Power, Cooling, and Control System Troubleshooting Guide

HTM-179-B
CRAY T90 Series Systems
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Figures

Tables

Record of Revision

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Revision A: August 1996

This version incorporates extensive text changes, updates Table 1 and Table 2 with the latest troubleshooting and service information, and adds Figure 2 and Table 3. All other versions of this document are obsolete.

Revision B: October 1997

This version incorporates changes to Figure 1 and Tables 1, 2, and 3 and makes all previous versions obsolete.

Read Me First

This troubleshooting guide provides information that helps you identify problems in the CRAY T90 series computer systems. Use this information to identify the problem and its causes and to perform corrective action.

This troubleshooting guide is divided into the following subsections:

- `nwacs` Fault Indications
- Control System Component Fault Indications
- Miscellaneous Failures

The `nwacs` fault indications are critical for effective troubleshooting. The first subsection, "`nwacs` Fault Indications," provides a troubleshooting guide that uses the `nwacs` program, which runs on the MWS.

However, the `nwacs` program does not indicate all faults. Some fault conditions in the control system are indicated by LEDs on the specific control system component. The "Control System Component Fault Indications" subsection provides information about these fault conditions.

In some cases, there might not be any fault indications. The "Miscellaneous Failures" subsection provides information about various failures that the `nwacs` program might not indicate.

nwacs Fault Indications

The `nwacs` program provides fault and status information. Figure 1 illustrates the sequence of fault indications, which depends on the command that initiated the control system.

Once the control system checks a certain condition, it continually checks that condition until another `nwacs` command is initiated. For example, once the control system checks for control system component failures and then proceeds to check for pump fault conditions, the control system continues to simultaneously check for control system component failures.

Table 1 provides a complete list of `nwacs` fault messages, possible causes, and the corresponding corrective action. In some instances, the corrective action may refer you to another subsection or to other documentation.

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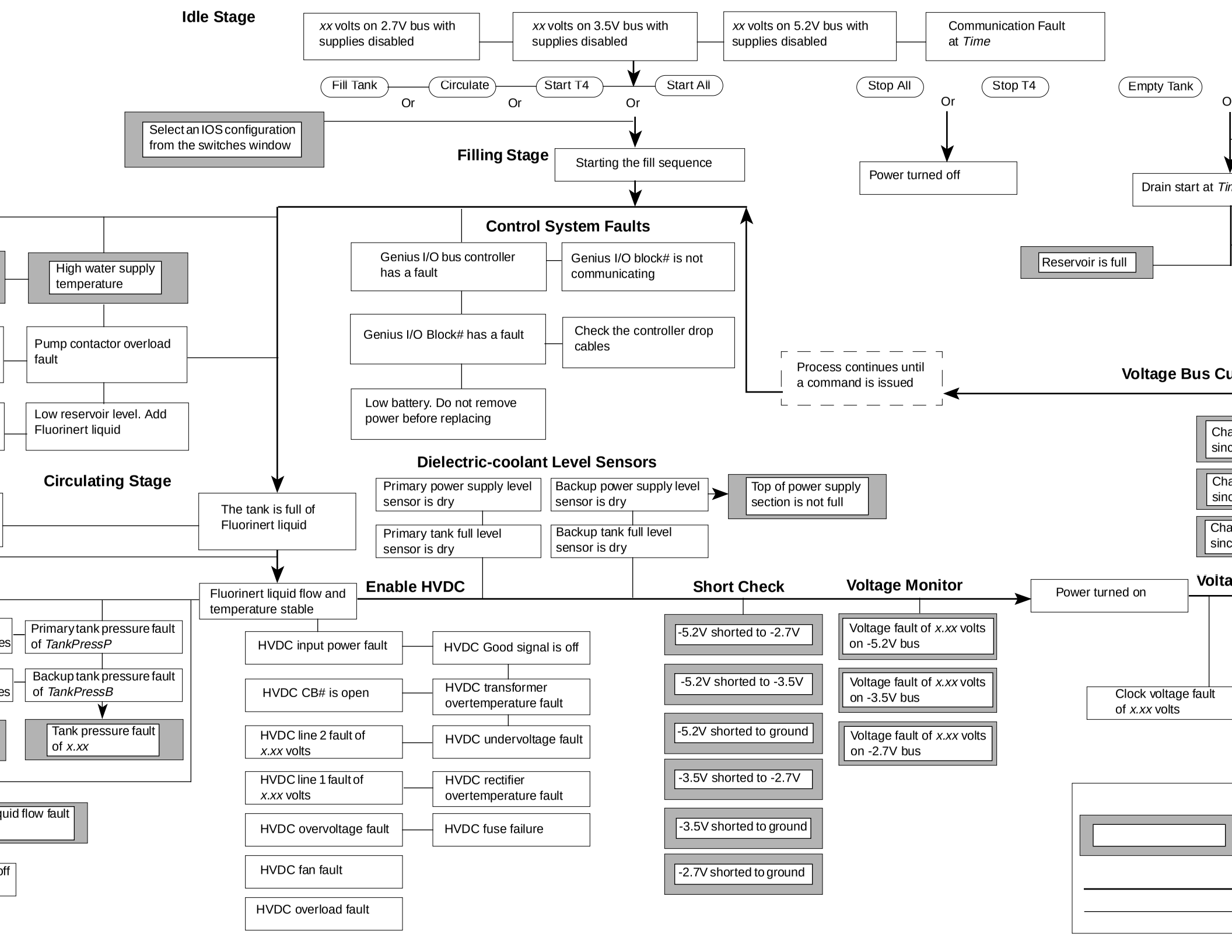

