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# Meteorological Monitoring Program (U)

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SAFETY • RESPONSIBILITY • SECURITY
SRS
SAVANNAH RIVER SITE

Westinghouse Savannah River Company
Savannah River Technology Center
Aiken, SC 29808

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# Section 1—Forward

## Introduction

The purpose of this technical report is to provide a comprehensive, detailed overview of the meteorological monitoring program at the Savannah River Site (SRS) near Aiken, South Carolina. The report is recommended for meteorologists, technicians, or any personnel who require an in-depth understanding of the meteorological monitoring program. The information which has been compiled for the report is current and the most accurate documentation available. However, when new information is generated or upgrades to the system occur revisions will be made.

## Historical Perspective

To better understand the current meteorological monitoring program, a description of the rationale and historical development of the system is provided in the following sections. Much of the historical information was provided by Todd V. Crawford who pioneered the first comprehensive meteorological monitoring program at the SRS.

## Rationale

The meteorological monitoring program at the Savannah River Site has been developed by the Environmental Technology Section (ETS) of the Savannah River Technology Center (SRTC). The principle function of this program is to provide current, accurate meteorological data as input for calculating the transport and diffusion of any unplanned release of an atmospheric effluent. For this reason, this program is an integral part of the emergency response capability at the SRS called the Weather INformation and Display (WIND) System. There are, however, many other uses for meteorological data at the SRS. Data which is archived over long periods is used to create data bases which represent the local climate. These climatological data bases are used in critical applications such as chronic dosimetric and air quality calculations, engineering analyses, and site environmental characterizations contained in Safety Analysis Reports (SAR), Environmental Impact Statements (EIS), and risk assessments. The current meteorological monitoring program meets or exceeds guidance criteria provided in Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance DOE/EH-0173T (DOE, 1991).

The primary meteorological requirements for an emergency response program are measurements made at the stack release height of wind speed, wind direction, and a method of determining atmospheric stability. The Environmental Technology Section (ETS) has created a meteorological monitoring program which satisfies the emergency response regulatory requirements and incorporates additional meteorological instrumentation used to support emergency response, engineering, and environmental studies. To accomplish the multiple goals of the meteorological monitoring program at the SRS a network of observation towers has been erected onsite. A 61-m tower is located in each of the following areas: A, C, D, F, H, K, L, and P. The siting of the Area towers is primarily based on the locations of the highest potential sources of atmospheric effluents onsite. The 61 m height corresponds to the stack height of the nearby facilities. The specific locations of the Area towers were chosen using the following requirements:

- location within 0.5—1.0 miles of the primary production facility within an area
- situated above relatively undisturbed forest (SRS is primarily covered by forest)

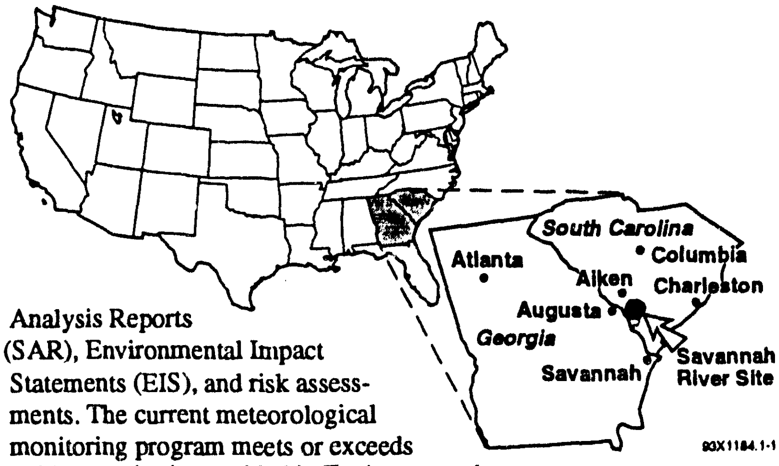



**Figure 1.1** ***The Savannah River Site, operated by Westinghouse for the Department of Energy, ~300 square mile area is located in southwest South Carolina along the Savannah River.***

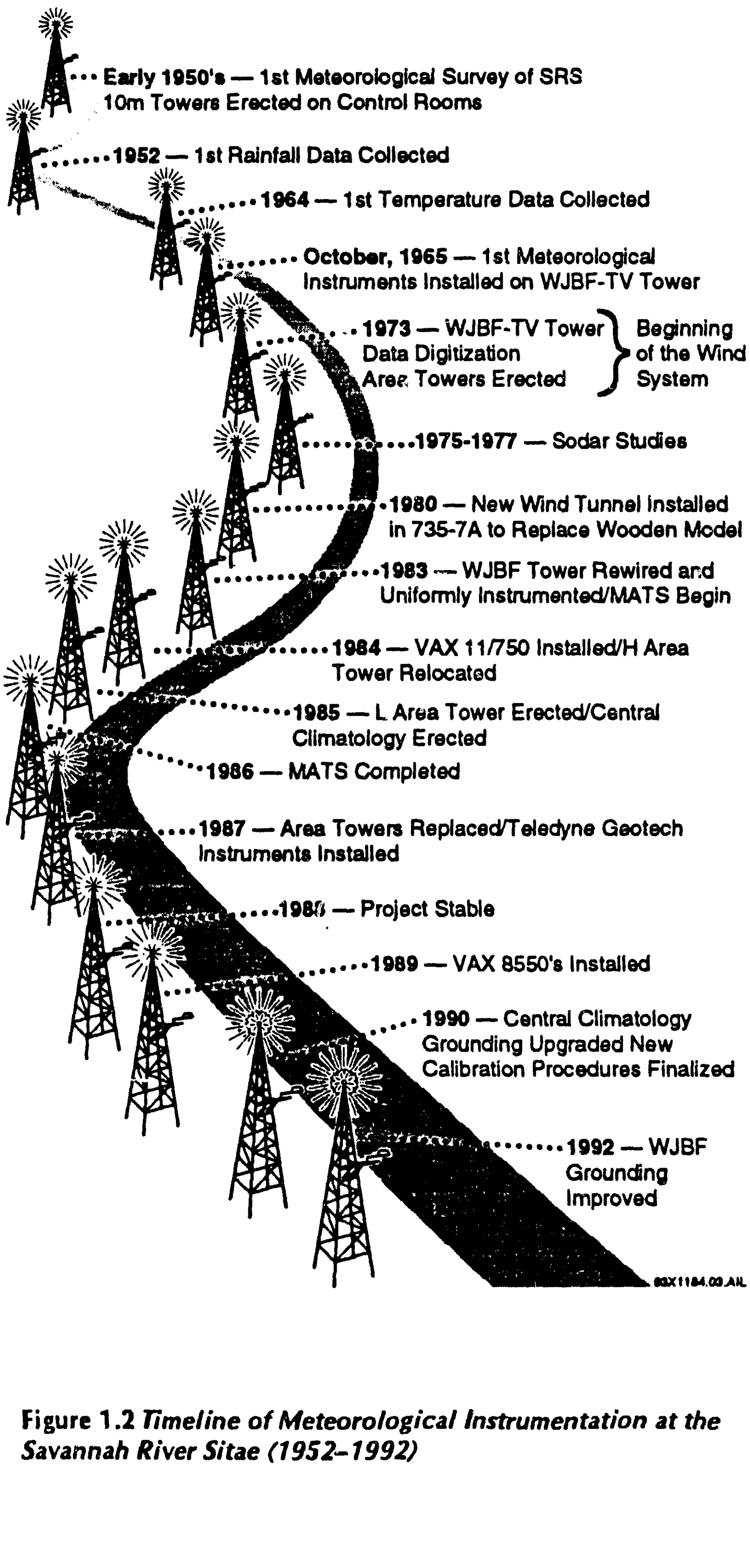



**Figure 1.2** *Timeline of Meteorological Instrumentation at the Savannah River Sitae (1952–1992)*

- raised at similar mean sea level (MSL) elevations to the nearby facility
- measurements taken at the major facility stack height of 61 m (200 ft) above the ground surface to ensure representative dose calculations

Additional meteorological instrumentation on the WJBF-TV tower near Beech Island, South Carolina provides data at seven heights up to 304 m. For research purposes another 61-m tower (Central Climatology), located in N Area, was erected in a clearing so that vertical profiles of several different variables could be measured. Measurements of solar radiation, precipitation, evaporation, soil temperature, and boundary layer structure with periodic measurements from a Sound Radar (Sodar) are also made at the Central Climatology site.

## History of Savannah River Site Instrumentation

Meteorological instrumentation used at the SRS has varied considerably throughout the history of the site. Much of the early climatological survey research (Falk, 1953) was done over short periods and with now obsolete instruments. Primary meteorological information was provided to SRS by the Augusta office of the Weather Bureau (now the National Weather Service). Eventually, anemometers and wind vanes were installed on short towers on top of each control room facility. Strip charts were used to record data, and bandwidth (standard deviation of wind azimuth angle) estimates were used in conjunction with nomographs to make downwind dose estimates. This system remained in place from the 1950s through the early 1970s. In some cases, the instrumentation has been left in place although calibration and maintenance have not usually been performed reliably.

In the mid 1960s, the first instruments were installed on the WJBF-TV tower. In 1966, a study was performed to determine the meteorological monitoring needs required for a proposed 850-ft reactor stack (Cooper and

Rusche, 1968). For this study, instruments were installed on the tower up to 1,200 ft. Additional instrumentation was installed on the 110-ft Casells Fire Tower. Data acquisition was accomplished through the use of "punch tape". A fire in May 1972 Temporarily halted data collection (Pendergast, 1975) at the TV tower.

In the early 1970s, the need for a much more comprehensive meteorological monitoring system became evident. New national environmental laws concerning air pollution monitoring were becoming increasingly more stringent. Specifically, the TV tower data at SRS showed that more accurate measurements of turbulence were necessary as well as measurements at stack height levels. In addition, due to the common occurrence of light winds, more sensitive meteorological sensors were recognized as a requirement onsite.

In the early 1970s, a comprehensive meteorological monitoring program was created. The new system incorporated a totally automated data acquisition network, data archival storage process, and "menu" access to atmospheric models used for emergency response. In 1973, the monitoring system at the TV tower was modified with improved meteorological instruments and computerized digitization equipment. Also, in 1973, 61 m towers were erected at A, C, D, F, H, K, and P areas. The height of these towers corresponded to the

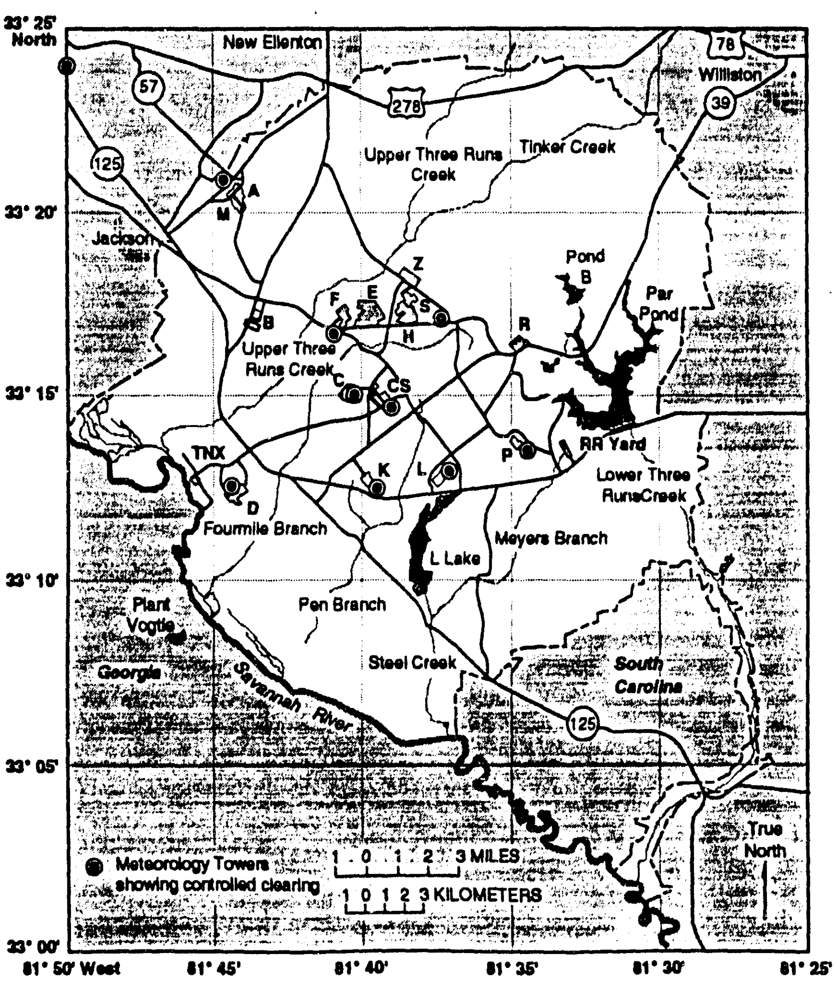



Figure 1.3 *Meteorological monitoring tower network*

average height of SRS facility stacks. Each tower was placed above the forest canopy within one-half-mile of a facility to obtain representative turbulence measurements above the surrounding, predominantly forested site. State-of-the-art turbulence instruments were installed on each tower. Data acquisition was accomplished by running signal cables to the nearest heated building where phone line access was available. Signals were then transmitted via phone line to a central computer in the SRTC (773-12A). Attachment A–3 provides a thorough description of the whole area monitoring system at its inception. This system was the beginning (Kern, 1975) of the WIND system as it stands today (Hunter, 1990).

