**SURFACE MODIFICATION NOTE 4**
Maintenance, Logistics, and Acquisition Division
W/OPS12: DAD

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| SUBJECT: | Modify Fischer and Porter Rebuild, Sutron Version (FPR-D) equipment, by installing a Solar Charge Regulator |
| PURPOSE: | Install a solar power regulator to prevent overcharging of the battery inside FPR-D equipped Fischer and Porter (F&P) gauges. |
| SITES AFFECTED: | All FPR-D rain gauge sites. Not all FPR-D sites will need this modification and wholesale implementation is not recommended or authorized. Only sites that experience abnormally short battery life due to overcharging should make this modification. See Appendix A, Section A.1 Guidance. |
| AUTHORIZATION: | The authority for this note is by National Weather Service Headquarters direction. |
| VERIFICATION STATEMENT: | This procedure was tested and verified at the Sterling Field Support Center, Sterling VA; NWSTC, Kansas City MO; and at two COOP sites managed by the Mobile, AL WFO. |
| ESTIMATED COMPLETION DATE: | As needed. |
| TIME REQUIRED: | Approximately 1.5 hour. |
| ACCOMPLISHED BY: | NWS Representative (NWSREP) for local COOP operations. |
| EQUIPMENT AFFECTED: | D111D-2A1 Sutron FPR-D logger |
| SPARES AFFECTED: | None. |
| PARTS/MATERIALS REQUIRED: | D900-1A1A2 Solar Regulator |
| | 017C-E-1825 push-on spade connectors, Female, crimp, or equiv. |
| | 017-B-2-32 12V 7Ah Battery, may be needed, a fully charged battery will definitely be needed |
| | Black & Red Electrical Tape or shrink tubing |
| SOURCE OF PARTS/MATERIALS: | Above ASN parts are available from NLSC |
| | Electrical tape is locally supplied. |
| DISPOSITION OF REMOVED PARTS/MATERIALS: | None. |
| TOOLS AND TEST EQUIPMENT REQUIRED: | Small Phillips, P2 Phillips, small flat blade screwdrivers, wire cutters/stripper, small needle nose pliers, crimp tool, volt/ohm meter |
| DOCUMENTS AFFECTED: | None |

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| PROCEDURE: | See Appendix A for installation and checkout instructions. |
| | See Appendix B for sample CSSA entries. |
| TECHNICAL ASSISTANCE: | For questions or problems pertaining to this note, contact Sterling Field Support Center at 703 661-1268 |
| REPORTING INSTRUCTIONS: | Report the completed modification using a CSSA site inspection report, and update the site metadata on the B-44 Station Information Report. Follow the reporting instructions in the Attachment B, for example forms and entries. |

Deirdre R. Jones
Director, Operations Division

Attachment A – Installation and Checkout Instructions for FPR-D Solar Regulator
Attachment B – Sample CSSA Report

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# ATTACHMENT A Installation and Checkout Instructions for FPR-D solar regulator

## A.1 Guidance

Field failure reports have indicated the 2 watt solar panel is capable of overcharging the 12V 7 AH battery of the FPR-D system in areas of bright sunshine during the summer months. This has been confirmed by testing at Sterling Field Support Center (SFSC). The FPR-D electronics draw very little power from the battery when everything is operating properly and during the summer months in areas of bright sunshine the battery is easily kept at full charge. When at full charge, the battery is no longer drawing power from the solar panels and the voltage output can rise to near open circuit voltage of the solar panel. Testing has shown this to be in excess of 17.6V. Voltage impressed on a 12V battery should never exceed 14.8V for any extended time as it will harm the battery chemistry.

The FPR-D batteries should last 5-8 years in normal life. If you have one that dies in 1-2 years and exhibits the following characteristics:
- the recorded battery voltage has been consistently 13+ volts, AND
- it suddenly drops to less than 11.8V and stays there.

Then the battery has lost a cell – a typical failure mode of overcharging. You can confirm cell loss by taking the battery back to your WFO and putting it on a charger (like the ones described in A.4.1, below) for 3 days. Follow the testing criteria in A.4.1 to see if the battery is good. You may also see white chalky deposits around the terminal seals or the battery vent, as overcharging will bubble electrolyte out the battery seals.

OR

- You measure voltage readings that exceed 15V on the battery during the middle of the day when the sun is brightest, then you know the battery will be overcharged. The battery voltage data collected within the FPR-D data are taken at midnight and are not valid for this test.

If you see either above scenario, then you should install a regulator at that site.

