HEU-T90 Cooling, Power, and Control Systems (New Design)

HMM-378-A
CRAY T90 Series Systems
Last Modified: July 1997

Figures

Tables

Record of Revision

January 1997

Original printing.

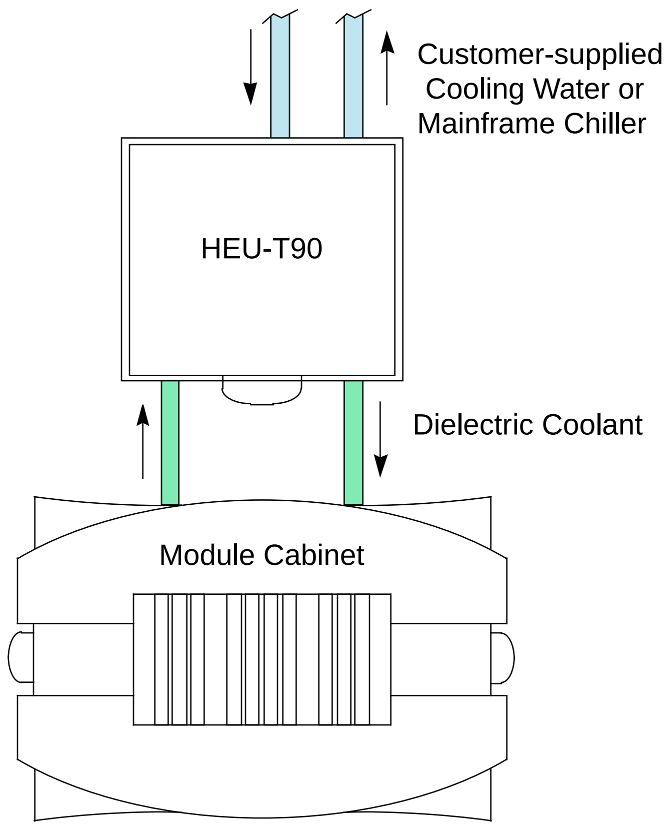
July 1997

Revision A is only a title change from HMM-378-0. This change was made to differentiate this document from *HEU-T90 Power, Cooling, and Control System*, publication number HTM-010-A. No other material has been added.

HEU-T90 Systems

The heat exchanger unit (HEU-T90) removes heat that is generated within a module cabinet and transfers the heat to customer-supplied cooling water (refer to Figure 1). Dielectric coolant circulates through the module cabinet and absorbs heat that is generated by the modules and power supplies. The heated dielectric coolant then flows to the HEU-T90 where the heat transfers from the dielectric coolant to customer-supplied cooling water.

Figure 1. HEU-T90 Function



This document provides information on the HEU-T90 that is used with the following CRAY T90 series systems:

- Serial numbers 7035 through 7099
- Serial numbers 7113 through 7199
- Serial numbers 7211 through 7299

Figure 2 shows a view of the HEU-T90 with the panels and some of the components removed. This view is hereafter referred to as the front view of the HEU-T90.

Figure 2. Front View of the HEU-T90

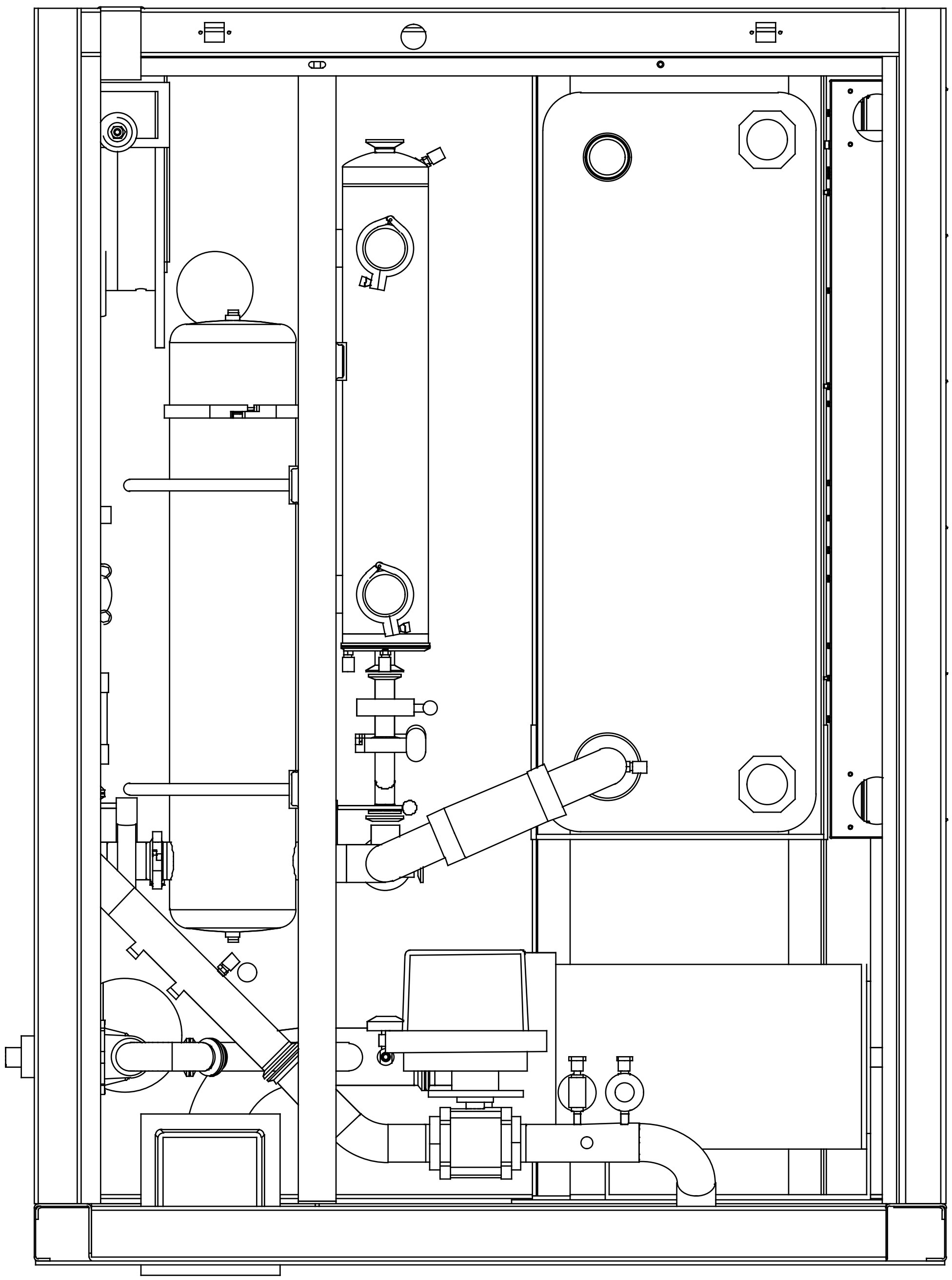
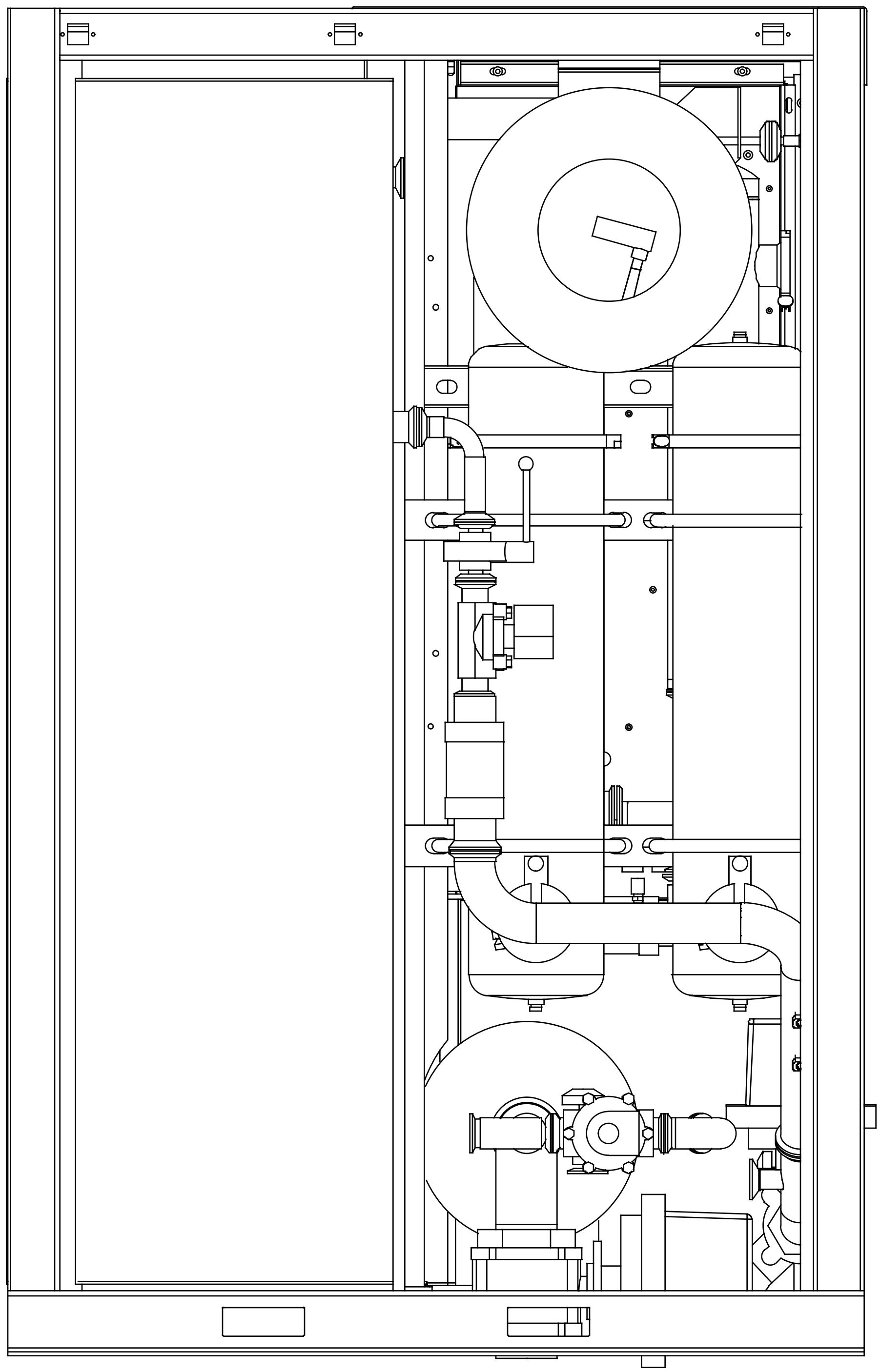


Figure 3 shows another view of the HEU-T90 with the panels and some of the components removed. This view is hereafter referred to as the side view of the HEU-T90.

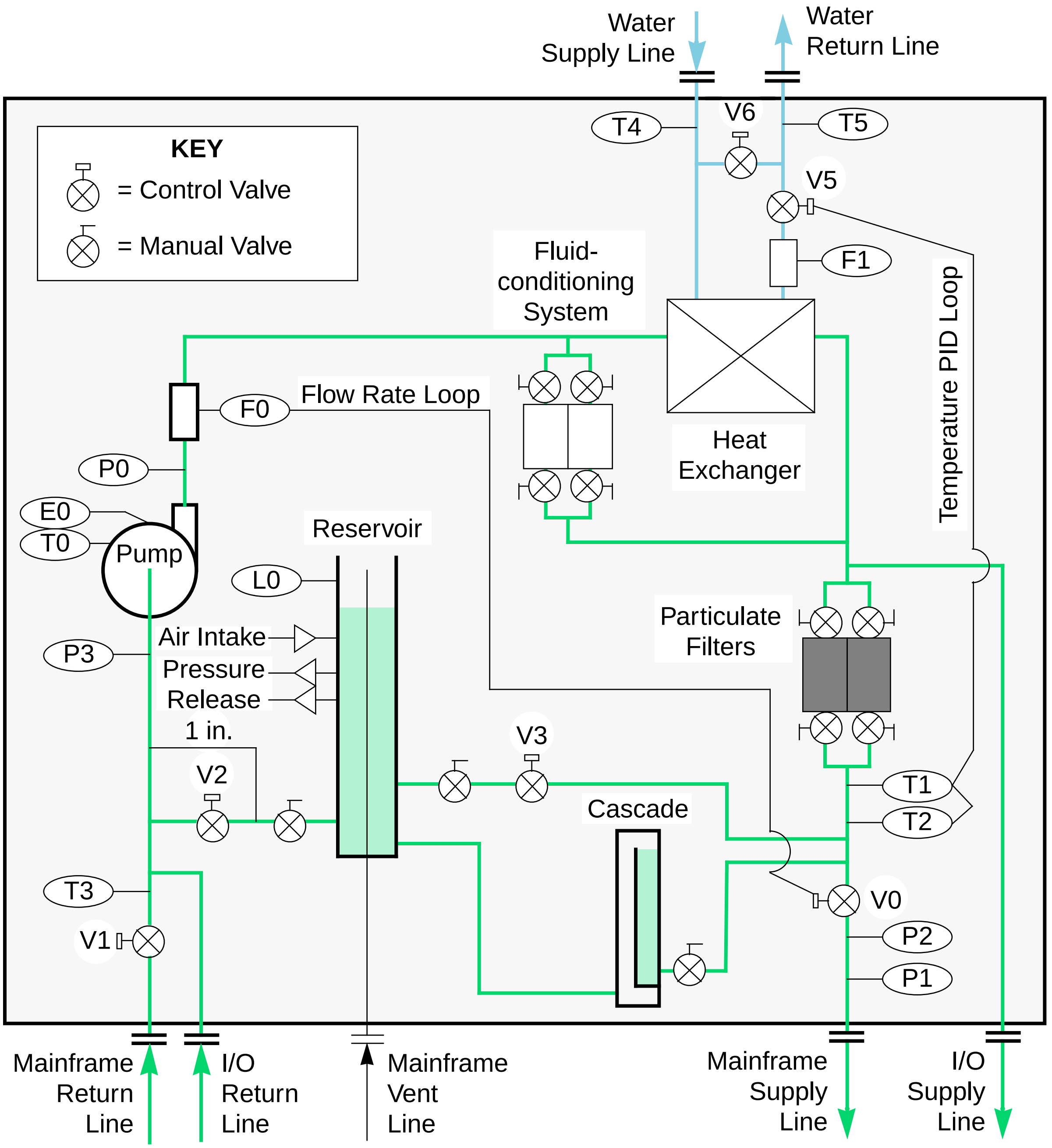
Figure 3. Side View of the HEU-T90



Cooling System

The cooling system has two main circuits: a dielectric-coolant circuit and a water circuit (refer to Figure 4). The following subsections describe each component of the cooling system. It may be helpful to refer back to Figure 4 while reading these subsections.