In the mid 1970s acoustic sounder studies were conducted to characterize the local climatology of the height of the atmospheric boundary layer (Schubert, 1975). This was some of the earliest Sodar research in the world. More recently, newer Sodars have been used in studies which compared Sodar data with the TV tower measurements (Kurzeja, 1992). Data from these studies has been used to characterize the atmospheric boundary layer commonly observed at SRS.

In November 1983, the TV tower was rewired and uniform instrumentation was installed at all levels. A 10 m tower which had been erected near the TV tower in the early 1970s was replaced with an 18 m tower. All levels now have a bivane, cup anemometer, and temperature probe, except at two meters where there is a temperature probe only. The previous instrument configuration selectively contained levels which housed temperature probes or vanes only. The data acquisition system at the tower was also upgraded. The present system uses instrumentation at 2 m (temperature only), 18 m, 36 m, 91 m, 137 m, 182 m, 243 m, and 304 m.

The area towers were modified in the 1980s. In 1984, the H-Area tower was moved to another nearby location since planned construction would likely alter the local wind field. A 61-m tower was added in 1985 at L area to coincide with the restart of the L Reactor.

In 1985, Central Climatology was created for local climatological and special measurement studies. A 61 m tower was erected in an open field and instrumented at 2 m, 18 m, 36 m, and 61 m with anemometers, bivanes, and temperature probes to obtain profiles of the boundary layer structure. Additional instrumentation for solar radiation, evaporation, precipitation, soil temperature, and atmospheric pressure measurements was installed at Central Climatology. At this time, a network of Sodars is being installed at Central Climatology and two other locations onsite.

In 1987, new and more stable area towers were installed to replace the original towers which had suffered degradation (except at H and L areas which had already been upgraded with the newer towers). More sophisticated, sensitive, and reliable instrumentation and communication hardware were installed at each new area tower (including H- and L-Area towers). In addition, lightning protection and grounding have been improved at the new area towers, and, consequently, post-1987 data losses due to lightning induced surges have been greatly reduced.

In 1991, the Central Climatology facility grounding system was upgraded with a more robust underground network of cables and welded connections. In 1992, the grounding system at the WJBF-TV tower was upgraded to lessen the occurrence of lightning related damages to instruments and in particular the telephone line equipment.

Today, the eight area towers, Central Climatology, and the WJBF-TV tower comprise the network of operational meteorological towers at the SRS. Other meteorological instrumentation is used by the ETS to measure atmospheric pressure (microbarograph), temperature and relative humidity (hygro-thermograph), and rainfall (a network of rain gauges). The record of some of these date back to the 1950s. The integrity of all data being gathered today is considerably higher than pre-1987 data due to increased reliability and durability of the meteorological instruments, more stable tower and instrument platforms, improved calibration procedures, and a more reliable data acquisition system. The network which is in place today routinely provides continuous data signals better than 90% of each month. Even during a tower failure, back-up power supplies (battery and diesel generator) or the redundancy of the site network of area towers will provide quality meteorological data.

In addition to the meteorological instrumentation mentioned above, other types of instrumentation have been used over the years during tracer gas release experiments conducted to evaluate SRS emergency response models. The Mesoscale Atmospheric Transport Studies (MATS) (Weber et al., 1992) utilized fixed and mobile atmospheric samplers as well as rawinsondes and airsondes for detailed atmospheric boundary layer measurements. In 1988, the Project STAble Boundary Layer Experiment (Weber and Kurzeja, 1991) was conducted to further investigate the behavior of tracer releases during nighttime conditions. The instrumentation of the STABLE included the atmospheric equipment used during the MATS, the ETS tower network, two Sodars, a thethersonde, an airsonde, and an ozone analyzer.

## References


Cooper, R. E. and B. C. Rusche, 1968: *The SRL Meteorological Program and Off-Site Dose Calculations*, DP-1163, E.I. DuPont de Nemours and Co., Inc., Savannah River Laboratory, Aiken SC.

DOE, 1991: *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T, U.S. Department of Energy, Washington, DC.

Falk, L. L., 1953: *Savannah River Plant Stack Gas Dispersion and Microclimate Survey*, DP-19, E.I. DuPont de Nemours and Co., Inc., Savannah River Laboratory, Aiken, SC.

Hunter, C. H., 1990: *Weather Information and Display (WIND) System User's Manual*, WSRC-TM-90-14, Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

Kern, C. D., 1975: *An Automated Data System for Emergency Meteorological Response*, Proceedings of the Third Environmental Protection Conference held at Chicago, IL, U.S. Energy Research and Development Administration, Washington, DC.

Kurzeja, R. J., 1992: *Comparison of a Doppler Sodar with Bivanes and Cup Anemometers*, Preprint of the Tenth Symposium on Turbulence and Diffusion held at Portland, Or. American Meteorological Society, Boston, MA.

Pendergast, M. M., 1975: *A Cautionary Note Concerning Aerodynamic Flying of Bivane Wind Direction Indicators*, Journal of Applied Meteorology, vol. 14, No. 4, American Meteorological Society, Boston, MA.

Schubert, J. F., 1974: *A Climatology of the Mixed Layer Using Acoustic Methods*, DP-1374, E.I. DuPont de Nemours and Co., Inc., Savannah River Laboratory, Aiken, SC.

Weber, A. H. and R. J. Kurzeja, 1991: *Nocturnal Planetary Layer Structure and Turbulence Episodes during the Project STABLE Field Program*, Journal of Applied Meteorology, Vol. 30, NO. 8, American Meteorological Society, Boston, MA.

Weber, A. H., S. Berman, R. J. Kurzeja, and R. P. Addis, 1992: *The MATS Experiments – Mesoscale Atmospheric Transport Studies at the Savannah River Site*, Nuclear Safety, Vol. 33, No. 1, U.S. DOE, Oak Ridge National Laboratory, Oak Ridge, TN.

# Section 2—Climate of the Savannah River Site

## Introduction

This chapter provides a brief description of the prevailing weather at the Savannah River Site. The information is general and useful in describing the types of meteorological conditions that the instrumentation of the meteorological monitoring program endure. More detailed climate information is provided in Hunter, 1990.

## Terrain and Predominant Weather Patterns

The Savannah River Site (SRS) is located on the Atlantic Coastal Plain of southern South Carolina about 20 miles southeast of Augusta, Georgia. The site encompasses about 300 square miles and is a secure area with public access limited to US Highway 278, SRS Road 1, through traffic on SC Highway 125 (SRS Road A), and the Seaboard Coastline Railroad. The topography of the SRS site area is characterized by gently rolling, forested hills with an adjacent flood plain near the river. The flood plain is thickly forested with 15 to 18 m deciduous trees. The higher terrain exhibits a more broken forest of 8 to 10 m pine and deciduous trees. Areas not covered by forest consist of a smaller percentage of fields, buildings, parking lots, roads, and two cooling lakes. The local SRS terrain elevations generally decrease gradually toward the Savannah River that runs along the southwestern boundary of the site. Site elevations range from 30 to 128 m above mean sea level.

The climate of the Savannah River Site area is classified as humid subtropical that is characterized as having relatively short, mild winters and long, warm, humid summers.

Summer weather usually lasts from May through September, when the area is subjected to the influence of the western extension of the semi-permanent Atlantic sub-tropical anticyclone (the Bermuda high-pressure system). As a result, winds are generally light and weather associated with low-pressure systems and fronts usually remains well to the north of the area. The Bermuda high is a persistent feature resulting in few breaks in the summer heat. Daytime temperatures are frequently above 32°C (90°F), and temperatures of 38°C (100°F) or greater occur once per year on the average. The relatively high heat and humidity often results in the development of scattered afternoon and evening thunderstorms.

During the fall, the influence of the Bermuda high begins to diminish, resulting in drier weather with more moderate temperatures. Average rainfall for the fall months is lower than averages for the other months of the year. Frequently, fall days are characterized by cool, clear mornings and warm, sunny afternoons.

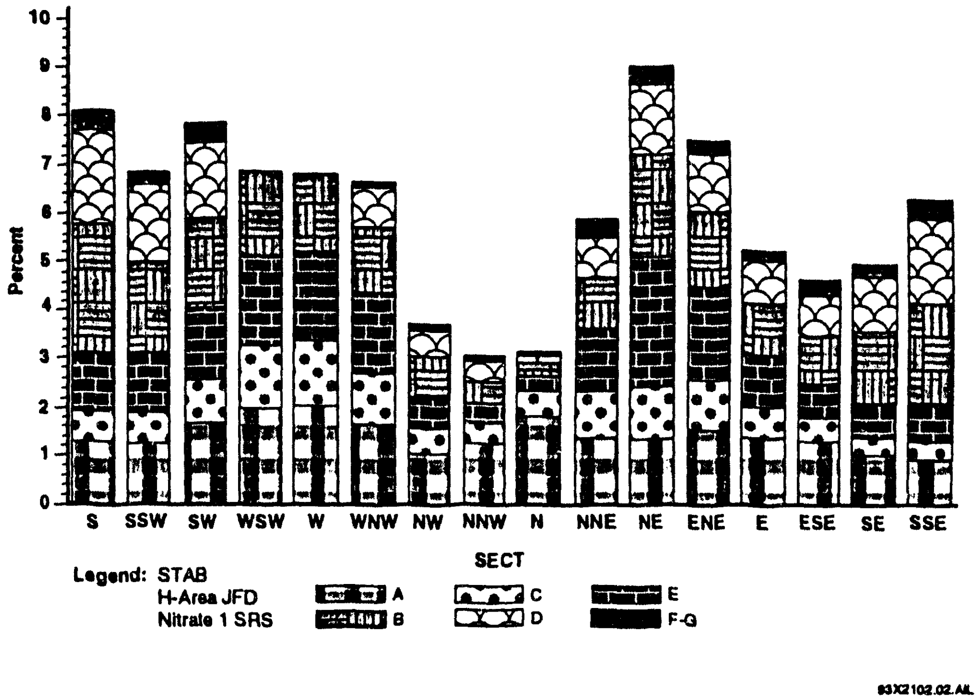
During the winter, migratory low-pressure systems and associated fronts influence the weather of the SRS area. Conditions frequently alternate between warm, moist subtropical air from the Gulf of Mexico and cool, dry polar air. Occasionally, an Arctic air mass will influence the area. However, the Appalachian Mountains to the northwest of the SRS moderate the extremely cold temperatures associated with the polar or Arctic air. Consequently, less than one-third of all winter days have minimum temperatures below freezing and temperatures below -7°C (20°F) are infrequent. Frozen precipitation occurs less than once per year on the average.

Spring is characterized by a higher frequency of tornadoes and severe thunderstorms than the other seasons of the year. This weather is often associated with the passage of cold fronts. Although weather during the spring is changeable and relatively windy, temperatures are usually mild.

## Wind

Figure 2.1 shows a joint frequency distribution of wind direction for the 1987–1991 period for the H-Area tower. Peaks in the northeast sector usually occur during the fall, and peaks in the southwest sector occur in the

Figure 2.1 *H Area 87-91 Data - All Stabilities*




spring and summer. More variability in wind speed and direction occur in the winter months as oscillations occur between humid air masses emanating from the Gulf of Mexico and cool, dry air masses from the polar regions pass over the local area.

Wind speed measurements during severe weather have been documented at SRS. On September 23, 1989, as the center of Hurricane Hugo passed about 100 miles north of SRS, a peak gust of 65 mph was measured at the C-Area Tower (Parker, 1990). On March 3, 1991, a gust of 81 mph was recorded at C Area as an intense thunderstorm, which produced a tornado a few moments later, passed over the tower (Parker, 1991).

## Temperature

Monthly and annual average temperatures for SRS (period of record, 1964–1992) are given in Table 2-1. At SRS, the annual average temperature is 65.0° F. July is the warmest month with an average maximum temperature of 92.0°F. January is the coldest month with an average minimum temperature of 35.5°F. The average dates of the first and last freeze are November 12 and March 16, respectively (Hunter, 1989).

## Precipitation

The annual average precipitation for SRS between 1952 and 1992 was 48.56 inches. Monthly average and extreme precipitation amounts are shown in Table 2-2. Precipitation is fairly well distributed throughout the year. Average precipitation totals for the fall months (September, October, and November) are less than average totals for the other seasons, accounting for only about 19 percent of the average annual total.

Extreme rainfall events of 5.2 inches in 3 hours and 7.39 inches in twelve hours have been documented on July 25 and August 22, 1990 (Addis and Kurzeja, 1992). These events were shown to exceed the expected 100 year extreme rainfall event total.

