NWSREP'S

FISCHER–PORTER REBUILD MODEL E (FPR-E)

OPERATIONS MANUAL

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service - Cooperative Weather Observer Program
Observing Services Division - W/OS7

Table of Contents: **Page**

1. Program Management……..... 5
   1.1 FPR-E System Configuration…… 5
   1.2 Maintenance Requirements…… 6
   1.3 System Modification Policy……..... 7
   1.4 Metadata Requirements…… 7
   1.5 File Retention Policy……..... 7

2. System Operations and Data Acquisition……..... 9
   2.1 FPR-E Primary Components…….. 9
   2.2 Data Acquisition – Observer's Responsibility……..... 11
   2.3 Observer Proficiency…….. 12
   2.4 Routine Checks by Observer…….. 13
   2.5 FPR Log Sheet – Reporting by Observer…….. .. 13
   2.6 Flash Drive File Reporting to WFO – Observer Responsibility…….. 14
   2.7 Email Reporting Option for Observers…….. 14
   2.8 Data Collection Requirements and Tasks…….. 15

3. Monthly Data Collation and Reporting to NCDC……..20
   3.1 Data Handling Procedures - Overview……..20
   3.2 Log-in Each Flash Drive When Received…… 20
   3.3 Create New Subfolder to Store New Monthly Data…….. 22
   3.4 Examine TXT File with Graphical Plotting Macro…….. ...23
   3.5 Examine TXT File to Confirm Observation Month is Present……...24
   3.6 Zip Compress All Rain Gauges' Data Files……..26
   3.7 Transmit Precipitation Data to NCDC…….....27
   3.8 Confirm NCDC Has Ingested Your Monthly Precipitation Files……...31
   3.9 If Error Flags Occur Access NCDC Troubleshooting Guide…….. 31
   3.10 Monthly Timeline of FPR Tasks…….....33

4. Quality Assurance and Best Practices……..35
   4.1 Data Quality Review (FPRE Plotting Macro)…….. ...35
   4.2 Reporting Bad Data NCDC…….. 38
   4.3 Data Acquisition Management (Flash Drives and Emailed Files)……...39
   4.4 Quality Assurance Checklist…….....40

5. Routine Maintenance ……..…….. 42
   5.1 Preparing for Semi-Annual Visitation…….. ..42
   5.2 Semi-Annual Visitation Checklist…….. 42
   5.3 Winter Operation…….. ...44
   5.4 Warm Season Operation…….. ..46
   5.5 Observer Delegated Actions …….. 46
   5.6 Journal Responsibility…….....48
   5.7 Rain Gauge Supplies……...49
   5.8 Solar Panel Exposure Issues…….. ..49
   5.9 Annual Inspection and Preventative Maintenance……...50

6. Sensor Calibration Policy…… 51
6.1 Rain Gauge Accuracy…….51
6.2 Calibration Check-Up Procedure……51

7. System Troubleshooting and Repair ……..……..……..53
7.1 Notify Sterling Field Support Center (SFSC) ……53
7.2 Logger Points of Failure and Troubleshooting…….……..……..53
7.3 Battery Voltage Too Low – Recurring Condition…….. .54
7.4 USB Error Code Definitions and Remedial Actions…….. 57
7.5 Flexure Replacement – Use Preassembled Weighing Mechanism to Swap-Out…….. .59

8. System Modification Policy……60
8.1 Management Responsibilities……60
8.2 Policy on Cooperative Station Management……...60
8.3 FPR-E System Modifications…….. 61
8.4 Manufacturer's Firmware Update……..62
8.5 Prohibition of Local Changes …….. 62
8.6 NWS Modification Notes…….. ..62

9. Metadata Requirements…….. 65
9.1 NWSREP Responsibilities……..65
9.2 Metadata Accuracy for FPR-E……...65
9.3 Station Profile – Detailed Entries……. 67
9.4 Site Inspection Report – Detailed Entries…….....70
9.5 Site Inspection Report – Valid Remarks ……....73
9.6 FPR Station Logbook……..75

Appendices: **Page**

A. Technical and Policy Documents……...76

B. FPR-E Modification Notes…….…….…….…….....78

C. Calibration Reset Instructions……..…….……79

D. Flexure Replacement Procedures.…….…….……86

E. Zeno Assembly Replacement and Shipping Instructions…….…….…….……96

F. FPR Log Sheet…….……..……99

G. FPR-E Lowest Replaceable Parts…….…….…..…… .100

Revisions with Effective Date: **Page**

1. FPR-E Packing Slip (08/15/2011, and removed 10/31/2014)…….……. 4

2. Fig 6.2, Detailed Entries for WS Station Profile (08/21/2011)……..…….....60

3. Sec 1.6.5, Required to Enter Logger Serial Number to Station Profile (12/15/2011)……......14

4. Fig 6.4, Location of Serial Number on the Logger (12/15/2011)…...…….....61
5. New email for Form 79-1D, HPD.NCDC@noaa.gov (2/1/2012)……..…….. 11
6. SFSC Notification Policy – Troubleshooting (2/1/2012)……...…..…….. 15
7. FPR-E Logger Recall Instructions (2/1/2012) (Removed 12/14/2012)…..…….....52
8. Zeno Assembly Replacement and Shipping Instructions (12/14/2012) ……. 52
9. Global Replacement of CSSA terminology with SIS terminology (1/14/2015)…….....2-101
10. Removed Chapter One, 'Implementation Responsibilities' (1/14/2015)…..……. 3-18
11. Installed Chapter One, 'Program Management' (1/14/2015)……..……. 5-8
12. Added a chapter on Quality Assurance and Best Practices (1/14/2015)…..……. 37-45
13. Split Chapter 4 into two, Routine Maintenance and System Troubleshooting (1/14/2015)……42
14. Moved Zeno Replacement and Shipping Instructions from Chap 4 to App E (1/14/2015)…. ..97
15. Removed Appendices A and B, and renumbered the others (1/14/2015) …….....77-101
16. Added appendix for Flexure Removal and Replacement, App D (1/14/2015)……..….....86
17. Removed Appendix F, placed content to Metadata Responsibilities, Chap 9 (1/14/2015)…….84

CHAPTER 1 – Program Management

1.1 FPR-E System Configuration:

The Fischer-Porter Rebuild, Version E configuration (FPR-E) kit was manufactured by Coastal Environmental Systems, Inc., for the modernization of the mechanical Fischer-Porter/Belfort (F&P) punch tape model rain gauge. In the three years 2012-2014, the National Weather Service (NWS) field offices modified 696 F&P mechanical gauges and 137 FPU rain gauges to the FPR-E configuration.

1.1.1 Qualification For Gauge Modernization: The FPR-E initial implementation kit is available only for legacy F&P gauge basic configuration, ones not configured with a shaft encoder (i.e., for telemetry service). The FPR-E may not be installed to any F&P gauges that use LARC phone modems or use GOES satellite telemetry equipment. In addition, gauges configured with the Fischer-Porter Rebuild Version D configuration (FPR-D) are not eligible for conversion to FPR-E.

1.1.2 Required Measurement Settings: The FPR-E models are internally programmed to produce data records in hundredths of an inch, once every 15 minutes, at HH:00, HH:15, HH:30, and HH:45. The rain gauge should always be set to Local Standard Time. Refer to the *FPR-E Assembly Procedures*, if you need to confirm the settings or make authorized changes.

1.1.3 USB Flash Drive: The Observer should always have an available Flash Drive on hand on the first day of each month. Direct your observers to phone you of immediately if they should lose the Flash Drive you issued to them.

Only use USB Flash Drives that are 2GB or less, and ones that are formatted for 32FAT. There should always be at least 3.5MB of memory volume available on the Flash Drive to accommodate the monthly data download.

1.1.4 Laptop Requirement for Calibration and On-Site Maintenance: The FPR-E rain gauge requires a portable computer (i.e. laptop) to conduct all calibration resets of the weighing sensor and any to achieve any type of configuration or firmware updates.

The minimum requirements for a Netbook/Laptop to serve the FPR-E/COOP maintenance are:

- Windows 7 Enterprise Operating System is required with Bitlocker that overrides the Safeboot application. Requires a Microsoft Software Assurance (SA) license. http://www.microsoft.com/licensing/about-licensing/windows7.aspx#tab=3

- Hardened metallic case with durable hinges

- USB to Serial DB-9F Connection With Null Modem (mark the cable 'Null-Modem Cable')

- Install HyperTerminal to Netbook. (May need to request ITO assistance.)

- Capability to Link-to-Network

- AutoUpdate via Network – No expense software
- Maintenance/ Repair Coverage by Existing Enterprise Software License
- Battery Life, 4.5 to 10 hours

The FPR-E requires a portable computer (i.e. laptop) to conduct all calibration resets of the weighing sensor and any to achieve any type of configuration or firmware updates.

1.1.5 Security Scanning for Virus/Malware: Observers at COOP sites are permitted to email the FPR-E precipitation data each month to an NWS email address. For the email method, the Weather Forecast Office (WFO) enterprise system will scan all attached files, per routine, for any malware or virus. If your observer uses the postal mailing service to report the monthly precipitation, you will need to follow your IT Specialist's instructions and be compliant with the NOAA policies on scanning external delivered removable memory devices.

The Information Technology Officer (ITO) has the responsibility to ensure virus/malware systems are used by the NWSREP on all external sourced media including USB Flash Drives. The ITO manages a secure platform and ensures routine updates of the McAfee Active Virus Defense (AVD) dat files.

Therefore, the NWSREP follows ITO security policy as it applies to these media that arrive each month.

If your ITO scans the Removable Memory devices, then ensure s/he communicates this action to you. Create an accurate account of which Flash Drives have been scanned and saved to the WFO workstation. If malware or a virus is detected on the Memory Device, then notify your ITO and regional IT system security officer.

If malware or virus is detected, and your ITO authorizes so, you may dispose of the Removable Memory device according to National Institute of Standards and Technology (NIST) policy, NISTS P800-88, revision 1, *Guidelines for Media Sanitization* (Sep 2012). The policy directive is accessed from the list available on: http://csrc.nist.gov/publications/PubsSPs.html.

1.2 Maintenance Requirements:

1.2.1 Routine Maintenance: In the course of normal operation the FPR-E will need routine periodic maintenance such as the emptying of the precipitation collection bucket. Instructions for this task and other routine maintenance actions are found in Chapter 5, of this manual. The NWSREP is expected to understand and be capable of conducting the routine maintenance actions.

1.2.2 Semi-Annual Maintenance: Twice each year the NWSREP is required to visit COOP sites in possession of the FPR equipment. This is done as a quality assurance measure to protect equipment from damage, and to ensure the proper measurement of precipitation data. A checklist of Semi-Annual Maintenance tasks is found in Chapter 5 of this manual.

1.2.3 Annual Maintenance: Once per year the NWSREP is required to check the calibration of the rain gauge weighing sensor. Calibration is checked at three levels, five inch, ten inch, and fifteen inch equivalent rainfall amounts. This requires the use the brass test weights. Instructions for calibration checks are given in Chapter 6. In the rare occasion the rain gauge fails the check then a full calibration reset is required. Instructions for the full calibration are found in Appendix C.

1.2.4 Restorative Maintenance: Some failures are evident upon inspection, such as a non-responsive display. Other failures (i.e., battery weakness, or low voltage) will be evident upon viewing of data through use of the FPRE_PlotData_V1_3.xls plotting macro whereby battery voltage and bucket levels are graphed. Chapter 7 gives detailed instructions that require careful attention to safety precautions in order to properly troubleshoot FPR-E electrical system.

1.3 System Modification Policy:

To keep the FPR-E systems running properly and to reduce risk of damage to equipment and data, new requirements may be proposed that involve some substantial change to the form, fit, and function of the FPR-E systems. The office responsible for proposing changes that affect, firmware, hardware, and software, is the Engineering and Acquisition Branch (OPS11), of the Office of Operational Systems.

The Observing Services Division (OS7) is responsible for evaluation and approval of the proposed changes and calls upon the Maintenance Branch (OPS12) to write the necessary COOP Modification Notes, and COOP Maintenance Notes. The COOP Program is managed similarly to, yet separately from the Hydrology program, which is governed by policy found in NWSI 30-2111, *Hydrologic Maintenance*. The NWSREP is responsible for installing the FPR-E system modification. Specific procedures for implementation of system modifications are given in Section 7 of this manual.

1.4 Metadata Requirements:

As stated in Section 8, *Requirements and Standards for NWS Climate Observations*, NWSI 10-1302, the COOP Program requires all hydrometeorological observations to be traceable to a minimum corresponding set of metadata. The NWS Representative (NWSREP) is responsible for entering these metadata into a centralized database (e.g., Station Information System [SIS]). The data can then be accessed by the National Climatic Data Center (NCDC) and help build accurate long term climate records.

The metadata you will enter to SIS is given in Section 9 of this manual and will describe the basic character of the FPR-E precipitation observations.

1.5 File Retention Policy:

The following data records and policy documents for FPR-E shall be saved by the WFO:

- FPR-E precipitation data files (e.g., Z5678AHA.txt) kept for at least 36 months on the network workstation. Retain the TXT data files with their original filename and format!

- Any *FPR Log Sheet*, or any *Flash Drive Tracking Table*, keep a printed or an electronic copy (i.e., optical scan of printed form) at WFO for 12 months.

- Bookmark: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm for ready access to FPR-E manuals and FPR-E policy directives issued by NWS headquarters. Update the bookmark every 6-months.

CHAPTER 2 – System Operations and Data Acquisition

2.1 FPR-E Primary Components:

The FPR-E modification consists of five major components: the load cell assembly (Fig 2.3), the Zeno Assembly (Fig 2.2), the solar panel (Fig 2.1), the 12-V battery, and a USB flash drive. A cable connects the load cell assembly to the Zeno Assembly. Another cable enters the Zeno Assembly to connect the solar panel to a voltage regulator to enable the battery to be recharged.

2.1.1 Data Logger: The Zeno Assembly contains the data logger and it fits in place where the mechanical weighing assembly and paper puncher had been mounted in the Fischer & Porter (F&P) housing. When you open the access door (Fig 2.1) you will see a clear plastic box (Fig 2.2) which contains the data recorder. This is known as the Zeno Assembly and it must remain closed in its protective, clear plastic shell. Behind the recorder you may see the weighing sensor, an S-shaped metallic bar that measures the weight of the bucket and its liquid contents (Fig 2.3).

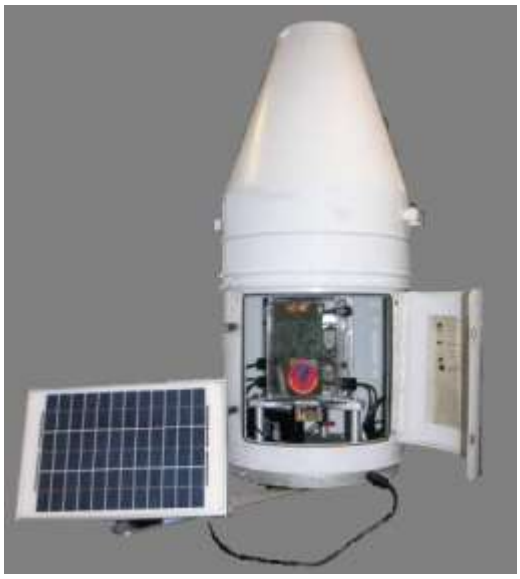

Figure 2.1 FPR-E Recording Rain Gauge

Figure 2.2 Zeno Assembly (Data Logger)

2.1.2 Weighing Sensor: The weight of the catch bucket with liquid pulls on an S-shaped metallic bar that stretches with increased weight. This weighing sensor is very sensitive and can detect changes of one thousandth of an inch of precipitation in a matter of several seconds. Readings from the sensor are processed by the recorder every 15 minutes and stored. The stored data is transferred to the USB memory stick, when the display is let, upon insertion to the data logger's USB port.

Figure 2.3 Weighing Sensor

2.1.3 Rain Gauge Display: The display stays in a sleep mode until you wake it up by pressing the Display button on the Zeno's right side (Fig 2.5).

This display tells you the accumulated rain-equivalent weight of everything in the bucket, i.e., rain water, plus any additives like food grade propylene glycol (FGPG) or oil. The units are hundredths of an inch of rainfall.

Figure 2.4 Rain Gauge Display

The Zeno Display will stay lit for about two-minutes before automatically going back to sleep.

Figure 2.5 Zeno Assembly (Data Logger)

2.1.4 Data Download to Flash Drive: To collect precipitation data, first make sure the display is lit-up and shows the current bucket level. Then insert the Flash Drive (i.e., memory stick) to the USB socket on the right side of the Zeno Assembly. **The display will respond with the amount of time that remains for the download to complete in minutes and seconds. It will take about 15 minutes to complete.** Your Observer should stand by to monitor the display for any display messages.

Figure 2.6 USB Flash Drive

Expect the recorder to take about fifteen (15) minutes to download to the Flash Drive. This is the routine monthly process whereby the last 100 days of precipitation are saved to the Flash drive. It is important to stand by the Zeno Assembly while it downloads the data because the system display may indicate messages other than time remaining to completion.

2.2 Data Acquisition – Observer's Responsibility:

2.2.1 Data Acquisition Timeliness: Instruct your observers to download in the first five days of each month, but never before 12am local time on the first day of month.

Inform them this outdoor task will take 15 minutes and requires them to stay near the Fischer-Porter gauge so they can monitor the display for any alert messages that could appear. They are to wait until the display message UFdC appears. This indicates the system has completed its data download to flash drive.

Ensure you provide each of your observers a printed copy of *FPR-E Observer Instructions*. Access the NWS website, http://www.nws.noaa.gov/ops2/Surface/Coopimplementation.htm; for the latest edition.

2.2.2 Un-cap the USB Port: First unscrew the cap that covers the Flash Drive socket (Fig 2.5).

2.2.3 Turn on the Display: Turn on the display by pressing the button several inches below the Flash Drive socket (Fig 2.5).

⚠ Important: The Flash Drive will not download unless the Zeno display is lit-up first, before you insert the Flash Drive.

2.2.4 Insert Flash Drive: Then insert the Flash Drive into the socket on the right side of the Zeno Assembly (Fig 2.5).

2.2.5 Display Activates: The display responds with the amount of time the Zeno will be active copying the last 100-days of data onto the Flash Drive. This 'time to complete,' is measured in minutes and seconds (Fig 2.9 shows 3 minutes and 23 seconds to finish).

The display counts down until the download is finished. This process might take 15-minutes to complete.

Figure 2.7 Flash Drive Port

2.2.6 Verify the End of Download: When the download is finished the code, **UFdC** will display. This stands for **U**SB **F**lash **d**ownload **C**omplete.

Figure 2.8 Time left to finish download

2.2.7 Remove Flash Drive: Pull the Flash Drive gently from its socket. Recap the Flash Drive.

2.2.8 Re-cap the USB Port: Place the circular cap which is kept on its chain, onto the USB socket, and screw it closed to a finger-tight level.

Figure 2.9 USB Flash drive completed (UDdC) indicates download has finished

At this point the Observer will take the Flash Drive to his/her PC and upload the TXT file while at the same time preparing an email to you as NWSREP. The observer attached the TXT file to the email and reports the data to you. For those observers who use the United States Postal Service, the observer places the Flash Drive into the pre-addressed WFO supplied padded envelope (see Figure 2.11).

2.3 Observer Proficiency:

Give a tutorial on how to download monthly data, for any new observers or any secondary observers who want to assist. Ensure they are familiar with the NWS operations and maintenance policy as outlined in, '***FPR-E Observer Instructions.'*** Encourage their dialogue, solicit their questions, and offer them additional instruction if needed.

These concepts need to be understood by the Observers as their responsibilities to the NWS:

- Timely operational download to Flash Drive on the first five (5) calendar days of the month. The Observer shall not download before 12AM on the first day of month!

- Ensure the display is lit before inserting the Flash Drive. Understand the system will pause for one or two minutes right before completion of the download. This is when the Flash drive is being formatted. Be patient and wait for display to post, "**UFdC.**" This indicates download is complete. Now is the time to remove the Flash Drive.

- Timely mailing of the Flash drive to the WFO on the same day as data was downloaded.

- If the observer uses Email, then ensure s/he uses your official NOAA address (i.e., **firstname.lastname@noaa.gov**) for timely Emailing in the first five days of the month. (Follow special Email instructions in Section 2.7, below.)

- Possess a printed copy of the ***FPR-E Observer Instructions,*** (June 2014).

- Possess a filled-in copy of the ***Mailing Address/WFO POC Sheet*** (Appendix A, *FPR-E Observer Instructions*, June 2014).

- If the observer conducts basic bucket maintenance, then ensure s/he reports the action to you, either by email or by postal service. The report is done using the FPR Log Sheet (See Appendix F), for an example.

When you open the F&P door press the Display Button on right side of Zeno Assembly, to light-up the display of the current bucket level.

2.4 Routine Checks by Observer:

2.4.1 Report Bucket Nearing Capacity: The display gives the current rain equivalent, in inches (i.e., 15.01 inches of liquid is indicated in Figure 2.10), of everything in the bucket. This includes rain water, melted snow, oil (to prevent evaporation), food grade propylene glycol (to prevent freezing solid), and possibly anything that fell or crawled into the bucket since it was last serviced.

Figure 2.10 Rain Gauge Display

2.4.2 Error Message in Display: Have your Observer phone you if the display ever reads a negative value or reports more than 15.00 inches, so as to prepare for draining before the fluid exceeds bucket capacity! This way you will know to arrange a visit to service the gauge.

2.4.3 Clean Solar Panel: Make sure the surface of the solar panel is free of dust or mildew or snow. Trim any tall grass, bushes, or tree branches that would cast a shadow on the solar panel.

2.4.4 Delegated Bucket Maintenance: Some Observers have an agreement with their NWSREP to drain the bucket; or add oil; or add food-grade propylene glycol. Instruct your Observers who have this responsibility they need to follow Chapter 5.6, Journal Responsibilities, to write their maintenance actions into the FPR Log Sheet (Appendix F) and mail/email you this log sheet at end of the month in which buck maintenance was performed.

2.5 FPR Log Sheet – Reporting by Observer:

Certain Observers are given the responsibility to perform gauge/bucket maintenance. These Observers are required to review and update the *FPR Log Sheet* for any performed maintenance or discrepancies that occurred since the last monthly submission.

When an observer encounters a system anomaly then they should phone the NWSREP and journal the anomaly to the *FPR Log Sheet*, in the Remarks section to describe the nature of the trouble and any system Error messages that appeared on the Zeno display. Phone back your

Observer to learn more about the reported discrepancy in an attempt to see if the problem is one the Observer could resolve on his/her own. If your Observer's *FPR Log Sheet* contains any maintenance entries then determine if the Site Inspection Report needs to be updated.

Observers may use the *FPR Log Sheet* to inform you if they need additional supplies or if there is a request to make station visitation for an operational issue that warrants your visit.

Note: Observers are *not* required to journal the date and time of the monthly Flash Drive download.

2.6 Flash Drive File Reporting to WFO – Observer's Responsibility:

Instruct your Observers to send you the Flash Drive precipitation data on the same day they downloaded it from the gauge. They can do this by email, if able, or by postal service, yet either way, they need to do this in the first five days of the month.

Emphasize to your Observer the importance of data file integrity – and never should the file be copied to their PC computer or opened. The observer may delete an older file from the Flash drive, yet always keep the two most recent months' files saved to the Flash drive.

Observers should have a full-time awareness of where their government-issued Flash Drive is located. The Flash Drive has to be in the possession of the Observer on the first day of each month to accomplish the download of the precipitation data file.

All the more important for Observers who do not use email to report their monthly precipitation is for them to understand how you will use the United States Postal Service (USPS) to routinely mail a Flash Drive each month to their preferred mailing address. This Flash Drive will be mailed in the familiar looking envelope and will be sent to arrive a day or two before the Observer downloads the monthly data.

If the observer lives in a zone that is remote or rural and postal deliveries are less reliable, then provide this observer with a spare government-issued Flash Drive.

Note: Do not leave the spare Flash Drive outdoors – as some may not work at cold temperatures.

2.7 Email Reporting Option for Observers:

2.7.1 Capabilities Required of Observer: In 2011, NWS Headquarters policy was updated to give Observers permission to e-mail the monthly FPR precipitation data to the WFO. As of 2014 a majority of the Observers email their monthly precipitation files to their WFO. The email reporting method is just an option and not a requirement. For those Observers who want to email, they need to meet these requirements:

- Their computer must have a USB port and observer must be able to view the file.
- Have internet access on the same computer with USB port.
- Able to send and email with a file attachment.
- Have knowledge of how to attach a file to an email message

- Observer fully understands the NWS will not offer **<u>any</u>** IT support for these tasks.

2.7.2 <u>Emailing Instructions for Observers</u>: Due to the many different operating systems and email clients in use, specific instructions will not possible here. These are generic instructions for the Observer to send the FPR-E monthly data file to your WFO. These same instructions are found in the June 2014 version, of the *FPR-E Observers Instructions,* posted to the NWS Headquarters COOP Modernization website.

a. Download the data from the gauge by established methods.

b. Insert the Flash Drive into an available USB port on your Observer computer.

c. Open your email client program.

d. Create a new message.

e. Address the message to your NWS Representative.

f. Give the message a subject of "**FPR Data: <station number>.** " Type your COOP Station Number (i.e., 41-1234) in place of <station number>.

g. You may pass along any pertinent information in the body of the email.

h. Attach the data file DIRECTLY FROM THE ELECTRONIC MEDIA. It is important that you DO NOT OPEN THE FILE OR COPY IT TO YOUR COMPUTER FIRST. If there is more than one file on the Flash Drive, select the file with the most recent date.

i. Send the email with attachment.

j. Since the data logger does not erase files from the Flash Drive, it will eventually become full. You may delete the file(s) from the Flash Drive after the email gets sent.

2.8 Data Collection Requirements and Tasks:

Instruct your observer to download the FPR-E data in the first five days of the month, yet not before 12AM on the first day of the month.

The majority of observers use e-mail to report their monthly precipitation data. The best practice is when the observer emails the precipitation data file to you on the <u>same day</u> as the download from the rain gauge.

As a matter of priority you should strive by the 15th of the month, to mail back (i.e., via U.S. Postal Service) the processed Flash Drive to the respective observers. In this way the Observers

should have their Flash Drive in their possession at the start of the new month to download new data.

You should keep a monthly Flash Drive Tracking Table (see Fig 3.1) to journal the date you mailed your Observers their Flash Drive. The term 'Incoming Flash Drive' refers to any Flash Drive or Email an Observer sends you, filled with the most recent month's records, but not yet uploaded to your WFO's workstation. The term 'Outgoing Flash Drive' applies to a Flash Drive after you have downloaded the TXT to the WFO's workstation. Once you complete this transfer, place the 'Outgoing Flash Drive' in a container or box, marked 'Outgoing.'

Figure 2.11 Mailer for Flash Drives and Log Sheets

2.8.1. Filename and Storage Standard:

The following naming convention for FPR-E precipitation data files, applies to all NWS offices handling FPR-E monthly precipitation data.

Example**:** **Z5678AHA.txt**

Format**:** **ZnnnnMDv.txt**

Translation**:** **Z** =Zeno is the model name
nnnn = COOP SID (Minus the two digit state code),
M = month of download
D = day of download
v = Incremental count, A, B, C, of the files downloaded on a given day.

Each filename generated by Zeno is coded this way to indicate the Month and Day of download.

Test your understanding. Confirm with the Table 2.1 these filenames. When downloaded on January 9, then MD appears '19'; if downloaded on Jan 15, then MD appears '1F'; downloaded on Sep 9, then MD appears '99'; if Sep 15, then MD appears '9F'; if Oct 9, then MD appears 'A9'; if Oct 17, then MD appear as '**AH'** as in the example on preceding page.

Ensure all monthly files in your laptop/netbook directory remain unchanged from their automatically named format! Never rename a data logger generated filename!
After you run McAfee Active Virus Defense (AVD) suite and you have confirmed 'no detections' remove the Flash Drive. Do not save the TXT file to the Virus Scanner PC.

This name convention applies to both platforms in the WFO where you handle FPR data files:

- Virus Scanner PC with McAfee and Federal Desktop Core Configuration (FDCC)
- NWS workstation's (i.e., AWIPS) directory for "HPD" (i.e., C:\HPD\YEAR\MONTH\)

Store, and do not delete the TXT data files for at least 36 months. Also, never rename files that are being stored. Always keep the file in its original filename, ZnnnnMDv.txt, (e.g., **Z5678AHA.txt**).

Download Month (M) Code Values

1	2	3	4	5	6	7	8	9	A	B	C
January	February	March	April	May	June	July	August	September	October	November	December

Download Day (D) Code Values

1	-	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	-	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Table 2.1 Month (M) and Day (D) Code for Data Filenames

Only the current TXT file shall be saved to a dedicated permanent directory on the NWS workstation, with a sub-directory structure that is organized by year and month as follows: C:\HPD\2011\OCT\.

