6.4 Meteorological Monitoring

The purpose of this section is to establish that the onsite meteorological measurements program and other data-collection programs used by STP 3 & 4 are adequate to: (1) describe local and regional atmospheric transport and diffusion characteristics, (2) ensure environmental protection, and (3) provide an adequate meteorological database for evaluation of the effects of plant operation. A discussion of the meteorological monitoring program for STP 3 & 4, which consists of two components: preoperational monitoring and operational monitoring, is provided. This discussion includes an analysis of the meteorological monitoring system that provides an evaluation of:

- The location of towers and instrument siting
- Meteorological parameters measured
- Meteorological sensors
- Data recording and transmission
- Instrument surveillance
- Data acquisition and reduction
- Data validation and screening
- Data display and archiving
- System accuracy
- Data recovery rate and annual and joint frequency distribution of data

This evaluation demonstrates that the meteorological program for STP 3 & 4 meets the relevant requirements, as described in 10 CFR Part 50, Appendix I; 10 CFR Sections 51.45 (c), 51.50, and 100.10 (c)(2); Section C of Regulatory Guide (RG) 1.23; Section C.4 of RG 1.111, Rev. 1; and RG 1.21.

6.4.1 Topographic Features of the Site Area

The location at which meteorological measurements are necessary in order to characterize the dispersion conditions at the site of interest, depends largely on the complexity of the terrain in the vicinity of the site.

The following briefly describes the topographic features of the STP site area. This description together with the discussion in Section 2.7 regarding the topographic features and the dispersion characteristics of the STP site, forms the basis for assessing adequacy of the meteorological monitoring program for STP 3 & 4.

The STP site is located in a rural area of south-central Matagorda County. Matagorda County lies in the Coastal Prairie region in the southeastern part of Texas, along the Gulf of Mexico. The prominent natural features of the region include the Colorado River, which bisects the county from north to south, and East and West Matagorda Bays, which are protected by the Matagorda Peninsula, a narrow barrier island, and Tres Palacios Bay and River. The west branch of the Colorado River, as well as several sloughs, flow through the STP site boundary.

The major local influence on onsite meteorology is the presence of the Gulf of Mexico, which is approximately 15 miles south of the STP site at its closest. Site vicinity and site area maps with an 8-kilometer (5-mile), 16-kilometer (10-mile), and 80-kilometer (50-mile) radius are shown in Figures 6.4-1, 6.4-2, and 6.4-3, respectively. As shown in Figure 6.4-3, terrain within 80 kilometers (50 miles) of the STP site is generally flat with variations less than 31 meters (100 feet) to the north and west. Along the Gulf of Mexico, a 30-mile long broad band of open prairie extends inland with elevations averaging about seven meters (23 feet) above mean sea level (MSL). Additional figures presenting terrain variations by downwind sector of the site are shown in Figure 2.7-16.

6.4.2 General Program Description

Because of the proximity of the proposed units to STP 1 & 2, STPNOC plans to use the existing meteorological data collection system to meet the meteorological monitoring requirements for STP 3 & 4. The following sections provide an assessment as to the adequacy of using the existing STP 1 & 2 meteorological program with respect to the atmospheric transport and diffusion characteristics within 80 kilometers (50 miles), the period of data used to support preapplication monitoring, and the adequacy and accuracy of the STP 1 & 2 meteorological system.

6.4.2.1 Need of Additional Data Sources for Airflow Trajectories

Since the STP site area is generally flat with airflow dominated mostly by large-scale weather patterns as concluded in Section 2.7, data collected by the existing STP 1 & 2 collection system can be used for the description of atmospheric transport and diffusion characteristics within 80 kilometers (50 miles) of STP 3 & 4.

Further, the modeling methodology used, XOQDOQ, to calculate dispersion estimates out to 50 miles from a site of interest does not require offsite data. The XOQDOQ model, an NRC-sponsored computational model based on RG 1.111 (Reference 6.4-1), is a constant mean wind direction model, using meteorological data from a single station to calculate dispersion estimates out to 50 miles from a site of interest. In the model, application of terrain induced airflow-recirculation factor options are provided to account for the effects of airflow recirculation phenomenon occurring within the area of interest when the meteorological data from a single station is used to represent the entire modeling domain. However, application of airflow-recirculation factor for sites located within open terrain is not required. This methodology implies that the meteorological data from an onsite station is reasonably representative of the entire modeling domain and adjustment to the dispersion estimates calculated by the model out to 50 miles of a site located within open terrain is not required.

For coastal sites located within open terrain such as the STP site, an airflow-recirculation factor provided in the XOQDOQ model is used to account for potential airflow recirculation due to sea breeze and land breeze effects and during the infrequent stagnation conditions that could lead to more restrictive dispersion estimates. With application of the appropriate airflow recirculation factor, this methodology further implies that using data collected from an onsite meteorological monitoring station for making dispersion estimates out to 50 miles of the site is considered to be adequate and acceptable. Therefore, no other offsite data collection systems have been considered while determining the dispersion characteristics of the STP site area.

6.4.2.2 Existing Meteorological Measurement Program

The onsite meteorological measurement program for STP 1 & 2 began operation in July 1973. The program includes a 60-meter guyed meteorological tower that serves as the primary data collection system and a 10-meter freestanding tower that serves as a backup to the primary system. The backup meteorological system is a completely independent system installed and maintained for the purpose of providing redundant site-specific meteorological information (10-meter wind speed, wind direction, temperature, and sigma theta), representative of the site environment. The locations of the meteorological towers with respect to the existing and proposed units are shown in Figure 6.4-4. The primary tower is located approximately 2.1 kilometers (1.3 miles) east of STP 3 & 4, while the backup tower is approximately 670.5 meters (2200 feet) south of the primary tower. Both locations are clear of man-made and natural obstructions which could influence the collection of meteorological data.

The onsite meteorological measurement program was upgraded in December 1994 to support emergency preparedness requirements and to replace existing equipment and sensors with improved instrumentation to enhance the maintainability and reliability of the system. The upgraded system included more reliable instrumentation, redundant data recording equipment, redundant power supplies, and redundant communication links. In 2005, the meteorological tower communication hardware, computer software, wind speed, wind direction, and delta-temperature instruments for the primary tower system were replaced. The wind speed and wind direction instruments for the backup tower system were also replaced in 2005.

For preparation of the STP 3 & 4 COL Application, adequacy and accuracy of the STP 1 & 2 meteorological collection system were assessed based on NUREG-1555 (Reference 6.4-3). The areas examined include tower locations, siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, data acquisition and reduction procedures, and the quality assurance program for sensors, recorders, and data reduction. The findings, as summarized in Tables 6.4-1, 6.4-2, 6.4-4 and 6.4-5, conclude that the instrument heights and locations, system accuracies, methodologies for data acquisition and reduction, and procedures for instrumentation surveillance conform to the applicable regulatory guidance (Reference 6.4-2) and industry standards (Reference 6.4-4). Therefore, data collected by the existing meteorological monitoring system for STP 1 & 2 provides a suitable data set for STP 3 & 4.

Because the existing tower and instrument siting conform to RG 1.23 (Reference 6.4-2), data collected by the tower is considered to be representative of the overall site meteorology. Instrumentation surveillance and data validation in accordance with the applicable regulatory and industry guidance has routinely been performed to ensure data quality as well as to achieve the acceptable annualized data recovery rate of 90%.

6.4.2.3 Period of Data Used To Support the Application

RG 1.23 (Reference 6.4-2) specifies the minimum amount of onsite meteorological data to be provided at the time of application for a combined license that does not reference an early site permit. It calls for a consecutive 24-month period of data that is defendable, representative, and complete, but not older than 10 years from the date of the application. The guidance further states that three or more years of data are preferable.

The 1999 and 2000 consecutive 24-month period of data taken for STP 1 & 2 was determined to be the most defendable (using validated data with the least data substitution), representative (tower and sensor siting in accordance with RG 1.23), and complete (with annualized data recovery rate well in excessive of 90 %), without being older than 10 years. Since RG 1.23 specifies that three or more years of data are preferable, three years (i.e., 1997, 1999–2000) of STP 1 & 2 data is used in support of the preoperational monitoring program for STP 3 & 4.

6.4.2.4 Proposed STP 3 & 4 Meteorological Monitoring Program

The proposed meteorological monitoring program consists of two components:

- Preoperational Monitoring – Due to their proximity, data collected by the STP 1 & 2 meteorological towers during 1997, 1999, and 2000 is used to establish a baseline for identifying and assessing environmental impacts resulting from operation of STP 3 & 4, as well as for assessing impacts of site preparation and construction of these new units.

- Operational Monitoring –Since the current meteorological monitoring program for STP 1 & 2 is conducted in accordance with the regulatory guidance criteria, the existing system will continue to be used for STP 3 & 4 during plant operation. Although the current system including both the tower and meteorological sensors may be upgraded periodically or replaced prior to new plant operation, the functional requirements of the operational program for STP 3 & 4 are described based on the current system.

Specifically, data collected by the STP 1 & 2 meteorological monitoring System is used for STP 3 & 4 to:

- Describe local and regional atmospheric transport and diffusion characteristics.

- Calculate the dispersion estimates for both postulated accidental and expected routine airborne releases of effluents.

- Evaluate environmental risk from the radiological consequences of a spectrum of accidents.

- Provide an adequate meteorological database for evaluation of the effects of plant construction and operation, including radiological and non-radiological impacts and real-time predictions of atmospheric effluent transport and diffusion.

6.4.3 Preoperational Monitoring

The meteorological monitoring system block diagrams of the preoperational monitoring program for STP 3 & 4 reflect the configuration of the onsite monitoring system during 1997, 1999, and 2000, as shown in Figures 6.4-5 and 6.4-6 for the primary and backup towers, respectively.

