Engineering & Acquisition Branch
W/OPS11:DAD/KRH
fpuinstall4.wpd
July 17, 2002

SUBJECT: Fischer - Porter Upgrade Installation at Operational Readiness Evaluation Sites

Purpose. As part of the Cooperative Observer Product (COOP) Improvement Program, the National Weather Service (W/OS7) is replacing the tape punch mechanism in Fischer & Porter/Belfort precipitation gauges with digital data recording and reporting capabilities. The planned replacement, known collectively as the Fischer - Porter Upgrade (FPU), has met contract acceptance test criteria and is certified for operational readiness evaluation (ORE) at selected sites prior to full program implementation.

The FPU is a replacement recording system that senses, converts, and records precipitation data at 15 minute intervals; maintains a non-volatile record of the data sufficient to support monthly data retrieval; allows operator notations to indicate changes due to emptying the gauge or other maintenance; provide a non-volatile removable electronic memory transport module; displays the amount of captured precipitation in inches of water; and, supports shaft encoder and thermistor measurements.

This procedure is authorized by the Chief, Observing Systems Division (W/OS7) for the limited purpose of providing instructions for the installation of the FPU at the ORE sites listed in Attachment A. A later NWS installation or equipment modification note will incorporate lessons learned during ORE and be issued to support the installation of production FPU equipment.

FPU Installation Kit. NWS Headquarters (W/OPS11) will ship an FPU installation kit to each ORE site. All sites will receive three cartons containing:

1. Stainless steel enclosure housing an installed gauge modification assembly (GMA) and containing a packaged load cell assembly, data keys, assorted cables, mounting hardware, and the contractor's operating and technical manuals.

2. Battery

3. Solar panel with mounting hardware

Selected weather forecast offices (WFOs) will receive one or more of the following separately packaged items:

1. Extreme environment (EEV) enclosure.

2. Display/communications unit (DCOM)

3. Data key reader with a compact disk containing licensed key reader software.

Site Responsibilities. The installing NWS Representative (NWSREP) is responsible for ensuring that a two to three-inch diameter (inner diameter) pole is available within five feet of the gauge for mounting the GMA enclosure and the solar panel. This mounting pole must be galvanized to resist the effects of weather and sufficiently rigid to support at least 125 pounds without bending or twisting. Schedule 40 galvanized pipe is recommended, with thick walled hot-dip galvanized fencing poles as an acceptable alternate. Do not used the thin walled flash galvanized (shiny or bright finish) fence poles. The pole

should be sunk at least 2 feet into the earth in solid compactable dirt, deeper if in sandy or loose soil. Also deeper if required by local building codes. If not set wholly in concrete, it will require a footer for support. The footer may be concrete, a large stone, bricks, metal floor flange (6" dia recommended) screwed onto the end of a threaded pipe, or other large non-crushable permanent object that will distribute the load on the end of the pipe over about a 6 inch dia area in the bottom of the hole. The hole may be filled completely with concrete or backfilled with dirt to within a foot of the surface, tamped, and then filled with concrete. The concrete at the surface is required to resist the twisting and levering forces of wind on the large enclosure and solar panel.

The GMA mounting hardware supplied as part of the installation kit is designed for pole mounted GMA enclosures; sites using tower mounts must supply any additional required mounting hardware. And, although the solar panel normally will mount on the same pole as the GMA enclosure, it can be mounted separately up to 20 feet away. The supplied cable is direct burial cable.

Sites where the air temperature routinely goes lower than -4°F for more than a day are classified as cold weather sites and they will receive a EEv enclosure for burial of the battery. At -4°F, lead acid batteries freeze and will not take a charge. Cold weather sites evaluating EEV capabilities must install EEv enclosures in an environment that will not go below -4 degrees Fahrenheit. As -4°F is well below freezing and the earth is a good thermal heat source, the EEv enclosure does not need to be buried below the local frost depth. If historical soil temperature data is available for the nearby area, use it to determine a depth that will keep the enclosure above -4°F. In most areas of the continental US, 4 -6 inches below ground is sufficient. The NWSREP should make this determination, and note the depth and the source of the reference data in the ORE log for the site.

Installing NWSREPs must have the following tools and test equipment:

9/16" socket wrench	Laptop computer w/ modem and terminal emulation program and the Windows 95 or 98 operating system
3/32" Allen wrench	Calibration weight set (D111-TE500 or weights calibrated to 15 inches equivalent water)
Needlenose pliers w/ wire cutters	DB9F to DB9M serial communications cable (not null modem)
Wire terminal crimping tool	Multi meter (or voltmeter and ohmmeter)
½" open wrench	Standard RJ-11 telephone cable (DCOM sites)
Excavation equipment (EEv sites)	

Estimated Time Required. An estimated four hours, exclusive of travel time and pole installation, will be required to unpack FPU equipment, replace the tape punch mechanism, mount the GMA and solar panel, connect sensor cables, and setup/configure the modified precipitation gauge.

Effect on Other Instructions. Applicable contents of this engineering instruction and the FPU technical manual temporarily supersede the following content in EHB-10:

Section 1.2: Items 10-204, 10-206, 10-207, and 10-208.

Section 4.2: Revised Maintenance Schedule for Fischer & Porter Punched Tape Precipitation Gage, April 30, 1976

Instrumental equipment listings in Section D, Hydrologic Equipment, EHB-1, will be modified to reflect experience gained during the FPU operational readiness evaluation period.

Disposition of Replaced Items. Tape punch mechanisms, solar panels, and batteries replaced by the FPU will be retained by the supporting NWSREPs until the completion of ORE. Following ORE, the Chief, Observing Systems Division (W/OS7) will either authorize the return of replaced items to the National Reconditioning Center or direct their reinstallation.