2.8.2 Instructions to Virus Scan and Upload the Data Files:

a. Follow your forecast office's established Virus scanning procedures for external flash drive media. The NWS uses McAfee Active Virus Protection (AVD).

b. If this is your office's policy, then work with your Information Technology Officer (ITO) to arrange a time for the ITO to scan as many Flash Drives as possible.

c. Ensure that all the Flash Drives are virus-free with no detections in accordance with the convention stated in Section 1.1.5. Increment the HPD subfolder for the current collection month (i.e., C:\HPD\2011\NOV\).

d. Upload the most recent month's TXT data file, from each Flash Drive to the NWS workstation. Click "File → Save As." Keep the filename unchanged for each TXT file. See Section 2.8.1, for details on the filename standard.

e. Ensure the most recent month is present in its entirety. Follow the instructions in Section 3.5, of this manual. View the TXT data file's contents from the pop-up 'Notepad' window to ensure the most recent month was delivered.

Delete the TXT file if it is missing 15 days or more from the collection month. Phone the Observer to inquire into the problem and ask Observer to perform a download today, and mail the data his earliest convenience. When you receive his Flash Drive, then mail the Observer a replacement Flash Drive because he has none.

f. To finish the process, delete the oldest of the two files on the Flash Drive.

g. Unplug the Flash Drive and place it in a new Jiffy envelope ready for mailing back to the
Observer.

2.8.3 Mail Back the Flash Drive to Observers Who Use Postal Service:

On or about the 15th of the month mail the observers their Flash Drive.

Flash Drives, when mailed to the Observers, are not required to be labeled to identify a specific COOP SID. The file is not required to have originated from the Observer to whom you are mailing. Rather, the purpose is to deliver a nearly blank Flash Drive. Likewise, the Observers are not required to label or identify on the flash drive any information.

You may choose to label the flash drives when necessary to resolve certain situations (i.e., flash drive missing current reporting month's file).

Write down to the monthly Flash Drive Tracking Table (Fig 3.1) the date you mailed-out the 'outgoing' Flash Drives.

Each Flash Drive should hold just two files: (a) the reporting month – with precipitation data in all 15-minute periods, from every day of the entire calendar month; and (b) a second file, the preceding month's TXT file, preferably from the same Observer's site.

Note: Each incoming Flash Drive should contain only two (2) TXT data files. The current reporting month and the preceding reporting month – each were given a filename upon download at the Observer's site. You may not rename any TXT data file, neither those on the Flash Drive nor those in your NWS workstation.

Note: Keep a log sheet to account for any incoming Flash Drive that arrives 'blank.' You may affix a label to these Flash Drives to check them later when you visit the COOP site.

Your next major responsibility is to transmit the monthly FPR precipitation records to the NCDC before the 25th of each month. For rare occasions, when the Observer was unable to mail the flash drive or was instructed by the WFO to postpone a download to Flash Drive, the date of your transmitting the FPR file may be extended by one or two weeks. The intention here is to limit unnecessary FTP transmissions and to simplify your Flash Drive tracking work.

2.8.4 Download All Observer Emailed Data Files to HPD Folders:

On or before the 25th of the month conduct several KEY WORD SEARCHES of the Inbox of the WFO email account where you receive all of the Observers monthly reported FPR precipitation data files.

Start your Key Word Search with the words "**FPR Data**" because these words are required to be written into the subject line by the Observers when they email you their monthly precipitation data files. See Section 2.7.2 for specific instructions for how Observers should address their emails to you.

Try each of these Key Word Searches in the email inbox, to locate all FPR files:

- "FPR Data"
- COOP SID (i.e., 41-5678) for each site with FPR gauge in your CWA
- Observer's Tag Name (or their specific Email Address)

Filter by email date, the found files, and examine the dates to ensure the most recent observing month was delivered.

Without opening the message's attachment, download the attached file to the HPD subfolder for the observation month (i.e., C:\HPD\2011\NOV\).

Check the inbox email messages for any additional information that may have been sent. Observers may report on maintenance actions conducted, supplies needed, bucket fluids that require disposal, and any relevant notes or comments on the rain gauge performance..

For your Observers who were delegated the bucket maintenance tasks are required to report the FPR Log Sheet, either by printed form via the United States Postal Service, or via Email, if they have an electronic form of the FPR Log Sheet.

CHAPTER 3 – Monthly Data Collation and Reporting to NCDC

3.1 Data Handling Procedures - Overview:

Each month, by the 25th day, you are required to FTP the data to ftp.ncdc.noaa.gov, the NCDC data ingest server in accordance with policy stated in, *Requirements and Standards for NWS Climate Observations*, NWSI 10-1302. This chapter gives detailed instructions to successfully collate and report the monthly precipitation files to NCDC.

a. By 10th day of month phone your Observer if you have not received the Flash Drive or the Emailed data file.

b. Scan the flash drives on the workstation your offices uses to scan 'External non-NWS memory devices. See Section 2.8.2, in preceding chapter for specific instructions. If the virus checker give a 'clean' report of the flash drive, then download the TXT file that has the most recent saved date, as seen in the Windows viewer environment.

c. Display the contents of data file in a graphical plot (i.e., FPRE_PlotData_V1_3.xls) or use Notepad to read the file and scroll through the most recent month, to ensure the 15-minute data records for the start and end of the month are present. If you see extensive numbers of records missing, then phone the observer. When you phone the observer, ask him/her if they noticed any system anomalies. Also ask observer to download to flash drive and send this new file to you.

d. Save the monthly Precipitation Data (i.e., Z5678AHA.TXT) files received from your observers into a single folder for named with the Month in which the most recent full month of precipitation was measured. This will enable you to quickly Zip together all files for quick upload to the NCDC monthly ingest server: For example:

   C:\HPD\2011\APR
   C:\HPD\2011\MAY
   C:\HPD\2011\JUN

e. No later than the 15th of month, mail back your observer one Flash drive, per routine.

f. By 25th of month, transmit to NCDC all your sites' FPR data in one Zip file.

3.2 Log-in Each Flash Drive When Received:

By the 15th of the month, ensure you have received either the Flash Drive or the Email from all your FPR observers.

Read the return address on the USPS mailing envelope (Fig 2.11) to identify from which site this Flash Drive originated, and mark the Flash Drive Tracking Table (Table 3.1) for the date it arrived.

Positively identify all observer files between the 5th and 15th of each month.

Check the same mailing envelope for these items:

- USB Flash Drive,
- *FPR Log Sheet* (for a report of bucket maintenance or anomaly).

The Jiffy No. 0 (zero) padded mailing envelope (Fig 2.11) is sufficient to hold the FPR Log Sheet and Flash Drive. This photo shows the standard ten inch square, darker color envelope. Newer, bubble-pack square envelopes have thinner paper and tear more easily and can result in the Flash Drive being lost in the mail.

If any Email or Flash Drive is missing on the 15th, first search your office's Email inbox, or incoming USPS mail station, for possible mis-distributed / misplaced envelopes.

The same day you open the envelope holding the Observer's mailed Flash Drive, log the date to the column marked 'WFO RECEIVED' in your Flash Drive Tracking Table (Table 3.1).

FLASH DRIVE TRACKING TABLE					
Month Ending	**COOP Station Name**	**WFO RECEIVED Observer's Flash Drive, i.e., Incoming drive:**	**WFO SCANNED Incoming Flash Drive for virus and malware:**	**WFO MAILED OUT Observer's Flash Drive, i.e., Outgoing drive:**	**WFO REPORTED Data File to NCDC:**
JUNE 30 2011	Angel Fire 1S	July 6th	July 15th	July 15th	July 25th
	Clovis	July 8th	July 15th	July 15th	July 25th
	Roswell 2S	July 19th	July 19th	July 19th	July 25th
	Socorro	July 7th	July 15th	July 15th	July 25th
	Tucumcari 4NE	**Not Arrived Yet:** Phoned him 7/20, to inquire. He'll mail it Monday.	July 29th same day as arrived!	July 29th same day as arrived!	July 29th as combined with the 7/25 zip file.

Table 3.1 Flash Drive Tracking Table

Note: You may want to wait until the 15th of the month until all Flash Drives have arrived, and scan them at the same time. Instruct the Information Technology Officer (ITO) to inform you when he/she has run the McAfee software on all Flash Drives. After you view the TXT file in Notepad and check the identity and date for current reporting month (see Section 3.5), log each Flash Drive as 'scanned' in the ***Flash Drive Tracking Table***.

Phone the Observer if his Flash Drive has not arrived by the 10th day of month.

Observer Emailed Precipitation Data: Account for each **email** data file received. If your office has a number of Observers who email, then modify the Flash Drive Tracking Table to accommodate the sites that send monthly FPR precipitation files.

Important: If you have not received the Observer's Flash Drive or Data Email by the 10th day of month, phone the Observer to inform him you are missing the current precipitation report and ask if he had any difficulties or was simply behind in mailing. On the 20th review the Flash Drive Tracking Table to identify any Flash Drive still missing, if so, phone that Observer a second time. If the Observer does not have a phone, or a phone answering system prevents direct conversation, then mail a letter to the attention of the Observer, to direct him to mail the Flash Drive.

3.3 Create New Subfolder to Store New Monthly Data:

Go to folder for the current year C:\HPD\2011\ and create a new monthly sub-folder, for the precipitation data collected for the full month of June, then name the sub-folder: C:\HPD\2011\JUNE\.

Move each of the Data Files the Observers have either Emailed you or U.S. Postal Service mailed you into this folder. Once you have received all rain gauge site monthly data, you will Zip all Data Files together and keep the Zip file in this same folder (i.e., C:\HPD\2011\JUNE).

Note: Always keep in mind that Notepad is the only program for viewing and opening the TXT stored in these directory folders! To do otherwise will corrupt the data format of the TXT file!

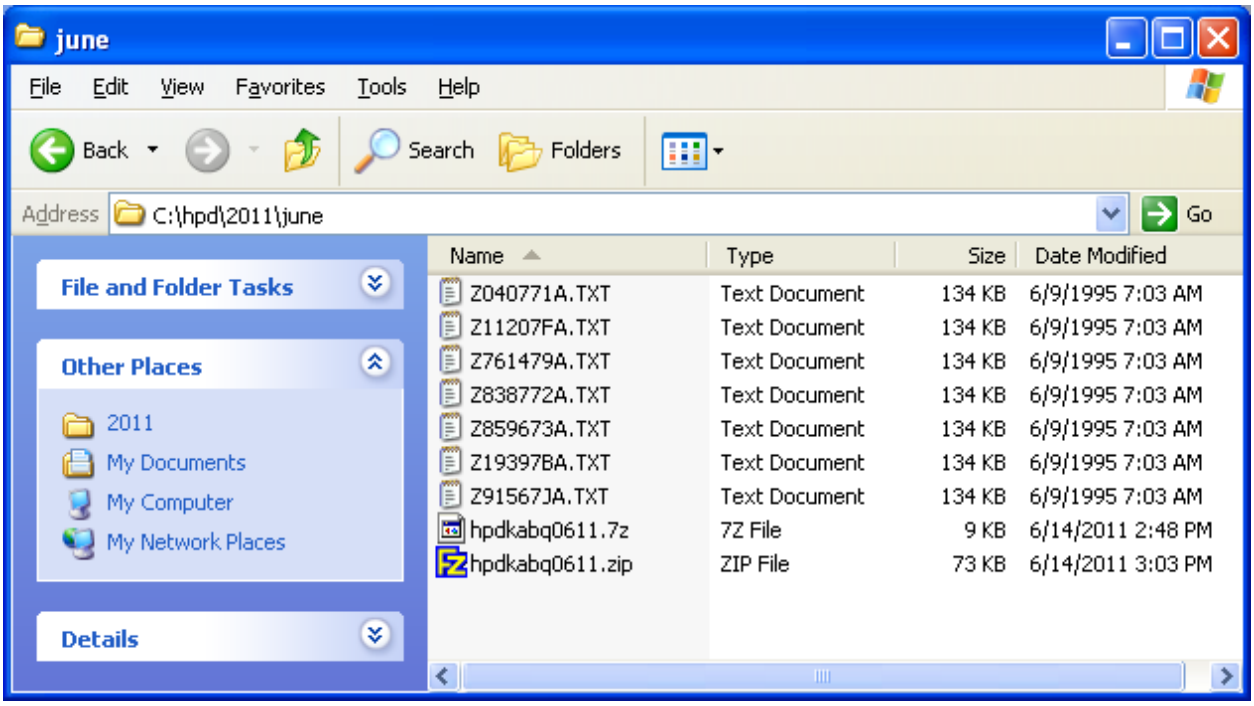

Figure 3.1 For Each Month Create a New Sub-Directory

3.4 Examine TXT file with Graphical Plotting Macro (FPRE_PlotData_V1_3.xls):

Examine the contents of the TXT data file, to identify from which COOP Site this Flash Drive originated.

At this time, it is essential to read the COOP Site Identifier (SID) in the first eight digits of each line (i.e., #41005678) and use this to update your 'Flash Drive Tracking Table.'

Update the Flash Drive Tracking Table in the respective row (i.e., Roswell 2S) and write in the date on which this TXT file was virus scanned and uploaded to NWS workstation.

The next section, 3.5, explains how to decode each of the nine fields in the FPR-E data records.

Always use Notepad (Fig 3.2) to view the TXT data file. Never open the TXT file at any time in an Excel (XLS) application!

Follow these Windows procedures to call up the Notepad application to view the TXT contents.

Access your Network station's file directory containing these FPR data files and carefully single click the right-mouse-button to select the TXT file for a controlled application opening within **Notepad** and not Excel.

Important: Be careful not to double click the TXT file as this will open it within the Excel spread-sheet applications program and you risk losing the date/time data format!

Now, click the right-mouse-button once to expand the drop down menu (see graphic, below), and notice the option "Open With". Slide the cursor to the word, 'Notepad' it is the second application listed on this pop-out menu. Single click on it to open a Notepad text screen viewer window and conduct your examination of the 15-minute data records.

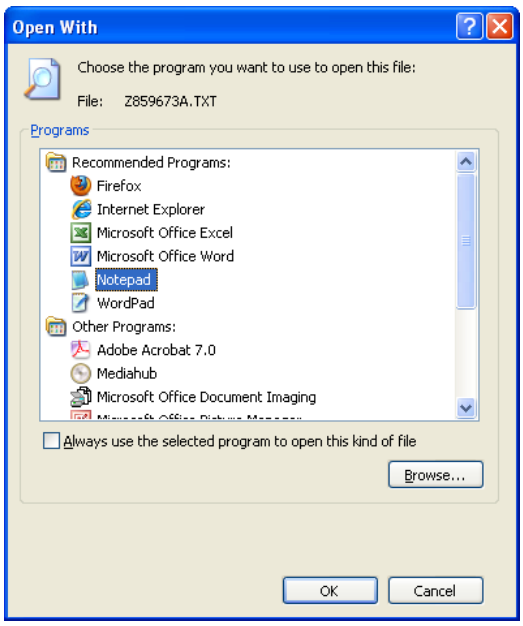

Figure 3.2 Use Notepad to View the Data Files

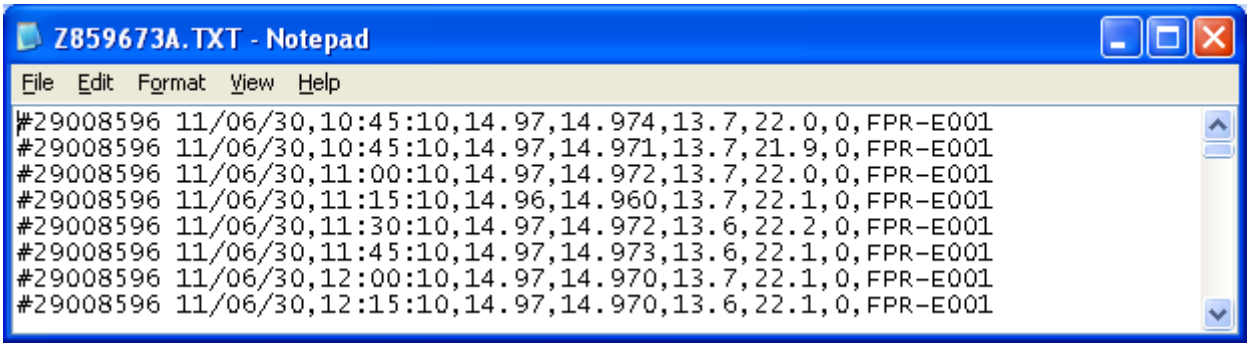

Figure 3.3 Portion of a Precipitation **Data File (Z26796HA.TXT)**

Saved files may be accessed by opening the TXT file with Notepad using the Mouse right-button. Notepad should open, displaying the selected file. See the example in Fig 3.3.

Note: Your TXT data will appear in Notepad similar to site, #29008596, Sumner Lake, NM, from October 17, 2010, about 18:00 local standard time.

3.5 Examine TXT to Confirm Observation Month is Present:

Give a quick one minute or so visual inspection of your Observer's TXT file's contents, to confirm the file holds the complete number of observations for the collection month. Confirm there is a precipitation record for the start of the month as accounted for by the 12:00AM record of the first day of the month as pointed out in the first **bold font** call-out in Figure 3.4. Notice the record, 13/04/01, 00:15:10, 2.65, marks the first full record of the day April 1, 2013.

Parameter	Example	Definition	Units
SS00NNNN	41002679	COOP station number	COOP SID Convention
Date	13/03/31	Year, Month, Day	YY/MM/DD
Time	23:30:10	Hour, Minute, Second	HH:MM:SS
PL	2.64	Current Precipitation Level	Inches (2 decimal places)
PC	2.644	Precipitation Calibration Value	Inches (3 decimal places)
BV	12.7	Battery Voltage	Volts (1 decimal place)
IT	23.0	Internal Temperature	Celsius (1 decimal place)
BIT	0	Built In Test	Integers
VERS	FPR-E001	Configuration Version	NWS Defined

Table 3.2. Code Explanation for the Fifteen Minutes Records (FPR-E)

Format: #SS00NNNN yy/mm/dd,hh:mm:ss,PL,PC,BV,IT,BIT,VERS

```
#41002679 13/03/31,23:15:10,2.64,2.645,12.7,23.2,0,FPR-E001
#41002679 13/03/31,23:30:10,2.64,2.644,12.7,23.0,0,FPR-E001
#41002679 13/03/31,23:45:10,2.64,2.644,12.7,22.9,0,FPR-E001
#41002679 13/04/01,00:00:10,2.65,2.647,12.7,22.7,0,FPR-E001
#41002679 13/04/01,00:15:10,2.65,2.647,12.7,22.5,0,FPR-E001 ← First 15-minute record of month.
#41002679 13/04/01,00:30:10,2.65,2.647,12.7,22.3,0,FPR-E001
#41002679 13/04/01,00:45:10,2.65,2.646,12.7,22.0,0,FPR-E001
#41002679 13/04/01,01:00:10,2.65,2.648,12.7,21.7,0,FPR-E001
#41002679 13/04/01,01:00:10,2.65,2.648,12.7,21.7,0,FPR-E001
#41002679 13/04/01,01:15:10,2.65,2.648,12.7,21.7,0,FPR-E001
#41002679 13/04/30,23:15:10,3.01,3.012,12.7,29.6,0,FPR-E001
#41002679 13/04/30,23:30:10,3.01,3.012,12.7,29.2,0,FPR-E001
#41002679 13/04/30,23:45:10,3.01,3.013,12.7,29.1,0,FPR-E001
#41002679 13/05/01,00:00:10,3.01,3.013,12.7,28.8,0,FPR-E001← Final 15-minute record of the month.
#41002679 13/05/01,00:15:10,3.01,3.013,12.7,28.4,0,FPR-E001
#41002679 13/05/01,00:30:10,3.01,3.012,12.7,28.0,0,FPR-E001
#41002679 13/05/01,00:45:10,3.01,3.012,12.7,27.5,0,FPR-E001
```

Figure 3.4. Expanded View of a Precipitation Data File to Point Out Dates/Times.

Scroll to the end of the TXT file and locate the end of the collection month. Confirm there is data from the end of the month as accounted for by the first 15-minute record past 12 Midnight on the first day of the new month.

If the collection month is missing (i.e., April), then phone the Observer and request s/he download and send you the data. The FPR-E logger holds 100-days of data. You have only 10-weeks after end of the collection month for the observer to report the full month, before it gets overwritten by new data.

If the 50% or more of the month's 15-minute records are missing, then notify the NCDC via email HPD.NCDC@NOAA.GOV.

After you have examined the TXT file for proper dates and times to verify the full reporting month is present, you may wish to confirm the Precip values are consistent in that they contain data and not 'zeroes.'

3.6 Zip Compress all Rain Gauges' Data Files:

Once you have received all the Observers Flash Drives and Emails for the reporting month (after logging their arrival in the Flash Drive/Email Log Sheet), you are ready to 'zip' all the TXT data files into a single .ZIP file on the NWS network workstation.

Use only the NWS network workstation to zip together all TXT files from the observed month.

a. Using Windows Explorer, select all files in folder by selecting one file in the folder and then using (Ctrl-A),

b. Right-Click on files and select "add to ZIP"

c. The file should now be re-named hpdkxxxMMyy.zip

You must always use this NCDC filename convention, **hpdkxxxMMyy.zip**, for all files transmitted to NCDC. Code explanation: kxxx= is your 4-letter WFO identification (e.g., kabq for Albuquerque), and >MM= is the data-month (i.e., 06), and >yy= is the data-year (i.e., 11).

Flash Drives Delivered Late to WFO: If any Observers have not yet sent you their Flash Drive, phone and remind them, and wait until the 25th of the month. Then, on or about the 25th of the month ZIP together all the TXT files you have collated in Section 3.3.

In certain rare cases of lateness, you may postpone the ZIP process and FTP transmission for six weeks beyond the 15th. August 31, 2011, is seven weeks 'late' from the Observer's reporting date for the June 1-30, 2011, precipitation report. Further lateness from the Observer will cause confusion in your account of HPD transmissions to NCDC. Remind the Observer to download and mail the Flash-Drive the first week of each month.

NCDC Advice on Zip Compression:

- The TXT data file must contain the **entire** month's data being reported in the file name of the zip file.

- For example, a ZIP file named **hpdkxxx0611.zip** must contain all data for the month of June. The Observers shall download the data logger to their key only after midnight on June 30, 2011. Since NCDC will be processing the June data, if any data is missing, it will not appear in the publication or archive databases, and will be marked "missing."

⚠ Do not right-click on the folder and "add to zip" as this causes your PC's folder name to appear to NCDC as the path name from which to extract data. Then, your data will never get processed by the ingest program!

⚠ Make sure that the "save full path info" is not checked under the Folder Option. This creates a separate sub-folder. Then, your data will never get processed by the ingest program!

⚠ Do not send a self-extracting executable file (.exe). The files must be zipped with a file compression utility such as 7-Zip or Winzip.

3.7 Transmit Precipitation Data to NCDC:

Between the 15th or 25th of month, you should have zipped together all your current TXT files at your NWS-network workstation (Sec 3.6, above). Now you are ready to start an FTP session.

Double-click the desktop icon for WsFTPLE (i.e., Ipswich WSFTP95.exe) on your network workstation. If there is no icon, run the executable file that is located in C:\Program_Files\WS_FTP Windows\. The Session Properties 'General' panel will open immediately (graphic, below). Confirm it is configured properly with each NWSRSEP to use 'anonymous' as his User ID, and each NWSREP shall use his NWS- network e-mail address as his Password.

Host Name / Address:
ftp.ncdc.noaa.gov
User ID: anonymous

your.name@e-mail.address.

The general session properties do not change, except for the Password field, which will show the e-mail address of the person who most recently transmitted an FTP data file to NCDC.

Also, about half of all offices send upper-air observations this same way. So, now update the Password: dialogue box with your name.

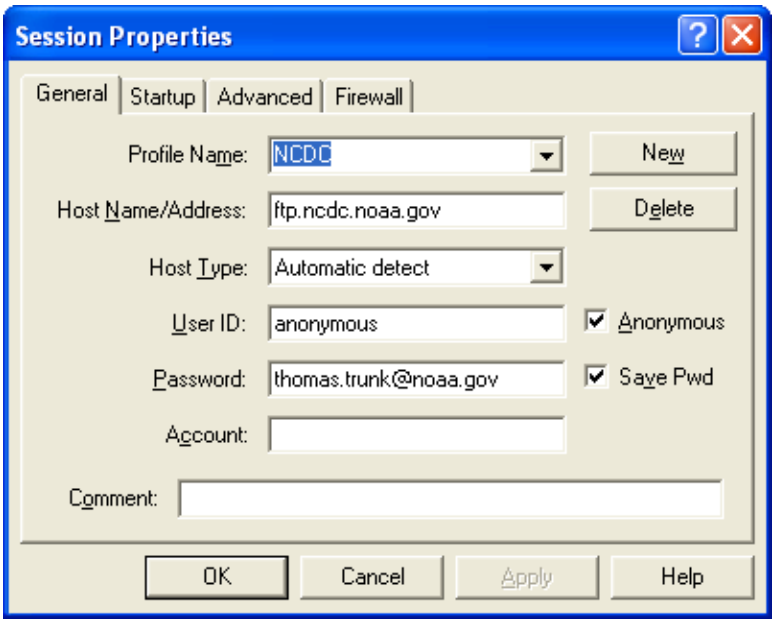

Figure 3.5. Set-up Your FTP Session

Click on the Apply button (on bottom of Figure 3.5, to the right of the 'OK' button) so you can enter your password (do not click on OK, yet call-up the 'Startup' tab immediately it is located on the top of Figure 3.6) to advance the session. The 'Remote Host Directory' will appear in the first line. This is the NCDC ingest webserver folder, and it should appear: **/pub/upload.**

Place your mouse cursor inside the second dialogue box, marked 'Initial Local Folder:' (see graphic, right) and update the default local folder from C:\hpd\2011\may, to C:\hpd\2011\june, by typing in the letters 'june' (below) and clicking on the button Apply.

Finally, while still in 'Session Properties', click on the OK, expect sound-effects (i.e., train-whistle), and the program will quickly update your FTP user-control panel (see graphic, below) as the Session Properties windows closes.

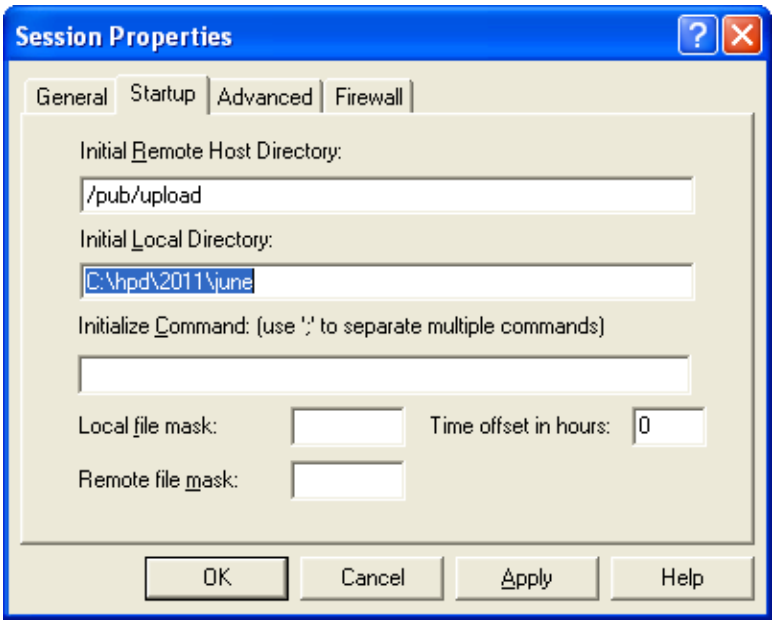

Figure 3.6 Select Your Data Sub-Directory

The FTP twin-pane user-control panel (see, below) is a standard design with the left-pane titled 'Local System', and the right-pane titled, 'Remote Site'. Your Observers' monthly data files are visible in the Local System's left-pane view arranged by filename as they appear in your NWS-network (AWIPS) workstation. The NCDC directory path for data file ingestion appears in the right-pane, under the title, Remote Site.

