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LANL Meteorological Program Improvements to Continue Meeting Annual 90 Percent Data Recovery Requirements

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CONTENTS

Tables

ACRONYMS

AC	Air Conditioning
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society for Mechanical Engineers
BNL	Brookhaven National Laboratory
CAPARS	Consequence Assessment and Protective Actions System
CFR	Code of Federal Regulations
CN	Change Notice
COTS	Commercial off the Shelf
DID	Defense in Depth
DMCC	DOE Meteorological Coordinating Council
DOE	Department of Energy
DSA	Documented Safety Assessment
EM	Environmental Management
EM&R	Emergency Management & Response
EPA	Environmental Protection Agency
ERO	Emergency Response Organization
ES&H	Environmental Safety & Health
FTE	Full Time Equivalent
FY	Fiscal Year
G	Guide
HC	Hazard Category
HDBK	Handbook
HVAC	Heating Ventilation and Air Conditioning
IT	Information Technology
JTA	Job Task Analysis
LANL	Los Alamos National Laboratory
LASO	Los Alamos Site Office
LOI	Line of Inquiry
M	meter
NCAR	National Center for Atmospheric Research
NESHAP	National Environmental Standards for Hazardous Air Pollutants
NNSA	National Nuclear Security Administration
NPH	Natural Phenomena Hazard
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NUMUG	Nuclear Utility Meteorological data User Group
O	Order
ORNL	Oak Ridge National Laboratory
PA	Protective Actions
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RG	Regulatory Guide
SB	Safety Basis
SC	Safety Class
SME	Subject Matter Expert
SODAR	Sound Detection and Ranging

SOP	Standard Operating Procedure
SQA	Software Quality Assurance
SRNL	Savannah River National Laboratory
SS	Safety Significant
SSC	Structure System and Component
STD	Standard
TA	Technical Area
UPS	Uninterruptible Power Supply
VCS	Voluntary Consensus Standard
WETF	Weapons Engineering Tritium Facility

1.0 BACKGROUND AND PURPOSES

1.1 Background

Recently, the Los Alamos National Laboratory (LANL) Environmental Protection and Compliance (EPC) and Safety Basis (SB) Divisions have collaborated on the latter's use of the meteorological data as input into dispersion analysis used to determine receptor dose consequences as a result of an accidental release of radioactive material from a LANL nuclear facility. The dose consequence calculations are part of the Department of Energy (DOE) approved Documented Safety Analysis (DSA), which describes the processes, hazards, and controls of nuclear operations within certain facilities at LANL. The DOE approved DSA is required according to Title 10 of the Code of Federal Regulations Part 830 (10CFR830), "Nuclear Safety Management" and is developed in accordance with the 10CFR830, Subpart B "Safety Basis" safe harbor methodology identified as DOE Standard 3009-94, or successor document (DOE STD 3009-94).

Subpart A "Quality Assurance Requirements" of 10CFR830 has some implication for the meteorological data because of its use in the DSA as described. The EPC organization is in discussions with the LANL Quality and Performance Assurance Division to ensure that the meteorological program as implemented meets applicable quality assurance (QA) requirements. In addition, EPC and SB have discussed certain aspects of the acceptability of the meteorological data. Specifically, Appendix A, "Atmospheric Dispersion," of DOE-STD-3009-94 Change Notice 3 (CN3) points to Nuclear Regulatory Commission (NRC) Regulatory Guide 1.23, which describes an acceptable means of generating the meteorological data upon which atmospheric dispersion and radiological consequence assessment is based. That version of DOE-STD-3009 was issued in 1994, and the cited NRC Regulatory Guide was issued in 1972 and subsequently revised in 2007. In 2014, DOE STD-3009-2014 replaced DOE-STD-3009-94 CN3.

Recently, DOE approved a dispersion protocol developed by LANL SB (RPT-SBD-384-R0), following Option 3 of DOE STD 3009-2014, Section 3.2.4.2. The protocol described topics such as converting the units of the LANL meteorological data so that it could be used as input into the DOE Toolbox MELCOR Accident Consequence Code Systems, 2nd revision (MACCS2) atmospheric code, and information on other input parameters such as dispersion coefficients, surface roughness (SR), and deposition velocity. The protocol also discussed the effects of an inversion layer and canyon effects. The information on surface roughness, inversion layer, and canyon effects was based on collaborative studies between EPC and SB. The protocol did not cite information on meteorological data collection requirements.

An evaluation of data collection requirements indicated some ambiguity, specifically regarding "completeness" of data. DOE-STD-3009-2014, Section 3.2.4.2, "Meteorological Data" states: "…For Options 2 and 3, the guidance in both Regulatory Guide 1.23 and in Environmental Protection Agency (EPA)-454/R-99-005, Meteorological Monitoring Guidance for Regulatory Modeling Applications are acceptable means of generating the meteorological data upon which dispersion is based."

Because the completeness requirements in Regulatory Guide 1.23 **and** EPA-454/R-99-005 differ in periodicity, LANL communicated via email with DOE staff at the Los Alamos Field Office (NA-LA) and DOE-EM on the interpretation of the completeness requirements (Reference LANL-DOE email communications) with respect to MACCS2 usage. The result of these communications was DOE's informal (via same e-mail communications) concurrence with the LANL SB position that meeting 90 percent **annual** completeness was sufficient to meet safe harbor requirements. The DOE-EM dispersion analysis subject matter expert (SME) suggested that LANL reach out to the DOE

Meteorological Coordinating Council (DMCC) for troubleshooting and advice should persistent issues with meeting completeness occur. The LANL dispersion analysis SME is a member in good standing with the DMCC, which conducted assist visits of the LANL meteorological program in August 2006 and August 2015. Observations and recommendations provided by the DMCC to improve the LANL meteorological program are presently being implemented, and those related to ensuring data completeness and data fidelity are included in this report.

1.2 Purposes

The purposes of this report are to evaluate the LANL meteorological program's historical success in meeting the annual 90 percent meteorological data recovery requirement and address any program weaknesses that resulted in data loss. After establishing certain weaknesses, it will be determined how the LANL meteorological program can be upgraded to ensure compliance with the data completeness requirement. The following are the components of the evaluation:

1. Establish the regulatory basis of 90 percent data recovery for the three meteorological parameters that are concurrently needed for a safety basis radiological consequence calculation (i.e., wind speed, wind direction, indicator of atmospheric turbulence). This requirement was first established in 1972 and subsequently has been better defined over the past 45+ years;

2. Determine how frequently the LANL meteorological program has met the annual data recovery goals over the past 10 years;

3. Determine the merits of meeting this metric and establish common industry best practices. Surveys of two national meteorological trade groups, the DMCC, and the Nuclear Utility Meteorological Data User Group (NUMUG) were taken to provide valuable insights; and

4. Identify meteorological program improvements that would be required to reduce uncertainties in meeting a 90 percent rate of data recovery on an annual basis. A status of the program improvements to the observations and recommendations related to improving data recovery, made by the DMCC in its August 2015 Assist Visit, is provided.