Installation Procedure. Install, setup, and calibrate the FPU following the procedures contained in Attachment B.

Maintenance. Preventative and corrective maintenance procedures for the FPU are found in the Fischer-Porter Upgrade Technical Manual, section 5. For the duration of the ORE, all requests for spares or repair parts should be directed to the POC identified in the Technical Assistance section, below.

Technical Assistance. Installation information assistance should be requested from David Desrosiers, Engineering & Acquisition Branch (W/OPS11), at (301) 713-1845, x115, or E-mail david.desrosiers@noaa.gov.

Reporting. Production installation and modification reporting procedures will be formally delineated in the FPU Implementation Plan by the appropriate offices cognizant with program reporting requirements. ORE activities are expected to keep a running log of all expended efforts, activities, material, and corrections/comments for submission with the site ORE report.

(Signature)
(Title)

ATTACHMENTS:

A - ORE Installation Sites
B - FPU Installation Procedures
C - Extreme Environment Installation

ATTACHMENT A

ORE Installation Sites

SID	Site	State	WFO	Climate Continuity Site	Notes
CTEA2	Central No.2	AK	PAF	50-1466	1,2,3
TONA2	Tonsina	AK	PAF	50-9385	1,2,3
MLBF1	Melbourne	FL	MLB	08-5612	1,2
KAXH1	Kaumana	HI	HFO	51-3510	1,2
WMLH1	Waimanolo Nanokia	HI	HFO	51-9534	1,2
WTCM7	NWSTC	MO	EAX	23-4377	1,2
SWLM8	Swan Lake	MT	MSO	24-8087	1,2
GRFN8	Grand Forks Univ	ND	FGF	32-3621	1,2,3
FLCO3	Falls City	OR	PQR	35-2800	1,2
NUBP4	San Juan	PR	SJU	66-6992	1,2
NAST1	Nashville	TN	OHX	40-6407	1,2
FWDT2	Fort Worth	TX	FWD	41-3285	1,2
OGDU1	Ogden Pioneer	UT	SLC	42-6404	1,2
WKFV2	Wakefield WFO	VA	AKQ	44-8800	1,2
SOSW6	Southside 3NN	WV	RLX	46-8351	1,2

Notes:

1. WFO will receive key reader
2. DCOM site
3. EEV site

ATTACHMENT B

FPU Installation Procedures

GENERAL

Installation procedures do not require any special tools. Items needed for installation and checkout include these instructions, existing calibration weights, multi meter (or voltmeter), and common SAE standard size hand tools such as screwdrivers (Phillips and flat blade), open end wrenches, socket wrenches and Allen wrenches. A laptop computer with a terminal emulation program such as HyperTerminal or ProComm and a straight through DB9M to DB9F communications cable are needed to enter site specific information and communicate with the GMA and DCOM through the laptop port. If the system is equipped with the DCOM and a dedicated phone line is available at the site, a standard telephone cable with RJ-11 connectors on each end is required for telephone communications.

NWSREPs should verify that the precipitation gauges to be modified are sited in accordance with [INSERT REFERENCE HERE] NWS siting guidlines.

UNPACK AND INSPECT THE FPU INSTALLATION KIT

Unpack the shipping cartons, inspect items for visible damage, and use the packing list and the following check off list to verify that the kit is complete.

RECEIVING CHECK OFF LIST

Container	Content	√
Large cardboard box	Stainless steel GMA enclosure with the GMA installed	
	FPU technical manual	
	Small padded envelope containing the load cell block assembly	
	Large padded envelope containing the load cell plunger, load cell mounting hardware, two data keys, battery cable, and ZENO3200 Manual on CD	
	Load cell cable	
	Thermistor cable	
	Mounting hardware	
	Contractor’s Certificate of Conformance. (All sites)	
Flat cardboard box	Solar panel, solar panel cable, and mounting hardware. (All sites)	

Container	Content	√
Heavy, white box	Battery. (All sites)	
2 cuft box	EEV enclosure (selected sites)	
1 cuft box	DCOM, AC power cable, and omnidirectional antenna (selected sites)	
small cbd box	Data key reader, key reader software CD, and software license (selected sites)	

Report visible damage or incomplete kit contents to David Desrosiers W/OPS11, 301-713-1845 x115, or E-mail to David.Desrosiers@noaa.gov.

INSTALLATION PROCEDURES

NOTE: The following procedures supersede corresponding instructions in Sections 2 and 3 of the FPU Technical Manual.

1. Precipitation Gauge Preparation

Process and annotate any existing paper tape record prior to beginning this procedure.

1.1 Remove the Fischer & Porter (FP) gauge housings and bucket.

1.2 Empty and dry the bucket.

1.3 Disconnect and remove the battery. Package and retain the battery for short term storage at the supporting WFO.

1.4 Remove the solar panel and piping mount; clean out threads and threaded hole in base. Package and retain the solar panel for short term storage at the supporting WFO.

1.5 Remove internal wiring, clamps, and terminal strip(s).

1.6 Loosen the two 7/16" bolts holding the punch assembly.

1.7 Remove the small slotted screw, releasing the eyelet end of the wound cable from the front support arm assembly.

1.8 Replace the small slotted screw.

1.9 Unhook the tension spring from the front support arm assembly.

1.10 Remove the punch assembly; tighten the two 7/16" bolts loosened in step 5.

1.11 Raise the front support arm assembly with shipping bolt so that the dash pot piston is near the top of travel.

1.12 Unscrew the zero adjust knob.

1.13 Remove the two helical main springs, hook, and zero adjust knob.

1.14 Remove the two screws holding the pointer and remove the pointer. Replace the screws.

1.15 Remove the tape spool assembly; replace screws.

1.16 Remove the dash pot and piston. Do NOT replace screws.

1.17 Remove the gasket and clean oil off all surfaces.

1.18 Dispose of oil in accordance with local environmental regulations.

1.19 Check all flexures. Replace any that are bent, kinked, cracked, or broken.

[M WYATT WILL PROVIDE FLEXURE PROCEDURE TO BE INSERTED HERE]

IMPORTANT!
All flexures must be flat and in good condition and all flexure mounting screws must be tight to ensure proper operation with the Load cell.

