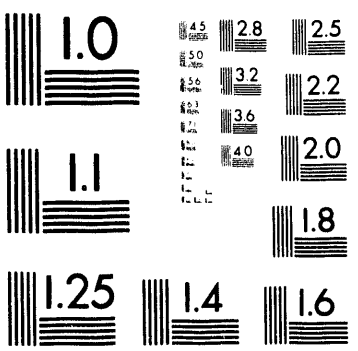
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
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PANTEX PLANT METEOROLOGICAL MONITORING PROGRAM

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SUMMARY

The current meteorological monitoring program of the U.S. Department of Energy's Pantex Plant, Amarillo, Texas, is described in detail. Instrumentation, meteorological data collection and management, and program management are reviewed. In addition, primary contacts are noted for instrumentation, calibration, data processing, and alternative databases. The quality assurance steps implemented during each portion of the meteorological monitoring program are also yindicated.

ACKNOWLEDGMENTS

The author would like to thank William A. Laseter for his assistance in tracking down the details necessary for the completion of this report. Without his help, this document would not have been as comprehensive.

CONTENTS

1.0 INTRODUCTION

This document describes the meteorological monitoring program at the U.S. Department of Energy's Pantex Plant in the Texas panhandle. The physical aspects of the program are described, as well as data and program management and quality assurance.

This introductory section summarizes

- the DOE meteorological monitoring requirements;
- general features of the Pantex meteorological program; and
- the Pantex region climatology.

1.1 METEOROLOGICAL PROGRAM OBJECTIVES

The type of meteorological information to be collected at Department of Energy (DOE) sites is not prescribed. The requisite information collected depends on each facility's environmental monitoring requirements, as well as the demands of managing both emergencies and occurrences (i.e., unusual release events not considered emergencies). The scope of a DOE meteorological monitoring program depends on the site size and topography, the location of critical receptors relative to potential release points, and the methods used for dose assessment. The scope is driven by the potential magnitude of hazardous airborne emissions, the possible pathways to the atmosphere, the distance to critical receptors, and the proximity to other DOE sites (DOE 1991).

The principal use of meteorological data at DOE sites is to characterize atmospheric dispersion (DOE 1991). Knowledge of atmospheric dispersion is important for both prospective and retrospective evaluations of routine and accidental airborne emissions.

Several regulations and a DOE guidance document implicitly address the site-specific needs for meteorological data used in atmospheric dispersion modeling. These include DOE/EH-0173T (DOE 1991), 40 CFR 61 (1990), and proposed rule 10 CFR 834. Both the 1991 DOE guidance and the proposed rule 10 CFR 834 review meteorological requirements for DOE site assessments of

planned and unplanned airborne releases. Subpart H of 40 CFR 61, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," implicitly refers to the application of meteorological measurements to determine compliance with the regulations; subpart H, part 61.93(a) refers to the use of computer models requiring annual meteorological data files; and part 61.93(b)(5) refers to air dispersion calculations. Proposed rule 10 CFR 834 (II)(D) specifies the meteorological information required for reporting in DOE Environmental Monitoring Plans (EMPs).

1.2 PANTEX METEOROLOGICAL PROGRAM

The meteorological monitoring program at Pantex is primarily managed by the Environmental Protection Department (EPD), with support provided by the Emergency Management Department (EMD). Some data evaluation is also performed for the Occurrence Management Department (OMD). These departments use the meteorological data to support their individual missions. The EPD, for example, uses the information for regulatory compliance calculations, dose assessments, and summary reports. The EMD requires the information for real-time assessments of accidental releases and safety evaluations.

The OMD has initiated procedures to use the Pantex meteorological data for facility management purposes. If freezing conditions are evolving, a Freeze Protection Warning System subroutine based on temperature change and wind speed will notify personnel at the Operations Center, where the meteorological data are collected. When the Freeze Protection Warning System is activated by the OMD, shift supervisors are notified. The shift supervisors then take action to prevent freeze damage (e.g., freezing pipes and ice build-up) to site facilities.

The OMD also uses the information for safety assessments. When on-site burning and spraying activities are planned, Operations Center personnel are contacted for wind speed and wind direction measurements. If these measurements are within acceptable limits and conditions, the activity can be conducted with an assurance of safety.