Do not confuse the above with battery charging problems where the battery is getting *insufficient* charge and slowly drops voltage to where the system shuts down, around 7 V. **Or** equip failures where a short, or a high load, drains the battery to shutdown; i.e. – leaving the FPR-D in the calibration menu will not allow the display to auto-shut-off and will drain the battery in just over a day. If the battery is being drained to where the system shuts down, then you must fix the charging or operating problem first, before you can determine (with time) whether you have an overcharge problem. If your solar panel is poorly located, does not get enough sun, has electrical problems, has poor connections, … etc, and will not provide enough power to charge the battery, then adding a regulator will not fix those problems.

## A.2 Preparation, at the WFO

### A.2.1 Regulator

Unpack and examine the D900-1A1A2 solar regulator received from NLSC.
Make sure you have a screwdriver suitable for the wire attachment screws on the regulator.
The green terminal blocks will detach from the regulator by grasping them and pulling straight out from the face of the regulator. This will make it easier to replace.

### A.2.2 Battery

Look at the data from your site. If the battery voltage was constantly below 11V, the battery probably needs replacing. It is not possible to troubleshoot electrical problems with a bad or



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discharged battery, so take a fresh, fully charged, replacement battery with you. The battery for this system is 017-B-2-32, available from NLSC. Unless the old battery voltage is above 12.2V, use the new battery for setup and troubleshooting and leave the new battery installed in the system. Be sure to charge the new battery BEFORE taking it out to the field.

You can not check battery quality in the field, bring the old battery back to the WFO to see if it is functional for other use or to discard. See section A.4.1 to check the old battery.

### A.2.3 Battery Terminals

If you are replacing the original battery that came with the FPR-D unit, you will need to modify the push-on spade connectors on the battery cable of the FPR-D unit. The original battery had small spade terminals, type F1; the replacement batteries will have larger, 0.25" wide spade terminals, type F2. Obtain from commercial sources push-on female crimp connectors like AMP 3-350820-2 which are insulated, or from NLSC ASN 017C-E-1825 which are not insulated. Be sure you take a crimp tool with you to the site.

Unless the wire jackets and polarity of power connection of the battery cable are already red (+) and black (-), you will need to mark the polarity of the new connectors once you crimp them in place. Take red and black electrical tape or shrink tubing with you. Mark the ground side with black electrical tape or tubing, and mark the positive (+) side wire with red electrical tape or tubing.

## A.3 Installation, at site

**CAUTION: Do NOT cut the solar panel wires ( Step 5 ) without following this procedure. If you forget and leave the battery connected you may create a flash fire, and injure or blind yourself, as well as damage the equipment and your tools.**

### A.3.1 Safety First !

1. Throw a dark cover over the solar panel to shut it down. A black plastic bag will not work as plastic is typically transparent to InfraRed Radiation (IR), and the solar panel will still generate voltage with IR. Use something solid like cardboard or an extra work jacket.
2. Disconnect *both* leads from the battery. Insulate them before you lay them down.
3. Using your volt/ohm meter set to volts; measure the voltage on the solar panel connections on the terminal block inside the FPR-D. If it is less than ~6V, it is safe to work with. It is very unlikely that you will get zero volts. Note which wire is positive (+), it should be the white wire.

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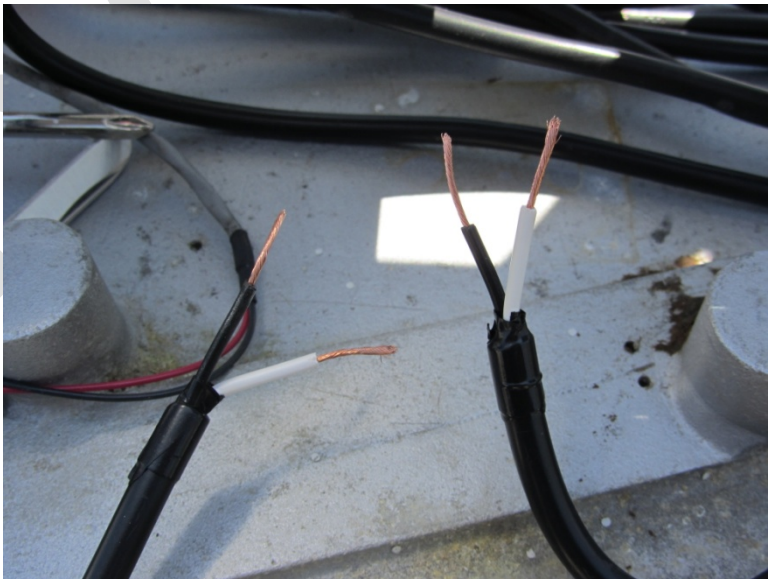
4. Disconnect the solar panel wires from the terminal block inside the enclosure. Insulate the positive (+) one. Do not withdraw the cable from the enclosure.