6.4.3.1 Location, Elevation, and Exposure of Instruments

Factors which were considered in determining the representativeness of the measurement location and installation of the instruments on the existing towers include the prevailing wind direction, topography, and location of man-made and vegetation obstructions.

Findings, as presented below, indicate that the data collected on the existing meteorological towers is suitable for use in characterizing atmospheric dispersion conditions for STP 3 & 4.

6.4.3.1.1 Tower and Instrument Siting

As shown in Figure 6.4-1, the area within an 8-kilometer (5-mile) radius of the proposed plant is generally flat with terrain variation less than 15 meters (50 feet). The new units are to be located at approximately 2.1 kilometers (1.3 miles) west of the primary and backup meteorological towers. The bases of both towers are at an elevation of approximately 8.5 meters (28 feet) MSL, while the finished plant grade of the new units is at 10.4 meters (34 feet) MSL along the road between the two units and slopes to 9.8 meters (32 feet) MSL at the 4 corners of the power block. Since the base of the towers is approximately the same elevation as the finished plant grade of the new units and because there are minimal terrain variations within 8 kilometers (5 miles) of the site as discussed in Subsection 6.4.1, it is concluded that the locations of the meteorological tower sites and the proposed STP 3 & 4 have similar meteorological exposures. The tower and instrument siting conformance status are summarized in Tables 6.4-1 and 6.4-2, respectively.

Obstructions

The wind sensors should be located over level, open terrain at a distance of at least 10 times the height of any nearby natural and man-made obstructions (e.g., terrain, trees, and buildings), if the height of the obstruction exceeds one-half the height of the wind measurements (Reference 6.4-2). Therefore, an assessment regarding whether the wind measurements made at locations and heights on the towers would avoid airflow modifications by obstructions was made and the findings are described below:

- The sizes of the environmental shelters housing the processing and recording equipment are: 3.4 meters x 3.4 meters x 3.3 meters (11 feet x 11 feet x 10.8 feet) for the primary system, and 2.4 meters x 3.0 meters x 2.7 meters (8 feet x 10 feet x 8.9 feet) for the backup system. These shelters are less than five meters in height, which is less than half of the lower level wind measurement height (10 meters), and are located downwind of the meteorological towers under the prevailing wind direction (i.e., south-southeast) to minimize wind turbulence and/or thermal effects on the meteorological measurements.

- The surrounding terrain, nearby trees, and plant structures (existing and planned) were also evaluated to determine whether they could affect the meteorological measurements.

  As shown in Figure 6.4-1, surrounding terrain of the meteorological towers is generally flat and no terrain-induced-airflow influence on the meteorological measurement is expected.

  Both the primary and backup meteorological towers are located in open fields. The nearby trees and brushes range from 15 feet to 30 feet tall and are mostly at 300 feet or more from the towers. During routine maintenance, these trees are to be trimmed periodically to ensure that the obstruction-height requirement is met (Reference 6.4-2).

  The tallest existing and planned buildings (both STP 1 & 2 and STP 3 & 4) are more than 1.6 kilometers (1 mile) from the meteorological towers and are less than 76 meters (250 feet) in height. Separations between the meteorological towers and these buildings are much greater than 10 times their respective heights.

- Wind sensors are mounted on a boom extending eight feet outward on the upwind side of the tower to minimize tower structure influence.

Therefore, it is concluded that the meteorological measurements are free of influence from any nearby natural and man-made obstructions.

Heat and Moisture Sensors

Based on the structure layout as shown in Figure 6.4-4, the ambient temperature and dew point measurements on the existing towers were assessed to determine whether they avoid air modification by any heat and moisture sources (e.g., ventilation sources, cooling towers, water bodies, large parking lots) and the findings are described below:

- Both the primary and backup towers are located on open fields with grassy surfaces underlying the meteorological tower. Currently, there are no large concrete or asphalt parking lots or temporary land disturbances such as plowed fields or storage areas nearby.
- The closest large concrete or asphalt parking lots and ventilation sources are located at STP 1 & 2, which is more than a mile from the meteorological towers.
- The proposed plant cooling system for STP 3 & 4 includes the Main Cooling Reservoir (MCR) and two banks of mechanical draft cooling towers. As shown in Figure 6.4-4, the MCR is approximately one mile southwest of the primary meteorological tower at its closest point, while the cooling towers are located directly west further than 1.5 miles from the meteorological towers. The STP 1 & 2 essential cooling pond is approximately 3500 feet and 2600 feet from the primary and backup towers, respectively. Therefore, location of the meteorological towers are not directly downwind of the cooling towers, MCR and cooling pond under the prevailing downwind wind direction (i.e., south-southeast).

With the large distance separation between the meteorological tower and these existing and planned nearby heat and moisture sources, influence on the ambient temperature, dew point, and relative humidity measurements will be minimal.

In addition, temperature sensors are mounted in fan-aspirated radiation shields, which are pointing downward to minimize the impact of thermal radiation and precipitation.

Wind Loss

The precipitation gauge is equipped with wind shields to minimize the loss of precipitation caused by wind.

6.4.3.1.2 Meteorological Parameters Measured

Meteorological instrumentation includes multiple levels of measurements on the 60-meter guyed primary tower, and a single level on the 10-meter freestanding backup tower. The meteorological instrumentation on these towers is summarized in Table 6.4-3.

On the primary tower, wind speed and wind direction are measured at 10 meters (33 feet) and 60 meters (197 feet) above ground level. The STP 3 & 4 reactor building plant stacks each has a height of 76 meters (249 feet) above ground level. The accident atmospheric release points for the ABWR include the plant stack and several other elevations below the upper wind measurement height (i.e., 60 meters). Meteorological parameters measured for these releases are consistent with RG 1.23, Section 2 (Reference 6.4-2).

Ambient temperature is monitored both at the 10- and the 60-meter levels. Vertical differential temperature (i.e., delta-T) is calculated as the difference between the temperatures measured at the 10-meter and 60-meter levels. Dew point temperature is measured at the 3-meter level. Additional relative humidity/temperature instrumentation at 10 and 60 meters were added in December 2006 for calculation of dew point temperature. These measurement heights represent water-vapor release from a range of alternative mechanical draft cooling tower designs to be considered for STP 3 & 4. Precipitation is measured at ground level near the base of the primary tower, while the solar radiation is measured at 2.5 meters above ground.

On the backup tower, wind speed, wind direction, wind direction standard deviation (i.e., sigma theta for atmospheric stability class determination), and ambient temperature are obtained at the 10-meter level.

6.4.3.1.3 Meteorological Sensors

A description of the meteorological sensors including sensor type, manufacturer model, sensor specifications (including sensor starting threshold, range, and measurement resolution), and system accuracy for the STP 1 & 2 data collection system during the preoperational monitoring period and for the current configuration are provided in Tables 6.4-4 and 6.4-5, respectively.

As discussed in Subsection 6.4.2, the existing meteorological data collection system was upgraded in 1994 to support emergency preparedness requirements and to replace existing equipment and sensors for both the primary and backup towers with state-of-the-art instrumentation to enhance maintainability and reliability of the system. Met One Instruments cup sets and bi-vane (for wind measurements), platinum resistance temperature sensors (for ambient temperature and delta-T calculations), a lithium chloride dew point sensor and an 8-inch rain gauge (tipping bucket) were installed on the primary tower during the 1994 system upgrade. The same type of sensors as those on the primary tower for wind and ambient temperature measurements were installed on the backup tower during the 1994 system upgrade.

In 2005, the meteorological tower communication hardware, computer software, wind speed, wind direction, and delta-temperature instruments for the primary tower system were replaced. The wind speed and wind direction instruments for the backup tower system were also replaced in 2005. The wind speed and wind direction sensors were replaced with single wind speed/direction sonic probes; i.e., one at each tower.

Serving STP 1 & 2, a lithium chloride chill mirror hygrometer was installed at approximately 3 meters above ground in 1994 to measure dew point temperature. Because the plant cooling system for STP 3 & 4 uses the MCR (existing) and two banks of mechanical cooling towers (to be built), relative humidity/dew point instrumentation at 10- and 60-meter levels was added to the primary tower in December 2006 to collect atmospheric moisture measurements of the water-vapor release.

Meteorological sensors used on both the primary and backup meteorological towers are designed to operate in the environmental conditions found at the STP site. Specifically, these instruments are capable of withstanding the following environmental conditions as provided in the specification of the upgraded meteorological monitoring system:

- Ambient temperature range of +5°F to +105°F.
- Wind load up to 125 mph (55.8 m/s) @ 30 feet on a 100-year recurring interval.

- Relative humidity range of 20% to 100%.

In July of 2003, the eye of a small hurricane (Claudette) passed south of the site and both towers and their equipment at the 10-meter level survived winds in excess of 80 miles per hour.

The instruments on the towers, past and present, are off-the-shelf components that are used universally throughout the nuclear industry and other industries for meteorological measurement. Based on operating experience, the only adverse operational effects that have been noted were the susceptibility of the rotating cup and weather vane instruments to bearing wear and degradation due to the site environmental conditions that required the instruments to be replaced approximately every six months. This type of wind sensor was replaced with the ultrasonic sensor that has no moving parts in 2005.

6.4.3.2 Data Recording and Transmission

A description of data output and recording systems and locations of these systems with respect to the onsite program is provided. Independent microprocessors are used as the primary data collection system for the primary and backup meteorological towers, with digital data recorders used as a backup data collection system.

The microprocessors sample the meteorological processor modules once per second for each parameter measured except for precipitation. Water collected by the rain gauge is automatically drained and counted each time an internal bucket fills with 0.01 inch of rainfall.

The microprocessors provide current sampling values as well as the 15- and 60-minute averages. Sigma theta is computed for each wind direction channel in the microprocessor. These calculated averages are output to the digital data recorders and on diskette and/or CD for system monitoring, data verification, and processing uses. In addition, the current values and the calculated averages including the data quality status flags are sent electronically to the Emergency Response Facility Data Acquisition and Display System (ERFDADS).

