500 psig	N/A
SPC-PIT-14	Pressure Indicator Transmitter	Provide nitrogen relief pressure control signal to SPC-PIC-14-1	Local	Bellows	0-500 psig	10-50 madc	N/A
SPC-PIC-14-1	Pressure Indicator Controller	Provide setpoint control signal to SPC-PY-14 for nitrogen pressure	SPC-Panel 3	P&I Controller	10-50 madc	10-50 madc	Variable
SPC-PY-14	Pressure Converter	Convert setpoint signal to air pressure control of SPC-PCV-14	SPC-PCV-14	I/P Converter	10-50 madc	3-15 psig	N/A
SPC-FE-15	Flow Element	Develops Differential Press. for Nitrogen Supply Header Flow Monitor and provides input to SPC-FSH-15	Local	Orifice	0-2 x 105 SCFH	0-462"WC	N/A
SPC-FSH-15	Flow Switch	Actuates high nitrogen flow alarms SPC-PAH-15-1&2, and indicates D/P	Local	Bellows	0-10"WC	0-10"WC	4.16"WC (20,000 SCFH)
SPC-PT-15	Pressure Transmitter	Provide RC pressure signal input from DH-V3 to SPC-PY-15	Local	Bellows	0-1000 psig	10-50 madc	N/A
SPC-PY-15	Repeater	Transmit RC pressure signal to SPC-PI-15-1, 15-2 & 15-3, DPI-10, DPS-10A, & PR-22	SPC-Panel 1	Current Repeater	10-50 madc	10-50 madc	N/A
SPC-PI-15-1	Pressure Indicator	Indicates RC pressure at DH-V3	SPC-Panel 1	Milliammeter	10-50 madc	0-1000 psig	N/A
SPC-PI-15-2	Pressure Indicator	Indicates RC pressure at DH-V3	SPC-Panel 3	Milliammeter	10-50 madc	0-500 psig	N/A
SPC-PI-15-3	Pressure Indicator	Indicates RC pressure at DH-V3	SPC-Panel 3	Digital	10-50 madc	0-500 psig	N/A
SPC-PIT-16	Pressure Indicator Transmitter	Provide nitrogen pressure signal to SPC-PIC-16 for pressure regulation	Local	Bellows	0-500 psig	10-50 madc 0-100%	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-PIC-16	Pressure Indicator Controller	Provide setpoint signal to SPC-PY-16-1 and HS-18	SPC-Panel 3	P&I Controller	10-50 madc	10-50 madc 1-5 VDC	Variable
SPC-PY-16-1	Pressure Converter	Convert setpoint signal to air pressure control of SPC-PRV-2B	Local	I/P Converter	10-50 madc	3-15 psig	Variable
SPC-PY-16-2	Pressure Converter	Convert nitrogen pressure setpoint signal to input to SPC-DPS-10B	SPC-Panel 1	V/I Converter	1-5 VDC	10-50 madc	N/A
SPC-PIT-17	Pressure Indicator Transmitter	Provide nitrogen pressure signal to SPC-PIC-17 for pressure regulation	Local	Bellows	0-500 psig	10-50 madc	N/A
SPC-PIC-17	Pressure Indicator Controller	Provide setpoint signal to SPC-PY-17 and HS-18	SPC-Panel 3	P&I Controller	10-50 madc	10-50 madc 1-5 VDC	
SPC-PY-17	Pressure Converter	Convert setpoint signal to air pressure control of SPC-PRV-2A	Local	I/P Converter	10-50 madc	3-15 psig	N/A
SPC-HS-18	Hand Switch	Select SPC-PIC-16 or 17 to select system pressure setpoint input to SPC-DPS-10B	SPC-Panel 3	Two Position (Maintained)	N/A	N/A	N/A
SPC-PI-18	Pressure Indicator	Provide RC pressure indication from DH-V3	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-21	Pressure Indicator	Indicate RC pressure from temporary nuclear sampling (SNS) system	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PT-22	Pressure Transmitter	Provide RC pressure signal from SNS system to SPC-PI-22-1&2, and PR-22	Local	Bellows	0-1000 psig	10-50 madc	N/A
SPC-PI-22-1	Pressure Indicator	Indicate RC pressure from SNS system	SPC-Panel 1	Milliammeter	10-50 madc	0-1000 psig	N/A
SPC-PI-22-2	Pressure Indicator	Indicate RC pressure from SNS system	SPC-Panel 3	Milliammeter	10-50 madc	0-1000 psig	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-PR-22/ SPC-PR-15	Pressure Recorder	Record RC pressure at SMS system and DH-V3	SPC-Panel 3	Strip Chart	10-50 psdc/ 0-50 psdc	0-1000 psig/ 0-500 psig	N/A
SPC-PI-23	Pressure Indicator	Indicate RC pressure at SMS system	Local	Bourdon Tube	Later	Later	N/A
SPC-PI-28	Pressure Indicator	Indicates N_2 pressure downstream of SPC-PRV-4	Local	Bourdon Tube	0-300 psig	0-300 psig	N/A
SPC-PI-29	Pressure Indicator	Indicates N_2 pressure to SPC-T-4	Local	Bourdon Tube	0-5 psig	0-5 psig	N/A
SPC-FI-30	Flow Indicator	Indicate SPC-T-4 vent line flow rate	Local	Rotameter	0-28 SCFM	0-100%	N/A
SPC-HS-17-1	Hand Switch	Control SPC surge tank SPC-T-1 outlet valve SPC-V71	SPC-Panel 1	3-position spring return	N/A	N/A	N/A
SPC-HS-71-2	Hand Switch	Control SPC surge tank SPC-T-1 outlet valve SPC-V71	SPC-Panel 3	3-position spring return	N/A	N/A	N/A
SPC-ZS-71	Limit Switch	Actuate alarms SPC-ZA-71-102 on SPC-V71 abnormal position	SPC-V71	Limit Switch	N/A	N/A	N/A
SPC-TI-101	Temperature Indicator	Indicates N_2 "B" header flask temperature	Local	Thermometer	0-200°F	0-200°F	N/A
SPC-TI-102	Temperature Indicator	Indicates N_2 "B" header flask temperature	Local	Thermometer	0-200°F	0-200°F	N/A
SPC-TI-103	Temperature Indicator	Indicates N_2 "A" header flask temperature	Local	Thermometer	0-200°F	0-200°F	N/A
SPC-TI-104	Temperature Indicator	Indicates N_2 "A" header flask temperature	Local	Thermometer	0-200°F	0-200°F	N/A
SPC-PI-105	Pressure Indicator	Indicates N_2 "B" header pressure	Local	Bourdon Tube	0-5000 psig	0-5000 psig	N/A