Provisions are also made for personnel safety with the atmospheric static and lightning sensors. Lightning warnings are communicated to site personnel when lightning is noted within 10 mi of the Plant, or if lightning is noted within 25 mi of the Plant and the atmospheric static sensors indicate levels above 2000 V/m. The lightning warnings indicate a potential hazard to utility workers and others working overhead. When the atmospheric static sensor alarm is activated (at the 2000-V/m level), burning-ground, firing-site, and high-voltage-line work is restricted.

1.3 PANTEX SITE CLIMATOLOGY

The approximately 10,000-acre Pantex Plant is located 17 miles northeast of Amarillo, Texas. The topography is relatively flat, characterized by rolling grassy plains with a number of natural playa basins. The Pantex Plant is surrounded by agricultural land.

The climate of the Pantex region was well summarized in the "Pantex Plant Site Environmental Report for Calendar Year 1989" (ES and MHSM 1990):

> The climate of the Pantex Plant, located on the Texas High Plains, is typical of continental interiors. It is characterized by large variations in daily temperature extremes, low relative humidity, and irregularly spaced rainfall of moderate amounts. The climate in Texas is mainly semiarid with mild winters. The Pantex Plant is in a windy area....The Pantex Plant is located in a moderate to high hazard zone for tornadoes.

The historic meteorological record of the Pantex region is briefly summarized in the following table (Bryson and Hare 1974; WDA 1990).

	Minimum	Mean	Maximum
Wind			
Most frequently from		SSW	
Mean daily speed (m/s)	5	6	7
Peak gust (m/s)		28	
Fastest one-minute (m/s)		26	
Temperature (° C)			
Mean daily	6.7	14.7	21.1
Extremes	-27		42
Precipitation (mm)			
Mean monthly		41	
Daily extreme		171	
Mean annual snowfall		340	
Mean number of days with:			
Precip. > 0.25 mm		69	
Thunderstorms		50	
Fog		23	

The Pantex Plant maintains a 60-m meteorological tower on the northeast corner of the site. The tower, located approximately 3700 m north of the Zone 12 production area, was originally installed to collect data for a nuclear-power-plant siting assessment. DOE acquired the tower in the late 1970s, and Pantex emergency operations personnel have since used it as their main source of meteorological data. Pantex did not maintain a computer database of the meteorological tower data before 1986 (BP and PNL 1992).

The details of the meteorological monitoring program, including instrumentation specifications and management of Pantex site meteorological data, are described in the remainder of this document. Alternate sources of meteorological data are also described.

2.0 INSTRUMENTATION

The meteorological data collected at the Pantex Plant are wind speed and direction, temperature, precipitation, relative humidity, barometric pressure, solar insolation, atmospheric static, and lightning detection. The atmospheric-static and lightning-detection measurements are taken primarily because of the high explosives inventories at Pantex, but also for personnel safety reasons. Since the topography at the Pantex Plant is very flat, personnel and their vehicles can attract a lightning strike by being the highest grounded points at a location. Except for atmospheric static, lightning detection, and solar insolation, all other meteorological measurements are used to characterize the dispersion of chemical and radiological releases.

Meteorological monitoring equipment can be of several types. Measurements made by non-recording instruments must be read and then logged manually. In contrast, recording instruments have a mechanism for automatically recording the measurements they take. All Pantex instruments used to characterize dispersion are digital recording instruments that utilize a system of data collection and recording endorsed by the Atmospheric Release Advisory Code (ARAC) emergency response computer code (see Section 4.1).

Instrumentation booms are located at the 10-m and 60-m meteorological tower elevations. Each boom extends westward approximately 12 ft from the 3-ft-wide tower. The main tower instrumentation power supply is 110-V alternating current with a gel-cell battery back-up power supply. A photovoltaic cell energizes the gel-cell battery.

2.1 SPECIFIC INSTRUMENTS

The wind and temperature sensors are located at the 10-m and 60-m levels of the meteorological monitoring tower. The instrumentation for measuring relative humidity is located only at the 10-m level. The barometric pressure instrumentation is located 2 m above ground, at the base of the tower. The solar insolation and precipitation instrumentation are located 10 m southwest

of the tower at ground level. The following instrumentation details are summarized from the manufacturer's specification documentation.

2.1.1 Wind

Two types of wind data are routinely collected at meteorological monitoring stations. Both wind speed and wind direction provide important information that helps to model the dispersion of airborne material.