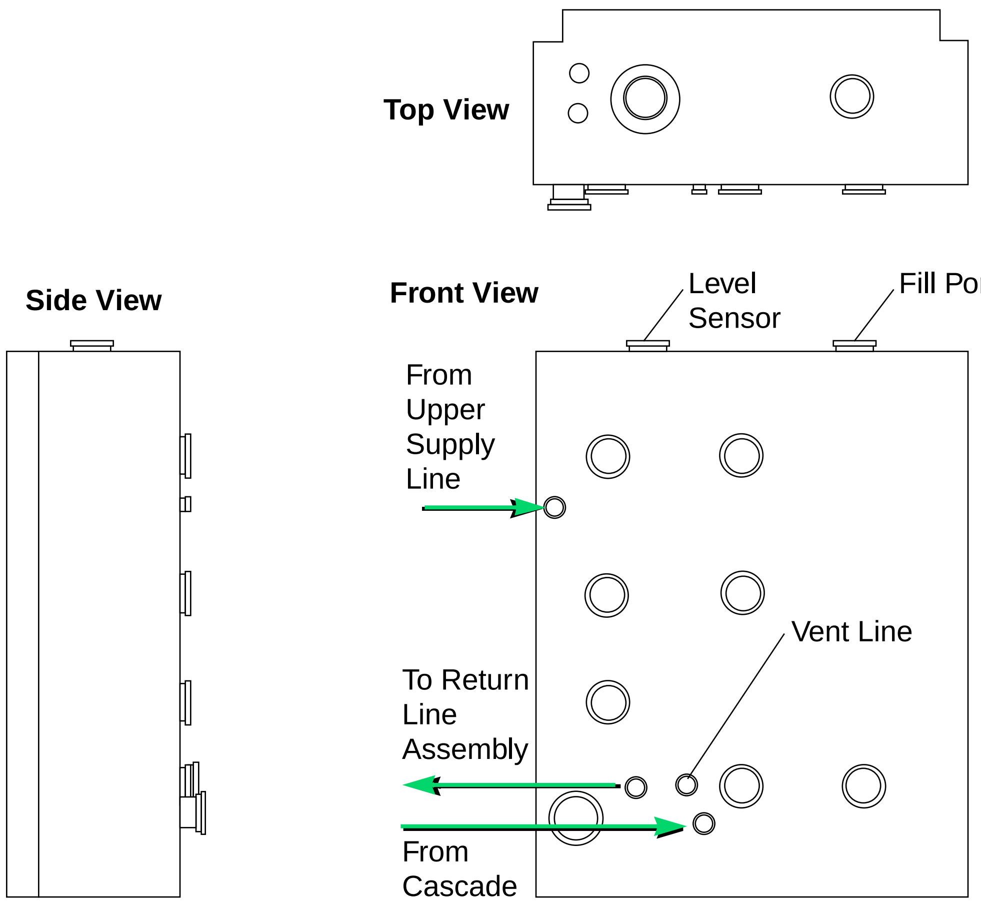
Figure 4. Cooling System Block Diagram



Reservoir

The reservoir is a storage container for dielectric coolant. When the computer system is powered down, the dielectric coolant drains from the module cabinets and transfers to the reservoir for storage. When the computer system is powered up, the dielectric coolant transfers from the reservoir to the computer system. The reservoir receives dielectric coolant from the upper supply line assembly and the cascade and transfers the dielectric coolant to the return line assembly (refer to Figure 5).

Figure 5. Reservoir



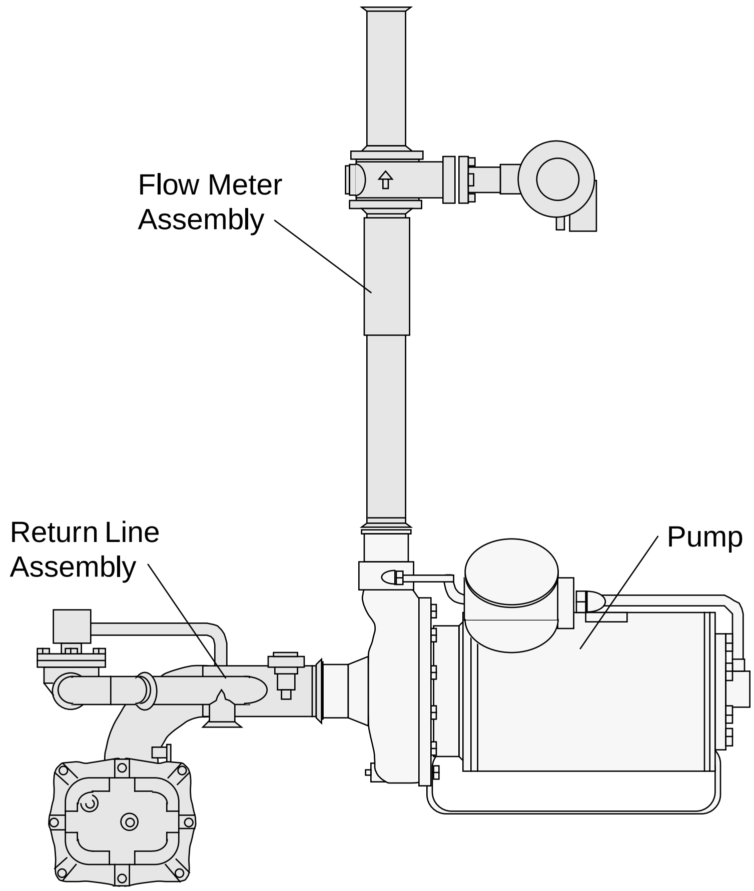
The reservoir has a 4-in. reservoir fill port that is located on top of the reservoir. When more dielectric coolant needs to be added to the reservoir, pour the dielectric coolant directly into the reservoir through the fill port.

The reservoir also has a vent line and level sensor (L0). The vent line receives any air that is in the module cabinet or supply line and transfers the air into the reservoir. The level sensor monitors the level of the dielectric coolant in the reservoir.

Return Line System

The return line system (refer to Figure 6) receives warm dielectric coolant from the mainframe module cabinet (and the IOS/SSD module cabinet in CRAY T94 systems) and transfers the dielectric coolant to the heat exchange system. The return line system has three assemblies: the return line assembly, the pump, and the flow meter assembly.

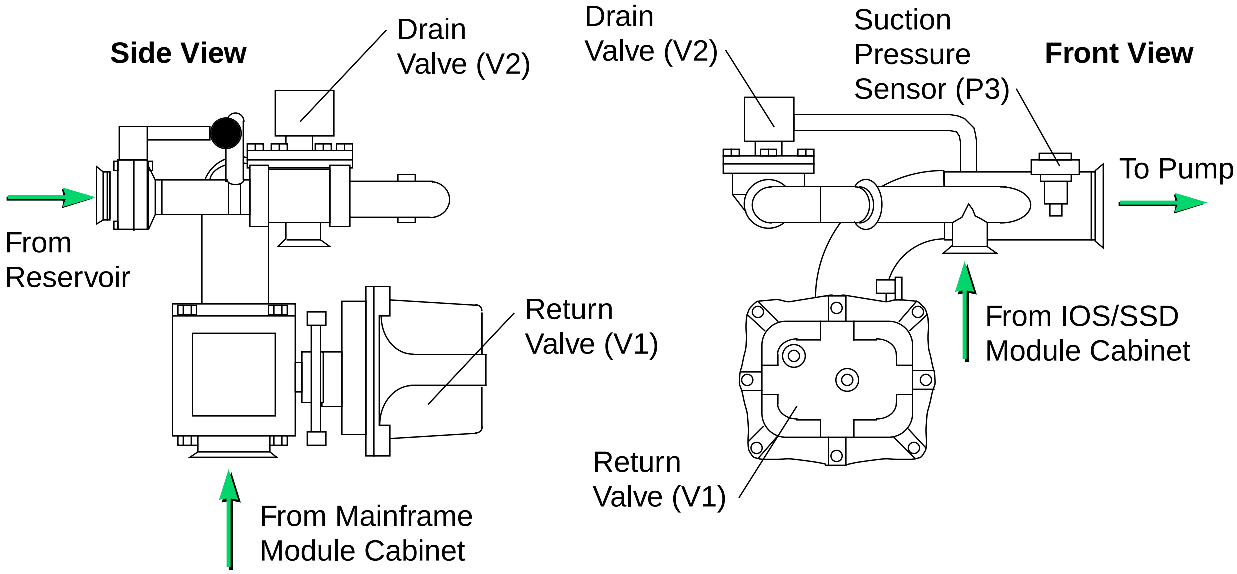
Figure 6. Return Line System



Return Line Assembly

The return line assembly receives dielectric coolant from the reservoir, the mainframe module cabinet, and/or the IOS/SSD module cabinet and transfers the dielectric coolant to the pump (refer to Figure 7). The HEU-T90 receives dielectric coolant from an IOS/SSD module cabinet only when the HEU-T90 is connected to a CRAY T94 system.

Figure 7. Return Line Assembly



The return line assembly has three valves: a return valve (V1), a drain valve (V2), and a manual valve. These valves control the flow of dielectric coolant during the reservoir draining process.

During normal operation, the return valve is open (on) and the drain valve is closed (off). This configuration causes dielectric coolant to flow from the module cabinet through the return line assembly and to the pump. (There is also a 1-in. bypass line that provides replacement fluid from the reservoir to maintain the net positive suction head pressure that is required for proper operation of the pump.)

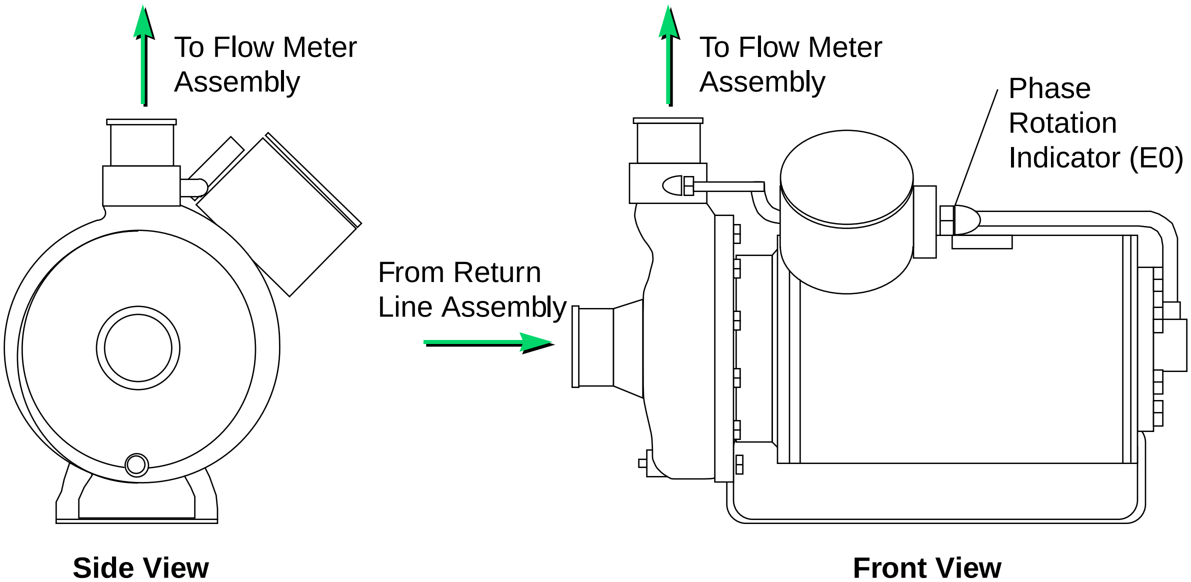
During a reservoir draining operation (mainframe filling operation), the return valve is closed (off) and the drain valve is open (on). This configuration causes the dielectric coolant to transfer from the reservoir through the return line, to the pump, and eventually to the mainframe.

The return line assembly also has a suction pressure sensor (P3) and temperature sensor (T3). These sensors check the pressure and temperature in the return line before the dielectric coolant enters the pump.

Pump

The centrifugal pump (refer to Figure 8) circulates dielectric coolant throughout the computer system. The pump receives dielectric coolant from the return line assembly and transfers the dielectric coolant to the flow meter assembly.

Figure 8. Pump



The pump operates on 50-Hz, 3-phase, 380-Vac or 60-Hz, 3-phase, 480-Vac power, which is supplied by the 3-pole male connector that is connected to the electrical control box. The pump is protected by overtemperature circuitry that shuts down the system if an overload causes the temperature to become too high. This circuitry includes the following components:

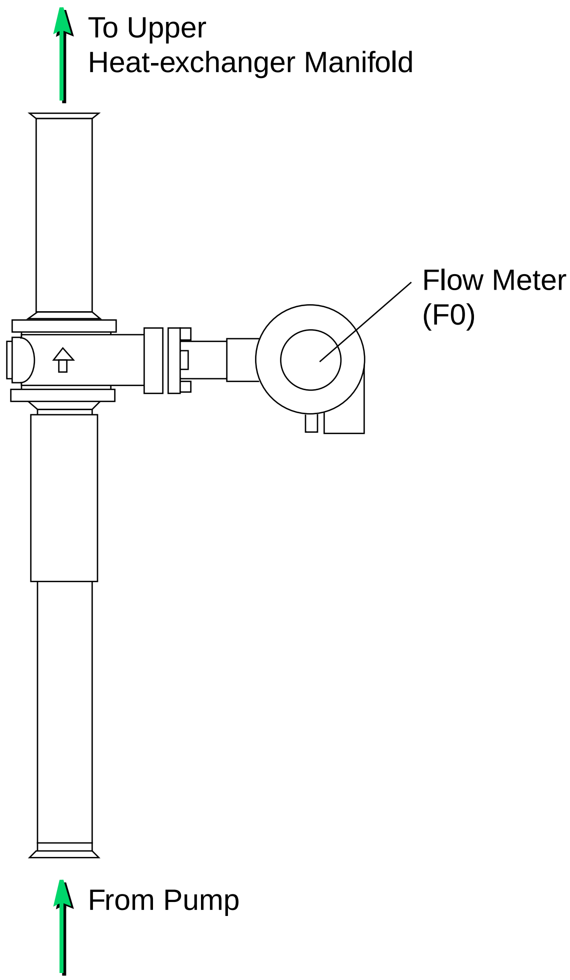
- Phase rotation indicator E0
- Pump temperature sensor T0 (located inside the pump windings)

The pump has a 6.75-in. diameter impeller for all HEU-T90 systems except for CRAY T916 or CRAY T932 systems that receive 50-Hz voltage. For these systems, the pump has a 7.75-in. diameter impeller.

Flow Meter Assembly

The flow meter assembly receives dielectric coolant from the pump, measures the flow rate of the dielectric coolant, and transfers the dielectric coolant to the heat exchange system (refer to Figure 9).

Figure 9. Flow Meter



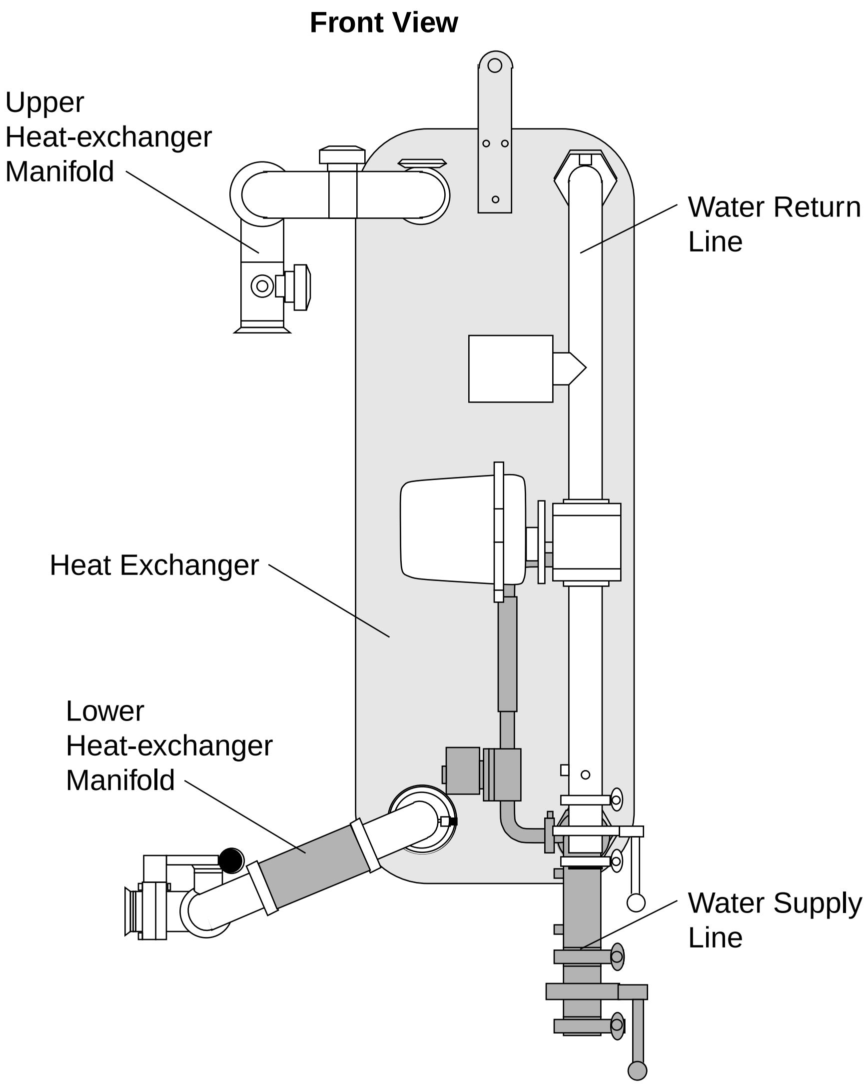
The flow meter assembly has a flow meter (F0). The control system adjusts the position of the supply valve on the supply line assembly based on the measurements it receives from the flow meter.