2.0 BASES FOR 90 PERCENT METEOROLOGICAL DATA RECOVERY REQUIREMENT

2.1 90 Percent Meteorological Data Recovery Regulatory History

Guidance on acceptable meteorological data recovery to ensure temporal representativeness of the data set has been remarkably constant since it was first introduced by the NRC in 1972. The magnitude of 90 percent has been in place for the past 45+ years, and for dispersion modeling purposes, is the joint data recovery of wind speed, wind direction, and an indicator of atmospheric turbulence, commonly presented as stability class.

Until the year 2000, this requirement had always been applied on an annual basis. At that time, the Environmental Protection Agency (EPA) issued its own guidance that recommended the requirement should be applied on a quarterly basis. EPA guidance was focused on DOE meeting annual 40 CFR 61 Appendix H, National Environmental Standards for Hazardous Air Pollutants (NESHAP) dispersion modeling requirements for normal releases of radionuclides. Therefore, by definition, it was not related to SB. In 2014, DOE AU-30 issued a revision to DOE-STD-3009-94 CN3, which, for the first time, recommended *either* quarterly **or** annual periods be applied to 90 percent meteorological data recovery.

The following presents the 90 percent data recovery guidance from NRC, DOE, and EPA in reverse chronological order to show the history of this guidance and its evolution.

2.1.1 DOE-HDBK-1224-2018, Hazard and Accident Analysis Handbook, Section 6.5, Characterization of Meteorological and Site Data

The application domain that atmospheric dispersion codes approximate establishes the types of meteorological data needed to drive such codes. The choice of code that the analyst uses to solve a specific application may be limited by the availability and fidelity of meteorological data. This subsection gives a brief discussion of various meteorological data sets often used as input to atmospheric dispersion codes.

DOE-STD-3009-2014, Section 3.2.4.2 provides three options for selecting atmospheric dispersion methodology and the resulting χ/Q and gives the following guidance for development of meteorological data:

> In the case of Option 1, follow the meteorological data guidance within NRC Regulatory Guide 1.23 Revision 1, Meteorological Monitoring Programs for Nuclear Power Plants. **For Options 2 and 3, the guidance in both Regulatory Guide 1.23 and in Environmental Protection Agency (EPA)-454/R-99-005, Meteorological Monitoring Guidance for Regulatory Modeling Applications, are acceptable means of generating the meteorological data upon which atmospheric dispersion is to be based.** These two guidance documents should be evaluated for their applicability to the site or facility being evaluated. In the development of the meteorological database for Option 3, the impact of local surface roughness on the data may have to be considered.

2.1.2 ANSI/ANS-3.11-2015, Determining Meteorological Information at Nuclear Facilities, Section 6.4 Data Recovery (2015)

Valid data recovery is a performance indicator of the quality and reliability of a database. Meteorological data recovery for wind speed, wind direction, and atmospheric turbulence shall be **at least 90 percent annually** (see [50] and [10]). The 90 percent recovery rate (i.e., number of valid hours divided by total number of hours in period) applies to both individual parameters as well as the composite of wind speed, wind direction, and atmospheric turbulence used in the compilation of joint frequency distributions. This 90 percent rate applies to all data sets of wind speed, wind direction, and stability classes that are used in consequence assessments and other applications involving atmospheric transport and dispersion modeling.

For other parameters (e.g., dew point temperature, barometric pressure, precipitation), the data recovery rate **shall also be at least 90 percent** (see [10] and [47]). This 90 percent data recovery rate should also be maintained for any data monitored by remote sensing devices.

[10] EPA-454/R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications, "U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (2000).

[47] U.S. Nuclear Regulatory Commission (NRC), "Regulatory Guide 1.23 Meteorological Monitoring Programs for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, D.C. (2007).

[50] DOE-HDBK-1216-2015, "Environmental Radiological Effluent Monitoring and Environmental Surveillance Handbook," U.S. Department of Energy, Washington, D.C. (2015).

2.1.3 DOE-HDBK-1216-2015, Environmental Radiological Monitoring and Environmental Surveillance, Section 5.8 Inspection, Maintenance, Protection, and Calibration Criteria (2015)

The meteorological monitoring program should include routine inspection of the measured data for validity. Scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system should be performed semi-annually at a minimum, or at another appropriate interval based on the calibration recommendations of the manufacturers. Inspections, maintenance, and calibrations should be conducted in accordance with written, controlled procedures. Logs of the inspections, maintenance, and calibrations should be kept and maintained as permanent records within the site's records management system.

ANSI/ANS-3.11-2005 (R2010) provides guidance on recommended calibration practices and field calibration checks for meteorological instrumentation. The meteorological monitoring system should be capable of providing **data recovery of at least 90 percent, which is quality assured on an annual basis** for the combination of wind direction, wind speed, and those data necessary to classify atmospheric stability.

All elements of the monitoring and data recording systems should be protected from lightning-induced electrical surges and severe environmental conditions. Functional checks of instrumentation, including recalibration, should be performed after exposure to damaging meteorological conditions or other events with the potential to compromise system integrity.

2.1.4 DOE-STD-3009-2014, Preparation of Nonreactor Nuclear Facility Documented Safety Analyses (2014)

For Options 2 and 3, guidance in both Regulatory Guide 1.23 and in Environmental Protection Agency (EPA)-454/R-99-005, Meteorological Monitoring Guidance for Regulatory Modeling Applications, are acceptable means of generating the meteorological data upon which dispersion is based.

2.1.5 DOE O 458.1 Administrative Change 3, Radiation Protection of the Public and the Environment (2013)

Meteorological monitoring must be commensurate with the level of site radiological activities, the site topographical characteristics, and the distance to critical receptors. The scope must be sufficient to characterize atmospheric dispersion and model the dose to members of the public over distances commensurate with the magnitude of potential source terms and possible pathways to the atmosphere.

Note: There is no specific guidance on meteorological data recovery.

2.1.6 DOE O 231.1B, Environmental Safety and Health Reporting (2012)

Site environmental management performance. Data must include effluent releases, environmental monitoring, and types and quantities of radioactive materials emitted or discharged to the environment, the estimated or calculated total effective dose to a representative person or maximally exposed member(s) of the public and the calculated collective dose to members of the public from exposure to radiation sources identified under DOE O 458.1, and, where it is of concern, releases of radon and its decay products from DOE sources and the resultant individual and collective dose from these radionuclides, which need not be combined with dose estimates from other sources.

Note: There is no specific guidance on meteorological data recovery.

2.1.7 NRC Regulatory Guide 1.23 Revision 1, Section 5 Instrument Maintenance and Servicing Schedules (2007)

Meteorological instruments should be inspected and serviced at a frequency that will ensure data recovery of at least **90 percent on an annual basis**. The 90 percent rate applies to the composite of all variables (e.g., the joint frequency distribution of wind speed, wind direction, stability class) needed to model atmospheric dispersion for each potential release pathway. In addition, the 90-percent rate applies individually to the other meteorological parameters.