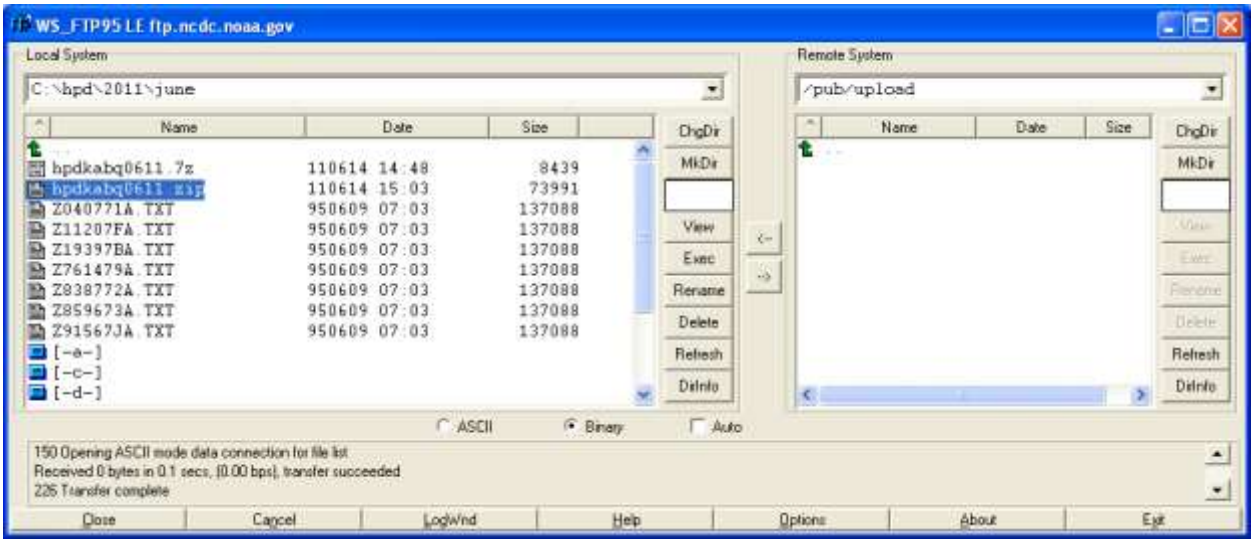

Figure 3.7 Select your ZIP file to send to NCDC

Note: Verify that your ZIP filename is properly coded and spelled: **hpdkxxxMMyy.zip** is the proper code, where 'kxxx= is your 4-letter WFO identification (e.g., kabq for Albuquerque), and 'MM' codes for data-month (i.e., 06), and yy= codes for data-year (i.e., 11). For zip files the year 'yy' is always on the end of the filename!

Note: Always name the ZIP file with the same month designation as the Collection Month of the observed precipitation data being reported to NCDC! You may call-up a full view of the precipitation data files to understand which TXT files you have just zipped. Use your mouse – locate the lowest tab in the median of the double-pane window – labeled 'DirInfo'. Click on this 'DirInfo' tab to open the viewer as seen in the illustration, below.

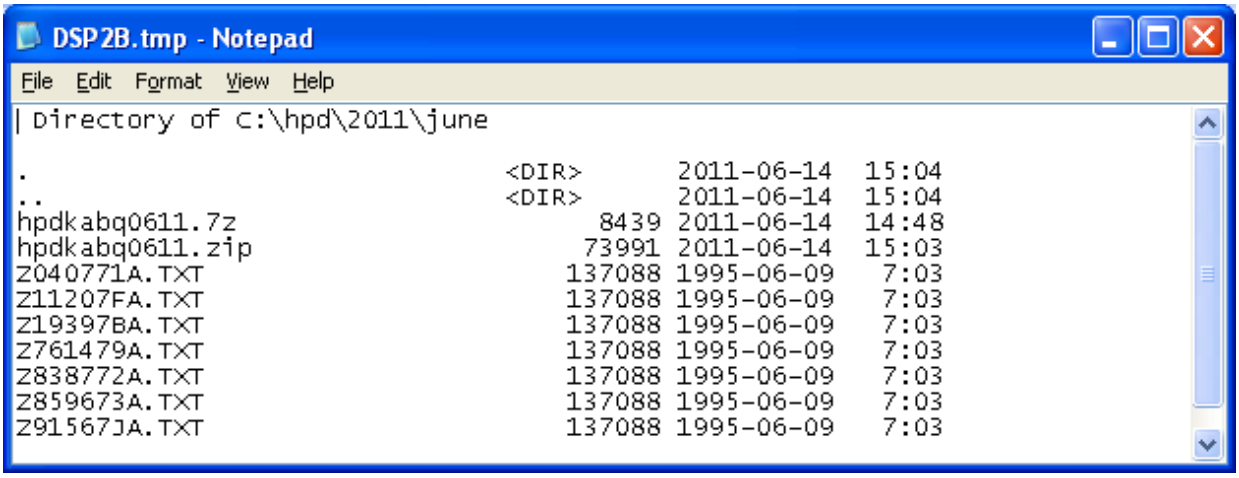

Figure 3.8 Keep the ZIP file saved within the Data Sub-Directory

Ensure that the Local System window displays the relevant month's FPR zip files (e.g., hpdkxxx0611.zip) along with the TXT filenames of each COOP station that sends you monthly FPR data. The Remote Site window will show no files having been uploaded as of this session.

a. **Select** the ZIP file (e.g., hpdknws0611.zip) you will send to NCDC. Even though you use **7-Zip** utility to compress your files, always remember, you **must rename** the file extension to "**.zip**". So, single click with left mouse button on the filename with the '.zip" extension in the left-side window, to select the file.

b. Locate the two small square buttons [←] and [→] that **control** the direction of FTP file transfer. They are located in the vertical median of the twin-pane panel.

c. Click on the right pointing button [→] and you will **transmit** your monthly FPR-ZIP file to the NCDC's data ingest port. Your task is now completed.

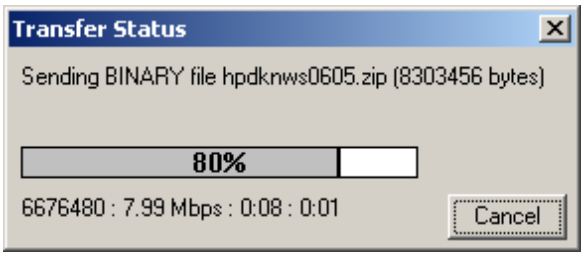

Figure 3.9 Ensure the FTP is successful!

At the 100% transfer complete, audio effects will sound (i.e., several rapid chirps).

d. Click on '**Exit**', on the menu bar at the bottom-right of the twin-pane panel.

e. Click on the receipt file that arrived upon successful transmission, titled "WS_FTP.LOG", highlighted in the graphic, below.

Note: It has been discovered some versions of Ipswitch FTP will not produce this *log* file.

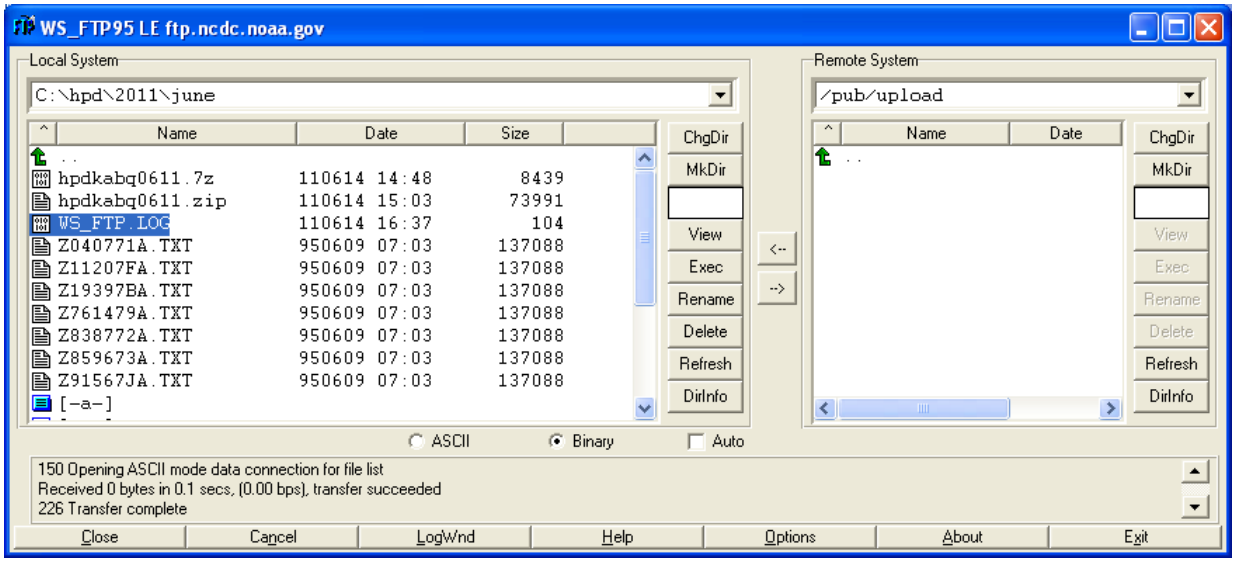

Figure 3.10 Example of a Receipt Message 'WS_FTP_LOG'

Select the WS_FTP.LOG in your subfolder C:\hpd\2011\june\ with mouse cursor (so it highlights), then click on the 'View' tab, to the right, the fourth tab from top of the center median. To produce an 'FTP transmission receipt'. Note the date and time 16:29 Jun 14, 2011.

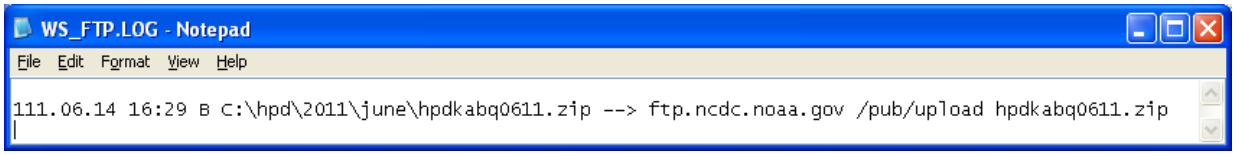

Figure 3.11 Contents of the 'WS_FTP_LOG' message

At NCDC an automated program (Cron job) will be looking for the "hpdknws0611" and the "zip" when it runs once each hour. Any files located will be automatically processed.

Immediately after you have FTP'd your Zip file, use the same utility to call up the 'message log' to confirm your Zip file was successfully received to the /upload/ folder. See the screen display, of the FTP-LE Message Log (see Fig 3.12, below).

Note: Email HPD.NCDC@noaa.gov, if you have any questions on Zip file compression or FTP transmission.

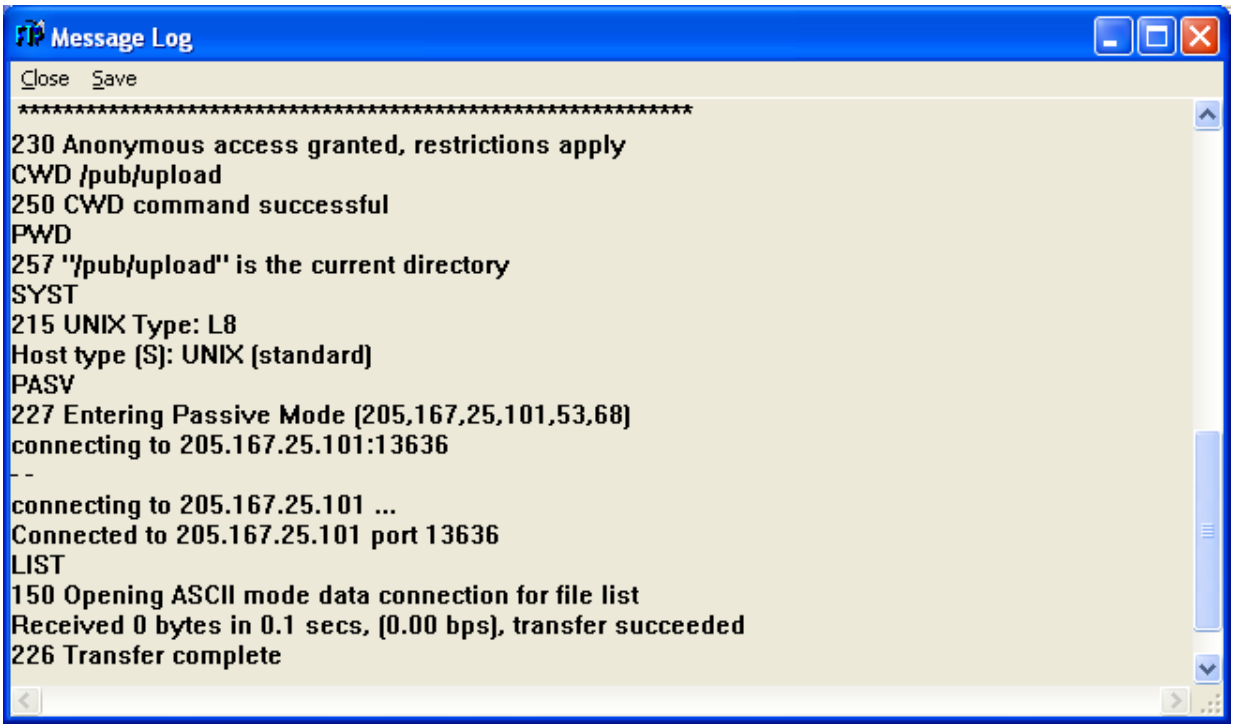

Figure 3.12 Message Log confirms Zip file was received to '/pub/upload'

3.8 Confirm NCDC Has Ingested Your Monthly Precipitation File:

Call up the NCDC website, 'HPD-Received,' the day after you have transmitted your monthly ZIP file. Check for the successful arrival of your monthly FPR data files in the folder that is named according to the month in which you uploaded the file (and not the month of the precipitation observation).

Type the NCDC ingest folder web address with the final portion, YYYYMM (gray shaded), http://www1.ncdc.noaa.gov/pub/data/hpd/inv/**hpd-inventory_201107**.txt ; for the year and month, you uploaded the Zip file to NCDC

For example, July is given in this situation in which you are routinely reporting the June 2011 precipitation files (i.e., HPD data).

Scroll through the reports, until you locate your office ID (e.g., **hpdkabq0611.zip**) with the files unpacked directly below the zip filename. (*Notice the '0611' in the zip file's name…this is proper - you must use the month '06' because this is when precipitation was measured…and the zip filename 'hpdkabq0611.zip' you created to contain all COOP sites for this reporting month*)

3.9 If 'ERROR' Flags Occur then Access NCDC Troubleshooting Guide:

If you do not see your ZIP file on the ingest website, or if ERROR messages appear next to your Log Files that were extracted from the ZIP file, then call up the, "*HPD Digital File Submission Troubleshooting Guide*" and diagnose the problem. Access the guide from the NCDC website:

http://www1.ncdc.noaa.gov/pub/data/hpd/inv/**HPDDigitalFileIssuesPrimer_02122014.pdf**

Try to diagnose if there was a common mistake made. Perhaps a misnamed file extension or you accidentally opened the log file into an Excel environment? Resolve the problem if possible, and resubmit the Zip file to the ingest folder.

Note: If your ZIP data file is still missing, then you need to email the NCDC on this address: HPD.NCDC@noaa.gov.

```
hpdkabq0611_c2011072510.zip    [Mon Jul 25 17:04:05 EDT 2011]:
    OK       Z808576A.TXT
    OK       Z283772A.TXT
    OK       Z718075A.TXT
    OK       Z851874A.TXT
```

Figure 3.13 NCDC Ingest Folder Reveals COOP Sites Received

Now ensure each of your FPR-E sites appears beneath your WFO zip file date line. Look for their COOP number (e.g., sites are 5678, 0890, 2177, and 3524). Each line should end with an ”OK” and not a “ERROR ” If “ERROR” appears analyze your Zip file to see if you accidentally zipped the folder rather than just the data file. If so, then re-Zip, and transmit data.

To prevent any problems with successful upload of data to NCDC, you should review the NCDC’s publication, *“HPD Digital File Submission Troubleshooting Guide.” It is available from their website:*
http://www1.ncdc.noaa.gov/pub/data/hpd/inv/HPDDigitalFileIssuesPrimer_02122014.pdf

If after you have analyzed and tried to resolve the problem, and your Data Files are still not appearing on the NCDC webserver, then email NCDC.HPD@noaa.gov to inform them. They may advise you contact the Sterling Field Hotline, NWS.SFSC@noaa.gov, to resolve the issue.

3.10 Monthly Timeline of FPR Tasks:

Day of Month	Countdown to FTP X-mission	Task to perform.
Jun 25th	T – 31 days	Access the http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_201106.txt website to confirm NCDC has received your precipitation data Zip file. (**Section 3.8**)
25th	T – 31	Mail back the Flash Drives to the Observers who mailed them.
July 1st	T - 24	Prepare a new ***Flash Drive Tracking Table*** for month ending June 30th.
3rd	T – 22	Log first Flash Drive arrival into your ***Flash Drive Tracking Table***. Did the Observer enclose any operational log-sheet or notes?
3rd	T – 22	McAfee virus scan each Flash Drive on same day it arrives. Then plug memory stick into NWS enterprise workstation USB port. Examine TXT file's date/time headings to confirm proper month.
10th	T – 15	Virus scan any outstanding Flash Drives and update the ***Flash Drive Tracking Table***. Identify any missing (late) drives. Check WFO mail inbox to reduce risk of envelopes getting misplaced. Phone the Observer to prompt for the missing (late) flash drive.
July 15	T – 10	Check WFO inbox and retrieve Observer envelopes to reduce risk of being misplaced. Upload any outstanding Flash Drives and update the ***Flash Drive Tracking Table***.
15th	T – 10	Take inventory of TXT files on your enterprise workstation. Examine the date/time fields to ensure the first and last days of the reporting month are present with no missing data.
15th	T – 10	Upload any outstanding Flash Drives and update the ***Flash Drive Tracking Table***. There should be no missing or late cards now. Check WFO mail inbox for any 'found' Flash Drive envelopes. Phone the Observer a second time (first time was on the 10th) to prompt him to mail it!
July 15	T – 10	Mail back the Flash Drives to those observers who have reported their monthly precipitation to you via the U.S. Postal Service.
25th	T – 0	Confirm all Flash Drives were received and McAffee virus scanned (PC/laptop) - then update the ***Flash Drive Tracking Table*** as necessary. Ensure all TXT files were saved to your proper month HPD folder in the NWS enterprise workstation.
25th	T – 0	ZIP all the TXT files submitted this month, to form a single bundled ZIP file.
25th	T – 0	Important: Ensure the filename is spelled properly. **Example: hpdkxxx0611.zip** Where the **kxxx** is the WFO site ID (e.g., kohx); the **06** is the data-filled month (June); and **11** represents year 2011.
July25th	T – 0	Report to NCDC all the sites monthly data with one ZIP file via F.T.P.
25th	T – 0	Access the http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_201107.txt website to confirm NCDC has received your FPR sites' monthly TXT files. (**Section 3.8**)

25th	T – 0	Delete the older of the two files from each Flash Drive. Strive to keep each Flash Drive holding just one data file, the one most recently downloaded by the Observer.
25th	T – 0	Mail each of your Observers his new Flash Drive. It should contain just one data file on it.

Table 3.3 Monthly Timeline of FPR Data Reporting Tasks

Note: T-0 Denotes the day on which you FTP'd the monthly files to NCDC.

CHAPTER 4 - Quality Assurance and Best Practices

4.1 Data Quality Review:

4.1.1 Data Degradation and Data Outages: Recording rain gauges are prone to a number of factors that challenge the quality of the precipitation record. Small variations on the order of ±0.01-inches that occur several times across 24-hours are common and should not be reported.

Evaporation is the most common issue, and less common are lawn sprinklers or objects that fall into the collection bucket. If the Observer informs the NWSREP of something that could cause errors in the precipitation record, then upon receipt of the file, the NWSREP uses the FPR Plotting Macro and then views the data file in Notepad, and if validated as a data problem, the NWSREP notifies the SFSC with an email of the effected file.

Bent, broken, and over-tightened flexures will result in a diurnal oscillatory pattern in the precipitation data (Figures 4.2 and 4.3). Rain gauge platforms that are not level and weighing assemblies that are misaligned will stress the flexures and corrupt the data. See Chapter 5, Routine Maintenance, for guidance on replacing flexures and leveling the rain gauge.

These events need to be documented by the WFO and communicated to the SFSC, and if warranted an Error Report submitted to NCDC via the Datzilla website. See Section 4.1.3, for NWSREP policy to report data errors.

Oscillations, drifts, or spikes in data that exceed ±0.04-inches should be reported to the Sterling Field Support Center (SFSC), NWS.SFSC@noaa.gov . Include a copy of the TXT or Notepad file with the data aberrations.

Data outages can be a problem if the solar panel is not getting full sunlight for eight hours per day. The FPR-E solar panel size is small, and several COOP sites situated in wooded areas in winter have experienced many hours of shaded conditions. The lack of recharge has led to a dead battery. You are advised to relocate the solar panel, or if not possible, consult with SFSC to determine the next course of action.

4.1.2 Check Data with Graphical Plotting Macro: The NWSREP confirms the Observer submitted a file that contains the most recent reporting month with no major quantities of data missing, before transferring the data to NCDC. To accomplish this quickly, the NWSREP applies the "FPRE_PlotData_V1_3.XLS" macro to get the full view of the last 100 days of recorded data.

The plotted chart (See Figure 4.1) enables the NWSREP to quickly determine if there is an issue with data quality – either missing data or aberrant data.

The 'FPR Plotting Macro' was developed by NWS Engineering and Acquisition Branch and made available on website: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm.

Caution: Once you run the plotting macro, do not save the file! The TXT/CSV files must remain unaltered and never opened into an XLS format! Therefore close the macro, and respond 'no' to the save-prompt.

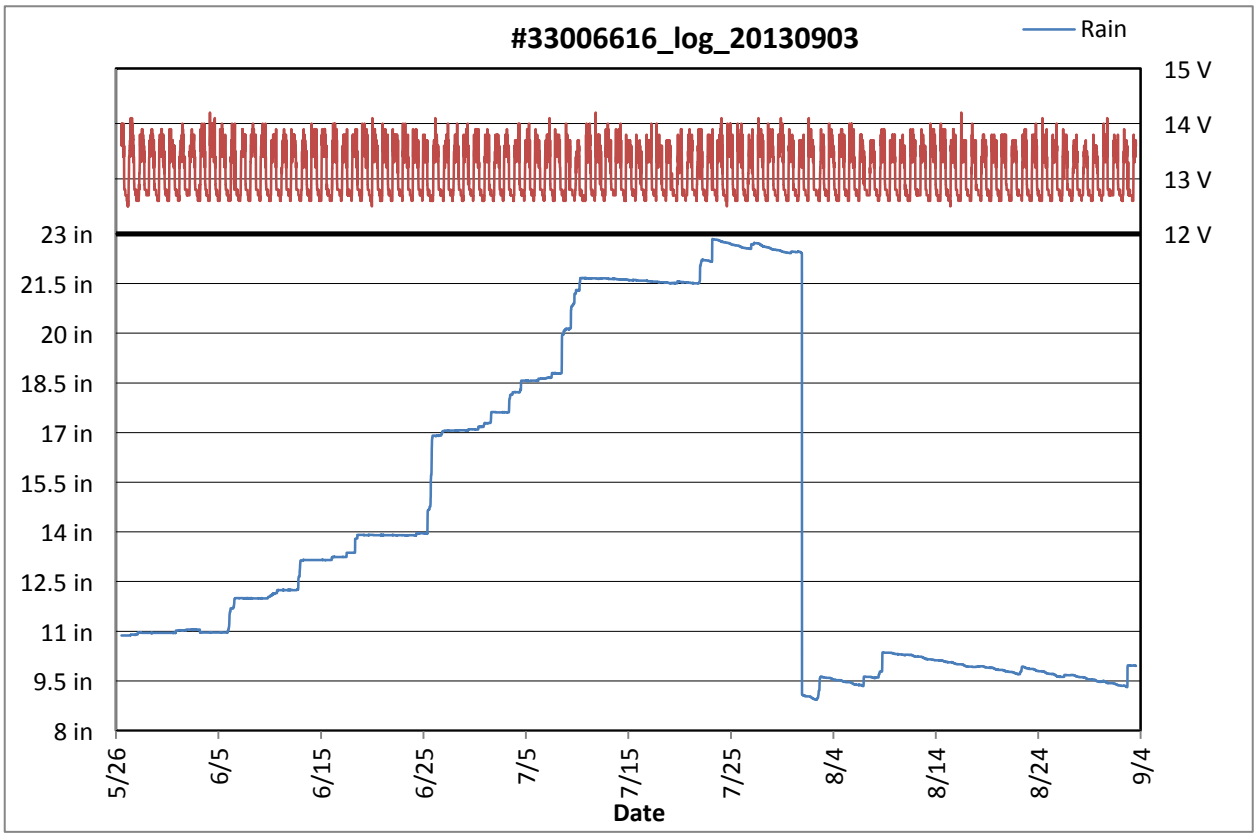

Figure 4-1. FPR-E Plotting Macro Plots Bucket Levels and Voltage

Look at the data with a plotting program "FPRE_PlotData_V1_3.xls" to verify the following:

- The data is smooth and continuous, not noisy, disjointed, or has other problems.
- The battery voltage is being maintained by the system.
- Evaporation is not evident in the data.
- Bucket level is not more than 15 inches.
- If there is a problem in the data file; does this problem fit a pattern from the same Observer?

Also, look at the data in a text viewer like Notepad to verify:

- The date/time of the start and end points of the data file are correct.
- The data file possesses proper filename, station number, Year/Month/Day.
- There are no data missing data problems, no garbled data; and there are no zeroes filling the pages.

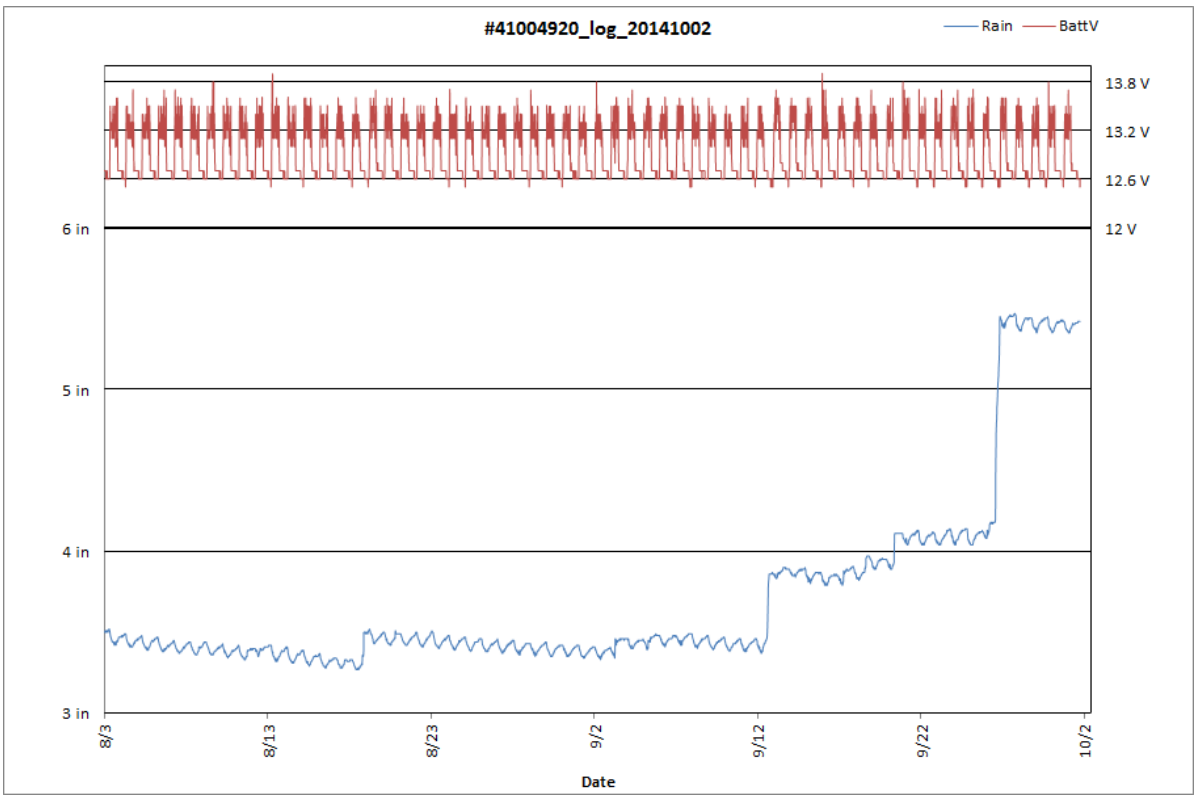

Figure 4-2. Report Noisy Data (Oscillations Exceed ±0.04 Inch) to SFSC.