Wind Speed

A 3-cup anemometer is used to measure wind speed, which is indicated by the rate of output pulses generated by a magnet mounted on the rotor shaft of the anemometer. The frequency of the output pulses is proportional to the wind speed. Complications caused by ice build-up are diminished by mounting the anemometer on a skirt that is not directly attached to the instrument shaft, and by using black paint on the instrument to enhance solar heating.

The instrument specifications of the wind speed sensors are as follows:

Operating threshold	0.8 m/s
Operating range	0 to 67 m/s
Accuracy	± 5% root mean square (RMS) error

Wind Direction

Single-vane wind-direction sensors are mounted at the 10-m and 60-m elevations. Like the wind-speed sensor, the potentiometer (the device that electronically indicates the direction of the vane) is mounted on an ice skirt to inhibit ice-immobilization of the unit during wet, freezing conditions. The instrumentation is not heated, but is painted black to enhance solar radiation absorption. The following specifications apply to the wind direction instrumentation:

Operating threshold	0.8 m/s
Operating range	0 degrees to 359 degrees from true N
Operating temperature	-40° C to +70° C
Maximum wind speed	67 m/s
Resolution	1 degree
Accuracy	± 5%
Distance constant	2.4 m

2.1.2 Temperature and Relative Humidity

Temperature and relative humidity are measured by a single instrument assembly at the 10-m elevation. Temperature measurements are also taken at the 60-m elevation. Temperature is measured by a thermistor, and relative humidity is measured by an electrolytic hygrometer. A thermistor denotes temperature by measuring the voltage, which changes according to the varying resistances of a material at different temperatures. An electrolytic hygrometer indicates the humidity by measuring the voltage resulting from capacitance changes of a material, relative to the current temperature.

The temperature/relative humidity assembly is shielded from direct sun and rain by a convection-aspirated shield. The white shield is a "triple-lampshade" design that ensures that two separate layers of aluminum are located between the sensors and direct sunlight. The shield is naturally aspirated.

Specifications of the temperature and atmospheric moisture sensors are as follows:

Temperature	
Accuracy	± 0.2° C at 0° C to 60° C ± 0.6° C at -50° C to 0° C
Range	-50° C to +60° C
Time constant	Approx. 30 sec
Relative humidity	
Accuracy at 20° C	±2% at 0% RH to 80% RH ±5% at 80% RH to 100% RH
Range	0% RH to 100% RH
Operating temperature	-40° C to +60° C

2.1.3 Precipitation

A tipping-bucket precipitation gauge is located 10 m southwest of the tower at ground level. The tipping-bucket design records small increments of precipitation over time. Each 0.01 inch of rain causes a mechanism to tip; a recording device registers the tip. Precipitation is recorded in units of inches per hour for readings made over the 15-min measurement interval. Tipping-bucket rain gauges will tend to underestimate cumulative rainfall

when the rainfall rate is greater than 1 in/hr.[a] The permanent (Misco) and temporary (Handar) instruments used on-site have the following specifications:

Sensitivity	0.01 inch
Saturation rate	Sierra Misco 6 in/h
	Handar 2 in/h
Accuracy	Sierra Misco (unknown)
	Handar < ±0.01 in for < 1 in/h of rain
	Handar < ±3% for > 1 in/h of rain

Currently, the Handar unit is being used temporarily while the permanent Sierra Misco unit is being repaired and re-installed. The Misco device is heated, but the Handar device is not. The Misco instrument is only heated to a temperature that permits melting of frozen precipitation.

2.1.4 Barometric Pressure

Barometric pressure is measured by an aneroid barometer located at the tower 2 m above ground level. This barometer indicates pressure changes by the movement of a diaphragm with a potentiometer used to indicate the movement. The following specifications apply to the aneroid barometer:

Range	929.5 mbars to 1200.5 mbars
Accuracy	±0.3% of range
Resolution	0.15% of range
Temperature coefficient	0.0045% per ° C
Operating range	-34° C to +82° C

2.1.5 Solar Insolation

The solar insolation instrument is located 10 m from the tower at ground level. Solar insolation measurements indicate the amount of radiant energy from the sun. These measurements are currently taken along with the other meteorological data and are recorded on the hard drive of the DEC PRO380 computer (see Section 4.1.1), but are not archived because of space limitations of the recording media. These data are not needed for any environmental monitoring or emergency management purposes.