1.20 Package removed tape punch mechanism components for short term storage at the supporting WFO

2. Install the Load Cell Assembly

NOTE: The load cell assembly is installed inside the FP gauge. All the equipment that interfaces to the FP gauge is mounted to existing threaded holes.

2.1 Unpack the GMA enclosure container.

2.2 Open the GMA enclosure; retrieve the small box within.

2.3 Find the padded envelope containing the load cell assembly.

CAUTION
Use care when handling the load cell assembly. Do not scratch the surface of the load cell. The ball must be present on the free end of the Load cell.

2.4 Find the envelope with four long 4-40 Allen head screws and washers. Place the washers on the screws with a lock washer sandwiched between the flat washer and the head of each screw.

2.5 Using a short individual Allen wrench and the long screws, install the load cell assembly where the dash pot was mounted. Finger tighten. The ball should be visible through the hole.

> **NOTE: The printed circuit board on the load cell assembly should face the door of the gauge.**

2.6 Apply anti-seize compound to the threads and install the plunger in the dash pot piston hole on the bottom of the front support arm assembly. Finger tighten. Do NOT use a wrench..

2.7 Ensure that the plunger is centered in the hole, then lower the shipping bolt until the plunger is near the ball. If adjustment is necessary, loosen the four scale support mounting bolts; re-tighten after adjustment.

Leave the front support arm supported on the shipping bolt until requested to lower it onto the ball in the Load Cell Calibration Procedure (Step 6, Procedure 7).

2.8 Find the load cell cable.

2.9 Feed the white plastic connector through the threaded inlet in the base of the gauge; plug it into the load cell connector. It is keyed and only fits easily when inserted the correct way. The retaining clip should snap when fully seated.

2.10 Separate the strain relief into its two parts; screw the coupler into the threaded inlet in the gauge base until fully seated.

2.11 Adjust the cable to leave a little slack inside the gauge; screw the spring part of the strain relief onto the coupler until the cable is captured (about fully seated).

3. Mount the GMA Enclosure and Solar Panel

3.1 Position the GMA enclosure facing north. The GMA enclosure may be pole-mounted using the supplied mounting hardware or on a tower using site-furnished mounting hardware.

> **NOTE: The GMA enclosure and solar panel must be installed at least <12" below orifice of the FP gauge when within 10 feet of the gauge. They also shall not be mounted in such a way as to form a wind fence that shields the FP gauge or allows snow to collect and shield or form a bridge to the gauge.**

3.2 Using a 9/16" socket, attach the pole hook bracket to the pole using one of the U-bolts. The U-bolts are sized for a 3" diameter pole. Use spacers as required if pole is less than 3" diameter.

3.3 Hang the GMA enclosure from the pole hook.

3.4 Secure the bottom of the GMA enclosure to the pole using the remaining U-bolt. Torque to hand tight, do not over tighten to the point where enclosure sheet metal begins to deform.

3.5 Mount the solar panel on the pole using the solar panel manufacturer's supplied pole mounting hardware. Make sure that the solar panel faces south and is not shaded by trees or other obstructions. (Cabling and connection instructions start in Step 14.)

NOTE: Always disconnect the solar panel before disconnecting the battery and always connect the solar panel AFTER connecting the battery.

3.6 Following the instructions provided with the solar panel mounting hardware, adjust the Solar Panel angle as appropriate for the site. See box below for guidance.

NOTE: Indicator holes are provided on the mounting hardware for 30, 45, and 60 degrees. Optimum mounting angle of the solar panel is dependent on the latitude of the location of the solar panel. Tilt angle is the amount of angle away from solar panel facing directly up. A rule of thumb for calculating the tilt angle is shown below.

Solar Panel Latitude	Panel Tilt Angle
0 - 4 degrees	10 degrees
5 - 20 degrees	latitude +10
21 - 46 degrees	latitude +11

3.7 Remove dust cap and connect the thermistor cable to the thermistor and underside of the GMA enclosure.

3.8 Connect the shaft encoder cable to the shaft encoder and to the underside of the GMA enclosure. Cut off the old connector and mount the new one.

3.9 At DCOM sites ONLY, attach the antenna to the underside of the GMA enclosure onto the **reverse thread** female SMA bulkhead connector. Finger tighten ONLY!

CAUTION: The battery weighs 57 lbs. Use a dolly to move it around and use two people to lift it into the enclosure.

3.10 Remove the 12V battery from its packaging. Remove terminal covers. Using a ½" wrench, attach the internal battery cable to the battery terminals:

red wire	to	red (+) terminal
black wire	to	black (-) terminal

Replace terminal covers.

3.11 Open the GMA enclosure.

3.12 Place the battery in the GMA enclosure to the left of the GMA with the terminal side close to the GMA.

3.13 Connect the internal battery cable to the GMA interface board. There is only one connector that fits this cable. It is keyed and latches.

The GMA will start up when power is applied.

3.14 Find the solar panel connecting cable. It has a small plastic box on one end.

3.15 Cut the cable that comes with the solar panel to desired length and strip the ends. Insert end into solar panel cable plastic connector box.