Idle Stage
xx volts on 2.7V bus with supplies disabled
xx volts on 3.5V bus with supplies disabled
xx volts on 5.2V bus with supplies disabled
Communication Fault at Time
Fill Tank
Circulate
Start T4
Start All
Or
Or
Or
Stop All
Or
Stop T4
Empty Tank
Select an IOS configuration from the switches window
Filling Stage
Starting the fill sequence
Power turned off
Drain start at Tim
Control System Faults
Genius I/O bus controller has a fault
Genius I/O block# is not communicating
Genius I/O Block# has a fault
Check the controller drop cables
Low battery. Do not remove power before replacing
High water supply temperature
Pump contactor overload fault
Low reservoir level. Add Fluorinert liquid
Reservoir is full
Process continues until a command is issued
Voltage Bus Cu
Dielectric-coolant Level Sensors
Primary power supply level sensor is dry
Backup power supply level sensor is dry
Top of power supply section is not full
Primary tank full level sensor is dry
Backup tank full level sensor is dry
Circulating Stage
The tank is full of Fluorinert liquid
Fluorinert liquid flow and temperature stable
Enable HVDC
Short Check
Voltage Monitor
Power turned on
Volta
Primary tank pressure fault of TankPressP
Backup tank pressure fault of TankPressB
Tank pressure fault of x.xx
HVDC input power fault
HVDC Good signal is off
HVDC CB# is open
HVDC transformer overtemperature fault
HVDC line 2 fault of x.xx volts
HVDC undervoltage fault
HVDC line 1 fault of x.xx volts
HVDC rectifier overtemperature fault
HVDC overvoltage fault
HVDC fuse failure
HVDC fan fault
HVDC overload fault
-5.2V shorted to -2.7V
-5.2V shorted to -3.5V
-5.2V shorted to ground
-3.5V shorted to -2.7V
-3.5V shorted to ground
-2.7V shorted to ground
Voltage fault of x.xx volts on -5.2V bus
Voltage fault of x.xx volts on -3.5V bus
Voltage fault of x.xx volts on -2.7V bus
Clock voltage fault of x.xx volts

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
None (Idle state)		x.xx volts on -5.2V bus with supplies disabled.	More than 1 volt exists on the bus after the control system disabled the power supplies.	-5.2-V power supply has not turned off.	Use the control system to check each -5.2-V power supply current status. Replace the faulty power supply.
		x.xx volts on -3.5V bus with supplies disabled.		-3.5-V power supply has not turned off.	Use the control system to check each -3.5-V power supply current status. Replace the faulty power supply.
		x.xx volts on -2.7V bus with supplies disabled.		-2.7-V power supply has not turned off.	Use the control system to check each -2.7-V power supply current status. Replace the faulty power supply.
		Check the controller drop cables.	The control system verifies that the controller drop cables are plugged in correctly; if they are not, this fault message appears.	The controller drop cables are not plugged in correctly.	Verify that the cables are plugged in correctly; swap drop cables if necessary.
Fill Tank	Starting the fill sequence.	Select an IOS configuration from the switches window.	The control system has different settings, depending on the configuration of the IOS. If no IOS is configured, the control system halts the start-up sequence until an IOS is selected.	No IOS model is selected.	Select the appropriate IOS model from the nwacs switches window.
Circulate	The tank is full. Coolant flow and temperature are stable.	Check cooling. Taking too long to stabilize.	More than 10 minutes passed since the power-up process was initiated; either the flow or the temperature is not within the correct range.	Flow or temperature problem.	Use the nwacs program to check the temperature and flow values. Refer to the temperature and flow fault messages for the appropriate corrective action.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		HVDC input power fault.	The input power (200/208 Vac or 400/480 Vac) to the HVDC is not within the specified voltage tolerance.	Customer power problem.	Verify that the customer’s feeder circuit breaker is closed. Verify that the correct voltage is applied to the HVDC. If the circuit breaker is closed or the incorrect voltage is being applied to the HVDC, contact the customer to remedy the problem.
				Uninterruptable power system (UPS) failure.	Contact the UPS service provider.
		HVDC CB1 is open.	HVDC CB1 is the main input-voltage circuit breaker in the HVDC; when this circuit breaker is open, no voltage is applied to the rectifier, which means that no voltage is being supplied to the mainframe.	CB1 was not closed prior to start-up.	Close CB1.
				Overvoltage condition.	Refer to the HVDC documentation for specific troubleshooting information.
				Faulty HVDC fuses F7 and F8.	
				Faulty rectifier.	
				Faulty PCA boards (BOL, BCL, IFL).	
				BOL PCA alarm threshold is wrong.	
				The HVDC was wired with the wrong phase rotation. The phase rotation should be A, B, C clockwise.	Check the phase rotation and fix if necessary.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		HVDC CB2 is open.	HVDC CB2 supplies 460-Vac power to the HEU-T90.	CB2 was not closed prior to start-up.	Close CB2.
				The current exceeded the 50-A circuit breaker rating (overload condition).	Check for other fault conditions; fix if necessary. Close CB2 and restart HVDC.
		HVDC CB3 is open.	HVDC CB3 supplies 330-Vdc power to the mainframe.	CB3 was not closed prior to start-up.	Close CB3.
				The current exceeded the100-A circuit breaker rating (overload condition).	Check for other fault conditions; fix if necessary. Close CB3 and restart the HVDC.
		HVDC CB4 is open.	HVDC CB4 supplies 330-Vdc power to the mainframe.	CB4 was not closed prior to start-up.	Close CB4.
				The current exceeded the 100-A circuit breaker rating (overload condition).	Check for other fault conditions; fix if necessary. Close CB4 and restart the HVDC.
		HVDC Good signal is off.	The HVDC Good signal is on when the HVDC is operating with no warnings or faults; the Good signal is off when a warning or fault condition exists within the HVDC. The HVDC may continue to operate when this signal is off. When the Good signal turns off, the Normal Operation lamp on the front of the HVDC unit also turns off.	A problem exists within the HVDC.	Refer to the HVDC troubleshooting documentation for more information about how to fix the problem.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		HVDC line 1 fault of x.xx volts.	HVDC line 1 voltage exceeded 390 Vdc.	A possible HVDC isolation board fault occurred.	If power comes on and the fault message appears, the HVDC isolation board failed; replace the board.
		HVDC line 2 fault of x.xx volts.	HVDC line 2 voltage exceeded 390 Vdc.		
		HVDC over voltage fault.	HVDC line voltage exceeded 390 Vdc.	A problem exists within the HVDC.	Refer to the HVDC troubleshooting documentation for more information about how to fix the problem.
		HVDC under voltage fault.	HVDC output voltage was below 290 Vdc.		
		HVDC overload fault.	HVDC DC output exceeded 150 amps DC.		
		HVDC transformer over temperature fault.	The thermostat inside the transformer sensed a temperature greater than 194 ^{o}F (90 ^{o}C).		
		HVDC fan fault.	The airflow sensor within the HVDC unit is not detecting any airflow.		
		HVDC rectifier over temperature fault.	The thermostat inside the rectifier sensed a temperature greater than 194 ^{o}F (90 ^{o}C) and shut the system down.		
		HVDC fuse failure.	The rectifier fuse within the HVDC failed. The fuses are F21, F22, and F23; if one of these fuses blows, the blown-fuse indicator pops out.		
		-5.2V shorted to -2.7V.	The voltage on the bus is more than 150 mV.	Module short, bus short, or debris on the bus.	Open the system and ohm the buses.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		-5.2V shorted to -3.5V.	The voltage on the bus is more than 150 mV.	Possible faulty power staging board assembly.	Check the power staging board assembly.
		-5.2V shorted to ground.	The voltage on the bus is less than 150 mV. A short to ground exists or the short check circuit failed.	Module short, bus short, or debris on the bus.	Open the system and ohm the buses.
		-3.5V shorted to -2.7V.	The voltage on the bus is more than 150 mV.	Module short, bus short, or debris on the bus.	Open the system and ohm the buses.
		-3.5V shorted to ground.	The voltage on the bus is less than 150 mV. A short to ground exists or the short check circuit failed.		
		-2.7V shorted to ground.	The voltage on the bus is less than 150 mV. A short to ground exists or the short check circuit failed.		