**Table 2-1.** Monthly Average and Extreme Temperatures for SRS (Period of Record 1964–1992).

| | Average Daily Temperature, °F | | | Extreme Temperature, °F | |
|---|---|---|---|---|---|
| **Month** | **Maximum** | **Minimum** | **Monthly** | **Maximum** | **Minimum** |
| January | 55.5 | 35.5 | 45.5 | 86 | -3 |
| February | 59.5 | 38.0 | 49.0 | 86 | 13 |
| March | 68.5 | 45.0 | 57.0 | 90 | 11 |
| April | 77.0 | 52.5 | 65.0 | 99 | 29 |
| May | 84.0 | 60.5 | 72.0 | 99 | 38 |
| June | 90.0 | 67.5 | 79.0 | 105 | 48 |
| July | 92.0 | 71.0 | 81.5 | 107 | 58 |
| August | 90.5 | 70.5 | 80.5 | 107 | 56 |
| September | 85.5 | 65.5 | 75.5 | 104 | 41 |
| October | 76.5 | 54.0 | 65.0 | 96 | 28 |
| November | 67.5 | 45.0 | 56.5 | 89 | 18 |
| December | 59.5 | 39.0 | 49.0 | 82 | 7 |
| Year | 75.5 | 54.0 | 65.0 | 107 | -3 |

**Table 2-2.** Total Precipitation (Water Equivalent) in Inches Recorded at SRS, 1952–1992.

| Month | Average | Maximum | Year | Minimum | Year |
|---|---|---|---|---|---|
| January | 4.15 | 10.02 | 1978 | 0.89 | 1981 |
| February | 4.41 | 7.94 | 1956 | 0.94 | 1968 |
| March | 4.87 | 10.96 | 1980 | 1.31 | 1985 |
| April | 3.50 | 8.20 | 1961 | 0.57 | 1972 |
| May | 4.03 | 10.90 | 1976 | 1.33 | 1965 |
| June | 4.40 | 10.89 | 1973 | 0.89 | 1990 |
| July | 5.19 | 11.48 | 1982 | 0.90 | 1980 |
| August | 5.04 | 12.34 | 1964 | 1.04 | 1963 |
| September | 3.79 | 8.71 | 1959 | 0.49 | 1985 |
| October | 2.93 | 19.62 | 1990 | 0.00 | 1963 |
| November | 2.71 | 7.78 | 1992 | 0.21 | 1958 |
| December | 3.55 | 9.55 | 1981 | 0.46 | 1955 |
| Annual | 48.56 | 73.47 | 1964 | 28.82 | 1954 |

## References

Addis, R. P. and R. J. Kurzeja, 1992: *Heavy Rainfall at the SRS in July, August, and October of 1990 (U)*. WSRC-TR-92-136. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

Hunter, C. H., 1989: *A Climatological Description of the Savannah River Site*. WSRC-RP-89-313. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

Parker, M. J., 1990: *Hurricane Hugo and Its Meteorological Effects on the Savannah River Site*. WSRC-RP-90-471. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

Parker, M. J., 1991: *Savannah River Site Tornado Damage of March, 1991*. WSRC-RP-91-439. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

# Section 3—Area Tower Monitoring System

## Introduction

The Area Towers are the 200 ft (61 m) meteorological observation towers that have been placed near each of eight facilities at SRS (A, C, D, F, H, K, L, and P Areas, see Figure 3.1). These towers provide the primary source of meteorological data that is used for emergency response to unplanned atmospheric releases of radiological or chemical effluents. In addition, long-term databases are created from the meteorological observations that are made continuously. These databases are used in environmental, safety, or annual dosimetric studies for operational or planned site facilities. The following sections describe the Area Towers and their instrumentation. Additional information concerning instrument specific maintenance is also provided.

## Historical Perspective

In the early 1970s, new environmental regulations (see Foreword) indicated that a comprehensive meteorological monitoring program was required at SRS. The Area Towers network became the primary source of accurate and timely measurements of wind speed, wind direction, and atmospheric turbulence for emergency response at SRS. Sites for the Area Towers were chosen in 1972 (L area 1985). The towers are located in the vicinity of

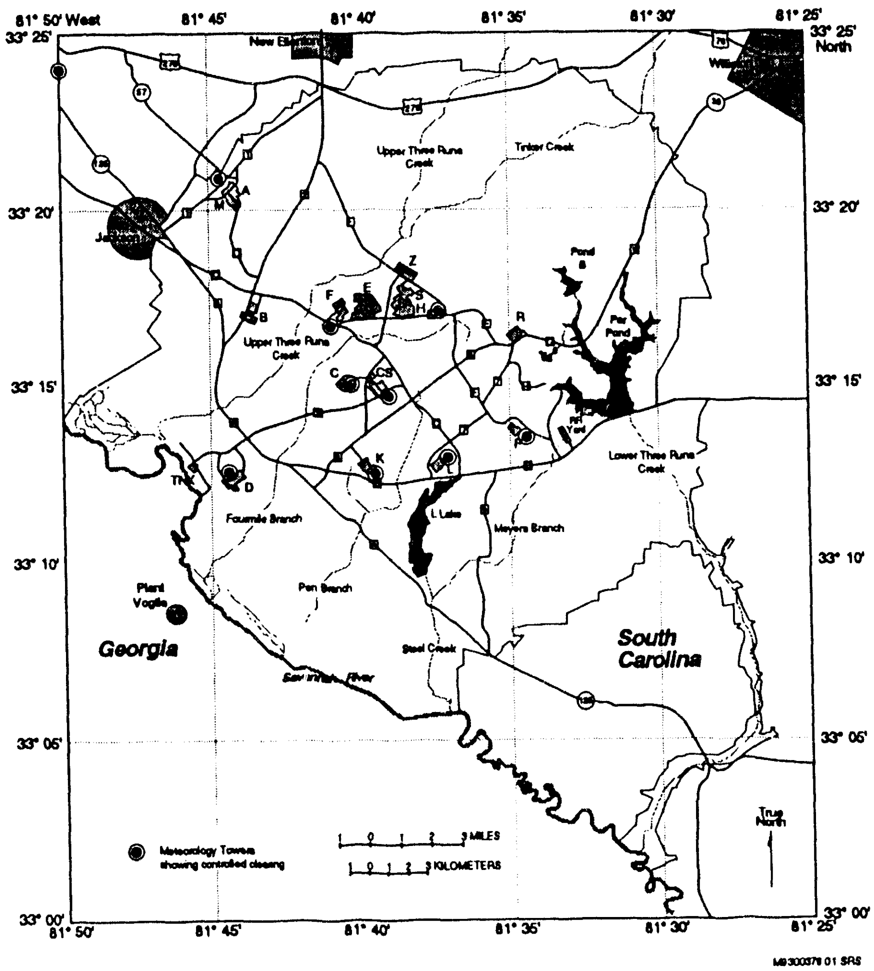



**Figure 3.1** Meteorological Monitoring Tower Network

major site facilities. The basic requirements used in selecting each area-tower site were:

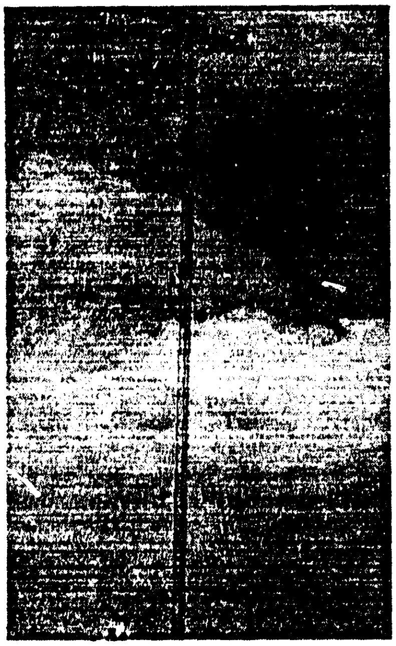


Figure 3.2a

- located within 0.5–1.0 mile of each operational production facility
- situated above relatively undisturbed forest
- raised at similar mean sea level (MSL) elevations to the nearby facility
- measurements taken at the major facility stack height of 200 ft (61 m) above the ground surface to ensure representative dose calculations

Near the end of 1987, new, more stable Area Towers were installed to replace the original towers (see Figure 3.2). These towers were erected within 10 ft of the original towers. The MRI Vector Vane was initially used as the wind speed and direction measuring instrument for the Area Towers (see Attachment A-1 for an electrical description of the Vector Vane). With the renovation conducted in 1987, Teledyne Geotech bivanes and cup anemometers were chosen to measure wind speed, direction, and atmospheric turbulence.

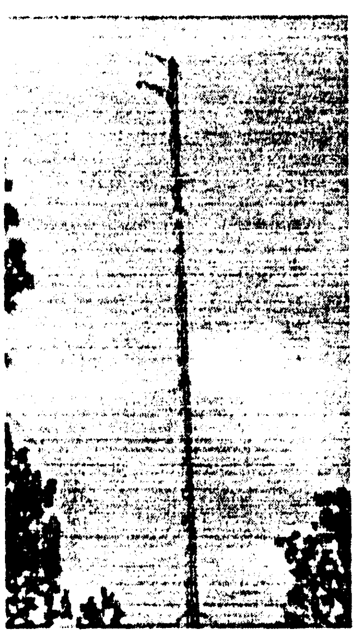


Figure 3.2b

Today, the Area Towers provide additional functions beyond emergency response for atmospheric effluents. Five-year databases (Hoel, 1983), (Laurinat, 1987), (Parker et al., 1992) have been created from archived tower data for use in environmental, engineering, and dosimetric studies. Also, the spatial variability of the local wind field at SRS, which is monitored by the Area Towers, is very useful for the regional 3-D model being developed by the ETS (Fast et al., 1991).

## Facility Layout

The facility layout at each of the eight Area Towers is nearly identical. A Rohn 55 triangular tower is anchored in a 125 $ft^3$ concrete pad. The tower structure is supported by three sets of guy wires separated by 120° (see Figure 3.3). A "data building" is located 30–40 ft from the base of the tower. This building (see Figure 3.4) is approximately 10 ft by 10 ft and is used to house the cabling, data transmission, and electrical-power-supply equipment required by the tower and instrumentation system. The data building is heavily insulated, and a nearly constant temperature within the building is maintained through the use of a heater and air conditioner. Extra space and a small table inside the building provide a work area for instrument maintenance.

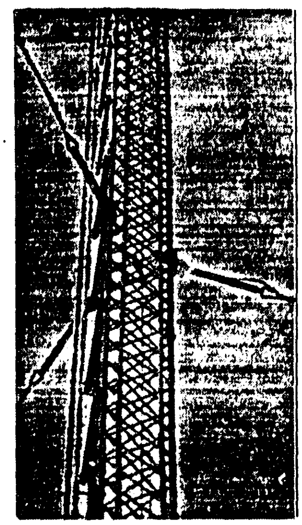
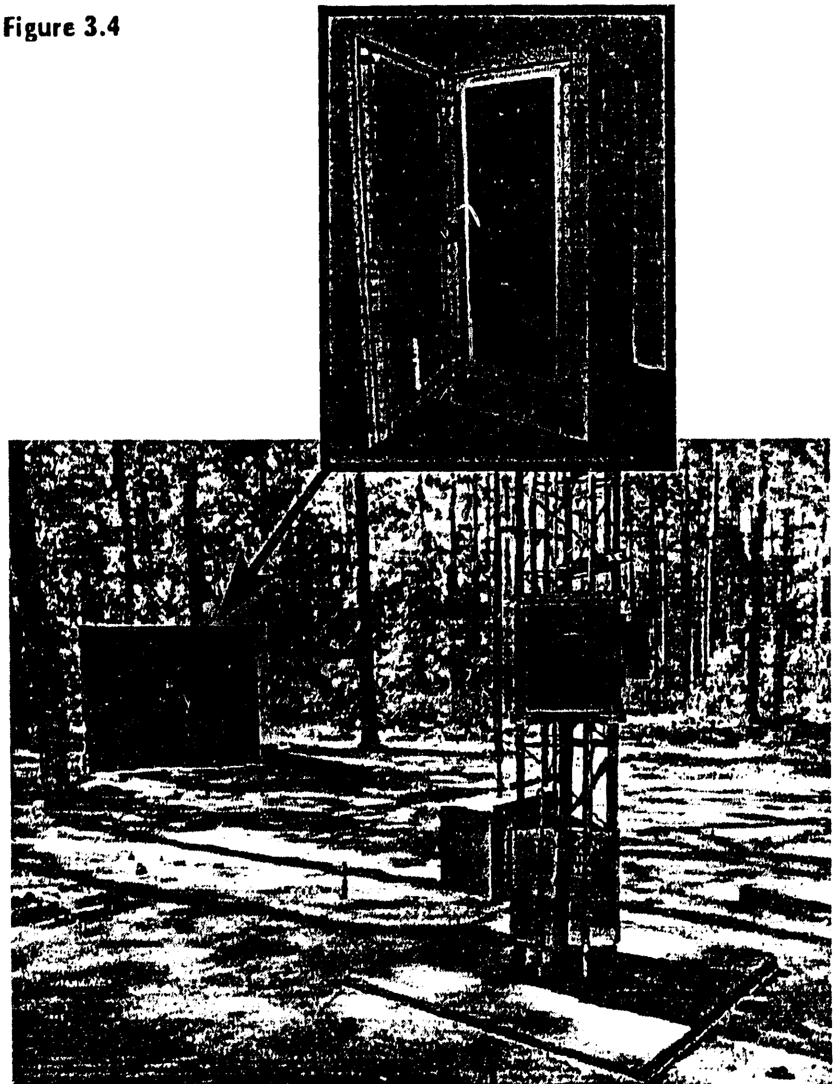


Figure 3.3

To maintain the forest canopy near each Area Tower, guidelines have been defined (SU-91-22-O see Attachment A-1) that restrict land usage for zones having a radii of 250 ft and 2000 ft from the base of each tower. No activity or construction is permitted within 250 ft of the tower. Any site activity or construction which is proposed within 2,000 ft of the tower must be approved by the ETS. The Savannah River Forest Station has implemented a specialized plan to maintain the height of the forest canopy through selective thinning and reseeding practices. In general, only small scale construction is permitted within 2000 ft of each tower.

