THE POWER COMPANY
TRACE ENGINEERING
5916 - 195th N.E., Arlington, WA 98223 Phone (360) 435-8826 Fax (360) 435-2229

Tech Note 2/24/97

Diversion Loads

Anyone dealing with solar, wind, or hydro power generation systems knows that a critical component in these systems is the charge/load controller(s).

The job of the charge controller is to see that a battery bank is charged in a controlled manner. Also, protection against over-discharge and overcharging is provided by disconnecting the charging source(s) from the battery should one of these conditions occur.

A load controller is generally designed to remove a load or loads from the system when an over-discharge or overload situation occurs.

A **diversion load controller** is designed to monitor battery state, and when the battery is full, divert the power coming out of the source (Solar, wind, or hydro generator) to a load which will utilize the excess power. Usually a water heater or some other type of heating element is present for this purpose.

Systems utilizing solar arrays do not have a requirement for diversion loads since a solar module can be open circuited without damage. However, even with a solar based system it is desirable to use excess power to operate DC loads. On the other side of the equation, when a wind or hydro generator is operating, the diversion load prevents over-speeding and self destruction. Unload the system by suddenly removing the load and the generator will overspeed and potentially fail. To drive this point home, imagine riding a bicycle up a big hill and you are standing up on the pedals working hard. All the sudden the chain breaks, and you no longer have any load to absorb your energy. You probably get the point!! The only way to safely deal with this situation is to either stop the generator, or allow its power output to continue, but divert it away from the batteries to prevent overcharging. This is the duty of a diversion load controller.

What Should I Use for a Diversion Load?

Several different types of diversion loads are available to the alternative energy market. These loads are designed to operate with the power output levels common to most diversion load controllers. The following are several available diversion loads which may be used successfully for heating water or air.

A 120VAC, 2000 watt water heater element available at most any hardware store, may be used with a 12, 24, or 48 volt DC system, however do not expect a 2000 watt power dissipation. The power draw is determined by the heater element's DC resistance, the output voltage of the controller, as well as the output current capability of the charging source(s). These heater elements were designed to operate at 120 Volts AC. A 48 volt 40 amp charge controller will operate just fine with this type of a system providing about 500 watts of power dissipation. A 12 or 24 volt diversion load controller will work but doesn't put out enough power to effectively heat water with only one element. The remedy to this type of problem is to parallel several of these heater elements to up the power output. The chart below shows power dissipation of a 120VAC, 2000 watt heater elements operated at different voltages. Note that the voltages given are roughly the bulk charge stage voltages for a given system. Remember that if you parallel heater elements the diversion load can handle more current.

System Voltage	Power	Amperage
@ 60Vdc (48Vdc system)	500W	8.6 Amps
@ 30Vdc (24Vdc system)	125W	4.3 Amps
@ 15Vdc (12Vdc system)	30W	2.1 Amps
@ 120 **VAC**	2000W	16.7 Amps

A couple of other excellent diversion loads which may be utilized effectively are available from Alternative Energy Engineering of Redway California.

5916 - 195th N.E., Arlington, WA 98223 Phone (360) 435-8826 Fax (360) 435-2229

1. **A 12/24 volt DC or 24/48 volt DC water heater element** (AEE Part #20-909 or #20-919 (24/48V))

2. **Open air heater with a fan** (AEE Part #20-913-12 (12V, 720W), #20-913-24 (24V,720W), #20-914-12 (12V,1440W), #20-915-24 (24V, 1440W), and #20-916-48 (48V,1440W)).

Either will accomplish the task, with the open air heater being a larger load. For more information contact:

Alternative Energy Engineering Tech Support at 1-800-800-0624,

or

to order call 1-800-777-6609
(FAX 1-800-777-6648).

Regardless of the type of diversion load you decide to utilize make sure that the diversion load can handle all the power the charging system is capable of putting out. Paralleling heater elements whether open air or water heater will allow more power dissipation.

A good rule of thumb is to not have a combined charging source greater than 80% of the diversion load controller's current handling ability. For example, if a Trace C40, 40 amp diversion load controller is being used, do not place a combination of charging sources which are capable of putting out more than 32 amps (80% of 40 amps) on the load controller's circuit. Sizing a diversion system this way allows a safety margin for unusual conditions. (High winds, high water flow, etc.)

It is **not** recommended that light bulbs be used as diversion loads for a couple of reasons.

1) An incandescent light bulb has a substantially lower cold filament resistance than when it is on. This means it draws more power (up to five times) to start the light when it is cold than once the filament has warmed up. Even a forty watt lightbulb may have an inrush amperage at turn on of 200 amps. This would cause the load controller to shut down.

2) In the event a light bulb load burns out, a smaller than necessary load will be present and the excess energy will have no where to go when the controller switches to diversion mode, the other bulbs will probably burn out in succession since they can't handle the excess current, and very quickly you will have a no load situation. This is what you were trying to avoid in the first place.

If you still have further questions about diversion loads, contact the Trace Engineering technical department or Alternative Energy Engineering.

TRACE ENGINEERING