As shown in Figures 6.4-5 and 6.4-6, before 2002 data was collected and stored by a RM21A computer independent of the meteorological tower and the local plant computers. From the retirement of the RM21A computer at the beginning of 2002 to present, data was averaged on the meteorological tower computers and transmitted to the local plant computers for storage and report generation. Refer to Figures 6.4-7 and 6.4-8 for the system block diagrams for the current configuration.

Since December 2006, hourly average data from the new 10- and 60-meter dew point instruments is recorded by a data logger attached to the base of the primary meteorological tower. Approximately once a week, the data is transmitted to a local computer and is subsequently uploaded to the plant computer system for evaluation and permanent storage.

The processing and recording equipment are housed in environmentally controlled (air conditioned) shelters. A direct readout capability from these recorders in situ during routine system inspection is included.

6.4.3.3 Instrumentation Surveillance

Calibration and maintenance of the onsite meteorological monitoring system is in accordance with RG 1.23, Section C 5, Regulatory Position, Instrument Maintenance and Servicing Schedules (Reference 6.4-2) and ANSI/ANS 3.11, Section 7, System Performance (Reference 6.4-4).

The existing meteorological monitoring system is calibrated semiannually at both the primary and backup towers, and channel checks are performed daily in order to achieve maximum data recovery. System operability is also checked by using the system dial-up capability to remotely monitor the system status.

Detailed instrument calibration procedures and acceptance criteria are strictly followed during system calibration. Calibrations verify and, if necessary, reestablish accuracies of sensors, associated signal processing equipment and displays. Routine calibrations include obtaining both “as-found” (before maintenance) and “as-left” (final configuration for operation) results. The end-to-end results are compared with expected values. Any observed anomalies that may affect equipment performance or reliability are reported for corrective action. If any acceptance criteria are not met during performance of calibration procedures, timely corrective measures (e.g., adjusting response to conform to desired results by qualified personnel on site or returning the sensor to vendor for calibration) are initiated.

Inspection, service, and maintenance, including preventive and/or corrective maintenance on system components for transmitting, manipulating, and/or processing meteorological data for computer display or storage, are performed according to the instrument manuals and plant surveillance program procedures to maintain at least 90% data recovery.

Maintenance and calibration activities on the primary tower are facilitated by the addition of an instrument elevator. The monitoring system is equipped with lightning protection and redundant power supply.

6.4.3.4 Data Acquisition and Reduction

Following an upgrade of the meteorological program in 1994 to meet emergency preparedness requirements, data has been collected and electronically transmitted to various plant computers for data validation, screening, display, storage, and report generation.

6.4.3.4.1 Data Validation and Screening

The microprocessors provide validation checks on the 15-minute averaged data. These checks consist of electrical status (i.e., system within predefined calibration test limits) and meteorological validations. System validations include the following checks: AC power, generator on-line, propane level, aspirators, and hard-disk availability. Meteorological validations are performed to ensure accurate data transmission from the sensors and include checks such as minimum wind speed, minimum wind direction, wind speed, and wind direction comparisons between the 10- and 60-meter levels, temperature ranges, and hourly delta-T limits.

Computer programs are used in the screening process to identify recurring types of data errors, including the following items:

- Missing data (out-of-range values) and unchanging data for the 10-meter wind speed, wind direction, and delta temperature for the primary tower.
- The daily average difference between the primary and backup tower wind speeds and wind directions measured at 10 meters.
- Periods of daytime stable and nighttime unstable conditions.

The parameter and the date(s) and time(s) requiring adjustment or correction are accurately identified. The reasons that the data is to be edited (missing or questionable) are indicated as well as the basis for the corrections or adjustments. Methods for data substitution include using the following:

- Alternate monitor (e.g., backup tower instrument or sigma theta to estimate delta temperature).
- Extrapolation for short durations if the observations before and after the missing/questionable data are consistent (persistence).
- Seasonal average data.

The quality of the adjusted data are indicated and tagged. Any data adjustments or corrections are documented and transmitted for retention.

In addition, visual scanning of the 10-meter wind speed and direction data is routinely performed for abnormal values or inconsistency.

Routine hourly average data is downloaded and formatted monthly for review and editing. Acceptable data editing methods have been established and implemented. Typically, missing or invalid primary tower 10-meter wind speed, wind direction, and delta temperature data are manually replaced with backup tower data. Upon completion of the validation and editing, the meteorological data constitute quality records.

Dew point data screening consists of plotting the ground level (approximately three meters), 10-meter, and 60-meter dew point temperatures using a spreadsheet program. Periods of strong divergence suggest questionable data.

6.4.3.4.2 Data Display and Archiving

The ERFDADS provides 15-minute averages of meteorological data for real-time display in the Control Room, Technical Support Center, and Emergency Operations Facility (RG 1.97, Reference 6.4-5). The STP 1 & 2 control rooms also display current 15-minute and 60-minute averages of the 10-meter level wind speed and direction via analog meters.

An additional feature of the Data Acquisition System is the storage of the 15- and 60-minute averaged meteorological data. At a minimum, the latest 12 months of averaged data resides on the system hard-drive. The historical data can be retrieved, archived, displayed, or printed.

Hourly averaged data is stored on local plant computers for trending and reporting purposes, consistent with RG 1.21 (Reference 6.4-6).

The 15- and 60-minute averaged wind speed, wind direction, and atmospheric stability data are submitted as inputs to the NRC's Emergency Response and Data Systems and this data can be accessed by the NRC through the dial-up modems.

6.4.3.4.3 System Accuracy

Sources of error for time-averaging digital systems include sensors, cables, signal conditioners, temperature environments for signal conditioning and recording, equipment, recorders, processors, data displays, and data reduction process.

The system accuracies of the proposed STP 3 & 4 meteorological data collection system were compared to the regulatory requirements and the findings are summarized in Tables 6.4-4 and 6.4-5. As shown in the tables, the system accuracies of the proposed system meet the regulatory guidance in RG 1.23 (Reference 6.4-2) and ANSI/ANS 3.11 (Reference 6.4-4).

In addition, the associated data collection and recording equipment accuracies are reported in Table 6.4-6 (Reference 6.4-7).

6.4.3.4.4 Data Recovery Rate and Annual Joint Frequency Distribution of Data

As discussed previously, three years of representative data (i.e., 1997, 1999, and 2000) collected at the existing primary and backup tower are used in preparing the STP 3 & 4 COLA. In addition to the data validation performed by STPNOC, an independent validation of the same data set by a professional environmental consulting firm concluded that the data set meets the regulatory requirements provided in RG 1.23 (Reference 6.4-2).

The annualized data recovery rates for 1997, 1999, and 2000 are presented in Table 6.4-7 for the individual parameters (i.e., wind speed, wind direction, ambient temperature, and temperature difference) and the composite parameters. As shown in the table, all data recovery rates meet the RG 1.23 (Reference 6.4-2) requirement of at least 90 %.

The required joint frequency distributions are presented in Tables 2.7-9 and 2.7-10 in the format described in RG 1.23 (Reference 6.4-2) for the following: wind speed and wind direction by stability class and by all stability classes combined for the 10- and 60-m level measurements.

In addition, an electronic sequential, hour-by-hour listing of the hourly data set, including stability class covering the same three-year period in the format described in RG 1.23 (Reference 6.4-2), is provided as a separate submittal supplemental to the application.

6.4.4 Operational Program

Because the existing onsite meteorological monitoring program is conducted in accordance with the guidance criteria and the system accuracy specified in RG 1.23 (Reference 6.4-2), the current system will continue to be used for STP 3 & 4 during plant operation. The functional requirements of the operational monitoring program for STP 3 & 4 are described below based on the current system for STP 1 & 2.

The meteorological monitoring system block diagrams for STP 3 & 4 during plant operation are provided in Figures 6.4-7 and 6.4-8 for the primary and backup towers, respectively.

6.4.4.1 Meteorological Instrumentation

Meteorological parameters measured at the primary and secondary towers conform to RG 1.23, Section 2 as discussed in Subsection 6.4.3.1.2.

Currently all meteorological parameter data signals from the primary and secondary towers come through an analog-to-digital converter processor at the meteorological tower shelter, and are transferred to the data logger for conversion, storage, and transmission. The data logger converts, tracks, trends, and transmits the data to shared data files located on two local computers. These shared data files are transmitted via wireless antenna to the Integrated Computer System (ICS), where the data is available to all ICS workstations in STP 1& 2 and emergency facilities. The ICS allows graphical trending and tabular listing of data and stores the data in its long-term memory for 18 months. After 18 months ,the data is transferred to compact disk for permanent storage.

Each meteorological tower has its own dedicated communication link to the ICS of STP 1 & 2 and hence the backup tower is the duplicate communication link for the primary tower.

Separate, independent data links to the data recording system, and data acquisition and reduction programs are required for STP 3 & 4. These required data links, recording methodologies and equipment, data analysis methodologies and procedures, and data display and storage will be designed and installed in accordance with the regulatory requirements discussed in Subsection 6.4.3. The architecture of these systems and programs will be similar to those of the current meteorological data collection system for STP 1 & 2.

6.4.4.2 Emergency Preparedness Support

The STP 3 & 4 onsite data collection system provides representative meteorological data for use in real-time atmospheric dispersion modeling for dose assessments during and following any accidental atmospheric radiological releases. The data is also used to represent meteorological conditions within the 10-mile Emergency Planning Zone radius (References 6.4-8 through 6.4-11).

Similar to the STP 1 & 2 onsite meteorological monitoring program, the microprocessors sample the meteorological processor modules once per second for each of the following parameters in order to provide near real-time meteorological data for use in atmospheric dispersion modeling: wind speed, wind direction, and ambient temperature for calculations of vertical temperature difference. Dose assessment calculations are performed using the most recent 15-minute average of data (RG 1.97, Reference 6.4-11).

