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Los Alamos
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Environmental Programs Directorate

Waste and Environmental Services (WES)

Technical Project Plan

for

Meteorological Monitoring

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1.0 PROGRAM STRUCTURE AND RESPONSIBILITIES

This Technical Project Plan (TPP) describes how meteorological monitoring will be conducted at LANL. This TPP is required by the WES-PLAN-311 "WES Division Quality Assurance Plan" to adopt quality practices specific to meteorological monitoring. The TPP will be reviewed annually and revised as necessary.

1.1 DOE Guidance

The following DOE orders and guidance describe the rationale and requirements for meteorological monitoring programs at DOE sites including LANL:

DOE Order 436.1 (DOE 2011) requires the implementation of an Environmental Management System at DOE sites to implement sound stewardship practices and to meet or exceed compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements. The Environmental Management System must be part of an Integrated Safety Management System (ISMS). As part of integrating an Environmental Management System into the site ISMS, an effluent monitoring and environmental surveillance program must be established.

DOE/EH-0173T (DOE 1991) describes the elements of an acceptable effluent monitoring and environmental surveillance program at DOE sites, including meeting the meteorological data needs, which are in support of facility operations, environmental impact assessments, environmental surveillance activities, safety analyses, environmental restoration activities, and the consequence assessment element of emergency preparedness and response. DOE/EH-0173T frequently refers to EPA-454/R-99-005 "Meteorological Monitoring Guidance for Regulatory Modeling Applications" and ANSI/ANS-3.11-2005 "Determining Meteorological Information at Nuclear Facilities" for further guidance.

DOE Order 151.1C (DOE 2005) establishes policy and assigns and describes roles and responsibilities for the DOE Emergency Management System (EMS). The DOE EMS provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery actions. Meteorological monitoring support of EMS is broad in nature, and covers, for example, weather forecasting and airborne plume modeling.

1.2 Organizational Structure

The LANL Meteorology Program is part of the Waste and Environmental Services (WES) Division. WES Division provides environmental expertise to the Laboratory. The primary customers of WES are the Environmental Programs (EP) Directorate, the Environment, Safety, and Health (ESH) Directorate, and the Environmental Stewardship Division. WES Division is composed of two groups: Environmental Data Analysis (EDA) and Waste Generator Services (WGS).

The Meteorology Program presently has the commitment of approximately 2.7 FTEs of effort of four LANL employees. All members of the program reside in the WES-EDA group.

The Meteorology Program is responsible for operational meteorological monitoring at LANL and is supported mainly by LANL General and Administrative (G&A) funding. Day-to-day management of the

Meteorology Program is the responsibility of the Meteorologist, who reports to WES-EDA line management.

1.3 Base Responsibilities

The Meteorology Program's work can be divided into four broad components: measurements, data management, analysis, and support of emergency management. Work in these four components can be considered either "base work" or "quality improvement work." "Base work" is continuous, routine work essential to providing customers with basic services.

"Quality improvement work" consists of short-term projects designed to fix or improve some aspect of the Program. Work assignments include base work plus quality improvement projects as time allows. The base work responsibilities of Meteorology Program members are given in the table below.

Job Title	Base Program Responsibilities
Meteorologists (1 FTE)	Plan, coordinate, and participate in programmatic work; oversee quality assurance; ensure goals are achieved in a cost-effective manner; submit budget performance data to upper management; handle data requests and conduct meteorological analyses; make data quality decisions; maintain plume modeling skills; maintain scenario information; forecast weather. Manage subcontract for tower inspection, maintenance, and repair.
Instrument Technician (1 FTE)	Maintain the measurement network including procurement, acceptance testing, installation, calibrations, inspections, data logger programming, and documentation; assist with data quality control activities.
Computer Programmer (0.3 FTE)	Build, maintain, and document the major software components of the Program; contribute appropriate computer science solutions and tools to achieving programmatic objectives; oversee computer systems administration.
Computer Administrator (0.4 FTE)	Maintain UNIX systems in a reliable, secure state; maintain software and hardware support contracts; perform data processing and backups; provide PC support.

2.0 PERSONNEL TRAINING AND QUALIFICATION

Meteorology Program personnel are selected through an extensive process aimed at ensuring sufficient training and qualification. Training is on-going, as personnel annually review Laboratory and WES Division-wide training requirements and all program-specific procedures applicable to their job assignments.

Staff is encouraged to continue their training and education in their individual areas of expertise; formal training and self-study in meteorology, instrumentation, and computer science are especially relevant to programmatic work. In addition to on-site training offered through LANL, attendance at professional meetings is encouraged to the extent the budget and time allow.

2.1 Personnel Qualifications

The table below summarizes necessary qualifications and mix of skills and level of proficiency required by programmatic work.