### A.3.2 Change the Wiring

5. Decide where inside the F&P you're going to place the regulator. See step 10 for logical choices. Then, (**you DID cover the solar panel didn't you?!!**) cut the solar panel wires leaving enough length to reach that location, typically 12 inches back from the data logger.

You may substitute other wire for this stub, but most FPR-D sites have excess solar panel wire, the enclosure cable clamp is already sized for this wire, and it's already in place in the logger. The picture of step 9 shows substituted wire.

6. Strip back the jacket and wire ends of both cut ends. Remove about 1.5 to 2 inches of the outer jacket, and then about ¾ of one inch from each of the black and white wires.



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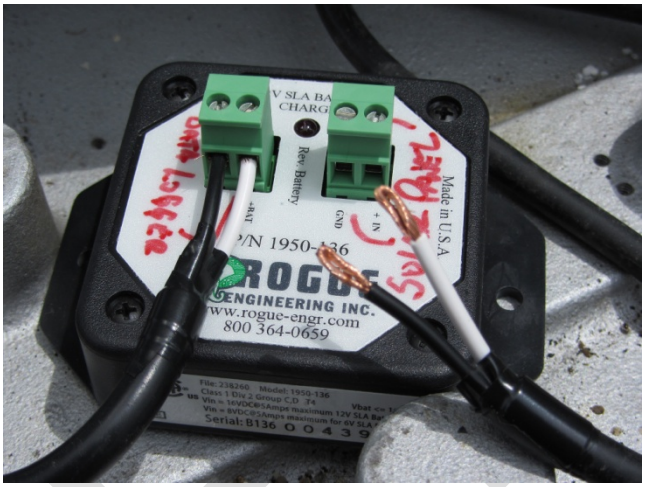
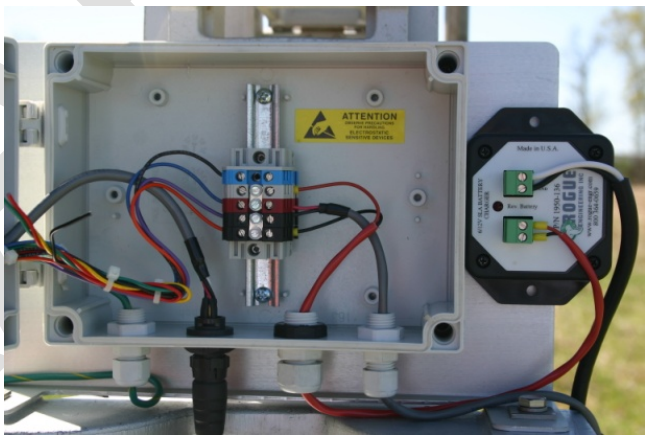
7. Connect the white wire going to the solar panel to the “+in” input and the black wire to the paired “GND” input on the regulator. With small needle nosed pliers, bend the copper wire over onto itself before inserting into the terminal blocks of the regulator. Make sure the screws are tight on the bare copper wire to ensure reliable connections.

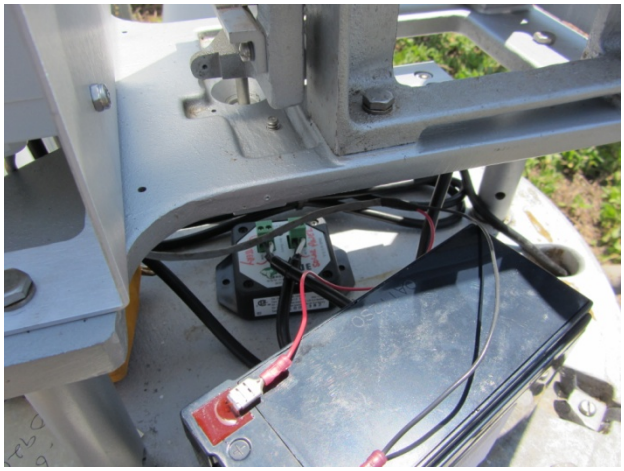



8. Connect the wire stub going into the logger to the battery side of the regulator, white wire to the “+BAT” input and the black wire to the paired “GND” input.