In order to identify rapidly changing meteorological conditions for use in performing emergency response dose consequence assessments, 15-minute average values are compiled for real-time display in the STP 3 & 4 Control Room, Technical Support Center, and Emergency Operations Facility. All the meteorological channels required for input to the dose assessment models are available and presented in a format compatible for input to these dose assessment models (RG 1.97, Reference 6.4-11).

Currently, provisions are in place to obtain representative regional meteorological data from the National Weather Service or Impact Weather Service (current meteorological contractor for STP 1 & 2) during an emergency if the site meteorological system is unavailable. The current (or similar) emergency plan procedures and the monitoring system arrangement will continue to be used for STP 3 & 4.

6.4.5 References

6.4-1 "Method for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," RG 1.111, Revision 1, July 1977.

6.4-2 "Meteorological Monitoring Programs for Nuclear Power Plants," RG 1.23, Revision 1, March 2007.

6.4-3 "Standard Review Plans for Environmental Reviews of Nuclear Power Plants," NUREG-1555, October 1999.

6.4-4 "American National Standard for Determining Meteorological Information at Nuclear Facilities," ANS/ANSI 3.11 - 2005, December 2005.

6.4-5 "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following An Accident," RG 1.97, Revision 3, May 1983.

6.4-6 "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," RG 1.21, Revision 1, June 1974.

6.4-7 "STPEGS Updated Safety Analysis Report, Units 1 and 2," Revision 13.

6.4-8 "Functional Criteria for Emergency Response Facilities," NUREG-0696, Final Report, February 1981.

6.4-9 "Clarification of TMI Action Plan Requirements," NUREG-0737, Final Report, November 1980.

6.4-10 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," NUREG-0654, Revision 1, Appendix 2, FEMA-REP-1, March 2002.

6.4-11 "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Regulatory Guide 1.97, Revision 4, June 2006.

Table 6.4-1 Meteorological Tower Siting Conformance Status

RG 1.23 Criteria	Conformance Status	Remarks
Tower Siting The meteorological tower sites and the proposed STP 3 & 4 location have similar meteorological exposure.	Yes	The site area is generally flat land
The base of the tower is at approximately the same elevation as the finished plant grade of the proposed units.	Yes	Tower elevation: 28' MSL Finished plant grade: 34' MSL
Location of the tower is not directly downwind of the existing and proposed plant cooling systems (i.e., MCR and the mechanical cooling towers) under the prevailing downwind wind direction.	Yes	Prevailing wind: SSE MCR – one mile S to SW of the meteorological towers Two banks of mechanical draft cooling towers – 1.5 mile west of the meteorological towers
Tower is not located on or near permanent man-made surface.	Yes	There are no large concrete or asphalt parking lot or temporary land disturbance, such as plowed fields or storage areas nearby. Both the primary and backup towers are located on open fields with grassy surface underlying the towers.

Table 6.4-2 Meteorological Sensor Siting Conformance Status

RG 1.23 Criteria	Conformance Status	Remarks
Sensor Siting		
Wind sensors are located at 10 obstruction heights away from such obstructions (including the existing and proposed unit complex, trees, and nearby terrain) to minimize any airflow modification (i.e., turbulent wake effects).	Yes	Both the primary and backup meteorological towers are located in open fields. The nearby trees and brushes range from 15 feet to 30 feet tall and are mostly 300 feet or more from the towers. During routine maintenance, these trees are to be trimmed periodically to ensure that the obstruction-height requirement is met.
Wind sensors are located at heights that avoid airflow modifications by nearby obstructions with heights exceeding one-half of the wind measurement.	Yes	Existing and STP 3 & 4 structures are less than 250 feet in height and over a mile from the meteorological towers. Instrument shelter heights are less than 11 feet, which is less than half of the lower level sensor height at 10m (33').
Wind sensors are located to reduce airflow modification and turbulence induced by the supporting structure itself.	Yes	Tower booms (8 feet long) are oriented into the prevailing winds to reduce tower effects on the measurements.
Air temperature and dew point sensors are located in such a way to avoid modification by the existing and proposed heat and moisture sources, such as ventilation systems, water bodies, or the influence of large parking lots or other paved surfaces.	Yes	No large water body, ventilation systems, and large parking lots within 1000' of the tower. The ground surface at the base of the towers has been kept natural (i.e., grasses). Temperature sensors are mounted in downward pointing fan-aspirated radiation shields to minimize the adverse influences of thermal radiation and precipitation.
Precipitation measured at ground level near the base of the tower.	Yes	Precipitation gauge is equipped with wind shields to minimize the wind-caused loss of precipitation.

Table 6.4-3 Proposed STP 3 & 4 System Meteorological Instrumentation

Parameter	Primary Tower Level (meters)	Backup Tower Level (meters)
Wind Speed	10, 60	10
Wind Direction	10, 60	10
Temperature	10, 60	10
Vertical Temperature Difference	(60-10)	None
Sigma Theta	None	10
Precipitation	0 (ground level)	None
Dew Point Relative Humidity/Temperature [1]	3 10, 60	None
Solar Radiometer	2.5	None

[1] Relative humidity/temperature instruments at 10 and 60 meters were added for dew point calculations in December 2006

Table 6.4-4 Meteorological System – Preoperational Configuration

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Instruments												
Wind Speed	Cup Anemometer	Met One Instruments/ Model 1564D, Model 170-41 or Model 170-43	0–100 mph	±0.1 mph	±0.2 m/s (±0.45 mph) or 5% of observed wind speed	0.2 m/s or 5% of observed wind speed	0.6 mph	< 0.45 m/s (1 mph)	0.085 mph	0.1 m/s or 0.1 mph	0.1 m/s	10 m, 60 m
Wind Direction	Wind Vane	Met One Instruments/ Model 1565D, With Quick two Vane, Model 53.2 or 53.4	0–360°	±0.4°	±5°	5° azimuth	0.7 mph	< 0.45 m/s (1 mph)	<1°	1.0°	1.0° azimuth	10 m, 60 m
Ambient Temperature	Platinum Resistance Temperature Device	Met One Instruments/ Models T-200, T-200UC	–20°C to +120°C (-4°F to +248°F)	±0.56°F	±0.5°C (±0.9°F)	0.5°C	N/A	N/A	Infinitesi-mal	0.1°C or 0.1°F	0.1°C	10 m, 60m
Differential Temperature [1]	N/A	N/A	N/A	±0.08°F	±0.1°C (±0.18°F)	0.1°C	N/A	N/A	infinitesi-mal	0.01°C or 0.01°F	0.01°C	60 m – 10 m
Dew Point	Lithium Chloride Chill Mirror (Optical) Dew Point Hygrometer	Met One Instruments/ Model 6354	–30° to 50°C (–22°F to 122°F)	±0.56°F	±1.5°C (±2.7°F)	1.5°C	N/A	N/A	0.1°F	0.1°C or 0.1°F	0.1°C	3 m [3]

Table 6.4-4 Meteorological System – Preoperational Configuration (Continued)

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Precipitation [4]	Tipping Bucket	Met One Instruments/ Model 375B	[4]	±1%	±10% for a volume equivalent to 2.54 mm (0.1 in) of precipitation at a rate <50 mm/h (<2 in/h)	±10% for a volume equivalent to 2.54 mm of precipitation at a rate <50 mm/h	N/A	N/A	0.01 in	0.25 mm or 0.01 in	0.25 mm	Tower base
Solar Radiometer	Copper constant thermopile	Met One Instruments/ Model 095	0-2 Langley/ min	±0.008 Langley/ min [5]	N/A	10 W/m^2 or 5% observed	N/A	N/A	0.001 Langley	N/A	1 W/m^2	2.5 m
Sigma-Theta [2]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.1° azimuth	10 m, 60 m

Table 6.4-4 Meteorological System – Preoperational Configuration (Continued)

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Relative Humidity / Temperature (for Dew Point calculations), [6]	Capacitive Polymer Humidity and Temperature Sensors	Vaisala / HMT337 with Vaisala HUMICAP 180L2	0% to 100% RH	At -10°C to +40°C (14°F to 104°F): ±(1.0+0.01 × reading) %RH At -40°C to +180°C (-40°F to 356°F): ±(1.5+0.02 × reading) %RH	±4% / ±1.5°C (±2.7°F)	1.5°C	N/A	N/A	0.1°F [2]	0.1%	0.1°C	10 m, 60 m
Wind Speed	Cup Anemometer	Met One Instruments/ Model 1564D, Model 170-41 or Model 170-43	0–100 mph	±0.1 mph	±0.2 m/s (±0.45 mph) or 5% of observed wind speed	0.2 m/s or 5% of observed wind speed	0.6 mph	< 0.45 m/s (1 mph)	0.085 mph	0.1 m/s or 0.1 mph	0.1 m/s	10 m
Wind Direction	Wind Vane	Met One Instruments/ Model 1565D, With Quick two Vane, Model 53.2 or 53.4	0–360 degrees	±0.4 degree	±5°	5° azimuth	0.7 mph (1.1 km/h)	< 0.45 m/s (1 mph)	< 1°	1.0°	1.0° azimuth	10 m

Table 6.4-4 Meteorological System – Preoperational Configuration (Continued)

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Ambient Temperature	Platinum Resistance Temperature Device	Met One Instruments/ Models T-200, T-200UC	-20°C to +120°C (–4°F to +248°F)	±0.56°F	±0.5°C (±0.9°F)	0.5°C	N/A	N/A	Infinitesi-mal	0.1°C or 0.1°F	0.1°C	10 m
Sigma-Theta [2]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.1° azimuth	10 m

[1] The Differential Temperature value is a calculated value based on arithmetic differences in the Ambient Temperature measurements at 60-meter and 10-meter locations.

