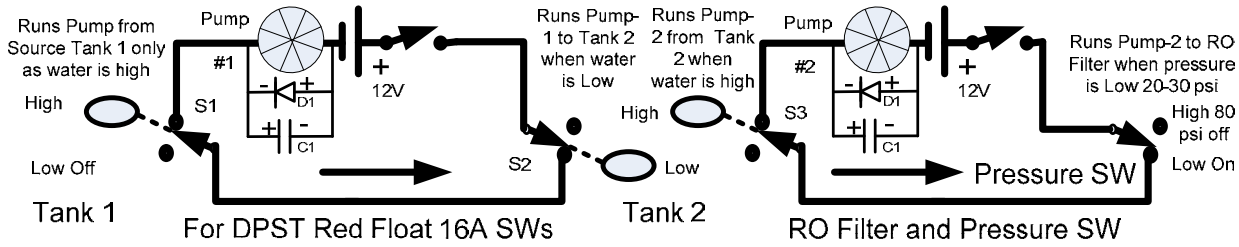
Rain Water Reverse Osmosis Unit for use after the Pole Shift

(12/24/2016)

Finding myself unable to purchase a portable RO brackish water purification system due to lack of product availability that fit my needs, I decided to build my own. The following is what was learned and what resulted. The control circuits became the main development effort so that is discussed first.

Electrical Control Circuits

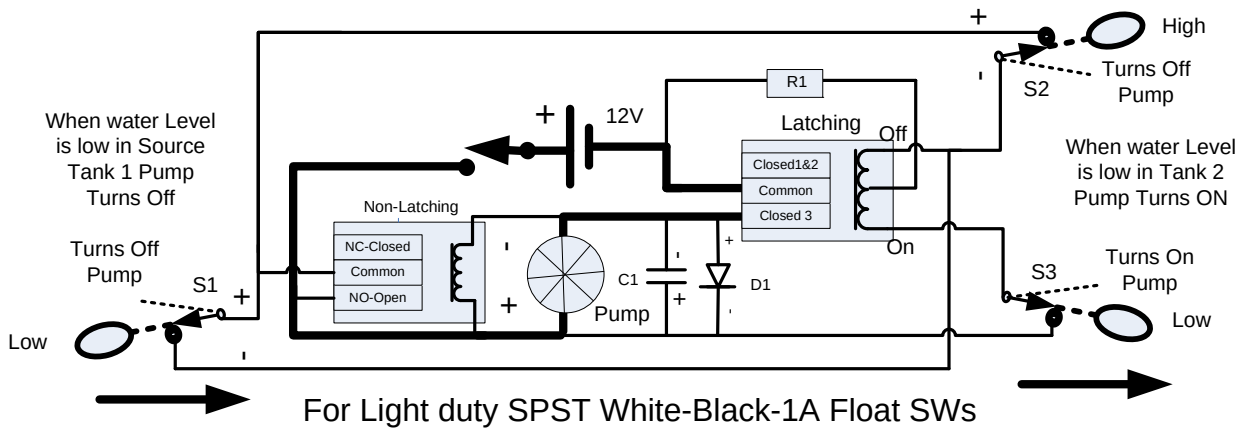
For transfer of water from one source tank through some filters to a holding tank takes a pump that needs to be turned on and off so the supply tank doesn't empty and the receiving tank doesn't over flow. One of the following circuits will apply depending on using a float switch that is capable of current values that will drive the supply pump directly or the float switch needs a relay controller to drive the pump. Filters of different types like particle, carbon, reverse osmoses can be put in between the two tanks. For pressure storage tanks the pump is turned off with a pressure switch usually as part of the pump but can be separate as needed.



The above uses a "TEMCo Liquid or Water Level Float Switch Sensor" from ebay or equivalent (several types exist). Shown below on the left with closed to pump in center and open when tank is full on right. Specs: 16 amp SPDT, up to 250v, 45 deg till to activate switch, 6 ft cable.

When only a low 1 amp float switch is available a relay control circuit is needed. These side or top mount float switches generally look like the following.

If this is the type of float you are planning to use then use one of the following two types of circuits for control.