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
	Power turned on.	Voltage fault of x.xx volts on -5.2V bus.	The fault message describes a high- or low-voltage fault condition. The bus voltage exceeded the high- or low-voltage limit (± 20% of the nominal voltage).	Multiple power supply failures occurred or a short circuit exists.	Possible burn condition. If a low-voltage condition exists and the control system displays a change of current message, then a burn condition probably exists. ***Do not open the system!*** Follow the standard burn procedure and perform the fluoride-ion test to check the PFIB level.
		Voltage fault of x.xx volts on -3.5V bus.			
		Voltage fault of x.xx volts on -2.7V bus.			
		Clock voltage fault of x.xx.	The clock module received voltage that was either too high or too low.	A faulty clock power supply or a short circuit exists.	Check the clock voltage level; replace if necessary. Check for short circuits and fix if necessary.
		Change of x.xx amps on -5.2 since last power up.	Ten seconds after power-up, the control system compares the existing current load with the recorded current load from the previous power-up. If the difference is more than 50 amps, the control system writes this status message.	Possible module short, bus short, or debris on the bus.	Possible burn condition. If a low-voltage condition exists and the control system displays a change of current message, then a burn condition probably exists. ***Do not open the system!*** Follow the standard burn procedure and perform the fluoride-ion test to check the PFIB level.
		Change of x.xx amps on -3.5 since last power up.		Modules were added or removed.	
		Change of x.xx amps on -2.7 since last power up.			