3.16 Crimp the supplied bullet connectors onto stripped cable ends.

3.17 Connect connectors with the solar panel cable connectors inside the solar panel cable connector box as shown below.

Solar Panel		GMA
Black/white stripe	to	White
Black	to	Black

3.18 Using tie wraps, strain relief the solar panel cable on the inside and outside of the solar panel cable connector box. Dab RTV on cable holes, trim tie wraps, and close the box. Secure the box up under the solar panel to keep it out of direct weather.

3.19 Connect to solar panel input (near front of box). Dress and secure wiring with tie wraps.

At this point the load cell assembly is installed, the plunger piece is aligned over the load cell, all cables are connected and the system is powered on. The following display should be illuminated and the GMA should now automatically start recording measurements and logging data

```
Date Time
Rain:       X.XX in
Temp:       x.x  °F
Shaft:      xx.x ft
```

3.20 Standard (non-EEv) sites are ready to start entering site specific information into the system, starting with Set Time and Date (Procedure 4). **EEV sites must now modify the GMA and install the EEv enclosure (jump to Attachment C) before executing Procedure 4.**

4. Set Time and Date

At the keypad on the GMA verify that the data display is active or press **<enter>** to wake up the GMA.

Wait for the data display to appear.

4.1 Access the user menu by pressing the Up and Down arrow keys.

There are three user menus:

1) Sensor Notation
2) Current Time and Date
3) Current Units

Repeated pressing of the Up or Down arrow key will cycle through the three menus and back to the data display.

4.2 Press the **Up** arrow key until the current date and time screen is displayed.

```
Current Date & Time
02/06/18    15:06:26
New Date & Time
```

4.3 Enter a new date and time using the format yy/mm/dd and hh/mm/ss. (Spacing, slashes, and colons are entered for you by Zenosoft.)

4.4 Press <**enter**> when done. Verify that the updated date/time are shown on the data display screen. Otherwise, go back and re-enter the date/time.

5. Set Up the GMA

The simplest and most direct way is to set up the GMA is via the laptop port. This requires a computer with a terminal emulation program such as ProComm or HyperTerminal and a straight through DB9M to DB9F cable.

5.1 Connect the serial cable to the DB9F on the GMA and connect the other end to the computer's serial port.

5.2 Set up the terminal emulation program using the following settings:

```
Baud rate 9600
Start bits 1
Stop bits 1
Data bits 8
Handshaking (flow control) none
Parity none
```

NOTE: Hyper Terminal can be accessed and set up as follows:

- From the active Windows screen, press **Start**, **Programs**, **Accessories**, **Communications**, and **Hyper Terminal**
- At the prompt enter a name for the connection and select an icon. Press **OK**
- At the **Connect To** prompt select **COM1** and press **OK**
- Enter the following port settings: 9600 bits per second, 8 data bits, no parity, 1 stop bit, and no flow control. Press **OK**

The Hyper Terminal screen will appear and you will be connected to COM1.

5.3 After connecting, type **u<enter>** to wake up the data logger and enter the Zeno user menu shown below.

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
(S) Sample Period Menu           (Q) Quit
(D) Data Retrieval Menu          (H) Help
```

All communications with the Zeno data logger inside the GMA is directed via menus activated by letter commands. The user menu is the starting point, all other menus can be reached by selecting one of the offered choices in the current menu. For example, to check the firmware version number, you start at the user menu, go to the functions menu and select the version command as shown in the next step.

5.4 Type **f<enter>** for the system functions menu. Type **v<enter>** to view software version. The correct firmware version number, date and time is V1.966-2637-GMA-1.3 MAY 9 2002.

5.5 Type **u<enter>** to return to the user menu.

6. Load GMA Site Identification

6.1 Access the GMA User menu via the laptop computer (as in the previous procedure).

6.2 At the user menu, type **f<enter>** to access system functions menu.

6.3 Type **c1/1234<enter>** where "1234" is the two digit numeric state number **followed by 2 zeros**. This uses the "Change Item #X to something else" command of the system function menu, to change Item #1.

6.4 Type **c2/5678<enter>** where again "5678" is the four character numeric SID.

6.5 Type **e<enter>** to save site information in non-volatile memory.

6.6 Type **q<enter>** to exit.

7. Calibrate the Load cell

The load cell is calibrated via the Zenosoft user menus which are accessed via the laptop computer as explained in Procedure 5.

> **NOTE: Check the flexures before starting the calibration procedure.** Verify that you have not inadvertently bent a flexure reassembling the gauge, or dropping a weight.

7.1 From the user menu, at the **'>'** prompt, type **t<enter>**. The unit will request a PASSWORD > type **zeno<enter>**. "Zeno" is the default password. Please do not change the password during the ORE. Entering the password will display a test menu similar to the one shown below:

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data     (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data  (P) SDI-12 Pass-Through Mode
(Cx) Calibrate Sensor Record x          (U) User Menu
(Vx) View Process Record x              (Q) Quit
(D) View Data Collection Counters       (H) Help
(B) Display BIT Status
```

7.2 At the **'>'** prompt, type **c1<enter>**. This is a request to calibrate sensor number one. This will display the sensor name, the current 'A' conversion coefficient, and a prompt to enter a new 'A' conversion coefficient.

Set initial gain to 1,000:

7.3 At the prompt to enter a new 'A' conversion coefficient, enter **0** (zero) **<enter>**.

```
Sensor Name: RainWeight
Conversion Coefficient A: 0
Enter new Conversion Coefficient A: 0
```

7.4 Similarly, the screen will display with the current 'B' coefficient and prompt for a new value. For this value type **1000<enter>**:

```
Conversion Coefficient B: 1256.6
Enter new Conversion Coefficient B: 1000
```

7.5 Finally, the screen will show the current 'C' coefficient and prompt for a new value. For this value type **0<enter>**:

```
Conversion Coefficient C: -4.92398.
Enter new Conversion Coefficient C: 0
```

After entering the new 'C' coefficient value, the screen will return to the test menu.