(a) Personal communication, S.F. Snyder, PNL, with Walter Bonzak, Handar, Inc., Sunnyvale, California.

2.1.6 Lightning Locator

An exceptional lightning location system was installed for the Pantex Plant. The system consists of three 6-ft triangulating antennas, which detect the presence and location of lightning strikes that occur within a 200-mi radius about the site. The measurements of the antennas are sent via a dedicated phone line to a "central position analyzer" located at the Operations Center. Measurements are taken that evaluate the lightning strike at 50 ft above the ground level to the ground level. Parameters measured are the location, voltage, current, time of strike, and time between return strokes. These details help to evaluate the effects of the incident. Lightning Location and Protection, Inc., of Tucson, Arizona, is the manufacturer of this system, which operates on a 100-V alternating-current power supply. No back-up power supplies are available to the towers. Both the locating accuracy and detection efficiency decrease with increasing distance from the Pantex Plant. In the future, upgrades are anticipated that will improve the locating accuracy (another antenna will be added and the central position analyzer will be upgraded).

Specifications for the lightning locator are as follows:

Range	Approx. 200-mi radius
Detection efficiency at:	
Pantex Plant	70%
Amarillo, Texas	70%
200 mi from Pantex	Approx. 50%
Locating accuracy	Approx. 2 km
Antenna locations:	
"Boys' Ranch"	Approx. 70 mi ENE of Pantex
Happy, Texas	Approx. 40 mi S of Amarillo
Panhandle, Texas	Approx. 11 mi W of Pantex

2.1.7 Atmospheric Static

The atmospheric static sensor is a modified Atlantic Scientific device that measures the electric potential gradient between the atmosphere and the ground. Devices are located in the north, south, and west sides of the site. Readings are taken every 2 sec and trends are noted for the last 30 min of

measurements. Lightning strikes can be predicted with these instruments within 10 min and 10 mi from the anticipated location. Each unit is installed approximately 24 inches above ground level. A warning indicator is tripped when 2000 V/m are measured. The measurements are sent via dedicated phone lines to a computer in the Operations Center. The following specification applies to the static sensor:

Operating range	1 V/m to 10,000 V/m

2.2 QUALITY ASSURANCE

Routine preventive maintenance, calibration, and certification of meteorological instrumentation is conducted semi-annually by the Boise Interagency Fire Center (BIFC),[a] under contract number FFP000026, for all instruments except the lightning and atmospheric static measurement systems. Temperature and wind sensors are replaced semi-annually with calibrated and certified sensors. The barometric pressure sensor is replaced annually. All other instruments are calibrated according to the manufacturer's specifications.

The telephone line and modem connecting the meteorological tower and the DEC computer (see Section 4.1.1) are checked for proper operation. The tower and guy-wire/grounding are also inspected. The gel-cell battery back-up power supply to the Handar box, located at the base of the tower, is also inspected as part of the semi-annual BIFC routine tests. Documentation of the work conducted by the BIFC on their semi-annual visits is provided to the contract technical representative.

Non-routine calibration or inspection of the tower instrumentation can be initiated by submitting a work request to the Pantex Crafts Instrument Shop. This group repairs or replaces the defective equipment by obtaining rebuilt parts from BIFC or calling in BIFC technicians.

The Pantex Plant Electronics Shop performs the calibration and maintenance on the lightning and atmospheric static sensors. The atmospheric

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(a) U.S. Department of Interior, Bureau of Land Management, Boise Interagency Fire Center, 3905 Vista Avenue, Boise, Idaho, FTS 208-389-2726.

static sensors are calibrated to 1000 V/m semi-annually. Quality control is performed by taking measurements at other potentials, and by noting trends between current and past measurements at the various other potentials. The lightning detection antennas are also serviced semi-annually. This maintenance includes site survey for physical damage and replacing the gasket that seals the antenna electronics. The lightning detection units are self-calibrating.

3.0 ROUTINE METEOROLOGICAL DATA PROCESSING

The ARAC software used by the EMD contains algorithms for the calculation of specific parameter values from the meteorological data collected. These parameters are calculated in the Handar box preprocessor every 15 minutes (see Section 4.1.1), and are recorded as part of the 15-min-interval data record. Some parameters, such as stability class, heating degree-days, and cooling degree-days, are calculated for non-ARAC purposes. The information in this section is largely summarized from the ARAC guide (Baskett et al. 1992).