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Change of x.xx amps on -2.7 since power up.	The control system compares the existing current load on each bus to the current load on the bus when the mainframe was initially powered down. If the difference is more than 50 amps, the control system writes this status message.	Voltage margin change.	Possible burn condition. If a low-voltage condition exists and the control system displays a change of current message, then a burn condition probably exists. ***Do not open the system!*** Follow the standard burn procedure and perform the fluoride-ion test to check the PFIB level.
		Change of x.xx amps on -5.2 since power up.		High memory activity (5.2 current will increase in times of high memory activity).	
		Change of x.xx amps on -3.5 since power up			
		Primary tank pressure fault of x.xx psi.	The primary pressure sensor (P1) in the HEU-T90 Fluorinert liquid supply line reported a pressure fault.	An intermittent pressure fault.	None
				A faulty Fluorinert liquid pressure sensor.	If one sensor continues to indicate a fault condition, check the other sensor reading. If the other sensor indicates a valid reading (other monitored conditions are not out of range), replace the sensor that indicates a fault. Check the cable wiring.
				A sense cable failed.	Check the cables and replace them if necessary.
				An actual fault condition.	Both sensors must indicate a fault condition in order for an actual fault condition to occur. Refer to the “Tank pressure fault” message for corrective actions.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Backup tank pressure fault of x.xx psi.	The backup pressure sensor (P2) in the HEU-T90 Fluorinert liquid supply line reported a pressure fault.	An intermittent pressure fault.	None.
				A faulty Fluorinert liquid pressure sensor.	If one sensor continues to indicate a fault condition, check the other sensor reading. If the other sensor indicates a valid reading (other monitored conditions are not out of range), replace the sensor that indicates a fault. Check the cable wiring.
				A sense cable failed.	Check the cables and replace them if necessary.
				An actual fault condition.	Both sensors must indicate a fault condition in order for an actual fault condition to occur. Refer to the “Tank pressure fault” message for corrective actions.
		Tank pressure fault (high).	This fault message appears only if **both** the primary and backup Fluorinert liquid pressure sensors sense a pressure fault. This condition shuts down the computer system. **NOTE:** This message should be preceded by the “Primary tank pressure fault of x.xx psi” message and the “Backup tank pressure fault of x.xx psi” message.	A valve is closed when it should be open.	Verify that the following valves are in the correct position for the associated sequence: supply valve, return valve, drain valve, and fill valve. If a valve is not operating correctly, verify that the correct voltage is being supplied to the valve and that the control system is operating correctly.
				The Fluorinert liquid return line is blocked.	Inspect the return line for any blockages; fix as necessary.
				The flow rate is too high.	Use `nwacs` to verify that the flow rate is within the specified range.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Tank pressure fault (low).	The tank pressure dropped below the limit. This condition shuts down the computer system.	The cooling system leaks.	Verify that there are no leaks in the system; fix as necessary.
				The flow rate is too low.	Use nwacs to verify that the flow rate is within the specified range.
			NOTE: This message should be preceded by the “Primary tank pressure fault of x.xx psi” message and the “Backup tank pressure fault of x.xx psi” message.	The particulate filters are plugged.	Check and replace the particulate filters if necessary.
		Primary coolant supply temperature of x.xx degrees.	The primary temperature sensor (T1) in the HEU-T90 Fluorinert liquid supply line reported a temperature fault.	An intermittent temperature fault.	None
				A faulty Fluorinert liquid temperature sensor.	If one sensor continues to indicate a fault condition, check the other sensor reading. If the other sensor indicates a valid reading (other monitored conditions are not out of range), replace the sensor that indicates a fault.
				A sense cable failed.	Check the cables and replace them if necessary.
				An actual fault condition.	Both sensors must indicate a fault condition in order for an actual fault condition to occur. Refer to the “Cooling temperature fault” message for corrective actions.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Backup coolant supply temperature of x.xx degrees.	The backup temperature sensor (T2) in the HEU-T90 Fluorinert liquid supply line reported a temperature fault.	An intermittent temperature fault.	None.
				A faulty Fluorinert liquid temperature sensor.	If one sensor continues to indicate a fault condition, check the other sensor reading. If the other sensor indicates a valid reading (other monitored conditions are not out of range), replace the sensor that indicates a fault.
				A sense cable failed.	Check the cables and replace them if necessary.
				An actual fault condition.	Both sensors must indicate a fault condition in order for an actual fault condition to occur. Refer to the “Cooling temperature fault” message for corrective actions.
		Coolant temperature fault of x.xx degrees.	This fault message appears only if **both** the primary and backup temperature sensors in the Fluorinert liquid supply line sense a temperature fault. This condition shuts down the computer system.	A control system hardware problem.	Verify that the I/O monitoring block is functioning properly; also check the Genius I/O bus controller module for faults. Fix the problems as necessary.
				The Fluorinert liquid supply-line actuator valve in the HEU is not working correctly; possible software problem.	Verify that the supply valve connections are good; if the valve and the valve connections are good, reload the control system software.
				A faulty Fluorinert liquid supply-line actuator valve in the HEU.	Replace the Fluorinert liquid supply-line actuator valve.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Cooling flow fault of x.xx gpm.	The flow rate is outside the fault limit range for more than 60 seconds. This condition shuts down the computer system.	The Fluorinert liquid supply valve in the HEU does not work correctly.	Verify that the supply valve and connections are good.
				A valve is closed when it should be open.	Check each valve for correct position, including any butterfly valves that might have been closed during maintenance activities.
				A blockage restricts the flow of Fluorinert liquid.	Check for elevated pressures within the system that might indicate blockage locations. Remove any blockages and restart the system.
				The pump failed.	Check to see that the pump is receiving the correct voltage (check for any contactor failures or control system failures). Replace the pump if necessary.
		Primary power supply full sensor is dry.	The primary level sensor in the power supply section is exposed.	Intermittent exposure of the level sensor can occur as a result of pressure changes, flow changes, or bubbles in the tank.	Ignore this message unless it consistently repeats and the other sensor does not indicate a problem; this situation indicates a possible faulty level sensor. Replace the sensor if necessary.
		Backup power supply full sensor is dry.	The backup level sensor in the power supply section is exposed.	Intermittent exposure of the level sensor can occur as a result of pressure changes, flow changes, or bubbles in the tank.	Ignore this message unless it consistently repeats and the other sensor does not indicate a problem; this situation indicates a possible faulty level sensor. Replace the sensor if necessary.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Top of power supply section is not full.	Both the primary and backup level sensors are exposed, which indicates that the power supply section is not full.	The cooling system leaks.	Verify that the system does not leak. Fix any leaks if necessary.
				The tank contains an excess amount of bubbles, which could indicate that a burn occurred.	Check the voltage and current change faults. Possible burn condition. ***Do not open the system!*** Perform the fluoride-ion test to check the PFIB level.
		Low reservoir level. Add coolant.	The level sensor within the HEU-T90 reservoir indicates that the Fluorinert liquid level in the reservoir is less than 5%.	Some of the Fluorinert liquid evaporated.	Add Fluorinert liquid.
				The cooling system leaks.	Verify that the system does not leak. Fix any leaks if necessary and add Fluorinert liquid.
		The tank reservoir is full.	The level sensor within the HEU-T90 reservoir indicates that the Fluorinert liquid level in the reservoir is greater than 99%. This fault message occurs during an Empty Modules or Empty Tank command; this message halts the process to prevent overfilling the reservoir.	Too much Fluorinert liquid was added after a leak or burn condition.	Remove some Fluorinert liquid from the reservoir.
		The reservoir is dry.	Status message.		
		Pump overtemperature fault.	The pump overtemperature thermostat tripped. **CAUTION**: the pump case is very hot.	The pump lost its cooling.	Verify that the pump has cooling (Fluorinert liquid flow) and that the pump is wired correctly. Fix the pump wiring if necessary.
				The pump is overloaded.	Let the pump cool and restart it. If the pump overtemperature thermostat trips again, replace the pump.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Pump contactor overload relay fault.	The pump contains an overload relay that trips when the circuit is overloaded.	Low input voltage.	Verify that the pump is receiving the correct input power at the contactor. If it is not, check the HVDC unit for proper operation.
				The pump is wired incorrectly.	Verify that the pump is wired correctly.
				The pump is overloaded.	Reset the overload contactor relay and try to restart the pump.
				A short circuit in the pump coil.	If all of the above actions fail, the pump has a short circuit. Replace the pump.
		Pump contactor fault.	The pump contactor did not close when the control system enabled the pump.	An open wire between the Genius I/O block numbers 1 and 2, channel 3.	Verify that the connection between the I/O block and the contactor is good. Fix the connection if necessary.
				A faulty contactor.	Replace the contactor.
		High water supply temperature.	The control system monitors the customer-supplied water to make sure that the water temperature is within specified limits.	Customer water problem.	Contact the customer to correct the water supply problem.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		No coolant flow. Check the pump.	No Fluorinert liquid flow occurred when the pump was enabled.	The pump lost its prime.	Bleed the air from the Schraeder valve and try to restart the HEU.
				A faulty valve.	Verify that all the valves are in the correct position (a valve may be closed instead of open). Fix or replace any faulty valve.
				The pump thermistor limits were exceeded.	Let the pump cool and restart it. If the pump overtemperature thermostat trips again, replace the pump.
				Low input voltage.	Verify that the pump is receiving the proper input power at the contactor. If it is not, check the HVDC unit for proper operation.
				The pump is wired incorrectly.	Verify that the pump is wired correctly.
				The pump is overloaded.	Reset the overload contactor relay and try to restart the pump.
				A short circuit in the pump coil.	If all of the above actions fail, the pump has a short circuit. Replace the pump.
				An open wire between the Genius I/O block numbers 1 and 2, channel 3.	Verify that the connection between the I/O block and the contactor is good. Fix the connection if necessary.
				A faulty contactor.	Replace the contactor.
				The pump lost its cooling.	Verify that the pump has cooling (Fluorinert liquid flow) and that the pump is wired correctly. Fix the pump wiring if necessary.