2.1.8 EPA-454/E-99-005 Section 5.3 Data Recovery (2000)

5.3.1 Length of Record

The duration of a meteorological monitoring program should be set to ensure that worst case meteorological conditions are adequately represented in the data base; the minimum duration for most dispersion modeling applications is one year. Recommendations on the length of record for regulatory dispersion modeling as published in The Guideline on Air Quality Models [1] are: five years of National Weather Service (NWS) meteorological data or at least one year of site-specific data. Consecutive years from the most recent, readily available 5-year period are preferred.

5.3.2 Completeness Requirement

Regulatory analyses for the short-term ambient air quality standards (1 to 24-hour averaging) involve the sequential application of a dispersion model to every hour in the analysis period (one to five years); such analyses require a meteorological record for every hour in the analysis period. Substitution for missing or invalid data is used to meet this requirement. Applicants in regulatory modeling analyses are allowed to substitute for up to 10 percent of the data; conversely, the meteorological data base must be 90 percent complete (before substitution) in order to be acceptable for use in regulatory dispersion modeling.

The following guidance should be followed for purposes of assessing compliance with the 90 percent completeness requirement: Lost data due to calibrations or other quality assurance procedures is considered missing data. A variable is not considered missing if data for a backup, collocated sensor is available. A variable is not considered missing if backup data from an analog system; which meets the applicable response, accuracy and resolution criteria; are available.

Site specific measurements for use in stability classification are considered equivalent such that the 90 percent requirement applies to stability and not to the measurements (e.g., σ_E and σ_A) used for estimating stability.

The 90 percent requirement applies on a quarterly basis such that 4 consecutive quarters with 90 percent recovery are required for an acceptable one-year data base.

The 90 percent requirement applies to each of the variables wind direction, wind speed, stability, and temperature and to the joint recovery of wind direction, wind speed, and stability.

Obtaining the 90 percent goal will necessarily require a commitment to routine preventive maintenance and strict adherence to approved quality assurance procedures (Sections 8.5 and 8.6). Some redundancy in sensors, recorders and data logging systems may also be necessary. With these prerequisites, the 90 percent requirement should be obtainable with available high-quality instrumentation.

Applicants failing to achieve such are required to continue monitoring until 4 consecutive quarters of acceptable data with 90 percent recovery have been obtained. Substitutions for missing data are allowed but may not exceed 10 percent of the hours (876 hours per year) in the data base. Substitution procedures are discussed in Section 6.8.

2.1.9 NRC Safety Guide 23 Section 5, Instrument Maintenance and Servicing Schedules (1972)

Meteorological instruments should be inspected and serviced at a frequency which will assure at least a **90 percent data recovery**, and which will minimize extended periods of instrument outage. The use of redundant sensors and/or recorders may be another acceptable means of achieving the 90 percent data recovery goal. The instruments should be calibrated at least semiannually.

Note: There is no specific guidance on the time period associated with meteorological data recovery.

2.2 Results of DMCC and NUMUG 90 Percent Data Recovery Surveys

A survey was developed to determine meteorological data recovery goals and the system infrastructure that is in place to maximize data recovery at DOE sites and nuclear power plants. The survey was sent to DMCC and NUMUG leadership to maximize the responses obtained. The DMCC has been actively assisting DOE meteorological program managers since 1994 and is populated by meteorologists at 13 DOE sites, reservations, and national laboratories. The NUMUG is populated by meteorologists at each of the civilian nuclear power plants and has provided guidance since 1991. Twelve survey responses were received, and the results are presented in Table 2-1.

Table 2-1: 90 Percent Data Recovery Survey Results

Location	Requirement
Brookhaven National Laboratory (BNL)	Annual
Browns Ferry Nuclear Plant	Annual
Monticello Nuclear Generating Plant	Annual
Perry Nuclear Power Plant	Annual
Nevada National Security Site	Annual
Oak Ridge National Laboratory (ORNL)	Quarterly & Annual
Salem and Hope Creek Nuclear Stations	Annual
Savannah River National Laboratory (SRNL)	Not required to meet 90%
Sequoyah Nuclear Plant	Annual
Susquehanna Nuclear Station	Annual
Watts Bar Nuclear Plant	Annual
Y-12 National Security Complex	Annual

The results of the survey indicate that a large majority of DOE sites and all civilian nuclear power plants use the annual meteorological data recovery metric. Moreover, it is likely that all other remaining nuclear power plants that did not respond to the survey base their data completeness on the NRC annual 90 percent data recovery guidance since Licensees tend to follow specific NRC guidance. The only NRC licensee or DOE site that responded to a quarterly completeness criterion was Oak Ridge National Laboratory (ORNL). Their best practice is driven by the EPA completeness criterion, but for databases developed to run the CAP-88PC code for NESHAP Annual Reports, they have an EPA regulatory requirement to meet 40 CFR 61 Subpart H. For 5-year databases to meet meteorological data requirements associated with Documented Safety Analyses (DSAs), the ORNL SB organization does not require quarterly 90 percent data recovery and adheres to annual 90 percent data recovery. This clearly shows that the quarterly requirement is not the industry standard and adopting it would add an unnecessary level of conservatism to the SB requirements.

The survey also showed that most of the DOE sites and NRC Licensees have redundant and defense in depth (DID) hardware and software in place to maximize their data recovery capability. Each of these measures provide a means of limiting data loss due to natural phenomena hazards (NPH) or loss of power, or redundancy of instrumentation to provide data substitution options. These data recovery enhancers include the following:

1. Lightning protection of the meteorological tower and its instrumentation,
2. Uninterrupted Power Supply (UPS) in case of loss of power,
3. Diesel generators for the UPS,
4. Redundant instrumentation,
5. Spare parts program, and
6. Defendable data substitution techniques.

3.0 LANL METEOROLOGICAL DATA COMPLETENESS

3.1 Data Completeness History

The LANL meteorological program has met its data completeness requirements for many years of its long operational history. Table 3-1 presents a recent sample of the 90 percent data recovery history for the 2007-2016 period at LANL's TA-06 tower, for which measurements are used for regulatory compliance. The wind variables (i.e., wind speed, wind direction, standard deviation of vertical speed) are based on level 1 (at 11.5 m above ground level) measurements, and temperature is based on level 0 (at 1.5 m above ground level) measurements. Table 3-2 shows whether the stringent quarterly 90 percent data recovery requirement was met. Based on an annual completeness requirement, LANL has met the requirement for 9 of the past 10 years. However, a quarterly completeness requirement would result in multiple years that did not meet that requirement.

For 2009, data from a nearby tower (TA-49), which is spatially representative to the TA-06 tower, is available for substitution for all missing variables, and its annual and quarterly completeness is shown in Tables 3-3 and Table 3-4, respectively. Over the past 5 years at TA-06, the LANL meteorological program did not meet the quarterly requirement for wind direction in 2014 and all variables in 2016. As these tables show, meteorological data from TA-49 is available for substitution for all variables in 2014 and 2016 that did not meet the stringent quarterly 90 percent data recovery objective.