[2] The Sigma-Theta value is a calculated value based on the Wind Direction variation measurements, and therefore has the same resolution as the Wind Direction measurements.

[3] The attachment arm for the Dew Point instrument is 2.77 meters above grade and the bottom of the instrument is 2.56 meters above grade.

[4] Water is collected and drained each time an internal bucket fills with 0.01 inches of water.

[5] As measured at the output of N0EM-XY-8134 (Primary equipment rack). One Langley/minute = 0.6974 kW/m2

[6] The Relative Humidity/Temperature instrument was installed and placed in operation in December of 2006.

Table 6.4-5 Meteorological System – Current Configuration

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
INSTRUMENTS												
Wind Speed	Ultrasonic	Met One Instruments/ Model 50.5 [6]	0 to 50 m/sec (0 to 112 mph)	±0.15 m/sec 5 m/sec or ±2% 5 m/sec (±0.33 mph 11.2 mph or ±2% 11.2 mph)	±0.2 m/s (±0.45 mph) or 5% of observed wind speed	0.2 m/s or 5% of observed wind speed	Virtually zero	< 0.45 m/s (1 mph)	0.1 m/sec (0.1 mph)	0.1 m/s or 0.1 mph	0.1 m/s	10 m, 60 m
Wind Direction	Ultrasonic	Met One Instruments/ Model 50.5 [6]	0° to 360°	±3 degree	±5°	5°azimuth	Virtually zero	< 0.45 m/s (1 mph)	0.1°	1.0°	1.0° azimuth	10 m, 60 m
Ambient Temperature	Platinum Resistance Temperature Device	Met One Instruments/ Models T-200, T-200UC	-20°C to +120°C (-4°F to +248°F)	±0.5°C (±0.9.°F)	±0.5°C (±0.9°F)	0.5°C	N/A	N/A	0.1°F	0.1°C or 0.1°F	0.1°C	10 m, 60 m
Differential Temperature [1]	N/A	N/A	N/A	±0.18°F	±0.1°C (±0.18°F)	0.1°C	N/A	N/A	0.01°F	0.01°C or 0.01°F	0.01°C	60 m – 10 m

Table 6.4-5 Meteorological System – Current Configuration (Continued)

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Relative Humidity/ Temperature (for Dew Point calculations) [2]	Capacitive Polymer Humidity and Temperature Sensors	Vaisala / HMT337 with Vaisala HUMICAP 180L2	0% to 100% RH	At -10°C to +40°C (14°F to 104°F): ±(1.0+0.01 × reading) %RH At -40°C to +180°C (-40°F to 356°F): ±(1.5+0.02 x reading) %RH	±4% / ±1.5°C (±2.7°F)	1.5°C	N/A	N/A	0.1% (R.H.) 0.1°F [1]	0.1%	0.1°C	10 m, 60 m
Precipitation [4]	Tipping Bucket	Met One Instruments/ Model 375B	[4]	±1%	±10% for a volume equivalent to 2.54 mm (0.1 in) of precipitation at a rate < 50 mm/h (<2 in/h)	±10% for a volume equivalent to 2.54 mm of precipitation at a rate < 50 mm/h	N/A	N/A	0.01 in	0.25 mm or 0.01 in	0.25 mm	Tower base
Solar Radiometer	Copper constant thermopile	Met One Instruments/ Model 095	0-2 Langley/ min	+0.008 Langley/ min [5]	N/A	10 W/m^2 or 5% observed	N/A	N/A	0.001 Langley	N/A	1 W/m^2	2.5 m

Table 6.4-5 Meteorological System – Current Configuration (Continued)

Sensed Parameter	Sensor Type	Manufacturer/ Model	Range	System Accuracy	System Accuracy (per RG 1.23, Ref. 6.4-2)	System Accuracy (per ANSI/ANS-3.11-2005, Ref. 6.4-4)	Starting Threshold	Starting Threshold (RG 1.23, Ref. 6.4-2)	Measurement Resolution	Measurement Resolution (per RG 1.23, Ref. 6.4-	Measurement Resolution (per ANSI/ANS-3.11-	Elevation
Sigma-Theta [3]	N/A	N/A	N/A	–	–	–	–	–	–	–	0.1° azimuth	10 m, 60 m
BACKUP Tower Instruments												
Wind Speed	Ultrasonic	Met One Instruments/ Model 50.5 [6]	0 to 50 m/sec (0 to 112 mph)	±0.15 m/sec 5 m/sec or ±2% 5 m/sec (±0.33 mph 11.2 mph or ±2% 11.2 mph)	±0.2 m/s (±0.45 mph) or 5% of observed wind speed	0.2 m/s or 5% of observed wind speed	Virtually zero	<0.45 m/s (1 mph)	0.1 m/sec (0.1 mph)	0.1 m/s or 0.1 mph	0.1 m/s	10 m
Wind Direction	Ultrasonic	Met One Instruments/ Model 50.5 [6]	0° to 360°	±3°	±5 degree	5 degrees azimuth	Virtually zero	<0.45 m/s (1 mph)	0.1 degree	1.0 degree	1.0° azimuth	10 m
Ambient Temperature	Platinum Resistance Temperature Device	Met One Instruments/ Models T-200, T-200UC	-20°C to +120°C (–4°F to +248°F)	±0.5°C (±0.9°F)	±0.5°C (±0.9°F)	0.5°C	N/A	N/A	1°F	0.1°C or 0.1°F	0.1°C	10 m
Sigma-Theta [3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.1° azimuth	10 m

[1] The Differential Temperature value is a calculated value based on arithmetic differences in the Ambient Temperature measurements at 60-meter and 10-meter locations.

[2] The Dew Point Temperature value is a calculated value based on Relative Humidity and Ambient Temperature.

[3] The Sigma-Theta value is a calculated value based on the Wind Direction variation measurements, and therefore has the same resolution as the Wind Direction measurements.

[4] Water is collected and drained each time an internal bucket fills with 0.01 inches of water.

[5] As measured at the output of N0EM-XY-8134 (Primary equipment rack). One Langley/minute = 0.6974 kW/m2

[6] The sonic Wind Speed / Direction instrument has an external electrical heater circuit.

Table 6.4-6 STP 3 & 4 Data Collection and Recording Equipment Accuracy

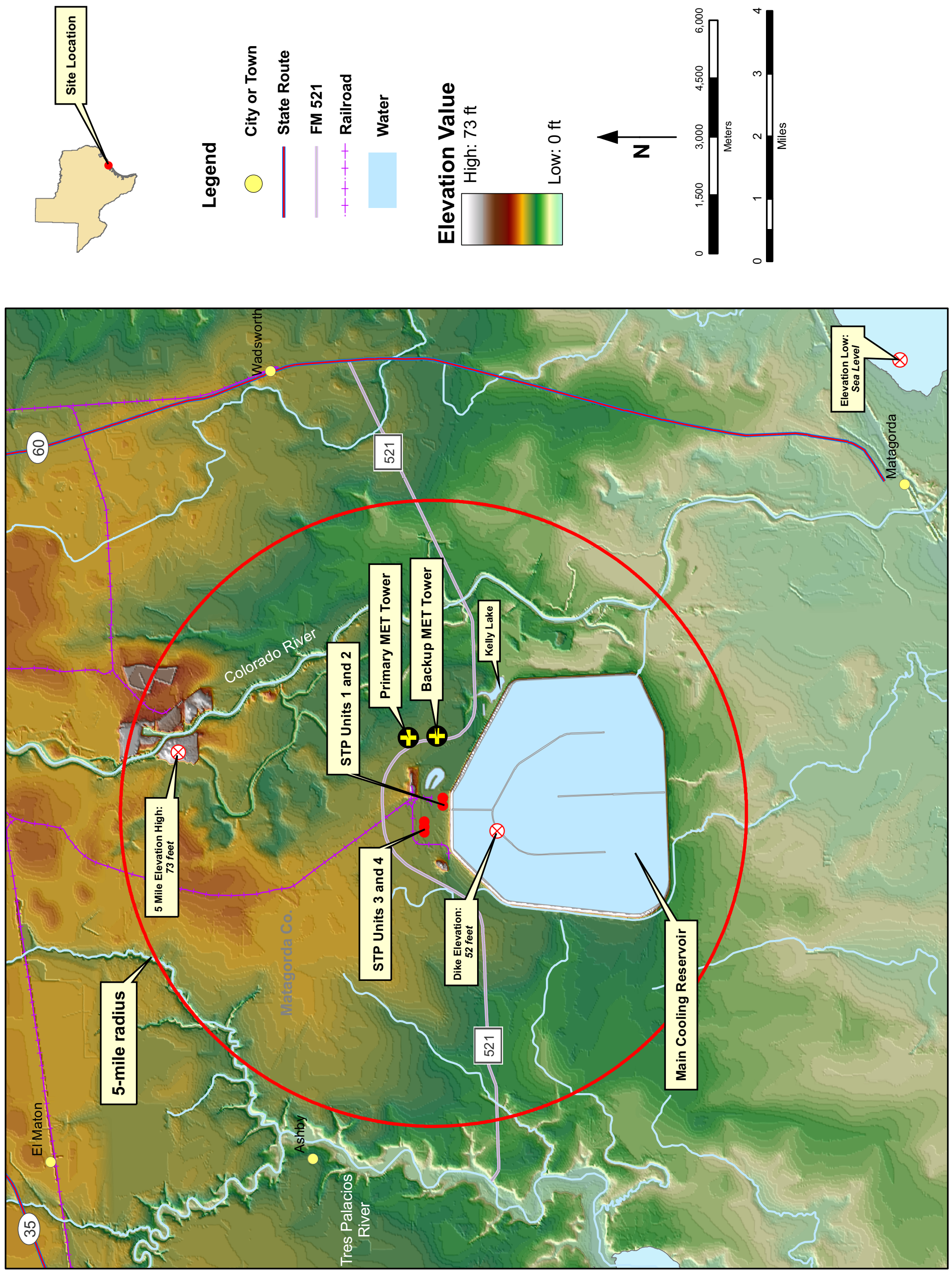
Equipment	System	Accuracy
Microprocessor	Primary and Backup	Better than +0.10% of full scale
Digital Data Recorder Temperature Delta temperature Dew Point Solar radiation Precipitation Wind speed Wind direction	Primary	Current: ±0.10% of full scale
Digital Data Recorder Temperature Wind speed Wind direction Sigma theta	Backup	Current: ±0.10% of full scale
Disk Drives Various digital devices	Primary and Backup	N/A

Data Source: Reference 6.4-7 STPEGS Updated Safety Analysis Report, Revision 13, May 1, 2006 – Table 2.3-24.