Figure 3.4



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## Instrumentation

### *Configuration*

Area Tower instrumentation is located at two levels. At 61 m, measurements of both the horizontal and vertical wind direction are made with a Teledyne Geotech Model 1585 bivane. Measurements of the horizontal-wind direction (azimuth) and the vertical-wind direction (elevation) are used to calculate atmospheric turbulence directly as the standard deviation of azimuth ($\sigma_A$) and the standard deviation of elevation ($\sigma_E$). Wind-speed measurements are made with a Teledyne Geotech Model 1564B cup anemometer. Air temperature and dew-point-temperature measurements are made using aspirated solar radiation shields. A platinum resistance probe, Teledyne Geotech Model T-200, for temperature measurements and lithium-chloride resistance probe, Teledyne Geotech Model DP-200B, for dew-point measurements are housed in separate aspirators. At 2 m, an aspirated platinum resistance temperature probe is mounted. In D Area, an additional level at 36 m (110 ft) is instrumented with a bivane and anemometer to measure atmospheric flows induced by the terrain in the Savannah River valley.

Instruments are mounted (see Figure 3.5) on a 2 m boom with a 1 m supporting crossarm used for the bivane and cup anemometer. The temperature probe is housed in an aspirated shield that extends below the crossarm. The aspirated dew-point probe housing is mounted to the support boom. The temperature probe at 2 m is mounted to the main tower structure away from the elevator tracks.

### *Sensors*

A description of each of the instruments used at the Area Towers follows. Additional maintenance tips for each sensor have been

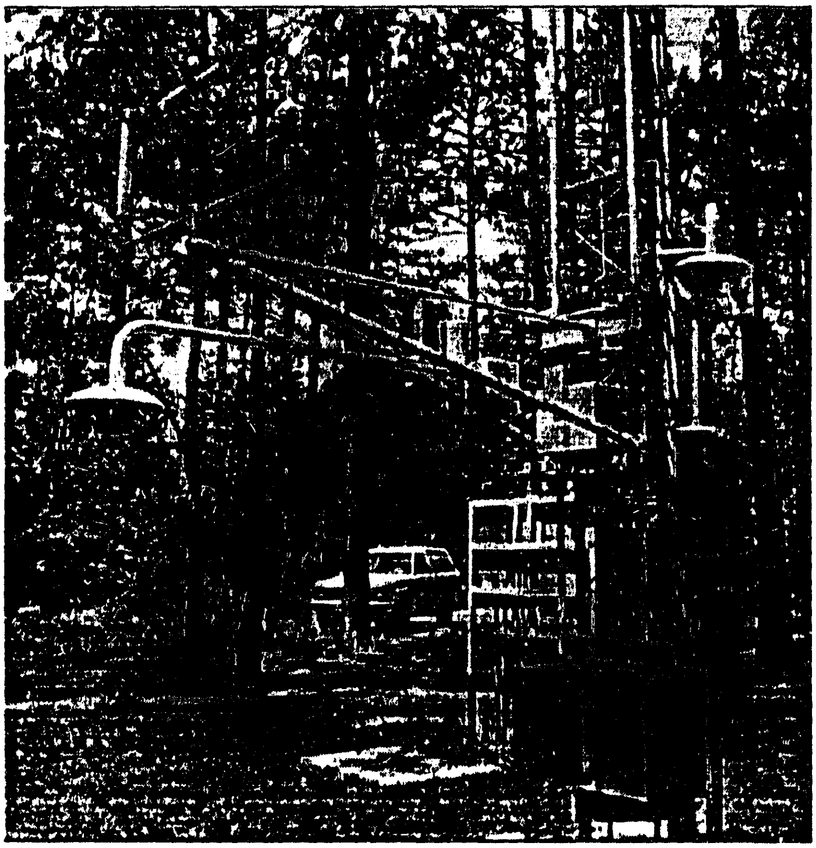


**Figure 3.5** ***Sensors on the Tower Boom***

added after the description of each instrument.

## *Teledyne Geotech Model 1585 Bivane*

The Teledyne Geotech Model 1585 bivane (Figure 3.6) is used to measure horizontal and vertical wind direction at the area towers. The model 1585 utilizes a unique method of creating electronic signals without the use of potentiometers that are commonly used in similar types of wind sensors. As the electromagnetic field properties (inductance) of a cam and ferrite core system change, the relative location of the vane shaft is determined in the horizontal and vertical planes. For the horizontal wind direction, the location is translated into a constant amplitude square wave. This signal is then compared to a "standing" square wave produced by signal processing cards. The difference between the position of the standing wave and the wave produced by the vane shaft is resolved into a voltage. This voltage is directly related to an angle measurement in degrees. For the vertical wind direction, the voltage (potential) produced by the cam/ferrite care system is interpreted as an angle measurement in degrees.

Using the Model 1585 bivane has many advantages. The method of angle measurement through the use of the resolving technique can reduce the "gap" which occurs when horizontal wind direction readings are made near 0° (360°). Vanes which utilize potentiometers are not able to make measurements within the physical gap between the "end" of the potentiometer coil and wiper. This gap in

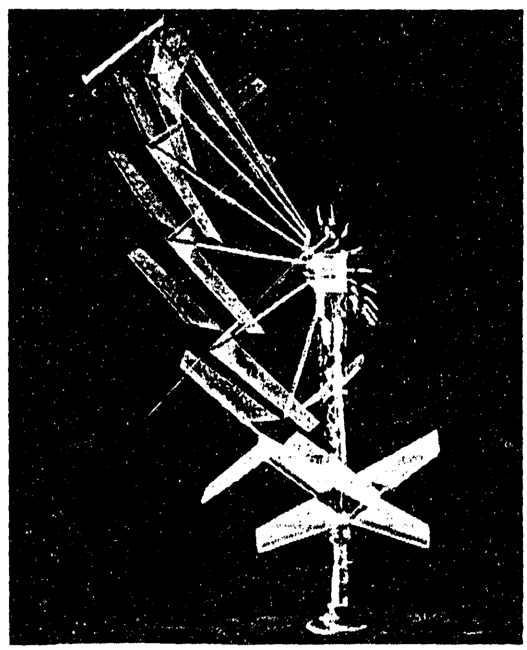


**Figure 3.6** *Teledyne Geotech Model 1585 bivane*

potentiometers usually results in a 3° to 5° dead zone. The Model 1585 bivane contains a gap of only 1°. Also, potentiometers will physically wear out in a matter of months whereas the electronic components of the Model 1585 will operate for years without any physical wear and tear. The signal outputs from the Model 1585 are in the form of audio frequencies which eliminates the problem of signal degradation with line length. Therefore, the line resistance of signal cables will not alter bivane readings and accurate readings can be made with any length of cable without signal degradation. The bivane has been shown to provide the most reliable and cost effective method to take accurate, direct measurements of turbulence (Hanna et al., 1977). Measurements of turbulence are expressed as standard deviations of fluctuations about the mean azimuth ($\sigma_A$) and elevation ($\sigma_E$) angle. See Table 3-1 for model 1585 specifications.

For more information on specifications, circuitry, or maintenance, please refer to Teledyne Geotech's *Operation and Maintenance Manual for Bivane Model 1585*. For more information about the circuitry, operation, and maintenance of the bivane signal processor cards see Teledyne Geotech's *Operation and Maintenance Manual for Wind Direction Processor Model 21.21* and *Operation and Maintenance Manual for Elevation Processor Model 21.24*.

### Teledyne Geotech Bivane Maintenance

Several areas require special attention when maintaining the Model 1585 bivane. Proper lubrication must be used in and around the bivane cam shaft and vane coupling when installing a vane to prevent seizing. Otherwise, serious damage to the ferrite core may occur if excessive force is needed to remove a stuck vane. Special attention should be given to using the bivane mounting holder properly. If the thumbscrew is tightened excessively, an imprint may occur on the bivane shaft which will inhibit future bivane orientation. This imprint may not allow the thumbscrew to align to a new position because the imprint will guide the thumbscrew to its former position. The expected field life of a bivane is normally 2–3 years before instrument refurbishment must be performed by Teledyne.

### Teledyne Geotech Model 1564B Cup Anemometer

Wind speed is measured at each Area Tower with a Teledyne Geotech Model 1564B cup anemometer with a molded polycarbonate 3 cup assembly Model 170-41 (see Figure 3.7 and Table 3-2). The anemometer takes readings of wind speed by relating the rate of rotation of the cups through the use of a light chopper attached to the support shaft of the cup housing. The light chopper rotates due to the move-

**Table 3-1.** Specifications of Teledyne Geotech Bivane Model 1585.

| | |
|---|---|
| Distance constant | 1.0 m vertical and horizontal |
| Accuracy | ±2° |
| Resolution | 0.072° horizontal |
| | 0.024° vertical |
| Damping ratio | 0.4 horizontal and vertical |
| Response threshold | 1.0 mph horizontal and vertical |
| Range | 0° to 360° horizontal |
| | -60° to +60° vertical |

**Table 3-2.** Specifications of Teledyne Geotech Wind-Speed Transmitter Model 1564B with a 3-Cup-Assembly Model 170-41.

| | |
|---|---|
| Distance constant | 1.5 m maximum |
| Accuracy | ±1% of true wind speed |
| Response threshold | 1.0 mph maximum |
| Range | 0 to 100 mph+ |

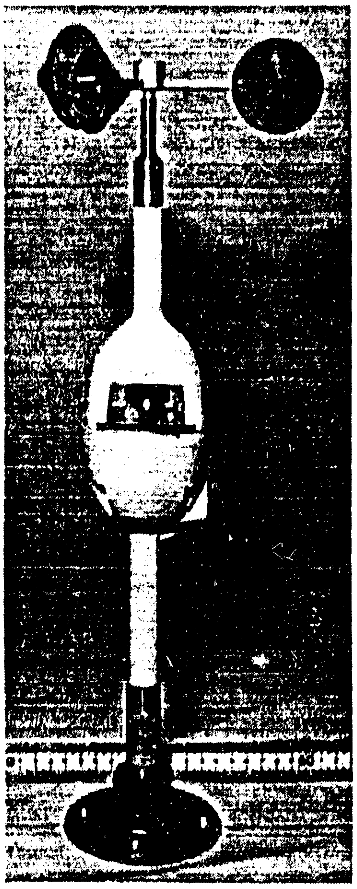


Figure 3.7

ment of the cups and passes through a photo-diode. The light chopper creates breaks in the light passing through the photo-diode. The frequency of the "breaks" is converted to a voltage by a signal processor card. This voltage is directly related to the wind speed. Although this method of measuring wind speed through the use of cups and a light chopper is common among anemometers, the Model 1564B has been constructed with high integrity electronic components which require very little maintenance and operate dependably for many years.

For more information on specifications, circuitry, or maintenance, please refer to Teledyne Geotech's *Operation and Maintenance Manual for Wind Speed Transmitter 1564B*. This manual also contains information concerning the 3-cup-assembly model 170-41. For more information about the circuitry, operation, and maintenance of the anemometer signal processor card see Teledyne Geotech's *Operation and Maintenance Manual for Wind Speed Processor Module Model 21.11*.

## Teledyne Geotech Anemometer Maintenance

The Model 1564B cup anemometer by Teledyne Geotech requires only a limited amount of special attention. Under normal conditions, regular bearing replacement will be the only necessary maintenance. Infrequently, the plug has been known to wear and fail when pins break or bend. Cups will last about 2–3 years before cracking or discoloring. New improved tinted cups which protect from ultra-violet rays and other sun related wear are available from Teledyne for use as replacements.

## Teledyne Geotech Model T-210 Temperature Probe

Air temperature is measured by a slow response resistance temperature probe. The probe used at each area tower at 2 m and 61 m is the Teledyne Geotech platinum-resistance temperature sensor Model T-201 which is housed in an aspirated shield (Figure 3.8 and Table 3-3). The simple probe is constructed with platinum wires sealed in a stainless-steel tube (0.25 in diameter x 4.0 in length). The wires in the probe relate electrical resistance to air temperature and are configured to reduce line resistance errors. Reliability of readings result from the long-term stability and durability of the sensor. The shield and aspirator ensure representative readings by protecting the sensor from excessive thermal radiation and providing sufficient ambient air flow. The shield itself is actually two shields which optimize radiation protection and the aspirator motor is equipped with an alarm which is set off by a lack of sufficient air flow.

