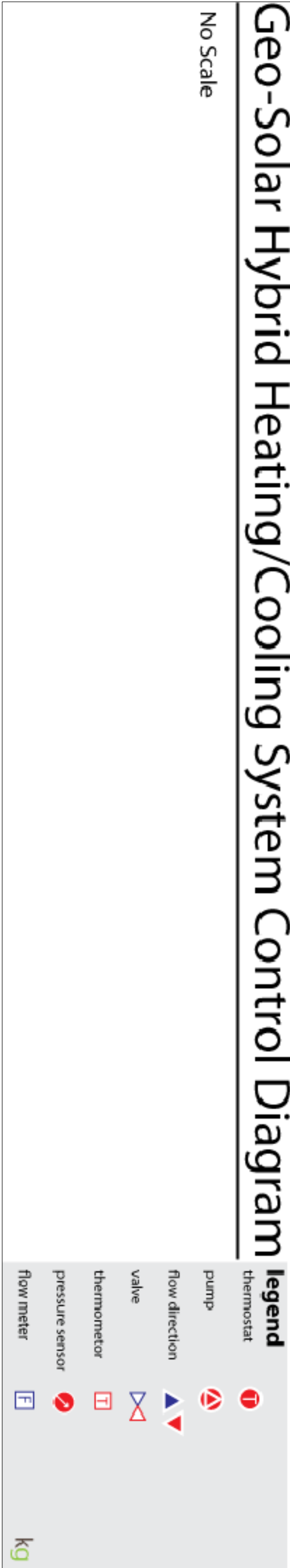


Geo-Solar Hybrid Heating/Cooling System Control Diagram

No Scale



Solar Thermal Collectors

Sequence of Operations

Heating (Winter) Modes

- * Occupied - Windows and Doors Closed
 - o In heating mode, the solar panels are manually uncovered.
 - o The two mass thermal storage tanks are manually valved open to the solar thermal collectors and domestic hot water sub-systems.
 - o When the collector temperature sensor T-1 is above its minimum setpoint (90 deg F, adj), the solar collector system is enabled. Below minimum setpoint, the system is not allowed to run.
 - o The differential temperature between collector temperature T-1 and the mass thermal storage water temperature sensor T-2 is monitored by the system differential controller.
 - o When the differential temperature is greater than or equal to the start-up temperature differential setpoint (8 deg F, adj), pump PP-1 is activated.
 - o Unheated water from the mass thermal storage tanks enters the solar panels, is heated, passes through the domestic water heat exchanger (unless manually bypassed), and returns to the mass thermal storage tanks.
 - o When the differential temperature is less than the stop temperature differential setpoint (4 deg F, adj), pump PP-1 is deactivated and the system drains by gravity back to the drainback tank.
 - o Collector temperature T-1 and storage tank temperature T-2 are monitored by the controller for system performance as well as control, and solar heat output and pump run time are indicated by the control system.

- * Occupied - Windows and Doors Open
 - o Same as Occupied - Closed hours heating mode.

- * Unoccupied
 - o Same as Occupied – Windows and Doors Closed hours heating mode.

- * Emergency
 - o Mass Storage Tank Temperature too high - If the storage tank temperature reaches its high temperature limit (200 deg F, adj), an alarm is generated in the control system and pump PP-1 is deactivated so it cannot operate until the tank temperature is 20 deg F (adj) below the tank heat limit (180 deg F, adj).
 - o Mass Storage Tank Temperature too low - If the storage tank temperature reaches its low temperature limit (80 deg F, adj), an alarm is generated in the control system and pump PP-1 is deactivated until the alarm is manually reset.
 - o Solar Collector Outlet temperature too low (freeze protection) – If solar collector outlet water temperature T-3 (backup sensor to solar collector sensor T-1) reaches 85 deg F while operating, a warning is generated in the control system. If it reaches 80 deg F while the system is operating, an alarm is generated and pump PP-1 is deactivated until the alarm is manually reset.
 - o Pump failure – If pump PP-1 is called to run but does not start as monitored by the controller, an alarm is generated.
 - o Leak detection – When system is in operation with pump PP-1 running, system pressure is monitored at pressure sensor P-1. If the pressure drops 3 psi (adj), below the normal system operating pressure (determined during system test and balancing), an alarm is generated indicating possible leak in system. Pressure is not alarmed when system is off to prevent nuisance alarms.

Shoulder (Spring - Fall) Modes

- * Occupied - Windows and Doors Closed
 - o During the shoulder season, the solar panels are manually covered and uncovered as required to meet the system operation (actual number covered and uncovered during varying conditions will be determined during installation and initial operation of system).
 - o The two mass thermal storage tanks are manually valved so that one tank is dedicated to storing heat from the solar thermal collection subsystem and the other is used for cooling storage from the geothermal subsystem. Refer to the Mass Thermal Storage for details.
 - o System enable and differential temperature controls function the same as during heating mode to start and stop pump PP-1.

- * Occupied - Windows and Doors Open
 - o Same as Occupied - Windows and Doors Closed hours shoulder mode.

- * Unoccupied
 - o Same as Occupied – Windows and Doors Closed hours shoulder mode.

- * Emergency
 - o Same as Emergency heating mode.