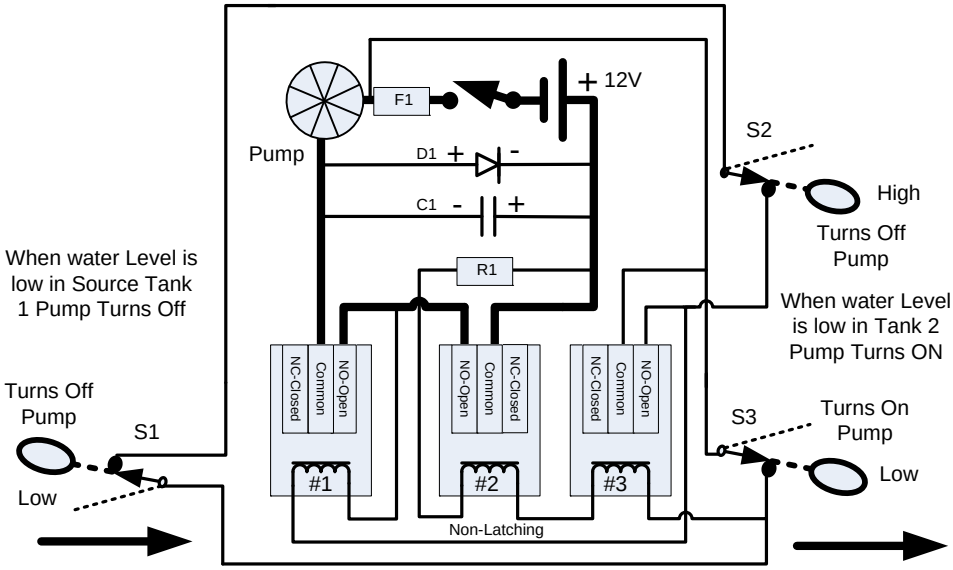
For Light duty SPST White-Black-1A Float SWs

The above shows how to control tank filling and transfer flow by using one latching and one non-latching relay. The values for C1=100uf, 50 to 100v works best in the range of pump currents 4-7 amps at 12 volts. For more information write up on how to suppress or snub the relay contacts point's arc. The non-latching relay in this case uses 30ma at 12volts. The 2-coil latching relay uses 5 volt at 113ma and has SPDT at 16 amps. R1= 69 ohms (used 51+18) approximately. The diode was 5 amp at 1000v and can be anything you have it. the diode and capacitor is for killing induction load, magnetic field rapid collapse producing high voltages, which might damage over time the contacts of the relay.

Normal operation: The sequence of switch action during normal operation is S3 closes due to low water and the pump turns on. The pump runs as long as S1 and S2 are open once one closes then the pump turns off and S1 or S2 can again open and the pump will not turn on until S3 closes again.

Abnormal switching due to malfunction: If S1 or S2 is closed when S3 turns on the pump will run filling tank2 shortly S3 will open and the pump goes off. If S1 or S2 and S3 open while the pump is running it will continue to run until either S1 or S2 closes.

If S1 or S2 is open and S3 closes the pump will run but this will not happen unless S1 float is stuck down and the water is above the float or the switch burns out or if S2 is lifted up or the switch is bad and open. It could overflow tank2 if S1 and S2 fail to close. None of these combinations will happen in normal run conditions.



For Light duty SPST White-Black-1A Float SWs

The above shows how to control on and off pump flow using only non-latching relays, with no power draw when off. Number 2 and 3 non-latching relays are 5 volts with a resistor R1=33 ohms to make the series wiring work at 12v. Number 1 is non-latching and works at 12 volt. F1 is a fuse if needed. C1=100 uf at 50 to 100v and D1= 5 Amp at 1000v. The float switches are the low current typically about 1amp max. The pump is any 12v pump of the range of 4 to 7 amps. If out of that range C1 will need to be checked to see if it still minimizes the spark of points opening and closing. See separate write up for this.

Normal operation: S3 closes as tank 2's water is used. This closes all three relays and the pump runs as long as S1 and S2 are closed once one opens then the pump turns off and S1 and S2 can again close and the pump will not turn on until S3 again closes and starts it.