For more information on specifications, circuitry, or maintenance, please refer to Teledyne Geotech's *Operation and Maintenance*

**Table 3-3.** Specifications of Teledyne Geotech Platinum Resistance Temperature Probe Model T-210 and Aspirated Thermal Radiation Shield Model 327-C.

| | |
|---|---|
| Time constant | 45 sec in moving air |
| Accuracy | ±0.25°C |
| Range | -50°C to 50°C |
| Aspiration rate | 6 m/s |
| Shielding | error < 0.1°C |

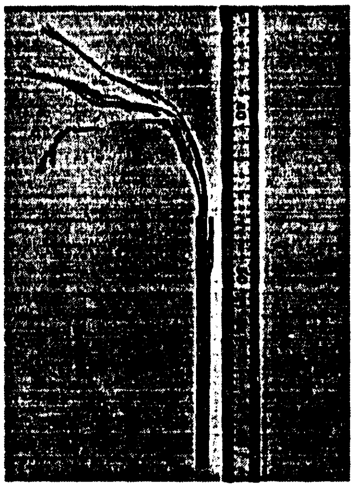


**Figure 3.8** *Teledyne Geotech Model T-210 Temperature Probe*

*Manual for Aspirated Thermal Radiation Shield Model 327-C.* This manual also contains information concerning the platinum-resistance temperature sensor, model T-210. For more information about the circuitry, operation, and maintenance of the temperature probe signal processor cards see Teledyne Geotech's *Operation and Maintenance Manual for Platinum RTD Sensors Model 21.32.*

## Teledyne Geotech Model DP-200B Dew Point Sensor

Teledyne Geotech Model DP-200B dew point temperature sensors are located at the 61-m level at each area tower (Figure 3.9 and Table 3-4). Dew point temperature is measured by a lithium chloride soaked wick which absorbs water from the air until an equilibrium temperature is reached and the absorption stabilizes. This equilibrium temperature, the dew point, is measured by the resistance of a platinum-wire coil surrounding the wick. The entire dew point sensor is housed in an aspirated shield to ensure a representative dew point reading by maintaining a steady flow of ambient air near the probe and by protecting against undue radiation. A baffle is used to reduce the air flow near the probe to less than 1% of the aspirated flow to inhibit undesirable induced cooling.

For more information on specifications, circuitry, or maintenance, please refer to Teledyne Geotech's *Operation and Maintenance Manual for Lithium Chloride Dew Point Sensor Model DP-200B*. For more information about the circuitry, operation, and maintenance of the dew-point probe signal-processor cards, see Teledyne Geotech's *Operation and Maintenance Manual for Platinum RTD Sensors Model 21.32 and Model 21.43 Dew Point.*

## Dew Point Sensor Maintenance

During probe refurbishment, there are several points of concern for Model DP-200B Dew Point Sensors in addition to

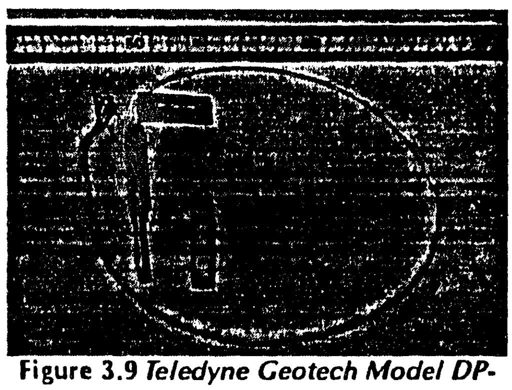


**Figure 3.9** *Teledyne Geotech Model DP-200B dew point temperature sensor*

**Table 3-4.** Specifications of Teledyne Geotech Lithium Chloride Dew Point Sensor (with aspirator/radiation shield) Model DP-200B.

| | |
|---|---|
| Time constant | 0.9 min. |
| Accuracy | ±1.7 °C |
| Range | -30°C to 50°C (dew point) |
| Aspiration rate | 1% > air flow due to baffle (inhibits induced cooling) |
| Shielding | error ±1°C |

the instructions in Teledyne Geotech's manual. If probes are tinged with excessive brown or green stains which are not removed by cleaning, then the probe may not operate correctly and should be tested for accuracy in the Meteorological Engineering Facility (735-7A) before reinstallation in the field. If any probe repels lithium chloride after repeated proper cleaning, then discard the probe. An oven set at 120°–140° can be used to dry the probes to remove moisture per Teledyne's procedure. Probes can be dunked into lithium chloride solution instead of using a dropper application only. The expected probe lifetime can be 4–5 years with proper cleaning every 6–24 months, but a shorter operable time period is likely if the probe is subjected to a relatively "dirty" environment (i.e., pollen, tree sap, etc.).

## Data-Signal Transmission

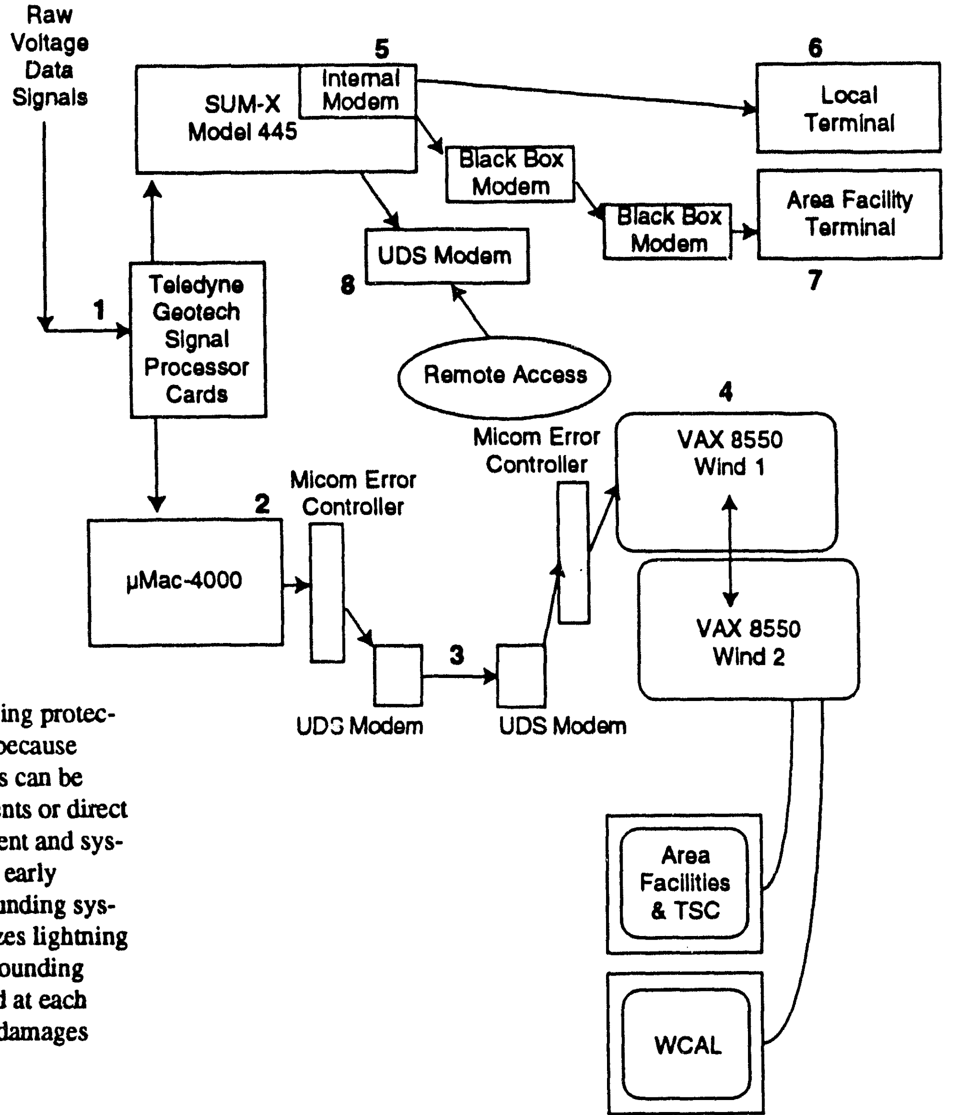
The process of sending information from a particular meteorological instrument through the meteorological monitoring network at SRS is actually very similar for each sensor. Figure10 is a schematic diagram of this process. The following is a step by step discussion of the meteorological data transmission with references to Figure 3.10.

In Step 1, continuous frequency signals (bivane and anemometer) or resistances (temperature or relative humidity probes) are converted to analog voltages by the signal processor cards. These cards are adjusted according to specific individual instrument specifications (i.e., for each cup anemometer, temperature sensor, and dew-point sensor) provided by the manufacturer or according to predetermined frequency/voltage relations (i.e., for the bivane).

At Step 2, the voltages are surveyed by the analog to digital data acquisition unit, the µMac-4000. The µMac-4000 digitizes, scales, and linearizes the signal. Data is continuously updated and stored in the random access memory (RAM) of the µMac-4000 After this signal conditioning is completed, the data is ready to be transmitted. The µMac-4000 sends a signal to a "sending" Micom error controller continuously. The signal then travels via a Universal Data Systems modem at 4800 baud, over a dedicated conditioned phone line, to another modem at the 773-A computer center (Step 3). The phone lines are conditioned by Southern Bell to ensure low signal to noise ratios and proper line resistance. This second modem in 773-A sends data to a "receiving" error controller. The error controllers maintain signal integrity by monitoring the transmit/receive status. Finally, these data are sent to the two VAX 8550 WIND System computers (Step 4) that sample the data signals every 1.5 seconds. Software on the VAX computes 15-minute averages and standard deviations.

Data is also stored at each tower location by a SUMX model 445 data logger (Step 5). Up to 14 days of data is stored by the SUMX and can be obtained via a modem. Data can be viewed locally via an internal modem and terminal at each tower (Step 6). All onsite production or processing facility control rooms have computer terminals and modems on dedi-

**Figure 3.10** ***Area Tower Data Collection and Transmission Flowchart***




cated phone lines that are used exclusively for accessing the data stored by the SUMX (Step 7). The use of a data logger provides a back-up system for data collection and is also accessible through the use of a terminal and modem (Step 8) for system maintenance.

## Lightning Suppression

The location of the SRS in the thunderstorm-prone southeastern US makes a quality lightning protection system extremely important because meteorological instrument failures can be caused by lightning induced currents or direct strikes. Lightning related instrument and system failures were prevalent in the early 1970's. However, the present grounding system at each tower greatly minimizes lightning related damages. A network of grounding cable and rods have been installed at each tower to inhibit lightning related damages (Figure 3.11).

At the top of each tower, two 4-ft lightning rods comprise the pinnacle of the lightning protection system. Three 2/0-stranded ground cables are connected to the two lightning rods and each wire descends via a separate tower support post. Each wire is connected to the top guy wire and then terminates at the second-highest guy.

The middle sections of each tower are grounded directly to each guy wire. A ground wire is connected to each tower support post and then to the nearest-guy wire.

At the base of the tower structure, a copper 2/0 stranded ground cable is connected to each of three tower supports. These cables pass underground, parallel to the support guy wires, beyond the base of the tower to ground cables in concentric circles of 8 ft and 50 ft radii buried 2.5 ft below the ground surface. The termination point for each tower support cable is at the ground level base of the guy wires that are also ground points for all of the guy wires. Ground rods, made primarily of copper, are located at every intersection of two ground cables and at the base of the guy wires.

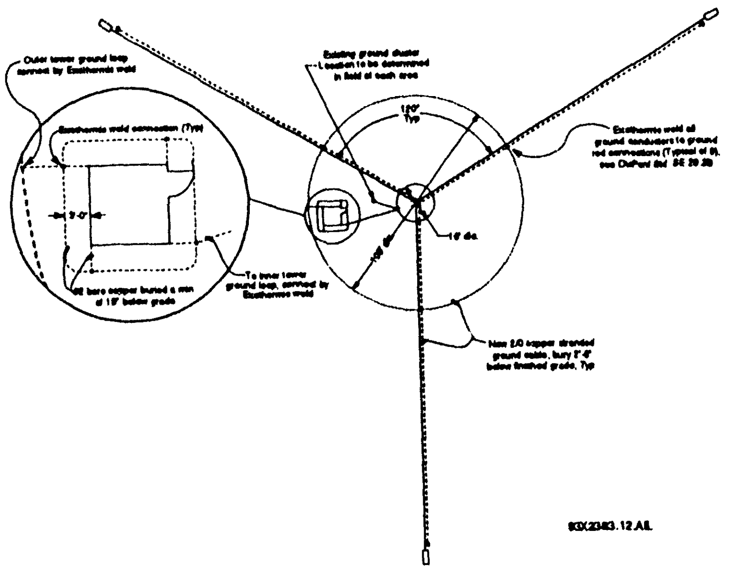


**Figure 3.11** Schematic

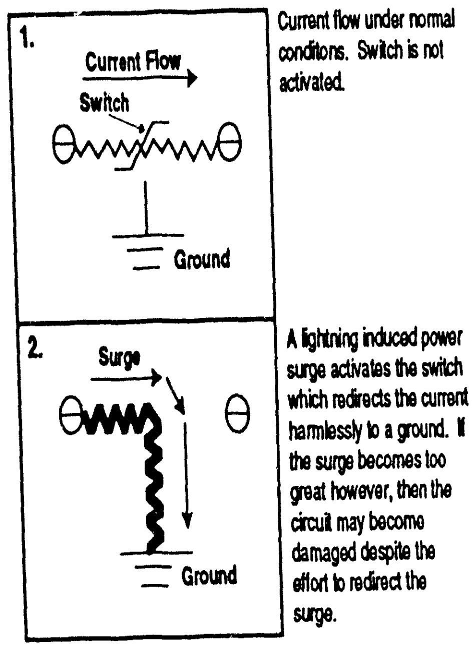



**Figure 3.12** ***Basic Description of a Surge Suppresser***

Each ground rod extends approximately 20–30 ft below the ground surface.