Table 6.4-7 Annual Data Recovery Rate (in percent) for STP 3 & 4 Meteorological Monitoring System (1997, 1999, and 2000)

Parameter	1997	1999	2000	3-Year Composite
Wind Speed (10 m)	100.0	99.6	99.5	99.7
Wind Speed (60 m)	96.2	93.6	90.9	93.6
Wind Direction (10 m)	99.9	99.6	99.5	99.7
Wind Direction (60 m)	96.4	94.6	91.1	94.0
Δ-Temperature (60 m–10 m) [1]	96.6	96.1	97.3	96.7
Ambient Temperature (10 m)	93.0	95.0	92.2	93.4
Ambient Temperature (60 m)	93.0	91.3	90.0	91.4
Composite Parameters				
WS/WD (10m), ΔT (60m–10m) [1]	96.6	96.1	97.3	96.7
WS/WD (60m), ΔT (60m–10m) [1]	95.3	91.6	90.6	92.5

[1] Temperature difference (ΔT) between 60-m and 10-m levels.



Source Data: ESRI, Data & Maps and StreetMap USA, 2005 Houston Lighting & Power Company, Drawing No. 9-Y-51-0-H-1151 Rev. 9
USGS, seamless data distribution, NED shaded relief

Figure 6.4-1 Site and Vicinity Map (5-Mile Radius)

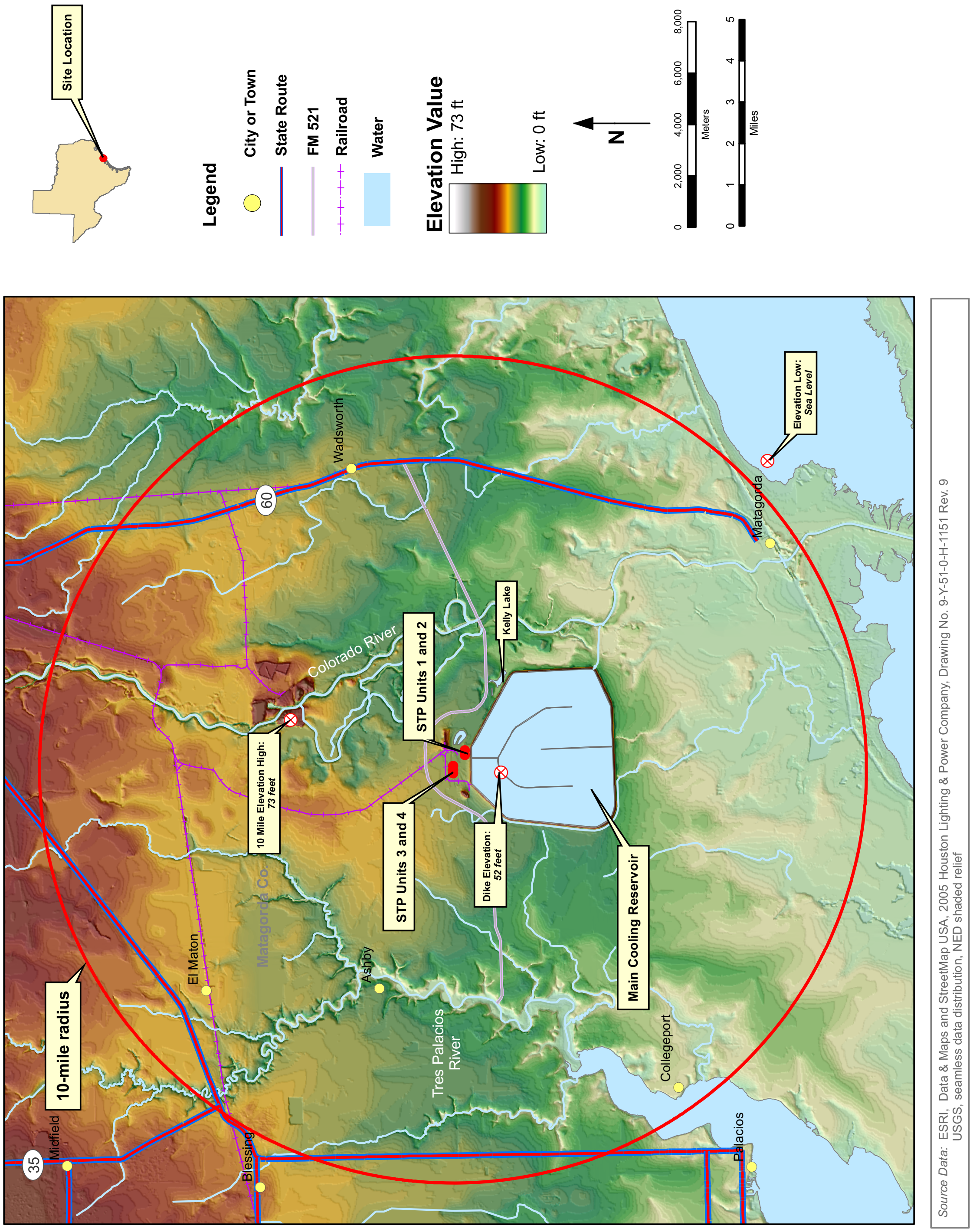


Figure 6.4-2 Site and Vicinity Map (10-Mile Radius)

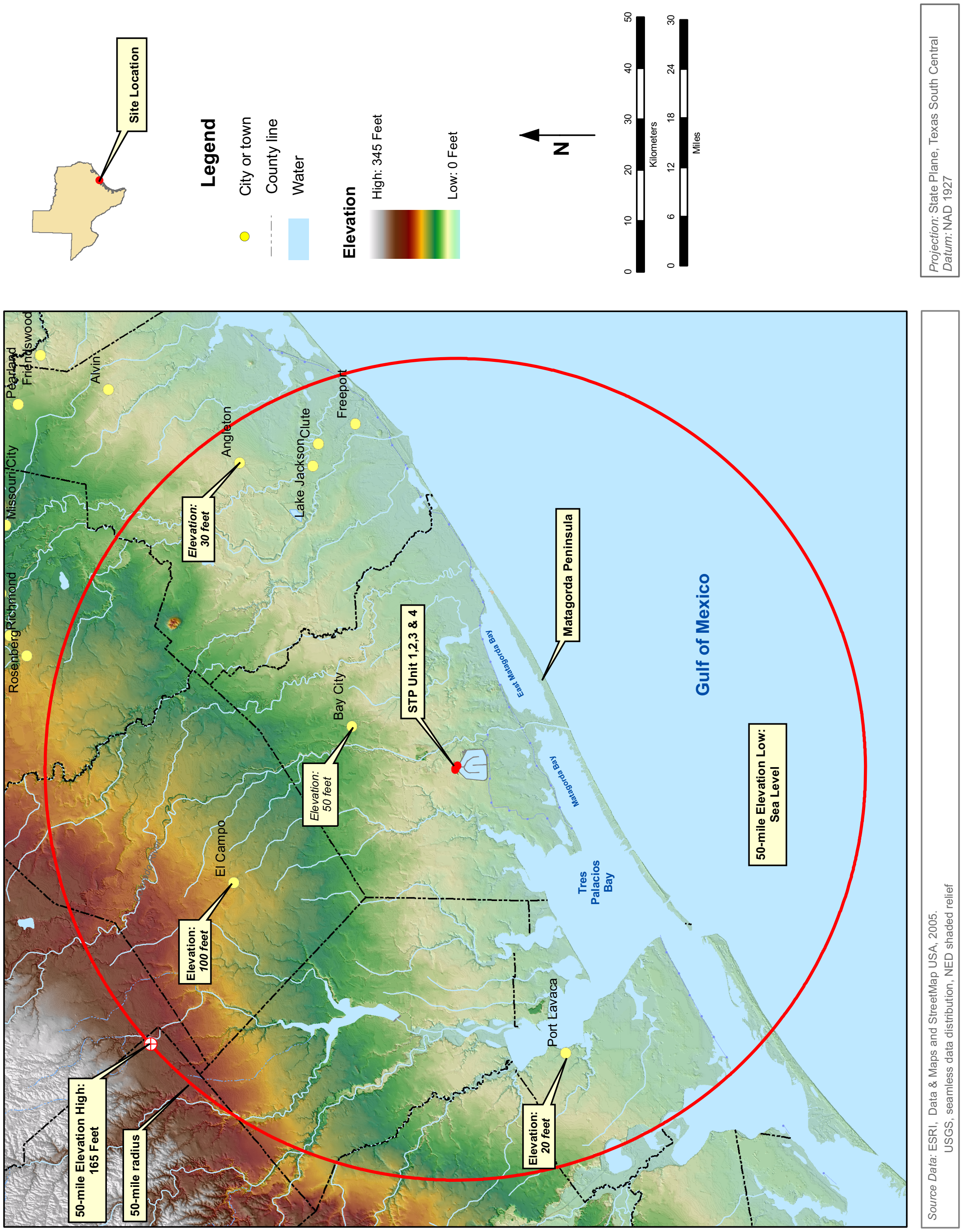


Figure 6.4-3 Site Area Map (50-Mile Radius)

