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The Meteorological Monitoring Audit, Preventative Maintenance and Quality Assurance Programs at a Former Nuclear Weapons Facility

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DISCLAIMER

INTRODUCTION

The purposes of the meteorological monitoring audit, preventative maintenance, and quality assurance programs at the Rocky Flats Environmental Technology Site (Site), are to (1) support Emergency Preparedness (EP) programs at the Site in assessing the transport, dispersion, and deposition of effluents actually or potentially released into the atmosphere by Site operations; and (2) provide information for onsite and offsite projects concerned with the design of environmental monitoring networks for impact assessments, environmental surveillance activities, and remediation activities. The risk from the Site includes chemical and radioactive emissions historically related to nuclear weapons component production activities that are currently associated with storage of large quantities of radionuclides (plutonium) and radioactive waste forms. The meteorological monitoring program provides information for site-specific weather forecasting, which supports Site operations, employee safety, and Emergency Preparedness operations.

REQUIREMENTS FOR HISTORICAL DATA AND MONITORING METEOROLOGICAL CONDITIONS

Title 40 Code of Federal Regulations (CFR) 61, Subparagraph H[1] and United States Department of Energy (DOE) Order 5400.1 "General Environmental Protection Program" (1988)[2], require the use of representative meteorological data for dispersion modeling of airborne emissions for the Site. DOE Order 151.1 "Comprehensive Emergency Management System" (1995)[3], requires DOE facilities to establish a meteorological monitoring program with routine measurements to be taken at locations and heights representative of atmospheric conditions into which material may be released and transported. DOE Order 5700.6C "Quality Assurance Non-Weapons Quality Assurance" (1993)[4] requires compliance with quality assurance (QA) and quality control (QC) procedures for obtaining monitoring data.

SITE LOCATION

The Site is located approximately 16 miles northwest of Denver and covers an area of 6,500 acres. Figure 1 displays the location of the Site with respect to the metropolitan Denver-Boulder area. The Site roughly forms a rectangle that is 4 miles wide west-to-east and 2.5 miles north-to-south and is situated on the eastern edge of a flat geological bench known as Rocky Flats. The 5-mile wide bench slopes slightly eastward from the eastern flank of the Rocky Mountain Front Range with an average slope of 100 to 120 feet per mile (about 2 percent) and an average elevation of 6,000 feet above mean sea level (ASL). Regional elevations range from 14,000 feet ASL at the Continental Divide 20 miles west to about 5,200 feet ASL in the South Platte River Valley 15 miles southeast of the Site.

DATA COLLECTION AND TRANSMISSION

Meteorological data are collected and transmitted from two meteorological towers located in the Site's West Buffer Zone (Figure 2). Both towers contain a Campbell Scientific datalogger Model CR-10 which measures data in a continuous stream and transmits every 15 minutes.[5] Telemetry is used to transmit data from the towers to the work environment. The dataloggers measure averages, maximums, minimums, totals, and standard deviations of the various meteorological parameters for each 15 minute period. The primary tower extends to 61-meters (200 feet), the backup tower to 10 meters (33 feet). The 61-meter tower is the primary source of meteorological data. Instrumentation on the primary tower measures meteorological parameters from four levels: 1.5, 10, 25, and 60 meters (Figure 3). The 1.5 meter level, which is the industry standard height for measuring temperature, also measures dew point temperature and relative humidity. Collectively, the 10, 25, and 60 meter levels measure incoming and outgoing solar radiation, atmospheric pressure, air density, soil heat flux, precipitation and vertical and horizontal wind speed and wind direction.[6]

METEOROLOGICAL MONITORING AUDIT PROGRAM

A performance audit of the meteorological monitoring sensors is used to provide a quantitative indication of the accuracy of the measurements. During a performance audit it is necessary to verify instrument operations by performing direct comparisons or by creating a synthetic signal corresponding to a known value for each specific variable. An audit of meteorological instrumentation is performed by initiating complete system checks for the individual sensors for each monitoring variable.[7]

QUALITY ASSURANCE METHODOLOGY

The performance audits have occurred approximately every six months since the fall of 1994. The performance audits for meteorological instrumentation were performed in accordance with the *Summary of Acceptable Audit Criteria*, derived from the Environmental Protection Agency (EPA) *Quality Assurance Handbook for Air Pollution Measurement Systems.*[8] All required checks, verifications, and audits were performed by an independent third party auditor. Acceptable methods and tolerances for the meteorological sensors included in the audit are provided in Table 1.