To calculate actual gain:

7.6 Start with an empty bucket. Lower the shipping bolt so that there is a visible gap (~ 1/4 inch) between the end of the bolt and the front support. Verify that the plunger is touching the load cell ball bearing and that the weight of the empty bucket assembly is on the load cell.

NOTE: The load cell is very sensitive. Use care to not bump the gauge during the following steps. If it is windy, replace the upper gauge cover during the following measurements. If it is very windy use the upper gauge cover with the funnel.

7.7 At the test menu prompt type **s1,1<enter>**. This will result in the output of sensor measurements for the first sensor (precipitation weighing sensor) every second:

7.8 The displayed value should change every six seconds (six readings) or so. Allow this to run for at least 30 seconds for the readings to stabilize. Then, as the numbers scroll by, record 10 different values and average them. Label the averaged value, B1, for use later.

7.9 When done, press **<enter>** on the laptop to halt the update. The test menu will return

7.10 Place exactly 15 inches of equivalent weight in the bucket. If using the F&P calibration weight set (D111-TE500), add the three large weights to the bucket. Be careful not to drop the weights. You will not damage the load cell, but you may bend the flexures.

7.11 At the test menu prompt type **s1,1<enter>**. Allow time for the readings to stabilize, then as the readings scroll by, record 10 different values and average them. Label the averaged value, B2, for later use.

7.12 When done, press <enter> to halt the update. The test menu will return.

7.13 Calculate new gain coefficient B with B = 15000/(B2-B1).
[This equation represents: (15" x gain) / (full weight - empty weight)]
Type **c1** at the prompt to enter the new gain coefficient B. Leave A and C at zero by pressing **<enter>** at both prompts. Enter the calculated B value for coefficient B.

The test menu will return.

To determine offset:

7.14 Adjust the precipitation gauge so that the weight of the empty bucket assembly is on the load cell.

7.15 At the test menu prompt type **'s1,1' followed by enter**. Record 10 different values and average them. Label this value as C3.

7.16 When done, press **<enter>** to halt the update. The test menu will return.

7.17 Calculate new coefficient C with C = -C3.
Type **c1** at the prompt to enter new calibration. Enter C value for coefficient C. Leave A and B as is by pressing <**enter**> for each.

The test menu will return.

Verify correct calibration:

7.18 With the plunger touching the load cell ball bearing and the weight of the bucket assembly on the load cell, place the equivalent weight of 15 inches of precipitation into the weighing bucket. (Add the three large weights of D111-TE500.)

7.19 At the test menu prompt type **'s1,1' and <enter>**. Verify that these values are 15.0 ± 0.1 inches. Press <**enter**> when done to stop the scrolling data and return to the test menu. If not within the above range, redo the calibration from step 7.3

Save the load cell calibration coefficients to memory:

7.20 While still at the test menu, type **u<enter>** for the user menu and then type **c<enter>** to enter the communications menu.

```
COMMUNICATIONS MENU
(Cn/m) Change Item n To Value m      (R) Repeater Menu
(M) Modem Menu                       (Tn) Terminal Mode On COM Port n
(P) Power Control Menu               (E) Save Parameters To EEPROM
(G) GOES Menu                        (U) User Menu
(A) ARGOS Menu                       (Q) Quit
(D) Digital Control Menu             (H) Help
Item 1: 9600 (COM1 Baud Rate)
Item 2: RS232 (COM1 Port Type).
Item 3: 8 (COM1 Data Bits Per Character)
Item 4: 1 (COM1 Start Bits)
Item 5: 1 (COM1 Stop Bits)
Item 6: NONE (COM1 Parity)
Item 7: 9600 (COM2 Baud Rate)
Item 8: RS232 (COM2 Port Type)
Item 9: 8 (COM2 Data Bits Per Character)
Item 10: 1 (COM2 Start Bits)
Item 11: 1 (COM2 Stop Bits)
Item 12: NONE (COM2 Parity)
Item 13: 9600 (COM3 Baud Rate)
Item 14: RS232 (COM3 Port Type)
Item 15: 8 (COM3 Data Bits Per Character)
Item 16: 1 (COM3 Start Bits)
Item 17: 1 (COM3 Stop Bits)
Item 18: NONE (COM3 Parity)
Item 19: COM1,COM2 (COM Ports to Exclude from User Interface)
Item 20: NO (Enable Exclusive CCSAIL Access)
```

7.21 Type **e<enter>** to save calibration values to EEPROM. The display should appear as below and then return to the communications menu.

```
Verifying parameters can be stored in EEPROM . . .
Saving parameters to EEPROM . . .
Saving sensor lists to EEPROM . . .
Saving process lists to EEPROM . . .
Saving data output lists to EEPROM . . .
Saving repeater lists to EEPROM . . .
Saving general serial scripts to EEPROM . . .
Saving constants to EEPROM . . .
1057 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 17, EEPROM Checksum = 200.
```

7.22 Type **q<enter>** to quit the Zenosoft menus.

The load cell calibration procedure is complete.

8. Enter Shaft Encoder Calibration Coefficients into ZENO GMA

This procedure describes how to enter known shaft encoder calibration coefficients into the GMA. Calibration coefficients for shaft encoder are pulse count to unit measure (one foot) and stream height initial value. Values for shaft encoder gain and offset are determined by NWS shaft encoder configuration.

