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03-13-07

To: **Yoshi Hoashi**

From: **Walt Pyle**

Re: **Nanopulser applied to sulfated batteries**

Hoashi-san,

We received the new 12 volt Nanopulser PG 12N battery de-sulfator yesterday. Thanks very much. We will install that Nanopulser permanently on H-Ion's string #1, battery #1, that was resurrected last week.

The #1 battery was in a 48 volt string of four 98 A-Hr 12 volt deep-cycle sealed marine cells. These batteries were about 6 months old, and purchased from West Marine. After a power failure to the battery float charger, and droop under the 5 ampere continuous load, to about 9 volts on each 12 volt battery, the string #1 batteries were recharged individually by our 12 volt maintenance [2 to 6 ampere] battery charger. Only two of the four 12 volt batteries in string #1 came back to life after charging [#2 and #3]. The other two [#1 and #4] would not charge; no current was measured into either 12 volt battery, while charging with the maintenance battery charger for several days.

Then, I tried a constant voltage power supply on battery #1 and raised the voltage to about 15 volts dc, with current limit set for protection. It would not charge, even with the higher applied voltage over several days.

After I installed the Nanopulser, the evening that it arrived, I put the maintenance charger back on battery #1 and went to bed. The next morning it was charging at 2 to 3 amperes! After about three days it was up to full charge and read 13.6 volts with the charger and Nanopulser removed. After sitting on the bench for about a week, with the Nanopulser and charger removed, Battery #1 read 12.6 volts.

Next, I set up the other bad 12 volt battery [#4] from string 1, by connecting it to the charger with the original Nanopulser PG 12N. At the start, the terminal voltage of the battery was 6.5 volts. After applying the Nanopulser and charger, the voltage was set to about 13 volts and a small current of about 0.5 amperes was measured [I left the current limit set to 1.5 amps]. Then I left battery #4 on charge for two days and then went back to check it. It was at 11.5 volts on the terminals and the current was up to 1.5 amperes. After another day, I checked again, and the current was still about 1.5 amps and voltage was 11.9. After two more days at 1.5 amps the voltage reached 12.3, and finally 12.6 after about two more days. This battery took longer than

the first one, and got warm to the touch, but eventually came back to full charge. The two batteries were re-installed in the string of 48 volts and put back on solar. The string read 55 volts today while "on sun". So, we are back in service with both batteries.

Regards....Walt Pyle H-Ion Solar Inc.

P.S. I just received two more Nanopulsers for a client with a big 48 volt battery bank and some vehicle batteries, one is 12 volts [for the vehicle batteries] and one is 48 volts [for the large solar electric energy storage system]. The big bank uses Yuasa Solar HUP 1 [I think they are 1200 A-Hrs in eight 12 volt steel cases, 4 in each series string, and two strings of 4 in parallel]. I will soon see if the 48 volt Nanopulser will be effective on such a big battery.

The Yuasa solar energy batteries have suffered some abuse after being overcharged in wind storms by a windmill source in parallel with the PVs, several times. This resulted in excessive gassing of the acid electrolyte in the Yuasa batteries, to a level below the tops of the plates, and some sulfation of the upper portion of the plates, which has in turn resulted in loss of storage capacity.