The flow meter assembly also has a discharge pressure sensor (P0). This pressure sensor checks the pressure in the line before the dielectric coolant enters the flow meter.

Heat Exchange System

The heat exchange system (refer to Figure 10) transfers heat from the dielectric coolant to water. The heat exchange system has five assemblies: the upper heat-exchanger manifold, the heat exchanger, the lower heat-exchanger manifold, the water supply line, and the water return line.

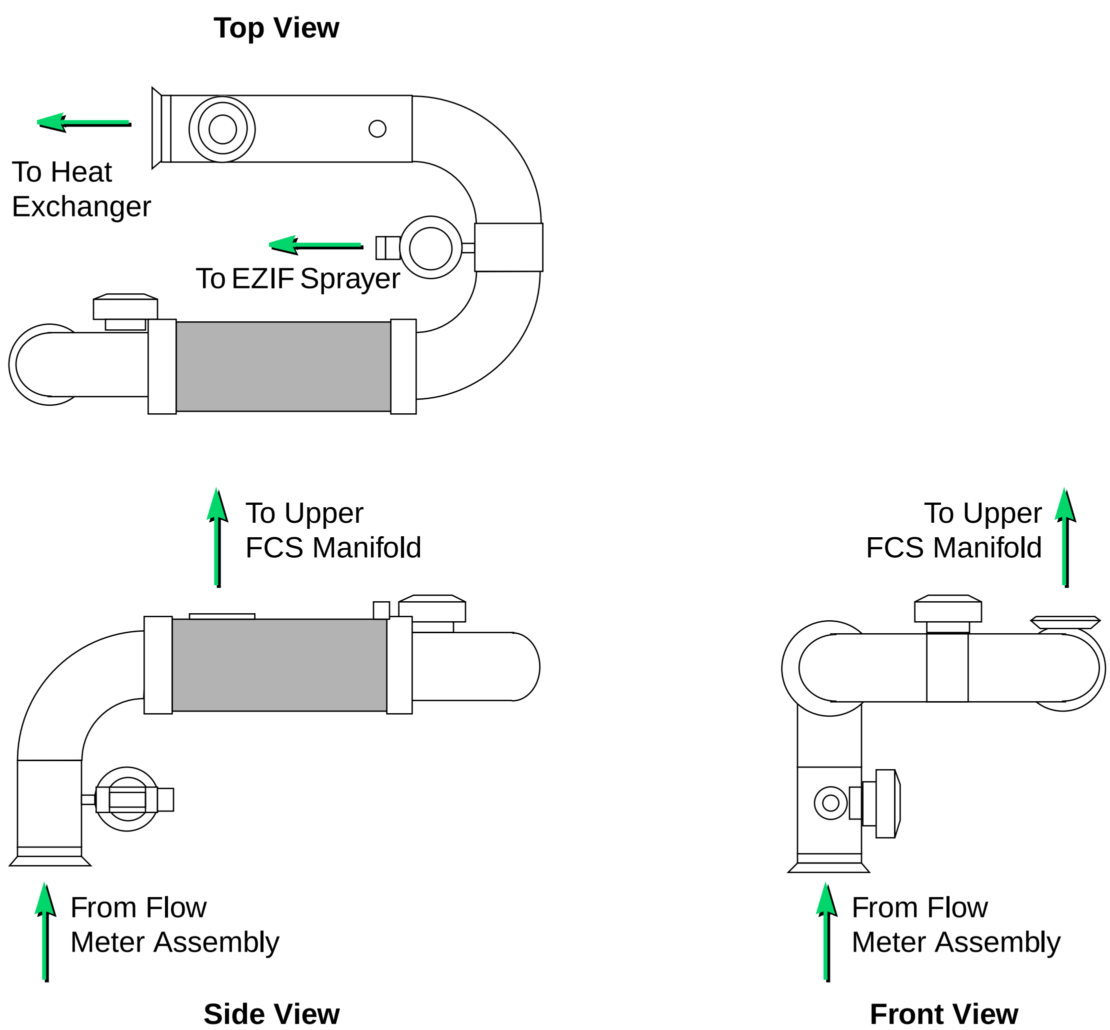
Figure 10. Heat Exchange System



Upper Heat-exchanger Manifold

The upper heat-exchanger manifold receives warm dielectric coolant from the flow meter assembly and transfers the dielectric coolant to the heat exchanger and the upper fluid conditioning system (FCS) manifold (refer to Figure 11).

Figure 11. Upper Heat-exchanger Manifold

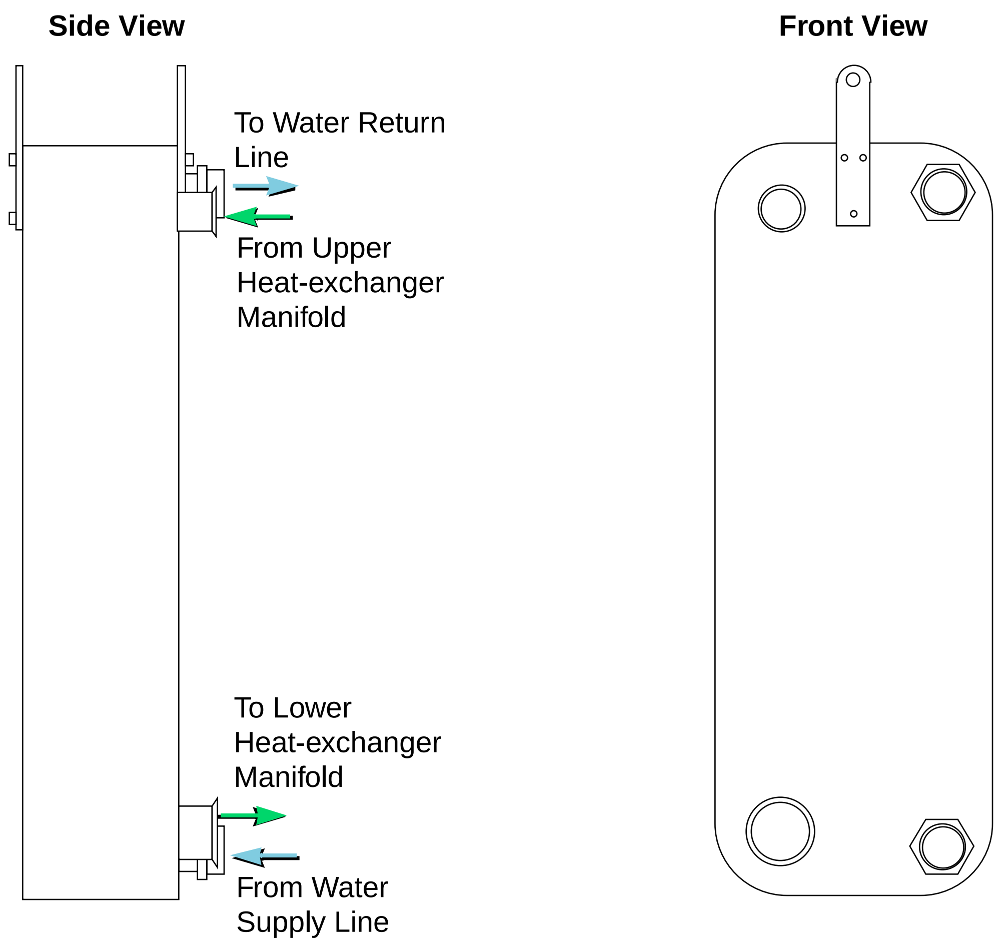


The upper heat-exchanger manifold divides the dielectric-coolant flow into two parallel paths. One path flows through the fluid conditioning system and the other path flows through the heat exchanger.

Heat Exchanger

The heat exchanger is a brazed assembly of thin corrugated metal plates stacked on top of each other. The heat exchanger receives dielectric coolant from the upper heat-exchanger manifold and transfers the dielectric coolant to the lower heat-exchanger manifold. The heat exchanger also receives water from the water supply line and transfers the water to the water return line (refer to Figure 12).

Figure 12. Heat Exchanger

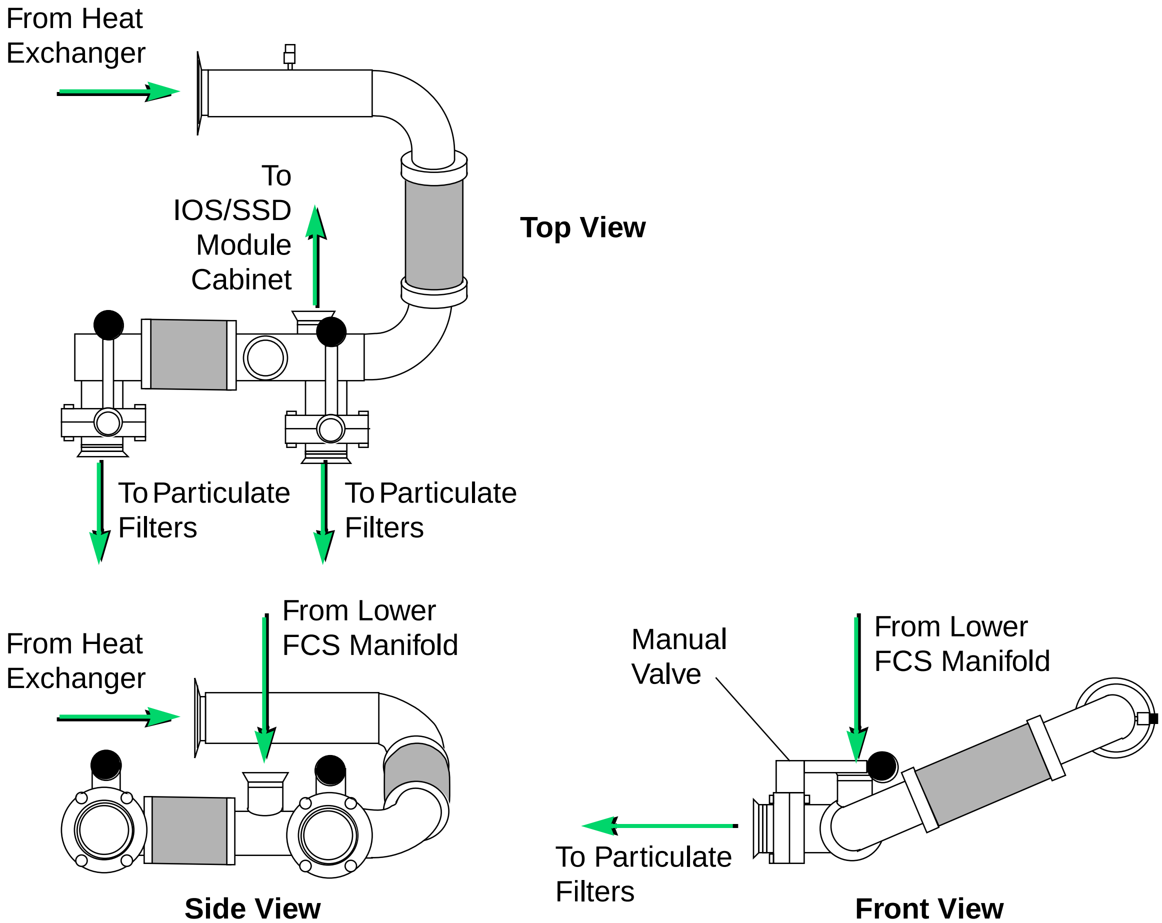


Heated dielectric coolant enters the heat exchanger and flows through channels that are formed by stacked metal plates. Cold water also enters the heat exchanger and flows through adjacent channels that are formed by stacked metal plates. The dielectric coolant always flows in the opposite direction of the cold water. Heat conducts from the warm dielectric coolant to the cold water.

Lower Heat-exchanger Manifold

The lower heat-exchanger manifold receives dielectric coolant from the heat exchanger and the lower FCS manifold and transfers the dielectric coolant to the IOS/SSD supply line and the particulate filters (refer to Figure 13).

Figure 13. Lower Heat-exchanger Manifold



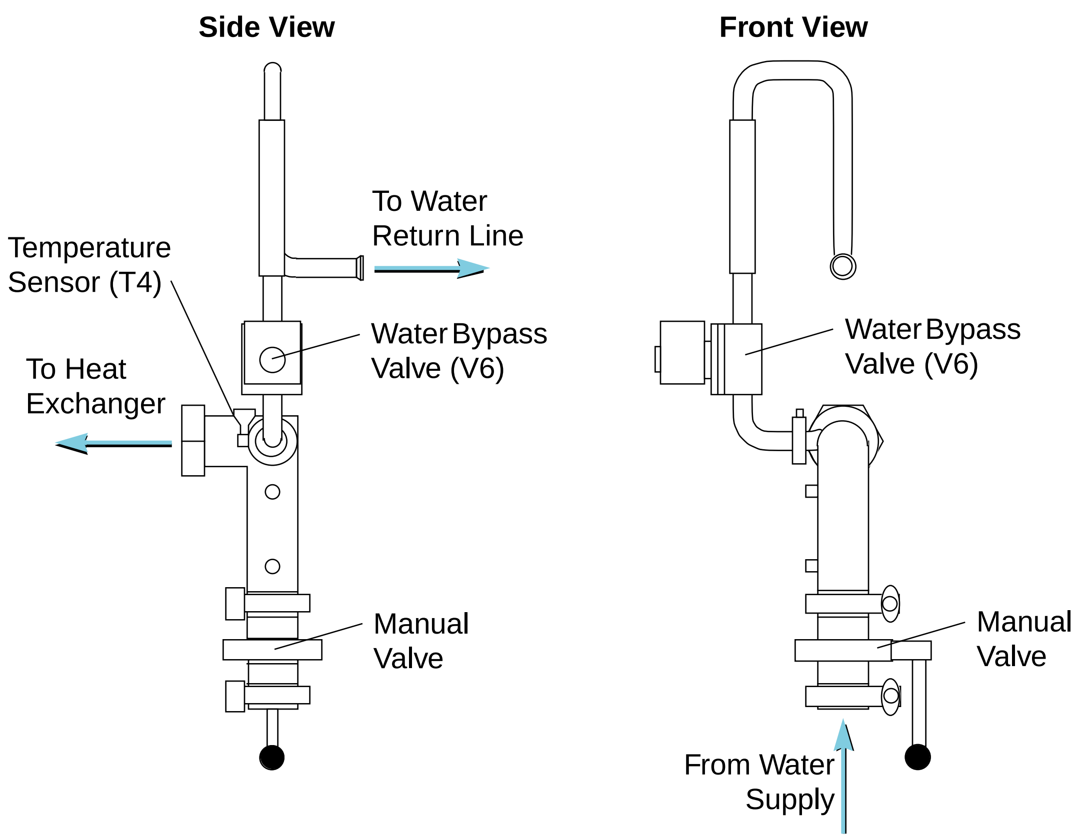
The IOS/SSD module cabinet does not use an immersion cooling technique. Because of this feature, the dielectric coolant does not have to be filtered by the particulate filters before it enters the IOS/SSD module cabinet. The HEU-T90 transfers dielectric coolant to an IOS/SSD module cabinet only when the HEU-T90 is connected to a CRAY T94 system.