TABLE 8 (Cont'd)

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-PI-106	Pressure Indicator	Indicates N_2 "B" header pressure	Local	Bourdon Tube	0-5000 psig	0-5000 psig	N/A
SPC-PI-107	Pressure Indicator	Indicates N_2 "A" header pressure	Local	Capillary Tube	0-500 psig	0-500 psig	N/A
SPC-PI-108	Pressure Indicator	Indicates N_2 "A" header pressure	Local	Capillary Tube	0-500 psig	0-500 psig	N/A
SPC-PI-109	Pressure Indicator	Indicates SPC-PRV-3D set pressure	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-110	Pressure Indicator	Indicates SPC-PRV-3C set pressure	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-111	Pressure Indicator	Indicates SPC-PRV-3B set pressure	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-112	Pressure Indicator	Indicates SPC-PRV-3A set pressure	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-113	Pressure Indicator	Indicates N_2 pressure to SPC-T-3	Local	Bourdon Tube	0-1000 psig	0-1000 psig	N/A
SPC-PI-114	Pressure Indicator	Indicates N_2 pressure to SPC-T-3	Local	Bourdon Tube	0-500 psig	0-500 psig	N/A
SPC-PI-214	Pressure Indicator	Indicates SPC-PRV-1 set pressure	SPC-PCV-14	Bourdon Tube	0-200 psig	0-200 psig	N/A
SPC-PI-26	Pressure Indicator	Indicates Packing Coolant pressure from PUMP-1B	Local	Bourdon Tube	0-30 psig	0-30 psig	N/A
SPC-PI-25	Pressure Indicator	Packing Coolant Disch. pressure from from PUMP-1A	Local	Bourdon Tube	0-30 psig	0-30 psig	N/A
SPC-PSL-27	Pressure Switch	Actuates low packing coolant pressure for PUMP-1A	Local	Later	Later	Later	Later
SPC-PSL-28	Pressure Switch	Actuates low packing coolant pressure for PUMP-1B	Local	Later	Later	Later	Later
SPC-MS-1A-5	Hand Switch	Close/Open overide switch for SPC-1A control circuit which actuates alarm on SPC-PWL-3	SPC-PWL-3	Selector	N/A	N/A	N/A

Instrumentation and Controls

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
SPC-HS-1B-5	Hand Switch	Close/Open overide switch for SPC-1B control circuit which actuates alarm on SPC-PNL-3	SPC-PNL-3	Selector	N/A	N/A	N/A
SPC-HS-3-5	Hand Switch	Close/Open overide switch for SPC-P-3 control circuit which controls alarm on SPC-PNL-3	SPC-PNL-3	Selector	N/A	N/A	N/A
For RCS Drain Down							
RC-LI-100A (Formally SPC-22-2)	Level Indicator	Indicate RCS water level during drain down condition.	SPC-PNL-3	Millimeter	10-50 madc	0-600 inches of water	N/A
RC-LR-100/SPC-PR-15 (Formally SPC-PR-22/SPC-PR-19)	Level Recorder	Record level of RCS during drain down	SPC-PNL-3	Strip Chart	10-50 madc/ 0-50 madc	0-1000 psig/ 0-500 psig	N/A
RC-LI-100 (Formally SPC-P1-22-1)	Level Indicator	Indicate RCS water level during drain down	SPC-PNL-1	Millimeter	10-50 madc	0-600 inches of water	N/A