✓ = met 90% data completeness

x = did not meet 90% data completeness

Table 3-1: TA-06 Meteorological Tower Annual Completeness

TA-06 Variables	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wind Speed	✓	✓	x	✓	✓	✓	✓	✓	✓	✓
Wind Direction	✓	✓	x	✓	✓	✓	✓	✓	✓	✓
Standard Deviation Vertical	✓	✓	x	✓	✓	✓	✓	✓	✓	✓
Temperature	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3-2: TA-06 Meteorological Tower Quarterly Completeness

TA-06 Variables	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wind Speed	x	✓	x	✓	✓	✓	✓	✓	✓	x
Wind Direction	x	✓	x	✓	✓	✓	✓	x	✓	x
Standard Deviation Vertical	x	✓	x	✓	✓	✓	✓	✓	✓	x
Temperature	x	✓	✓	✓	✓	✓	✓	✓	✓	x

Table 3-3: TA-49 Meteorological Tower Annual Completeness

TA-49 Variables	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wind Speed	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Wind Direction	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Standard Deviation Vertical	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Temperature	✓	✓	✓	✓	✓	✓	x	✓	✓	✓

Table 3-4: TA-49 Meteorological Tower Quarterly Completeness

TA-49 Variables	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Wind Speed	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Wind Direction	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Standard Deviation Vertical	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Temperature	✓	✓	✓	✓	✓	✓	x	✓	✓	✓

3.2 Reasons Why Data Recovery Goals Were Not Met

The LANL meteorological program has met its annual meteorological data completeness goals, as well as the quarterly completeness goals, 100 percent of the time when using TA-49 meteorological data substitution. However, there were some quarters where the data recovery goals were not met by TA-06 and TA-49, although not simultaneously. Based on examination of the LANL meteorological data recovery history, the following reasons can be attributed to not meeting those goals:

- A hail storm damaged TA-06 instruments in 2009,
- The TA-49 instrument boom hoist system failed in 2013, and
- Temperature sensor wiring and connectors corroded at TA-49 in 2013.

Towers were unavailable for data logger upgrades to all towers. Although annual 90 percent data recovery goals were met at Tower TA-06, it is somewhat troubling that all quarterly goals were not met, even though this stringent requirement is not tied to SB. Accordingly, the remainder of this report will focus on program improvements, if implemented, that will ensure, with confidence, that even the more stringent data completeness goal can be met.

4.0 RECOMMENDED LANL METEOROLOGICAL PROGRAM IMPROVEMENTS TO IMPROVE DATA COMPLETENESS

4.1 Overview of 2006 and 2015 DMCC Assist Visits

The DMCC conducted an assist visit of the LANL meteorological program in August 2006, and several observations and recommendations were recorded (DMCC 2006). On August 20-21, 2015, a follow-up meteorological program assist visit was conducted to determine progress in meeting observations and recommendations from the prior assist visit (DMCC 2015).

Five attributes of an effective meteorological program were developed by the DMCC:

"It is the policy of the DOE to protect the safety and health of all employees and the public and to protect the environment around the large DOE reservations. This requires, in part, a dedicated DOE-based meteorological program that, at a minimum, encompasses the following five (5) attributes:

1. Designed with an onsite meteorological monitoring capability that fully addresses applicable mission requirements, and appropriate to the activities, hazards, and topographical characteristics of the reservation.
2. Constructed with program elements that reflect sound management practices and good scientific principles; and which meet the numerous regulatory requirements associated with the atmospheric sciences.
3. Staffed with dedicated, experienced, and fully qualified professionals that perform duties related to protecting personnel, facilities, and equipment from severe or extreme meteorological conditions, are capable of responding to onsite accidents involving hazardous materials, and are skilled at preparing environmental, safety, health, and/or consequence assessments.
4. Equipped with adequate DOE facilities that house and office professional and technical personnel, communications systems, computer systems, and scientific instruments; with an infrastructure that maximizes output and effectiveness.
5. Provided with proper, dedicated equipment and instrumentation that is necessary to resolve the relevant meteorological parameters defining atmospheric transport and dispersion processes; as well as identifying meteorological conditions that could produce a threat or challenge to the safety or health of personnel, damage or destroy DOE property or equipment, or lead to a variety of accidents that could result in injury or loss of life."

At the highest level, the assist visit team looked at each of these five program attributes as part of its programmatic evaluation.

The meteorological program was then evaluated relative to the following high-level questions:

1. What is the state of the meteorological services provided to its customers?

2. What is the quality of meteorological data provided to its customers, and is it adequate and available to meet all customer needs?
3. What is the quality of atmospheric transport and diffusion modeling provided to its customers, and is it applicable to complex wind flow patterns at LANL?
4. Are the current and future meteorological service customers being serviced appropriately?
5. Are there adequate human resources to meet present and future program customer needs, and are they being appropriately leveraged?
6. Are existing instrumentation, facilities and systems adequate to meet present and future customer needs?
7. Are LANL meteorological services conducted in an efficient, cost-effective manner?
8. Is meteorological data used to ensure safety & health of LANL personnel?

More specific evaluations were performed by the assist visit team relative to 23 objectives extracted from ANSI/ANS-3.11-2015 and 14 objectives associated with consequence assessment and atmospheric transport and diffusion modeling in the consequence assessment element of DOE G 151.1-1.

This follow-up assist visit was conducted in four parts:

Part I: In 2006, the meteorological program was compared to the 23 performance criteria within a Voluntary Consensus Standard (VCS), ANSI/ANS-3.11-2005(R2010), and the 19 performance criteria associated with consequence assessment element of DOE G 151.1-1, supplemented by draft DOE G 151.1-XY. The team looked at the progress made on each of the 2006 recommendations and provided a status of the present program relative to these monitoring and consequence assessment performance criteria.

The following general performance requirements were evaluated:

- Objectives 1-1 through 1-4: Meteorological monitoring system (4 requirements);
- Objectives 2-1 through 2-3: Siting of meteorological observation instruments (3 requirements);
- Objectives 3-1 through 3-5: Data acquisition system (5 requirements);
- Objectives 4-1 through 4-7: Data management (7 requirements);
- Objectives 5-1 through 5-4: System performance (4 requirements);
- Objectives 6-1 through 6-10: Consequence assessment modeling attributes and integration with emergency response program (10 requirements); and
- Objectives 6-11 through 6-14: Consequence assessment modeling attributes and integration with offsite authorities (4 requirements).

Part II: The present custodians of the meteorological monitoring program were interviewed to establish the most recent program baseline and the status of its implementation. In addition, visual surveillances of a sample of the instrumentation were performed and evaluated to determine how it met the applicable performance objectives of ANSI/ANS-3.11-2015.

Part III: The present meteorological data customers were interviewed to determine the level of their satisfaction with the meteorological data products and services and to identify any improvements. Representatives of the following customers were either interviewed or information about the LANL interface was provided by: (1) Safety Basis; (2) Emergency Management & Response; (3) Environmental Compliance; (4) Operations; and; (5) Environmental Safety & Health (ES&H).