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Genius block #1 (HEU) has a fault.	A Genius I/O monitoring block has a fault condition. This fault condition should not cause a computer system shutdown.	An open wire on the monitoring block.	Check for any open wires to the monitoring block and fix them if necessary
		Genius block #2 (HEU) has a fault.		A faulty monitoring block.	Replace the monitoring block.
		Genius block #3 (HEU) has a fault.		A possible fault condition that registers on the monitoring block.	Clear the fault with a hand-held monitor; if the fault does not clear, the hand-held monitor should indicate the location of the problem.
		Genius block #4 (HEU) has a fault.			
		Genius block #5 (HEU) has a fault.			
		Genius block #6 (HVDC) has a fault.			
		Genius block #1 (HEU) is not communicating.	A Genius I/O monitoring block in the HEU did not communicate with the Genius I/O bus controller for five bus scans.	No power to the monitoring block.	Verify that the block has power; restore power if necessary.
		Genius block #2 (HEU) is not communicating.		The local area network (LAN) cable is damaged or disconnected.	Verify that the LAN cable is not damaged or disconnected. Fix or replace it as necessary.
		Genius block #3 (HEU) is not communicating.			
		Genius block #4 (HEU) is not communicating.			
		Genius block #5 (HEU) is not communicating.			
		Genius block #6 (HVDC) is not communicating.			

Table 1. Status and Fault Message Troubleshooting Chart

Command	Status Message	Fault Message	Description	Possible Cause	Corrective Action
		Genius bus controller has a fault.	The Genius I/O bus controller quit functioning. The backup controller picks up operation of the Genius I/O network until the primary Genius I/O bus controller is operating again.	The LAN cable connection is damaged or disconnected.	Verify that the LAN cable is not damaged or disconnected. Fix or replace it as necessary.
				A faulty Genius I/O bus controller module.	Replace the Genius I/O bus controller.
		Low battery - do not remove power before replacing.	Battery backup in either the CPU or state logic processor modules is low. This battery provides protection against memory loss in the event of a power outage.	A battery is low.	Replace the battery before you remove power from the control system rack.
Stop T4 Stop All	Power turned off.				
Empty Modules Empty Tank	Starting drain cycle.				
		Cooling cannot be turned off until power is removed.	The control system sent a signal to the power supplies to turn off, but they did not turn off. The control system does not remove cooling until the power is removed.	The HVDC is stuck on and the power supplies are stuck on.	Open the circuit breaker to the HVDC.