The data building is also grounded. Four-ground rods are located at each corner and four more are located at the corners of a square that extends 3 ft beyond the outside of the building. All of these rods are connected by ground cable. The data-building ground system is tied to the 8 and 50 ft radii ground cables of the tower.

When possible the grounding network for each tower has been tied to the existing grounding network of the tower that had been previously erected at the site.

The grounding network is supplemented by additional lightning suppression circuitry (Figure 3.12). Surge suppressors are used to protect against damaging power "spikes" caused by lightning induced electrical current. Basically, these surge suppressers work by redirecting current through a ground wire when potential differences (voltages) become too great. Residual current that escapes the grounding pathway is channeled to a zener diode that further protects the instrument circuitry. Surge suppressers are located at three strategic locations between each instrument and its respective signal processor card. The first location is at the junction box attached to the tower at 200 ft. These surge suppressers inhibit surges that flow from the tower structure toward the instrument. The other two locations, at the tower base junction box and the instrument cabinet inside the data building, have surge suppressers that inhibit flow from the tower toward the signal processor cards.

Surge protector power strips are connected to electrical outlets to prevent surges from coming from an A/C power source.

Surge protectors are also used to protect the various phone lines in the data building.

## Electrical Power Supply

Electrical power is supplied to each tower via the SRS grid. Onsite power production accounts for about 40% of the SRS needs with the remaining portion supplied by South Carolina Electric and Gas. In the event of a power outage, portable diesel or gasoline generators are used to supply an individual tower with electricity.

The power supplied to each tower is normal 110-VAC. It is backed-up by an uninterruptable power supply (UPS) located in the data building at the base of the tower. The UPS is powered by two-deep-cycle batteries that are in a continuous state of charge under normal operating conditions, and can provide up to 5.5 hours of back-up power automatically if the main-power supply is unavailable. Diesel generators are available as an alternate back-up power source in the event that the power supply to any tower is interrupted for more than a few hours. All meteorological instrumentation and signal processing equipment installed at the area towers are powered by 12-VDC. Transformers convert 110-VAC power to 12-VDC to provide the appropriate current for each instrument.

## Routine Facility Maintenance

Each tower facility undergoes several types of maintenance. Maintenance is separated into quarterly and annual inspections. Quarterly inspections are made of the electric winch and cables of each tower. During the annual inspection, three separate SRS service groups interact by checking the condition of electrical (E & I) components (motor, circuit breakers, etc.), mechanical (Maintenance) components (lubrication level of the gear box, loose bolts, etc.), and rigging (T & T) (winch cable, clamps, etc.). Annual inspections of tower orientation (twist) are made by an off-site vendor. During an inspection, the structure of the tower is inspected for irregularities or "kinks" that, if necessary, can be corrected by adjusting the appropriate guy wires. The winch cable is checked for wear, and the condition of the lightning rods are also documented. Guy wire tension measurements are made at the end of an inspection. Grounds keeping involves routine grass cutting and/or forest canopy culling or trimming. The entire maintenance process is coordinated by the ETS.

## Area Specific Descriptions

Characteristics of each specific area are described in the following sections. Elevation is given with respect to height above mean sea level (MSL).

### *A-Area*

The A-Area Tower facility is located at 33° 20' 48" N, 81° 44' 30" W (Plant Coordinates N 107585.75, E 50949.56) at an elevation of 109 m (358 ft) in the vicinity of the main Savannah River/Department of Energy administration buildings and the Savannah River Technology Center (Figure 3.13). Emergency response operational control facilities (i.e. Savannah River Site Operations Facility (SRSOF), Emergency Operating Facility (EOF), Weather Center Analysis Laboratory (WCAL)) are also located in A Area. The potential for harmful atmospheric releases in this area is minimal and is limited to waste disposal failure (i.e. exhaust hoods, low level drains and tanks, etc.). The A-Area Tower is also located the farthest north of any Area Tower and represents an important data point when creating spatially averaged means of meteorological variables.

The area within 2000 ft of the A-Area Tower varies. The building/parking lot complex is located to the east and southeast of the tower. Generally, all other quadrants are forested. The forest buffer between the tower and the building/parking lot complex is approximately 300–500 ft. There is no pronounced terrain slope. Instrumentation is directed west.

## *C Area*

The C-Area Tower facility is located at 33° 15' 0" N, 81° 40' 9" W (Plant Coordinates N 66163.32, E 47901.90) at an elevation of 92 m (303 ft) in close proximity to the C Reactor (Figure 3.14). This reactor is not operating (in "cold" standby) but is used for training purposes. The potential for a harmful atmospheric release is virtually non-existent. The location of C Area toward the center of SRS provides a central data point for spatial averaging. The C-Area Tower is located about 1 mile away from the Central Climatology Tower and provides a means of measurement comparison at 61m.

The forest canopy within 2,000 ft is full to the north, northeast, south, and southeast of the tower. The C-Area building complex dominates the terrain to the west of the tower. The N-Area (Central Shops) building complex is located to the east of the C-Area Tower facility, but a half-mile wide forest buffer helps to protect the tower from building wake effects. The terrain slope near the tower is negligible and the ground is composed primarily of sand as opposed to red clay at the other towers. Instrumentation is directed west.

## *D-Area*

The D-Area Tower facility is located at 33° 12' 32" N, 81° 44' 27" W (Plant Coordinates N 67167.79, E 21328.71) at an elevation of 43 m (142 ft), differs slightly from other WIND System towers (Figure 3.15). D Area is the location for onsite electrical power and steam production. Its location is in the flood plain of the Savannah River in the western portion of SRS. Drainage flows play an important role in the river valley, and an extra level of instrumentation, identical to the 61m level minus temperature and dew point instruments, has been installed at 36m to measure drainage related phenomena. Consequently, the increased storage requirements due to the extra level of instrumentation mean that the SUMX data logger only can store five days of data as opposed to 14 days at the other Area Towers.

The forest canopy within 2,000 ft of the D-Area Tower is generally full, except for powerline path clearings, to the southwest, west, north, and northeast. The canopy is virtually non-existent to the south and east. The terrain slopes slightly from northwest to southeast. The canopy is predominantly composed of hard-wood trees as opposed to pine trees at the other sites. Instrumentation is directed to the south.

## *F-Area*

F Area is the location for various processing facilities. The F-Area Tower facility (Figure 3.16) is located to the west of the building complex at 33° 16' 42" N, 81° 40' 58" W (Plant Coordinates N 76773.21, E 50798.16) at an elevation of 88 m (290 ft). Although the risk is slight, the potential for harmful releases exists due to the extensive use of numerous radioactive isotopes in this area. The proximity of the SRS burial grounds also increases the importance of the F-Area Tower facility.

The forest canopy within 2000 ft of the F-Area Tower facility contains breaks due to roads, buildings, and construction. These breaks are nearly evenly distributed in all quadrants. A clay pit encompassing approximately 30 acres is located a few-hundred feet to the southwest of the tower. The terrain slopes gently from the northwest to southeast. Instrumentation is directed to the west.

## *H-Area*

H Area is the site of tritium production from processed nuclear fuel. Potential tritium releases are the major concern for this area. The H-Area Tower facility (Figure 3.17) is located at 33° 16' 57" N, 81° 37' 14" W (Plant Coordinates N 68833.98, E 66772.14) at an elevation of 91 m (300 ft) to the east of the main building complex. This tower had been previously located to the west (site coordinates N 70413.00, E 64256.00) of the present site but was moved in 1984 because of construction and forest removal near the previous position.

The forest canopy within 2000 ft of the tower is nearly completely intact except for a small area to the extreme southwest of the tower. Meteorologically, this tower provides the most representative data for flow over the forest canopy regardless of wind direction due to the completeness of the canopy. The terrain slope is negligible. Instrumentation is directed west.

### K-Area

K Area is the site of one of the production reactors at SRS. Meteorological monitoring at this site is done for potential releases from the reactor stack or filters. The close proximity of L Area (see next section) also makes K Area a potential back-up meteorological monitoring site should L-Area Tower become inoperable. The K-Area Tower facility (Figure 3.18) is located at 33° 12' 27" N, 81° 39' 30" W (Plant Coordinates N 51712.39, E 41285.51) at an elevation of 31 m (267 ft) to the south of the complex.

The forest canopy within 2000 ft of the K-Area Tower is generally full in all directions except to the north where a considerable portion of the radius zone falls over the building complex. The terrain slope is negligible. Instrumentation is directed west.

### L-Area

L Area is also the site of one of the production reactors (L Reactor is in standby) at the SRS. Meteorological monitoring at this site is done for potential releases from the reactor stack or filters, and the L-Area Tower may serve as a back-up to K Area. A 1000-acre cooling retention reservoir, L Lake, is located to the south-southwest of the L-Area Tower facility. Under certain conditions, turbulence measurements may be lowered due to a more laminar flow over L Lake. Normally, this phenomenon is only observed when a strong wind from a small south-southwest arc is observed. The L-Area Tower facility (Figure 3.19) is located at 33° 12' 56" N, 81° 37' 2" W (Plant Coordinates N 46650.00, E 53198.59) at an elevation of 85 m (280 ft) to the east of the L-Area complex. This tower was not part of the original Area Tower network, it was erected in 1985.

The forest canopy within the 2000 ft radius zone of the L-Area Tower is generally intact except for the area adjacent to the building complex. The slope of the terrain is gentle from northwest to southeast. Instrumentation is directed to the south.

### P-Area

P Area, like K and L Areas, is the site of a production reactor (P Reactor is in "cold" standby) at the SRS. Meteorological monitoring at this site is done for potential releases from the reactor stack or filters. Similar to L Area, turbulence measured at the P-Area Tower facility can be lowered due to the proximity of Par Pond, a cooling retention reservoir for P and R Reactors (R Reactor is no longer in service). This phenomenon normally occurs only with a strong northeast wind and is not likely to be as pronounced as at L Area since the water is farther from the P-Area tower. The P-Area Tower facility (Figure 3.20) is located at 33° 13' 32" N, 81° 34' 21" W (Plant Coordinates N 41457.50, E 66333.85) elevation of 93 m (306 ft) to the southeast of the P-Area building complex.

The forest canopy within 2000 ft of the P-Area Tower is generally full to the east and south. The canopy is more broken to the north and west with the P-Area building complex to the northwest. The terrain slope is gentle from northwest to southeast. Instrumentation is directed west.

## References

Fast, J. D., B. L. O'Steen, and R. P. Addis, 1991: *Development of an Advanced Atmospheric /Transport Model for Emergency Response Purposes (U).* WSRC-RP-91-577. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

Hanna, S. R. et. al., 1977: *AMS Workshop on Stabiiity Classification Schemes and Sigma Curves--Summary of Recommendations.* Vol. 58, No. 12. Bulletin of the American Meteorological Society, Boston.

Hoel, D. D., 1983: *Climatology of the Savannah River Plant Site.* DPST-83-703. Savannah River Laboratory, E. I. du Pont de Nemours & Co., Aiken, SC.

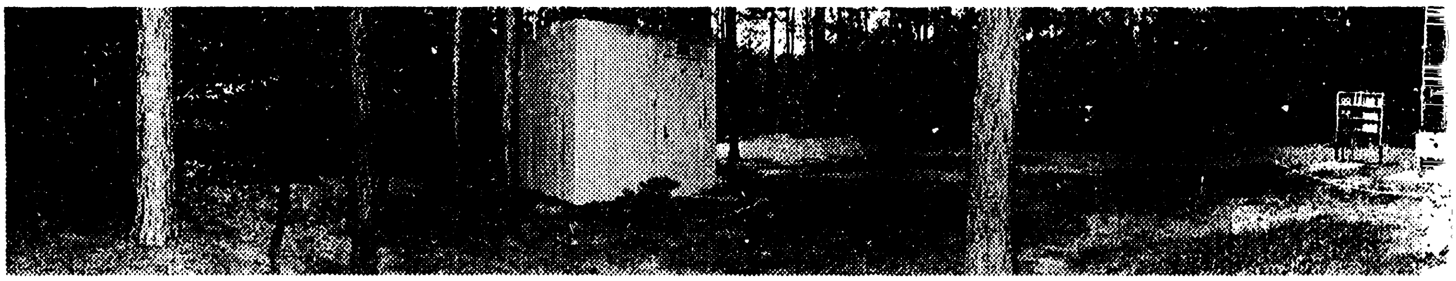
Laurinat, J. E., 1987: *Average Wind Statistics for SRP Area Meteorological Towers.* DPST-87-341. Savannah River Laboratory, E. I. du Pont de Nemours & Co., Aiken, SC.

Parker, M. J., R. P. Addis, C. H. Hunter, R. J. Kurzeja, C. P. Tatum, and A. H. Weber, 1992: *The 1987-1991 Savannah River Site Meteorological Data Base (U).* WSRC-RP-92-598. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

## Attachments

1. MRI Model 1053 III-2 Vector Vane
2. Site Use Guidelines for the Zones Surrounding the SRL/Environmental Technology Section Meteorological Towers
3. Savannah River Site – E & I Department, WIND Data Facilities Seminar Package.

