



Solar Domestic Hot Water with Pool System

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June-2009

Objective:

To control a Solar Thermal Drain-Back system used to heat Domestic Hot Water (DHW) and use remaining excess energy for a swimming pool. The system must be fully accountable and report system failures and faults.

System Description:

Eight 4ft x 10ft glazed collectors were installed on a south facing roof, and connected to two stainless steel heat exchangers by way of the Drain-Back tank and 3-way valve. The secondary side of the domestic hot water heat exchanger is feeding a 120G storage tank, while the secondary side of the pool heat exchanger is inserted between the pool-filter and pool-heater.



Picture 1: View of Panels

Drain-Back systems must always be able to “drain back”, and this system is no different. The 3-way valve is constructed such that it always provides an open port to either the domestic hot water or pool side. A level-switch is included in the Drain-Back tank to detect a low closed-loop fluid condition.



Picture 2: A Thor Solar Panel Temperature Sensor

A Thor Solar Panel Temperature sensor, together with two additional sensors used to measure solar panel inlet and outlet temperatures. The three sensors provide a unique method of system startup, and closed loop flow regulation. The Thor Solar Panel Temperature sensor is installed in between the absorber plate and solar panel glass.



Picture 2: A 3-Way valve with Closed-Loop and DHW Pumps

A Lauritzen Inc. Thor Solar Thermal Controller is used to manage and supervise the pumps, heat-exchangers, and valve and temperature sensors. Typically the system will heat the domestic hot water storage tank up to a set-point, after which the thermal energy is diverted into the pool. The pool heat-exchanger is monitored to maintain a safe operating temperature in order to prevent heat damage to the PVC fittings and pipes.



Picture 3: Tube-in-Shell Heat-Exchanger for Pool

The Thor controller is connected to the Lauritzen Inc. servers through a 10Mb Ethernet cable, and provides periodic updates of system status. Similarly, a connection can be established from the Lauritzen Valhalla server to the Thor controller to provide diagnostics, on-line technician support, as well as remote software updates.

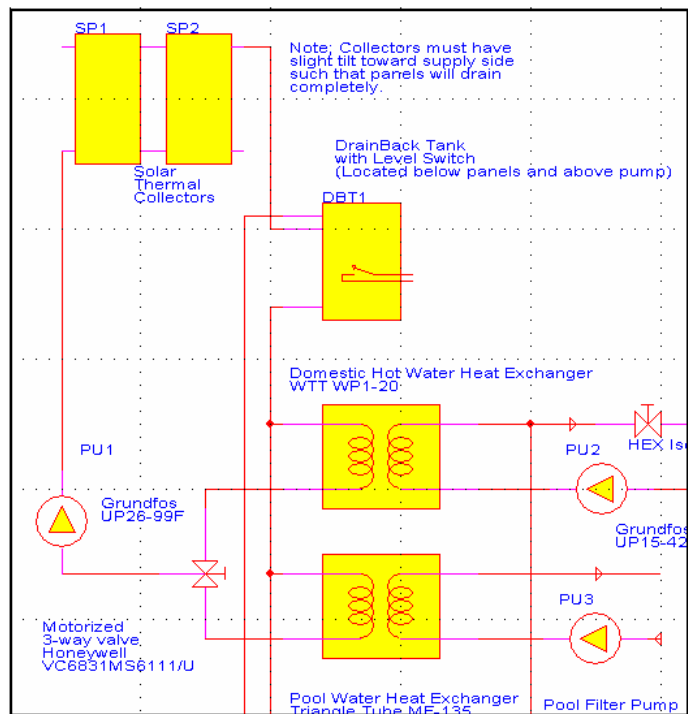


Figure 1: Schematic of Closed Loop

System Operation:

The daily solar operation typically finds a depleted DHW storage tank and/or requiring a temperature boost. At that time the Thor controller will wait until a sufficient panels

temperature exists, and at that time start the Closed-Loop pump. Once the closed loop has achieved proper operating temperature, the DHW pump on the secondary side of the DHW heat-exchanger is modulated to facilitate a gradual temperature increase in the DHW storage tank. The maximum DHW storage tank temperature limit was set to 122F (50C) in order to prolong the storage tank lifetime. Note; a higher temperature limit would have been used in case the typical DHW water consumption would have been higher. See Chart #1 for a graphical view of a typical daily storage tank temperature charge.