Meteorologist	Should have a graduate degree in meteorology. A substantial research background is also necessary to be fully effective in assisting LANL personnel with a wide variety of analyses. Should also have electromechanical and computer programming experience in order to effectively oversee all aspects of the Program. LANL Subcontract Technical Representative (STR), LANL R&D electrical worker, and first aid/CPR training are required to fulfill work responsibilities. Other specific training is designated in procedures or Integrated Work Documents (IWDs).
Instrument Technician	Must be an accomplished electromechanical technician with formal training in electronics and several years of experience. Good understanding of meteorological sensors, data loggers, and general principles of engineering and measurement science is also necessary. Should be an independent worker with strong problem-solving skills. LANL R&D electrical worker and first aid/CPR training are required to fulfill work responsibilities. Other specific training is designated in procedures or Integrated Work Documents (IWDs).
Computer Programmer	Must have formal training in computer science. Should have several years experience in UNIX, as well as in C, Perl, and PV Wave programming languages. Should be proficient in visual basic and web design. LANL R&D electrical worker training is required. Other specific training is designated in procedures or Integrated Work Documents (IWDs).
Computer Administrator	Should have experience in system administration tools and processes plus a good working knowledge of UNIX commands and utilities. Should be proficient at data processing. Specific training is designated in procedures or Integrated Work Documents (IWDs).

3.0 QUALITY IMPROVEMENT

WES Division-wide guidance on quality improvement is provided by WES-PLAN-301 “Quality Assurance Plan for the Waste and Environmental Services Division”. LANL-wide guidance on quality improvement is provided by the LANL Implementation Support Document ISD 322-4 “Issues and Corrective Action Management Process”.

Within the Meteorology Program, several processes will be pursued to detect and prevent quality problems;

- Automated data checks: meteorological values that fall outside a prescribed range are reassigned non-values. An email is automatically sent to all program personnel alerting them of the details of each automatic data value change. Other checks include comparing 15 minute rainfall totals with 24 hour summary values.
- Manual data check: the meteorologist will use a PV-Wave software program to graphically review meteorological data every week. The high frequency of manual data checks have proven to be key to quickly identifying malfunctioning instruments. When unrealistic values are encountered, the data values are manually reassigned non-values and all personnel are alerted through the tower log book.
- Automated computer systems data check: the computer programmer will use a PV-Wave software program to review status of data collection and transfer between meteorological towers, data loggers, WES-EDA computer systems and data archiving systems. An email is automatically sent to all program personnel alerting them of the details of any data transfer issues (e.g. transfer did not occur, transfer occurred late, etc).
- Manual data check: the instrumentation technician performs a daily review of data capture information to identify instrumentation issues. The instrument technician will inspect all instrument sites once per month to identify instrument or safety/security issues.
- Management Updates: the Meteorologist will regularly update line management on data quality issues and administrative topics such as budget and activities.
- Customer feedback: users of the meteorological data contact Meteorology Program personnel with questions and problems concerning the data and tools provided by the Program at weather@lanl.gov.
- Independent assessment: audits provide a fully independent source of quality control. Independent assessment is addressed further in chapter 11.

4.0 DOCUMENTS AND RECORDS

The Meteorology Program will follow WES Division procedures for developing and maintaining procedures, records management, and document control. The Meteorology Program will maintain formal documentation that documents the work and results of the Program. The Program generates records of methods used, work completed, results of its measurement and analysis activities, and data quality. Records associated with the various program components are stored in the instrument lab (TA-54-1001) and/or the meteorology lab (moving from TA-59-1 to TA-00-1237). In addition, efforts have recently begun to transfer some Meteorology documents and records for permanent storage at redundant locations, such as on the electronic document management system “Sharepoint”.

Record	Description	Location	Responsible Person
Meteorological station workbooks	Station engineering drawing, wiring diagrams, instrumental configuration, and data logger programs	Notebook by station, instrument lab	Instrument Technician
Calibration activity workbooks	Notes on all instrument calibration and repair activity	Various notebooks, instrument lab	Instrument Technician
Audit reports	Results of independent performance audits	Various notebooks, instrument lab and meteorology lab	Meteorologist
Meteorological site logbook (tower logbook)	Record of all events at the stations, including instrumentation failure, changes in data acquisition, downtime for audits and repairs, and a record of data editing	Meteorology lab	Meteorologist
Station descriptions	Types of measurements made, physical description of stations	The Weather Machine under Data Requests/Raw Data and Documentation/Analyses	Computer Programmer

Records associated with data management:

Record	Description	Location	Responsible Person
Code documentation	User guides to the C and PV-Wave executables used in data processing and analysis	Notebook, “User’s Guide to UNIX Software for Meteorological Operations,”	Computer Programmer
Data files	Binary and text data files	Wxmach/data	Computer Administrator
Backup tapes	Backups for UNIX machines	Stored at meteorology lab daily and weekly, weekly and quarterly back- ups stored at	Computer Administrator
Routine weather reports	Monthly summary text, monthly summary graphic, daily observations	File cabinet, instrument lab	Meteorologist

Records associated with analysis:

Record	Description	Location	Responsible Person

Technical reports	Official LANL reports describing results of analyses of local meteorological measurements. See bibliography in "Meteorological Analysis Notebook."	Shelved in meteorology lab	Meteorologist

Records associated with emergency management:

Record	Description	Location	Responsible Person
MIDAS alterations	Documentation of changes to scenarios within MIDAS	"MIDAS Changes Notebook," meteorology lab.	Meteorologist

5.0 WORK PROCESSES

The EPA document "Guidance on Systematic Planning Using the Data Quality Objectives Process" (EPA QA/G-4, 2006) establishes methods for determining Data Quality Objectives. Sections 5.1 and 5.2 address the main elements of a Data Quality Objective (DQO) analysis for the Meteorology Project, including the identification of data objectives, identification of information needed to accomplish these objectives, and the level of certainty that is required of the data.

5.1 Data Objectives

Following the DOE Orders listed in 1.0, the Meteorology Program has two main objectives: (1) provide general meteorological support for LANL regulatory compliance activities, operations, hazards assessment, safety analysis, environmental studies, experiments, etc., and (2) maintain airborne plume modeling capability for the LANL Emergency Management System.

5.1.1 General Meteorological Support

General meteorological support spans a broad range of LANL projects and programs per DOE Order 436.1 and DOE/EH-0173T. Site-specific meteorological data are routinely required for demonstrating regulatory compliance in the areas of air quality, water quality, waste management, as well as supporting monitoring programs in biology, hydrology, and health physics, to name a few applications.

To meet this objective, continuous measurement of wind, temperature, humidity, dew point temperature, pressure, shortwave and long wave radiation, precipitation, and lightning will be performed, quality-controlled, archived, and made accessible through the Weather Machine (http://weather.lanl.gov).

The program staff will assist customers with meteorological data analysis and interpretation. The program will provide support to Laboratory operations coordinators with forecasts and analyses if future weather conditions may adversely affect safe operations at, and travel around, the Laboratory (e.g., snow, heavy rain, or lightning).

5.1.2 Plume Modeling

The Meteorology Program will provide data and expertise to assist Emergency Operations in the calculation of potential radiological or toxicological hazards in the event of an accidental or sabotage-related release of hazardous materials to the atmosphere. These calculations require meteorological conditions including wind speed and direction, standard deviation of wind direction or some other indicator of stability class, temperature, and precipitation. Results of the calculations are used to classify the incident, and the incident classification leads to decisions regarding the LANL response.

5.2 Measurements and Accuracy

To serve the broad range of meteorological applications, it is necessary to measure a comprehensive set of variables at multiple locations. It is also necessary to operate stations at the upper and lower elevations of the site due to the significant change in elevation across LANL. Many weather variables have been listed in 5.1. The most critical variables, arguably, are those associated with emergency management including wind speed and direction, a stability indicator (such as standard deviation of wind direction), temperature, precipitation, and humidity. Clearly, however, there is demand for a very broad range of additional variables including, for example, solar and infrared radiation, soil temperature, and soil moisture.

Customers generally do not provide specific requirements concerning the level of accuracy or precision of the measurements that they use. Therefore, a formal DQO analysis, in which the importance of each variable would be gauged along with required accuracy, would be impractical to perform since it would require input on data and accuracy from so many customers. Fortunately, measurements and accuracy guidelines are prescribed by the EPA and the American National Standards Institute.

Our data quality goal is to meet the stringent accuracy guidelines set forth by ANSI. A complete list of variables that we measure is presented below, along with our instrumental accuracy and the ANSI accuracy requirement. In every case except for terrestrial radiation and dew point temperature, the instrument accuracy of our measurements matches or exceeds the ANSI standard for system accuracy. However, dew point temperature is derived from temperature and relative humidity. Simple calculations of dew point temperature versus small changes in the dependent variables show that the error obeys the ±1.5 degree limit except where temperature is very high and humidity is very low. Thus, the ±1.5 degree limit is mostly satisfied.

It should be noted, however, that instrument accuracy is a single component of system accuracy which encompasses sensors, data processing equipment, computer, calibrations, etc. The error bars on system accuracy, listed by ANSI, must equal or exceed the error range associated with instrument accuracy.