9. Reconnect the old solar panel wire (now regulator output) to the terminal block in the logger, white (+) wire to terminal 2 from top and black wire to terminal 5.




10. The regulator can be mounted to the backing plate of the FPR-D if you have a drill and screws (photo above) , or it fits nicely in the bottom of the gauge beside the battery.



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### A.3.3 Modify Battery Terminals on Battery Cable ( if necessary)

11. If you are replacing the original battery with one from NLSC, cut the small push-on terminals from the battery cable, strip about 3/8 of one inch and crimp on the larger push-on connectors. Mark the wire polarity as mentioned previously.

### A.3.4 Reconnect and Test

12. Reconnect the battery.
13. Uncover the panel.
14. See if everything works.

The voltage on the panel and the voltage on the battery can now be measured right on the regulator terminals. The panel side voltage should be higher than the battery side if the sun is out. If the battery is accepting charge, the voltage *difference* between panel side and battery side will typically be ~0.4V. If the battery is fully charged, this voltage difference could be many volts, but the battery side should never be higher than 14.8V. If the battery side reads higher than 15V, it is likely that the regulator has failed.

## A.4 Additional Information

### A.4.1 Checking the Old Battery

Place the old battery on a 2 or 3 stage charger designed for sealed lead acid batteries, like the D900-2A1 from NLSC or the Deltran Battery Tender Junior 12V@0.75A from commercial sources. Do not use an automotive charger, it will not fully charge the battery. Leave the battery on the charger until the charger indicates it is in “float” mode, indicating the battery is fully charged. This may take up to 3 days. Disconnect the charger and let the battery rest for overnight. Measure the resting voltage on or after the following day. If it is less than 12.2 volts, the battery is damaged and should be discarded. Batteries that test good can be set aside for use at the next site. The design life of these batteries is 5 to 7 years of use so plan accordingly. Be sure to charge any battery BEFORE taking it out to the field.

### A.4.2 Checking the Regulator.

It is not possible to check the regulator by simply hooking it up to a solar panel and looking at the output voltage. Even hooking a resistor to the output side will not provide a reliable test. The regulator must see a battery voltage to work properly and the output of the regulator will depend on the state of charge of the battery connected. If you see the conditions in A.3.4 above, except the last one, the regulator is working.

### A.4.3 Regulator Configuration

The D900-1A1A2 NLSC stock bin is a generic bin for solar regulators and so far two models have occupied it, an ASC model, and the Rogue model pictured in this Note. They both operate and connect as described by this note.

The ASC regulator is for 12V battery operation only and is not configurable.

The Rogue model is configurable for charging voltage, charging rate, and float operation. From the factory and from NLSC the Rogue regulator will be configured for 12V/full charge/with float



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operation. You do NOT need to open the regulator or change any jumpers to use this regulator with the FPR-D system if this regulator is new from NLSC. If you read the data sheet that comes with the Rogue model regulator you will see the other modes it can provide.

### A.4.4 Reverse Battery Indicator

If the battery is wired up with the positive and negative terminals reversed, the red Reverse Battery LED will light. The regulator is internally protected from damage from reverse wiring on both the solar panel and battery terminals, but must be wired correctly to charge the battery.