Control System Fault Indications

Troubleshooting the control system involves several steps and components. Numerous conditions can cause problems; in order to fix a problem, you must first isolate the problem. Problems can be caused by either a computer system fault or by a control system failure. This subsection provides information to help you isolate these problems.

The MWS is the major component in troubleshooting; therefore, check the MWS first. The MWS runs the `nwacs` program that interfaces with the control system program. The `nwacs` program reports any monitored condition faults and any control system faults. If a monitored condition fault occurs, the `nwacs` program indicates the specific problem that requires corrective action. If a control system fault occurs, the `nwacs` program indicates the slot number of the failed component and the type of failure.

Two types of control system failures can occur: controller rack failure and I/O system failure. The following subsections describe these two failures.

Controller Rack Failure

After the failure is isolated as a controller rack failure, the next step is to determine which component failed and what caused the failure. Table 2 provides a fault chart for the rack controller components. The first column in the table, *Rack Component*, indicates the rack component. The second and third columns, *LED* and *Status*, list LED statuses for each component. The fourth column, *Possible Problem*, lists the possible problem as indicated by the statuses of the LEDs. The fifth column, *Corrective Action*, lists the actions necessary to fix the problems.

Table 2. Controller Rack Troubleshooting Information

Rack Component	LED	Status	Possible Problem	Corrective Action
Power supply	LOGIC POWER	On	None.	None.
		Off	Control system does not have incoming power.	Check the incoming power; if there is no incoming power, restore the power.
			Power supply failed.	Replace the failed power supply.
			Ineffective ground connection.	Check the ground connection; fix it if necessary.

Table 2. Controller Rack Troubleshooting Information (continued)

Rack Component	LED	Status	Possible Problem	Corrective Action
CPU	OK	On	None.	None.
		Blinking	The system failed. **NOTE:** It is normal for this LED to flash during the power-up process while the CPU performs self-check diagnostics.	Replace the CPU module.
		Off	The system failed and all communications ceased.	Replace the CPU module.
	RUN	On	None.	None.
		Off	The CPU is in the stop mode.	Verify that the CPU mode switch is in the *Run With Outputs Enabled* setting. Put the switch into the *Outputs Disabled* position and then back to the *Outputs Enabled* position.
	ENABLED	On	None.	None.
		Off	The CPU outputs are disabled.	Verify that the CPU mode switch is in the *Run With Outputs Enabled* setting. Change the switch setting if necessary.
State Logic Processor	STATUS	On	None.	None.
		Off	The state logic processor is not communicating with the system.	Check to see whether any other component failed; if no other component failed, replace the state logic processor.
			The state logic processor failed.	Replace the state logic processor.

Table 2. Controller Rack Troubleshooting Information (continued)

Rack Component	LED	Status	Possible Problem	Corrective Action
Genius I/O Bus Controller (GBC)	OK	On	None.	None.
		Blinking	GBC is installed in a slot that is not configured for a GBC. **NOTE:** It is normal for this LED to flash during the power-up process while the CPU performs self-check diagnostics.	Install the GBC in the correct location.
		Off	The GBC module failed.	Check the CH 1 OK LED; if it is off, replace the GBC module.
	CH 1 OK	On	None.	None.
		Off	The GBC module had a bus or bus controller failure while the CPU was running. **NOTE:** If the failure is a bus controller failure, the LED remains off. However, if the failure is a bus failure, the LED illuminates after the bus failure (for example, a broken wire or too many bus errors) is corrected.	Check for an I/O system failure. Refer to the following “I/O System Failure” subsection for more information.
TTL Input Module				
12-Vdc Power Supply	POWER ON	On	None.	None.
		Off	The component failed or a short circuit exists.	Fix the short circuit or replace the component.
			The state logic processor module failed; the output control signals are lost.	Check and reset the state logic processor module.
Analog Base Converter Module	OK	On	None.	None.
		Off	The component failed.	Replace the component.
Voltage Input Expander Module	OK	On	None.	None.
		Off	The component failed.	Replace the component.

Table 2. Controller Rack Troubleshooting Information (continued)

Rack Component	LED	Status	Possible Problem	Corrective Action
VMIVME-4132 Analog Output Board	FAIL	On	The board lost connection to the main CPU.	Reset the main CPU: open the PLC door, locate the mode switch, toggle the switch to the *run with outputs disabled* (center) position, and then toggle the switch back to the *run with outputs enabled* (top) position.
		On	The board blocks are jumpered incorrectly.	Check the board jumpers at locations J1 - J7. Compare the jumper configuration to Table 3. Fix the jumpers if necessary and restart. If the board fails during restart, replace the board.
		On	The board failed.	Replace the board.
		Off	None.	None.

The analog output board contains seven jumper blocks that must be configured correctly for proper control system operation. Table 3 provides the analog output board jumper configurations for the CRAY T90 series systems. Figure 2 illustrates the jumper locations in the analog output board.