Abnormal switching due to malfunction or by hand: If S1 or S2 is open and S3 sticks in the closed condition the pump will continue to run until S3 is open. S1 open will not happen unless S1 float is stuck down and the water is above the float or the switch burns out or if S2 is lifted up or the switch is bad and open. To over flow tank 2 S1 or S2 need to be stuck open and S3 needs to be stuck closed. None of these combinations will happen in normal run conditions.

Note carefully: That the orientation of the float switches on the two tanks for each circuit is completely different. Use care in mounting the float switches as to witch way the "On" position should face up or down.

Comments and analysis: Neither of the circuits above draws current when the pump is off. The contacts are rated at 10 Amp for the 3 relay rendition and the contacts for the latching relay are rated at 16 Amp. The 3 relay approach uses about 60ma less current than the 2 relay approach when the latching relay operates however once the pump starts the 3 relay approach uses about 60 ma more current than the latching approach. The 3 relay approach is a bit less likely to get into a runaway condition where the pump continues to run no matter what. When power is removed all is reset. The latching on can still be in a pump On so that when power comes back it will run the pump. This being the more important factor my current choice is to use the 3 relay approach.

RO waist water amount: when the pressure is high around 80 psi on the RO filter then there is about equal quantity of good or filter water to waste water. If pressure is low 60 psi or lower then there is more waste water than good water. If water is cold below 70 degrees then the filtration is sluggish and more waste water results.

Pictures of the built semi-portable unit

Purchase a standard under the sink RO unit then replace the RO filter with a 100 GPD filter. Remove the old restrictor from the waist water output of the RO filter. An adjustable needle valve will do this when done. Then build up the extra filters as needed. Use 12v DC pumps capable of 80 psi. There are lots of low in cost types on eBay along with included or separate pressure switch. Purchase a low wattage UV-light from ebay or a local dealer. Pressure gauge, valves, fittings, hose, and storage tanks are available locally. Stock up on lots of filters especially the particle and carbon block filters.

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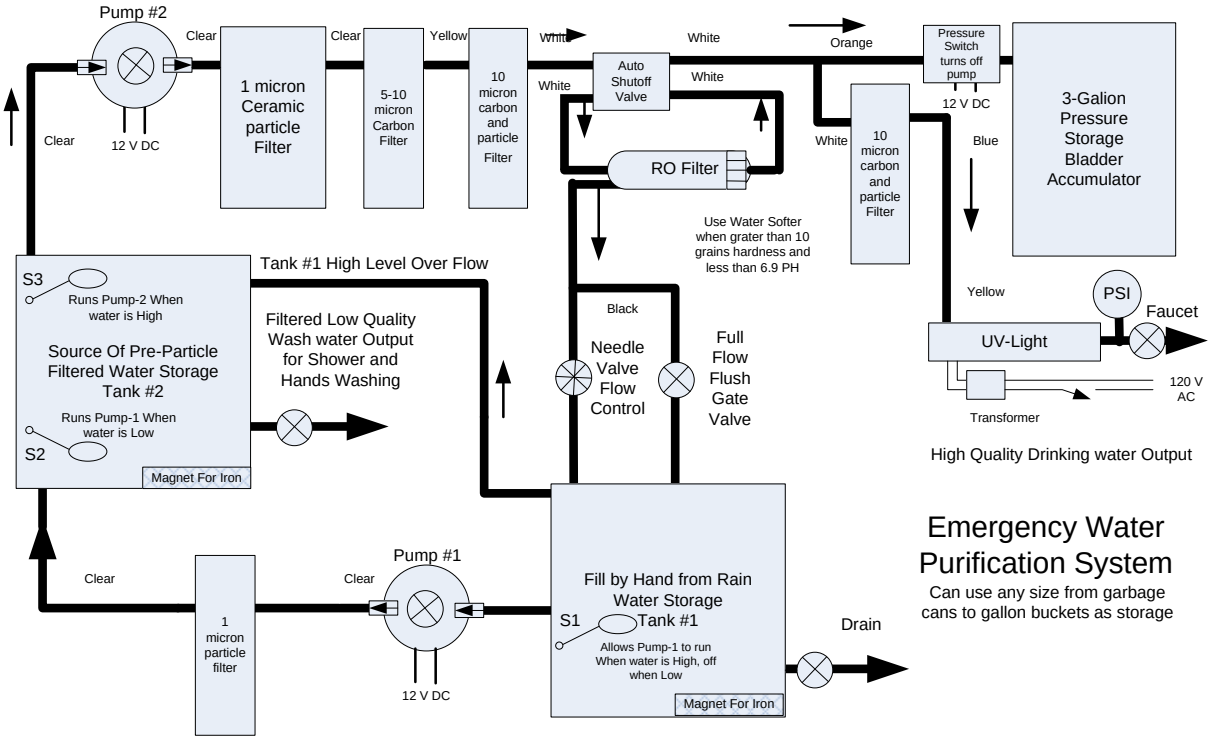