The lower heat-exchanger manifold has two manual valves. When closed, each valve disables the flow of dielectric coolant to one particulate filter. During normal operation, open both manual valves so that dielectric coolant flows through both particulate filters. When closed, a manual valves isolates a particulate filter so that you can replace it while the system is running.

Water Supply Line

The water supply line receives customer-supplied cooling water and transfers the water to the heat exchanger (refer to Figure 14). Water flows from the customer-supplied cooling water source to the water supply line through piping under the computer room floor.

Figure 14. Water Supply Assembly



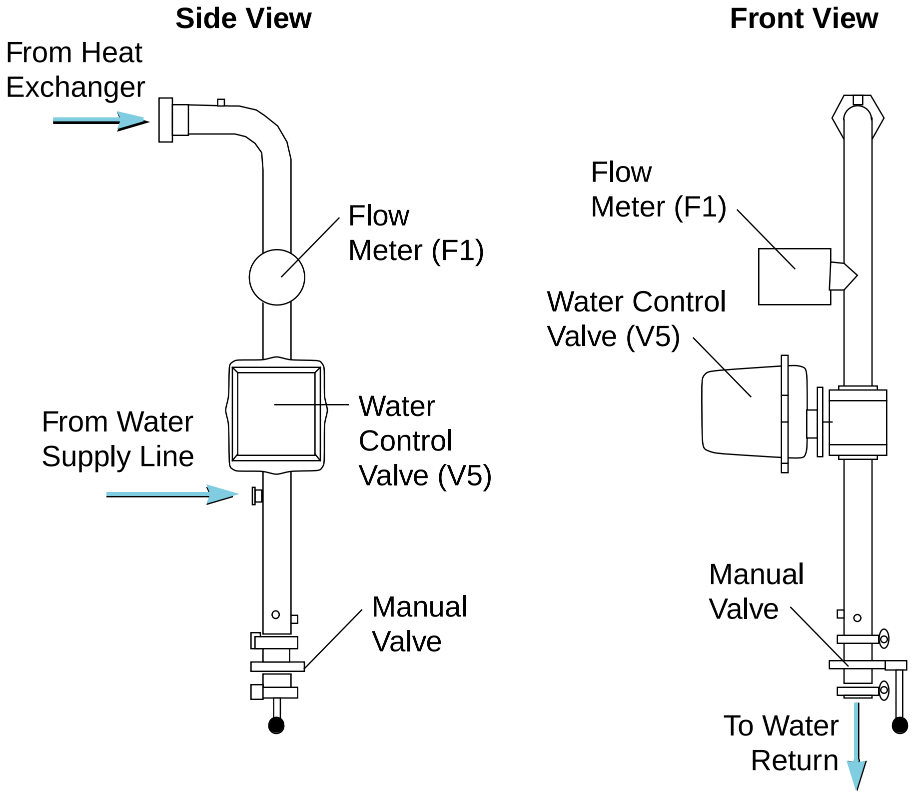
The water supply line has two valves: the water bypass valve (V6) and a manual valve. The water bypass valve routes water around the heat exchanger when the HEU-T90 is not operating. Water routes from the water supply line, through the water bypass valve, through the water bypass line, and to the water return line. The water flows at a reduced rate to minimize delays in system start-up time. (Delays can occur when stagnant water loops warm to room temperature.) The manual valve turns the supply of water on or off.

The water supply line also has a temperature sensor (T4). This sensor monitors the temperature of the supply water before it enters the heat exchanger.

Water Return Line

The water return line receives warm water from the heat exchanger and transfers the water to the customer-supplied chiller (refer to Figure 15). Water flows from the water return line to the chiller through piping under the computer room floor.

Figure 15. Water Return Assembly



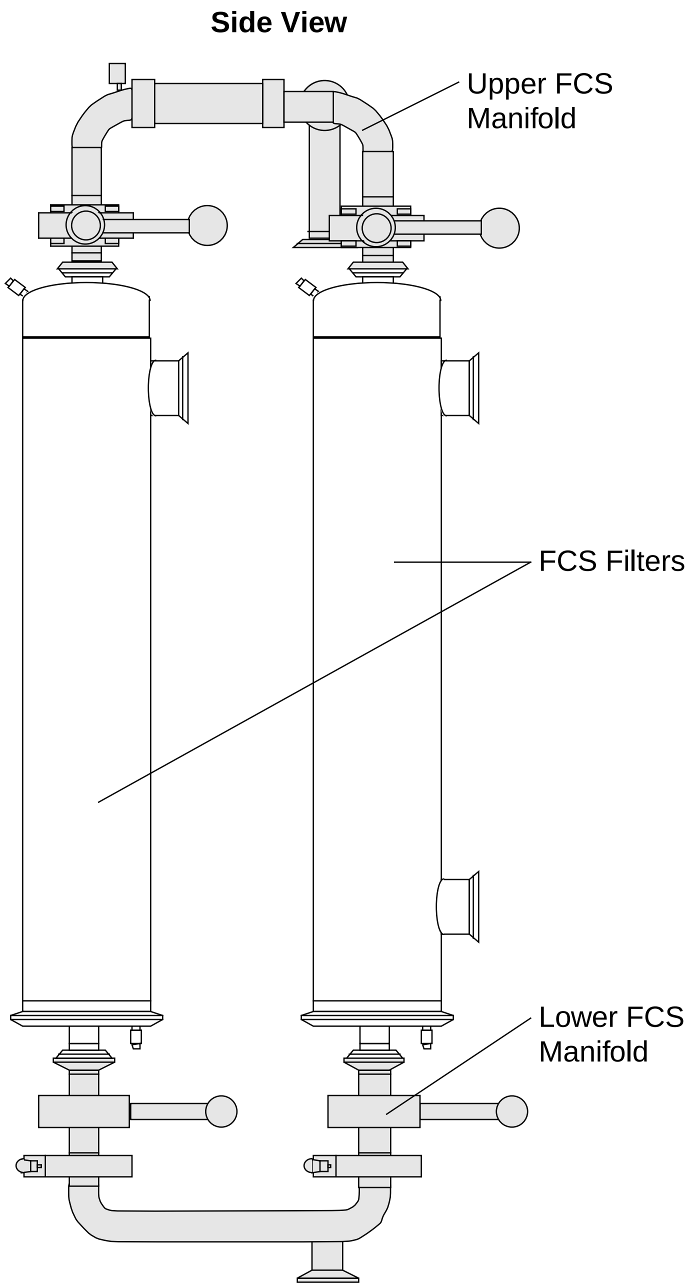
The water return assembly has a water control valve (V5), a flow meter (F1), and a manual valve. The water control valve controls the flow of water through the heat exchanger. The control system adjusts the position of the water control valve based on the measurements it receives from the temperature sensors (T1 and T2) on the supply line. The manual valve isolates the water return line from the customer-supplied chiller return line.

The water return line also has a temperature sensor (T5). This sensor monitors the temperature of the return water after it exits the heat exchanger.

Fluid Conditioning System

The fluid-conditioning system (FCS) performs chemical filtration (refer to Figure 16). The FCS is in parallel with the dielectric-coolant line that goes into the heat exchanger. The FCS consists of three assemblies: the upper FCS manifold, the FCS filters, and the lower FCS manifold.

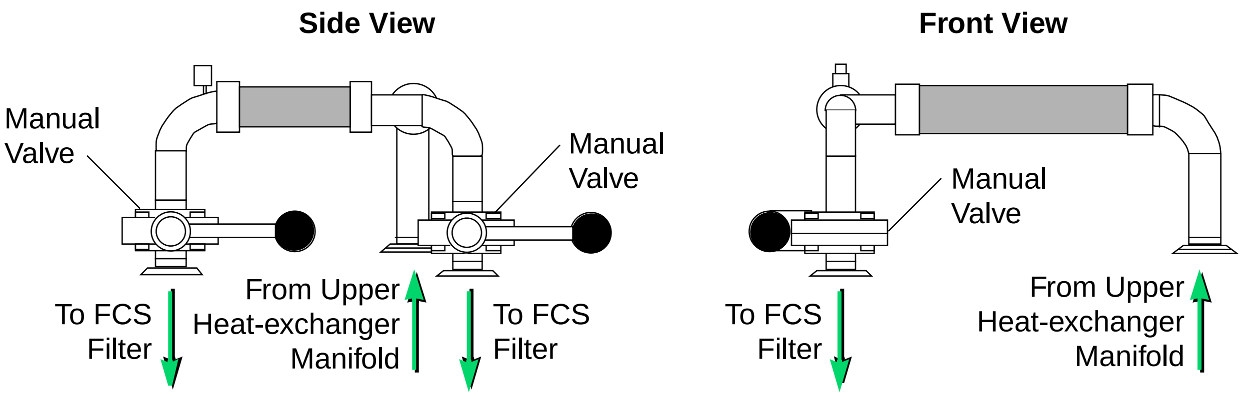
Figure 16. Fluid Conditioning System



Upper FCS Manifold

The upper FCS manifold receives dielectric coolant from the upper heat-exchanger manifold and transfers the coolant to the FCS filters (refer to Figure 17).

Figure 17. Upper FCS Manifold



The upper FCS manifold has two manual valves. When closed, each valve disables the flow of dielectric coolant to one FCS filter. During normal operation, open one manual valve and close the other manual valve. This configuration reserves one filter in case the other filter is saturated with water or organics.

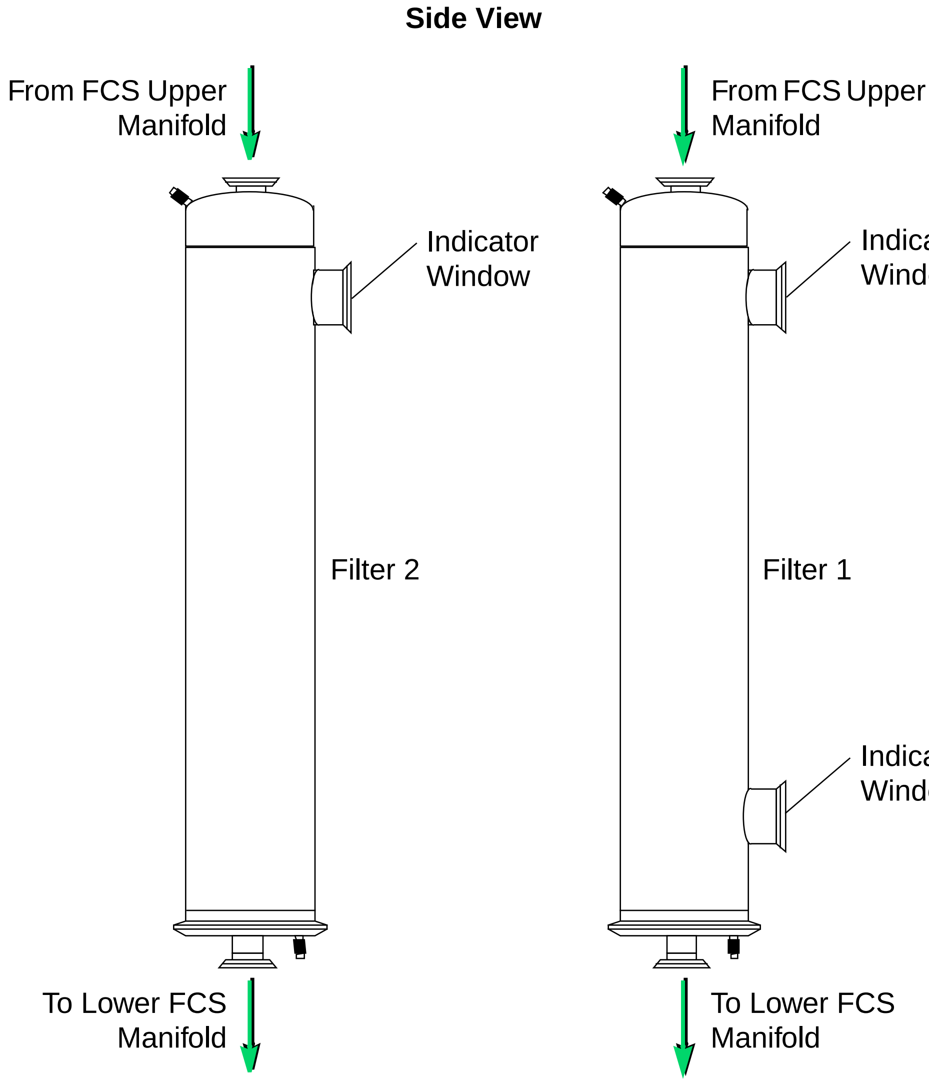
NOTE: The lower FCS manifold also contains manual valves. You must set these valves to the same configuration as the upper FCS manifold valves.

In addition to reserving an FCS filter during normal operation, the manual valves isolate an FCS filter so that you can replace it while the system is running.

FCS Filters

The FCS has two FCS filters (refer to Figure 18). Each FCS filter receives dielectric coolant from the upper FCS manifold, filters the dielectric coolant, and transfers the dielectric coolant to the lower FCS manifold.

Figure 18. FCS Filter

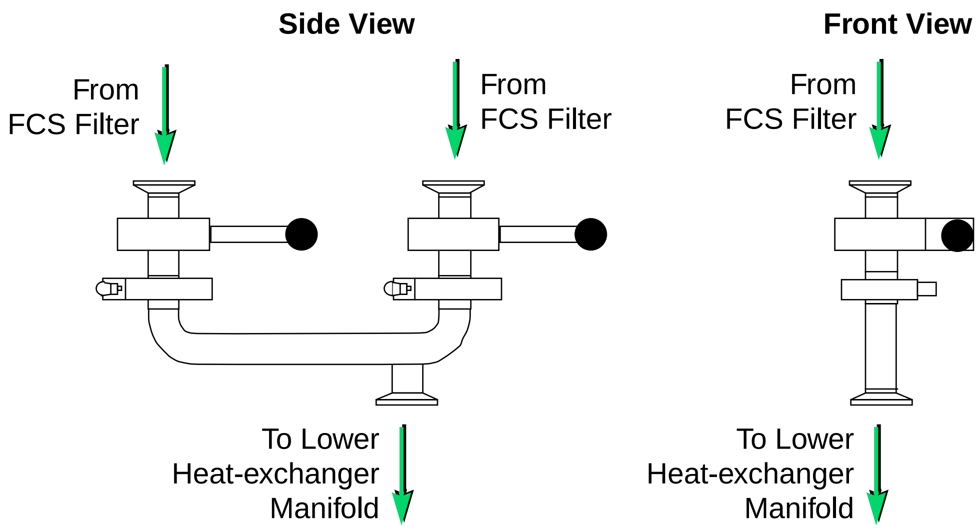


The FCS filters have glass indicator windows that contain a combination of white and colored beads. Filter 1 has two indicator windows (top and bottom), and filter 2 has one indicator window (top). When all the beads in the top indicator window are a uniform color, the filter is saturated with organics and needs to be replaced. When all the beads in the bottom indicator window of filter 1 are a uniform color, the filter is saturated with water and needs to be replaced.

Lower FCS Manifold

The lower FCS manifold receives dielectric coolant from the FCS filters and transfers the coolant to the lower heat-exchanger manifold (refer to Figure 19).

Figure 19. Lower FCS Manifold



The lower FCS manifold has two manual valves. When closed, each valve disables the flow of dielectric coolant from one FCS filter. During normal operation, open one manual valve and close the other manual valve. This configuration reserves one filter in case the other filter is saturated with water or organics.