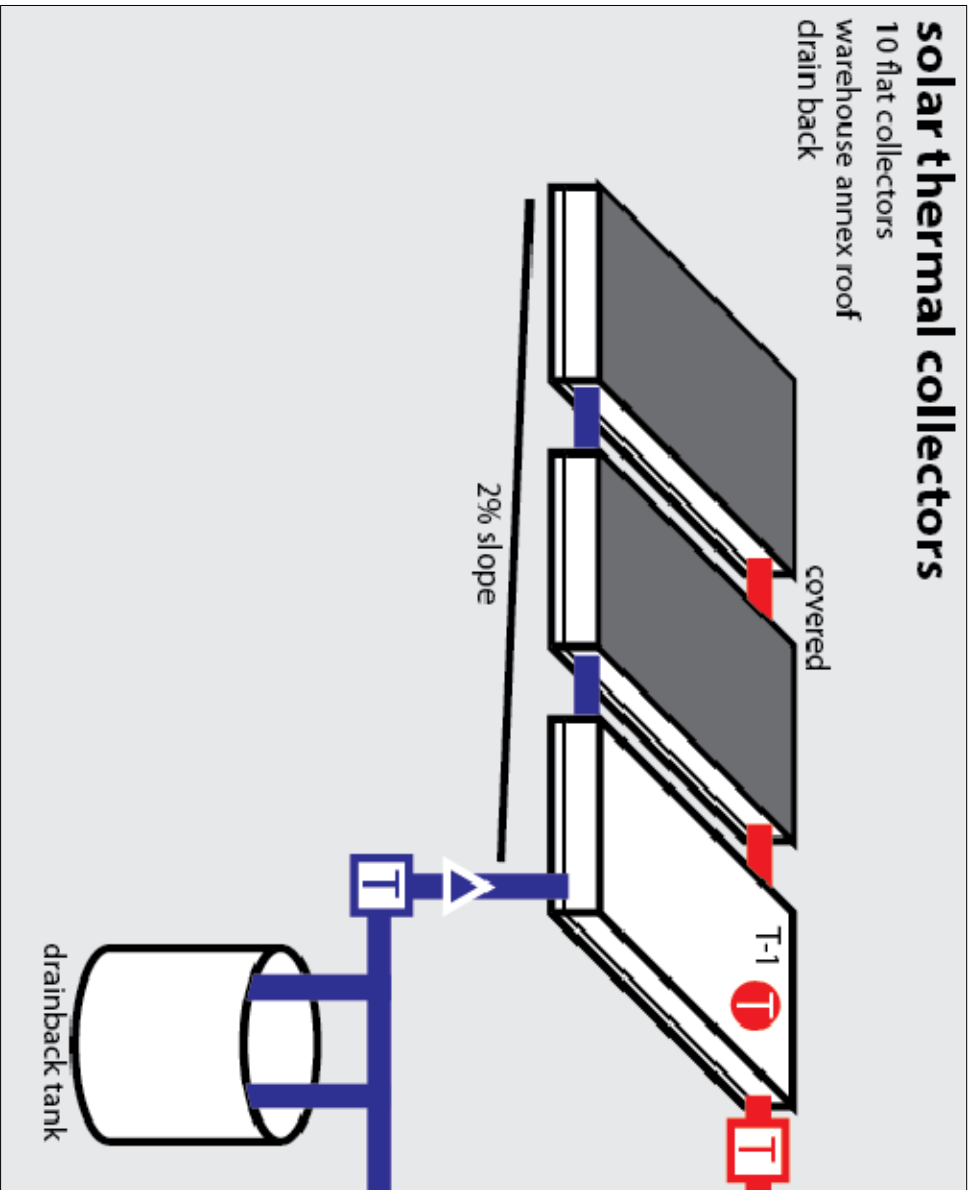
Cooling (Summer) Modes

- * Occupied - Windows and Doors Closed
 - o In cooling mode, eight (8) of the solar panels are manually covered and two (2) remain uncovered as required for domestic water pre-heating (actual number covered and uncovered will be determined during installation and initial operation of system).
 - o Covered panels operate as photovoltaic collectors.
 - o The two mass thermal storage tanks are manually isolated from the solar thermal collectors and domestic hot water subsystems so that flow through the solar collectors bypasses the mass thermal storage.
 - o A drainback tank is provided in the domestic hot water circuit to provide space for the water to drain from the collectors when the system is deactivated.
 - o With system on, full flow is maintained through all solar panels, both covered and uncovered.
 - o System enable and differential temperature controls function the same as during heating mode to start and stop pump PP-1 except that domestic water pre-heat tank temperature sensor T-4 is substituted for mass storage tank temperature sensor T-2 for differential temperature comparison.
 - o Refer to the Solar Domestic Hot Water for integration with auxiliary domestic water heating.

- * Occupied - Windows and Doors Open
 - o Same as Occupied - Windows and Doors Closed hours cooling mode.

- * Unoccupied
 - o Same during Occupied – Windows and Doors Closed hours cooling mode for domestic water pre-heat exchanger operation.
 - o Refer to Solar Domestic Hot Water for Unoccupied operation of auxiliary domestic water heating.

- * Emergency
 - o Same as Emergency heating mode except that domestic water pre-heat tank temperature sensor T-4 is substituted for mass storage tank temperature sensor T-2.



Solar panels will be covered in summer.

DESIGNED	TJB	CHECKED		PROJECT NO.
DRAWN	RAJ	CHECKED		0923
APPROVED	TJB	DATE		SHEET NO.
SOLAR COLLECTORS				M-2

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