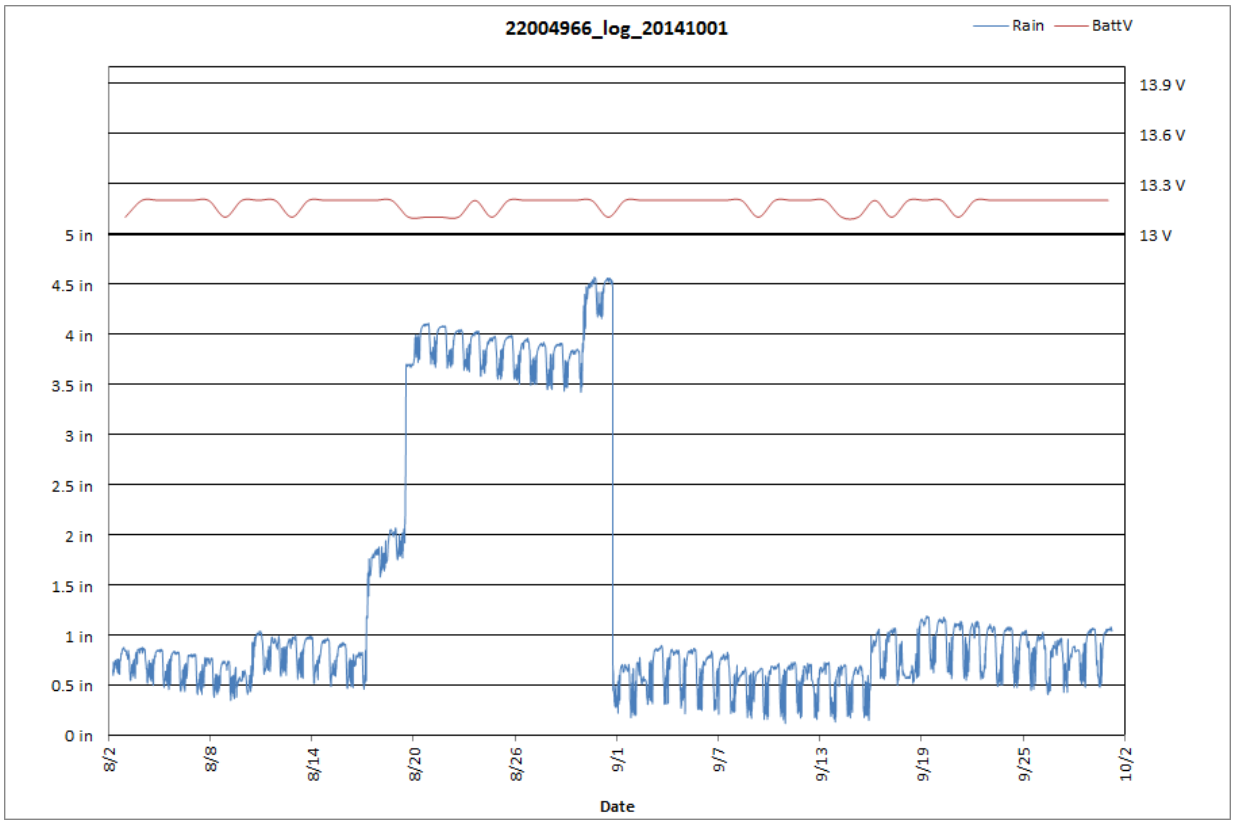

Figure 4-3. Report Bad Data (Oscillations Exceed ±0.10-inch) to NCDC.

Obtain a copy of the **FPRE_PlotData** Excel program from the NWS HQ website: http://www.weather.gov/ops2/Surface/coopimplementation.htm

4.2 Reporting Bad Data to NCDC:

The NCDC has advised NWS the best practice to account for bad or missing FPR precipitation data is to report the event into the Datzilla system. First coordinate with the Sterling Field Support Center, via email NWS.SFSC@noaa.gov, to report the problem with your rain gauge or precipitation data. Inform them you seek to change the official NCDC precipitation record.

The Datzilla system enables registered users to flag specific range of observed data as bad, and ensures that NCDC will have a permanent record of the problem. It is a web based interface that allows select partners (including WFOs) to request changes to the NCDC datasets to ensure the accuracy of the official climate record.

You may access the system, http://datzilla.srcc.lsu.edu/datzilla/ and if you do not have a Datzilla account notify your Regional Cooperative Program Manager (RCPM).

Datzilla also allows you to search and review previously entered reports – ones you have entered and reports other offices have entered, before you report an error. This function will not be described here, however, you can use the word 'FPR' as a keyword to get a sense for phrasing your error report.

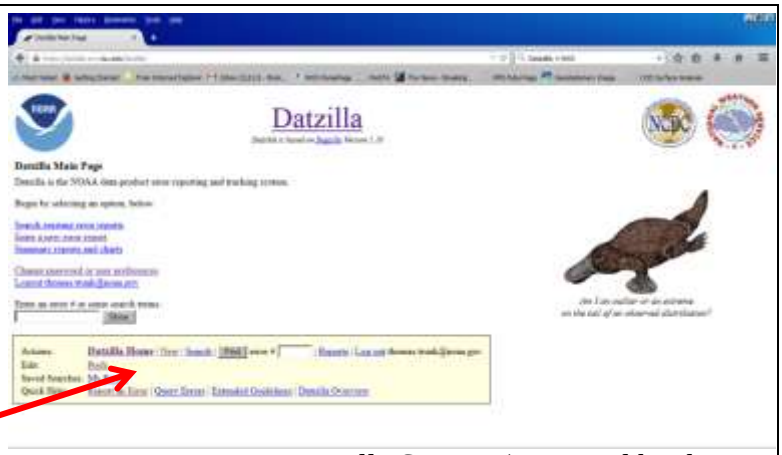

Figure 4-4. Log-in to Datzilla System (Managed by the Southern Region Climate Center).

a. After log-in, click on the word, 'New' in this panel.

The next panel opens.

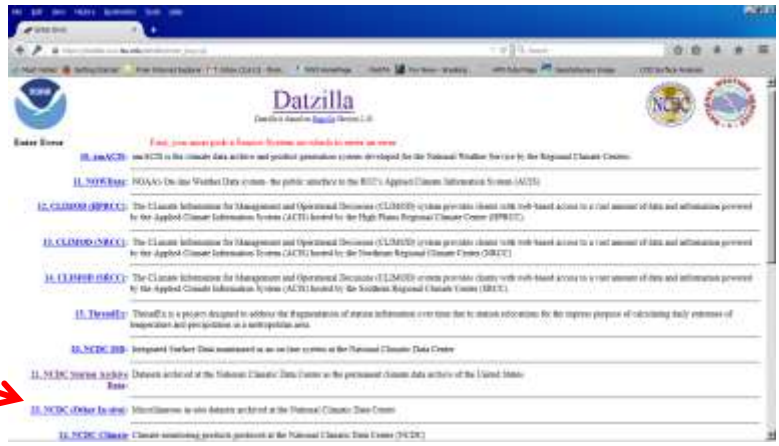

Figure 4-5. Click on #21, *NCDC Station Archive Data*.

b. Click on number '21. NCDC Station Archive Data.

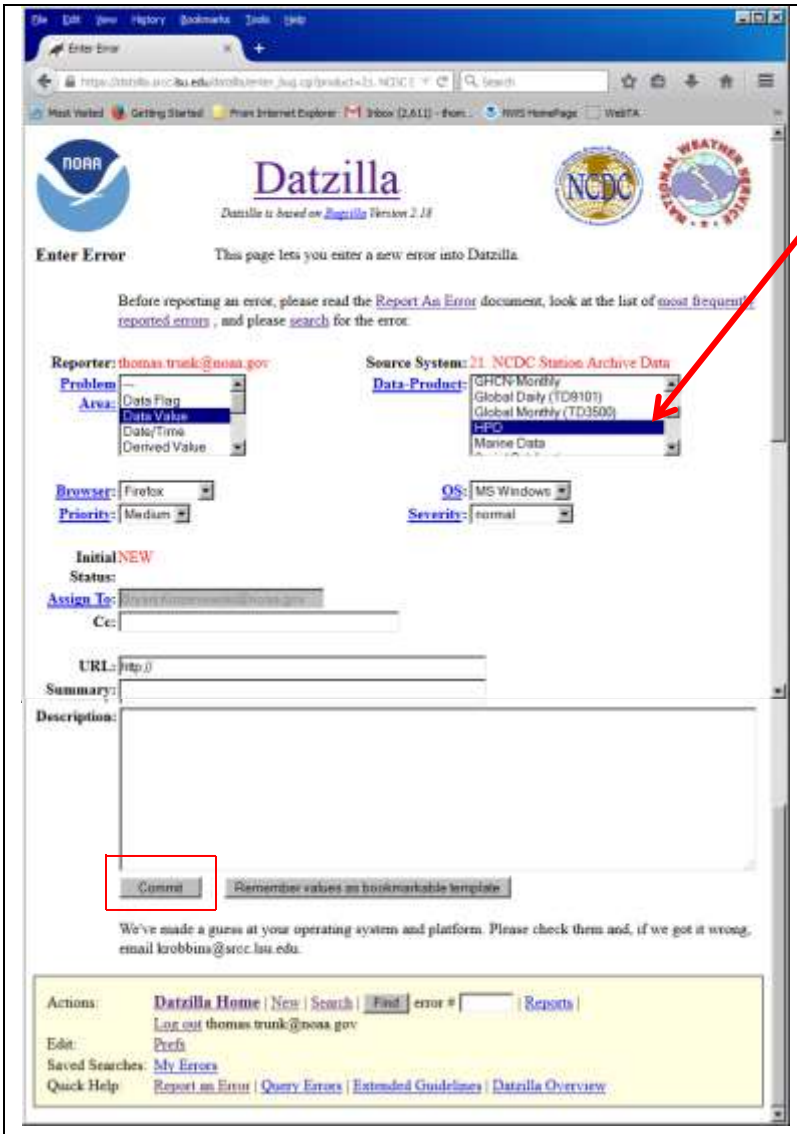

Figure 4-6. Datzilla System for Reporting Errors

c. Select, "HPD" for the **Data-Product**, window.

d. Write a short description in the **Summary:** window (i.e., Gauge Bucket Overflowed)

e. Write a detailed description in the **Description:** large window. Give the date/hour of the event and the range of data affected by the event.

f. Click on the **Commit** button to create a 'Ticket."

g. You will receive an Email from Datzilla, to which you can respond with attached files.

h. Attach the precipitation monthly data file (i.e., **Z4576AHA.TXT** file) to the Ticket (email), and

i. If available, attach the *FPR Log Sheet* (ms-word.doc) to provide maintenance history for this specific rain gauge.

4.3 Data Acquisition Management (Flash Drives and Emailed Files):

Establish strict logistics management of all your sites Flash Drives through use of a Flash Drive Tracking Table (Figure 3.1) posted in your WFO. See Section 3.2, of this manual, for more on the Flash Drive Tracking Tables.

Carefully follow the instructions given in this manual, in Section 2.8, to ensure timely and efficient collection and storage of all the FPR-E monthly data files.

Offer your observers the opportunity to email the monthly precipitation data to your NWSREP email address. See qualifications for email participation, found in Section 2.7 of this manual.

Spare Flash Drives: At the time the FPR-E was installed at the Observer's property just one government issued USB Flash Drive was provided the Observer. Ensure you have a minimum

quantity of spare Flash Drives one spare for each Observer who uses the postal service to mail you the monthly data. Spare Flash Drives should not be larger than 2GB, and not require any special formatting.

4.4 Quality Assurance Checklist:

Use these 'best practices' to prevent transmission of incorrect monthly files, improperly named files, and prevent a disorganized exchange of Flash Drives. These guidelines need to be stressed when you train a new person on FPR-E tasks.

4.4.1 Log-in the Flash Drives and E-Mails that arrive each Month:

- Establish a Flash Drive Tracking Table template; update and print it monthly
- Consider a QA Log Sheet for broader, more general FPR responsibilities
- Establish firm time-table, routine
- Perform Quality Assurance review of the monthly data files (see 4.1)

4.4.2 Transmit to NCDC:

- Assure all FPR data files are FTP'd to NCDC in sufficient time to meet the deadline of the 25th day of Month
- Do not e-mail the FPR data files to NCDC.
- Check NCDC Inventory web site to confirm NCDC receipt of all of your FTP'd files
- http://www1.ncdc.noaa.gov/pub/data/hpd/inv/hpd-inventory_201108.txt (see Section 3.8 of this Manual)

4.4.3 Data File Retention and Availability of Ready Reference Instructions:

- Save the FPR-E precipitation data files (e.g., Z5678AHA.TXT) for at least 36 months on the network workstation. Retain these data files with their original filename and format! The NCDC may need you to resend missed data and SFSC may request past data to complete a trouble ticket.

- Save the *FPR Log Sheet*, or any *Flash Drive Tracking Table*, for 12 months.

- Make available the Instruction and Policy Manuals with a Browser Bookmark: Save this address: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm for ready access to FPR-E manuals and FPR-E policy directives issued by NWS headquarters. Update this bookmark every 6-months.

4.3.4 Set a 'Best Practice Policy' for your WFO to handle all the FPR stations.

- Establish expectations with Cooperative Institutions.
- Establish consistency
  - Schedule firm cut off for routine receipt
  - Follow-up on missing Data Emails, and Flash-Drives consistently
  - Establish deadlines, patterns with Observers

4.3.5 Perform Quality Assurance Review:

- Have there been quality improvements (observer) for same site?
- Log problems at the WFO to establish patterns
- Read and take action on any FPR Log Sheet that is submitted by the Observer.
- Determine QC corrective procedures. Is there something NCDC can do; or recover?
- Schedule your QC. Does NCDC need to be specially notified about this Station's data?
- Follow-up with your Observer, and with NCDC if needed.

CHAPTER 5 – Routine Maintenance

5.1 Preparing for Semi-Annual Site Visitation:

A day or two prior to your trip, call up the Site **Inspection Report** and review the results of your last inspection. Call up any other ready reference you may have, such as FPR Log Sheets you may have received from the observer.

Phone the observer to ask if he or she has any special needs with regard to the FPR-E operations. Does the observer have any bucket maintenance responsibilities? If so do they have a hardcopy or softcopy of the FPR Log Sheet? Does this site require multi-gallon containers or instructions for the proper disposal of bucket liquids? Does this observer use the Postal Service to report the monthly precipitation data? If so, does the observer need mailing supplies (i.e., Jiffy envelope)?

Check the NWS web site, www.nws.noaa.gov/ops2/Surface/coopimplementation.htm, to see if there are any Mod Notes that may apply to the FPR-E equipment at this site. If the 12V battery needs to be replaced, you will need to modify the battery cables (i.e., COOP D111E Note 2).

For general policy on COOP site visits, access Appendix B, **Visitation Procedures**, in NWSI 10-1307, *Cooperative Program Management and Operations* (Aug 2012). This directive is located on the NWS web site: http://www.nws.noaa.gov/directives/sym/pd01013007curr.pdf.

Note: Offices with 10 or more sites with FPR-E gauges may benefit from creation of an electronic logbook that comprises FPR calibration data, supply inventory, and special notes.

5.2 Semi-Annual Visitation Checklist:

SEMI-ANNUAL MAINTENANCE AND CHECK POINTS		
What to Check	**How to Check**	**Precautions and Remarks**
1. Overall Appearance	Observe paint finish, or evidence of vandalism.	Clean oil film from the outside of gauge using nonflammable liquid detergent.
2. Weather Stripping around Base Plate and Access Door.	Check for breaks or general deterioration. Weather stripping is used around Base Plate (ASN part D111-1MS100).	Replace as needed the weather stripping or door gasket. Cut base plate weather stripping to about 50 inches.

3. Horizontal and Vertical Flexures in the Weighing Mechanism.	A quick glance will reveal the condition of the four horizontal flexures. If any are bent, broken, or binding it might affect gauge calibration. Ensure you replace any horizontal flexures which are 'v-shaped.' The upper-rear flexure (ASN part D111-SP112) is most susceptible to bending.	Use the smallest test weight of the D111-500TE set to ensure the Precipitation display shows a change in current values. If it does not change, the flexure(s) should be replaced.
4. Funnel	Use the funnel in warm season. Remove funnel for winter season when snow or freezing precipitation is expected.	On the *FPR Log Sheet* check boxes, 'Funnel-Out'. Reinstall funnel after winter season then check, 'Funnel- In.'
5. Charging Collection Bucket – Warm Season Operation.	Collection bucket is charged for warm season by adding one-half quart of oil (ASN part, '014-O-15); to retard evaporation.	Before charging bucket, remove any foreign material and clean the interior surface.
6. Charging Collection Bucket – Cold Season Operation.	When collection bucket is charged for winter weather, add two quarts of FGPG, (ASN part # D111-153) then add one half-quart of oil. For exact amount see Table 5.2.	For colder climate sites where temperatures drop to 15°F and colder, more FGPG needs to be added when collected rain and melted snow dilutes the FGPG concentration. Refer to Table 5.2, for the number of quarts to add as the bucket level rises.
7. Draining or Emptying the Collection Bucket	The collection bucket is drained when the display indicates **15 inches or more.** See NWSM 50-5116, section 2.11.1, for rules on disposal.	Revise *FPR Log Sheet* by marking box 'Add FGPG' and if oil was added, 'mark the box 'Add Oil.' Before you start any action, press the display

	The used-oil contractor will usually accept this oil-propylene glycol mixture. Ensure the Observer has one printed copy of the Material Safety Data Sheet (MSDS) for the Oil. The MSDS can be printed from the CLS parts ordering website. See NWSM 50-5116, section 2.11.1, for rules on disposal. The used-oil contractor will usually accept this oil-propylene glycol mixture. Look to check behind the Zeno Assembly to ensure the load cell is hanging – and not fallen off its S-Hook.	button to learn the level in the bucket. Journal this number to *FPR Log Sheet*. Mark the *FPR Log Sheet*, 'Bucket emptied' or 'Partial Drained' if cleaned, write in notes section: 'Cleaned Bucket'. When you have completed all bucket re-charging actions write the new value of the precipitation display (or dial reading) to *FPR Log Sheet.* Complete loss of data results when the S-Hook (and load cell) fall off their mounting. This can occur when Shipping bolt is extended or when bucket is removed from force post.
8. Calibration Check	At least once per year, use the brass test weights to check the sensor calibration at 5.0 inches, 10.0 inches, and 15.0 inches.	Refer Chapter 6, of the *FPR-E Operations Manual,* for instructions.

Table 5.1 Semi-Annual Maintenance and Check Points

5.3 Winter Operation:

Minimize the risk of damage to the collection bucket from freezing of the bucket fluids. When water freezes it expands and presses the bucket walls and can crack the floor of the bucket.

a. At the start of winter, remove funnel from the cone shaped hood. Remove the hood, tip it upside down. Rotate the funnel so its slots allow it to slide free from the three pins. Store the funnel in the base of gauge. Make a note in *FPR Log Sheet* that funnel was removed for winter.

b. Empty the collection bucket with the drain tube into a multi-gallon container. **Caution:** A full bucket can weigh 40 pounds. Always be careful when unhooking the drain tube from the rim of the bucket – seal the end and lower the plastic tube into the container, before releasing the pressure. Be patient, as it may take more than five minutes to drain a full bucket.

Note: To conserve oil in the bucket you may partially drain the bucket, rather than completely emptying the bucket. A partial draining should result in a minimum quantity of liquids that measure approximately one-inch deep in the collection bucket.

c. Clean and dry the empty bucket. Return bucket to its position on the force post.

d. Initial charge: Into the empty bucket, pour an amount of FGPG as specified by one of the three temperature categories listed in this table. Choose the category that offers protection against the coldest condition possible for the site. Make an initial charge of 1.0 quart of FGPG if the coldest the site could get is 15ºF.

Coldest Temperature	Initial charge and subsequent charges of FGPG. Each time the Zeno Display rises and reaches: 3.5 inches, 7.0 inches, 10.5 inches, and 14.0 inches, then add this amount of FGPG.	To Maintain this Concentration
+ 15º F	1.0 quart	25%
0º F	1.5 quarts	35%
- 30º F	2.0 quarts	50%

Table 5.2 For Increasing Display Levels – Add More FGPG to Bucket

Note: An initial two quarts charge of food grade propylene glycol (FGPG) produces a height of just one inch in bucket. Never use commercial anti-freeze and do not add water.

e. Subsequent Charges: When the Zeno Display shows the level has reached 3.5 inches add the specified amount of FGPG; for example the coldest category sites (- 30ºF) require 2 quarts be added. Always add the same amount as the initial charge. If you had not serviced the bucket at either 3.5 inches, or 7.0 inches, or 10.5 inches and now notice the bucket holds 11 inches, and you are in the coldest category, then pour six quarts of propylene glycol to maintain the 50% concentration. To prevent the bucket contents from ever freezing add FGPG per the schedule in Table 5.2, each time the level reaches 3.5, 7.0, 10.5, and 14.0 inches.

f. Install one-half quart of oil after the initial charge of FGPG. For sites more prone to evaporation, these include tropical sites and sites with windy conditions with low relative humidity; ensure a film of oil is visible after draining water/FGPG mixture. Use NWS supplies, only.

g. Make no adjustments to the gauge after FGPG and/or oil has been added.

h. Document the date and hour each time the bucket was charged with FGPG and/or oil. Remember to journal this action into the *FPR Log Sheet* (Appendix F).

If you have a site where you are fully confident they can assist you, then train them in the agreed to maintenance actions and provide them with the necessary supplies and forms. Inform the Observers that all check-ups and bucket discharges shall be conducted in dry weather only.

5.4 Warm Season Operation:

In spring or early summer, remove the hood and inspect the contents of the bucket with a mixing stick (i.e., paint stirrer). Remove and properly dispose of any leaves or debris that might have collected when the funnel was removed at start of winter season. Then with the stick, ensure there is still a one-quarter inch film of oil on the surface to inhibit evaporation. If the Zeno's **Display** value exceeds **15.00 inches** on the day you are installing the funnel then perform a partial emptying of the bucket by keeping the oil from running out the drain tube. Add FGPG if local conditions require.

To install the funnel remove the conical hood, turn it upside down, and fasten the funnel by rotating its three slots onto the three pins of the cone shaped hood. Return this hood assembly to the gauge. Check the box 'Installed Funnel' in the *FPR Log Sheet* .

5.5 Observer Delegated Actions:

Some offices have an agreement with Observers to assist in basic works of maintenance on the FPR-E. Consider asking your Observers if they could conduct the following activities:

- Draining and recharging the collection bucket
- Installing/removing funnel
- Cleaning the solar panel

5.5.1 Delegated Responsibilities: If your Observer has agreed to take-on routine maintenance activities, then the Observer also must agree to take on the responsibility of writing journal entries to the *FPR Log Sheet*. The Observer shall follow the instructions for completing the *FPR Log Sheet* (Appendix F) whenever the buck is drained, emptied, or the fluid levels in any way are altered. Likewise whenever Food Grade Propylene Glycol (FGPG) is added to prevent freezing, or oil is added to retard evaporation. The Observer will write these actions to the *FPR Log Sheet.*

Then on the next available routine monthly mailing after these actions, the Observer will enclose a hard copy of the *FPR Log Sheet*, into the same mailer-envelope as the Flash-Drive, and mail to the attention of the NWSREP. If the Observer uses e-mail, he will attach a softcopy of *the FPR Log Sheet*, as a separate file, when he emails the monthly data file.

Before Observer Begins Maintenance Activity: Observer needs to obtain the *FPR Log Sheet*, and write down the current Date (MM/DD/YYYY), and Start Time (HH:MM, for local 'standard' hours, i.e., do not use Daylight Time values). The Observer then writes down the 'Amount' that appears in the display – this is the bucket level that is about to change.

Maintenance Activities to be Noted: Observer moves to Column 3, 'Routine Actions,' and marks off one or more of the Check Boxes that describe this maintenance action.

Types of Maintenance Activities:

- Partial Draining of Bucket: Drain the bucket into a sealable container. When finished, return the drain tube to its operational position, and in the same row of the *FPR Log Sheet* write down the Stop Time, and the Amount that now appears in the display. Make sure you marked the box, "Partial Drain" in the 'Routine Actions' column. See example in Appendix I.

- Emptying of Bucket: Empty the bucket into a sealable container. When finished, return the drain tube to its operational position, and in the same row of the *FPR Log Sheet* write down the Stop Time, and the Amount that now appears in the display. Make sure you marked the box "Partial Drain" in the 'Routine Actions' column.

- Added FGPG (Winter): Add one or more whole Quarts of Food Grade Propylene Glycol (FGPG) to prevent seasonal freezing of the bucket fluids. Make sure you marked the box 'Add FGPG' in the 'Routine Actions' column.

- Added Oil: Add one quart of Oil to the bucket to retard evaporation of the collected precipitation liquids. Make sure you marked the box, 'Add Oil' in the Routine Actions, column.

- Removed/Installed Funnel: Remove the funnel at start of winter season, and install the funnel at start of summer season. Make sure you marked the box, 'Funnel In' when you are installing the funnel. Make sure you mark the box, 'Funnel Out' when you are removing the funnel in the Routine Actions column.

- Removed Object from Bucket: Twice yearly inspection of the contents of the bucket is advised. If you find an object, such as a pinecone, bird, or small animal, proceed to empty, rinse, and towel dry the bucket. Then describe the object that was removed, with a written entry to the 'Special Notes' section (Log Sheet, Column 5).

- Cleaning of Gauge Exterior: Use a damp cloth or paper towel with rubber gloves to wipe clean the exterior surfaces of the access door, lower casing, and the hood.

5.5.2 When Observer Reports a Technical Fault or Error Message: Phone the Observer and inquire into the nature of the event s/he reported on the *FPR Log Sheet.* Analyze and understand the history of installation, implementation, calibration data, maintenance actions, and seasonal weather conditions that might have contributed to the reported event. Does the event involve a faulty or broken system component that could be resolved with a maintenance visit?

Phone Sterling Field Support Center (SFSC), on 703-661-1259, or email nws.sfsc@noaa.gov, if there is a system technical error. Inform your RCPM to report what type of maintenance action was necessary. See Chapter 7, System Troubleshooting and Repair, of this *FPR Operations Manual*, for general policy on trouble shooting and see Appendix E, for guidance on returning bad parts.

FPR LOG SHEET

Forecast Office (SID): TAE COOP Station Name: Pinetree State Park (01-5678) Your NWSREP Name: M. Jones

Date MM/DD/YYYY	Time hh:mm am/pm	Amount NN.cc	Routine Actions	Special Notes (i.e., displayed error messages, etc.)
03/28/2014	Start: 10:15 am Stop: 10:45 am	15.47 02.75	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☒ Partial Drain Funnel - ☒ In ☐ Out	
06/14/2014	Start: 4:15 pm Stop: 4:45 pm	8.72 8.72	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☐ Out	'Err 12' message displayed. Phoned NWSREP.
09/28/2014	Start: 2:30 am Stop: 2:45 am	10.39 10.39	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☒ Out	Wiped down the F&P shell to remove dust.

Fig 5.11. Observer is Required to Use the *FPR Log Sheet*, when Authorized to Drain Bucket, Add Food Grade Propylene Glycol (FGPG), Add Oil, or Change the Funnel.

5.6 Journal Responsibility:

5.6.1 Bucket Maintenance – Journal Entries: When routine maintenance activity changes the weight of the collection bucket – the precipitation record for the climate program is at risk of data corruption. To avoid damaging the climate data record, changes in the bucket level have to be accounted for with a written entry in the *FPR Log Sheet*. Each time you or your observer add Food Grade Propylene Glycol (FGPG) for winter season – this must be accounted, and when the one-half quart of oil is added to the bucket to prevent evaporation write an entry to the *FPR Log Sheet*. Appendix F, gives an example with instructions on how to journal these important interruptions in the data record to the *FPR Log Sheet*.

The *FPR Log Sheet* is formatted so you can mark with a pen multiple boxes for a given maintenance job, and simply report the Start Time, Stop Time, the corresponding Bucket Level (i.e., display reading), at start and finish of the maintenance.

5.6.2. Bucket Capacity: The bucket's capacity is about 20 inches of precipitation or 4.9 gallons. Advise the Observer to daily monitor the Zeno's **Display** readings and to phone you when it surpasses **15.00 inches**, at that time the collection bucket needs to be drained. Always schedule the bucket draining to be done when weather is dry, when no precipitation is forecast for either the day before, or the day of, this important maintenance.

If your Observer has agreed to conduct the bucket draining or emptying, then remind him/her to always **make note of the Level in the bucket to the *FPR Log Sheet*.** Also, have him/her write down the Day/Hour/Minute the Bucket activity was started and completed, and write down the new Level in the bucket.

Note: Remind your Observer to mail you the ***FPR Log Sheet*** as soon as the next monthly Flash Drive is mailed. You should enter his maintenance actions to your SIS site inspection report for continuity of records.

⚠ **Caution:** When the Shipping Bolt is used in times of Bucket removal, you risk the S-Hook falling off its mounting and the sensor giving negative values for the levels seen in the Zeno display. Take careful observation of the S-Hook when you are placing the bucket back on the force post. In most circumstances the removal of the bucket or draining fluids from the bucket will not result in the S-Hook falling off.

5.6.3 System Discrepancies Noted: The observer should always journal to the *FPR Log Sheet* any error code that appears in the display. A list of USB error codes appears in Section 7.4 of this manual.

Drifting clock time is another important discrepancy to note. This can occur when the small internal battery loses charge. Small errors of several minutes are tolerable, however errors that are ten minutes and greater need to be reported to the NWSREP for response.