To arrive at an estimate of system accuracy, let us make the fair assumption that the error associated with data processing equipment and computer (e.g. machine error) is negligible in comparison with instrument accuracy. In this case, data processing and computer error contribute only negligibly to system error. We might also assume, with less confidence, that error associated with calibration is negligible and so does not significantly contribute to system error.

Another apparent source of error is error associated with set-up. This is error introduced between the time of purchase and calibration (if applicable) and the time that the instruments are set up and collecting

data. One clear error of this sort is the orientation of the anemometers. We estimate this error to be 1 degree. Adding this error to the instrument error associated with the anemometers of ±3 degrees, our estimated system accuracy on the anemometers increases to ±4 degrees, still within the ANSI error bounds. There is no apparent set up error associated with the other instruments.

Measured Parameter	Units	Instrument Accuracy (±)	ANSI System Accuracy Requirement (±)
Wind speed (u)	meters per second	0.2	0.2 or 5%
Standard Deviation of Wind Speed (σ_u)	meters per second	n/a	n/a
Wind Direction (θ)	degrees azimuth	3	5
Standard Deviation of Wind Direction (σ_θ)	degrees azimuth	n/a	n/a
Vertical Wind Speed (w)	meters per second	0.1	n/a
Standard Deviation of Vertical Wind Speed (σ_w)	meters per second	n/a	n/a
Temperature (T)	degrees Celsius	0.1	0.5
Barometric Pressure (p)	millibars	0.6	3
Relative Humidity (h)	percent	1	4
Dew point Temperature (T_d)	degrees Celsius	3.3	1.5
Precipitation (r)	inches	0.05r	0.10r
Snow Depth (s_d)	inches	0.4	n/a
Snowfall (s_f)	inches	0.4	n/a
Lightning Stroke Count (l)	number	n/a	n/a
10-hour Fine-dead Fuel Moisture (W_{10})	percent	n/a	n/a
Solar radiation (K↓, K↑)	Watts per square meter	0.035K (zenith angle 0–70^o)	0.05K
Terrestrial Radiation (L↓, L↑)	Watts per square meter	0.06L	0.05L
Soil Temperature (T_s)	degrees Celsius	0.3	J

5.3 Categories of Work

The Meteorology Program commits to perform work that naturally divides into the four major work components listed in the table below. Each of the four components is examined in detail in section **5.3.1** through **5.3.4**.

Process	Description
Instrumentation	Measurements will be taken using a comprehensive network of instrumented towers, precipitation stations, and SODAR continuously gather meteorological data.
Data management and accessibility	Meteorological data will be acquired, processed, stored, and made available for emergency management and general use. Computer system management and software development are part of this effort.
Analysis	Knowledge and understanding of meteorology will be applied to a broad range of research efforts and problem solving across LANL.
Emergency management support	Software, hardware, and airborne plume modeling skills will be maintained as part of a continuing commitment to support consequence assessment.

5.3.1 Instrumentation

A network of seven towers gathers meteorological data. Four of the towers are located on mesa tops (TA-6, TA-49, TA-53, and TA-54), two are in canyons (TA-41, Mortandad), and one is on top of Pajarito Mountain. The TA-6 tower is the official meteorological measurement site for the Laboratory and the town of Los Alamos. The TA-54 tower is the official meteorological measurement site for the town of White Rock. A sonic detection and ranging (SODAR) instrument is located adjacent to the TA-6 meteorological tower. One additional precipitation measurement location exists in North Community of Los Alamos.

The following table lists procedures that will be followed with regard to the maintenance of the instrument network.

Procedure Identifier	Title
RRES-MAQ-401	Meteorological Tower Climbing and Support
EP-ERSS-SOP-5131	Calibration and Maintenance of Instruments for the Meteorology Monitoring Program
ENV-MAQ-404	Repairing, Maintaining, and Calibrating Meteorological Instruments in the Field
EP-ERSS-SOP-5100	Meteorological Tower Hoist Operation

Fig. 1 shows the locations of the Meteorology stations. An abundance of detail on the instrumentation can be found in LA-UR-03-8097 “Meteorological Monitoring at Los Alamos”, which can be downloaded from the Weather Machine.

With the exception of the Mortandad Canyon station, all elevated instruments are supported by towers of open-lattice construction with instruments mounted on booms. To reduce flow distortion by the tower, booms face westward into the prevailing wind and boom lengths are more than twice the tower width. The booms are attached to an elevator that can be lowered for instrumentation inspection and replacement.

The Mortandad Canyon tower is a 10-meter tower composed of a moveable post mounted on a fixed tripod. The post is mounted on a hinge and can be lowered from the vertical position to a horizontal position using a hand-operated winch for instrument inspection or replacement. But as with other towers, elevated measurements are taken at a distance from the tower of more than twice the tower width, and the tower itself is leeward to the instruments.