Panel Mounted Annunciators and Computer Inputs

Panel Mounted Annunciators

Identification	Measured Variable, Units	Alarm High	Alarm Low	Source	Variable Range	Panel	
SPC-LAL-1B1	SPC-T-1 low level, %	N/A		21%	SPC-LSL-1B	0-100%	SPC-1
SPC-LAL-1B2	SPC-T-1 low level, %	N/A		21%	SPC-LSL-1B	0-100%	SPC-3
SPC-LAL-1C1	SPC-T-1 low level, %	N/A		21%	SPC-LSL-1C	0-100%	SPC-1
SPC-LAL-1C2	SPC-T-1 low level, %	N/A		21%	SPC-LSL-1C	0-100%	SPC-3
SPC-LALH-3A1	SPC-T-3, hi/low level, %	82%		35%	SPC-LSHH-3A	0-100%	SPC-1
SPC-LALH-3A2	SPC-T-3, hi/low level, %	82%		35%	SPC-LSHH-3A	0-100%	SPC-3
SPC-LALH-3B1	SPC-T-3, hi/low level, %	82%		35%	SPC-LSLL-3B	0-100%	SPC-1
SPC-LALH-3B2	SPC-T-3, hi/low level, %	82%		35%	SPC-LSLL-3B	0-100%	SPC-3
SPC-LALL-3A1	SPC-T-3, low level, %	N/A		35%	SPC-LSLL-3A	0-100%	SPC-1
SPC-LALL-3A2	SPC-T-3, low level, %	N/A		35%	SPC-LSLL-3A	0-100%	SPC-3
SPC-LALL-3B1	SPC-T-3, low level, %	N/A		35%	SPC-LSLL-3B	0-100%	SPC-1
SPC-LALL-3B2	SPC-T-3, low level, %	N/A		35%	SPC-LSLL-3B	0-100%	SPC-3
SPC-TAHL-4-1	SPC-T-4 hi/low temperature, °F	170		150	SPC-TSL-4	0-300%	SPC-1
SPC-TAHL-4-2	SPC-T-4 hi/low temperature, °F	170		150	SPC-TSL-4	0-300%	SPC-3
SPC-LAL-4-1	SPC-T-4 low level, %	N/A		37%	SPC-LSHL-4	0-100%	SPC-1
SPC-LAL-4-2	SPC-T-4 low level, %	N/A		37%	SPC-LSHL-4	0-100%	SPC-3
SPC-LAH-4-1	SPC-T-4 hi level, %	96%		N/A	SPC-LSHL-4	0-100%	SPC-1

TABLE 9 (Cont'd)

Panel Mounted Annunciators and Computer Inputs

Panel Mounted Annunciators

Identification	Measured Variable, Units	Alarm High	Alarm Low	Source	Range	Variable Panel
SPC-LAH-4-2	SPC-T-4 hi level, %	96%	N/A	SPC-LSHL-4	0-100%	SPC-3
SPC-DPAH-10A-1	SPC/RC differential pressure, psid	+25	-25	SPC-DPS-10A	±1000 psid	SPC-1
SPC-DPAH-10A-2	SPC/RC differential pressure, psid	+25	-25	SPC-DPS-10A	±1000 psid	SPC-3
SPC-DPAH-10B-1	SPC pressure/setpoint differential pressure, psid	+25	-25	SPC-DPS-10B	±1000 psid	SPC-1
SPC-DPAH-10B-2	SPC pressure/setpoint differential pressure, psid	+25	-25	SPC-DPS-10B	±1000 psid	SPC-3
SPC-PAL-11-1	Low SPC nitrogen pressure, psig	N/A	225	SPC-PS-11	0-500 psig	SPC-1
SPC-PAL-11-2	Low SPC nitrogen pressure, psig	N/A	225	SPC-PS-11	0-500 psig	SPC-3
SPC-ZA-71-1	SPC-V71 valve position	N/A	N/A	SPC-ZS-71	N/A	SPC-1
SPC-ZA-71-2	SPC-V71 valve position	N/A	N/A	SPC-ZS-71	N/A	SPC-3
SPC-FAH-15-1	High nitrogen flow	20,000 SCFH	N/A	SPC-FSH-15	0-10"WG	SPC-1
SPC-FAH-15-2	High nitrogen flow	20,000 SCFH	N/A	SPC-FSH-15	0-10"WG	SPC-3
SPC-PAL-27	Low pressure P-1A packing coolant	N/A	(Later)	SPC-PSL-27	(Later)	SPC-3
SPC-PAL-28	Low pressure P-1B packing coolant	N/A	(Later)	SPC-PSL-28	(Later)	SPC-3

Computer Inputs

None