The pressure switch on the pump needs to be set higher than the pressure switch at the storage tank, so that it will turn off when the storage tank reaches a given high pressure. Adjust as high as possible for good water production and to minimize energy used.

If water hardness is over 10 grains and less than 6.9 PH then may need to use a water softener first. At the very lest do a full flow flush across the membrane more often. A 0-999 PPM total dissolved solids TDS meter can be purchased from eBay at low cost. A translation table from grains to PPM follows.

If you have enough or can afford the power needed use a distiller to purify your water as the Zeta's recommend. Power needed is about 3.8 Kilowatt-hrs for one gallon of water. This is about 10.5 amps running for 3 hours at 120 volts. This is easy to afford before the pole shift but how about after when one generates ones own power any way one can with very scarce fuel.

A RO unit designed as above at 100 GPD running on 12volts and 120v for uv is estimated to take about 15 min/gal of run time and use less than 30 watt-hrs/gallon of power. This is 100-200 times less power than distillation. Yes, it isn't quite as good or pure as distillation; however, for some it may be more sustainable over time. It is defiantly not 100 times worse than distilling.

Understanding Water Hardness
What does my water test mean?

- 0-60ppm/0-3.5gpg – Soft Water: Your water does not contain a lot of dissolved minerals. It is very rare for water to be this soft naturally – usually it happens when you have a whole-home water softener. You can use any detergent WITHOUT a water softener.

- 60-120ppm/3.5-7gpg – Moderate Water: Your water contains some dissolved minerals, but not enough to cause major problems. If your water is naturally soft, it is probably around this range. You can use mainstream detergents WITHOUT a water softener, and plant-based or free and clear detergents WITH a water softener. If you use a water softener, you should add it to your main wash only.

- 120-250ppm/7-14.5gpg – Hard Water: Your water contains a fair amount of dissolved minerals. This can cause problems over time if left untreated. Most of the USA has water around this range. Any detergent will benefit from a softener at this range, though with some mainstream detergents such as Tide Powder, a water softener is not needed until 180ppm * At around 180+ppm/10.5gpg you will need to add half the amount of water softener to your prewash cycle. *

- 250-500ppm/14.5-29gpg – Very Hard Water: Your water contains a lot of dissolved minerals. This will cause problems quickly if left untreated. You can use any detergent, but you may have better luck with mainstream powder detergents. You should add a water softener to your prewash AND main wash.

- 500+ppm/29+gpg – Extremely Hard Water: Your water is basically made of rocks. Plant-based and free and clear detergents will not work as well at this level of hardness; mainstream powder detergent will likely be most effective for you. Water at this level will require a softener in every load of laundry--including your prewash and main wash for diapers.

6-2-15

Water Hardness Scale		
Grains/Gallon	mg/L & ppm	Classification
Less than 1	Less than 17.1	Soft
1 to 3.5	17.1 to 60	Slightly hard
3.5 to 7.0	60 to 120	Moderately hard
7.0 to 10.5	120 to 180	Hard
10.5 and over	180 and over	Like a stone
Note - one grain per gallon = 17.1 parts per million (ppm)		

The rain water that I have tested is usually very soft, especially if not let sit or flow on the ground for very long. If captured close to where it rained then it doesn't get much chance to pick up dissolved solids. This will be a bit worse after the pole shift as the ash from volcanic activity will be leeched out of the atmosphere with the rain. However, it would be better starting with rain water than water from streams or rivers.