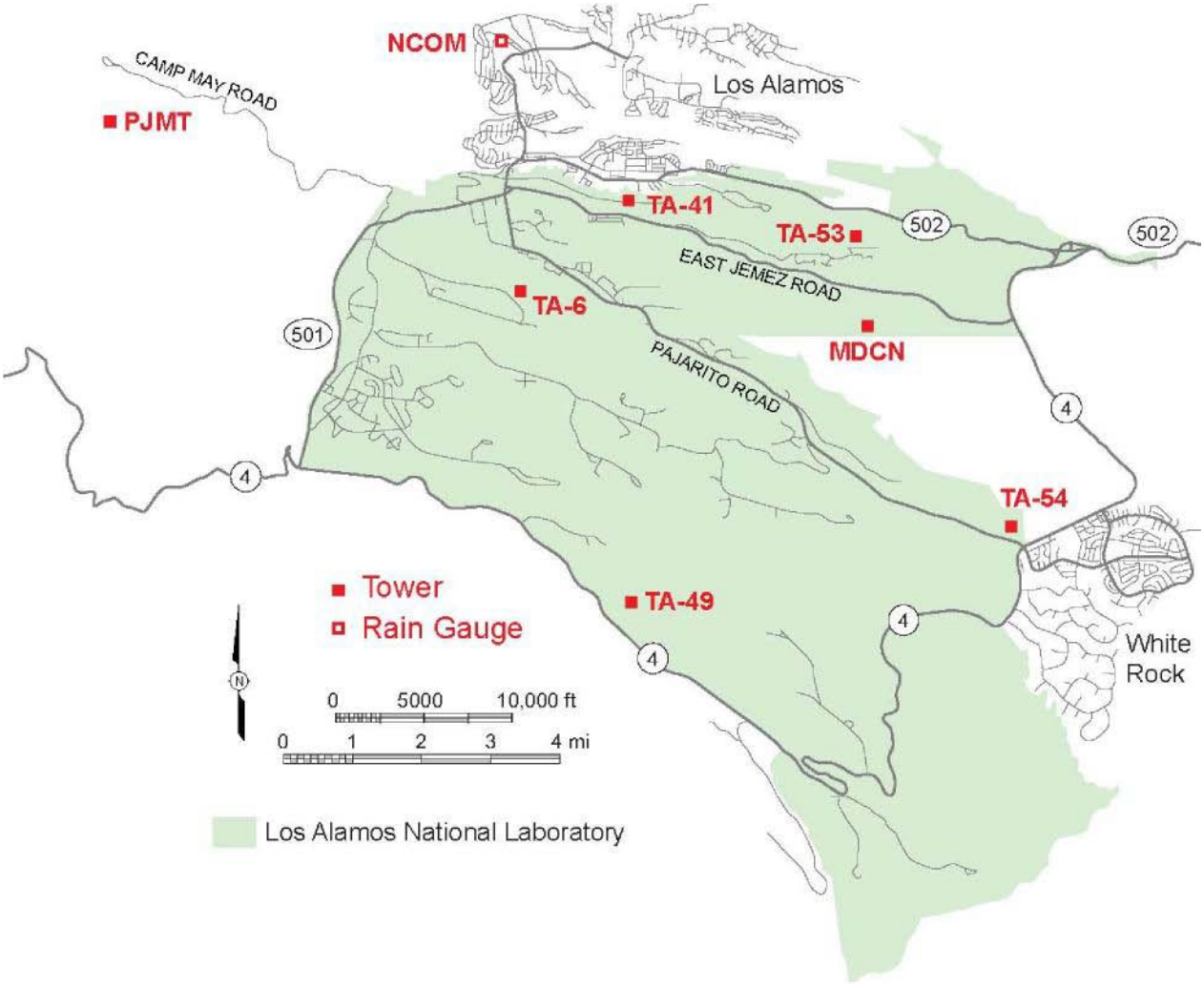

Fig. 1 Map of meteorological stations at LANL

5.3.1.1 Measurements

The table below lists the variables that are measured at the various tower locations, along with the height of the measurement above ground level in meters, marked by a "√ ". Most towers are instrumented at several levels.