3.1 PERCENT DATA RECOVERY

It is important to have an indication of the fraction of the time that data were successfully recorded by the Handar equipment. This information is indicated by the "% Data Recovery" column of the summary output data. To calculate the data recovery, the number of 15-min-interval data actually recorded is divided by the total number of 15-min intervals over the time period of interest. The quotient is then multiplied by 100 to generate the percent units.

3.2 SIGMA-THETA

The sigma-theta (σ_θ) is a parameter that describes the standard deviation of the horizontal wind direction. The ARAC atmospheric transport code uses sigma-theta as the indicator of turbulence and dispersion. The units are tenths-of-degrees. Values of approximately 2.0 tenths-of-degrees indicate unstable conditions, while values of approximately 0.3 tenths-of-degrees are considered stable.

3.3 STABILITY CLASS

The preprocessor calculates the Pasquill stability class of the 15-min measurements. The ARAC software defines stability class according to an algorithm that considers the sigma-theta, time of day, wind speed, surface roughness in the vicinity of the tower, and instrumentation level. Stability

classes are indicated by alphabetic letters from A to F; an A stability class indicates very unstable conditions and F stability classes indicate very stable conditions. To improve data manipulation, the values are recorded numerically (i.e., stability class A=1, B=2,...F=6).

3.4 HEATING DEGREE-DAYS

Information on heating degree-days provides an indication of the heating energy requirements of a location for facilities management purposes. A threshold of 65° F is used in the algorithm for calculating heating degree-days:

$$HDD = \Sigma\ (65 - T_{ave,i})$$

where HDD = heating degree-days, and

$T_{ave,i}$ = average daily temperature for day i.

For all $T_{ave,i}$ greater than 65° F, the value of HDD for day i is zero. Winters are classified as mild if the season had fewer than 2000 HDDs, moderate if 2000–4000 HDDs, severe if 4000–8000 HDDs, and very severe if more than 8000 HDDs (Houghton 1985). This information is not currently used by Pantex site personnel.

3.5 COOLING DEGREE-DAYS

Cooling degree-days are similar to heating degree-days. Cooling degree-days provide an indication of the cooling energy requirements of a location for facilities management purposes. The algorithm for calculating cooling degree-days uses a 75° F threshold (which differs from the 65° F threshold used by the National Weather Service):

$$CDD = \Sigma\ (T_{ave,i} - 75)$$

where CDD = cooling degree-days, and

$T_{ave,i}$ = average daily temperature for day i.

As with heating degree-days, negative CDD values for day i are zero. Summers are classified as hot if there are more than 2500 CDDs, warm if 2500–1000

CDDs, and mild if fewer than 1000 CDDs (Houghton 1985). This information is not currently used by Pantex Plant personnel.

3.6 QUALITY ASSURANCE

Subsequent to publication of the ARAC guide, no formal quality assurance measures were conducted on the algorithms used to calculate the above parameters. All available ARAC quality assurance documentation is included in the ARAC guide (Baskett et al. 1992).

4.0 METEOROLOGICAL DATABASE

Meteorological data are used to model the dispersion of airborne materials. The data must be recorded and archived for later manipulation. The meteorological database recording, reporting, and record-storage system implemented at Pantex is described in this section.

4.1 DATA COLLECTION AND RECORDING

The EMD has custodial care of the meteorological data collection computers at the Pantex Plant. The Atmospheric Release Advisory Capability (ARAC) system used by the EMD was selected as the code used at the Pantex Plant to aid in the evaluation of hazardous material releases. The ARAC system advocates the use of Handar meteorological towers and instrumentation.[a] In addition to the ARAC computers, two separate computers receive the atmospheric static and lightning detection instrumentation.

4.1.1 Electronic Data Collection

Digital meteorological data are stored temporarily on a data acquisition system (the Handar 540 Data Collection Platform, or the "Handar box") near the base of the Pantex Plant meteorological tower. The Handar system was installed on the tower in 1986, the same year that the ARAC system was implemented at the Pantex Plant. The Handar system electronically transmits the meteorological data two minutes after each quarter-hour from the Handar box to the DEC PRO380 computer (hereafter referred to as "the DEC computer") in the Operations Center (Building 12-36). This computer is dedicated to collecting and recording the meteorological data.