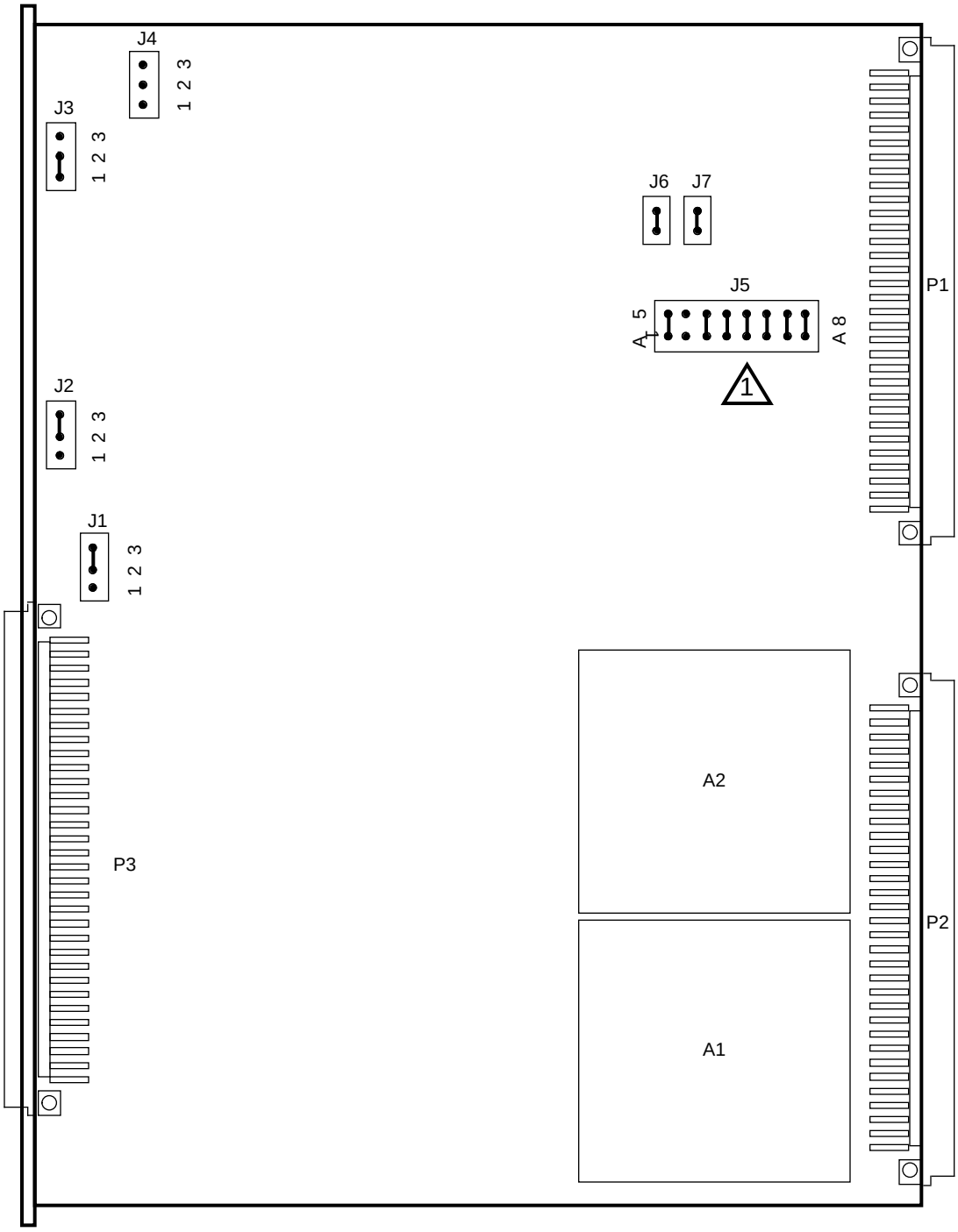
Table 3. Analog Output Board Jumper Configurations

Jumper Block	CRAY T94 System	CRAY T916 System	CRAY T932 System
J1	o o-o 1 2 3	o o-o 1 2 3	o o-o 1 2 3
J2	o o-o 1 2 3	o o-o 1 2 3	o o-o 1 2 3
J3	o-o o 1 2 3	o-o o 1 2 3	o-o o 1 2 3
J4	o o o 1 2 3	o o o 1 2 3	o o o 1 2 3

Table 3. Analog Output Board Jumper Configurations (continued)

Jumper Block	CRAY T94 System	CRAY T916 System	CRAY T932 System
J5	A15 o-o o-o o-o o-o o-o o-o o-o o-o A08	A15 o-o o-o o-o o-o o-o o-o o-o o-o A08	A15 o-o o-o o-o o-o o-o o-o o-o o-o A08
J6	o-o	o-o	o-o
J7	o-o	o-o	o-o

Figure 2. Analog Output Board Jumper Locations



1 A11 of J5 is not jumpered in the CRAY T932 system only.

I/O System Failure

An I/O system failure occurs when either a GBC module fails (slot 3) or an I/O remote monitoring block fails. The `nwacs` program indicates a GBC module failure as a “slot 3 failure”; an unilluminated “OK” status LED or “CH 1 OK” status LED on the GBC module also indicates this failure. All of these conditions can exist simultaneously, and any of these conditions can indicate a possible I/O system failure. Use the hand-held monitor when all of these conditions exist simultaneously. Refer to the *Control System Overview* document, Cray Research publication number HTM-065-0, for detailed instructions about the hand-held monitor.

When troubleshooting the I/O system, you must determine if the fault condition originates in the GBC module or in an I/O remote monitoring block. Table 4 provides the I/O remote monitoring block LED fault information. Table 5 provides information about troubleshooting the I/O system of the control system. Table 6 provides the GBC fault information.

Note: The two I/O remote monitoring blocks (analog I/O monitoring block and 115-Vac monitoring block) contain identical status LEDs; therefore, you can troubleshoot both monitoring blocks in the same manner.