Height (m)	Wind						Atmospheric State								Radiative Fluxes			
	u	σ_u	θ	σ_θ	w	σ_w	T	p	h	T_d	r	s_d	s_f	I	K↓	K↑	L↓	L↑
TA-6 (Official Los Alamos weather station)																		
1.2							√	√	√	√	√	√	√	√	√	√	√	√
11.5	√	√	√	√	√	√	√											
23.0	√	√	√	√	√	√	√											
46.0	√	√	√	√	√	√	√											
92.0	√	√	√	√	√	√	√											
TA-54 (Official White Rock weather station)																		
1.2							√	√	√	√	√				√	√	√	√
11.5	√	√	√	√	√	√	√											
23.0	√	√	√	√	√	√	√											
46.0	√	√	√	√	√	√	√											
TA-41 (Los Alamos Canyon)																		
1.2							√								√			
11.5	√	√	√	√	√	√	√											
23.0	√	√	√	√	√	√	√											

Height (m)	Wind						Atmospheric State								Radiative Fluxes			
	u	σ_u	θ	σ_θ	w	σ_w	T	p	h	T_d	r	s_d	s_f	I	K↓	K↑	L↓	L↑
TA-49 (Bandelier)																		
1.2							√		√	√	√				√			
11.5	√	√	√	√	√	√	√											
23.0	√	√	√	√	√	√	√											
46.0	√	√	√	√	√	√	√											
TA-53 (Neutron Scattering Science Center)																		
1.2							√		√	√	√				√			
11.5	√	√	√	√	√	√	√											
23.0	√	√	√	√	√	√	√											
46.0	√	√	√	√	√	√	√											
Mortandad Canyon																		
1.2							√								√			
10.0	√	√	√	√	√	√	√											
North Community																		
1.2											√							
Pajarito Mountain																		
2.0							√	√	√	√	√	√	√					
36.6*	√	√	√	√			√											

Note: LANL removed the 36 m level instrumentation on the Pajarito Mountain tower at the request of the tower operator in August 2008. As of August 2011, LANL is in negotiation with the tower operator to restart these measurements.

5.3.1.2 Calibration

The entire network will undergo periodic calibration inspections and refurbishment as required by the instrumentation. In 2012, we perform a 1-year cycle for refurbishment of most instruments, as recommended by the manufacturer. As part of the refurbishment process, instruments are removed from towers and a post-calibration is performed to ensure that the instruments were functioning properly. The replacement instruments undergo a rigorous pre-calibration process to ensure proper future function. Some instrumentation requires calibration less frequently (e.g. solar radiation sensors), therefore not included in the 1-year cycle.

The procedures EP-ERSS-SOP-5131 “Calibration and Maintenance of Instruments for the Meteorology Monitoring Program” and ENV-MAQ-404 “Repairing, Maintaining, and Calibrating Meteorological Instruments in the Field” cover instrument calibration in detail.

5.3.1.3 Preventive Maintenance

Manufacturer’s guidelines for preventative maintenance are followed. In addition, station sites are visited monthly and instruments are examined for damage. The meteorologist’s quality control check, performed about twice per week using PV-Wave software, is very effective for spotting quality problems quickly. The graphical quality control software shows all tower levels of data simultaneously for each variable, so a malfunctioning instrument at a given level is usually instantly apparent. Chapter 3.0 lists quality improvement activities aimed at preventative maintenance.

The instrumentation technician performs a visual inspection of all instruments once a month. Binoculars are used to inspect instrumentation located on tower booms above ground level. The instrument technician performs a hoist inspection once per year. A subcontractor performs a tower inspection once per year to assure the structural integrity of the towers and guy lines is maintained.

5.3.2 Data Management and Accessibility

The Meteorology Program is committed to maintaining a constant stream of high quality weather data and accessibility to those data.

The following table lists procedures that will be followed with regard to data management and accessibility.

Procedure Identifier	Title
SOP-5160	Routine Meteorological Data Processing
ESH-17-406 R1	Hewlett Packard Unix Workstation Backup
Documentation written by Darryl Holt	To be reviewed to determine usefulness of publishing as an LA-UR

5.3.2.1 The Weather Machine

The Program distributes data and information to many customers from its website, known as the LANL Weather Machine, at http://weather.lanl.gov, internally and http://www.weather.lanl.gov for users external to the LANL yellow network. The website provides: details and specifications of the instrument network, current and recent conditions around Los Alamos, current regional and national weather conditions, weather forecast products, local climatological information, local meteorological data, and air quality model input data sets

The website's Data Requests section provides a series of web forms for automated data requests, enabling customers to download archived data for use in various projects. Users can also download special meteorological data sets for running some of the more common air dispersion and dose assessment models, which may be used for air permitting or demonstrating regulatory compliance. The meteorological data are pre-formatted for the intended model, requiring minimal additional processing by the user.

5.3.2.2 Software Quality

The LANL Weather Machine and associated software for processing meteorological measurements have been identified as risk level 4 under LANL P1040, Software Quality. As these software systems are in production and are not undergoing review/upgrade at this time, they were identified as a legacy system requirement no further upgrade to software documentation.

5.3.3 Analysis

The Meteorology Program is committed to providing meteorological expertise for effective application of the weather data that we collect, and for many weather-related applications as required by LANL. Due to the widely varying nature of the analyses that we perform, there are no procedures that guide this portion of our work.