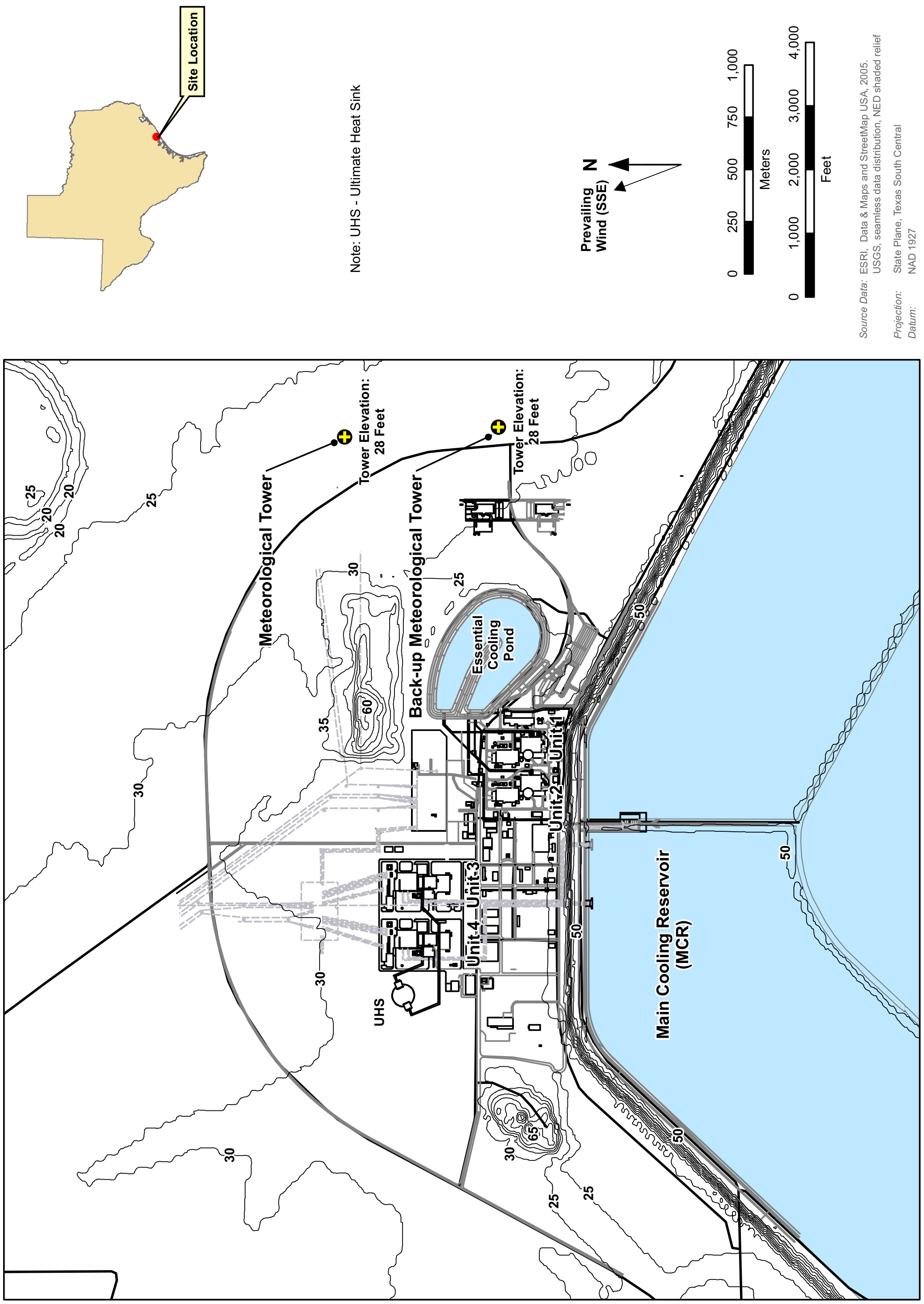


Figure 6.4-4 Location of Meteorological Towers

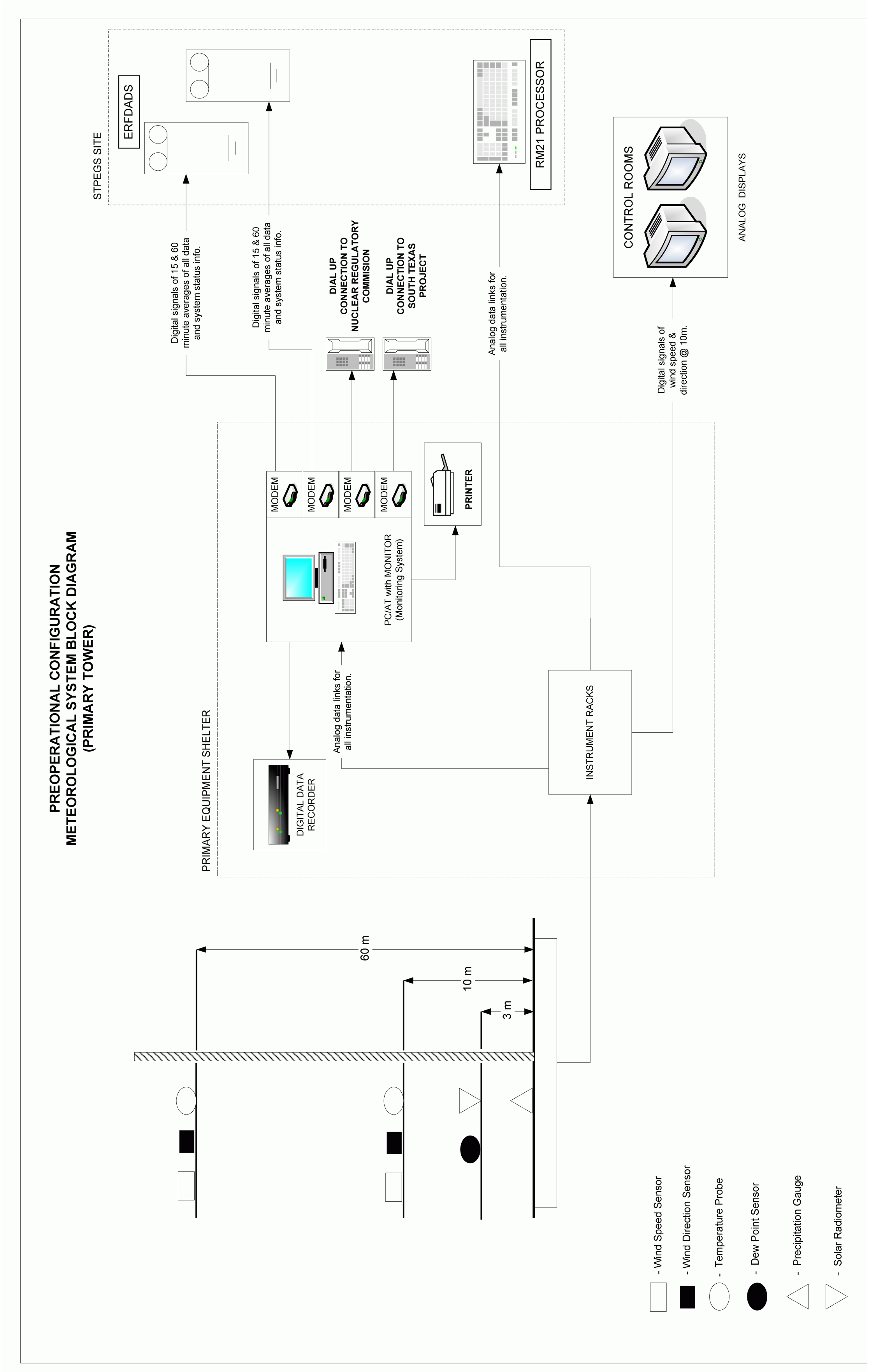


Figure 6.4-5 Meteorological System Block Diagram (Primary Tower – Preoperational Configuration)