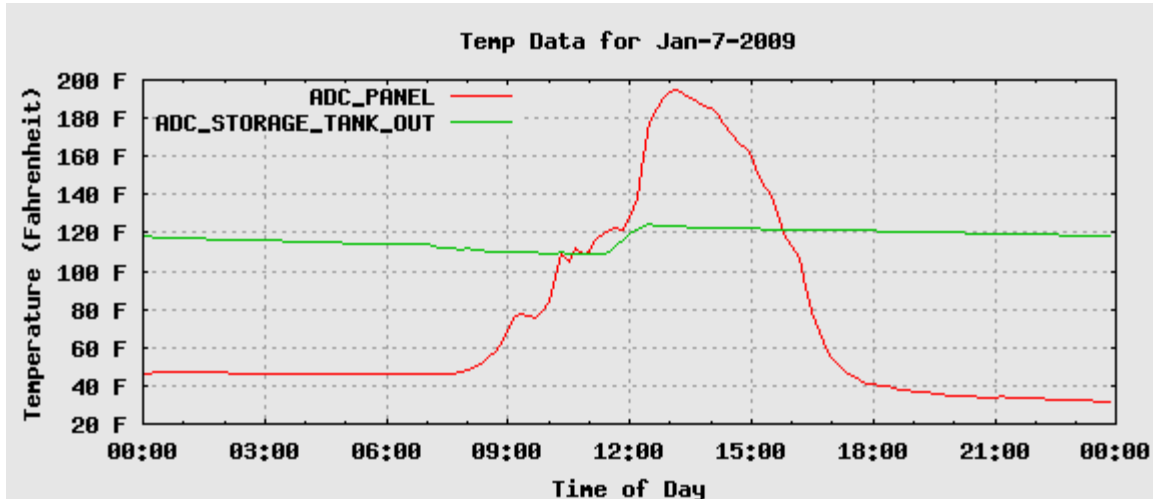


Chart #1: Chart showing Daily Panel and Storage Temperature

If the pool heater is disabled, the solar system has no other way of dispersing the thermal energy, and the Thor controller will stop the closed-loop pump. At that time the closed-loop fluid will drain from the panels into the drain-back tank, and the solar panels will experience a rapid temperature increase (see Chart #1 at 12:30). Since flat plate solar thermal panels are built to withstand being exposed without fluid flow, thermal run-away in drain-back systems is not a problem.

A flow meter inserted in the cold water feed to the solar storage tank measures DHW usage. Together with three temperature sensors, the Thor controller is able to calculate solar energy (sometimes referred to as a BTU meter) consumed as well as the energy contributed with the conventional natural gas based water heater (NG Booster).

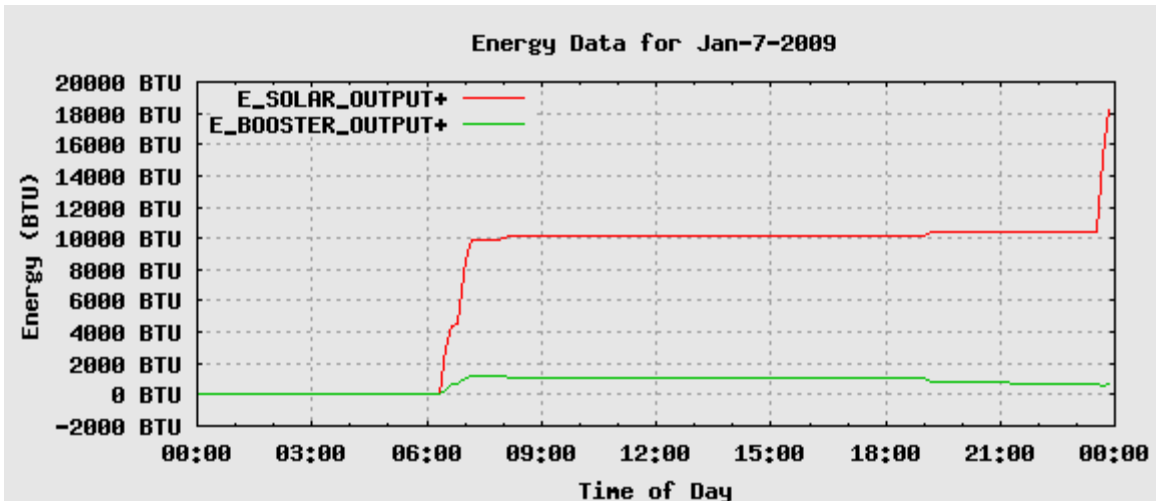


Chart #2: Chart showing net energy contributed by Solar and a NG Booster.

With the pool heat-exchanger enabled, the Thor controller will divert thermal energy into the pool after charging the DHW storage tank. See Chart #3; at 9:30 the DHW is charged and the 3-way valve is changed to divert heat to the pool system. Note; temperature sensor is attached to the shell of the heat exchanger near the secondary output, and does not reflect the pool temperature.