5.3.4 Emergency Management Support

The Meteorology Program is committed to assisting the Emergency Response organization of LANL. This takes the form of plume modeling and weather forecasting during emergencies and exercises, and weather forecasting when inclement weather threatens the normal operations of LANL. Guidance for the emergency management portion of our work is often provided by procedures and other direction from the Emergency Response Division.

We have established a goal of 95% data capture rate for all wind speed variables, to assure that these data are available for use in plume modeling during an unplanned release.

5.3.5 Air Quality Compliance Support

The meteorology program provides wind speed, direction, and stability information to support atmospheric dispersion calculations performed for air quality compliance activities. The data are used in calculating the annual air pathway maximum exposed individual and in calculating ambient air quality impacts for

non-radiological air emissions. We have established a goal of 95% data capture rate for all wind speed variables to assure that these data are available for these compliance demonstrations.

6.0 DESIGN

The basic elements of the Meteorology Program, including standard meteorological measurements, plume calculations, and data storage, were initially designed to meet the basic monitoring requirements set forth in the DOE orders. Over the years these elements have been continually refined to reflect advances in technology, to reflect changes in ideas of what is acceptable and defensible, and to meet the increasing demand for meteorological information. For example, the internet has been utilized to make this meteorological information readily available to the Laboratory community, with the development of the Program's website "The Weather Machine" (http://weather.lanl.gov).

General design considerations are listed in the table below.

Element	Design Requirement
Instrumentation	Must be capable of continuous operation in all weather conditions
Computer systems	Must handle computation- and graphics-intensive applications in a secure and reliable manner
Station network	Must measure adequately the variance in all important meteorological variables across a large site having complex terrain
Archive	Must be accessible and contain useful and accurate data
Automation	Improve cost effectiveness
Plume modeling systems	Must be appropriate for complex terrain where chemicals and radiological materials are used at multiple facilities

7.0 PROCUREMENT

The Meteorology Program procures critical items and services in accordance with the LANL policies and procedures for procurement. Specifications are established to meet requirements, and then commercially available equipment is evaluated against these specifications. The Meteorology Program will follow LANL-wide guidance on procurement as provided by the LANL Implementation Support Document ISD 840-1.1 "Procurement Quality".

The Meteorology Program procures equipment and services from reputable vendors that are recognized for their quality through years of experience. For example, many of our instruments are purchased from Campbell Scientific, a name that is synonymous in the meteorology community with high quality, advanced grade operational weather observation instrumentation. Because of well-established relationships with vendors, we are able to ensure that goods operate as they should; vendors are quick to correct problems such as defects with the interest of maintaining the relationship. We have also been flexible enough to change vendors when warranted. Instrumentation and equipment have been evaluated as Management Level 4, as the instrumentation and equipment performance in monitored following installation.

8.0 INSPECTION AND ACCEPTANCE TESTING

All instruments will be inspected upon receipt to confirm the good condition of the instruments and the correct number of instruments was received. All instruments are calibrated before installation. Calibration is addressed in chapter **5.3.1.2** of this document. The procedures EP-ERSS-SOP-5131 "Calibration and Maintenance of Instruments for the Meteorology Monitoring Program" and ENV-MAQ-404 "Repairing, Maintaining, and Calibrating Meteorological Instruments in the Field" cover instrument calibration in detail.

A number of inspections, automated and manual, will be performed to ensure that the data are of good quality and that the instruments are functioning properly. Chapter 3 describes these methods in detail.

9.0 MANAGEMENT ASSESSMENT

LANL-wide guidance on management assessment is provided by ISD 322-1.0 "Management Assessment" and will be followed by the Meteorology Program.

To assist group management in tracking developments and progress in the Meteorology Program, a monthly status report is prepared and sent to line management. This report highlights accomplishments and improvements in the quality of the Program, tracks budget, and identifies issues.

10.0 INDEPENDENT ASSESSMENT

LANL-wide guidance on independent assessment is provided by ISD 328-1.0 "Independent Assessment" and this guidance will be followed by the Meteorology Program.

Periodic system and performance audits of the Meteorology Program are conducted by qualified external entities. Formal reports are shelved at TA-59-1, room 178. The most recent system audit, which comprised of an evaluation of the whole of the Program (equipment, procedures, training, records, etc), was performed by the DOE Meteorological Coordinating Council in 2006. The most recent performance audit, which focused on the measurements aspect of the Program, was performed on the TA-54 tower in 2003.