Part IV: A questionnaire was provided to the lead meteorologist associated with 31 meteorological program Lines of Inquiry (LOI) in DOE-HDBK-1216-2015. Responses to those LOI's were documented in the assist visit report.

The DMCC assist visit team concluded that although there are many observations and recommendations, and the program is not fully compliant with ANSI/ANS-3.11-2015 and the consequence assessment element of DOE G 151.1-1, it is still a very strong and well-managed program. Fulfillment of the recommendations, which is at the discretion of LANL management, will result in a superior program and better services to the internal and external customer base.

4.2 DMCC Assist Visit Observations and Recommendations Related to Improving Data Recovery

Eight of the DMCC assist visit observations and recommendations from both the August 2006 and August 2015 assist visits are related to improving data recovery. When fully addressed, the ability of the LANL meteorological program to continue meeting data recovery goals will be further enhanced. The following presents these observations and recommendations.

The present status of the program improvements to meet the intent of the DMCC assist visit recommendations and future program improvements are presented in Sections 4.3 and 4.4, respectively.

Recommendation #1: Increase Meteorological Program Human Resources

2006 Assist Visit Observation	**#06-01**: The scope of the existing meteorological program, especially the vital support required by EM&R, cannot be effectively accomplished with the present manpower allocation. The important Emergency Response Organization (ERO) meteorologist/consequence assessor position, which should be 3-deep, is presently 1-deep. When this individual is ill or on vacation, there is no coverage. This is further exacerbated by the expected learning curve of two individuals who have recently joined the program due to recent retirements.
2006 DMCC Recommendation	**#06-01:** Perform a Job Task Analysis (JTA) of the meteorological program and determine realistic manpower requirements, accounting for program upgrades, to meet all customer needs. Consider increasing FTE count of meteorologists, instrumentation technicians, and software developers to meet the identified human resource requirements.
2015 Pre-Assist Visit Response	Performed in FY15; review with DMCC in August 2015.
2015 DMCC Observation	**#15-01**: A thorough JTA was performed, which showed a FTE count of 2.5. This is slightly low for a site with six meteorological towers and a SODAR actively supporting many LANL customers. The consequence assessment ERO position only has one meteorologist to support it (soon to be two), and this, like all ERO positions, needs three individuals. Based on the extent of work to support all LANL customers and to meet ERO needs, another part-time meteorologist would be needed to provide sufficient human resources.
2015 DMCC Recommendation	**#15-01**: Seek another LANL scientist that could be given collateral duties to fill the third ERO meteorologist position and perform technical tasks that would meet present human resource needs. In addition, summer interns can alleviate some of the workload.

Recommendation #2: Increase the Number of Instrumented Meteorological Towers

2006 Assist Visit Observation	**#06-02**: Although there are six meteorological towers, this array of towers may not be sufficient to develop an accurate three-dimensional wind field, which is necessary to drive the complex terrain transport and dispersion model needed to make accurate protective actions for LANL workers and protective action recommendations for the public. Additional, strategically placed meteorological towers and an additional SODAR (i.e., canyon) may need to be deployed to effectively characterize the three-dimensional flow field.
2015 Pre-Assist Visit Response	The meteorology network was assessed in 1994 for adequacy of emergency response protective actions for residents of Los Alamos (i.e., LA-UR-94-3587). It was found to be adequate, since protective actions (PA) in Los Alamos County are made based on neighborhoods and not downwind sectors. Adding meteorology towers in the Los Alamos town site did not change PA decisions. However, a specific assessment of White Rock decisions was not made, but professional judgment indicated that a similar assumption is appropriate for White Rock due to the proximity of the TA-54 tower to White Rock. An evaluation concerning San Ildefonso Pueblo lands has not been made. A study has been proposed for FY16 and over-target funds requested. The two areas of concern are TA-16 (WETF) and TA-54 Area G (White Rock and San Ildefonso lands). The study proposal will be reviewed by the DMCC in August 2015.
2015 DMCC Observation	**#15-02**: The meteorological tower coverage for the CAPARS modeling study proposal was discussed, and two candidate sites were visited. A 20-meter solar-powered battery backup tower would provide coverage for TA-16 since this hazardous facility is outside the 2-km radius of met tower coverage and would add another data point for the CAPARS wind field algorithm. A 10-meter solar-powered battery-backup tower in the canyon near TA-36 would provide insight into canyon-mesa flows and would improve the CAPARS wind field calculation.
2015 DMCC Recommendation	**#15-02**: Without budget constraints, procure two additional meteorological towers, site them nearby the TA-16 facility and in the canyon nearby the TA-36 facility, and then perform a study to determine whether LANL wind fields are adequately characterized.

Recommendation #3: Develop Environmentally-Controlled Data Shed Linkage to Data Logger

2006 Assist Visit Observation	**#06-07**: At all of the meteorological monitoring stations, the environmentally controlled shed, which houses the data logging equipment, is cooled by an air conditioner. If the air conditioner fails due to mechanical trouble or due to a loss of power to the shed, there may be equipment failure and data loss until the next surveillance is conducted and the failure is noticed
2006 DMCC Recommendation	**#06-07**: Develop an electronic signal to remotely indicate that the air conditioning in the tower instrument sheds have failed.
2015 Pre-Assist Visit Response	The heater/AC unit at TA-6 has been recently replaced and is in progress for TA-54.
2015 DMCC Observation	**#15-07**: The shed that contained the data logging equipment at TA-6 was surveilled. Currently, there is no method to remotely check the temperature inside the shed with data logging and communications equipment. There is a parameter that is transmitted back to the data technician that shows the real-time shed temperature.
2015 DMCC Recommendation	**#15-04**: Continue to complete the CR-3000 data logger upgrade and installation. Include a check of the data logger temperature parameter into the daily data review procedure to identify HVAC operational failures.

Recommendation #4: Improve Meteorological Data Checking Software

2006 Assist Visit Observation	**#06-09**: Data validation, which is performed without a procedure, uses a Commercially Off The Shelf (COTS) program (i.e., PV-WAVE), which is effective in determining if individual parameters are out of range or behaving erratically. This can be improved by coupling it with a screening program of inter-parameter checks (e.g., stability class versus wind speed).
2006 DMCC Recommendation	**#06-09**: Consider developing a data validation procedure and augment the protocol with inter-parameter check screening software. (e.g., stability class versus wind speed).
2015 Pre-Assist Visit Response	This is an opportunity for improvement. However, a long-term data management plan is not yet determined, and spending resources on this action is not considered of added value at this time. The data are reviewed on a daily and weekly basis to identify these kinds of issues.
2015 DMCC Observation	**#15-09**: SOP-5160, "Routine Meteorological Data Processing," was reviewed and is judged to be sufficient. Additional parameter and inter-parameter checking software is available at other DOE sites and should be reviewed for implementation to improve the data screening process.
2015 DMCC Recommendation	**#15-06**: The meteorological data validation process can be improved with additional parameter and inter-parameter checking software. Contact other DOE sites and review its checks to improve the data screening process.