8.1 Access the GMA user menu via the laptop.

8.2 Once at the user menu, type **z<enter>** to access Zeno program menu.

8.3 Enter the Administrator's password **ZENO** and **<enter>**.

> **NOTE: This action shuts down all GMA data collection.**

8.4 Type **p<enter>** to access the process menu.

8.5 Type **j5<space>c6/gain<enter>**, where gain is the shaft encoder to feet conversion factor.

> **NOTE: For NWS installations using the Handar 436A with a one-foot circumference wheel, enter "0.01" to set each pulse to 1/100 of a foot.**

8.6 Type **j5<space>c7/number<enter>**, where the number is a real number representing the current stream level in feet. This sets the shaft encoder stream height offset.

8.7 Once calibration is complete, type **z<enter>** to exit the process menu.

8.8 Type **e<enter>** to save calibration values. Wait for the save to finish.

8.9 Type **q<enter>** to exit the Zenosoft menus.

9. GMA Functional Checkout

9.1 Type **x** or **<enter>** on the GMA keypad to light up the display.

9.2 Place a reference weight into precipitation bucket. A single large weight represents five inches of precipitation; the RAIN value on the display should show the increase.

9.3 Verify that display is updating with new measurement data every ten seconds.

NOTE: If the GMA was only recently powered up, there may be no data available as indicated by dashes ("- - -"). Data will be available at the quarter of the hour of the GMA system clock.

Verify Data Key Operation:

9.4 With the display active, insert a data key into the data key receptacle.

9.5 Turn the data key one-quarter turn clockwise.

9.6 Watch the GMA display for verification of key insert.

9.7 Watch the GMA display for verification of key download.

9.8 Watch the GMA display for notice of key download completion and request for removal.

9.9 Remove the data key.

9.10 Verify display message return to data display.

Verify Data Logging:

9.11 Access the GMA user menu. See Steps 1 - 5, Procedure 7.

9.12 Type **d<enter>** to access ZENO data retrieval menu

9.13 Type ***<enter>** to display all ZENO data records. Look for breaks in the time stamp of data records. Breaks will indicate data not taken.

9.14 Insert the data key into data key reader. View data key data records with data key reader software. Compare data key data records with terminal program data records in previous step. Verify they are the same.

9.15 Type **q<enter>** to exit user menu.

Verify Date/Time:

9.16 Set time and date via the keypad. See Procedure 4.

Verify Sensor Notation Operation:

9.17 Enter the sensor notations by pressing **Up** and **Down** arrows on the keypad to reach the menu.

9.18 Push 789 on keypad. "789" should display. Now press **<enter>**. This should generate an error.

9.19 Push 456 on keypad. "456" should display. Now press **<enter>**. This should generate an error.

9.20 Push 123 on keypad. "123" should display. Now press **<enter>**. This should generate a message that says "Sensor notation accepted".

Verify Display Units:

9.21 Enter the display units menu by pressing **Up** and **Down** arrows on the keypad to reach the menu.

9.22 Press **x** on the keypad. Display should prompt for change in Rain Units.

9.23 Press **2** on the keypad. Units should be changed to mm.

9.24 Press **<enter>** to pass through various units change menus. Display should show.

```
Current Units:
Rain: mm
Temp: ˚C
Shaft: Feet
```

Functional check out is complete.

10. Install the DCOM

The DCOM is comprised of the ZENO DCOM, AC power cord, and DCOM antenna. The DCOM is used only with a GMA that is radio equipped. This procedure assumes that the GMA is installed and powered up.

10.1 Place the DCOM in an indoor or sheltered location with line of sight visibility through a window or other opening) to the GMA antenna. At the max range of 500 yards, line of sight will be necessary. At shorter distances, the link may work through a wall or two, but do not expect it to work if the unit is over the hill (below the near horizon), behind the barn or with any large metal

objects between them.

10.2 Connect the antenna to the back of the DCOM. The antenna is a reverse thread SMA connection. **Finger tighten only!**

10.3 If a telephone line is **available** for NWS use (there are no program funds for new phone services), connect a phone cable to a phone jack and the back of the DCOM. The internal modem is configured to answer incoming rings – do not leave the unit connected to the observer's phone line.

10.4 Attach the AC power cord to the DCOM AC power receptacle.

10.5 Plug the AC power cord into an 110V AC outlet. The DCOM display will be illuminated, showing a splash screen, when the AC power cord is plugged into an AC outlet.

The DCOM is now waiting to receive radio transmissions from the GMA. When received, the DCOM will begin logging and displaying them. Until transmission is received from the GMA, data will appear as **"-------"**. The DCOM's data is accessible by: (1) outside phone dial-up, (2) user initiated (button) dial-out, (3) the display, and (4) the maintenance port.

10.6 Enter the site specific parameters following the setup procedures in Procedure 11.

10.7 Perform the DCOM functional test following Procedure 12.

11. DCOM SETUP

Set up the DCOM via the laptop port. This requires a computer with a terminal emulation program such as ProComm or Hyper Terminal and a straight through DB9M to DB9F cable.