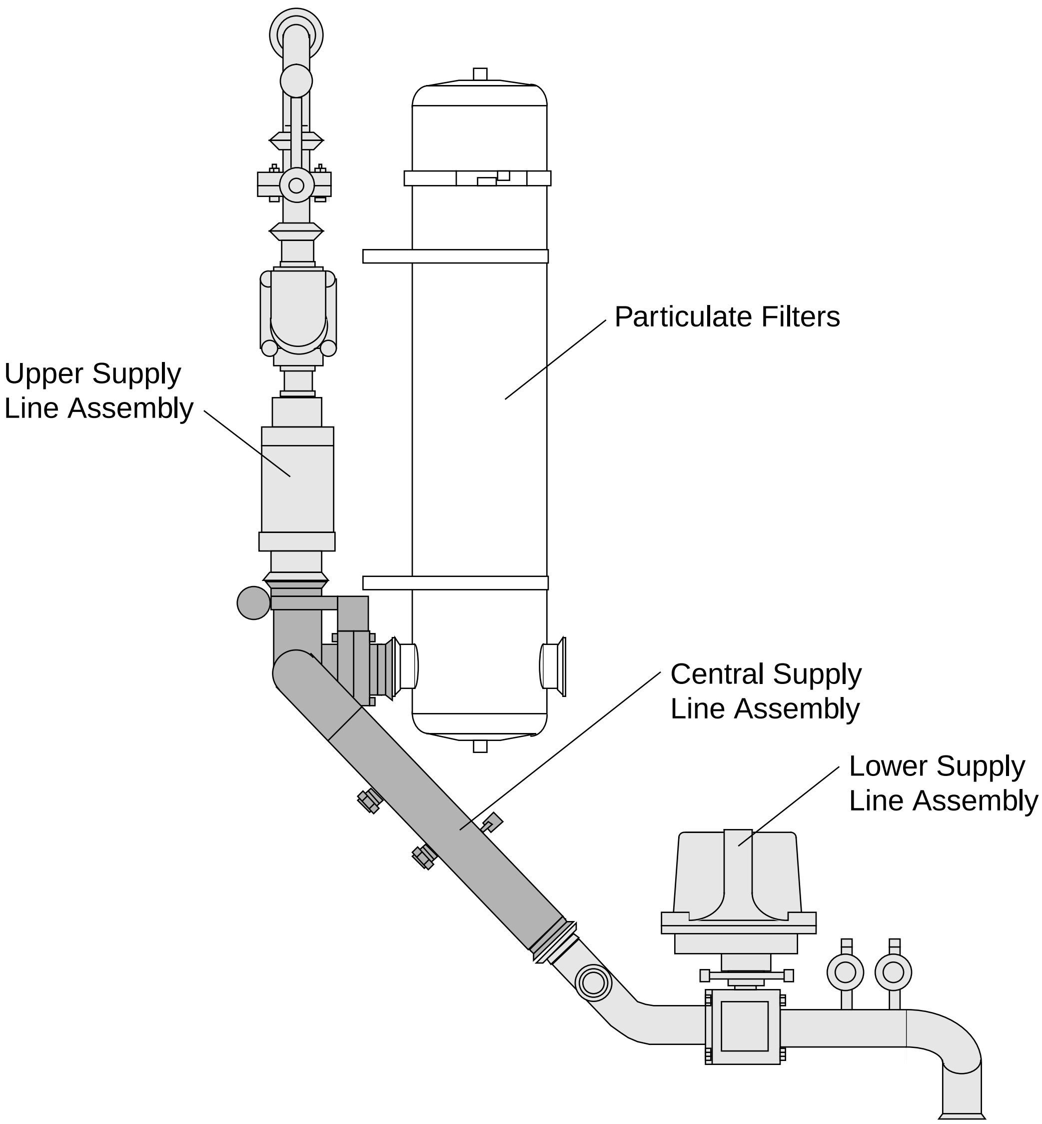
NOTE: The upper FCS manifold contains manual valves. You must set these valves to the same configuration as the lower FCS manifold valves.

In addition to reserving an FCS filter during normal operation, the manual valves isolate an FCS filter so that you can replace it while the system is running.

Supply Line

The supply line (refer to Figure 20) transfers dielectric-coolant from the HEU-T90 to the mainframe and IOS/SSD module cabinets. The supply line consists of four assemblies: the particulate filters, the central supply line assembly, the upper supply line assembly, and the lower supply line assembly.

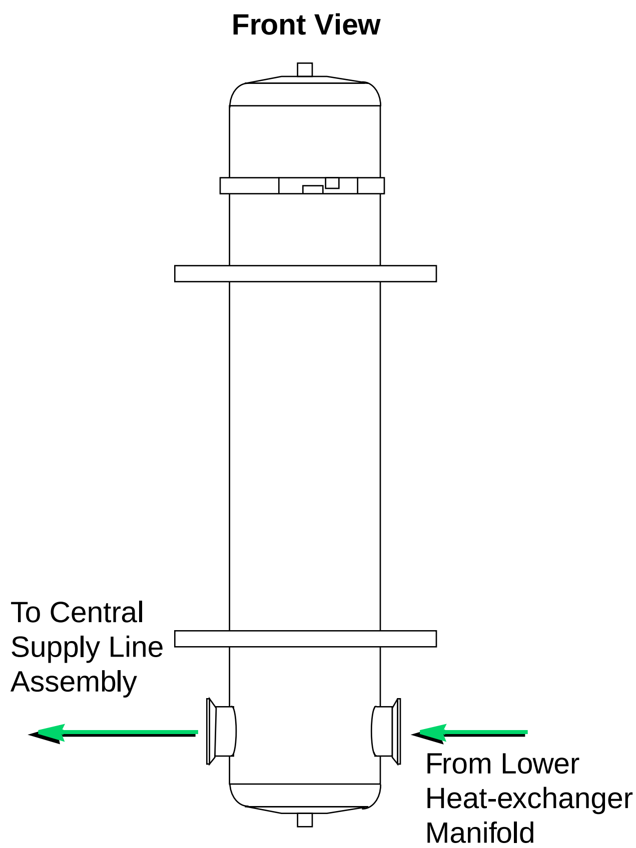
Figure 20. Supply Line



Particulate Filters

The two particulate filters are cylindrical stainless steel housings that each have three filter elements. The particulate filters remove particles larger than 1.5 microns from the dielectric coolant. The particulate filters receive dielectric coolant from the lower heat-exchanger manifold, filter the dielectric coolant, and transfer the dielectric coolant to the central supply line assembly (refer to Figure 21).

Figure 21. Particulate Filter



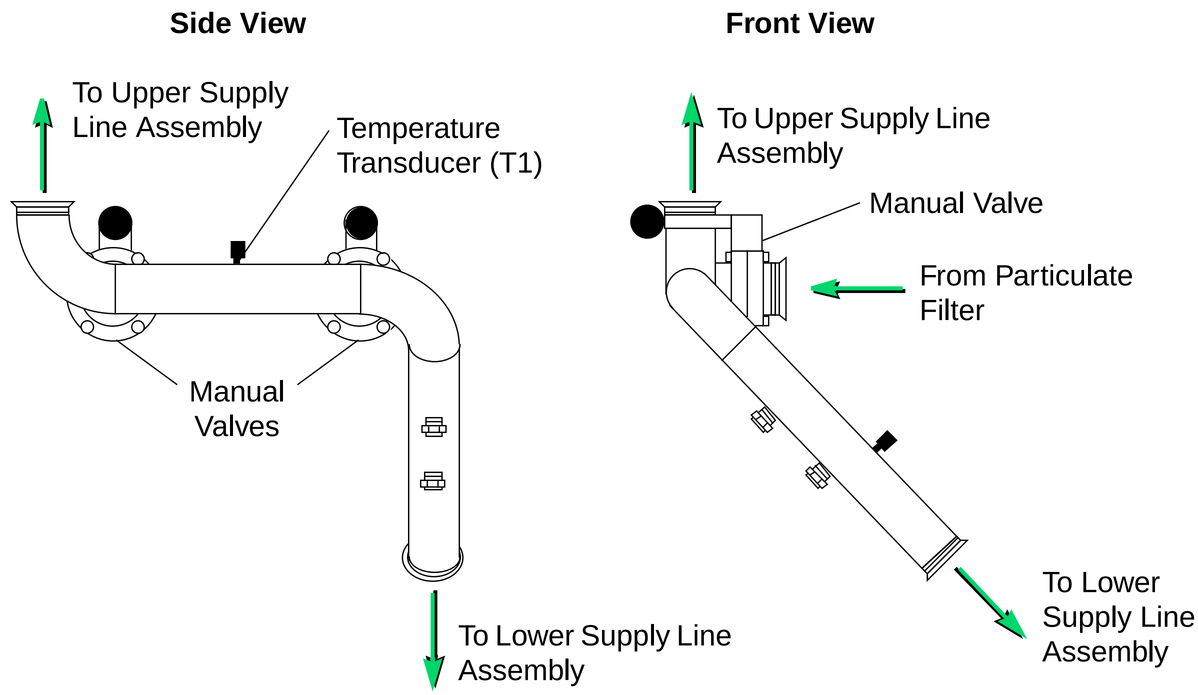
Dielectric coolant normally flows through both particulate filters. Use the manual valves on the lower heat-exchanger manifold and the central supply line assembly to isolate a single filter if you need to replace the filter. This feature enables the system to keep running while you replace the filter.

NOTE: If the manual valves are opened or closed too quickly, the rapid change in dielectric coolant flow could cause the control system to detect a flow or pressure fault.

Central Supply Line Assembly

The central supply line assembly receives dielectric coolant from the particulate filters and transfers the dielectric coolant to the upper supply line assembly and the lower supply line assembly (refer to Figure 22).

Figure 22. Central Supply Line Assembly



The central supply line assembly has two manual valves. When closed, each valve disables the flow of dielectric coolant from one particulate filter. During normal operation, open both manual valves so that dielectric coolant flows from both particulate filters. When closed, a manual valve isolates a particulate filter so that you can replace it while the system is running.

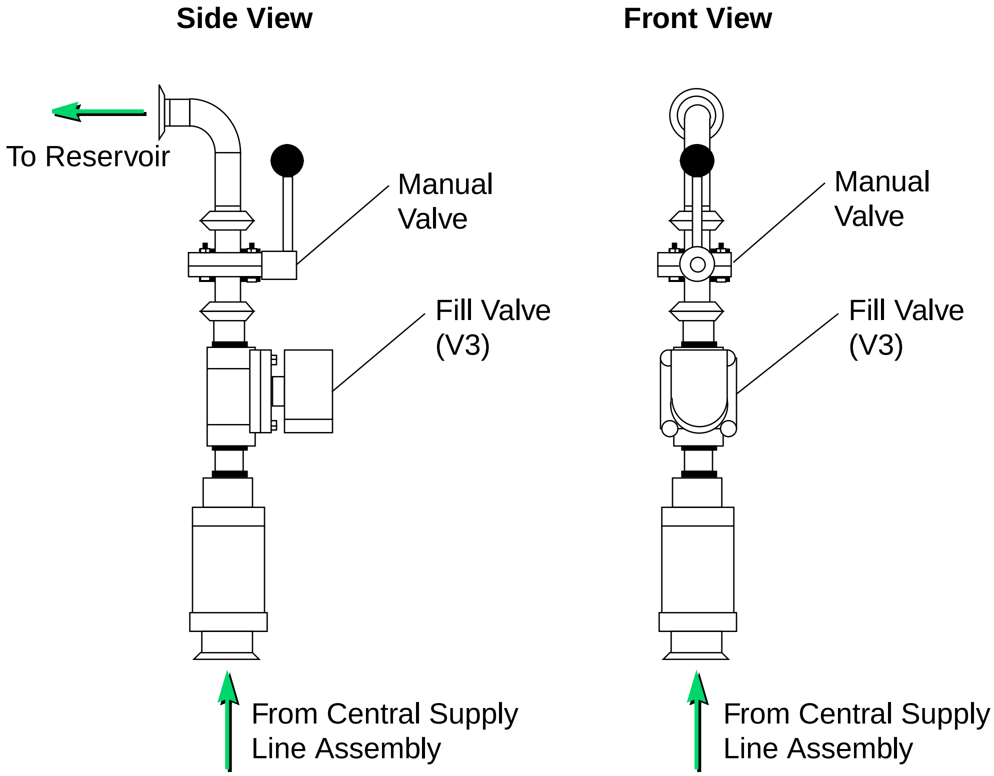
NOTE: If the manual valves are opened or closed too quickly, the rapid change in dielectric coolant flow could cause the control system to detect a flow or pressure fault.

The central supply line assembly also has two temperature sensors (T1 and T2). The control system adjusts the position of the water control valve on the water return line based on the measurements it receives from temperature sensors.

Upper Supply Line Assembly

The upper supply line assembly receives dielectric coolant from the central supply line assembly and transfers the dielectric coolant to the reservoir (refer to Figure 23).

Figure 23. Upper Supply Line Assembly

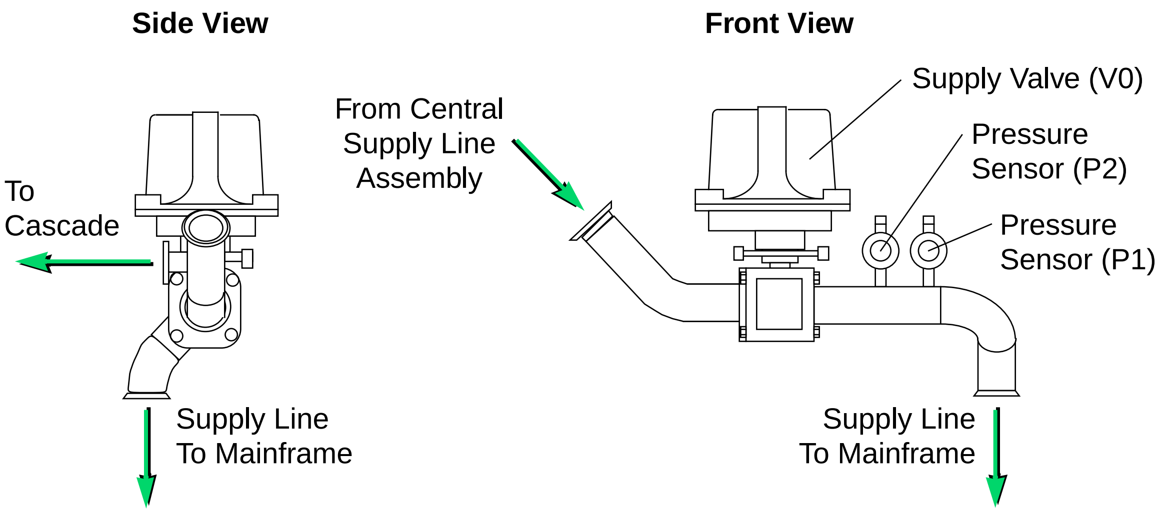


The upper supply line assembly contains a fill valve (V3) and a manual valve. The fill valve (V3) is a solenoid control valve that opens only during the reservoir filling process. (During the reservoir filling process, the supply valve on the lower supply line is closed.) When open, the fill valve diverts the flow of dielectric coolant so that it fills the reservoir. Customer Service personnel use the manual valve to tune system performance during installation and then lock it into position. This valve should not be adjusted unless Customer Service personnel determine that system performance needs to change.

Lower Supply Line Assembly

The lower supply line assembly receives dielectric coolant from the central supply line assembly and transfers the dielectric coolant to the mainframe module cabinet and the cascade (refer to Figure 24).