PREVENTATIVE MAINTENANCE STANDARD OPERATING PROCEDURES

The purpose of the preventative maintenance plan is to establish guidelines and standard operating procedures (SOP's) for conducting routine site visits, perform scheduled maintenance activities, and support meteorological sensor replacement and repair for the two Site meteorological towers. The goal of the plan is to provide a "stand alone" preventative maintenance plan which details schedules, frequencies, and responsibilities for Site technicians to follow.

The preventative maintenance plan consists of visual inspections, periodic sensor cleaning, scheduled instrument and individual part replacements and troubleshooting procedures. The plan discusses routine site visits, including the day-to-day responsibilities of the on-site technician and provides a site checklist (Figure 4).[9] The maintenance required, procedures, and schedules for the individual sensors for both the primary 61-meter tower and backup 10-meter tower are provided in the plan. Site checklists for quarterly, semi-annual, and annual visits are similar to the bi-weekly visit form provided in Figure 4.

SUMMARY

The Site meteorological monitoring audit, preventative maintenance, and quality assurance programs have significantly progressed over the past two years. The meteorological monitoring audit program has helped validate the data utilized in assessing the transport, dispersion, and deposition of effluents potentially released into the atmosphere by Site operations. The overall success of this program led to the preparation and implementation of a preventative maintenance plan. The preventative maintenance plan has established guidelines and SOP's for inspecting, maintaining, and repairing meteorological instrumentation on two towers. Quality assurance of the Site meteorological monitoring program has been in strict accordance with EPA criteria. A training program for Site technicians on this topic was provided by an independent third party contractor. A major factor in the overall success of the meteorological monitoring program at the Site will be an adequate supply of funding for performance of semi-annual third party audits and for trained Site technicians to perform the necessary tower inspections and routine maintenance required to adequately sustain the instrumentation.

REFERENCES

1. National Emissions Standards of Radionuclides Other Than Radon from Department of Energy (DOE) Facilities, U.S. Environmental Protection Agency, Code of Federal Regulations, Title 40, Part 61, Subpart H, December 15, 1989.

2. DOE Order 5400.1, "General Environmental Protection Program," U.S. Department of Energy, Washington, D.C., IV.6, November 9, 1988.

3. DOE Order 151.1, "Comprehensive Emergency Management System," U.S. Department of Energy, Washington, D.C., September 15, 1995.

4. DOE Order 5700.6C, "Quality Assurance Non-Weapons Quality Assurance," U.S. Department of Energy, Washington, D.C., January 1993.

5. C.L. Dickerman and D.R. Maxwell, "Management of meteorological data at a former nuclear weapons facility," 88th Annual Meeting and Exhibition, Air & Waste Management Association, San Antonio, Texas, 1995.

6. D.R. Maxwell and B.M. Bowen, "The meteorological monitoring program at a former nuclear weapons plant," 87th Annual Meeting and Exhibition, Air & Waste Management Association, Cincinnati, Ohio, 1994.

7. Meteorological Quality Assurance Audit for Rocky Flats Environmental Technology Site, Rocky Flats Environmental Associates, Inc., Golden, Colorado, June 30, 1995.

8. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements, U.S. Environmental Protection Agency, EPA/600/4-90/003, August 1990.

9. Rocky Flats Environmental Technology Site Meteorological Program Preventative Maintenance Standard Operating Procedures, Rocky Flats Environmental Associates, Inc., Golden, Colorado, May 12, 1995.

AUDIT METHODS AND ACCEPTABLE TOLERANCES *

Variable	Audit Method	Tolerance
Wind direction	Orientation and Linearity	± 2° and ± 5°
	Starting Torque (Climatronics F460)	≤ 8.0 gm-cm
	Starting Torque (RM Young 05305)	≤ 11.0 gm-cm
Horizontal Wind Speed	Synchronous Motor	± 0.2 m/sec
	Torque Watch (Start Threshold - F460)	≤ 0.4 gm-cm
	Torque Watch (Start Threshold - RM Young)	≤ 1.0 gm-cm
Vertical Wind Speed	Synchronous Motor	± 0.2 m/sec
	Torque Watch (Starting Threshold)	≤ 0.5 gm-cm
Temperature	NIST Thermometer Comparison (3 Point verification)	± 0.5° C
Relative Humidity	NIST Psychrometer Collocation	± 10%
Precipitation	Volumetric measurement	± 10%
Pyranometer (Eppley 8-48)	Certified Collocation (24 Hour Comparison)	± 5%
Pyrgeometer (Eppley PIR)	Certified Collocation (Night Comparison)	± 6%
Barometric Pressure	Certified Collocation	± 1.5 % RPD
Soil Flux	Temperature Differential	± 10%
Dew Point Temperature	NIST Psychrometer Collocation	± 0.5° C
Sigma Theta ($\sigma\theta$)	Two Point Verification/Calculation	
Sigma W (σw) Sigma U (σu)	Zero Verification/Calculation Verification	None
Boom Heights	Direct Measurement (Tape Measure)	± 1.0 meter