5.7 Rain Gauge Supplies:

These quantities will vary as a function of the amount of precipitation a site receives in a given season. Phone your Observer and ask if the gauge requires any special servicing: :

- One quart of oil might be consumed each year.
- Three 2-quart containers of Food Grade Propylene Glycol might be consumed each year.
- One multi-gallon sealable plastic container available to discard bucket fluids.

5.8 Solar Panel Exposure Issues:

If any part of the FPR-E solar panel is shaded, the panel may shut down and not deliver any power to the logger. The solar panel is comprised of multiple solar cells connected in series to give the voltage needed and then in parallel to give the power needed.

The solar panel gets mounted for full sun and not in the fringe area under trees or behind guy wires or tower supports. The FPR-E is supplied with a 15-foot connecting cable. The cable can be extended as far as needed.

Power problems have been reported where construction or farming resulted in a film of dust coating the panel. The NWSREP trains the Observer to inspect and clean the solar panel, and advises the Observer to inspect the panel on a regular schedule.

5.9 Annual Inspection and Preventive Maintenance:

These ten inspection points should be checked at least once per year.

- **Calibration Check:** Follow procedure in Chapter 6. If any one test point fails, conduct a full reset of the system calibration- as described in Appendix C.

- **Drain Tube on Collection Bucket:** Check for leakage and deterioration of the drain tube. Assure the clip on the end of the tube has a clip that fastens securely to the rim of the bucket. Order new tubing when needed, agency stock number: S100-1A6MP10.

- **Four Horizontal Flexures:** Remove lower casing and examine horizontal flexures for bent appearance. Diurnal saw-tooth pattern in precipitation data is one symptom of bent or binding flexures.

- **Force Post Condition:** Force post should be clean (i.e., understand insects can inhabit this area). Ensure force post never rubs or binds against its access hole in the lower casing. Adjust lower casing if necessary. Force posts that bind result in data quality degradations.

- **Level to True Horizontal:** Ensure the entire gauge is level. Use carpenter's level to adjust the base plate.

- **Door Latches:** Ensure hinges, latches and locks are working properly. If any are worn or broken, order a replacement latches (D111-1MP100) or new door (D111-1A101).

- **Solar Panel:** Ensure the solar panel is not covered by dust, bird droppings, or obstructed by any objects. See Section 5.8 for guidance if solar panel needs to be relocated.

- **Overall Appearance:** If cleaning was unable to restore appearance, then plan to order a casing (D111-1A100-2) and/or hood (D111-1A100-1). Upon replacement plan to have the old equipment repainted at a shop near the forecast office.

- **On-Site Gauge Supplies:** If delegated, ensure the Observer has one quart of oil, and if cold climate, three 2-quart containers of food grade propylene glycol. Does site have a multi-gallon sealable container to hold decanted bucket fluids?

- **Observer Supplies:** If delegated, ensure new *FPR Log Sheets* are on site. If Observer mails Flash Drive through U.S. Postal Service, ensure a 12 month supply of shipping envelopes. Ensure your NWSREP point of contact information (i.e., phone number, email, address) is up to date, and printed for Observer.

CHAPTER 6 – Sensor Calibration Policy

6.1 Rain Gauge Accuracy:

At least once per year, preferably at the time of the semi-annual site visitation, conduct a Calibration Check-Up on the FPR-E rain gauge. This requires the use of the large brass test weights and a lap top computer. You may use one, two, or three test weights, so long as each is the 4,111 gram size. Each weight is equivalent to five inches of rain water.

If the rain gauge tests within the standard calibration range (Table 6.1) you will *not* have to conduct a complete reset of calibration of the FPR-E system.

Follow the steps section 6.2, 'Calibration Check-Up Procedure.' The same procedures are also instructed in Section 20, of the *FPR-E Assembly Procedures* (February 2012). If the Zeno display returns you Display values that fall into the acceptable range as called for by the FPR-E Calibration Check Table (Table 6.1), then you will *not* need to re-calibrate the load cell sensor. If the display gives values outside the criteria given by the Calibration Check Table (Table 6.1), then calibrate the sensor through the ZENO Data Logger's Test Menu. The full calibration reset instructions are also given in Appendix C, of this manual.

Policy requires the calibration check to be performed at least once per year, preferably at time of one of the Semi-Annual visits. Only if the Calibration Check-Up fails to come into tolerance of ±0.25 inch at all three check points, will you need to conduct a full calibration reset with an empty and dry bucket. This requires use of the laptop (Section 1.14 of this manual) to access the ZENO menu system. Otherwise, you should not perform a calibration reset.

6.2 Calibration Check-Up Procedure (After Bucket is Drained):

Before you install oil or food grade propylene glycol for routine operation and while the bucket is still clean and dry, perform this Calibration Check. Take the un-weighted measurement first, and then place the three weights sequentially on top of bucket to test the three reference points.

Note: To reduce the waiting time, you are instructed to speed-up the Zeno's sampling rate from once per 15 minutes (900 seconds) to once every 10-seconds. For instructions on this temporary change, see Appendix C, Section 1.2, of this manual. Caution, if you fail to return system to 900 seconds, then memory will be consumed and system will not compile a full month's record!

a. Take the hood off. Lay a carpenter's level across top. This will keep the brass weights dry if you have already placed oil or food grade propylene glycol in the bucket.

b. Activate the display by pressing the button on the side of the ZENO Assembly. Write down this reading in hundredths of an inch to a piece of paper.

Figure 6.1 Brass Weight on Top of Bucket

c. Place one brass weight (4111g size) upon the carpenter's level.

d. Wait 30 seconds, look at the display and write down this value to hundredths of an inch and subtract from it the value you wrote in Step "b." This is value of the Calibration Test Point for the **5.0 inch** equivalent rain.

e. Compare this value obtained in Step 'd.' with the acceptable range values given in Table 6.1, for the test point of 5.0 inches. If it fails, you will have to perform a full calibration reset.

f. Add a second brass weight (4111g) to the carpenter's level, to test the accuracy of the sensor for the **10.0 inch** test point. Follow the same procedures in Steps c., d., and e. If it fails at 10.0 inches you need to perform a full calibration reset.

g. Add a third brass weight (4111g) to the carpenter's level to test the accuracy of the sensor for the **15.0 inch** test point. Follow the same procedures in Steps c., d., and e. If it fails at 15.0 inches you need to perform a full calibration reset.

⚠ Always remember to return the Sample Interval Time back to 15 minutes (900 seconds) once you have concluded the calibration check. For instructions on how to change the Sample Interval Time, see Appendix C of this manual, Section 1.6, paragraph f.

Calibration Check Table		
CAL TEST POINTS	**WEIGHTS REQUIRED**	**ACCEPTABLE RANGE**
5.0" equivalent rain	1 brass weight of 4,111 g	4.75 " thru 5.24"
10.0" equivalent rain	2 brass weights of 4,111 g	9.75" thru 10.24"
15.0" equivalent rain	3 brass weights of 4,111 g	14.75" thru 15.24"

Table 6.1. FPR-E Accuracy Tolerance - Calibration Reset Not Required

If each of the three Calibration Test Point values meets the acceptable range given Table 6.1, then the sensor calibration is acceptable and a calibration reset is <u>not</u> needed. Write into your Site Inspection report '**Sensor Calibration Check Passed.**' You may enter the same phrase into the Special Notes column of the *FPR Log Sheet*.

If any one of the three Calibration Test Point values fell outside of its respective range, then you will need to conduct a full calibration reset as described in Appendix C, of this manual. Write into your Site Inspection report, '**Sensor Calibration Was Reset: New Coefficients, A=0; B=1286.0523; C= -4.1076**" Note, these values are for example only.

CHAPTER 7 – System Troubleshooting and Repair

7.1 Notify Sterling Field Support Center (SFSC):

When the FPR-E precipitation data appears with a diurnal oscillation that exceeds ±0.10 inch, or the system experiences a technical failure, you will report the trouble to the Sterling Field Support Center (SFSC) by phone 703-661-1268 (8am-5pm ET Mon-Fri). Their backup line is 703-661-1293. You may email them on: NWS.SFSC@noaa.gov.

After you notify SFSC, you notify your Regional COOP Program Manager of the issue.

Inform the SFSC technical specialist whether your office has an "in-office spare FPR-E" one in which you can take to the COOP site to troubleshoot the gauge. The SFSC Hotline may instruct you to follow specific testing procedures and if the component tests 'bad' you may need to ship the bad component to National Reconditioning Center (NRC).

Note: Do not attempt to repair or order repair parts from NLSC, until you have first contacted SFSC to report the problem.

7.2 Logger Points of Failure and Troubleshooting:

The Zeno Data Logger is a microprocessor controlled instrument. It can detect and report malfunctions. This section describes five types of break downs that affect the logger or its display. You can troubleshoot using a Laptop PC connected to the Zeno Assembly. You are encouraged to read Section 6, of the Coastal Environmental Systems, Inc., "*FPR Kit Operations and Maintenance Manual, ver 4.2*" © 2010.

7.2.1. No Display on Zeno Assembly: It is normal for the display to go dark (asleep) after approximately two minutes of inactivity. Wake-up the display by pressing the display button, on the right side of the Zeno Assembly and the screen will illuminate. (see Figure 2.5).

If the Zeno Display fails to respond, there are five fault conditions that could be the cause. Before troubleshooting, disconnect the solar panel cable. Test and replace each as necessary in this order of progression.

- Faulty battery,
- Faulty battery cable,
- Faulty battery charger,
- Blown fuse,
- Faulty Zeno Assembly.

Use your multi-meter at the battery terminals and cable wires to rule out faulty battery and charger. If it is lower than 11.5V, then check the solar charging. Refer to the Section Sect 7.3.3, for testing of solar charging. Review a recent data file to examine the voltage history, recorded in every 15-minute record to see when or how often the battery voltage is too low.

7.2.2 Precipitation Sensor Data Missing, Out of Range, or No Change: These conditions may be caused by a faulty load cell assembly or faulty Zeno data logger. Remove and replace each unit, until system is functioning properly. Eupiment needed:

- Spare Load Cell assembly
- Spare Data Logger
- Calibration Weights

7.2.3 Zeno Logger Displays 'Er30': If the Zeno Assembly displays Er30, wait 30 seconds and push the display button again. If there is no data in the logger then wait at least 15 minutes before pushing the button again. And if the Zeno still displays Er30, then remove and replace the Zeno Assembly. For a list of part numbers, see Appendix G of this manual.

7.2.4 Data cannot be Retrieved from USB Flash Drive: If data cannot be retrieved from the USB flash drive, it may be due to a faulty USB Flash Drive or due to a faulty Zeno Assembly. First obtain a known good USB flash drive that is freshly formatted; and if the data still cannot be retrieved, replace the Zeno Assembly (data logger).

7.2.5 Wrong Time/Date on Data: The date/time stamp is established from an internal real time clock (RTC). The RTC has a 10-year lithium battery source, which is independent of the system backup battery. This allows the RTC to keep time even if all external power is removed. The clock is calibrated to give an accuracy of 30 seconds per month (2 parts per million). However, if either the clock or the clock battery fails, the time and date will begin to deteriorate. If this occurs, remove and replace the Zeno Assembly.

7.3 Battery Voltage Too Low – Recurring Condition:

Always carry a spare fully charged 12-V battery with you when visiting an FPR-E site. It is not possible to troubleshoot the system if the existing battery is dead or low on charge.

The 12-V battery weighs four pounds, and is a sealed lead-acid (SLA) battery rated 7 Amp-Hours. Battery voltage is a problem when it runs below 11.5V. Repeated system shutdown due to low battery voltage is caused by either:

a. No sunlight on panel:
   - Panel Fully or partially shaded by obstructions
   - Weak or low sun angle (i.e., Alaska in winter)
   - Panel dirty

b. System fault, load failure:
   - System shorted, or high load, draining battery too fast.
   - Fuse blown

c. Charging system failure:
   - Panel, regulator or connection failure. See *FPR-E Assembly Procedures*, Sections 19.4, and 19.5, for illustrations to see which terminal in the junction box the multi meter probes need to touch.

d. Battery failure:
- Battery cell shorted
- Battery worn out
- Battery destroyed by repeated deep discharge cycles

All the above must be checked when you see repeated shutdowns in the data, or have a dead system. To troubleshoot a failing system use the following instructions.

7.3.1 First Check the Battery Voltage: Disconnect positive lead from battery. Measure the voltage across battery.

a. If below 12.0V, swap out battery with fully charged spare. Do not reconnect positive lead to battery, yet.

b. If about 12.0V, proceed to '*Check System Fault, Load Failure'* do not reconnect positive lead to battery, yet.

7.3.2 Check System Fault, Load Failure: With solar panel in full sun, oriented to sun, and clean:

a. Solar Panel Wake Up – wake up logger to see if it will run on solar panel alone.
- Logger wakes up – Good. Proceed to Battery wake up.
- Logger does not wake up– proceed to *Check Charging System* (Section 7.3.3).

b. Battery Wake Up – Disconnect solar panel, connect positive lead to fully charged battery.
- Logger wakes up – Good. System will run on both battery and solar panel confirmed. Proceed to *Check Charging System* (Section 7.3.3).
- Logger does not wake up
    1. Check fuse – replace as necessary.
        a. Fuse blows again, replace Zeno logger assembly.
    2. Replace Zeno logger assembly.

7.3.3 Check Charging System: With solar panel in FULL sun, oriented to sun, and clean, disconnect positive lead from battery, measure voltage on battery and on positive lead. Voltage on disconnected positive lead must be higher than Battery voltage by 1.2V (at a minimum) in order to charge battery.

a. **Positive Lead Voltage** - Must be 13.6V or higher and could be > 26V.
- If 13.6 to 27.0V, solar panel voltage is okay. Go to *Load Test* in next paragraph (b).
- If not 13.6 to 27.0V, the go to *Troubleshoot Charging System* in final paragraph (c).

b. **Load Test** – Connect 40-50 ohm 10 watt resistor across the positive lead and negative lead. Measure the voltage across the resistor.
- If still above 13.6V, charging system is working fine.
- If below 13.6V, find what is stopping the current from solar panel / wiring /

connectors / regulator path. Corrosion in connectors is typical cause. Go to *Troubleshoot Charging System* in final paragraph (c).

c. **Troubleshoot Charging System** – Leave battery disconnected, and check every connection between the solar panel and the battery connectors. Start with the connections closest to the solar panel, disconnecting each pair in turn, and proceed toward the battery, applying the aforementioned tests 7.3.3.a (*Positive Lead Voltage*), and 7.3.3.b (*Load Test*), at each pair of connections. Reconnect the connection pair you are testing, before proceeding to the next connection pair in the wires to the battery.

- If both tests are good at the connections closest to the solar panel, reconnect those and move to the next pair of connections toward the battery, repeat tests at each successive accessible point in charging path until you find blockage. Repair the fault.
- If both tests are bad at the connections closest to the solar panel, then the solar panel is bad and should be replaced.
- Done when both tests (e.g., *Positive Lead Voltage*; and *Load Test*; above) pass at the battery leads.

7.3.4 Return All Cable Wires to their Operational Connections: Following 7.3.3 above will result in all connectors between the solar panel and the battery connected except the battery terminals. Connect those to the battery now. At this point the system should be working fine on a good battery/power system.

7.3.5 Check Old Battery: This can NOT be done in the field.

a. Take the old battery back to your WFO workshop charging station

b. Connect it to an AC charger that is appropriate for the size of the battery.

c. Leave it on for three (3) days.

d. Disconnect from the charger.

e. Wait 12 hours for it to cool to room temperature. Have nothing connected to the battery.

f. Measure battery voltage. It should be fully charged.

- 12.6V or above, battery is good. Load test it if you have a 1 amp load tester to confirm (do NOT use an automotive load tester!!) Put battery in your truck as a spare.
- 11.2V and below. Battery is bad, has at least one cell dead. Discard/recycle battery per NWS guidelines.

Caution: Be familiar with the safety precautions when you are charging a lead-acid battery. Access NWSM 50-1115, Chapter 15, https://www.ops1.nws.noaa.gov/Secure/SAFETY/EHB-15/Procedures_2011/pd05011015f_15.pdf and read Procedure 15.3, *Battery Charging and Storage Operations*.

7.3.6 Solar Panel Location: If any part of the solar panel is shaded, the panel can shutdown and not deliver any power to the application. The solar panels are made with multiple solar cells connected in series to give the voltage needed and then in parallel to give the power needed. When a solar cell is shaded it becomes a high resistance to any current impressed upon it. Thus, if any individual cell of a series string is shaded, that cell will block the current generated by the other cells in that string, effectively shutting off the output.

Mount the solar panels where they are in full sun, not in the fringe area under trees or behind guy wires or tower supports. Also, problems have been reported where construction or farming resulted in a coating of dust on the panel.

So, train the Observer to inspect and clean the solar panel as needed (especially of snow and ice). The FPR-E is supplied with a 15 foot connecting cable. The cable can be extended as far as you need, provided you use good outdoor rated wire of the same size or larger, and make waterproof connections above ground. If you need to trench the cable, use direct burial rated cable.

7.4 USB Error Code Definitions and Remedial Actions:

Observers should be reminded to be very patient during the final minutes of the monthly data download. This is the time when the system formats the flash drive. You must wait until the message 'UFdC' appears in the display before removing the flash drive. This will normally take fifteen minutes. If the observer removes the drive before the UFdC message appears, an error condition will result and the Error number will display.

Instruct the Observer to phone you as first course of action, when an Error Code appears.

Error Number	**USB Error Description**	**Action Number** ***See Table 7.2***
1	Too many files saved on the same day (26 max (A -Z))	01, 03, 04
2	Flash drive unplugged during transfer	01
3	Zeno has no records to upload	01
10	UFAT chip failed to reset	02
11	UFAT invalid USB device inserted	02, 03, 04
12	Mount the flash driver failed - bad connection?	02, 03, 04
13	UFAT failed to higher baud rate	02
14	UFAT failed to read free blocks	02
15	UFAT failed to read free blocks	02
16	Insufficient space on flash drive	04, 03
17	UFAT failed to create /CES directory	02, 03, 04
18	UFAT failed to change to /CES directory	02, 03, 04
19	UFAT failed to set date	02, note 1
20	failed to initiate 128 byte write	02, 03, 04
21	failed to conclude 128 byte write	02, 03, 04

22	UFAT failed to open file for write	02, 03, 04
23	UFAT failed to close file after write	02, 03, 04
24	ZENO failed to read file date command	02, 03, 04
40-49	Various X-modem transfer failures	02

Table 7.1 USB Error Codes

Note: Error code '30' indicates a 'general' Zeno Assembly error. See section 7.2.3 for specific instructions.

Action Number	Action(s) to be taken
01	**Refer to manual for proper operation of unit.**
02	**Retry same USB drive.** 1. Press button. Wait for display to go off. 2. Remove USB drive. 3. Insert same USB drive. 4. Press button. 5. Pass if now working. Fail if same or new error appears. 6. Go to next action, if no next action listed then: 7. Record error and return unit for service with error record.
03	**Retry different USB drive.** 1. Press button. Wait for display to go off. 2. Remove UBS drive. 3. Insert different USB drive. 4. Press button. 5. Pass if now working. Fail if same or new error appears. 6. Go to next action, if no next action listed then: 7. Record error and return unit for service with error record.
04	**Erase the USB drive.** 1. Press button. Wait for display to go off. 2. Remove UBS drive. 3. Use a laptop to erase the USB drive 4. Insert USB drive. 5. Press button. 6. Pass if now working. Fail if same or new error appears. 7. Go to next action, if no next action listed then: 8. Record error and return unit for service with error record.

Table 7.2 Actions Needed to Clear the USB Errors Indicated in Table 7.1

Additional Notes:

- Error 19 may be caused by an unreadable time in the Zeno-3200 CPU board. This may be caused by incorrectly setting the time or by a low on-board backup battery voltage and a loss of external power. Setting the time correctly in the Zeno may fix this error, however, it is important to make sure that the Zeno does not also have a problem which caused the clock to be incorrect.
- The flash drive should be a FAT32 formatted drive.
- On flash drives larger than 2GB there can be read/write issues if there is more than 2GB of data on the drive.
- Please use the manufacturer's flash drives or equivalent. Some drives can have timing issues with the F&P USB driver.

7.5 Flexure Replacement – Use Preassembled Weighing Mechanism to Swap-out:

Gauges with ±0.10 inch and greater diurnal oscillation, should be written up to the maintenance planning checklist, for a priority maintenance visit, for the change-out of the FPR-E gauge's weighing mechanism. An example of this oscillation pattern is given in Figure 4.3, in the Quality Assurance chapter.

Refer to Appendix D of this manual for instructions on how to swap out a field rain gauge with bad flexures with a preassembled weighing mechanism built inside your WFO.

Appendix D, also gives the detailed instructions for how to rebuild the weighing mechanism by installing new flexures and thereby restock a preassembled spare weighing mechanism in your WFO.

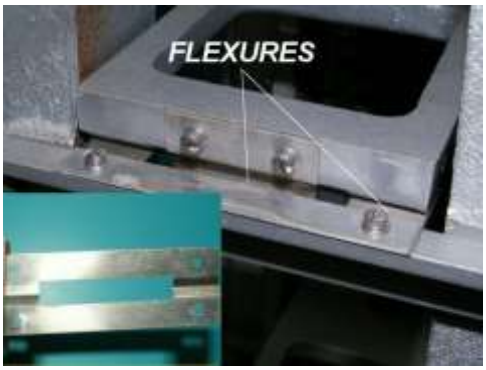

Figure 7.1 Damaged Horizontal Flexure. Note the V-shape bend.

CHAPTER 8 – System Modification Policy

8.1 Management Responsibilities:

Unlike ASOS managers, national managers who maintain COOP observing systems are *not* governed by the instructions covered in NWSI 30-1203, *Configuration Management Policy for Operational Systems*. However, instructions in the NWS Directives System which apply to the surface observing program's parts logistics, maintenance, and configuration control, also apply to the cooperative observer program. Field, regional, and national managers follow the specific policies outlined in the, *Cooperative Program Management and Operations* (NWSI 10-1307) directive.

The NWS headquarters office in charge of the Cooperative Observer Program (i.e., OS7) will:

a. Evaluate existing and new requirements for FPR-E systems.

b. Fund, coordinate, and manage the development and certification of proposed changes that include Modification Notes to keep the FPR-E systems working properly.

c. Delegate to Engineering and Acquisition Branch, the development and publication of Maintenance and Modification Notes.

d. Delegate to Engineering and Acquisition Branch, the determination of costs for proposed changes.

e. Fund, coordinate, and manage the implementation of any new hardware and/or software for the FPR-E systems.

f. Coordinate change actions with Regional Managers, and maintains procedural and policy documents on, http://www.nws.noaa.gov/osp2/Surface/coopimplementation, the COOP Modernization web site; and ensure Mod Notes are posted on the NWSHQ Operational Systems site: http://www.ops1.nws.noaa.gov, under Surface Hydrology and COOP.

g. Verify completion of maintenance actions with effected field offices through the Station Information System (SIS) through updates to the Station Profile reports and the Station Inspection reports.

8.2 Policy on Cooperative Station Management:

The overarching directive that governs the implementation, operation, maintenance, and modification of any type of meteorological or hydrological observing equipment, is the NWSI 10-1307, http://www.nws.noaa.gov/directives/sym/pd01013007curr.pdf, *Cooperative Program Management and Operations (Aug 2012)*.

Field and region managers who make equipment and service changes at the volunteer Observer sites whether in response to Observer requests, or in compliance with national headquarters directives, then have to comply with the policies in the NWSI 10-1307, *Cooperative Program Management and Operations*, Section 6. In that section, managers are instructed to use the

national data base of COOP site metadata to track numerous minor and major modifications to each of the approximately nine thousand sites. With implementation of the Station Information System (SIS) relatively few policies and procedures have changed. For this reason the NWSM 10-1313 remains a valid reference for FPR metadata entries until the directive is revised for SIS.

The project to convert the F&P rain gauges to electronic sensing and logging began in 2004 when the Office of Operational Systems issued their *FPU Operational Implementation Plan* (OIP). All field managers involved in the FPU, FPR-D, and FPR-E projects, had to abide by the OIP's management and administrative instructions.

A technical manual, the ***FPR-E Assembly Procedures***, was written to give a detailed description of the authorized configuration of the FPR system with an account of the Part Numbers and Software versions used in the FPR-E modification kit.

For the management of the FPR-E systems, including operations, maintenance, and issuance of Mod Notes for the FPR-E system, this handbook, the *FPR-E Operations Manual*, will be the governing document.

8.3 FPR-E System Modifications:

8.3.1 Hardware: Hardware components that may be affected by modifications appear in Appendix G, of this manual. The significant hardware groupings are:

- Load Cell Sensor Assembly
- Zeno Data Logger
- Solar Panel
- 12V Battery

Hardware modifications are issued as COOP Mod Notes by the NWS headquarters. They should be printed and filed in Appendix B, of this ***FPR-E Operations Manual***. For example the FPR-E Mod Note to change the battery cable connectors, is directed upon replacement of the original battery. The note is 'COOP D111E Note 2.' It was authorized as a routine maintenance action, effective August 6, 2014.

8.3.2 Software: Software may be affected by upgrades issued by NWS Headquarters, refer to Chap 8.2, *FPR-E Assembly Procedures*, to identify the initial issue version number (i.e., V2.02-Z16eD Jan 28 2009). The significant software groupings in the FPR-E program are:

- Operating System of Zeno data logger (Coastal Environmental Systems, Inc.)
- Configuration Version (i.e., FPR-E001 is the initial issue by NWSHQ)
- McAfee Active Virus Defense (AVD) Suite
- Windows based operating system (i.e., Windows 7, Professional) used by NWSREP to access Zeno data logger via Laptop/Netbook

8.3.3 Precedence of Mod-Note Implementation: When changes are needed to be made as soon as practical (within one to four weeks) the RCPM will inform you of the subject of the Mod Note, and provide you the website and/or email to access the specific instructions. However, COOP Mod Notes rarely get issued with that high or urgent precedence. Rather, the level of importance for implementation is found within the cover page of the Mod Note, stated in the heading, "Estimated Completion Date."

Most Mod Notes are specified with a completion date 'As Needed.' This is the case for COOP D111E Note 2, for battery cable modification. The phrase 'as needed' applies to when need arises to replace the 12-volt battery upon its exhaustion. Some Mod Notes will *not* apply to all sites, so carefully read the heading, 'Sites Affected' on the cover page. The heading 'Purpose' should adequately explain the reason for the modification.

It is the NWSREPs' responsibility to review all possible COOP Mod Notes for applicability to their field equipment. As a general rule of thumb Mod Notes that do not have a high level of precedence, should be implemented within 12 months or by the next regularly scheduled visit to the site.

8.4 Manufacturer's Firmware Update:

As of 2015 there is no anticipation the manufacturer (Coastal Environmental Systems, Inc.) will make an update to firmware that would require the NWSREP to install firmware to the Zeno Assembly. Should there be one the policy given in Section 8.6 will apply.

8.5 Prohibition of Local Changes:

Each FPR-E system comes delivered with a manufacturer developed firmware already installed. The data logger firmware version number (e.g., **V2.02-Z16eD Jan 28 2009**) can be accessed through laptop/Netbook via the Zeno System Function Menu, and select 'Program Version.'

This FPR-E firmware is standardized and configuration controlled. The configuration version number is visible at the end of each 15-minute data record (e.g., FPR-E001). No one has authority to change the data logger configuration software without the express and written direction from the National Cooperative Program Manager (NCPM).

The FPR-E data logger will produce two types of measurements by default: the precipitation level and battery voltage. While the logger is capable of temperature sensor input, the FPR-E will not be configured to input the MMTS thermistor readings.

As of 2015 only the precipitation data is certified for operational use. In the future, if a temperature sensor becomes certified for use, updates will be given to the NWS field offices to install configuration software.

8.6 NWS Modification Notes:

All Modification Notes issued from headquarters shall take into consideration the length of time that may be required to implement the Modification Note, due to the following: FPR site unique properties, difficult site exposures, harsh climates, difficult electrical grounding, and temporary interruption to institutional site activities, and interruptions to agreements with network users.

Emergency modification work is authorized for immediate restorative maintenance, when hardware or software has been damaged or at risk as described in the Modification Note. Preventative actions will only be authorized on a case by case basis, after the Engineering and Acquisition Branch has been informed of site history and reviewed system outages or degradation from: (a) damaged hardware or software, or (b) hardware/software failures with damaged equipment.

Implementation of a Modification Note must be completed by the 'Estimated Completion Date' date. Submit a rendition update for your SIS Station Profile as soon as possible after the maintenance was completed, and no later than two weeks after the action.

8.6.1 Requires Rendition Update of Station Profile: Report any completed modifications (i.e., COOP D111E NOTE 2) as a Rendition update to the Station Information System (SIS) Station Profile (i.e., Station Information Report).