Figure 24. Lower Supply Line Assembly



The lower supply line assembly has a supply valve (V0) and pressure sensors (P1 and P2). The supply valve is a control valve on the supply line that controls the flow rate of dielectric coolant to the mainframe module cabinet. The control system adjusts the supply valve according to measurements the control system receives from the flow meter that is located on the flow meter assembly.

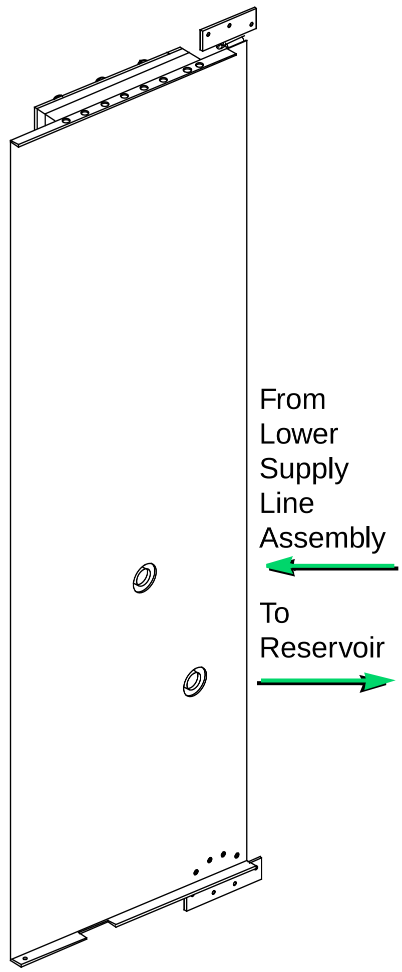
The supply valve is also used during the reservoir filling process. During the reservoir filling process, the supply valve is closed so that it prevents the dielectric coolant from flowing to the module cabinet. (During the reservoir filling process, the fill valve on the upper supply line assembly is open so that dielectric coolant transfers to the reservoir.)

The pressure sensors measure the pressure in the supply line before the dielectric coolant transfers to the mainframe module cabinet.

Cascade

The cascade is an aesthetic assembly that has clear plastic and a light at the top so that the dielectric coolant can be viewed as it cascades to the bottom of the cascade plenum. The cascade receives dielectric coolant from the lower supply line assembly, displays the dielectric coolant to the customer, and transfers the dielectric coolant to the reservoir (refer to *Figure 25*).

Figure 25. Cascade



Dielectric coolant enters the cascade plenum. The dielectric coolant cascades down through the cascade plenum and then flows through an exit hole back to the reservoir.

The cascade has a manual valve. The manual valve adjusts the amount of dielectric coolant that flows through the cascade. When closed, the manual valve isolates the cascade from the supply of dielectric coolant.

Power System

The power system distributes electric power to the HEU-T90 components. The power system receives voltage from an uniterruptable power source (optional) through the high-voltage DC (HVDC) cabinet. The power system components reside in the power-and-control box (refer to Figure 26).

Figure 26. Power Components in the Power-and-control Box

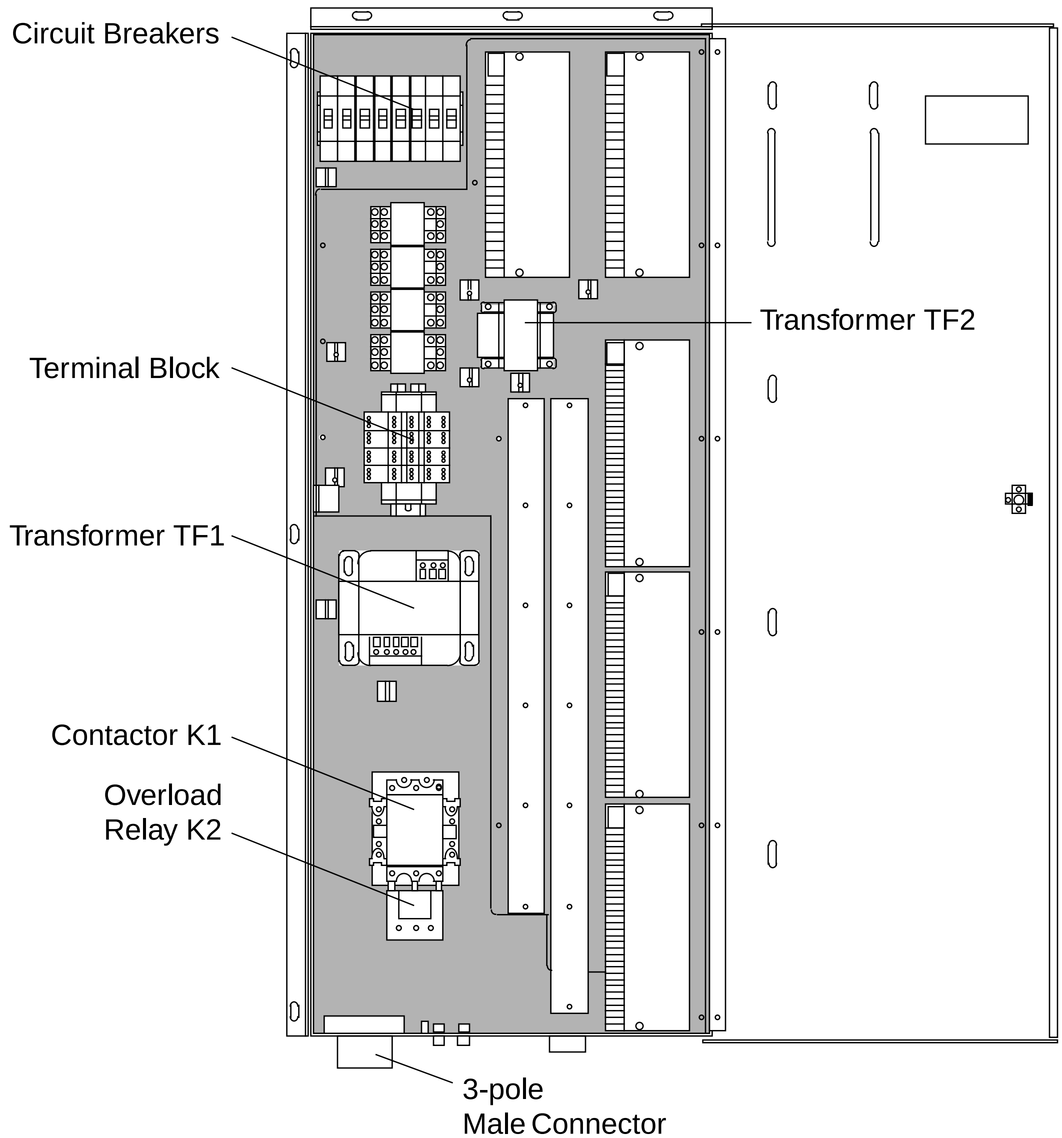
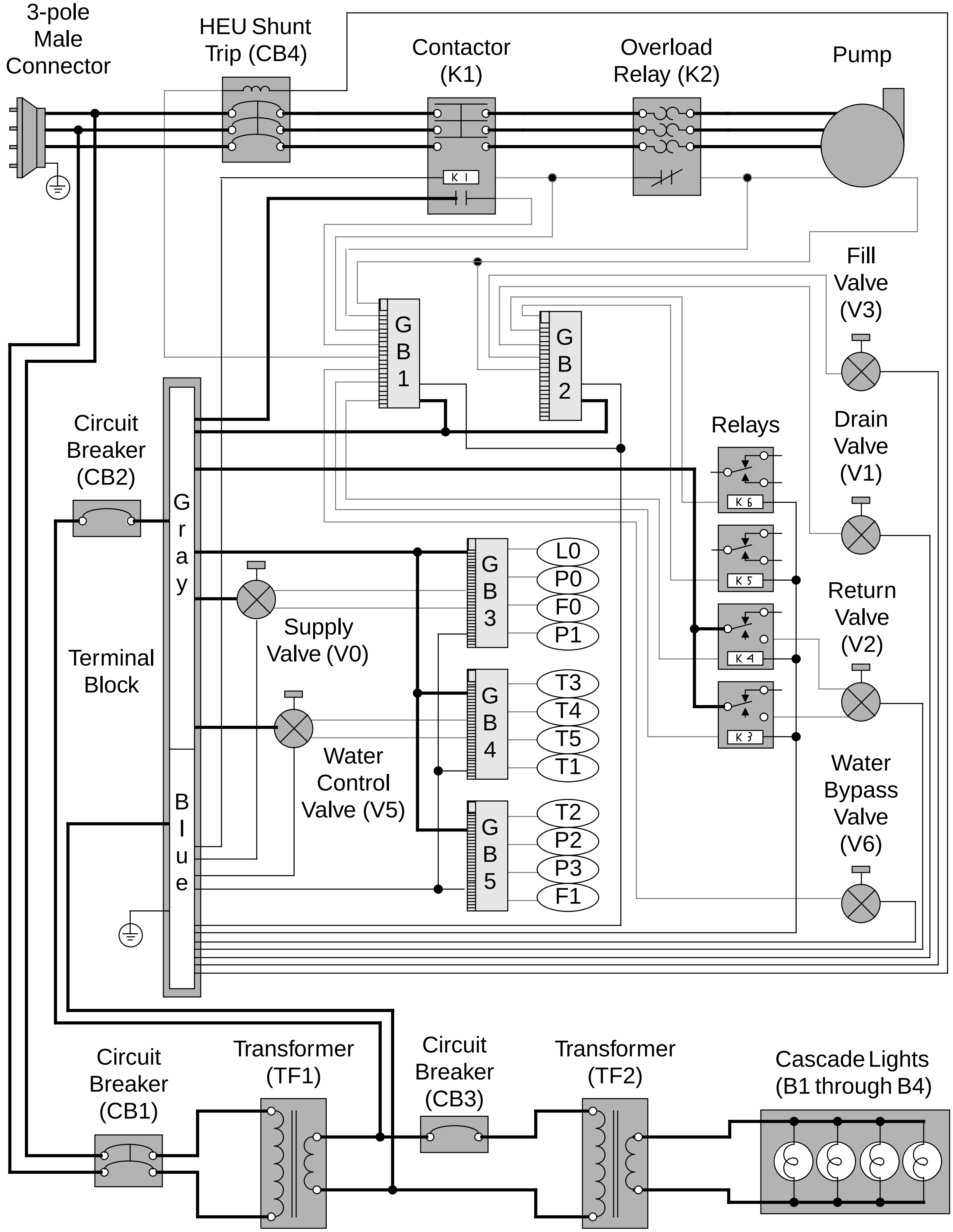


Figure 27 shows a simplified schematic of the power system, and the following subsections describe each component of the power system. It may be helpful to refer back to Figure 27 while you read these subsections.

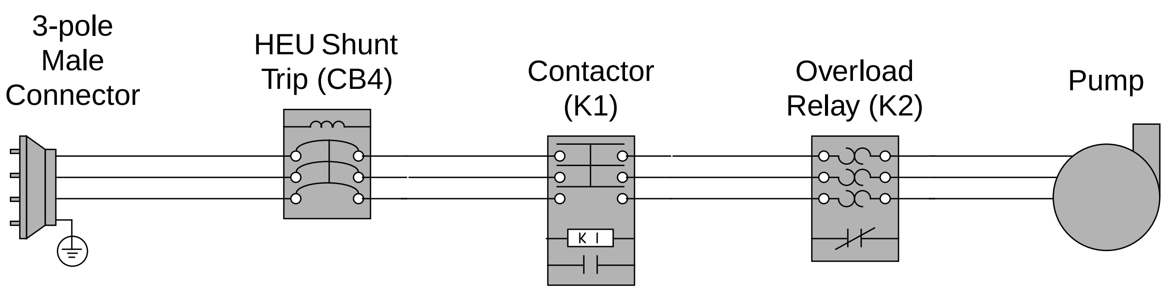
Figure 27. Power System



Pump Power Circuit

Figure 28 shows a simplified schematic of the pump power circuit.

Figure 28. Pump Power Circuit



The HEU-T90 has a 3-pole male connector that is rated for a maximum of 50 amps. This connector receives voltage from the HVDC cabinet, and the voltage may be in either of the following forms:

- 50-Hz, 3-phase, 380-Vac
- 60-Hz, 3-phase, 480-Vac

The 3-pole male connector connects to circuit breaker 4 (CB4) and transfers 3 phases of voltage to CB4. CB4 is a 3-phase circuit breaker that is rated for a maximum of 480 volts and 50 amps.

CB4 also has a shunt trip. The shunt trip opens CB4 based on signals it receives from the control system. When open, CB4 disconnects the pump from the supply voltage.

CB4 connects to the contactor (K1) and transfers 3 phases of voltage to the contactor. The contactor opens or closes based on signals it receives from the control system and overload relay. When open, the contactor disconnects the pump from the supply voltage.

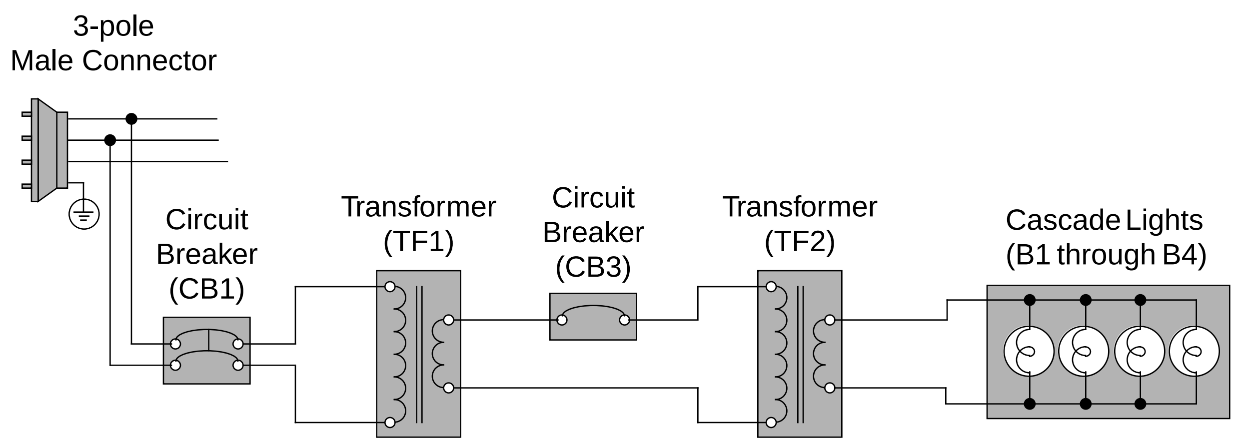
The contactor connects to an overload relay (K2) and transfers 3 phases of voltage to the overload relay. The overload relay is adjustable to detect a range of 36 to 52 amps. The overload relay opens when the pump draws more amps than a specified value that is set on the overload relay. When open, the overload relay signals the contactor to open and disconnect the pump from the supply voltage.

The overload relay connects to the pump and transfers 3 phases of 380 Vac or 480 Vac to the pump.

Cascade-lights Power Circuit

Figure 29 shows a simplified schematic of the cascade-lights power circuit.

Figure 29. Cascade-lights Power Circuit



The HEU-T90 has a 3-pole male connector that is rated for a maximum of 50 amps. This connector receives voltage from the HVDC, and the voltage may be in either of the following forms:

- 50-Hz, 3-phase, 380-Vac
- 60-Hz, 3-phase, 480-Vac

The 3-pole male connector connects to circuit breaker 1 (CB1) and transfers 2 phases of voltage to CB1. CB1 is a 2-phase circuit breaker that is rated for a maximum of 480 volts and 1.6 amps. When open, CB1 disconnects all the electrical components (except for the pump) from the supply voltage.

CB1 connects to a step-down transformer (TF1). TF1 converts the voltage it receives from CB1 into 120 Vac. TF1 is rated at a maximum of 500 VA.

TF1 connects to circuit breaker 3 (CB3). CB3 is a single-phase circuit breaker that is rated for a maximum of 1 amp. When open, CB3 disconnects the cascade lights from the supply voltage.