The current ARAC DEC-computer system is scheduled to be upgraded in the Summer of 1993 with an ARAC UNIX system running on different hardware. Future revisions of this document should incorporate any data collection, recording, and archiving changes that result from this upgrade.

(a) Handar, Inc. 1188 Bordeaux Drive, Sunnyvale, California, 94089. 408-734-9640.

The meteorological data are recorded by the Handar box every 1 sec to 8 sec. The readings are preprocessed by the Handar box to obtain 15-min averages of the collected wind, temperature, and relative-humidity data before the data are sent to the DEC computer. Only the 15-min averages are accessible to system users. The Handar box can store approximately three days' worth of data for the two tower levels. The meteorological data are sent from the Handar box to the DEC computer via a dedicated, buried phone line. If this transmission system fails, ARAC personnel can call the Handar box through another, non-dedicated phone line.

4.1.2 Data Recording

The ARAC meteorological data are initially recorded in the hard drives of both the DEC computer and an IBM-compatible computer. All instrument data collected at each 15-min interval from each tower level are recorded on a single line of the ASCII-format database. The time-stamp is in Greenwich Mean Time (GMT), which is 6 hours ahead of Pantex local standard time and 5 hours ahead of Pantex daylight savings time. An explanation of the ASCII record format follows.

Example: 910801014509.1 147005.44028.7033.00 PANTEX1 01

Format: yymmddhhiixx.xbdddsss.sPttt.thhhp.ppTTTTTTTbll

Field index:

yy	year
mm	month
dd	day (GMT)
hh	hour (GMT)
ii	minute (only output: 00, 15, 30, 45) (GMT)
xx.x	wind speed (tenths of m/s)
b	blank
ddd	wind direction (degrees from true N)
sss.s	sigma-theta (tenths of degrees)
P	Pasquill stability class
ttt.t	temperature (tenths of ° C)
hhh	relative humidity (integer percent)
p.pp	precipitation rate (in/h); most records (as in the previous example) omit the units-digit when "0" and insert a blank after the hundredths-digit.
TTTTTTT	tower number (output is from PANTEX only)
b	(blank)
ll	instrument level; 01 = 10-m level, 02 = 60-m level

The atmospheric static and lightning detection sensors transmit information via dedicated phone lines. The information is received by two different computers. The atmospheric static database includes the date and atmospheric static measurement. The lightning detection database, which is more detailed, includes the location (longitude and latitude), the distance from the site, the charge of the strike (i.e., positive or negative), and the time. Although each sensor sends in information on separate computers, the data from each are used together to interpret the potential hazard.

4.2 DATA STORAGE AND ARCHIVING

The ARAC 15-min-interval data record is stored on a DEC-computer hard drive in a DEC/POS format immediately after being transferred from the Handar box. Recent improvements have the data simultaneously being transferred to a DOS-format computer. The Handar box information passes through KERMIT before entering the DOS-computer hard disk. All DEC and ASCII data are recorded in the same measurement units. Once a month, the DEC/POS and ASCII data are manually transferred onto floppy disks. Two copies of each data format are maintained on floppy disks. The primary data set is kept at the Operations Center and a back-up set is kept by the EPD. In addition, the 15-min-interval records are manually transferred by EPD personnel to hard (paper) copies every week.

The hard drives of the atmospheric static and lightning detection computers are periodically downloaded to floppy diskettes. The floppy diskettes are stored at the Operations Center.

4.3 DATA REPORTS

The ARAC system is inflexible in the types of data reports that can be generated directly from the DEC computer. Anyone interested in a special format may, of course, obtain the ASCII data and abstract the information externally. The only "special report" that can be obtained from the DEC computer is a screen print of the 15-min averages.

Routine reports, which include daily and monthly summaries, are prepared by EPD personnel. No annual summaries are currently compiled from the Pantex meteorological database. The daily and monthly summaries include

- the minimum, maximum, and average daily temperature, wind speed, wind direction, sigma-theta, and stability class for both the 10-m and 60-m elevations;
- the minimum, maximum, and average relative humidity, barometric pressure, and precipitation rate for the 10-m elevation or ground level;
- the percent data recovery for each summary item; and
- the number of heating degree-days and cooling degree-days.