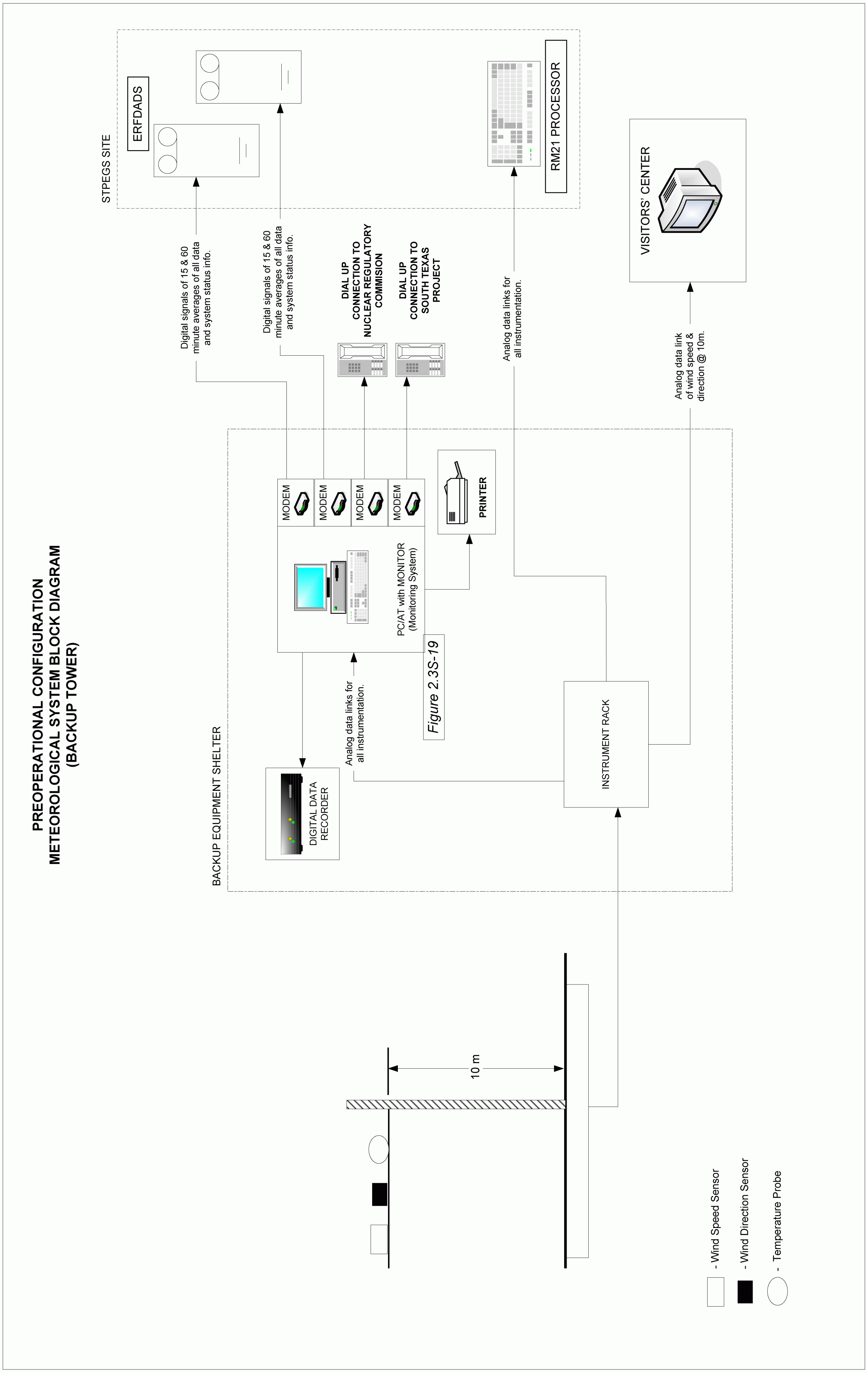


Figure 6.4-6 Meteorological System Block Diagram (Backup Tower – Preoperational Configuration)

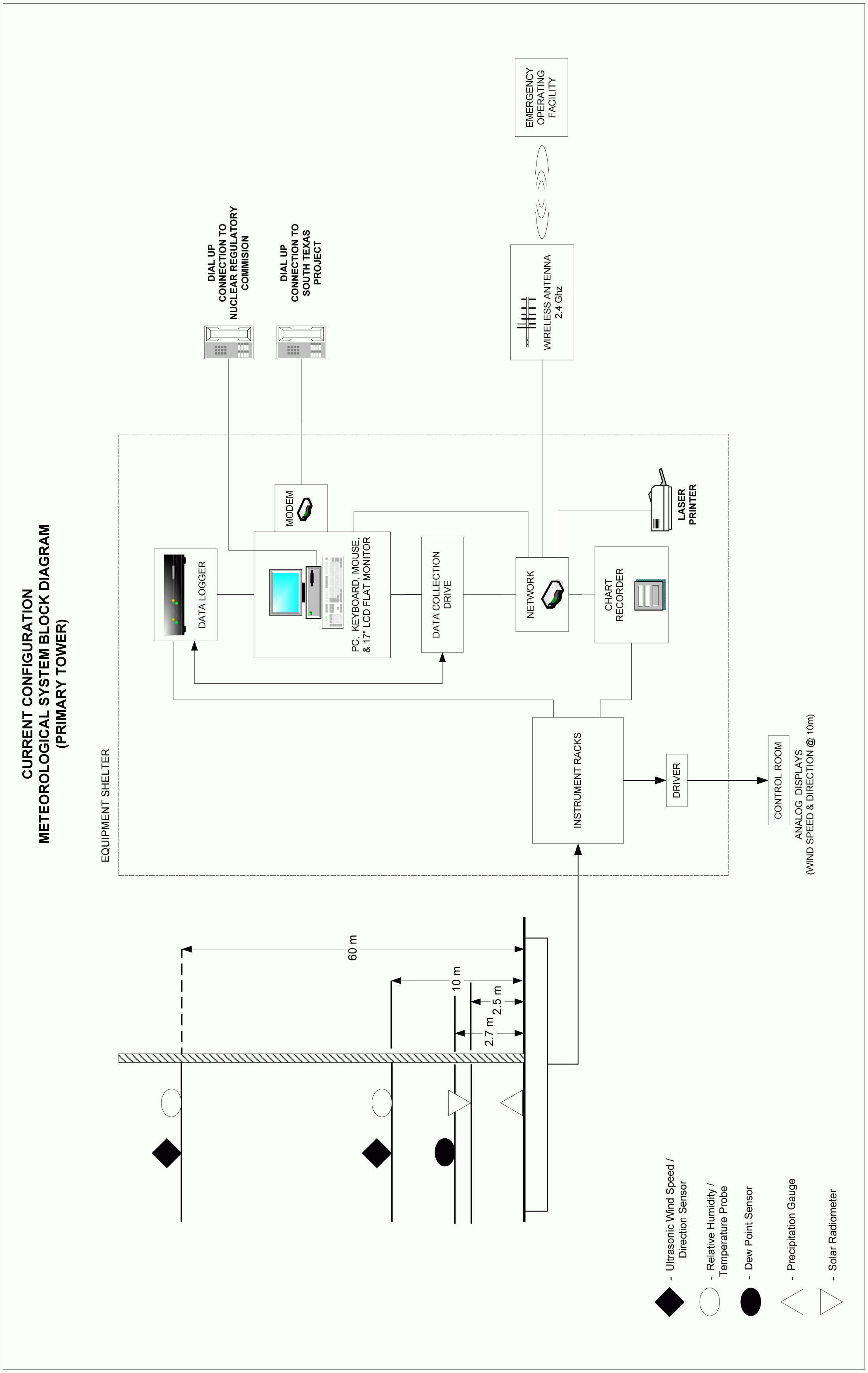


Figure 6.4-7 Meteorological System Block Diagram (Primary Tower – Current Configuration)

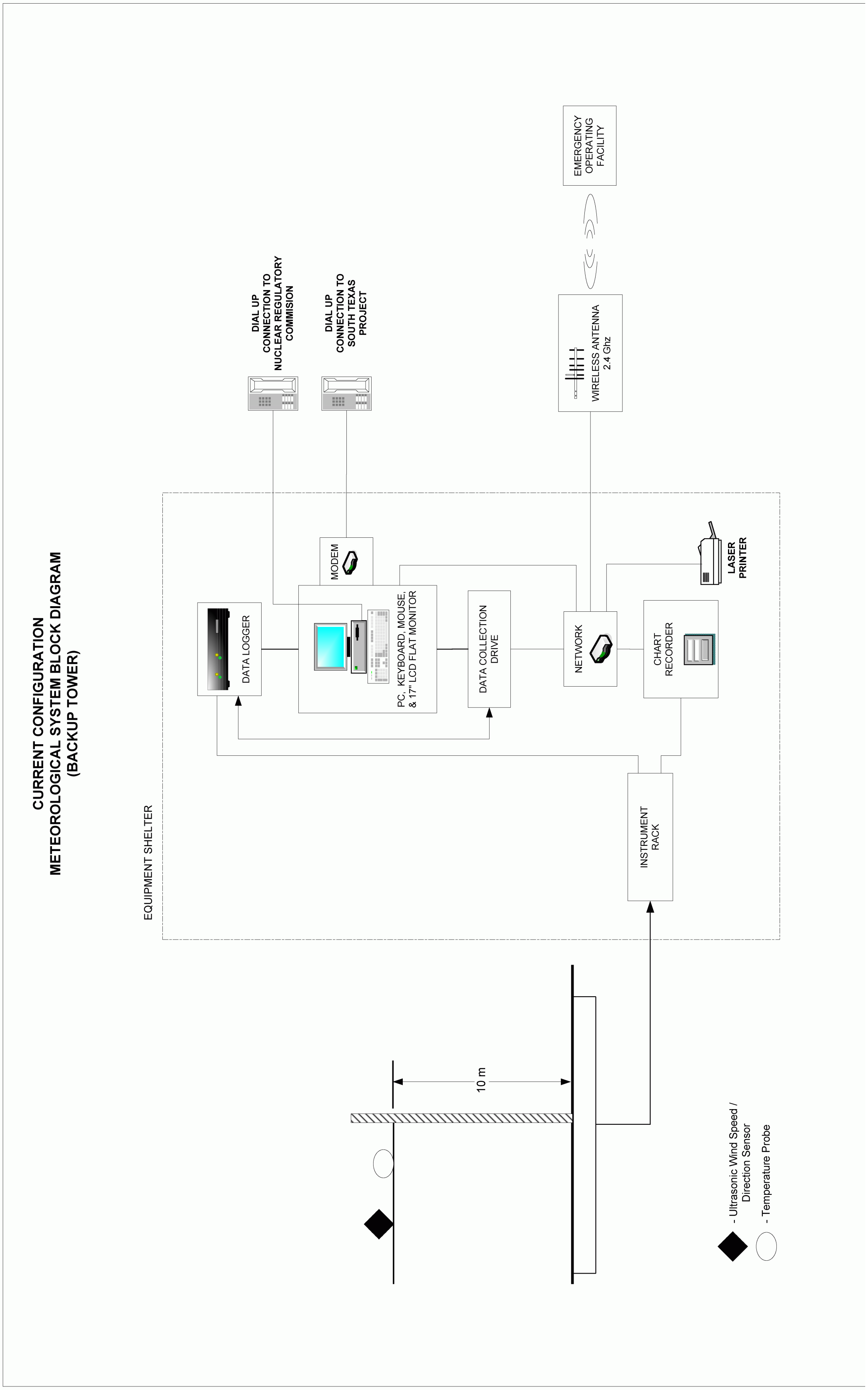


Figure 6.4-8 Meteorological System Block Diagram (Backup Tower – Current Configuration)