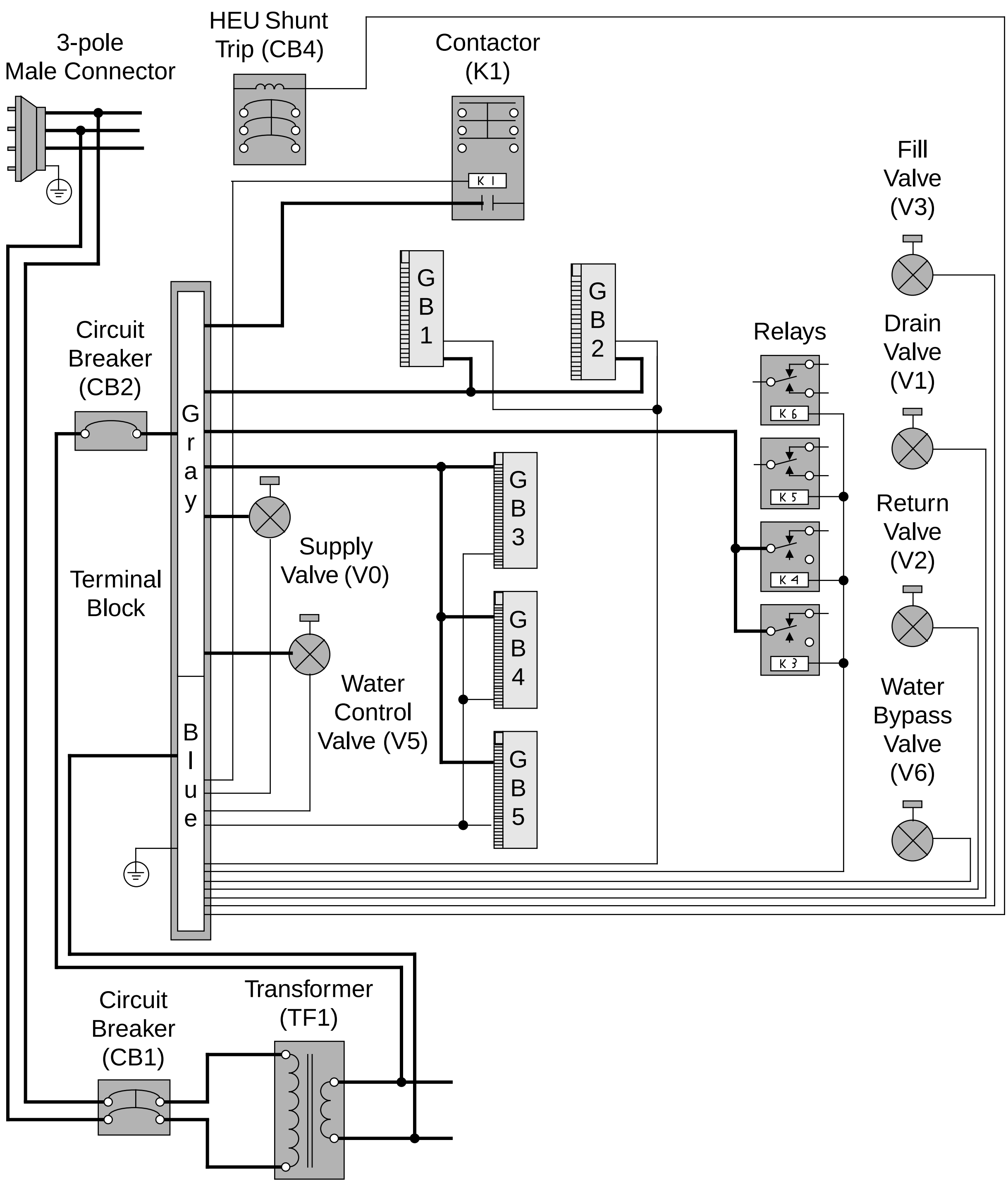
CB3 connects to a step-down transformer (TF2). TF2 converts the voltage it receives from CB3 into 12 Vac. TF2 is rated at a maximum of 100 VA.

TF2 connects to the cascade-light assembly. The cascade-light assembly contains light bulbs that are wired in parallel. If one light bulb burns out, the other light bulbs still function.

Control-system-components Power Circuit

Figure 30 shows a simplified schematic of the control-system-components power circuit.

Figure 30. Control-system-components Power Circuit



The HEU-T90 has a 3-pole male connector that is rated for a maximum of 50 amps. This connector receives voltage from the HVDC, and the voltage may be in either of the following forms:

- 50-Hz, 3-phase, 380-Vac
- 60-Hz, 3-phase, 480-Vac

The 3-pole male connector connects to circuit breaker 1 (CB1) and transfers 2 phases of voltage to CB1. CB1 is a 2-phase circuit breaker that is rated for a maximum of 480 volts and 1.6 amps. When open, CB1 disconnects all the electrical components (except for the pump) from the supply voltage.

CB1 connects to a step-down transformer (TF1). TF1 converts the voltage it receives from CB1 into 120 Vac. TF1 is rated at a maximum of 500 VA.

TF1 connects to circuit breaker 2 (CB2). CB2 is a single-phase circuit breaker that is rated for a maximum of 3 amps. When open, CB2 disconnects the control system components from the supply voltage.

CB2 connects to a terminal block. The terminal block distributes voltage to the control system components. The terminal block has two types of connections: gray and blue. The gray connections of the terminal block distribute the line portion of the voltage to the control system components. The blue connections of the terminal block distribute the neutral portion of the voltage to the control system components. Refer to Table 1 for the terminal block connections.

Table 1. Terminal Block Connections

Terminal Block	Connection Number	Connects to the Following Control System Components
Gray (Line Connections)	1	CB2
	2	Contactor
	3 through 18	Not used
	19	Monitoring blocks GB1 and GB2, connection #5
	20	Monitoring blocks GB3, GB 4, and GB5, connection #6
	21	Supply valve (V0)
	22	Not used
	23	Water control valve (V5)
	24	Relays K3 and K4, connection #7
Blue (Neutral Connections)	25	Transformer (TF1)
	26	Contactor (K1)
	27 through 36	Not used
	37	Shunt trip (CB4)
	38	Monitoring blocks GB1 and GB2, connection #18
	39	Monitoring blocks GB3, GB4, and GB5, connection # 7
	40	Water bypass valve (V6)
	41	Drain valve (V2)
	42	Fill valve (V3)
	43	Return valve (V1)
	44	Supply valve (V0)
	45	Not used
	46	Water control valve (V5)
	47	Relays K3, K4, K5, and K6, connection #B (hex)
	48	Neutral connection

Control System

The control system monitors the HEU-T90 for acceptable environmental conditions. If conditions are out of range, the control system either adjusts valves to compensate for the out-of-range condition or shuts the computer system down to protect the equipment from damage. The HEU-T90 control system components reside in the power-and-control box (refer to Figure 31).

Figure 31. Control System Components in the Power-and-control Box

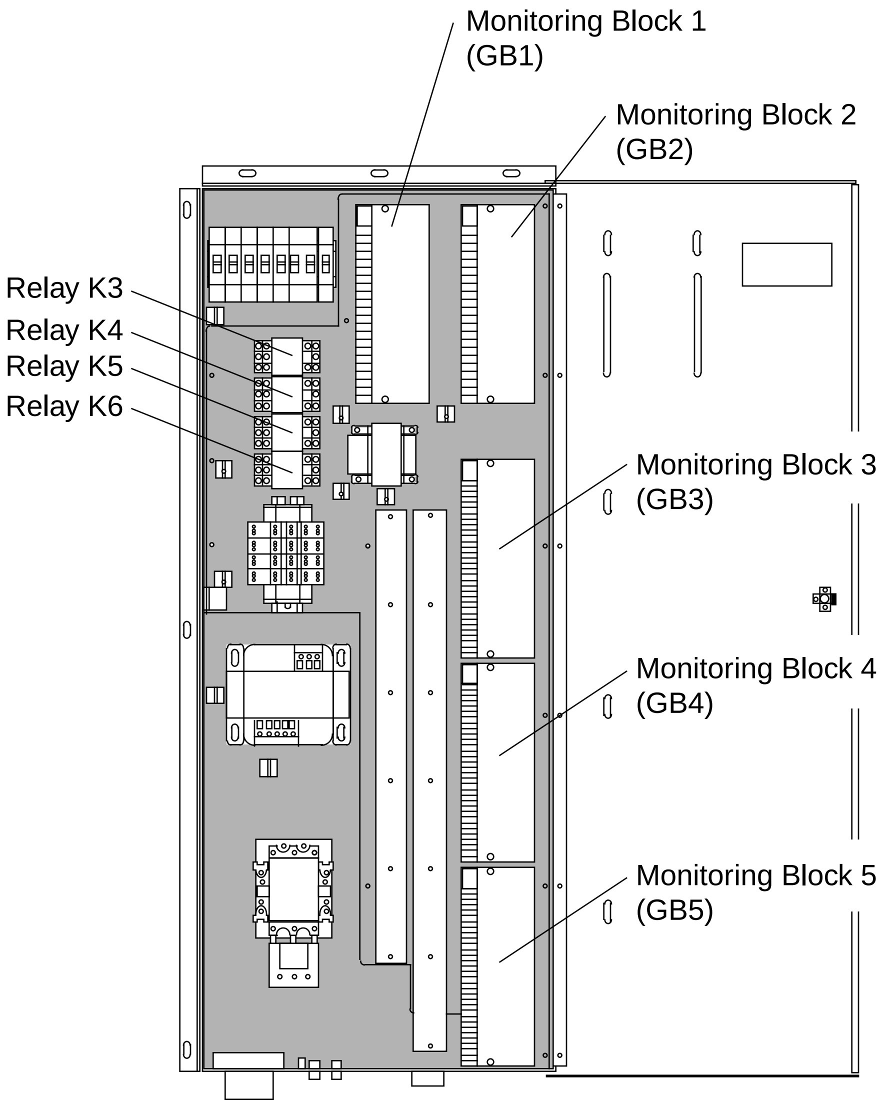
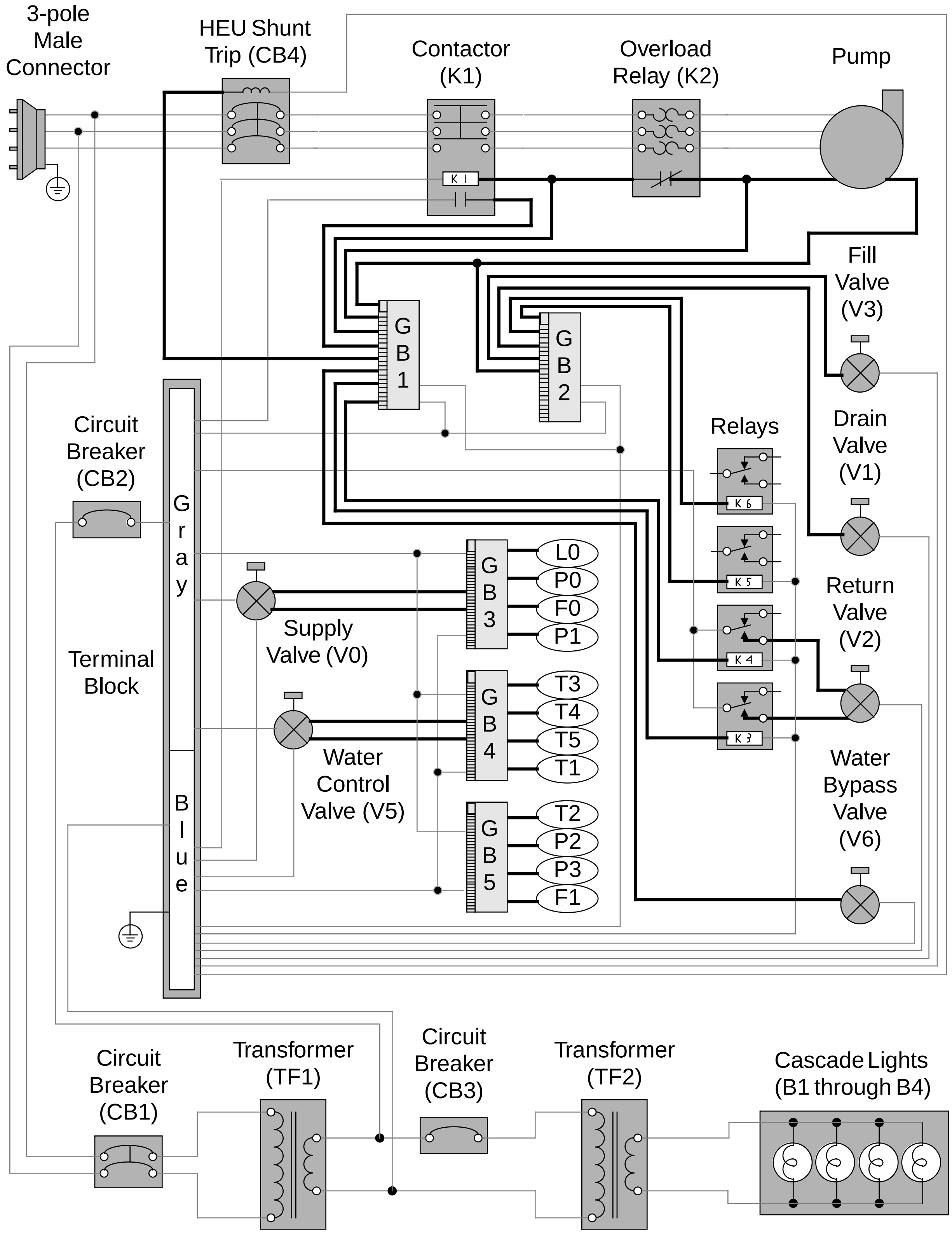


Figure 32 shows a simplified schematic of the control system, and the following subsections describe each component of the control system. It may be helpful to refer back to Figure 32 while you read these subsections.

Figure 32. Control System

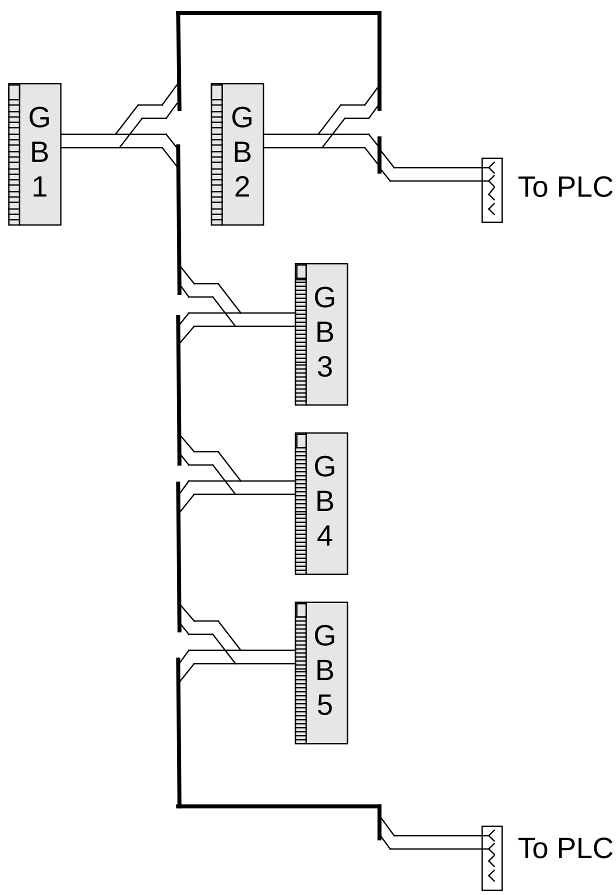


The main components of the control system are five monitoring blocks (GB1 through GB5). The monitoring blocks receive information from temperature sensors, pressure sensors, flow meters, and level sensors. The monitoring blocks then send this information to a programmable logic controller (PLC) in the mainframe. The PLC uses the information to determine low and high alarms, overrange and underrange conditions, open wires, output feedback errors, and internal fault conditions.