11.1 Connect the serial cable to the DB9F on the DCOM and connect the other end to the computers serial port.

11.2 Set up the terminal emulation program using the following settings (the same as the GMA settings):

```
Baud rate: 9600
Start bits: 1
Stop bits: 1
Data bits: 8
Flow control: none
Parity: none
```

11.3 After connecting, type **u<enter>** to enter the user menu. The ZENO will display the menu:

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
```

```
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

Check Software Version:

11.4 Type **f<enter>** to enter the system functions menu. The ZENO will display the menu:

```
SYSTEM FUNCTIONS MENU
(Cn/m)Change Item n To Value m          (I) Contact Information
(S)   System Date And Time              (E) Save Parameters To EEPROM
(T)   Calibrate Internal Temperature    (U) User Menu
(V)   Program Version                   (Q) Quit
(K)   Constants Menu                    (H) Help
(B)   BIT Names Menu

Item  1:  4          (Primary Unit/Experiment ID)
Item  2:  4          (Secondary Unit/Experiment ID)
Item  3:  2          (Data Dump Format)
Item  4:  1          (Real Time Output Format)
Item  5:  0          (Add Compass To Vane)
Item  6:  0          (Compass Offset)
Item  7:  0          (Barometer Elevation)
Item  8:             (Bad Sensor Value Replace)
Item  9:  TTL        (Display COM Port)
Item 10:  NO         (Display On Permanently)
Item 11:  5          (Display On Time)
Item 12:  NO         (Download Records In Ascending Order)
```

11.5 Type **v<enter>** to view the program version. The correct firmware version number is V1.966. The word “DCOM” indicates that you are communicating with the DCOM. The Zeno will respond with a line mostly identical to:

```
ZENO-3200 (DCOM) using ZENOSOFT V1.966-2637-DCOM-1.3 May  9 2002
14:01:01 CS 7469 (C)opyright 1995-2002, Coastal Environmental Systems,
Seattle, WA, USA.
```

Set Date and Time:

11.6 While still in the system function menu, type **s<enter>** to set the system date and time. The ZENO will respond with:

```
Current Date and Time:   02/06/21 14:38:09
Enter new Date and Time:
```

11.7 Pressing **<enter>** will keep the current values. To change any of the values, enter them all including the slashes and colons in the format: YY/MM/DD[space]HH:MM:SS. Set the DCOM time as close as possible to the GMA time. (The DCOM time will be used to time stamp all data

collected to and sent from DCOM memory.)

Set Site ID:

11.8 While still in the system function menu, type **c1/1234<enter>** where "1234" is the two digit numeric state number **followed by 2 zeros**. Set the same as the GMA ID.

11.9 While still in the system function menu, type **c2/5678<enter>** where "5678" is the four character numeric SID. Set the same as the GMA SID.

Set CallOut Phone Number:

11.10 Type **u<enter>** to return to the user menu.

11.11 Type **c<enter>** to go to the communications menu.

11.12 Type **m<enter>** to go to the modem menu.

11.13 Type **c5/AreaCodePhoneNumber<enter>**, where AreaCodePhoneNumber is the phone number you wish the DCOM to call when the button on the front is pushed. Spaces are not allowed, but commas or dashes may be used to separate the numbers, e.g. 1,301,713-1845. The DCOM will expect to connect to a modem to download the number of data records indicated under the system function menu, item #13. The default is 1 data record (1 quarter hour reading).

Save SetUp Info:

11.14 While still in the communications menu, type **e<enter>** to save the setup information in non-volatile memory.

11.15 After the save is finished, type **q<enter>** to quit the user interface and exit.

12. DCOM Functional Checkout

Verify Display Update:

12.1 Verify that display is updating on the quarter of the hour. This demonstrates that the DCOM is receiving radio transmissions from the GMA. Time/Date will update every 10 seconds, data display will update every 15 minutes. Until the first data transmission is received, the display will show dashes.

Verify Modem Operation (applicable only if a telephone line is available, if the telephone cable has been installed (if Step 3 Procedure 10 was completed), and if there is a computer/modem at the programmed phone number that is ready to answer the callout):

12.2 Press the **SEND DATA** button.

12.3 Verify Display message **`Dialing out`**.

12.4 Verify Display message **`Sending Data`**.

12.5 Verify Display message **`Download Complete`**.

12.6 Verify Display message returns to DCOM Data display.

12.7 Verify DCOM display of GMA data.

Verify Maintenance Port and Pass Thru Operation:

12.8 Plug in a serial extension cable (male dsub-9 to female dsub-9 cable with all signals through) into the DCOM front panel dsub9 connector. Plug the other end of serial cable into a computer (may be a desktop PC, laptop PC, or PDA.

12.9 Power on the computer. Start operation of terminal program. Set communication parameters to 9600 BAUD, 8 data bits, 1 start bit, 1 stop bit, no parity, no flow control.

12.10 On the computer, enter **u<enter>**. Verify access into ZENO user menu. You are now connected to the DCOM's internal ZENO-3200 CPU. All ZENO functions are now accessible.

12.11 On the computer, enter **c<enter>**. Verify that you are in the communications menu.

12.12 On the computer, enter **t1<enter>**. The sets the DCOM Zeno to pass thru mode to the DCOM radio, which is predefined to be on Port 1.

12.13 The DCOM ZENO will request the following port info, your responses are in bold:

```
Enter Port Type (RS232H, RS232, RADIO OR TW-RADIO):  rs232
Enter Device Baud Rate: 9600
Enter Device Parity (N,E,O): n
Enter Device Number of Data Bits (7 or 8): 8
Waiting for COM port 1.  Press any key to exit...
*** Entering Terminal Mode on COM Port 1 ***
Press <ESC> on this terminal to exit.
NOTE: Data collection has been halted.
```

12.14 If you get the last two messages above, you are connected to the remote (GMA) ZENO. The last line reminds you that data collection in the local ZENO (the DCOM) is not active and any GMA data broadcast sent out at this time will not be received or logged in the DCOM. Type **u<enter>** to enter the user interface in the remote ZENO:

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
```

```
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

12.15 While in passthru mode, if there is not a continuous exchange of information to keep the link open, the GMA (remote) Zeno will time out the user interface in about 5 seconds and warn you with the following message:

```
> WARNING: Loss of Carrier Detect Signal. Exiting user interface!
```

This will drop you out of the GMA user interface, but not the link. Pressing <escape> will terminate the link and return you to the communication menu in the DCOM. Typing **u<enter>** will return you to the user menu of the GMA.