** Derived from EPA's QA Handbook, Volume IV, Meteorological Measurements*

Table 1. Audit Methods and Acceptable Tolerances

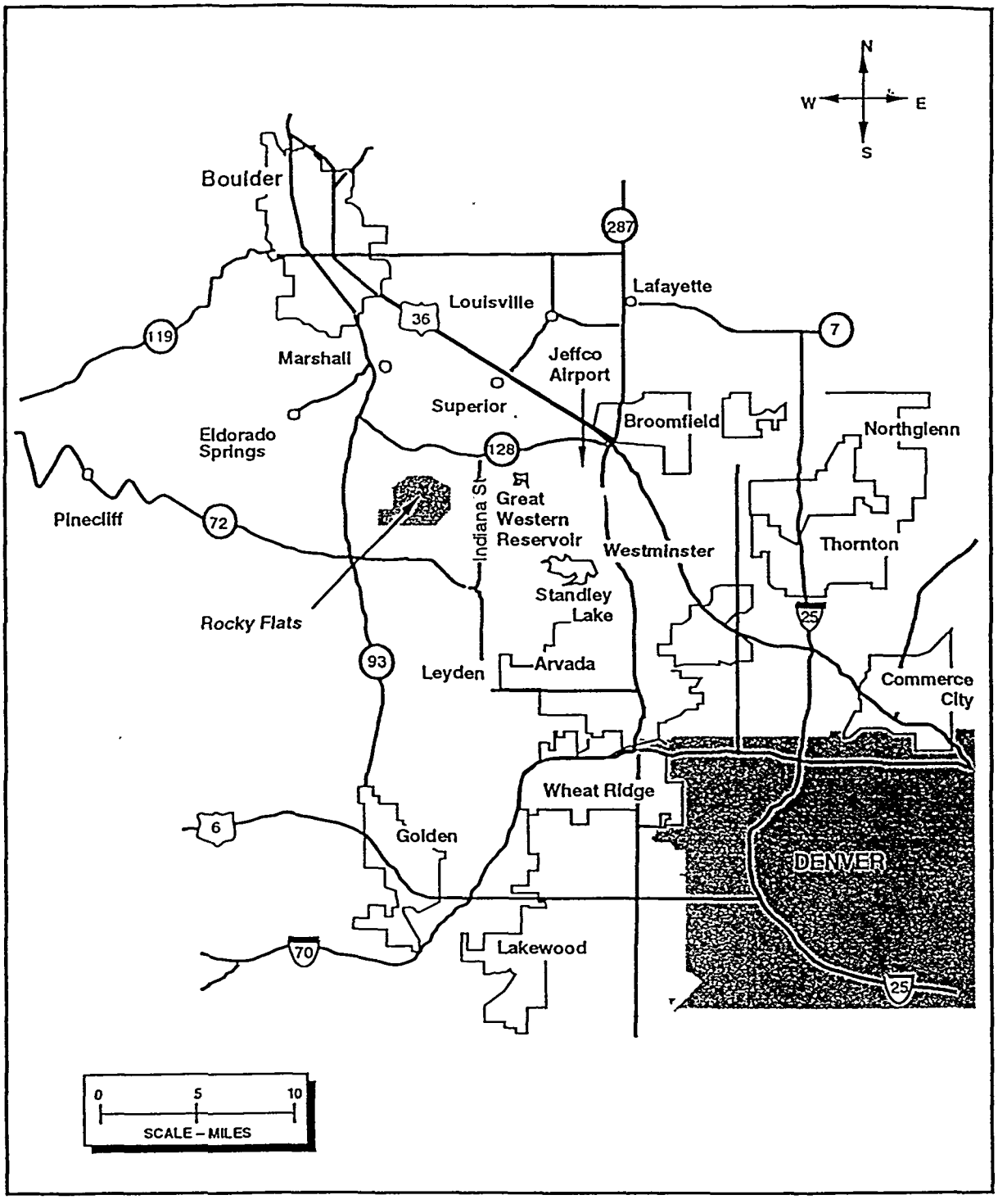

Figure 1. Area Map of Rocky Flats Environmental Technology Site and Surrounding Communities