The monitoring blocks also receive control information from the PLC. This information signals the monitoring blocks to open or close valves, relays, and the shunt trip.

The monitoring blocks connect to the PLC over a local area network. Figure 33 is a simplified schematic of the serial connections between the monitoring blocks and the PLC.

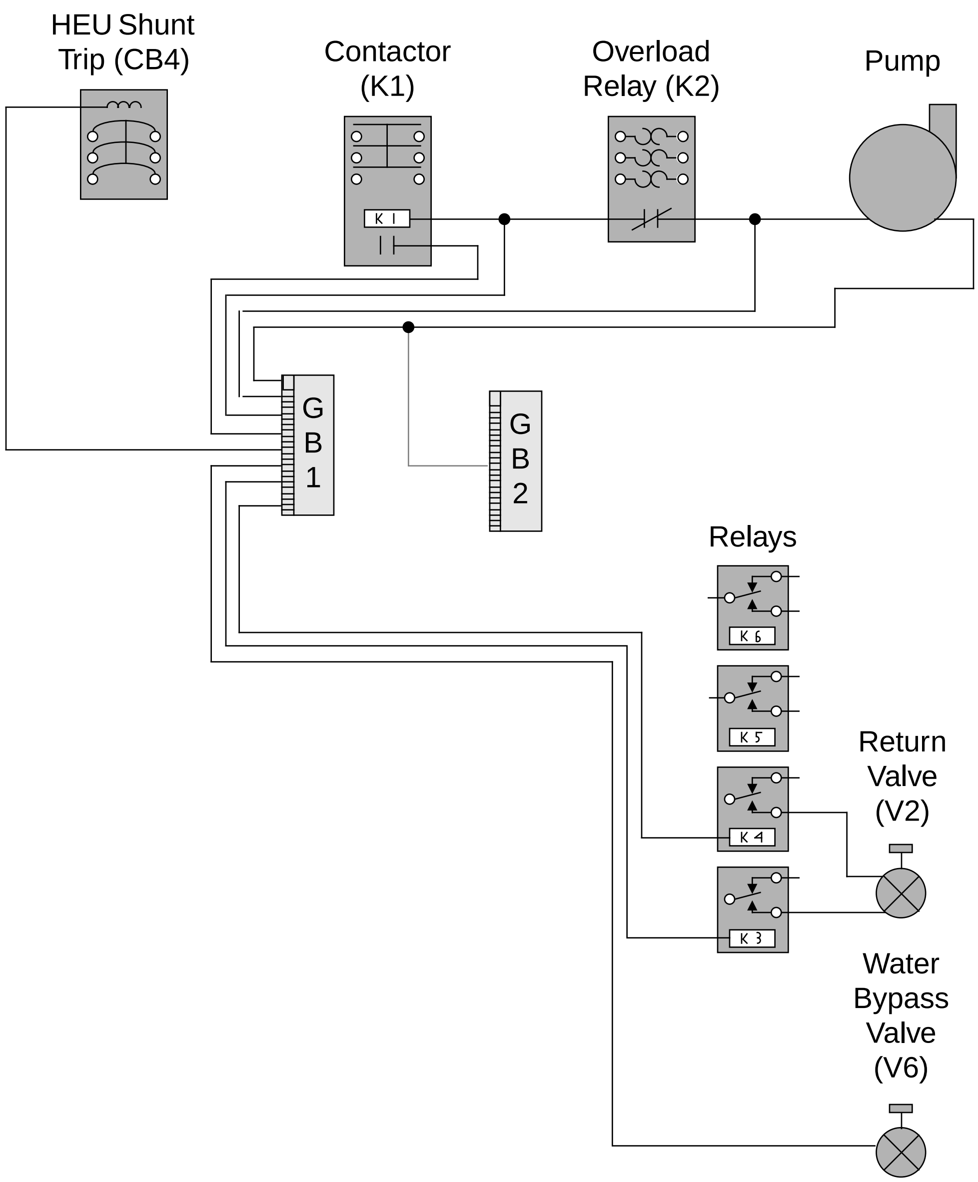
Figure 33. Serial Connection to the PLC



Monitoring Block 1

Monitoring block 1 has eight identical 115 Vac circuits. Each circuit is either an input circuit or an output circuit that connects to a control system component (refer to Figure 34).

Figure 34. Monitoring Block 1 Connections



Each circuit has an LED that indicates the circuit status. Table 2 lists the circuits and describes the status displayed by the LED.

Table 2. Monitoring Block 1 Circuit Descriptions

Connection Number	Circuit	Name	LED	Description
10	1	Open Return Valve	On	Return valve is opening; LED illuminates briefly while valve opens.
			Off	Valve is idle.
11	2	Close Return Valve	On	Return valve is closing; LED illuminates briefly while valve closes.
			Off	Valve is idle.
12	3	Pump Enable	On	Pump is enabled.
			Off	Pump is idle.
13	4	Water Bypass Valve	On	Valve is energized (open).
			Off	Valve is not energized (closed).
14	5	HEU Shunt Trip	On	Shunt trip is energized, CB4 is opened.
			Off	Shunt trip is not energized.
15	6	Pump Overtemp	On	Pump is operating normally.
			Off	If HEU is supposed to be running and this LED is not illuminated, a pump overtemperature condition exists.
16	7	Overload Relay	On	Overload relay is OK.
			Off	If HEU is supposed to be running and this LED is not illuminated, an overload condition exists.
17	8	Contactor	On	Contactor is OK.
			Off	If HEU is supposed to be running and this LED is not illuminated, a contactor fault exists.

Circuits 1 and 2 of monitoring block 1 each connect to a relay (K3 and K4). These relays send signals that open and close the return valve. Figure 35 shows the connection numbers for each relay.

Figure 35. Relay Connection Numbers, Relays K3 and K4

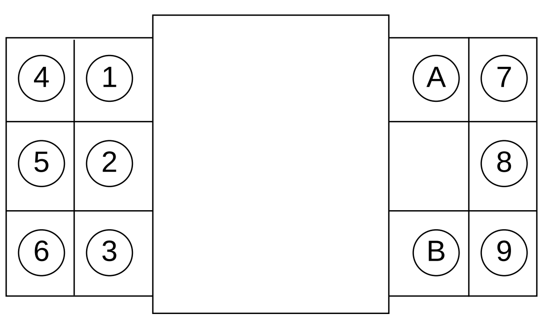


Table 3 shows the connections for relays K3 and K4.

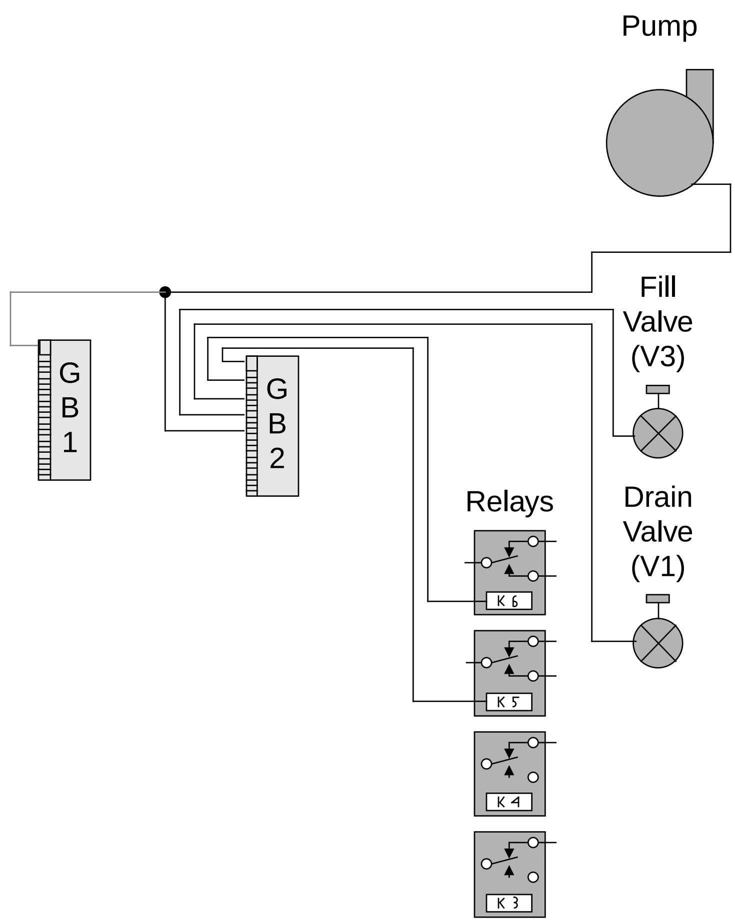
Table 3. K3 and K4 Relay Connections

Connection Number (Hex)	K3	K4
1	Not connected	Not connected
2	Not connected	Not connected
3	Not connected	Not connected
4	Return valve open (counterclockwise - CCW)	Return valve close (clockwise - CW)
5	Not connected	Not connected
6	Not connected	Not connected
7	Line connection Gray terminal block connection number 24	Line connection Gray terminal block connection number 24
8	Not connected	Not connected
9	Not connected	Not connected
A	Monitoring block 1 connection number 10	Monitoring block 1 connection number 11
B	Neutral connection blue terminal block connection number 47	Neutral connection blue terminal block connection number 47

Monitoring Block 2

Monitoring block 2 has eight identical 115 Vac circuits; however, only six of the circuits are connected to control system components. Each circuit is either an input circuit or an output circuit that connects to a control system component (refer to Figure 36).

Figure 36. Monitoring Block 2 Connections



Each circuit has an LED that indicates the circuit status. Table 4 lists the circuits and describes the status displayed by the LED.

Table 4. Monitoring Block 2 Channel Descriptions

Connection Number	Channel	Condition	LED	Description
10	1	Drain Valve	On	Valve is energized (closed).
			Off	Valve is not energized (open).
11	2	Fill Valve	On	Valve is energized (open).
			Off	Valve is not energized (closed).
12	3	Pump Enable	On	Pump is enabled.
			Off	Pump is not enabled.
13	4	Relay K6 Power on relay	On	Mainframe power is on.
			Off	Mainframe power is off.
14	5	Relay K5 Fault relay	On	Mainframe has a fault condition.
			Off	Mainframe does not have a fault condition.
15	6	Not used	On	Not used.
			Off	Not used.
16	7	Not used	On	Not used.
			Off	Not used.
17	8	New HEU	On	Indicates that the HEU-T90 is the new design.
			Off	Not applicable.

Circuits 4 and 5 of monitoring block 2 each connect to a relay (K5 and K6). These relays are status relays that are not connected to any other control system components. Customers may connect relays K5 and K6 to external devices such as lights or alarms. Figure 37 shows the connection numbers for each relay.

Figure 37. Relay Connection Numbers, Relays K5 and K6

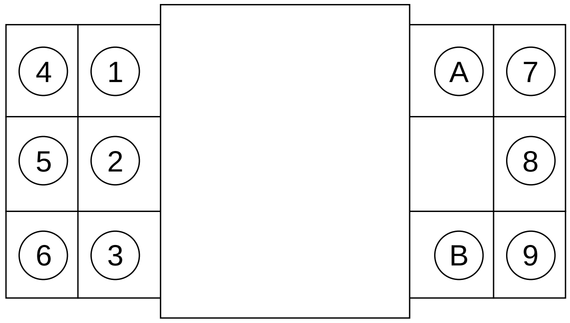


Table 5 lists the connections for relays K5 and K6.

Table 5. K5 and K6 Relay Connections

Connection Number (Hex)	K5	K6
1	Normally closed 1	Normally closed 1
2	Not connected	Not connected
3	Normally closed 2	Normally closed 2
4	Normally open 1	Normally open 1
5	Not connected	Not connected
6	Normally open 2	Normally open 2
7	Common 1	Common 1
8	Not connected	Not connected
9	Common 2	Common 2
A	Monitoring block 2 connection number 14	Monitoring block 2 connection number 13
B	Neutral connection blue terminal block connection number 47	Neutral connection blue terminal block connection number 47

Monitoring Block 3

Monitoring block 3 has six 4-to-20 mA analog circuits. Four of the circuits are input circuits and two of the circuits are output circuits. Each circuit may connect to a control system component (refer to Figure 38).

Figure 38. Monitoring Block 3 Connections

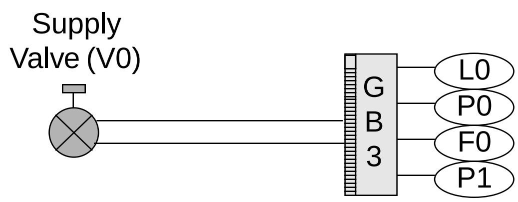


Table 6 lists the input and output circuits for monitoring block 3.

Table 6. Monitoring Block 3 Input and Output Circuits

Circuit	Description	Control System Component	Control System Component Location
Output 1	Supply valve circuit	Supply valve (V0)	Lower supply line assembly
Output 2	Not used	Not applicable	Not applicable
Input 1	Reservoir level circuit	Level sensor (L0)	Reservoir
Input 2	Discharge pressure circuit	Discharge pressure sensor (P0)	Flow meter assembly
Input 3	Supply flow circuit	Flow meter (F0)	Flow meter assembly
Input 4	Tank pressure (P) circuit	Primary Pressure sensor (P1)	Lower supply line assembly

Monitoring Block 4

Monitoring block 4 has six 4-to-20 mA analog circuits. Four of the circuits are input circuits and two of the circuits are output circuits. Each circuit may connect to a control system component (refer to Figure 39).

Figure 39. Monitoring Block 4 Connections

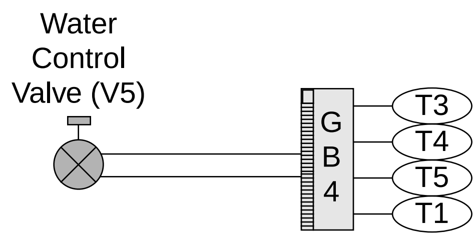


Table 7 lists the input and output circuits for monitoring block 4.

Table 7. Monitoring Block 4 Input and Output Circuits

Channel	Description	Control System Component	Control System Component Location
Output 1	Water control valve circuit	Water control valve (V5)	Water return line
Output 2	Not used	Not applicable	Not applicable
Input 1	Suction temperature circuit	Temperature sensor (T3)	Return line assembly
Input 2	Water in temperature circuit	Temperature sensor (T4)	Water supply line
Input 3	Water out temperature circuit	Temperature sensor (T5)	Water return line
Input 4	Supply temperature (P) circuit	Primary temperature sensor (T1)	Central supply line assembly

Monitoring Block 5

Monitoring block 5 has six 4-to-20 mA analog circuits. Four of the circuits are input circuits and two of the circuits are output circuits. Each circuit may connect to a control system component (refer to Figure 40).

Figure 40. Monitoring Block 5 Connections

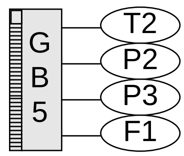


Table 8 lists the input and output circuits for monitoring block 5.

Table 8. Monitoring Block 5 Input and Output Circuits

Channel	Description	Control System Component	Control System Component Location
Output 1	Not used	Not applicable	Not applicable
Output 2	Not used	Not applicable	Not applicable
Input 1	Supply temperature (B) circuit	Backup temperature sensor (T2)	Central supply line assembly
Input 2	Tank pressure (B) circuit	Backup pressure sensor (P2)	Lower supply line assembly
Input 3	Suction pressure circuit	Pressure sensor (P3)	Return line assembly
Input 4	Water flow circuit	Flow meter (F1)	Water return line

Index

F

H

K

L

M

O

P

R

S

T

U

V

W