Recommendation #5: Revise Meteorology Technical Project Plan and QAPP

2006 Assist Visit Observation	**#06-10**: The Quality Assurance Project Plan (QAPP) for the meteorological monitoring project does not adequately describe the program's quality assurance principles. A revision, which is being drafted, should be completed in a timely manner, and compared to ANSI/ANS-3.2, which is recommended in ANSI/ANS-3.11.
2006 DMCC Recommendation	**#06-10**: Update QAPP for ANSI/ANS-3.2 and ANSI/ANSI-3.11.
2015 Pre-Assist Visit Response	This is planned to be done by the end of FY15. The QAPP has been updated, but not the entire ANSI/ANS-3.11 standard has been included; specifically, the instrument uncertainty calculation. It will be reviewed by the DMCC in the August 2015 assist visit.
2015 DMCC Observation	**#15-10**: The QAPP and the Meteorology Technical Project Plan were reviewed with respect to compliance with ANSI/ANS-3.11-2005(R2010) and EPA guidance. In general, both of these plans provide sufficient information on the program and its management. Small improvements are still needed, which will be outlined in the Assist Visit report.
2015 DMCC Recommendation	**#15-07**: Revise Meteorology Technical Project Plan and QAPP to meet all ANSI/ANS-3.11-2005(R2010) requirements.

Recommendation #6: Increase Site Inspections of Meteorological Towers and Instrumentation

2006 Assist Visit Observation	**#06-11**: Field surveillances are infrequently conducted at each of the six meteorological towers. In addition, a surveillance procedure and checklist are not in place.
2006 DMCC Recommendation	**#06-11**: Develop a met tower field surveillance procedure and checklist.
2015 Pre-Assist Visit Response	This is planned to be done by the end of FY15. The QAPP has been updated, but not the entire ANSI/ANS-3.11 standard has been included; specifically, the instrument uncertainty calculation. It will be reviewed by the DMCC in the August 2015 assist visit.
2015 DMCC Observation	**#15-11**: ENV-ES-MAQ-405.0, "Meteorology Tower Site Inspections," was reviewed and judged to be adequate. It was learned that field surveillances of the instrumentation is generally performed on a monthly or bi-monthly basis.
2015 DMCC Recommendation	**#15-08**: These surveillances should be performed more frequently for early detection of any instrument malfunctions to avoid unwanted large data losses. The frequency of the instrumentation field surveillances should be increased to at least twice per month, or weekly, if possible.

Recommendation #7: Increase Field Calibrations of Meteorological Instrumentation

2006 Assist Visit Observation	**#06-13**: ANSI/ANS-3.11 recommends that field calibrations of meteorological instrumentation be performed on a semiannual basis. Recent LANL meteorological calibration cycle is on the order of two years, which is not frequent enough.
2006 DMCC Recommendation	**#06-13**: Implement six-month cycle for calibration of met towers.
2015 Pre-Assist Visit Response	The calibration frequency has been updated to annual, from bi-annual (see http://www.lanl.gov/community-environment/environmental-stewardship/_assets/docs/qa/meteorology/WES-PLAN-300.pdf) based on manufacturers recommendations. The calibration frequency of wind measurements has been updated to every six months.
2015 DMCC Observation	**#15-13**: ENV-CP-SOP-5131.2, "Calibration, Refurbishment & Maintenance of Meteorology Program Equipment," was reviewed. It was noted that a semi-annual calibration frequency of six months of the meteorological parameters that are used for atmospheric dispersion meets the ANSI/ANS-3.11-2005(R2010) requirements was established. A QA Review of the meteorological instrument was performed in 2013 (LA-UR-15-26835) and found a few areas of improvement and showed the calibration program was of high quality.
2015 DMCC Recommendation	**#15-10**: Continue to explore opportunities, methods, and resources to calibrate all meteorological parameters at six-month intervals per ANSI/ANS-3.11-2005(R2010).

Recommendation #8: Develop Spare Parts Procedure

2006 Assist Visit Observation	**#06-14**: There is no formal procedure that enables the management of meteorological system spare parts. With only an informal accounting of the spare parts, the risk of running low on vital parts is increased, which could lead to undesirable instrument outages if no replacement parts are available. Overall system redundancy should be addressed.
2006 DMCC Recommendation	**#06-14**: Consider developing a system for managing spare parts. Develop an analysis of met system components to determine areas where there are single points of failure.
2015 Pre-Assist Visit Response	This is an opportunity for improvement that has been partially addressed. It will be completed in FY15.
2015 DMCC Observation	**#15-14**: Spare parts are documented by the meteorological technician using a comprehensive spreadsheet. However, without a formal procedure to account for spare parts inventory on a real-time basis, there is a better chance of not having a key part available when an unexpected failure occurs. In addition, an analysis of which failed parts would result in significant data loss of key meteorological parameters would focus spare part resources.
2015 DMCC Recommendation	**#15-11**: Develop a procedure for managing spare parts. Include an analysis of meteorological system components to determine areas where there are single points of failure.

4.3 Summary of Current Program Improvements since 2015 DMCC Assist Visit

Since August 2014, LANL management has actively addressed many of the DMCC observations and recommendations as it recognized that these are designed to improve all aspects of the meteorological program. Accordingly, many program improvements since the 2015 DMCC assist visit have been implemented and each of these will improve meteorological data recovery. A letter from the DMCC to the LANL meteorology program is presented in the Appendix that discusses the status of the improvements and upgrades suggested in the assist visit. Table 4-1 shows how the present implementation has improved the meteorological program’s capacity to meet important data recovery goals.