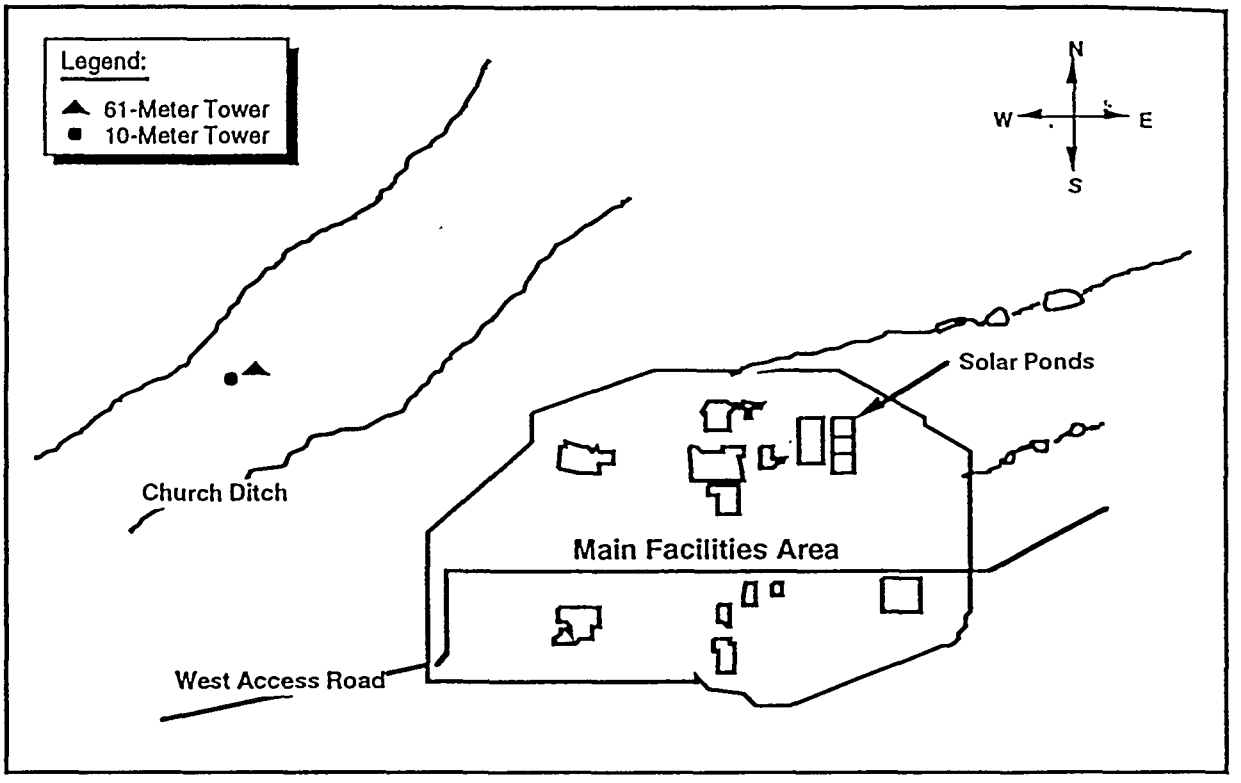

Figure 2. Locations of Collocated Meteorology Towers at Rocky Flats Environmental Technology Site