A-Area Tower 1988



A-Area Tower 1993

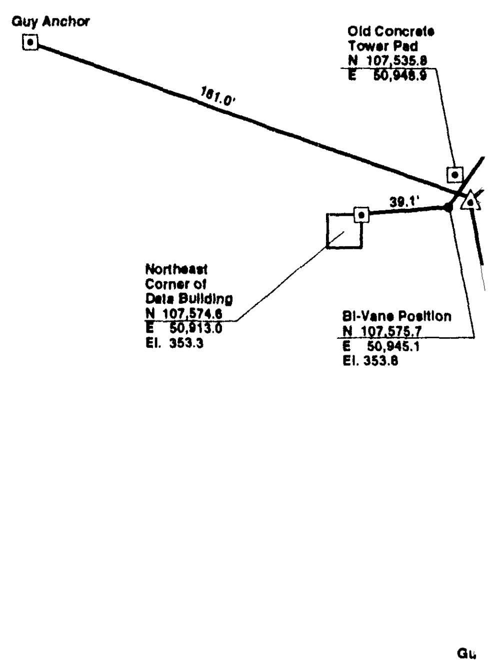
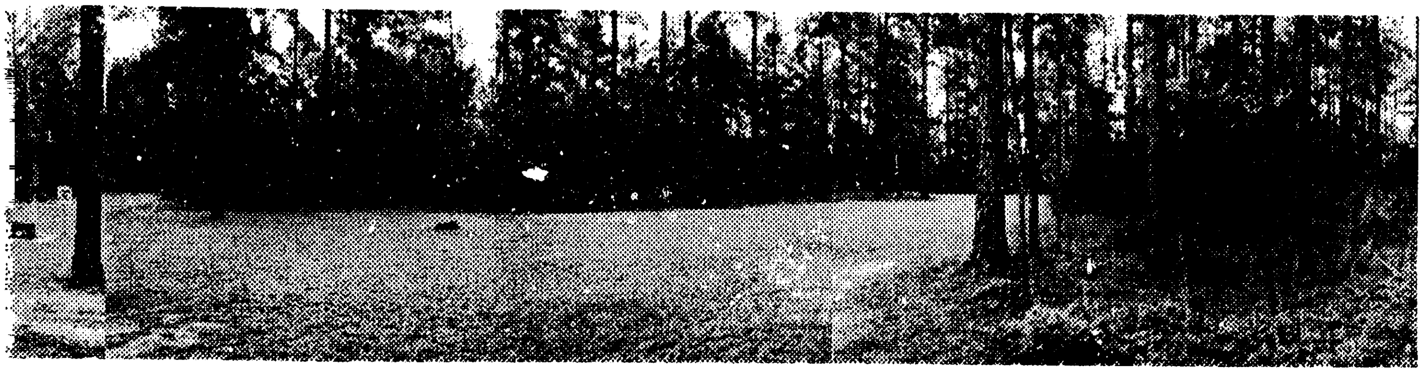
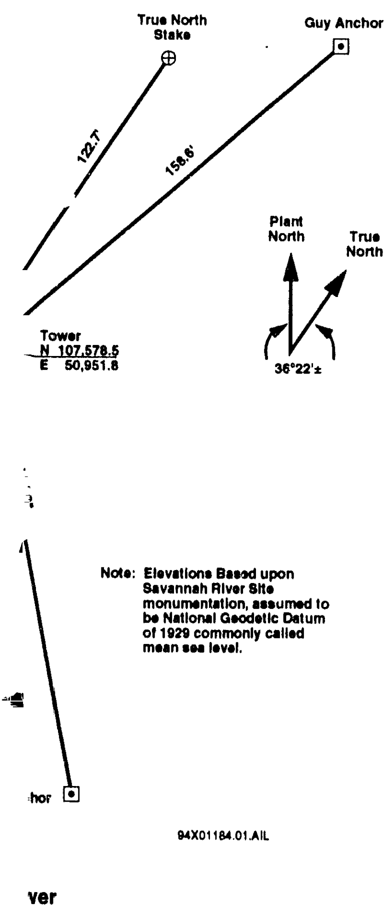



**Figure 3-13.** A-Area Tower

**A-Area Meteorlogical Tc**

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Stake
Guy Anchor
122.7'
158.6'
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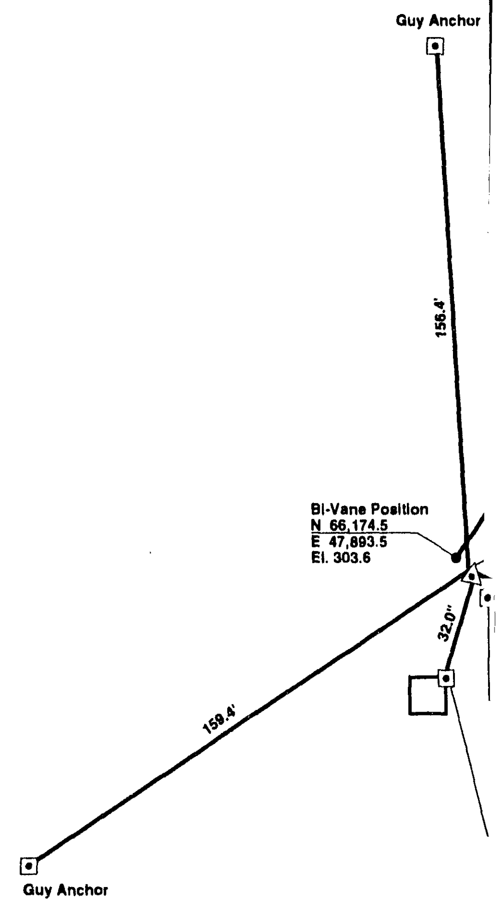
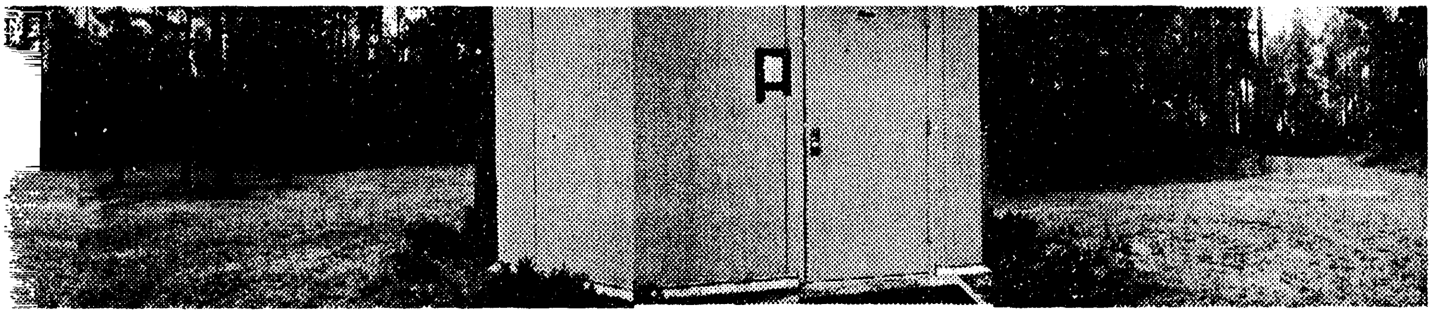
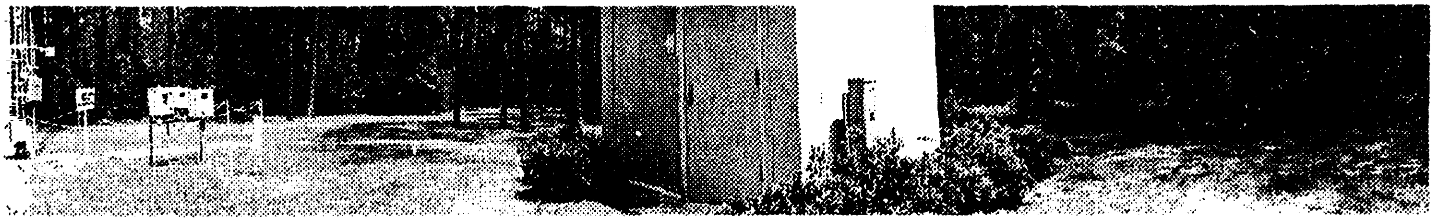
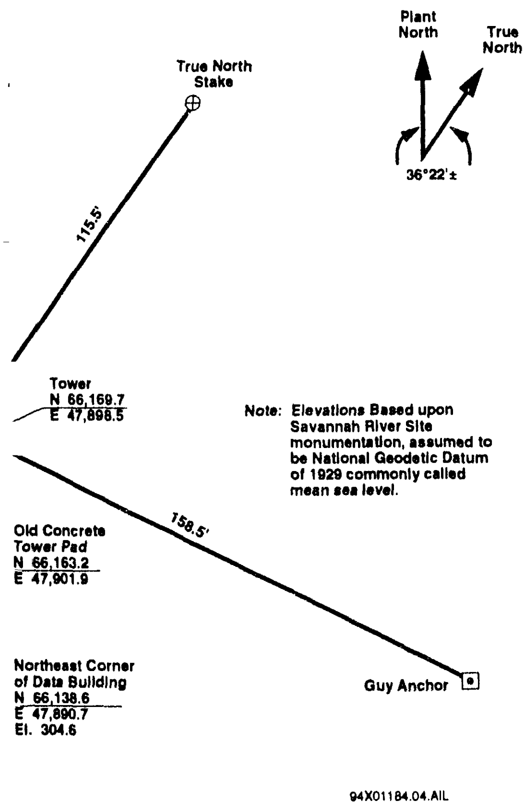



**Figure 3-14.** C-Area Tower

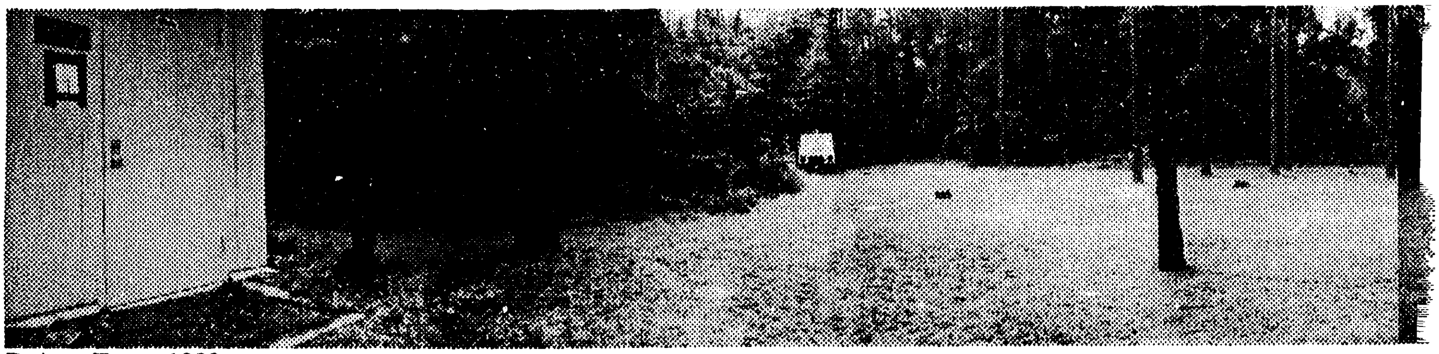
C-Area Metec








**logical Tower**



D-Area Tower 1988

D-Area Tower 1993

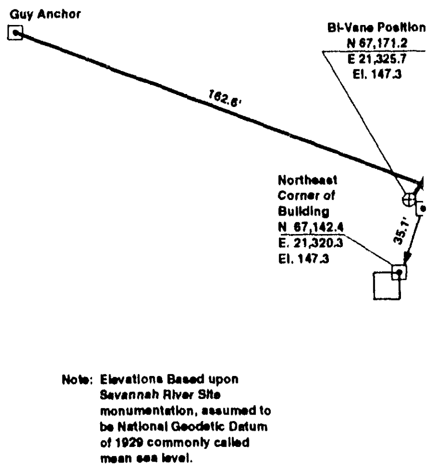
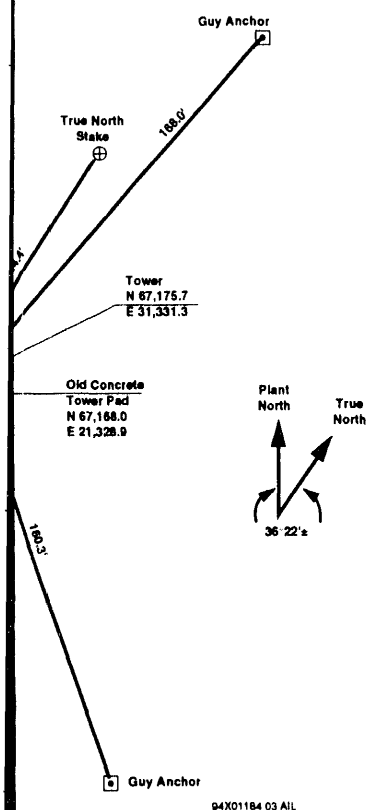