Table 4-1: Current Implementation of DMCC Assist Visit Recommendations

DMCC Recommendation	Present LANL Meteorological Program Implementation Status	Present Improvements to Data Recovery
#06-01: Perform a JTA of the meteorological program and determine realistic manpower requirements, accounting for program upgrades, to meet all customer needs. Consider increasing FTE count of meteorologists, instrumentation technicians, and software developers to meet the identified human resource requirements.	The meteorological program presently still has one full-time meteorologist and 1.5 FTEs of electronic technician and information technology support. Efforts that have been made to acquire an additional entry level meteorologist have not yet been successful, as over-target requests for FY17 and FY18 were not funded.	None. The meteorological program still suffers from understaffing, which limits its progress to improving data recovery.
#15-02: Without budget constraints, procure two additional meteorological towers and site them near the TA-16 facility and in the canyon near the TA-36 facility, and then perform a study to determine whether LANL wind fields are adequately characterized.	An over-target request was made for one or 2 additional towers in FY17 but was not funded.	None. The meteorological program still suffers from insufficient funding, which limits its progress to improving data recovery.
#15-04: Continue to complete the CR-3000 data logger upgrade and installation. Include a check of the data logger temperature parameter into the daily data review procedure to identify HVAC operational failures.	All data loggers are updated to the CR-3000. In the public tables of each data logger, the data logger panel temperature is available.	The new data logger provides additional data checks to assist the LANL meteorologist in determining instrument hardware and/or software malfunctions.
#15-06: The meteorological data validation process can be improved with software for additional parameter and inter-parameter checking. Contact other DOE sites and review their checks to improve the data screening process.	The NCAR software, Chords, was initially tested for a new data management system. After several security flags were issued due to the software, LANL meteorology decided to switch to a MySQL database. The same acceptable ranges for data from the old system will be used for the new system. SOP-5160 was revised in July 2016 to account for the new internal data validation software.	The new MySQL data base and the revision to SOP-5160 provides the LANL meteorologist with an additional tool to determine when data is out of range or inconsistent with climatic conditions.
#15-07: Revise Meteorology Technical Project Plan and QAPP to meet all ANSI/ANS-3.11-2005(R2010) requirements.	Most of the QAPP procedures were updated since the 2015 DMCC Assist Visit including a separation of procedures for calibrations for wind and temperature sensors and a new document for operation and maintenance of the TA-5 MDCN tower. Documents that were added or updated to QAPP include the following: (1) EPC-CP-QP-405: Meteorology Tower Site Inspections; (2) EPC-CP-SOP-5101: Mortandad Canyon TA-5-061 Meteorology Tilt Tower Operation and Maintenance; (3) EPC-CP-SOP-5131: Calibration, Maintenance and Control of Data Loggers and Miscellaneous Meteorology Monitoring Instruments; (4) EPC-CP-SOP-5132: Calibration, Refurbishment, and Control of Meteorology Wind Monitoring Instruments; (5) EPC-CP-SOP-5135: Calibration, Care, and Control of Meteorology Program Temperature Sensors; (6) EPC-CP-SOP-5160: Routine Meteorological Data Processing; and, (7) EPC-CP-TPP-MetM: Technical Project Plan for Meteorological Monitoring	The revised QAPP procedures improve the day-to-day operation of the meteorological program.
#15-08: These surveillances should be performed more frequently for early detection of any instrument malfunctions to avoid unwanted large data losses. The frequency of the instrumentation field surveillances should be increased to at least twice per month, or weekly, if possible.	The LANL meteorology group is currently performing meteorology tower site surveillances every other month but concur that monthly is a better frequency. For perspective, there is no historical example of finding an instrument problem via the site inspections. Instrument issues are typically found prior to a site inspection, as a result of the thorough data review on a daily and weekly basis. For these reasons, weekly site visits are not warranted and twice a month	Any increased frequency of meteorology tower site surveillances improves the chances of early detection of instrument malfunction.

	visits would be a best practice, if staffing allowed.	
#15-10: Continue to explore opportunities, methods, and resources to calibrate all meteorological parameters at six-month intervals per ANSI/ANS-3.11-2005(R2010).	Wind instruments are calibrated every 6 months, and all other instruments follow the manufacturer's recommendations and the LANL operating experience.	None. No changes to calibration frequency.
#15-11: Develop a procedure for managing spare parts. Include an analysis of meteorological system components to determine areas where there are single points of failure.	A spare parts inventory program has been recently developed.	The new spare parts inventory program enables the meteorology program to understand its inventory of spare parts and a means to monitor availability of parts that are needed. Should an unexpected failure of an instrument occur, it can be replaced promptly.

4.4 Anticipated FY18-FY19 Program Improvements

Table 4-1 shows how LANL management is attempting to address many of the DMCC observations and recommendations. Implementation is subject to the level of resources that LANL management can apply to the meteorological program.

Table 4-2 identifies future meteorological program improvements in response to DMCC assist visit observations and recommendations related to meeting the annual 90 percent data recovery goal that, when appropriately funded, will further improve the meteorological program's capacity to continue to consistently meet data recovery metrics.

Table 4-2: Future Implementation of DMCC Assist Visit Recommendations

DMCC Recommendation	Future LANL Meteorological Program Implementation	Future Improvements to Data Recovery
#06-01: Perform a JTA of the meteorological program and determine realistic manpower requirements, accounting for program upgrades, to meet all customer needs. Consider increasing FTE count of meteorologists, instrumentation technicians, and software developers to meet the identified human resource requirements.	The meteorology program continues to stress to management that a 2nd meteorologist would fill an institutional need to support nuclear facilities, emergency operations, and run a quality program.	Additional staffing, either by a LANL employee or summer intern, will provide additional human resources to apply to data recovery improvements.
#15-02: Without budget constraints, procure two additional meteorological towers, site them near the TA-16 facility and in the canyon near the TA-36 facility, and then perform a study to determine whether LANL wind fields are adequately characterized.	An over-target request will be made for one or 2 additional towers in FY18 and beyond.	Additional funding will provide additional human resources and instrumentation to apply to any data recovery improvements.
#15-04: Continue to complete the CR-3000 data logger upgrade and installation. Include a check of the data logger temperature parameter into the daily data review procedure to identify HVAC operational failures.	Once all data logger programs are updated, the data logger temperature will be added to the daily data review procedure**.**	Completion of all data logger programs and the revised daily data review procedure will assist the meteorologist in determining malfunctioning hardware and/or software issues.
#15-06: The meteorological data validation process can be improved with software for additional parameter and inter-parameter checking. Contact other DOE sites and review their checks to improve the data screening process.	Additional work from Campbell Scientific and assistance from IT to update the servers are needed to complete the system and website upgrade. EPC-CP-SOP-5160 will be revised when the new meteorological data management system is complete.	Completion of the revision to SOP-5160 will provide the LANL meteorologist with an additional tool to determine when data is out of range or inconsistent with climatic conditions.
#15-07: Revise Meteorology Technical Project Plan and QAPP to meet all ANSI/ANS-3.11-2005(R2010) requirements.	Continue to add new documents to the QAPP.	Additional improvements to QAPP procedures will continue to improve the day-to-day operation of the meteorological program.
#15-08: These surveillances should be performed more frequently for early detection of any instrument malfunctions to avoid unwanted large data losses. The frequency of the instrumentation field surveillances should be increased to at least twice per month or weekly, if possible.	Efforts to acquire a part-time second instrument technician will be requested for FY18 and beyond.	The additional part-time second instrument technician will enable an increased frequency of meteorology tower site surveillances, which will improve the chances of early detection of instrument malfunction.
#15-10: Continue to explore opportunities, methods, and resources to calibrate all meteorological parameters at six-month intervals per ANSI/ANS-3.11-2005(R2010).	Calibration results will continue to be reviewed for all instruments and the frequency will be adjusted following ANSI/ANS-3.11-2015 guidance.	Meeting the calibration frequencies in ANSI/ANS-3.11-2015 will improve, in a timely manner, the chances of detecting instruments that are out of calibration.
#15-11: Develop a procedure for managing spare parts. Include an analysis of meteorological system components to determine areas where there are single points of failure.	A spare parts inventory procedure for maintaining this inventory and for tracking the performance of the equipment will be developed.	The new spare parts inventory procedure will further enable the meteorology program to promptly replace an unexpected instrument.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Accurate, quality-assured meteorological data at a minimum of annual 90 percent recovery is a vital input element to radiological and hazardous chemical consequence assessment dispersion modeling in DSAs. Accordingly, the fidelity and completeness of atmospheric measurements may potentially affect the implementation of safety class (SC) and safety significant (SS) controls associated with the safety of LANL workers and the public. In May 2017, LANL SB determined that the meteorological program is subject to 10 CFR 830 and applicable DOE-STD-3009-94 CN3 and DOE-STD-3009-2014 requirements. Within those requirements, the completeness of the 5-year meteorological database needs to meet annual 90 percent data recovery goals. This report evaluated the LANL meteorological program against this metric and determined that it has been and is presently capable of meeting this requirement on a consistent basis. The implementation of eight meteorological program improvements related to enhancing data recovery, as recommended in the DMCC August 2015 meteorological program assist visit, will ensure the LANL SB annual 90 percent meteorological data recovery goal can be consistently met in the future. Significant progress has been made towards such implementation since the August 2015 DMCC assist visit.