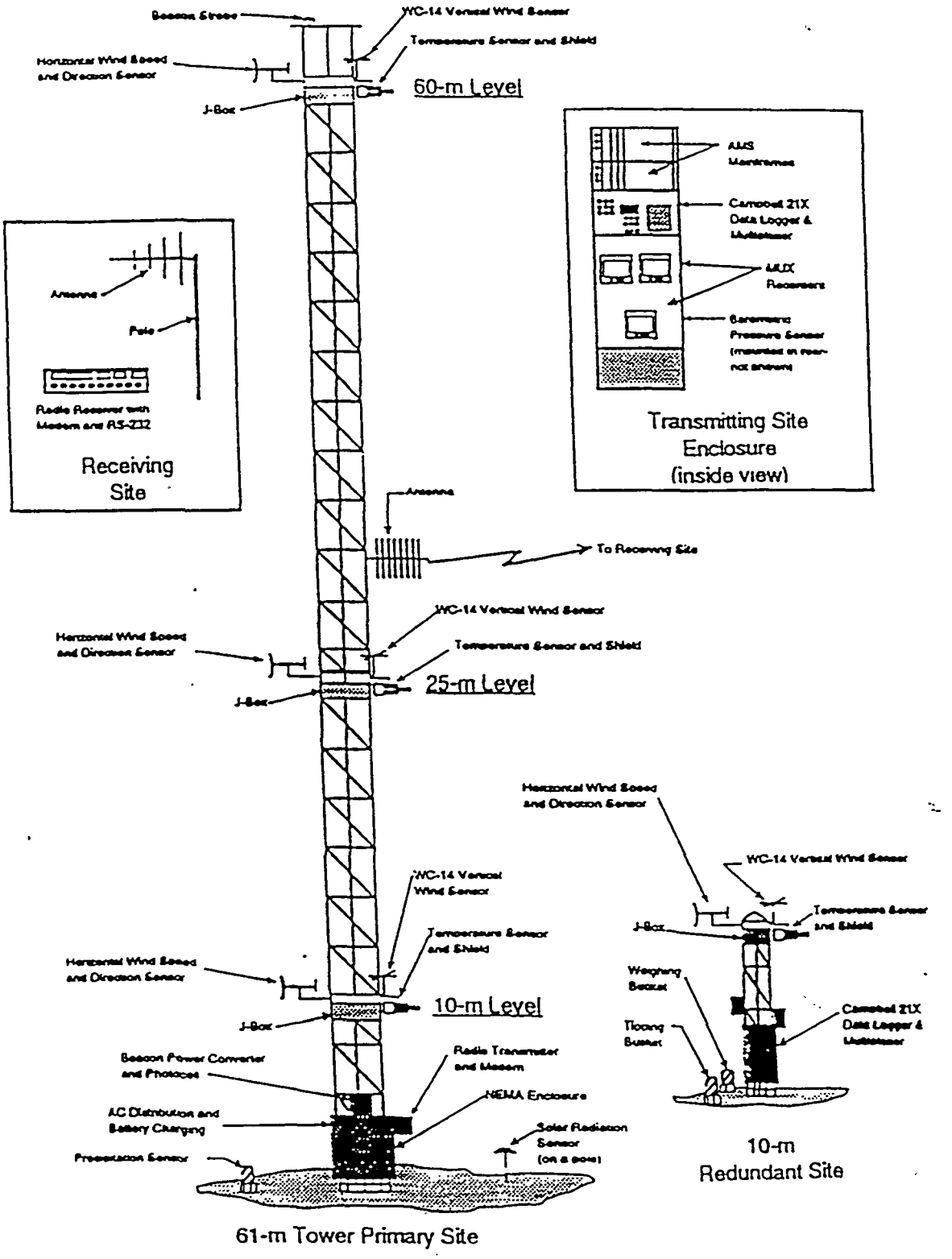

Figure 3. Meteorological Monitoring Tower Configuration

BI-WEEKLY VISIT
RFETS METEOROLOGICAL PROGRAM
MAINTENANCE SCHEDULE CHECKLIST
60 METER AND 10 METER TOWER

INSTRUMENT DESCRIPTION	MAINTENANCE ACTIVITY			COMMENTS	DATE/ TECH	DATE/ TECH	DATE/ TECH	DATE/ TECH	DATE/ TECH
	EXAMINE	CLEAN	REPLACE						
Climatronics Model 100075 Wind Speed	Each Visit	3 months	Bearings - 1 year						
Climatronics Model 102139 Wind Directio	Each Visit	3 months	Bearings - 1 year						
Climatronics Model 100093 Temperature	Each Visit	3 months	If Defective						
Climatronics 100093-Fast Response Tem	Each Visit	3 months	If Defective						
Rotronics MP-1000	Each Visit	6 months	If Defective						
Eppley 8-48 Pyranometer (Solar Radiation	Each Visit	3 months	If Defective	Factory Cal. Each Yr					
Eppley PIR Pyrgeometer (Solar Radiation)	Each Visit	3 months	If Defective	Factory Cal. Each Yr					
Novalynx Precipitation Gauge	Each Visit	3 months	If Defective						
Setra Systems 270 Barometric Pressure	NA	NA	If Defective						
Campbell Soil Heat Flux HFT-1	NA	NA	If Defective						
Campbell Soil Temperature 107B	NA	NA	If Defective						
Ophir Optical Hygrometer	Each Visit	3 months	If Defective						
R.M. Young Model 05103 Wind Spd/Dir.	Each Visit	3 months	Bearings - 1 year						
Gill Model 27106 Vertical Wind Speed	Each Visit	3 months	Bearings - 1 year						
Belfort S-780-300MM Precipitation Gauge	Each Visit	3 months	If Defective						

DATE:_____

TECH:_____

Figure 4. Bi-Weekly Visit Meteorological Program Maintenance Checklist