To account for the modification, you need to edit the 'Permanent Remarks' field to clearly indicate in plain English the subject of the modification. In this example the, "FPR-E Battery Cable Modification" was issued by NWS Headquarters with the title, "COOP D111E NOTE 2." The equipment description portions of the Station Profile allow you to update the serial number of the Load Cell, and the Zeno Assembly, if either of these primary components has been replaced due to Mod Note implementation.

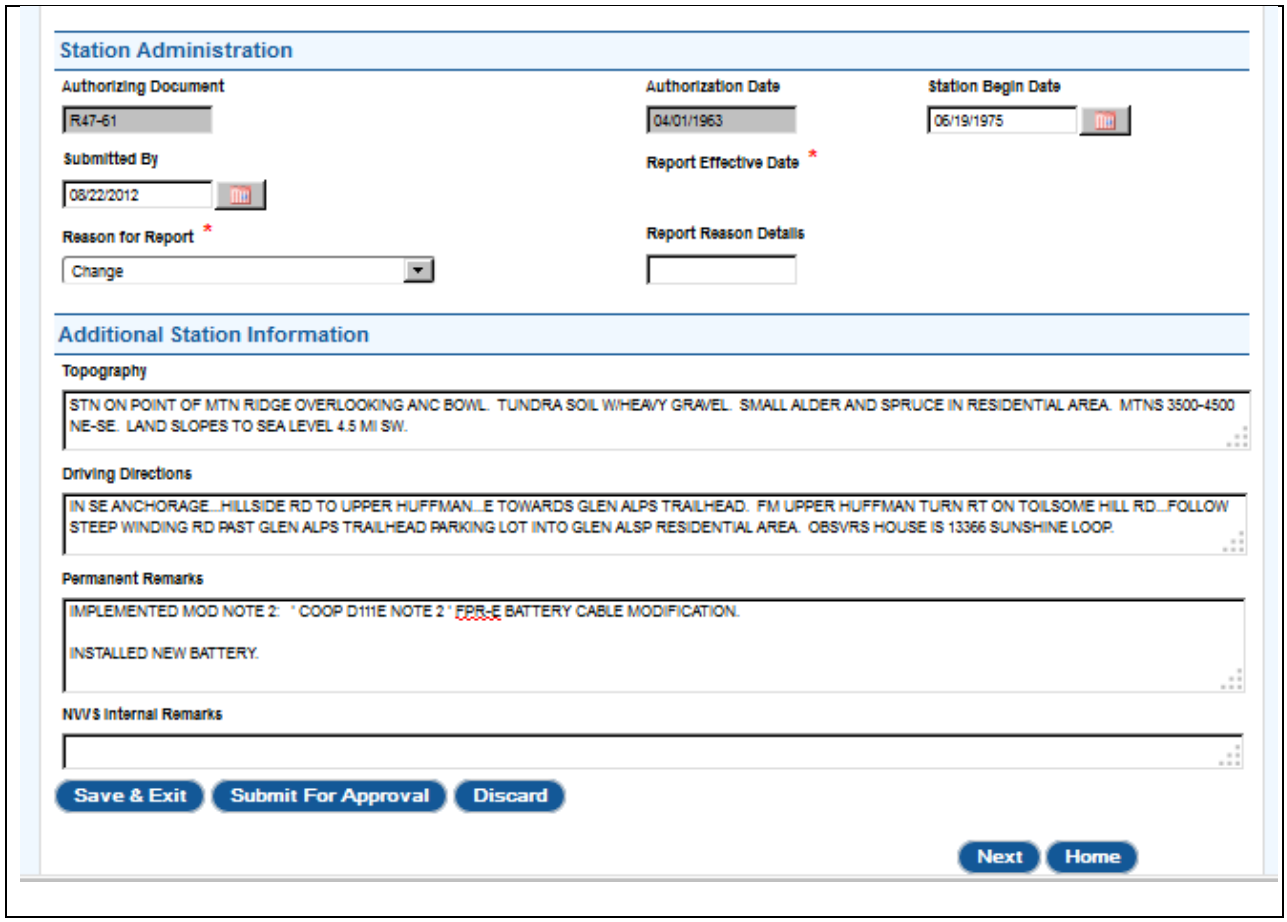

Fig 8.1 SIS Rendition Update Required for Mod Note Implementation (Permanent Remarks)

8.6.2 Requires Filing a Station Inspection Report: To account for the amount of labor and the nature of the technical changes made to accomplish the implementation of a Mod Note, the same officer who traveled to the COOP site and conducted the modification, should be the person to file the Station Inspection Report.

Follow the detailed instructions in Chapter 9.4, of this manual, to create a Site Inspection Report that accounts for the implementation of a Mod Note. For an example of detailed entries that may be required see Figure 9.6.

Notice, the Site Inspection Report offers separate categories of work, including: Calibrated, Repaired, Modified, Installed, Removed, Moved, and Painted. Choose the column marked, 'Modified' and choose the equipment row marked, 'FPR-E' and click on the check box.

Then proceed to enter any specific information that changed due to the Mod Note (i.e., calibration values) and enter that information in the Remarks field of the Site Inspection Report'. Before closing the Inspection Report, make sure the Remarks field contains a plain English description of the modification along with the official title of the Mod Note (i.e., COOP D111E Note 2).

8.6.3 Records Retention - Modification Notes: Every 6 months visit the NWS HQ website and check for any possible Mod Notes that apply to the FPR-E rain gauge: http://www.nws.noaa.gov/ops2/Surface/coopimplementation.

Download and print all FPR-E Mod Notes and file them to this *FPR-E Operations Manual*. This is because some of the modification requirements could apply at a future time to one or more of the FPR-E gauges in your Cooperative Program Area (CPA).

Note: As of March 2015, there are just two Mod Notes in effect. The first 'COOP D111E Note 1' is the assembly instruction for initial implementation of the Kit to convert the F&P Mechanical Gauge to the FPR-E configuration type.

The second, 'COOP D111E Note 2' applies as needed when the 12-V battery needs replacement, then the FPR-E battery cable connectors will need to be modified in accordance with the Note 2.

For ready reference, print 'COOP D111E Note 2,' and file it into Appendix B, *Modification Notes*, of this manual. Print all subsequent Mod Notes, and file into Appendix B.

CHAPTER 9 – Metadata Requirements

9.1 NWSREP Responsibilities:

There are two categories of metadata for the FPR-E. The first includes permanent values (equipment model type, serial numbers, location) established at time of operational implementation. The second include maintenance data (i.e., calibration values, seasonal maintenance) that are overcome by successive actions or inspections.

The NWSREP generates metadata to account for these FPR-E actions:

- Initial installation of FPR-E system is accounted by Station Information System (SIS) Station Profile.
- Seasonal Maintenance (draining) is accounted by SIS Inspection Report.
- Routine checks of calibration are accounted by SIS Inspection Report.
- Restorative Maintenance is accounted by SIS Inspection Report.
- Equipment Modification Notes are accounted by Station Profile <u>and</u> Inspection Report.

The NWSREP stores FPR-E metadata in these locations:

- Station Profile gets saved to the SIS database.
- Site Inspection Report saved to SIS locally at WFO - yet Regional HQ may have access. if necessary, Station Inspection, is the backup printed form (i.e., Form B-23.)
- Current FPR-E system calibration data and bucket level status and seasonal maintenance can be copied from Site Inspection Report and saved to a *FPR-E Logbook*. This way all rain gauges in CPA can be accessed in one notebook to facilitate planning for semi-annual site visits.

9.2 Metadata Accuracy for FPR-E:

The NWSREP conducts semi-annual visits to the COOP sites with FPR-E gauges and checks the calibration of the weighing sensor. If the calibration needs to be reset, then new calibration coefficients (A, B, and C) are generated and have to be saved in the Site Inspection report.

If the weighing sensor (load cell) is replaced from failure, or due to a system-wide equipment modification, this will change the values of permanent metadata in the Station Profile. The NWSREP is responsible for updating the metadata as needed following restorative maintenance or Mod Note implementation.

The SIS data base is the single most authoritative source of COOP station information. The information it contains describes site location, exposure, dates of changed equipment, and

method of data reporting. These elements of information constitute 'metadata' that are then used by the NCDC to create a permanent archive of station information. The accuracy of each of these parameters should be checked every six months.

When an FPR-E recording gauge is implemented, it is critical to update the Station Profile Station Information Report's '***Remarks***' field with the following text: "UPDATED EQUIPMENT, CHANGED F&P TO FPR-E WITH USB FLASH DRIVE."

Two types of information are saved to the SIS application; permanent and non-permanent metadata. Permanent values are saved to the SIS Station Profile. For example, the serial number of the load cell and Zeno data logger are treated as permanent values. The other type is maintenance metadata that is non-permanent. These include the Calibration Coefficients (A, B, and C) and Calibration Constants (C1, C2, and C3). These values will be saved to the SIS Site Inspection report and are not distributed from the forecast office.

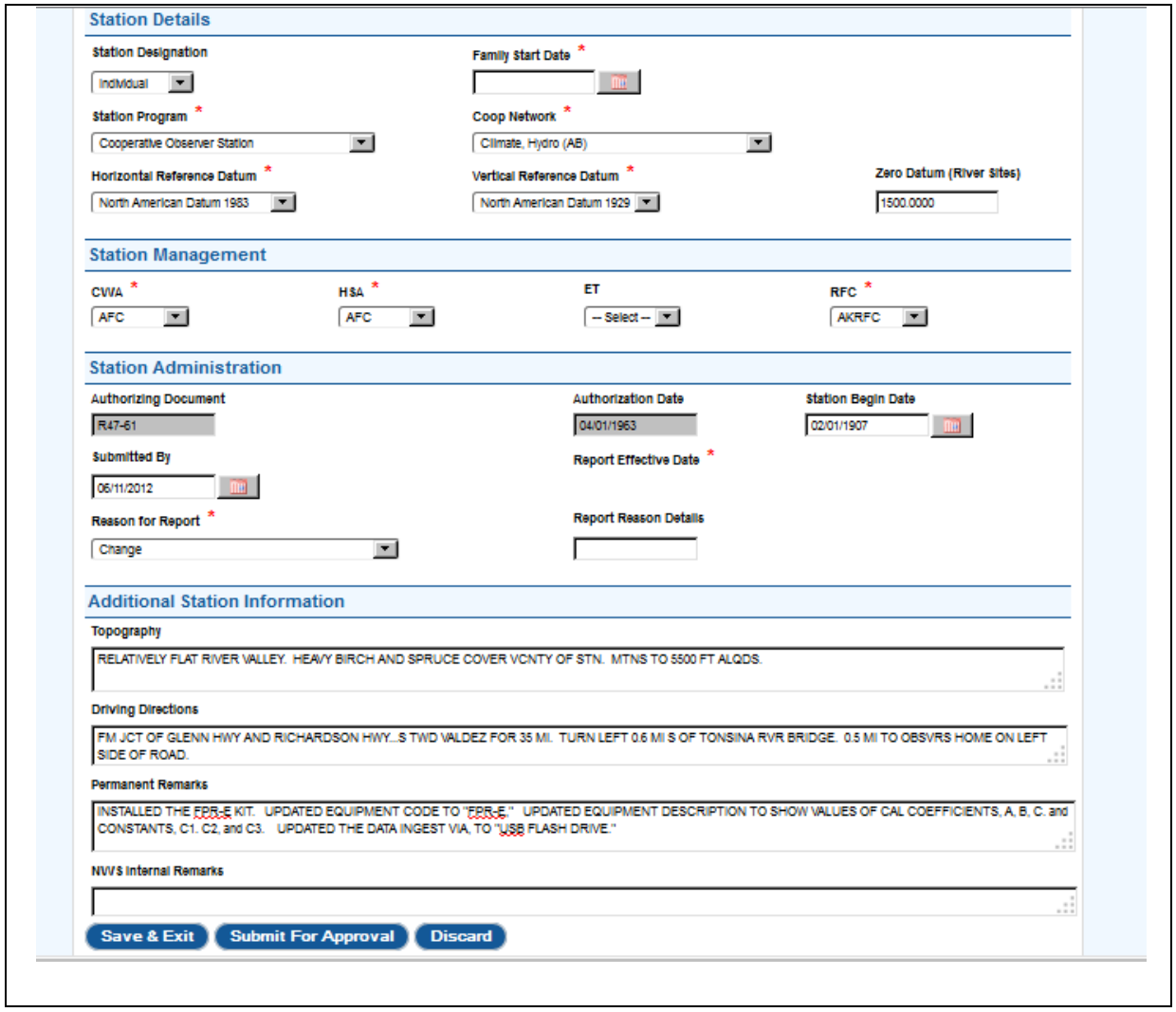

Figure 9.1 Station Profile Rendition Update Upon FPR-E Installation

Policy on how metadata shall be accounted in SIS (Station Profile) is found in the ***SIS User Guide***. The ***SIS User Guide***, is accessible from the "Help" link next to the "Reports' link, at the top of the SIS application's **home page**.

9.3 Station Profile – Detailed Entries:

The first page of the Station Profile in the SIS gives the reason why a new Rendition of Station Profile was necessary. Click on the drop down menu for "Reason for Report" and select "Change" from the options available.

For installation of FPR-E rain gauge, make these entries in screen categories marked with the red asterisk. See Fig 9.1 for the required metadata parameters.

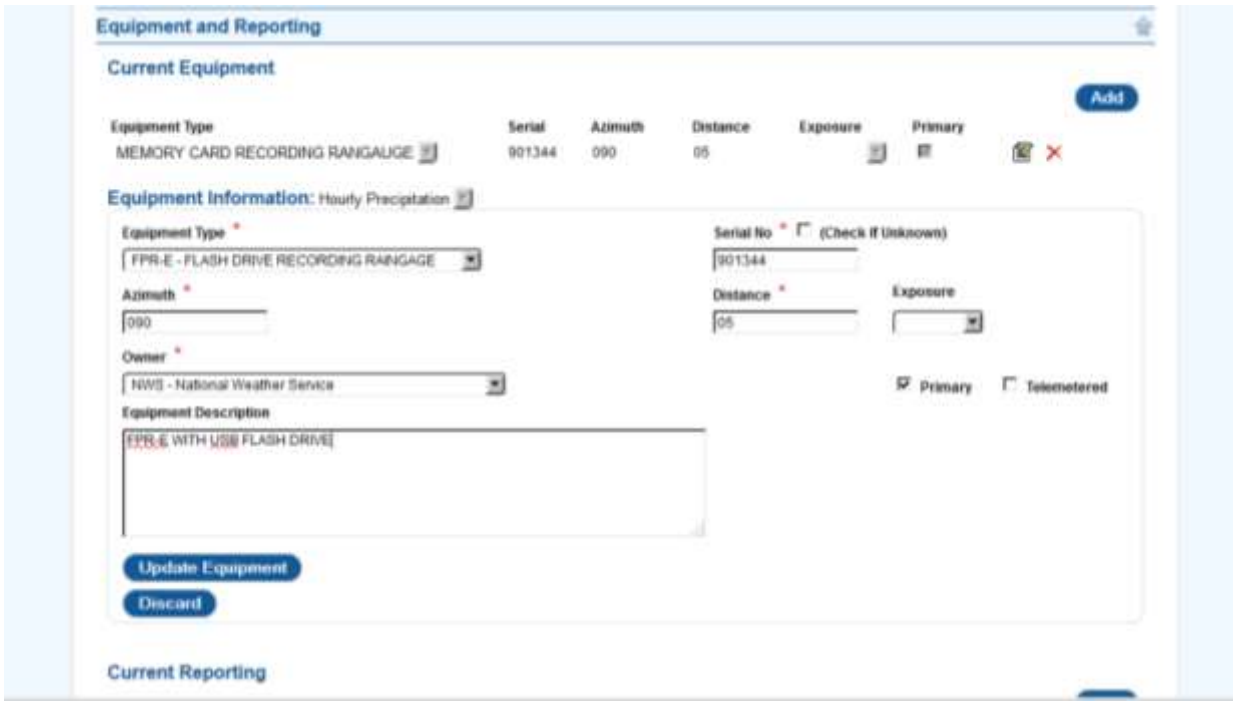

Figure 9.2 Detailed Entries for 'Equipment and Reporting' page of Station Profile.

Enter a short description to the Remarks box to explain in plain English the change you have made.

For example: "**Updated equipment, replaced F&P with FPR-E. Requires USB Flash Drive to download data.**" See Figure 9.2.

Then make the following changes in the Station Profile, in the SIS:

9.3.1 <u>Current Equipment Field: Equipment Type</u>:

a. ***Current Equipment***, select '**FPR-E – Flash Drive Recording Gauge'** from the drop-down menu. This replaces F&P.

b. ***Serial Numbers,*** enter the Load Cell's serial number (i.e., 70054747), and enter the Zeno Data Logger's serial number. Enter the two serial numbers separated by semicolon, a space, and # sign as follows: **70054747; #103.**
See Fig 9.3, and 9.4 (below).

The eight digit serial number appears on the white decal on the front of the Load Cell.

Load Cell Serial Number
i.e., 70054747

Figure 9.3 Load Cell's Serial Number

The three digit serial number for the data logger (Zeno Assembly) appears on the right side of the unit, an inch above the Display On/Off button.

Zeno Assembly Serial Number
i.e., 103

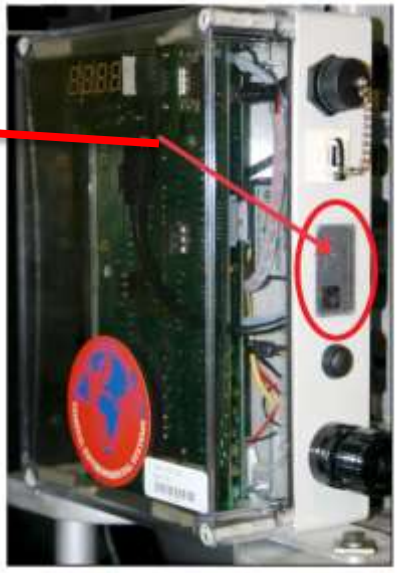

Figure 9.4 Zeno Assembly's Serial Number

c. ***Azimuth***, Enter the bearing (in degrees) the FPR-E subtends from the point where the SRG is situated. The SRG is the geospatial reference point of the COOP Site.

d. ***Distance,*** Enter the numerical value in feet the FPR is separated from the SRG.

e. ***Owner***, keep **NWS** as the default agency for this category.

f. ***Equipment Description***, Enter the words, "FPR-E Recording Gauge with USB Flash Drive." If you have installed an official Modification to the system, then enter a second sentence that gives an explanation of the Modification (i.e.,

Installed FPRE battery cable modification to fit F2 terminals.) and include the official number (i.e., COOP D111E Note 2).

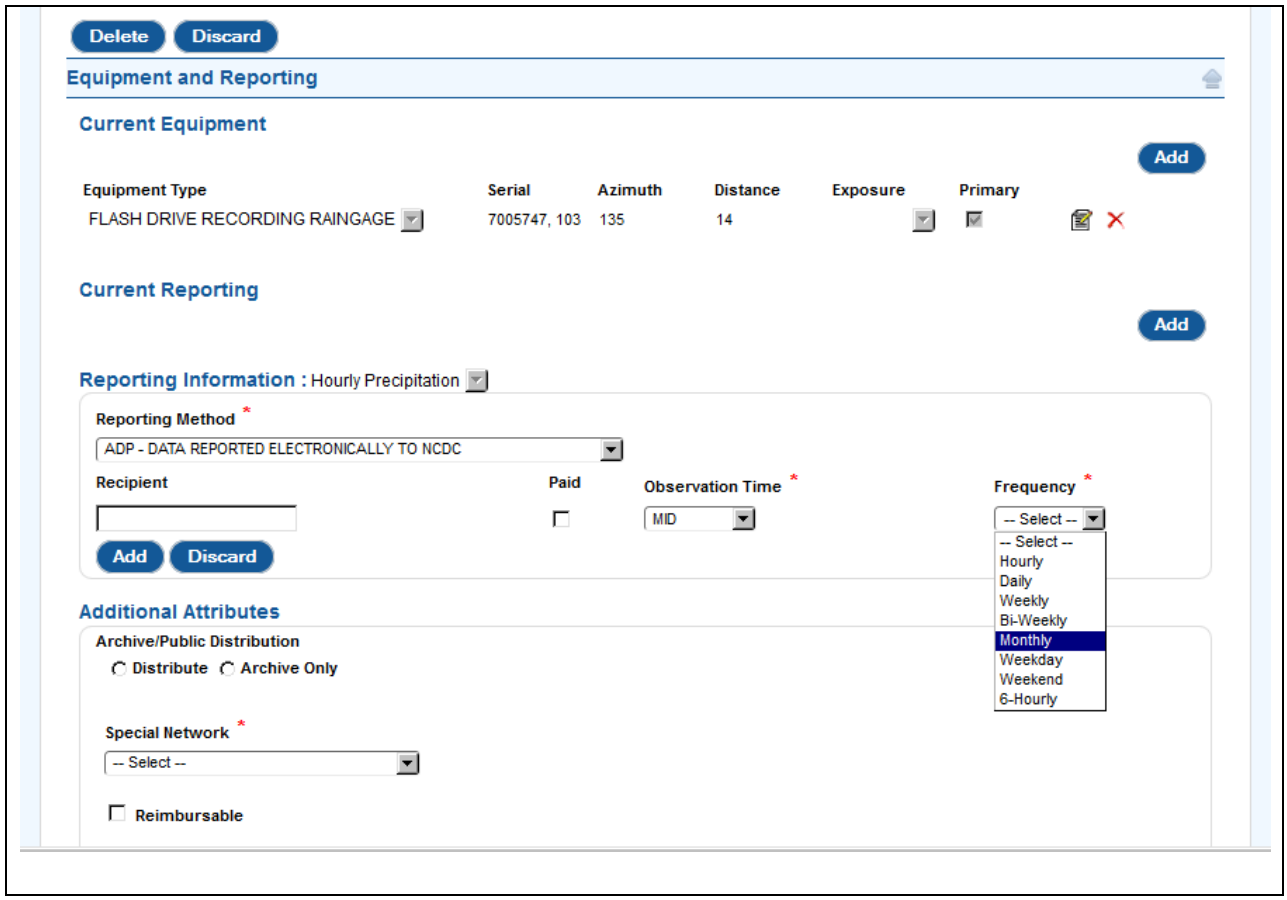

Figure 9.5 Detailed Entries for 'Current Reporting' field of the Station Profile.

9.3.2 <u>Current Reporting Field: Hourly Precipitation Data</u>:

a. ***Reporting Method***, select '**ADP – Electronic Reporting Method**.'

b. ***Recipient***, type-in free text the WFO identifier (i.e., "**LZK**"), and '**NCDC**' separated by a comma (LZK, NCDC).

c. ***Observation Time***, select '**MID**' from the drop-down, this refers to midnight.

d. ***Frequency,*** Select "**MONTHLY**" from the drop-down (see Figure 9.5).

e. ***Archive / Public Distribution,*** Data from virtually every FPR gauge that is <u>*not*</u> telemeterized, gets processed by NCDC for 'Public Distribution.' Click on the radio-button for public distribution.

f. ***Special Network***, Select '**NONE**' from the drop-down, unless rain gauge is part of a special network of the several dozen listed in the SIS drop-down menu.

Reference: The ***SIS User Guide*** gives further guidance on how to navigate between the fields and menus within the pages of the Station Profile's user interface. There are approximately ten major pages: Station Details, Station Management, Station Administration, Additional Station Information, Current Observer(s), Current Observation(s), Current Obstructions, Station Information, Equipment Information, and Equipment and Reporting.

9.4 Site Inspection Report – Detailed Entries:

When you have completed site visitation and are back in the office, access the SIS and click on the top bar, the tab for 'Inspections.' System will prompt you to either create a report, or edit an existing report.

Account for the following in the 'Inspection Data.' Refer to Figure 9.6 as a guide:

- **Trip Date:** 09/17/2014 (Select from the on screen calendar.)
- **Start Date:** 09/17/2014 (Format: mm/dd/yyyy)
- **End Date:** 09/17/2014 (Format: mm/dd/yyyy)
- **Day Trip?** Click on Yes button; or No button, if an overnight trip.
- **Per Diem?** If YES, then click on check box. If not Per Diem, leave blank.
- **Trip Miles:** 239 (free text)
- **Trip Cost:** 195.00 (free text)
- **Staff Hours:** 12 (free text)
- **Remarks:** Enter a simple one or two sentence description for the purpose of this trip. For the FPR-E rain gauge, accurate metadata is required for the weighing sensor (i.e., the load cell). Enter the Calibration Coefficients (A, B, C) and the three Calibration Constants (C1, C2, C3) into the Remarks field. See Chapter 8, when you are conducting a system modification (i.e., COOP D111E NOTE 2).

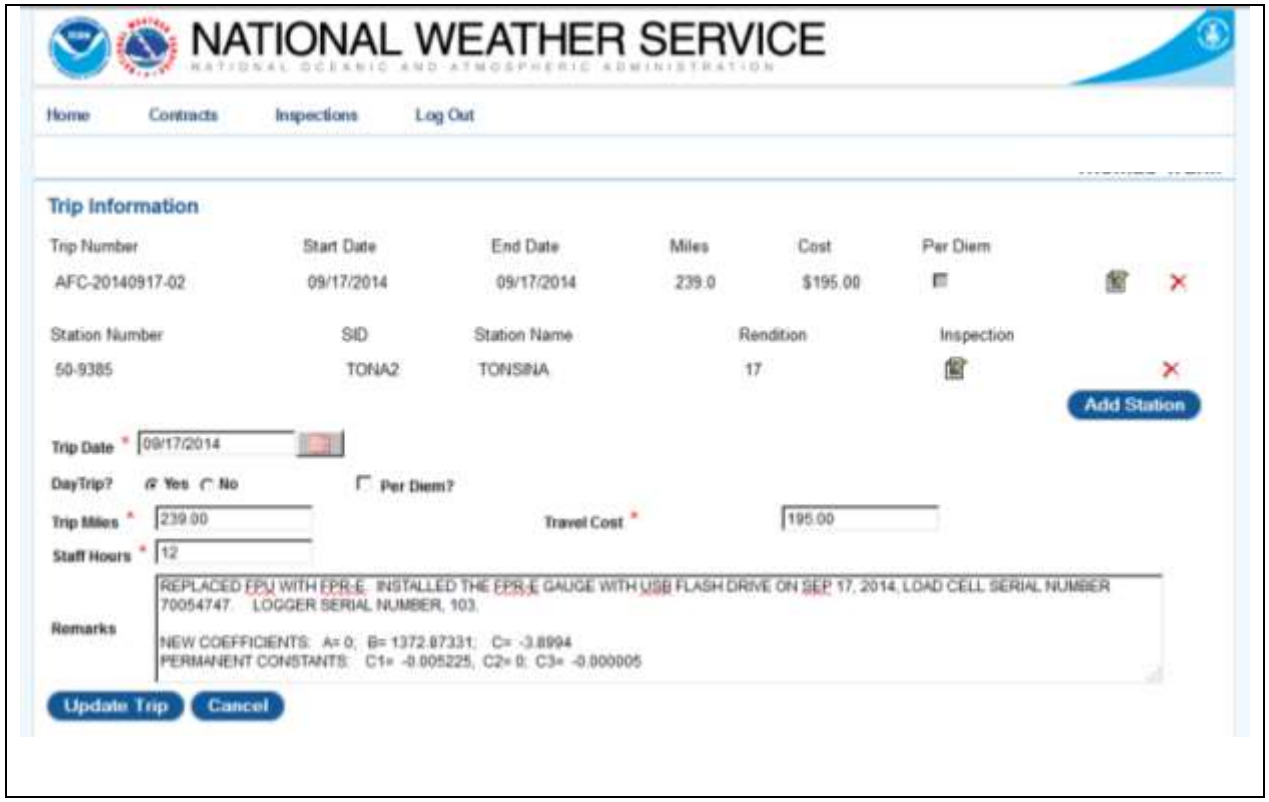

Figure 9.6 SIS Site Inspection Report – For Initial Installation

9.4.1 Inspection Report - Remarks for Initial Implementation: Each site inspection report is saved to the SIS local database as a required document for ready reference. The initial installation report should never be deleted because it contains relevant metadata to describe the weighing sensor and calibration coefficients not saved to the Station Profile.

The ***Remarks*** field in the Site Inspection report should contain these five parameters:

- Description of Action and Date of Action – Replaced F&P (or FPU) with FPR-E equipment on Month, Day, Year. (See Figure 9.6).
- Serial Numbers – Enter into the same user entry field the eight digit Serial Number of the Load Cell, and the three-digit number of the Zeno Assembly (i.e., data logger). See Figure 9.6.
- New Coefficients – These are values A, B, and C, that were calculated on-site when the sensor was attached to the site-specific collection bucket. See Figure 9.6.
- Permanent Constants – These values C1, C2, and C3, are permanent and located on the small edge of the Load Cell. If the Load Cell is replaced, then the Permanent Constants data needs to be revised in the Remarks field. See Figure 9.6.