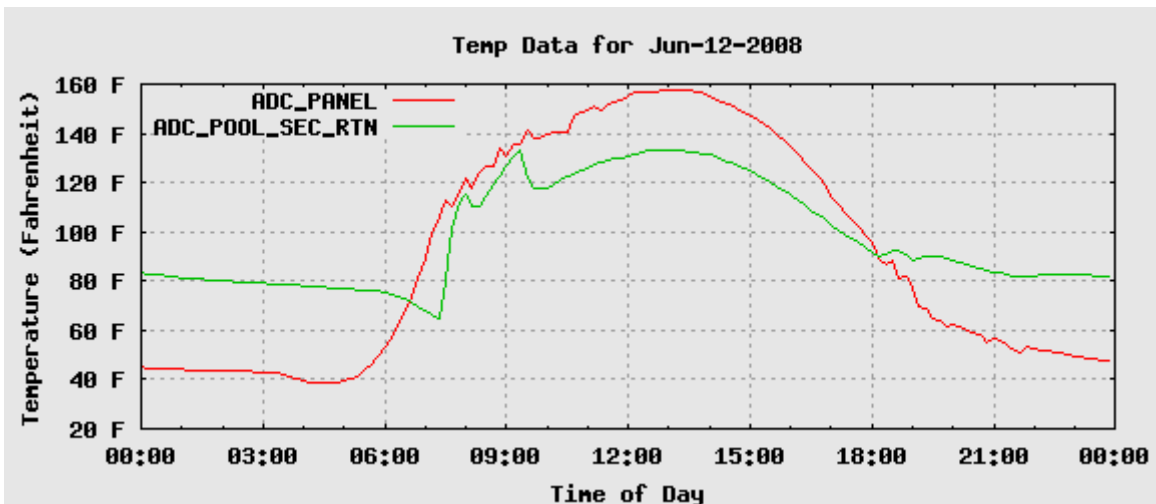


Chart #3: Chart showing secondary output side of Pool Heat-Exchanger.

Most pool systems are plumbed with PVC pipe which cannot withstand high fluid temperatures. One of the features of the pool temperature sensors is to sense a flow fault in the pool plumbing system. Such a fault occurred as indicated in Chart #4.

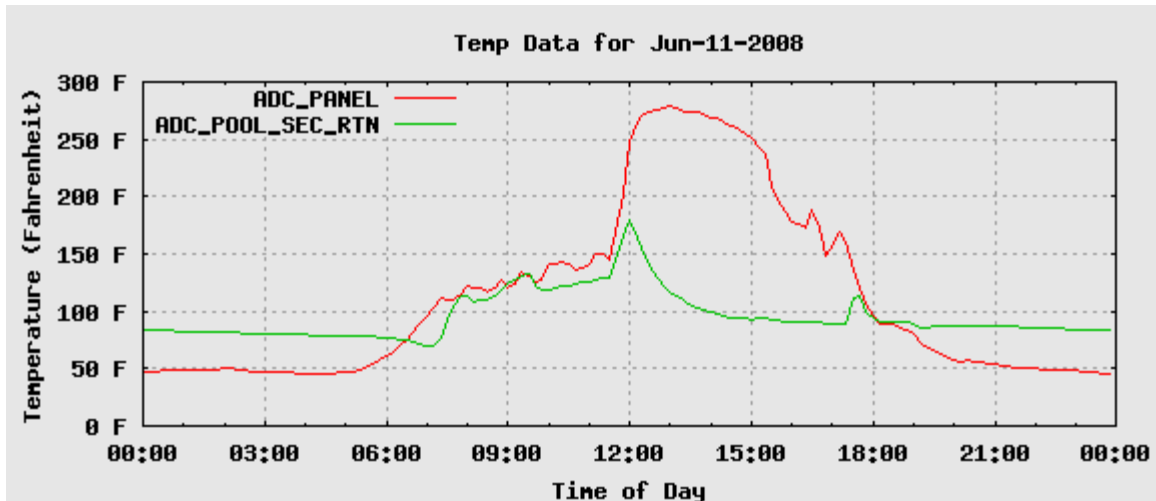


Chart #4: Chart showing a pool flow fault

A faulty flow in the secondary side of the pool heat exchanger can occur with a blocked pool filter, low pool water condition, or incorrect pool operation. When that happens, it is important to be able to stop the continued flow into the primary side of the pool heat exchanger in order to prevent PVC piping damage. At Jun-11 such an event happened. The pool water level was low, and the Thor controller detected inadequate cooling which caused the Solar system to be shut-down for the remainder of the day. When such faults occur, an alarm is sent to the system operator, which can be the system owner, or an assigned technician.

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Conclusion:

The Thor based combined Solar Domestic Hot Water and Pool heating controller has been in operation since Feb-2007. During the summer months the system is able to produce nearly 100TKWh (Thermal KWh) of energy, while delivering nearly 100% of all the thermal energy required by the Domestic Hot Water system throughout the year.

Aside from the numerous Low Pool-Water alerts, the controller has also detected one low closed loop fluid condition.