The daily summaries are compiled from information in the DEC-computer hard drive. This information can contain inaccurate wind information if aberrant wind data, which were collected during sensors failures, are part of the data set. When out-of-range readings are part of the data set (i.e., "////" data), they are appropriately omitted from the summary's averages and data recoverability statistics.

The lightning detection instruction output is displayed on a computer screen, with lightning strikes indicated on a USGS map outline. The map outline indicates where the lightning has struck, relative to the Pantex Plant and Amarillo.

4.4 QUALITY ASSURANCE

The quality assurance (QA) program for the ARAC data acquisition system includes manual and electronic data-quality inspections, review of the data summaries, preparation of back-up data sets, and the availability of back-up power and computer resources.

The electronic data QA includes indications of out-of-range measurements and prompts when wind data are suspect. Anomalous meteorological data readings are indicated in the data records. The following ranges define the anomalies:

	Less than	More than
Temperature (° C)	-60.0	60.0
Wind speed (m/s)	0.0	50.0
Wind gust (m/s)	0.0	100.0
Wind direction (degrees)	0	360
Sigma-theta (degrees)	0.0	360
Relative humidity (%)	0.0	100

These abnormal readings are replaced in the data records by slashes (e.g., ////).

When suspect wind data are recorded for 15 continuous hours, the message "Bad Metdata" is sent to the DEC electronic message system. Suspect wind data includes wind gust measurements of zero and consistent wind-direction measurements over 15 continuous hours. These events normally occur when sensors ice up. A log is kept to indicate the time periods of the inaccurate data blocks. These data blocks of incorrect wind data must be manually corrected. Corrections are made by replacing the erroneous readings with slashes.

A check of the gel-cell battery back-up power supply for the Handar box is conducted weekly from the DEC computer when the daily meteorological statistics are summarized. The battery-check reports are kept with the meteorological data in the Operations Center. Several times a week, the DEC computer output is inspected visually to verify that the meteorological measurements are reasonable.

No routine maintenance of the DEC computer is performed. A back-up DEC computer is immediately available in the Operations Center, if needed. The OC is equipped with back-up generators in the event of AC-power failure.

5.0 ALTERNATIVE METEOROLOGICAL DATA

Regional, hourly meteorological data can alternatively be obtained from the National Weather Service (NWS). The NWS maintains a meteorological station in Amarillo, Texas, at the Amarillo International Airport (NWS station 23047). Snyder (1993) showed that the hourly measurements recorded at Amarillo are slightly different than those made at the Pantex site, but are considered to be acceptably representative of Pantex site conditions. The Amarillo data can be obtained from either the regional or national Climate Centers.

The regional office address is:

J. Grymes
Southern Regional Climate Center
Department of Geography and Anthropology
Room 254 Howe-Russell
Louisiana State University
Baton Rouge, Louisiana 70803
504-388-6184 (FAX -2912).

The data from this facility are essentially raw measurements, but arrangements may be made for some data processing and formatting to be done. This regional office can provide more recent data than the national office. Currently, the pricing structure of the regional office data appears to be more favorable, although it seems to be in a development phase.

The national office address is:

National Oceanic and Atmospheric Administration
National Climatic Data Center
Federal Building
Asheville, North Carolina 28801-2696
704-259-0682 (FAX -0876).

Amaraillo data can be obtained from the national office for all data collection periods, except for approximately the last month of collection. Data can be ordered in the exact form required. Due to the workload of the national office, some delay in receipt of the order should be expected. Rush service is available at an extra charge, but still may require a week or so to process.

6.0 PANTEX METEOROLOGICAL PROGRAM MANAGEMENT

The Pantex Plant is currently undergoing organizational restructuring. The program management information presented here is, therefore, cursory.

Both the EPD and the EMD use the information collected by the site meteorological tower. The EPD is responsible for maintaining the meteorological database and uses the summary information compiled from the data more often than the EMD. The EMD is the custodian of the devices used to record the information and is more apt to use the real-time data.

Financial and personnel resources required for the continued operation of the Pantex meteorological program have been shared between the two departments. Most of the personnel resources have been provided by the EPD.

Training for operating the Operations Center DEC computer is conducted annually. This training, which is conducted by ARAC personnel from Lawrence Livermore National Laboratory, includes operation of the ARAC software and interpretation of the ARAC isopleth output. Funding for the training session is provided by the department of the staff member attending the session.

7.0 REFERENCES

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