9.4.2 Inspection Report - Remarks for Calibration Check (Annual)**:** You are required to check the calibration performance at least once per year. Document the results of the check into the Remarks field of the Inspection report. The outcome of the test may result in changed Calibration Coefficients A, B, and C.

Enter this statement to the Remarks field when the Calibration Check passes (i.e., ±0.25 inch of the test point values; 5.00 inches, 10.00 inches, and 15.00 inches).

"Sensor Calibration Check Passed: Coefficients, A = 0; B = 1372.87331; C = - 3.8994"

If the test of Calibration fails at any one of the three test points (i.e., 5-inches, 10-inches, 15-inches), you will need to re-calibrate the weighing sensor in accordance with the detailed instructions given by Appendix C, of this manual.

You will need to calculate new values for Coefficients B and C.

When done re-calibrating enter this statement to the Remarks field.

"Sensor Calibration Was Reset: New Coefficients, A = 0; B = 1286.0523; C = - 4.1076"

Note: These values are for example only. Each rain gauge will produce specific values.

When a Calibration Check is performed you should document this required maintenance in the lower portion of the Inspection screen (Figure 9.6) where you are given options for the type of maintenance performed. After the column Routine Maintenance, the first category is "Calibrated." Follow these guidelines for calibration and other maintenance actions.

- If a Calibration Reset was not necessary, click on the check-box '**Routine Maintenance**.'
- If a Calibration Reset was necessary, and completed, then click on the check-box, '**Calibrated.'**
- If you restored the FPR system to full operation, click on the check-box '**Repaired.**'
- If you removed a bad part from FPR and replaced it, click on check-box '**Replaced.**'
- If a configuration change (i.e., Modification Note) was made, click on the check-box '**Modified.**'
- If an FPR rain gauge was installed to this COOP site, when there had never been and F&P installed to this COOP site, then click on the check box, '**Installed**.'
- If the FPR rain gauge was removed from this COOP site, click on the check box, '**Removed**.'
- If the FPR rain gauge was Moved or Relocated from this COOP site, click on the check box, '**Moved/Relocated**.'

- If the FPR shell (hood and/or lower housing) was painted, click on the check box, '**Painted**.'

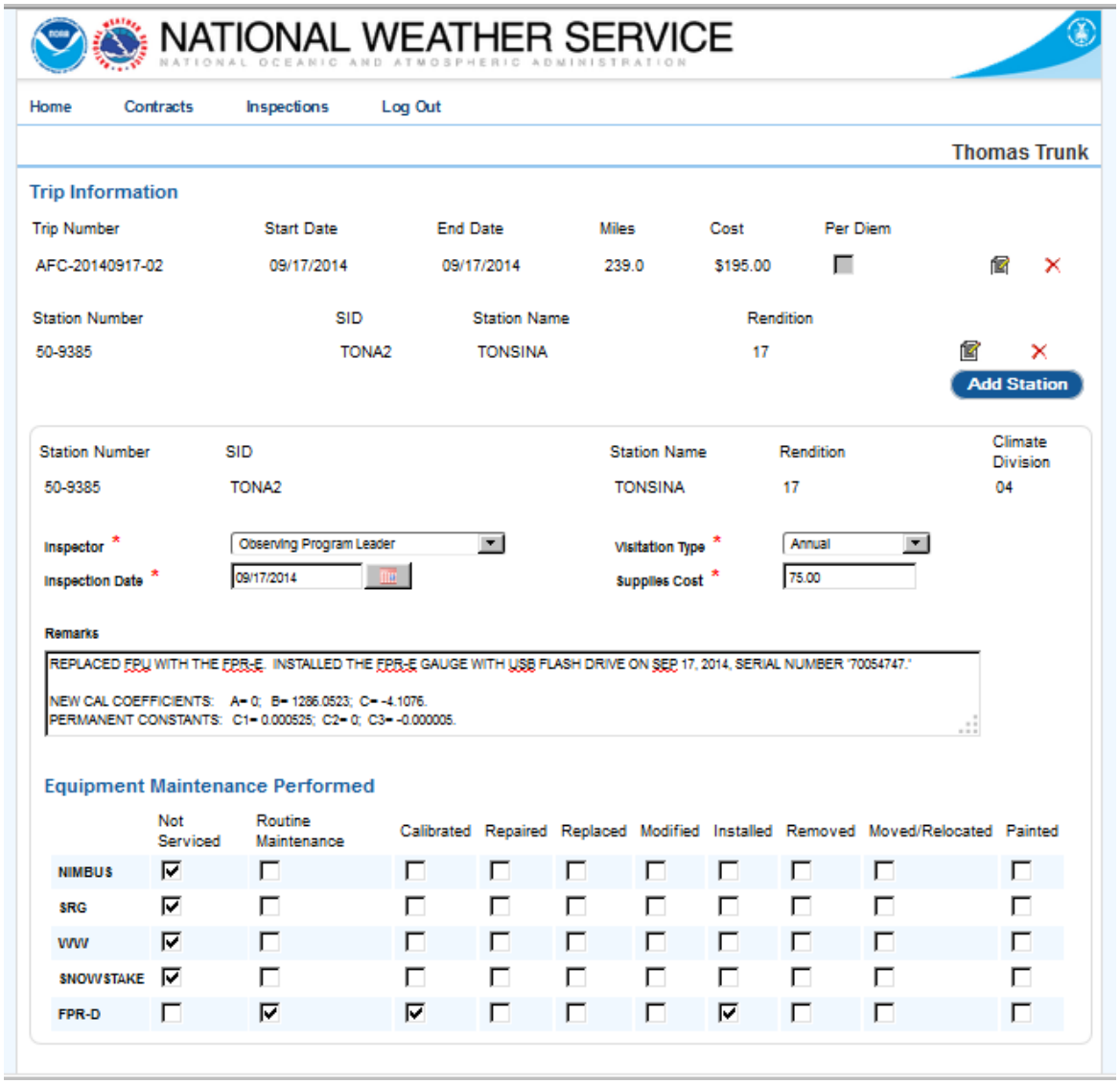

Figure 9.7 Site Inspection Report – Type of Maintenance Performed

9.5 Site Inspection Report – Valid Remarks for FPR-E Maintenance:

The FPR-E system does not flag/indicate external activity, nor does it have functionality for user entered notation codes. Therefore, both Observer and NWSREP shall document maintenance actions (i.e., draining bucket, adding food grade propylene glycol, or adding oil) to an *FPR Log Sheet* as the means to schedule future preventive maintenance and prevent bucket overflow and bucket freezes that would result in a loss of, or degradation of, precipitation data in the climate record.

Valid Remarks to Include to Site Inspection Report	
Annual Visit	Cleaned FPR-E ZENO® Assembly
Semi-Annual Visit	Cal Coefficient B – Value before Calibration
Emergency Visit	Cal Coefficient B – Value after Calibration
Awake Display – Start	Cal Coefficient C – Value before Calibration
Awake Display – End	Cal Coefficient C – Value after Calibration
Precip Level Before Bucket Serviced	Installed Auto-Syphon
Precip Level After Bucket Serviced	Removed Auto-Syphon
Calibration Check – Good Readings	Time is more than 15 minutes slow.
Calibration Check – Reset Performed	Time is more than 15 minutes fast.
Partially drained bucket – some liquid remains in bucket	Replaced one Flexure – Upper Rear
Emptied bucket	Replaced multiple Flexures
Added Oil to bucket	Replaced FPR-E ZENO® Assembly – With same model
Added Food Grade Propylene Glycol (FGPG) to bucket	Replaced Load Cell Assembly – With same model
Emptied and cleaned bucket	Replaced S hook
Installed Funnel	Replaced desiccant bags
Removed Funnel	Replaced fuse
Foreign Object Found in Bucket	Gauge moved to a compatible location – equipment move
Data downloaded to USB Flash Drive	Gauge moved to a non-compatible location – station relocation
Cleaned F&P Housing	Gauge removed from service – placed in storage
Cleaned Solar Panel	Gauge put back in service after being in storage

Table 9.1 - Valid Comments for Site Inspection Report – Remarks Field

Table 9.1 gives the range of potential notes you should enter to the Remarks field of the SIS Site Inspection Report. While at the rain gauge the NWSREP (and Observer, if delegated) shall journal to the ***FPR Log Sheet*** any maintenance action that appears in this table. Reminder: While at the rain gauge you need to wake-up the display by pressing the black push button on the right side of the Zeno data logger and then journal the reading (i.e., bucket level) to the *FPR Log Sheet*.

9.6 FPR Station Logbook:

After you create a Site Inspection Report in SIS and after your Station Profile update was successfully processed by NCDC and is accessible in the data base, consider the benefits of organizing an **optional** FPR Logbook (electronic), particularly if you have more than ten COOP sites with FPR-E equipment.

The FPR Logbook will account for your installation work, expenses, calibration coefficients, calibration check dates, semi-annual visitation, maintenance trips, and any delegated maintenance responsibility given to the Observer. In this way you will have a ready reference from which to retrieve detailed information on FPR-E system and Observer correspondence.

Be careful in the metadata entries to distinguish between the two models of FPR, the Sutron model (FPR-D) and the CES, Inc. model (FPR-E). With the exception of three forecast offices, each office was delivered just one model type (i.e., FPR-E).

You may want to spell out the definition of the ‘E’ suffix in the FPR-E acronym. The ‘E’ identifies this equipment as manufactured by Coastal Environmental Systems, Inc. (CES). Both the weighing sensor assembly and data logger were manufactured by CES, Inc.

APPENDIX A – TECHNICAL AND POLICY DOCUMENTS

1. FPR-E Technical and Instructional Handbooks:

http://www.nws.noaa.gov/ops2/Surface/coopimplementation.htm

a. ***Configuration File for FPR-E Assembly*** *– January 2011*

b. ***FPR-E Assembly Procedures*** *– Feb 2012*

c. ***FPR-E Observer Instructions*** *– June 2014*

d. ***FPR-E Operations Manual*** *– Jan 2015*

e. ***FPRE_PlotData_V1_3.xls*** *– July 2012*

f. ***COOP Mod Note D111E Note 2, Battery Cable Modification*** *– August 2014*

2. NWS Policy and Program Management Documents:

a. *NWSM 10-1315, COOP Station Observations and Maintenance* (April 2014) *
http://www.nws.noaa.gov/directives/sym/pd01013015curr.pdf

b. *NWSM 10-1313, CSSA User Manual* (May 27, 2013) *****
http://www.nws.noaa.gov/directives/sym/pd01013013curr.pdf

c. *EHB-1: Instrumental Equipment Catalog*
https://www.ops1.nws.noaa.gov/Secure/ehbs/EHB1files/ehb1.htm

d. *EHB-10: Hydrologic Equipment*
https://www.ops1.nws.noaa.gov/Secure/ehbs/EHB10/hndbk10.pdf

e. *NWSM 50-1115: Occupational Safety and Health Manual*
https://www.ops1.nws.noaa.gov/Secure/SAFETY/Safety_manual.htm

r. *Integrated Logistics Support Planning* NDS 30-3102
http://www.nws.noaa.gov/directives/030/030.htm

g. *Supply Manual and Catalog* NDS 30-3101
http://www.nws.noaa.gov/directives/030/030.htm

***** The Observing Services Division of the Office of Climate, Water, and Weather Services (OCWWS) is the Office of Primary Responsibility (OPR) for these asterisked documents. The CSSA system was shut down in October 2014, and was replaced by the Station Information System (SIS) in November 2014. The general policies in the NWSM 10-1313, will remain valid for the SIS applications.

3. Sterling Field Support Center (SFSC)

The Sterling Field Support Center (SFSC) provides a critical service to the National Weather Service (NWS) field community through use of their years of knowledge and experience gained through extensive sensor and system testing and maintenance. The SFSC has assisted the field since 2009 with the deployment and operation of the Fischer Porter Rebuild (FPR) rain gauges.

When you have a an operational or maintenance anomaly or a system failure on any FPR-E rain gauge, phone the SFSC, 8:30am – 5:00pm, Monday – Friday, on 703-661-1268; or e-mail them, nws.sfsc@noaa.gov.

Before calling SFSC, write down the issue or question and inform your Regional COOP Manager by phone or email.

All emails and phone calls received during the hours of operation will be responded to in a timely manner. Emails received during non-operation hours will be returned in the order they are received on the following day in which the facility is open. The SFSC is closed for all federal holidays.

SFSC Contact Center Information:

Main Line: 703-661-1268

Back-up Line: 703-661-1293

Email: nws.sfsc@noaa.gov

APPENDIX B – LIST OF ALL FPR-E MODIFICATION NOTES

Issue Date:	Title of NWS Engineering Mod Note:	Regions/ Sites Effected	Complete-by Date:
09/2013	COOP D111E Note 1, 'Fischer-Porter Belfort Rebuild Version E (FPR-E) Installation'	All	Six Months
08/2014	COOP D111E Note 2, 'Battery Cable Modification'	All	As Needed

See Chapter 6.3 of this manual for policy on compliance with, and documentation of each Engineering Modification Note that affects FPR-E operational systems.

APPENDIX C - CALIBRATION RESET PROCEDURE

1. Introduction to Reset Calibration:

If the Calibration Check (described in Chapter 5, of this manual) results in the Zeno Display failing to give readings within the acceptable range of ±0.25 of the brass weights loaded, then take the following steps to perform a complete Calibration Reset of the sensor. A Laptop / Netbook is required to access the Zeno data logger and conduct the Calibration Reset.

NOTE: Check the flexures before starting the calibration procedure. Verify that you have not inadvertently bent a flexure.

1.1 Enter the Load Cell Calibration Constants (C1, C2, C3) that you had entered into your Site Inspection Report :

a. Access the ZENO® User Menu via the Netbook / Laptop.

b. At the User Menu, type **F** <**enter**> to access the System Functions Menu.

c. At the Systems Function Menu, type **K** <**enter**> to access the Constants Menu.

d. Type **C1/n** <**enter**> where "n" is the C1 calibration constant from the tag on the load cell. This uses the "Change Item n To Value m" command of the Constants Menu, to change Item #1.

e. Type **C2/n** <**enter**> where "n" is the C2 calibration constant from the tag on the load cell. (i.e., this value is usually zero; '0')

f. Type **C3/n** <**enter**> where "n" is the C3 calibration constant from the tag on the load cell.

NOTE: Remember to type in a Minus Sign if either C1 or C3 is negative!

g. Type **E <enter**> to save calibration constant information in non-volatile memory.

h. Type **Q** <**enter**> to exit.

1.2 Enter the Initial Load Cell Calibration Coefficients (A, B, C):

a. At the User Menu, type **S** <**enter**> to access the Sample Period Menu. It is necessary to temporarily change the Sample Interval and Offset values for the calibration procedure.

b. Type **C1/12**<**enter**>**.** The screen will update the Sample Period Menu to the one shown below:

SAMPLE PERIOD MENU
(Cn/m) Change Item n To Value m (Q) Quit
(E) Save Parameters To EEPROM (H) Help
(U) User Menu

Item 1: 12 (Sample Interval Time)
Item 2: 10 (Sample Duration Time)
Item 3: 0 (Sample Offset Time)

d. Type **U** <**enter**> to return to the ZENO® User Menu. Then type **T** <**enter**> to display a Test Menu similar to the one shown below:

NOTE: To access the Test Menu more efficiently while in another menu, type **U T** <**enter**>. This shortcut can also be applied to other menus located above the User Menu.

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

e. Type **C2**<**enter**>. This is a request to calibrate sensor number two. If prompted for the Administrator Password, enter FPRECOASTAL.

This will display the sensor name, the current 'A' conversion coefficient, and a prompt to enter a new 'A' conversion coefficient, e.g.:

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

f. Type **0** (zero) <**enter**> for the new 'A' conversion coefficient.

g. Similarly, the screen will display the current 'B' coefficient and prompt for a new value. Type **2000**<**enter**> for the new 'B' conversion coefficient.

Conversion Coefficient B: 1256.6
Enter new Conversion Coefficient B: 2000

h. Finally, the screen will show the current 'C' coefficient and prompt for a new value. Type **0**<**enter**> for the new 'C' conversion coefficient

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

i. Type **u**<**enter**> to return to the ZENO® User Menu.

1.3 Calculate the Actual Gain/Slope:

a. With an empty dry bucket on the gauge, 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 weight of the empty bucket assembly is on the load cell.

b. At the User Menu, type **D** <**enter**> to access the Data Retrieval Menu.

c. Allow the system to run for at least 90 seconds. Type **L6**<**enter**> to look at the last 6 Precipitation Calibration (PC) data samples. The PC data value will be to three decimal places and is the fifth field for each sample record. If the last three are stable readings (i.e. within ±0.005”), then write down the last PC data value and label it B1 for later use. If they are not stable then wait for 60 more seconds and repeat.

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.

CAUTION: Be careful not to drop the weights. You could damage the load cell and/or bend the flexures. We recommend that you raise the shipping bolt while adding or removing weights to the bucket, and subsequently, lowering the shipping bolt to verify that the weight of the bucket assembly is on the load cell.

d. Place 15 inches of weight into bucket. These are the three brass weights marked “4111G”.

e. Allow the system to run for at least 90 seconds. Type **L6**<**enter**> to look at the last 6 Precipitation Calibration (PC) data samples. If the last three are stable readings, then write down the last PC data value and label it B2 for later use.

f. Calculate the new gain coefficient B with B = 30000/(B2-B1).
[This equation represents: (15" x gain) / (full weight - empty weight)]

g. Type **U T** <**enter**> to access the Test Menu. Type **C2**<**enter**> to enter the new gain coefficient B. If prompted, enter password: FPRECOASTAL. Leave A and C at zero by pressing <**enter**> at both prompts. Enter the calculated B value for coefficient B.

1.4 Calculate the Actual Offset:

a. Remove test weights from the bucket.

b. Type **U D**<**enter**> to access the Data Retrieval Menu. Allow the system to run for at least 90 seconds. Type **L6**<**enter**> to look at the last 6 Precipitation Calibration (PC) data samples. If the last three are stable readings, then write down the last PC data value and label it C3 for later use.

c. Calculate new coefficient C with C = **-** C3.

d. Type **U T**<**enter**> to access the Test Menu. Type **C2**<**enter**> to enter the new offset coefficient C. If prompted, enter password: FPRECOASTAL. Enter the calculated C value for coefficient C. Leave A and B as is by pressing <**enter**> for each.

1.5 Adjust the Actual Offset (Thermal Offset Correction):

Under some conditions there can be a small additional offset correction required due to temperature corrections done automatically by the instrument. With the bucket still empty, perform the following:

a. Type **U D** <**enter**> to access the Data Retrieval Menu. Allow the system to run for at least 90 seconds. Type **L6**<**enter**> to look at the last 6 Precipitation Calibration (PC) data samples. If the last three are stable readings, then write down the last PC data value and label it C4 for later use.

b. If C4 is not = 0, then calculate the new coefficient C with C = -(C3+C4).

c. Type **U T** <**enter**> to access the Test Menu. Type **C2**<**enter**> to enter the new offset coefficient C. If prompted, enter password: FPRECOASTAL. Enter the calculated C value for coefficient C. Leave A and B as is by pressing <**enter**> for each. (If the new C value has not changed, press <**enter**> to leave the C coefficient as is).

1.6 Verify Correct Calibration:

a. Verify that the weight of the empty bucket assembly is on the load cell.

b. Type **U D**<**enter**> to access the Data Retrieval Menu. Allow the system to run for at least 45 seconds. Type **L3**<**enter**> to look at the last 3 Precipitation Calibration (PC) data samples. Verify that these values are 0.0 ± 0.02 inches. If not within the above range, redo the calibration, starting with Section 1.2, Step ‘d.’

c. Raise the bucket with the shipping bolt then place the equivalent weight of 15 inches of precipitation into the weighing bucket. (Use the same three large brass weights (4111) as used in Section 1.3, Step ‘d.’) Lower the shipping bolt one-quarter inch below the point at which the load cell is supporting the bucket weight.

d. Type **U D**<**enter**> to access the Data Retrieval Menu. Allow the system to run for at least 45 seconds. Type **L3**<**enter**> to look at the last 3 Precipitation Calibration (PC) data samples. Verify that these values are 15.0 ± 0.02 inches. If not within the above range, redo the calibration, starting with Section 1.2, Step ‘d.’

e. If the calibration was successful, type **U S**<**enter**> to access the Sample Period Menu to reset the Sample Interval and Offset lines to the original values.

f. At the Sample Period Menu prompt, type **C1/900** <**enter**>**.** You should see the following on your screen:

SAMPLE PERIOD MENU
(Cn/m) Change Item n To Value m (Q) Quit
(E) Save Parameters To EEPROM (H) Help
(U) User Menu

Item 1: 900 (Sample Interval Time)
Item 2: 10 (Sample Duration Time)
Item 3: 0 (Sample Offset Time)

1.7 Save the Load Cell Calibration Coefficients:

a. While still at the Sample Period Menu, type **E** <**enter**> to save calibration values to EEPROM. The display should appear similar (the numbers will be different) to that shown below:

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.

NOTE: This action shuts down all ZENO® data logging.

b. Type **U T** <**enter**> to access the Test Menu. Type **C2**<**enter**> to view the conversion coefficients (if prompted for the Administrator Password, **FPRECOASTAL**). Leave A, B and C as is by pressing <**enter**> for each.

c. Write down the values of the three conversion coefficients (A, B [Gain/Slope], C [Offset]) for ready reference for when you are conducting a future calibration **check** at the Observer's site. If the check fails to show measurements within ±0.25 inch of 15.0 inches you will need this reference to see if the cal values have changed.

d. Type **Q** <**enter**> to exit.

FPR-E Worksheet for Full Calibration

#	Parameter	Value
1	Serial Number, Load Cell	i.e., 70054747
2	Calibration Constant C1	i.e., 0.0011
3	Calibration Constant C2	i.e., 0
4	Calibration Constant C3	i.e., - 0.00003
4	Firmware Version	i.e., V2.02-Z16eD Jan 28 2009
6	Configuration Version	i.e., FPRE_ConfigFile_SID.txt
7	COOP Site ID	i.e., 41-5678
8	Site ID	i.e., 5678
9	State ID plus 2 zeros	i.e., 4100
10	PC data for b1	
11	PC data for b2	
12	B = 30000/(b2-b1)	
13	PC data for c3	
14	C = -c3	
15	PC data for c4	
16	C = -(c3+c4)	
17	Cal Coefficient A	i.e., **0** (Will always be zero)
18	Cal Coefficient B	i.e., 1256.6432
19	Cal Coefficient C	i.e., - 3.5564 (Will always be a negative value)
Note: "PC data" is the Precipitation Calibration Value in Inches (3 decimal places).		

Note: These Coefficients are for example only, each rain gauge will return unique values. Also, remember Coefficient 'C' is a negative value, so include the minus sign.

1.8 Site Inspection Report (Access from SIS):

From the SIS home page access the **Inspections Menu** and from the two drop-down choices select '**Create Trip'**.

After entering the pertinent trip information (i.e., Trip date, Station Number, Visitation Type) go to the **Remarks** field. From the notes you wrote at time of inspection and Calibration reset you should have the new values for each of the Calibration Coefficients A, B, and C.

Type into the Remarks field the outcome of the Calibration Reset procedure.

- Calibration Reset Performed. New Calibration Coefficients are: A = 0; B = 1256.6432; and C = - 3.5564. *Example only, actual values will be different*.

Next, immediately below the Remarks field, see the **Equipment Maintenance Performed** matrix (illustrated in Figure 9.7). Notice it has one row each for each piece of equipment at this specific COOP site. Identify the row titled "FPR-E" and the ten (10) check boxes on this row. Mouse-click on the box "**Calibrated**," because you performed the **Calibration Reset** procedure.

Note: For inspections when the weighing sensor checked within tolerance at all three test points, and no calibration reset was performed, you mouse-click on the box, "**Routine Maintenance**" and *not* the Calibration box.

APPENDIX D - FLEXURE REMOVAL AND REPLACMENT (IN-OFFICE)

1. Introduction to Flexures Maintenance:

If any graphical plots of FPR precipitation data appear with a saw-tooth data pattern (Figure D.1) it is probably because the horizontal flexures are bent, broken, or binding. Rain gauges that have less than ±0.10 inch diurnal oscillation should be written up to a maintenance planning checklist as having suspected flexure problems. For gauges with a minor saw-tooth pattern, you should plot the data file you receive each month to monitor the problem to see if it is growing worse.

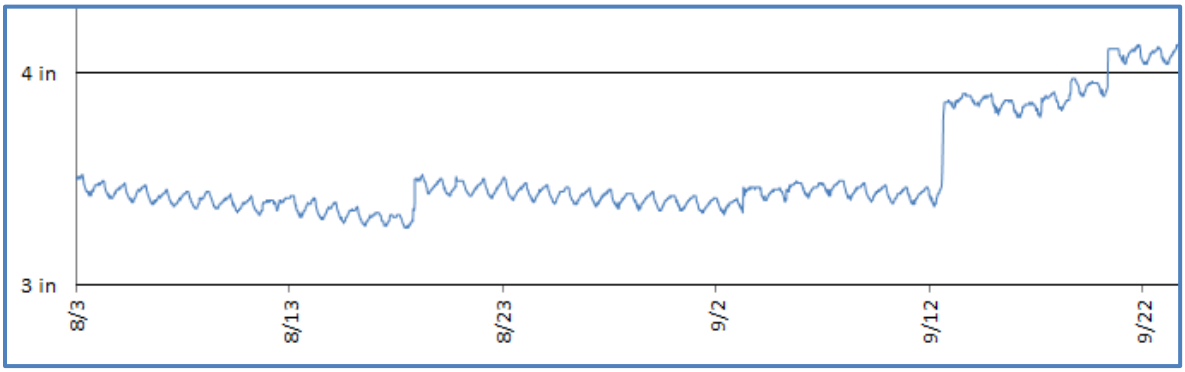

Figure D-1. Bad Flexures Can Produce Diurnal Oscillation Pattern (FPR Gauge)

Gauges with ±0.10 inch and <u>greater</u> diurnal oscillation, should be designated as a priority maintenance job, and scheduled for your next visit to the COOP site.

Figure D-2.

Figure D-3. Example of Bent Flexures

Figure D-4.

Flexures are susceptible to damage from; dropped collection buckets, rough handling during maintenance, and unsecured lever arms when gauge is being transported. Horizontal flexures will deform to a "v-shape" and produce poor data quality (Figure D.1). They are also at risk of

breaking and further corrupting the data. Poor data quality may also be indicative of 'binding flexures.' The binding flexures should be removed and replaced according to these same instructions.

2. On-Site Change-out of Weighing Mechanism:

We do not recommend replacing flexures outdoors because the process requires dexterity to handle small parts, and requires adequate lighting in a calm and dry setting. Instead, the best practice is to replace the whole Weighing Mechanism with a pre-assembled spare with documented good flexures. The change-out itself is not difficult, it requires just four screws (7/16 inch) to be removed from the base of the Scale Frame to remove it from the Stage (see Figure D-5). To prepare for this removal, you will need to drain and remove the collection bucket and remove the lower casing assembly. Always plan ahead and reserve the needed time to conduct full bucket maintenance when you change-out the weighing mechanism.

2.1 Weighing Mechanism Change-Out Tasks: At the observer's site, you will perform these tasks to efficiently replace the weighing mechanism and return the FPR-E to operational status:

a. Remove the hood.

b. Drain the collection bucket.

c. Remove the collection bucket.

d. Remove the force post.

e. Remove the lower casing.

f. Unhook the FPR-E Load Cell from the S-Hook, and from the lower tensioning hook.

g. Remove the four 7/16 inch hex bolts at bottom of Weighing Mechanism.

h. Remove the Weighing Mechanism.

i. Level the Base Plate with carpenter's level.

j. Install a preassembled spare Weighing Mechanism, with documented good flexures.

k. Replace the casing, force post, and collection bucket.

l. Conduct a full calibration of FPR-E gauge.

m. Charge the bucket for seasonal operational use.

3. In-Office Replacement of Flexures – Detailed Instructions:

Flexure replacement is a time consuming process. The upper rear Horizontal Flexure is the most accessible for replacement. However, all flexures should be examined when and precipitation data develops a diurnal oscillation pattern. Flexures need to be replaced inside a workshop

environment. If spare F&P legacy equipment is available in your WFO, you are strongly encouraged to prepare a weighing mechanism as a preassembled spare kit. Follow the instructions given in this section.

The spare Weighing Mechanism should consist of the Weighing Mechanism without the Load Cell and without the Force Post (Figure D-5). The spare will have new flexures in all four junctions and have both Lever Arms fastened with wire or string to the Scale Frame to prevent any motion. The spare should be kept protected with suitable packing material in a cardboard box, ready for transport to the site.

Background: Each Lever Arm has the same flexure configurations (Front and Back) as the other. In each of the four locations each flexure is connected to its Lever Arm by two screws and by two screws the same flexure is connected to its respective L-shaped Mounting Bracket (see Figure D-5).