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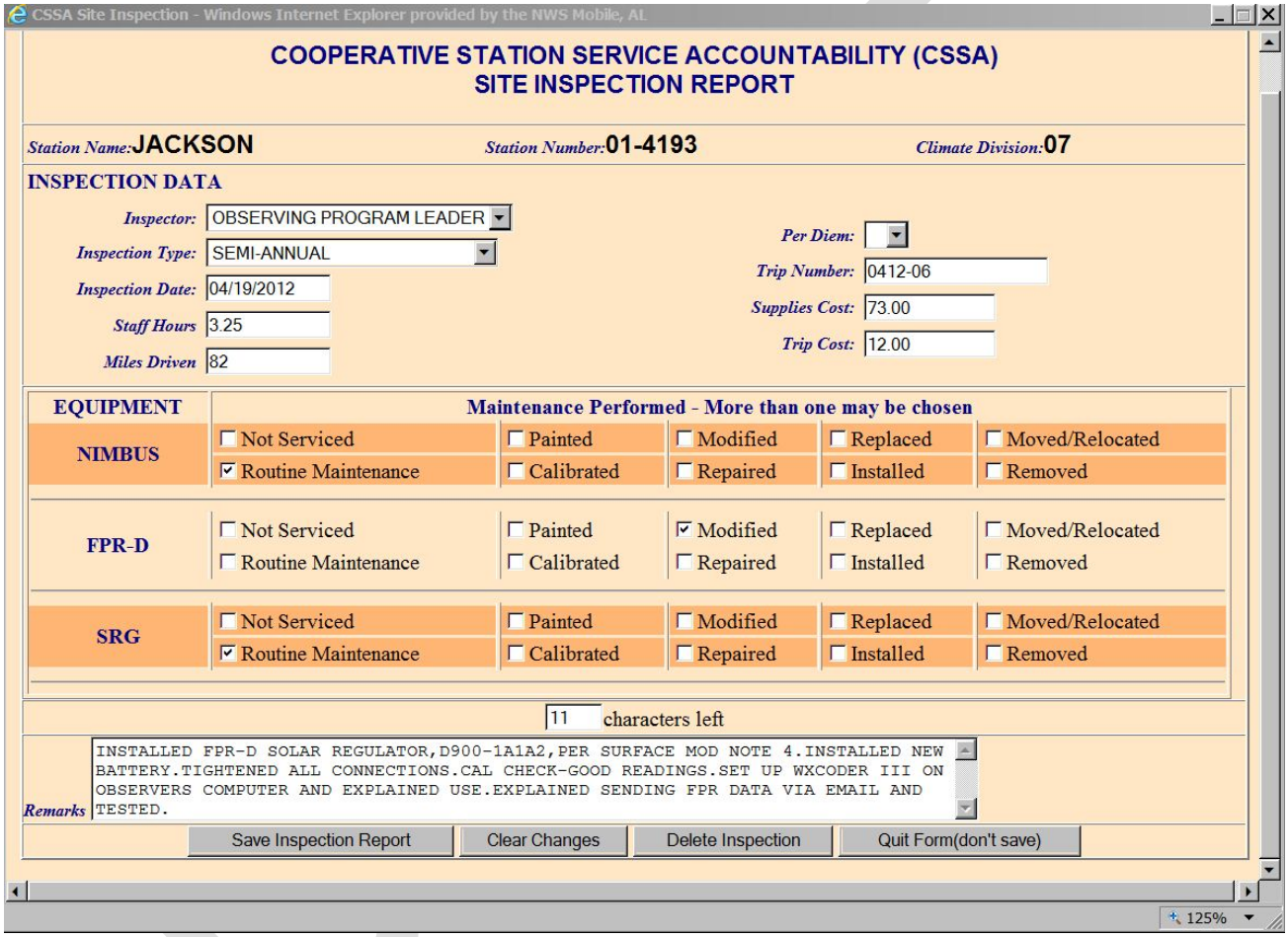
# ATTACHMENT B Sample CSSA Report

## *B.1* Metadata Requirements on FPR-D Solar Regulator Implementation:

### B.1.1 Create a CSSA Site Inspection Report:

When you have completed the FPR-D Solar Regulator installation and are back in the office, access your CSSA and call up the CSSA Station Name/CSSA Station Number to generate a new Site Inspection Report. Account for the total hours of work and total dollars of expense you incurred to install the Solar Regulator in the FPR-D system.




Be sure to complete all these fields to account for your FPR-D Solar Regulator installation work!

**Inspector:……..** select from pull-down menu as appropriate
**Inspection Type:……..** select from pull-down menu as appropriate
**Inspection Date:……** mm/dd/yyyy
**Staff Hours:……..** x
**Miles Driven:……..** xxx
**Per Diem:……..** select from pull-down menu as appropriate
**Trip Number:……** "your trip number"
**Supplies Cost:……** xx.xx
**Trip Cost:……..** xxx.xx

In the *Equipment* category FPR-D under *Maintenance Performed*, click “Modified.”
Then, in the bottom of the CSSA Site Inspection Report, in the free text field, enter:

**“Installed the FPR-D Solar Regulator, D900-1A1A2, per Surface Mod Note 4.“** and any other explanatory text necessary for the inspection.

### B.1.2 Update the B-44 for Solar Regulator modification to FPR-D Equipment:

Make the following changes in the Station Information Report (B44):

- *Equipment Description* enter text “**FPR-D with Solar Panel Regulator**”.

### B.1.3 Update the Remarks Section, B-44:

In the *Remarks* section enter: “**Updated FPR-D, installed Solar Panel Regulator, D900-1A1A2, per Surface Mod Note 4.”**

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