11.0 DOE AND DMCC QAP CRITERIA

The DOE Meteorological Coordinating Council (DMCC) uses QAP criteria that are based on American National Standards Institute recommendations, rather than the DOE QAP criteria used in this QAPP. The crosswalk below is provided as a link between the DMCC QAP Criteria and the chapters in this QAPP. Each of the thirteen DMCC QAP criteria on the left is matched to one or more of the ten criteria used by DOE, which correspond to chapters two through eleven in this QAPP.

1. Project organization and responsibilities: 1.0 Program Structure and Responsibilities
2. Data Quality Objectives: 5.0 Work Processes
3. Sampling procedures: 4.0 Documents and Records, 5.0 Work Processes
4. Sample custody: 4.0 Documents and Records
5. Calibrations: 5.0 Work Processes
6. Analytical procedures: 4.0 Documents and Records, 5.0 Work Processes

7. Data reduction, validation, and reporting: 3.0 Quality Improvement, 4.0 Documents and Records, 8.0 Inspection and Acceptance Testing
8. Internal quality control checks: 3.0 Quality Improvement
9. Performance and system audits: 9.0 Management Assessment, 10.0 Independent Assessment
10. Preventative Maintenance: 5.0 Work Processes
11. Assessment of data precision, accuracy, and completeness: 5.0 Work Processes, 8.0 Inspection and Acceptance Testing
12. Corrective actions: 3.0 Quality Improvement, 9.0 Management Assessment, 10.0 Independent Assessment
13. Quality Assurance reports to management: 9.0 Management Assessment

12.0 LIST OF ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
ANS	American Nuclear Society
DCC	Document Control Coordinator
DMCC	DOE Meteorological Coordinating Council
DOE	U.S Department of Energy
EMS	Emergency Management System
ENV	Environmental Stewardship (Division)
EP	Environmental Programs
EPA	Environmental Protection Agency
ER	Environmental Restoration
WES	Waste and Environmental Services (Division)
ETSC	Emergency Technical Support Center
FTE	Full Time Employee
G&A	General and Administrative
GS	Geotechnical Services
HVAC	Heating, Ventilating, and Air Conditioning
ISD	Implementation Support Document
ISMS	Integrated Safety Management System
LANL	Los Alamos National Laboratory
MAQ	Meteorology and Air Quality
MEI	Maximum Exposed Individual
MIDAS	Meteorological Information and Dispersion Assessment System
NARAC	National Atmospheric Release Advisory System
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	Nation Pollutant Discharge Elimination System

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RRES	Risk Reduction and Environmental Stewardship (Division)
RS	Remedy Services
SAR	Safety Analysis Report
SODAR	Sonic Detection and Ranging
SOP	Standard Operating Procedure
TA	Technical Area

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13.0 APPENDIX A

Los Alamos NATIONAL LABORATORY EST. 1943

memorandum

Environmental Programs
Environmental Data and Analysis, EDA

To/MS: Doug Wedman, QA-DO, MS C343
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Phone/Fax: 667-0898/665-3669
Symbol: WES-EDA-11-011
Date: May 17, 2011

Subject: Calibration for the Meteorology Program of WES-EDA

LANL calibration policy P330-2 emphasizes the utilization of the Standards and Calibration Laboratory (S&CL) for calibration. The Meteorology Program proposes to meet the Laboratory calibration requirements as described below. Meteorology instrument calibration will vary among three instrument classes. The three classes, along with the proposed means of calibration, are as follows:

1. Instruments historically calibrated by LANL S&CL, including multimeters, precision mercury thermometers, wind speed calibrator motors, and barometric pressure sensors will continue to be calibrated by S&CL.
2. Instruments that were historically sent to the manufacturer for calibration, including solar and infrared radiation sensors, absolute humidity sensors, and dataloggers will continue to be sent to the manufacturer for calibration. We believe it would be most expedient for Meteorology Program personnel to package and ship the instruments.
3. The Meteorology Program proposes to continue to calibrate instruments that were historically calibrated by the Meteorology Program in the meteorology lab, including wind anemometers, thermometers, precipitation gauges, and snow depth gauges. We propose to manage these calibrations through implementation of our calibration procedure EP-ERSS-SOP-5131. This procedure will be emailed for S&CL review and approval. Instruments will be calibrated to manufacturer's advertised and recommend specifications which meet or exceed ANSI/ANS-3.11-2005 accuracy requirements, as demonstrated in EP-ERSS-QAPP-05, the QAPP for Meteorological Monitoring. Calibration will be performed by a skilled technician who has over seven years of metrology experience. Calibration records and supporting documentation will continue to be maintained in the Meteorology Program's instrument laboratory and will be available for SC&L review.

Thank you for your support of cost effective, compliant calibration for the LANL Meteorology Program.

Attachment: EP-ERSS-SOP-5131, Calibration and Maintenance of Instruments for the Meteorology Monitoring Project

Cy:
WES-EDA File, MS M996