12.16 Type **u<enter>** to access the ZENO-GMA user menu.

```
USER MENU
(C) Communications Menu             (T) Test Menu
(F) System Functions Menu           (Z) Zeno Program Menu
(S) Sample Period Menu              (Q) Quit
(D) Data Retrieval Menu             (H) Help
```

NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number.

12.17 Type **f<enter>** to access the system functions menu.

```
SYSTEM FUNCTIONS MENU
(Cn/m) Change Item n To Value m         (I) Contact Information
(S)    System Date And Time             (E) Save Parameters To EEPROM
(T)    Calibrate Internal Temperature   (U) User Menu
(V)    Program Version                  (Q) Quit
(K)    Constants Menu                   (H) Help
(B)    BIT Names Menu

Item  1:  4          (Primary Unit/Experiment ID)
Item  2:  4          (Secondary Unit/Experiment ID)
Item  3:  2          (Data Dump Format)
Item  4:  1          (Real Time Output Format)
Item  5:  0          (Add Compass To Vane)
Item  6:  0          (Compass Offset)
Item  7:  0          (Barometer Elevation)
Item  8:             (Bad Sensor Value Replace)
Item  9:  TTL        (Display COM Port)
Item 10:  NO         (Display On Permanently)
Item 11:  5          (Display On Time)
Item 12:  NO         (Download Records In Ascending Order)
```

12.18 Type **v<enter>** to display the software version.

```
ZENO-3200 (GMA) using ZENOSOFT V1.966-2637-GMA-1.3 May  9 2002 10:33:50
CS 2BAE (C)opyright 1995-2002, Coastal Environmental Systems, Seattle,
```

WA, USA.

The “GMA” in the version response above indicates that you are talking to the GMA Zeno. All system functions are accessible to you at this point including a full data download.

12.19 Type **q<enter>** to exit GMA user menu.

12.20 Type **<esc>** to exit pass-through mode on the DCOM Zeno.

12.21 Type **q<enter>** to exit the DCOM user menu.

Remote Dial-In Checkout:

Note: This requires a dedicated phone line attached to the DCOM and a second phone line to be able to call the F&P gauge.

12.22 Dial into the DCOM using a terminal program via a telephone modem. Type **u<enter>** to enter DCOM user menu. Type **c<enter>** to enter communications menu. Type **t1<enter>** to set pass-through mode on com1. Rs232 format. Type **u<enter>** to access ZENO-GMA menu. NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number. Type **f<enter>** then **v<enter>**. The date and firmware version number for the GMA is V1.966-2637-GMA-1.1 MAY 2 2002 09:49:28 CS 6D02.

12.23 Type **q<enter>** to exit GMA user menu.

12.24 Type **<esc>** to exit pass-through mode on the DCOM Zeno.

12.25 Type **q<enter>** to exit DCOM user menu.

12.26 Hang-up modem connection.

The DCOM functional checkout is now complete.

ATTACHMENT C

Extreme Environment Installation

1. Modify the GMA for Extreme Environmental Conditions

The EEv enclosure is provided for use and designed for burial in extreme environments. It is a fiberglass enclosure, with an internal EEv interface board, battery hold down, plastic latch securing clips, and jumper block PCA. This procedure assumes that GMA enclosure and solar panel have been mounted (Procedure 3).

1. Disconnect solar panel cable from the underside of the GMA enclosure.

2. Open the GMA enclosure.

3. Disconnect the internal battery cable from the GMA interface board.

4. Remove the battery and internal battery cable; place them beside the EEV enclosure. Do not connect.

5. Use a Phillips screwdriver to remove the four retaining screws and remove the cover from the battery charger PCA. The battery charger printed circuit assembly contains the fuse and is located behind the serial port and data key port in the GMA.

6. Use a Phillips screwdriver to remove the screw and hex nut holding the battery charger PCA integrated circuit to the vertical side panel. Retain the screw, nut, insulating washer, and thermal gasket for use in the EEV enclosure.

7. Using pliers (if required), remove the four nylon standoffs holding the battery charger PCA to the GMA.

8. Remove the battery charger PCA, lifting it straight up to keep from bending the interconnect pins; hold until Step 10.

9. Mount the jumper block PCA (supplied with the EEV enclosure) into the battery charger PCA location in the GMA see Steps 7, 6, and 5 above.

10. Install the battery charger PCA in the EEV enclosure using the four screws and standoffs, screw, and hex nut (Steps 8, 7, and 6 above). Confirm the interconnect pins and screw holes all line up before pressing into place.

11. Install the battery in the EEV enclosure using the hold down strap with mounting hardware. (Required to minimize battery movement during installation.)

12. Connect the internal battery cable to the battery, red to + and black to -.

13. Verify that the battery cable is connected to the EEV interface board.

14. Close and latch the EEV enclosure. Secure the latches with the supplied plastic clips.

15. There are two cables coming from the EEV enclosure. Connect one cable to the solar panel cable. Connect the other cable to the solar panel input of the GMA. Connectors on the EEV cables are keyed such that there is no way to incorrectly connect cables.

16. Dress and secure all wiring. Mount the mid-cable connected pair of connectors out of direct weather, if possible.

17. With all cables connected, the GMA should be powered on and operating.

2. Install the EEV Enclosure

Bury, mount, or position the EEV enclosure in an environment that will not go below –4 degrees Fahrenheit. It is suggested that the enclosure be laid down when buried such that the cables enter the enclosure parallel to the earth.

> **NOTE: ORE sites have the option of burying EEV Enclosures either below the local frost line or at a depth considered appropriate by the installing DAPM. Regardless of the option exercised, the actual depth selected should be reported in each site's ORE report.**