5.2 Recommendations

LANL meteorological program management should continue to strive to apply its limited resources and seek to acquire additional human capital and physical resources, as appropriate, to upgrade the hardware and software elements of the meteorological program and implement its operational procedures and QAPP to ensure it will consistently meet important SB data recovery requirements in the future. These improvements are summarized in the future improvements to data recovery, Table 4-2, as follows:

1. Additional staffing, either by a LANL employee or summer intern, will provide additional human resources to apply to data recovery improvements;

2. Additional funding will provide additional human resources and instrumentation to apply to any data recover improvements;

3. Completion of all data logger programs and the revised daily data review procedure will assist the meteorologist in determining malfunctioning hardware and/or software issues;

4. Completion of the revision to SOP-5160 will provide the LANL meteorologist with an additional tool to determine when data is out of range or inconsistent with climatic conditions;

5. Additional improvements to QAPP procedures will continue to improve the day-to-day operation of the meteorological program;

6. An additional part-time second instrument technician will enable an increased frequency of meteorology tower site surveillances, which will improve the chances of early detection of instrument malfunction;

7. Meeting the calibration frequencies in ANSI/ANS-3.11-2015 will improve, in a timely manner, the chances of detecting instruments that are out of calibration; and,

8. A new spare parts inventory procedure would further enable the meteorology program to promptly replace an unexpected instrument failure.

LANL management should also consider a follow-up DMCC assist visit in late-2018 or early-2019 to independently evaluate the meteorological program enhancement progress.

6.0 REFERENCES

1. 10 CFR 830, *Nuclear Safety Management*, 2011

2. ANSI/ANS-3.11-2005 (R2010), *Determining Meteorological Information for Nuclear Facilities*, American Nuclear Society, 2010

3. ANSI/ANS 3.11-2015, *Determining Meteorological Information for Nuclear Facilities*, American Nuclear Society, 2015

4. ASME/NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*, 2008

5. DMCC Assist Visit Report on the LANL Meteorological Program, 2006

6. DMCC Assist Visit Report on the LANL Meteorological Program, 2015

7. DOE-HDBK-1216-2015, Environmental Radiological Monitoring and Environmental Surveillance, Section 5.8 Inspection, Maintenance, Protection, and Calibration Criteria, 2015

8. DOE-HDBK-1224-201X, *Hazard and Accident Analysis Handbook*, Section 6.5, Characterization of Meteorological and Site Data, (not yet issued)

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10. DOE O 414.1D CN 1, *Quality Assurance*, 2013

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13. EPA-454/R-99-005 EPA-454/R-99-005, *Meteorological Monitoring Guidance for Regulatory Modeling Applications,* Section 5.3, Data Recovery, 2000

14. LANL-DOE Email communications: Subject: *Question on Requirements for Completeness Requirements for Meteorological Data*, dated 8/11/17 through 9/7/17.

15. LANL Procedure EPC-CP-QP-405, *Meteorology Tower Site Inspections*, 2017

16. LANL Procedure EPC-CP-SOP-5101, *Mortandad Canyon TA-5-061 Meteorology Tilt Tower Operation and Maintenance*, 2017

17. LANL Procedure EPC-CP-SOP-5131, *Calibration, Maintenance and Control of Data Loggers and Miscellaneous Meteorology Monitoring Instruments*, 2017

18. LANL Procedure EPC-CP-SOP-5132, *Calibration, Refurbishment, and Control of Meteorology Wind Monitoring Instruments*, 2017

19. LANL Procedure EPC-CP-SOP-5135, *Calibration, Care, and Control of Meteorology Program Temperature Sensors*, 2017

20. LANL Procedure EPC-CP-SOP-5160, *Routine Meteorological Data Processing,* 2017

21. LANL Procedure EPC-CP-TPP-Met M, *Technical Project Plan for Meteorological Monitoring*, 2017

22. LANL Procedure SD-330, *Los Alamos Quality Assurance Program*, 2017

23. NRC Safety Guide 23, Onsite *Meteorological Programs*, Section 5, Instrument Maintenance and Servicing Schedules, 1972

24. NRC Regulatory Guide 1.23, Revision 1, *Meteorological Monitoring Programs for Nuclear Power Plants*, 2007

25. RPT-SBD-384-R0, *Protocol and Input Parameters for LANL Dispersion Analysis*, 2015

7.0 APPENDIX

DOE Meteorological Coordinating Council (DMCC)

To: David Bruggeman, Meteorologist
Los Alamos National Laboratory
Los Alamos, NM

From: Walt Schalk, Chairman
DOE Meteorological Coordinating Council, NA-41

Date: 13 July 2018

Subject: LANL Meteorological Data Completeness and 2015 DMCC Assist Visit Progress

The DOE Meteorological Coordinating Council (DMCC) is encouraged by the improvements and upgrades completed to and for the Los Alamos National Laboratory (LANL) Meteorology Program, especially with a lean budget. The improvements to the processes, procedures, meteorological database, and the weather station data loggers will improve the weather data and it's accessibility to better support the safety, environmental compliance, and consequence assessment activities for the Site.

The DMCC's Assist Visit in 2015 identified the improvement items listed above, as well as several additional items, as opportunities to improve the LANL Meteorology Program. All improvements to the program are applauded. However, there are several improvement opportunities from the 2015 Assist Visit that would elevate the capabilities of the LANL Meteorology Program. These include the addition of one or two weather towers and the increase in electronics technician and meteorologist resources/staffing.

The DMCC encourages the LANL Meteorology Program to work with LANL Management to explore and develop a multi-year plan to include appropriate funding to continue the improvements to the Meteorology Program. These improvements will enhance the capabilities of the Program to better support the Safety, Environmental Compliance, and Consequence Assessment programs of the Site and compliance with DOE Order 151.1D.

The DMCC also recommends that a follow-up Assist Visit to LANL be scheduled for FY2019.

Please contact the DMCC if we can be of assistance.

Best Regards,

Walt Schalk
Chairman, DMCC

NNSS Weather Operations
Director, NOAA ARL/SORD
Las Vegas, NV