The easiest method of replacing the flexures is to remove each Lever Arm one at a time. Before you remove the Lever Arms, you will need to remove the Collection Bucket, Force Post, and Zeno Assembly. Note: The Zeno Assembly can remain connected to load cell, solar power, and battery power.

Without removing any cables or power supply, lay the Zeno Assembly on the base plate. Unhook the FPR-E Load Cell from the top hook, and unhook the bottom of the Load Cell from lower arm's hook (See Figure D-5). Set the Load Cell off to the side away from the 12-V battery.

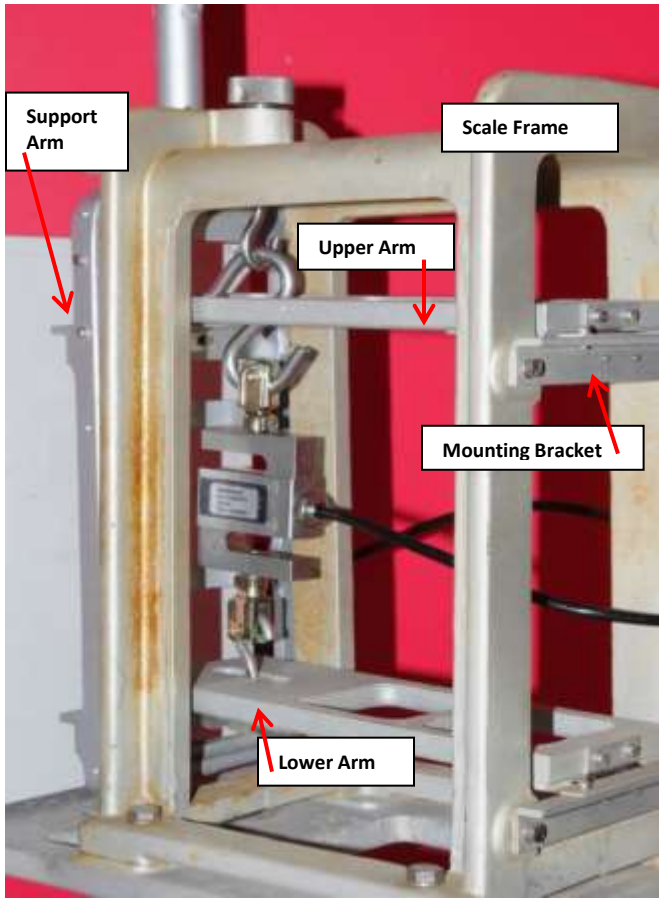

Figure D-5. Weighing Mechanism (aka, the Tower).

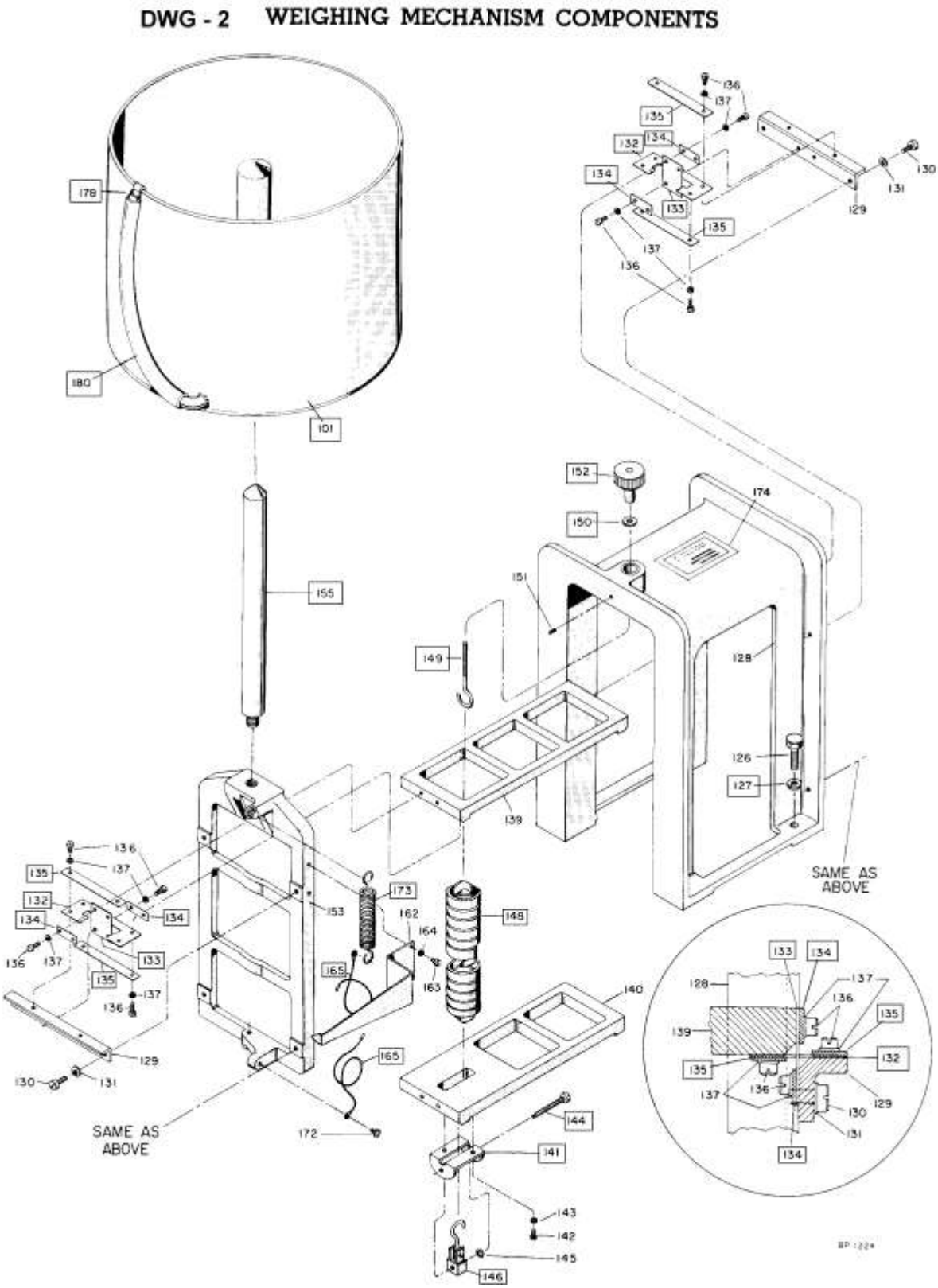

Figure D-6. Lever Arms and Flexures Are Used Operationally on all FPR model gauges.

PARTS LIST – WEIGHING MECHANISM COMPONENTS		
Drawing Item#	**Agency Stock No.**	**Description**
101	D111-1SP104	BUCKET, MANUAL DRAIN
126	D111-____	BOLT, 7/16 inch Hex Head
127	D111-4H103	WASHER
128	D111-___	SUPPORT, SCALE (FRAME)
129	D111-____	BRACKET, Flexure
130	D111-TMS900	SCREW, Fillister Head
131	D111-TMS900	WASHER, Lock #8
132	D111-3SP112	FLEXURE, HORIZONTAL
133	D111-3SP116	FLEXURE, VERTICAL
134	D111-3SP117	PLATE, CLAMP, FOR VERTICAL FLEXURE
135	D111-3SP118	PLATE, CLAMP, FOR HORIZONTAL FLEXURE
136	D111-TMS900	SCREW, Fillister Head #4-40-0.250
137	D111-TMS900	WASHER, Lock #4
139	D111-___	ARM, Lever: Upper
140	D111-___	ARM, Lever: Lower
141	D111-3SP114	BRACKET, RANGE ADJUST
142	D111-___	SCREW, Truss Head
143	D111-TMS900	WASHER, Lock: #4
144	D111-3H110	SCREW, RANGE ADJUST
145	D111-TMS900	RING FASTENER, External
146	D111-3A111	COUPLING ASSEMBLY
148	D111-3MP111	SPRING, MAIN ***(Not Applicable to FPR-E)***
149	D111-3SP113	HOOK, UPPER MAIN SPRING
150	D111-3H112	WASHER, D, UPPER HOOK GUIDE
151	D111-____	SET SCREW, Hex Hole
152	D111-1SP115	KNOB, ZERO ADJUST
153	D111-____	SUPPORT ARM ASSEMBLY
155	D111-3SP119	POST, SCALE FOR WEIGHING ASSY
162	D111-____	POINTER ***(Not Applicable to FPR-E)***
163	D111-TMS900	SCREW, Fillister Head: #4-40-0.250 ***(Not Applicable to FPR-E)***
164	D111-TMS900	WASHER, Lock: #4 ***(Not Applicable to FPR-E)***
165	D111-3W110	CABLE, MECHANICAL GUIDE ***(Not Applicable to FPR-E)***
172	D111-TMS900	SCREW, Binding Head ***(Not Applicable to FPR-E)***
173	D111-3MP110	SPRING ***(Not Applicable to FPR-E)***
174	D111-_____	NAMEPLATE
178	D111-1SP100	NOZZLE, DRAIN, WITH CLIP
180	D111-1SP106	TUBING, TYGON: 7/16 INCH O.D. 5/16 INCH I.D. AND 12 INCHES LONG

Table D-1. Parts Description for Weighing Mechanism (see Drawing in Figure D-6)

3.1 Remove Upper Lever Arm:

1. Loosen the rear Mounting Bracket by loosening its two screws (#8-32-0.375). Hold the center of the arm to prevent it from falling, or tie it to the top of the Scale Frame.
2. At the front of the Arm, remove the two visible screws that hold the Horizontal Flexure to the Mounting Bracket.
3. At the front of the Arm, remove the two visible screws that attach the Vertical Flexure to the Arm.
4. At this point, with the arm braced, take out the two screws you loosened in step #1, that hold the rear Mounting Bracket to the Scale Frame.
5. Now, holding the Arm from its center, carefully carry the arm out from the weighing mechanism. This arm has three of the four flexures attached to it. Only the front Vertical Flexure was left behind. You will remove that flexure after you remove the others from this arm.

3.2 Remove Flexures:

1. Set the Arm with rear Mounting Bracket still attached onto a prepared surface so you can remove all flexure screws. At rear of the Arm, remove the two screws in the Vertical Flexure that had connected it to the Mounting Bracket.
2. At rear of the Arm, remove the two visible screws in the Horizontal Flexure that attach it to the Mounting Bracket. The Mounting Bracket is now removed from the arm.
3. From this same rear of the Arm, proceed to remove the two visible screws that connect the Vertical Flexure to the Arm. **The rear Vertical Flexure is now removed.**

Figure D-7. Upper-Rear Connection

4. At this same end, remove the two screws that connect the Horizontal Flexure to the underside of the arm. **The rear Horizontal Flexure is now removed.**
5. On the front end of the arm, just the Horizontal Flexure remains. Remove the two screws that fasten it to the underside of the arm. **The front Horizontal Flexure is now removed.**

6. Finally, go to the front Mounting Bracket and remove the two screws that still hold the Vertical Flexure to this Mounting Bracket. **The front Vertical Flexure is now removed.**

   Note: At this point you have removed all four flexures associated with the Upper Arm.

Figure D-8. Upper-Front Connection.

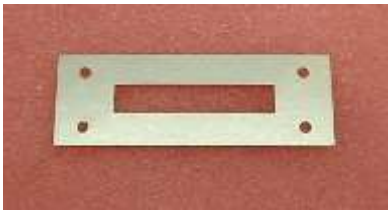

Figure D-9. Horizontal Flexure

Figure D-10. Vertical Flexure

3.3 Install New Flexures:

1. Install one new Horizontal Flexure and one new Vertical Flexure on the rear end of the arm by following steps #2 and #3, in next paragraphs. Then install to the front of the arm, one new Vertical Flexure and one new Horizontal Flexure, by following steps #4 and #5. Each flexure requires one plate clamp, two lock washers, and two screws to attach to the arm. See Figure D-5, for a diagram for how the flexures and fasteners are assembled.

2. Install to the rear of the underside of the Arm, one Horizontal Flexure. Align one pair of the widely spaced holes (Figure D-9) in this flexure with the two holes on the underside of arm. Then add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

Figure D-11. Lower-Rear Connection.

3. Install to the rear of the Arm, one Vertical Flexure. Align the top two holes (Figure D-10) in the flexure with the two holes in back edge of Arm. Then, add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

4. Install to the front of the Arm, one Vertical Flexure. Align the top two holes in flexure (Figure D-10) with two holes on front edge of Arm. Then, add the plate clamp. Insert one screw with lock washer into each hole.

   Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.

5. Install to the front of the Arm, one Horizontal Flexure. Align one pair of widely spaced holes (Figure D-9) in this flexure to the two holes in the underside of the arm. Then add the plate clamp. Insert one screw with lock washer into each hole. *Thread these screws lightly into the Arm until they fit snugly. Do not tighten - save for Section 3.6.*

Figure D-12. Lower-Front Connection.

Caution: Never grip the Lever Arm by the ends or you will damage the flexures. Instead, always handle the arms at their midpoint, and leave the ends free from contact.

3.4 Remove Lower Lever Arm, Remove Its Flexures, and Install New Flexures

1. Remove the Lower Arm from the weighing assembly. Follow the same steps #1 – 5, from Section 3.1.

2. Remove the Range Adjust Bracket (Item #141, in Table D-1) from the underside of the Lower Arm because it is an obstruction for access to the flexure screws. See Figure D-13. This is a small bracket that anchors the Coupling Assembly (e.g., #146 in Table D-1) that secures the bottom end of the FPR-E load cell with a hook. Remove the two quarter inch screws that attach the Range Adjust Bracket to the lower Arm.

3. Remove all four flexures from the Lower Arm. Repeat steps #1- 6, from Section 3.2.

4. Install all four flexures to the Lower Arm. Repeat steps #1- 5, from Section 3.3. At this point all flexure screws should be fitted into the Arm snugly. They will be tightened to 8 pound-inches, in Section 3.6.

5. Install the Range Adjust Bracket (it includes the Coupling Assembly) to the underside of the Lower Arm (Figure D-13). Use the same the two screws (#4-40-0.25) you removed in Step #2.

Note: The Lower Arm with its new flexures is now ready to be installed to the Weighing Mechanism according to the same instructions as given in Section 3.5 for the Upper Arm.

3.5 Install Lever Arms:

1. Reinstall the rear Mounting Bracket that was removed in Section 3.1, step 4. Use the two fillister head screws (#8-32-0.375) with the #8 lock washers to install to the Scale Frame. Tighten these screws.

2. Brace the arm by wrapping string or wire around it and the Scale Frame. Then move the Arm back to position so the front of the Arm can be attached to the inside of the front Mounting Bracket. You have to access this point from below and inside the weighing mechanism, where you will screw the front Vertical Flexure into the front Mounting Bracket. Install each of the two screws to attach arm to the front Mounting Bracket. Use the proper sequence: flexure onto mounting bracket, plate clamp onto flexure, and insert screw with lock washer into each hole. Thread the screws so each fit snugly – do not tighten.

Figure D-13. Bracket is on Underside of Lower Arm.

3. Upon completing step 1, the front Horizontal Flexure lies flat upon the Mounting Bracket and is most easy to access. On top of this Horizontal Flexure, place the horizontal plate clamp, and insert one screw each, with lock washer, into the two holes. Thread the two screws down into the bracket (visible), so they fit snugly. (See Figure D-12.)

   Note: Avoid damaging new flexures always hold the Lever Arm from its midpoint, and not from the ends.

4. With the upper Arm held securely by string or wire to the Frame, connect the back end of the Arm to the rear Mounting Bracket. Connect the rear Vertical Flexure to the inside face of the bracket. This point requires access from inside the weighing mechanism. Place the flexure directly onto the bracket then add the plate clamp. Then thread each screw with its lock washer snugly into the bracket.

5. Upon completing step 4, the rear Horizontal Flexure will lie flat against the Mounting Bracket. This is easy to access. Place a plate clamp on top of the Horizontal Flexure, align the two holes, and thread each screw (visible) with its lock washer into the bracket. Thread each screw to fit snugly.

   Remove the string or any other support you had for the Arm.

6. Install the Lower Lever Arm in the same exact manner. Follow the Steps #1 – 5, above.

3.6 Tighten all Screws Sequentially:

Both arms need to be installed to the weighing assembly with screws threaded 'snugly' before this procedure is possible. You will tighten all 32 flexure screws in a pattern going from one arm's flexure to the next arm's alternate side flexure.

1. Horizontal Flexures: Start with the two left-side screws on the lower rear Horizontal Flexure and move to the two right-side screws in the upper front Horizontal Flexure. Then tighten the two right-side screws on lower rear Horizontal Flexure and move to the two left-side screws in the left-side of the upper front Horizontal Flexure.

2. Vertical Flexures: Tighten the four screws in an X pattern on each flexure. Start with the lower rear flexure and move to the upper front flexure. Then do the upper rear flexure and move to the lower front flexure.

   NOTE: Be careful not to exceed 8 lb-in (± 1 lb-in) as the final torque.

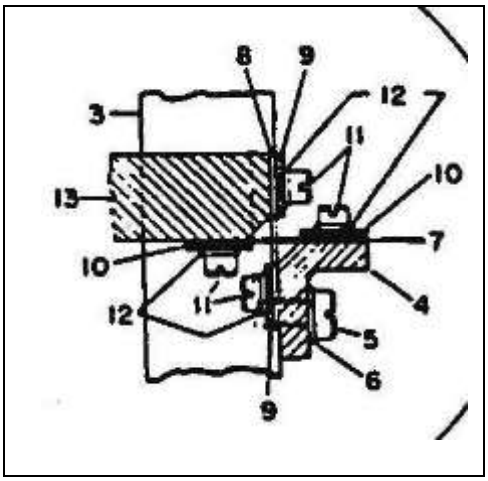

Figure D-14. Location of Flexure Screws (Item #11). Four per each Flexure.

APPENDIX E - ZENO ASSEMBLY REMOVAL AND SHIPPING INSTRUCTIONS

The Zeno Assembly includes the USB Flash Drive fixture where the Observer takes the monthly download of precipitation data. The USB Flash Drive fixture has been known to break and if this occurs you will need to order a replacement Zeno Assembly. The part number is "D111E-2" and it should be ordered from NLSC as you would any other broken part.

If the Zeno Assembly becomes broken in some other way, for example if the clear plastic cover is cracked and moisture could enter the assembly and risk the integrity of the circuit boards, then you will need to order a replacement Zeno Assembly (D111E-2).

There are no lower replaceable parts on the Zeno Assembly, the entire unit gets replaced.

After you determine the need to replace a Zeno Assembly, follow these instructions.

1. Order a replacement Zeno Assembly from NLSC: Part number is 'D111E-2.'

1.1. Prepare to Remove Zeno Assembly at COOP Site:

a. Download Precipitation Data to Flash-Drive: Conduct your maintenance visit on a rain-free day. Bring the laptop/netbook to enter SID number and calibrate the new logger at the site. Download the last 100-days of data onto your USB Flash Drive, for routine reporting to NCDC. Follow instructions in Section 10.2.2, *FPR-E Assembly Procedures.* After the system has completed its download to Flash Drive, turn the display off.

b. Power-Down System: Refer to *FPR-E Assembly Procedures,* Sections 4, 5, 6, 7, 8, 9, 10, and 12, to work in reverse order, to remove the ZENO Assembly from the rain gauge. **Important:** You may need to use an Electrostatic Discharge (ESD) grounding strap.

1. Open the clear plastic case: Refer to the instructions in Section 5.8, of the *FPR-E Assembly Procedures.*

CAUTION: The next step involves working on a LIVE electrical circuit. Do not allow your screwdriver or the disconnected wires to touch any exposed circuits in the opened box.

2. Disconnect the solar panel cable from the Zeno Assembly: Refer to Sections 5.9 and 5.10 (and photo in Section 5.11) in *FPR-E Assembly Procedures,* to remove white wire and black wire from their terminals.

3. Disconnect the battery connectors from the 12V battery's terminals: Refer to Section 6 and photo in Section 6.3, in *FPR-E Assembly Procedures*. Do not disconnect the battery cable from the Zeno Assembly.

4. Disconnect Load Cell Cable: Refer to instructions in Sections 4.8, Section 4.9, and Sec 4.10 and the wiring diagram in Section 4.12, of the *FPR-E Assembly Procedures*.

5. Dismount Zeno Assembly: Refer to instructions in Sections 4.1, 4.2, 4.3, 4.4, and Section 4.6, in the *FPR-E Assembly Procedures.*

1.2 Mount and Initialize New Zeno Assembly: Follow instructions as they appear in Section 7, *FPR-E Assembly Procedures*. Then initial-configure the logger, Section 8.4 (Install Configuration File "FPRE_ConfigFile_SID.txt"), update the Password, enter the SID, set the date and time.

a. Calibrate System with Test Weights: With collection bucket in place, and protector-bolt retracted, calibrate the system exactly as described in Section 9 *FPR-E Assembly Procedures*.

b. Functional Checkout: Verify proper data display, data download, and data logging, as described in Section 10, *FPR-E Assembly Procedures*.

1.3 Package and Ship Bad Assembly to National Reconditioning Center: Return all the original hardware, namely the stuffing glands, washers and caps. Of the three cables (battery, solar, and sensor) return only the *battery cable*.

a. Prepare a Form H-14, Equipment Return Tag: Fill out all 12 boxes. Take special care to write-in the explanation, as noted in Line Item #11. Make sure the H-14 is complete and enclosed in the box you will send to National Reconditioning Center (NRC).

b. Pack the Broken Zeno Assembly: Use the box in which you received the replacement Zeno Assembly. Use the same padding, clear plastic wrap, to protect the Bad logger.

c. **Important** to Ensure All Port-Glands Get Returned: Double check to ensure each of the three ports on the broken Logger has a rubber stuffing piece, plastic washer, and a cap.

d. Ship to National Reconditioning Center (NRC): Prepare a UPS Shipping Label, as follows – as you would any part that requires repair work.

NOAA-National Reconditioning Center (NRC)
Weather Systems Repair Branch (W-OPS62) Org Code: WG9162
1520 East Bannister Road
Kansas City, Missouri 64131-3009
816-823-1057 x245

1.4 Update the Metadata in the Site Inspection (SIS): Follow instructions in Chapter 9.4 of this manual for where in the Site Inspection Report to enter the new logger's Serial Number (i.e., #324) and the new Calibration Coefficients (i.e., A, B, and C). Retain the same numeric values for Calibration Constant 1, Constant 2, Constant 3, because you did not change the Load Cell.

APPENDIX F - SAMPLE FPR LOG SHEET

FPR LOG SHEET

Forecast Office (SID): TAE **COOP Station Name:** Pinetree State Park (01-5678) **Your NWSREP Name:** M. Jones .

Date	Time	Amount	Routine Actions	Special Notes (i.e., displayed error messages, etc.)
03/28/2011	Start: 10:15 am Stop: 10:45 am	15.47 02.75	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☒ Partial Drain Funnel - ☒ In ☐ Out	
06/14/2011	Start: 4:15 pm Stop: 4:45 pm	8.72 8.72	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☐ Out	'Err 12' message displayed. Phoned NWSREP.
09/28/2011	Start: 2:30 am Stop: 2:45 am	10.39 10.39	☐ Add Oil ☐ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☒ Out	Wiped down the F&P shell to remove dust.
10/15/2011	Stop: 11:15 am Stop: 12:15 pm	14.35 0.35	☒ Add Oil ☐ Add FGPG ☒ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☐ Out	Removed pinecone, cleaned bucket, and then added one half quart of oil.
12/21/2011	Start: 9:30 am Stop: 9:30 am	6.14 6.43	☐ Add Oil ☒ Add FGPG ☐ Empty Bucket ☐ Partial Drain Funnel - ☐ In ☐ Out	Very cold month – had to add 2 quarts of FGPG to prevent ice damage.

Instructions: Before you start your action, enter the date and then at time of maintenance, enter current time (standard time, not daylight time) on the 'Start' line in Column 2. Then press the Display button to view the Amount in bucket. Write this value in Column 3 (Amount). Then mark appropriate box(es) in Column 4 (Routine Actions) to indicate your actions. If not a routine action, write your comments in Column 5 (Special Notes). When you have completed your action, go back to Column 2, and enter current time (standard time, only) into the 'Stop' line. Always phone your NWSREP if an error message displays or display fails to light-up on command. Always mail your Log Sheets to your NWSREP. Keep spare sheets inside shelter.

APPENDIX G – FPR-E LOWEST REPLACEABLE PARTS

FPR-E Lowest Replaceable Parts				
General Name	**Short Description**	**Long Description**	**Stock**	**SMR**
Load Cell Assembly	Load Cell Assembly, FPR	Load Cell Assembly, FPR, complete with load cell, S Hook, and mounting hardware (CES)	**D111E-1**	PAODD
S Hook, LC mounting	S Hook, Load Cell mounting, FPR	S Hook, Load Cell mounting, FPR (CES or Open Market	**D111E-1MP1**	PAOZZ
Null Modem Cable	Null Modem Cable, FPR	Null Modem Cable, DB9F to DB9F, 3-meter, FPR	**D111E-1W1**	PAOZZ
FPR-E ZENO® Assembly	ZENO® FPX Assembly with Bracket	ZENO® FPX Assembly for F&P Gauge Rebuild, includes ZENO® datalogger, solar panel regulator, display, push button, USB Flash Drive interface, housing & mounting bracket (CES)	**D111E-2**	PAODD
Battery	Battery, 12V, 7AH, Sealed Lead Acid	Battery, 12V, 7AH, Sealed Lead Acid, Spade Terminals, 4 lbs, Panasonic LC-R127R2P or Equivalent	**D111E-2B1** or **017-B-2-32**	PAOZZ
Battery Cable	Battery Cable, FPR Kit	Battery Cable with original F1 connector.	**D111E-2CBL1**	PAOZZ
Battery Cable Connector	Quarter Inch Wide Spade Terminal	New connector needed when replacing the initial issued CES battery with NLSC stock battery (017-B-2-32). Use new connector to modify D111E-2CBL1 (cable).	**017C-E-1825**	PAOZZ
Stuffing Gland	Gland Fitting, FPR Kit	Gland Fitting, FPR Kit	**D111E-2MP1**	PAOZZ
Desiccant Bag	Desiccant Bag	Desiccant Bag, ½-Unit (16.5g Clay). P/N TBD	**T.B.D.**	PAOZZ
CES FPR Manual	Manual FPR, OEM, CES	Manual, FPR, OEM (CES)	**D111E-2D1**	PAOZZ
Fuse	Fuse, 250V, 2A	Fuse, 250V, 2A	**D111E-2F1** or **017-F-5-31S**	PAOZZ
Solar Panel Assembly	Solar Panel, 10W, 12V nom, @0.66A, no regulator	Solar Panel, 10W, with Diode, 12V nom. @0.66A, no regulator, metal frame, 15 ft cable, hardware and mounting arm (CES)	**D111E-3**	PAODD
Solar Panel (only)	Solar Panel only, 10W, 12V nom, @0.66A, no regulator, FPR Kit	Solar Panel only, 10W, with Diode, 12V nom. @0.66A, no regulator, metal frame, with 15 feet cable, PowerUp BSP-1012	**D111E-3A1**	PAODD
Solar Panel Mount (only)	Mounting Hardware, for Solar Panel, FPR Kit	Mounting Hardware, hardware and mounting arm (CES), custom for PowerUP BSP-1012 solar panel and F&P gauge, FPR Kit	**D111E-3A2**	PAOZZ

Explanation of Source, Maintenance, and Recoverability Codes (SM&R) Acronyms

PADDD: You must return these parts (i.e., faulty regulator) to National Reconditioning Center (NRC) in exchange for a replacement.
The 'PA' signifies item procured and stocked for anticipated or known usage that is not deteriorative in nature; the 'DD' signifies the part must be shipped to the depot (NRC) together with its integral component(s) for disassembly and be repaired by the depot (NRC); and the final 'D' signifies that just the depot (NRC) is authorized to repair, condemn, or dispose of this part.

PAODD: You must return these parts (i.e., faulty GMA) to NRC in exchange for a replacement.
The 'PA' signifies item procured and stocked for anticipated or known usage that is not deteriorative in nature; the 'OD' signifies this part shall be isolated and removed by the field and shipped to the depot (NRC) where the depot (NRC) will perform the repair; and the final 'D' signifies that just the depot (NRC) is authorized to repair, condemn, or dispose of this part.

PAOZZ: A non-repairable part. You may dispose of these parts (i.e., 5 Amp fuse) at the Weather Forecast Office (WFO).
The 'PA' signifies item procured and stocked for anticipated or known usage that is not deteriorative in nature; the 'OZ' signifies the field level shall remove and replace this part, however it is non-repairable and no repair to the item is authorized.
The final 'Z' signifies that the field office is authorized to condemn and dispose of the part when it becomes unserviceable.

Reference: EHB-1, *Instrumental Equipment Catalog* (Issuance 1996-1), Section 2.3, Source, Maintenance and Recoverability Code (SM&R).