Table 4. I/O Remote Monitoring Block LED Fault Information

Unit OK LED	I/O Enabled	Indication
On	On	The block is functioning and is communicating with the CPU.
On	Off	The block is functioning but did not communicate with the CPU for three bus scans.
On	Blinking	The block is functioning, but the I/O circuit was forced.
Blinking	On	The block had a circuit fault but is communicating with the CPU.
Blinking	Off	The block had a circuit fault and is not communicating with the CPU.
Alternate blinking		The block had a circuit fault, and the I/O circuit was forced.
Blinking together		The block is not communicating with the CPU because of a block number conflict.
Off	Off	The block does not have power.
		The block is faulty.
Off	Blinking	The electronics assembly and terminal assembly are mismatched.

Table 5. I/O Remote Monitoring Block Troubleshooting

Problem Indication	Possible Problem	Corrective Action
Unit OK and I/O Enabled LEDs are blinking together	The components within the I/O system have duplicate device numbers.	Use the hand-held monitor to verify the device numbers; assign a device number according to the device number on the block if necessary.
Unit OK LED remains off after power-up	The electronics assembly is not properly attached to the terminal assembly.	Verify that the two assemblies are attached correctly; fix the attachment if necessary.
	The block power wires are not connected to the correct terminals.	Verify that the power wires are attached correctly and fix the wires if necessary.
	The I/O system bus may not be terminated properly.	Check to see if other blocks in the system indicate the same problem; if so, verify that the last component in the I/O system is terminated correctly with a 150-ohm resistor on I/O monitoring block number 6.
None of the circuits on a block are working	The terminal assembly wiring is not correct.	Verify that the terminal assembly wiring is properly attached.
	The terminal assembly voltage is not correct.	Verify the correct voltage for the terminal assembly.
	The device has the same number as another block in the I/O system.	Check to see if the Unit OK and I/O Enabled LEDs are blinking together; this condition indicates that the block has an incorrect number. Verify the block number.
One circuit on the block is not working or is not being recognized by the CPU	The sensor or control valve may not be working.	Switch the wire from the sensor or control valve to another circuit on the block to verify the sensor or control valve operation.
	The wiring for that circuit is incorrect.	Check the circuit wiring.
	The electronics assembly is not installed correctly.	Reinstall the electronics assembly.
	An improper voltage is being applied to the terminal assembly.	Verify that the voltage levels for the terminal assembly are correct.
	The electronics assembly is faulty.	Replace the electronics assembly.
Unit OK LED is blinking	The block has a faulty circuit.	Use the hand-held monitor to check the circuit for the fault.
		Power down the block and then power it up again.
		Use the hand-held monitor to issue the Clear All Circuit Faults command. If this does not clear the fault condition, replace the block.

Table 6. GBC Fault Indications

Component	Problem Indication	Possible Problem	Corrective Action
GBC	No status LEDs are illuminated.	The GBC is not receiving enough power from the power supply.	Check the power supply.
	GBC is not communicating with the CPU.	The CPU may be in the wrong operation mode.	Verify the CPU operation mode and correct it if necessary.
	GBC is not communicating with the I/O system bus. OK and CH 1 OK LEDs are blinking together.	Two devices on the I/O bus may be configured with the same device number.	Use the hand-held monitor to check the device numbers; reconfigure any device that has inaccurate numbers.
		Serial 1 and serial 2 wires are crossed.	Check these wires and fix them if necessary.
		The GBC device address is wrong.	Use the hand-held monitor to verify that the GBC device address is correct.
		The baud rate is wrong.	Verify that the baud rates are correct for each component of the I/O system.
	GBC is not operating normally.	The I/O system is not wired correctly.	Verify that the I/O system is daisy chained correctly.
		The I/O system bus cable is too close to the high-voltage wiring.	Check the cable location and move it if necessary.
		A cable broke.	Use the hand-held monitor to check for a broken cable.
		A cable shield is not installed or grounded correctly.	Check all cable shielding for correct installation and grounding.
	Communications are intermittent.	The remote monitoring blocks might have mixed baud rates.	Use the hand-held monitor to verify the baud rate of each remote monitoring block; change the baud rate if necessary. **NOTE:** The I/O system cannot function properly with monitoring blocks with mixed baud rates. After you change the baud rate, you must power cycle the remote monitoring block to implement the new baud rate.
		Some wires might be broken.	Check all wires and connections.

Miscellaneous Failures

The control system may not indicate all problems. These situations are more difficult to troubleshoot. Table 7 provides a list of problems that the control system might not indicate and describes the problems and the actions you can take to correct them.

Table 7. Miscellaneous Failures

Problem	Possible Cause	Corrective Action
Beads in the fluid-conditioning system indicator window are all the same color.	A low-level burn condition may exist or did exist within the system; if the beads turn the same color, acids or organics are present in the Fluorinert liquid.	Possible burn condition. ***Do not open the system! Follow standard burn procedures.*** Perform the fluoride-ion test to check the PFIB level.
		If the burn condition occurred some time ago, replace the filters.
The mainframe does not drain.	Power was not removed from the computer system.	Check the `nwacs` program for any error conditions. Enter a Stop All or Stop T4 command to remove power from the mainframe.
	Control system hardware problem.	Refer to the “Control System Component Fault Indications” subsection for more information about possible problems.
	The I/O solenoid valve on the CRAY T94 mainframe does not open.	Verify that the solenoid is receiving power from the control system. If not, fix the control system problem.
		Replace the solenoid valve.
	The Fluorinert liquid return valve in the HEU is faulty.	Replace the valve.
	The HEU pump is air-locked.	Bleed air from the Schraeder valve located at the highest point in the HEU.