**Figure 3-15.** D-Area Tower


Guy Anchor
True North Stake
188.0'
Tower
N 67,175.7
E 31,331.3
Old Concrete Tower Pad
N 67,168.0
E 21,328.9
Plant North
True North
36°22'±
180.3'
Guy Anchor
94X01184 03 AIL

l Tower

F-Area Tower 1988

F-Area Tower 1993

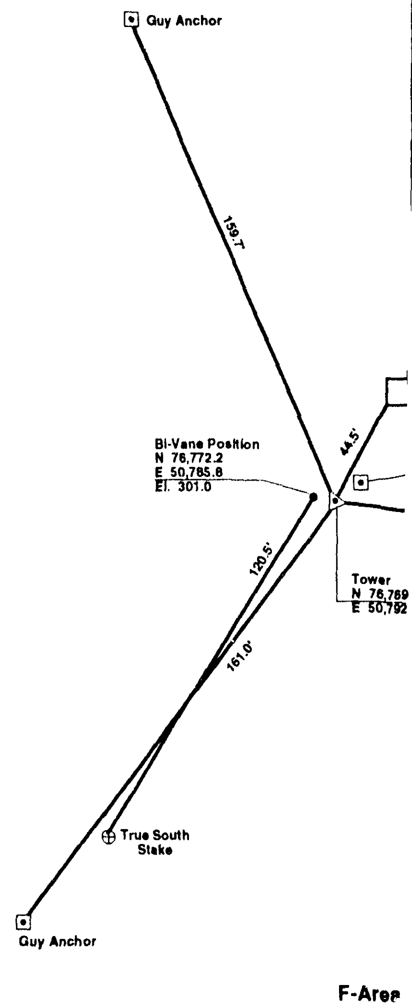
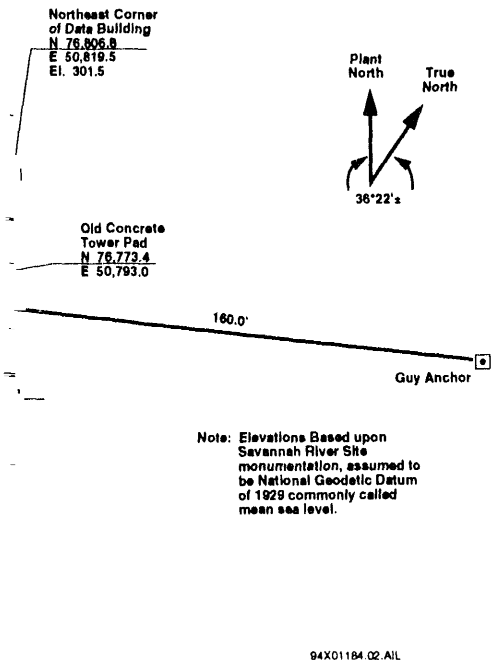



**Figure 3-16.** F-Area Tower




leteorlogical Tower

H-Area Tower 1988

H-Area Tower 1993

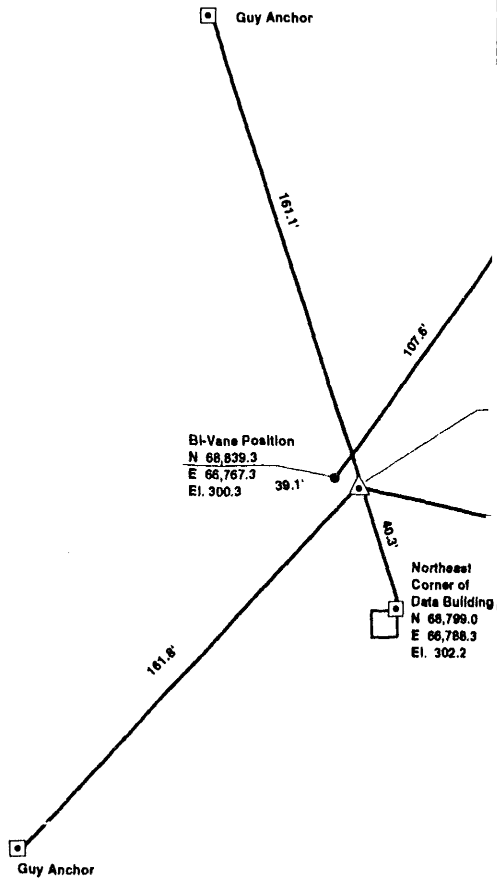
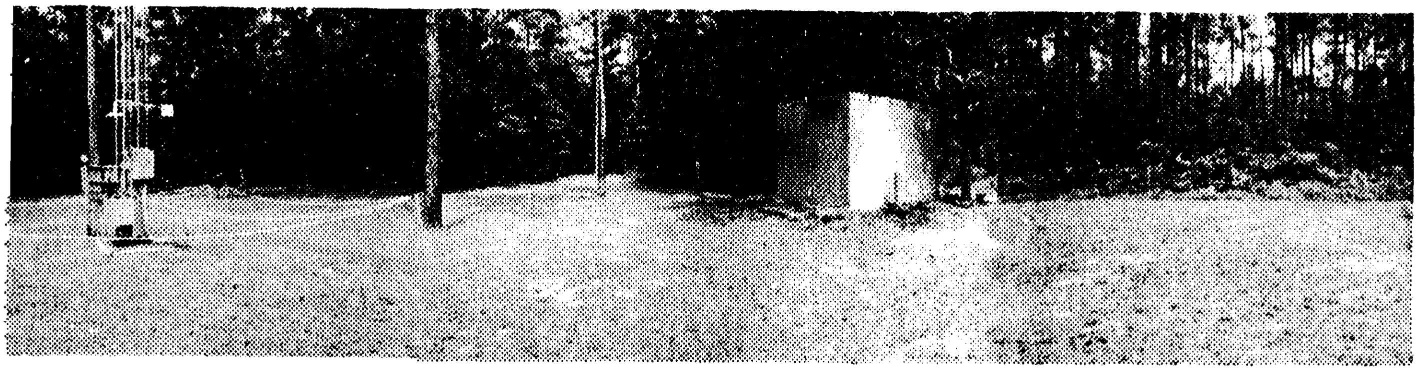
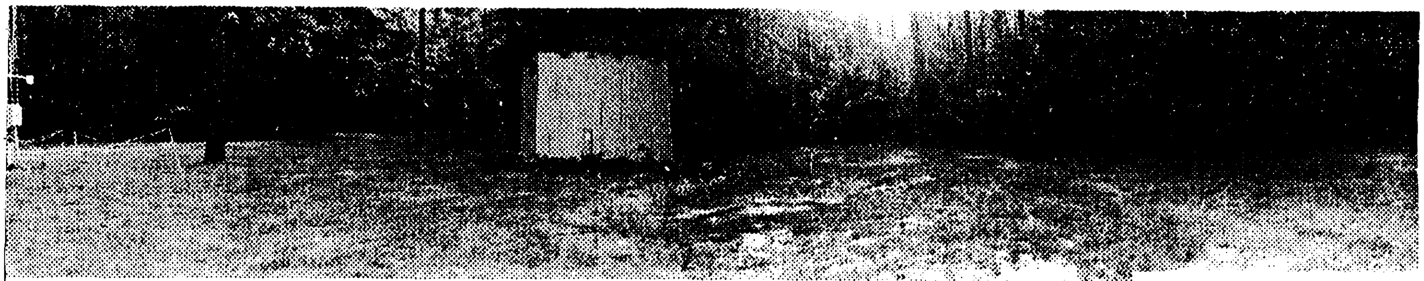
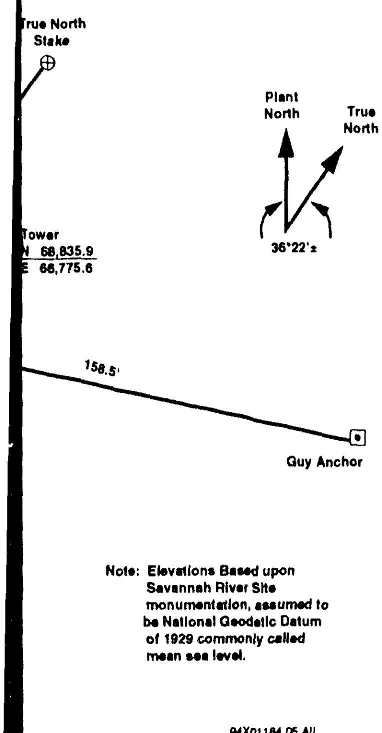



**Figure 3-17.** H-Area Tower

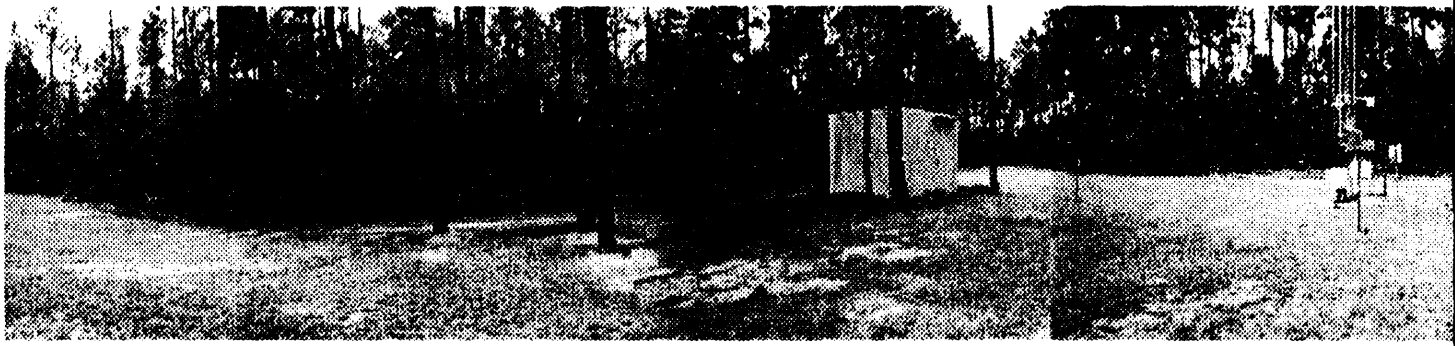
**H-Area Meteorlogical**



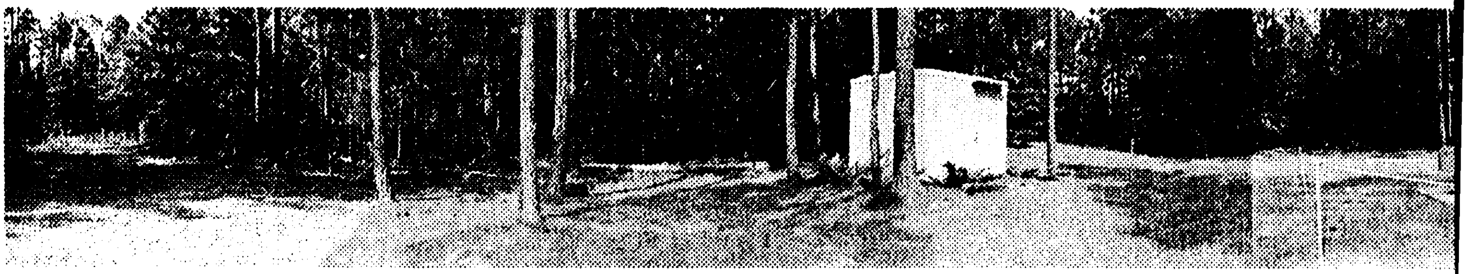



True North
Stake
Plant
North
True
North
36°22'±
Tower
N 68,835.9
E 66,775.6
156.5'
Guy Anchor
Note: Elevations Based upon Savannah River Site monumentation, assumed to be National Geodetic Datum of 1929 commonly called mean sea level.
94X01184.05.AIL

ower



K-Area Tower 1988



K-Area Tower 1993

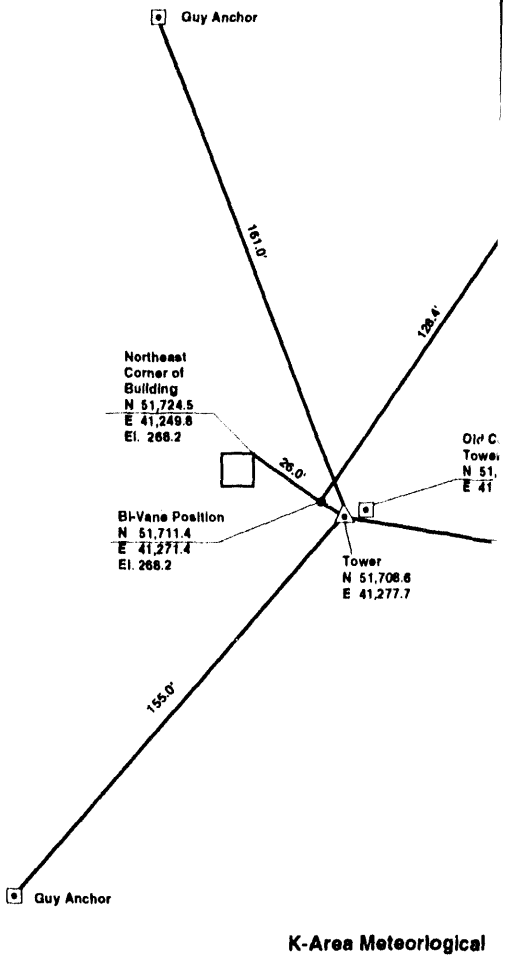
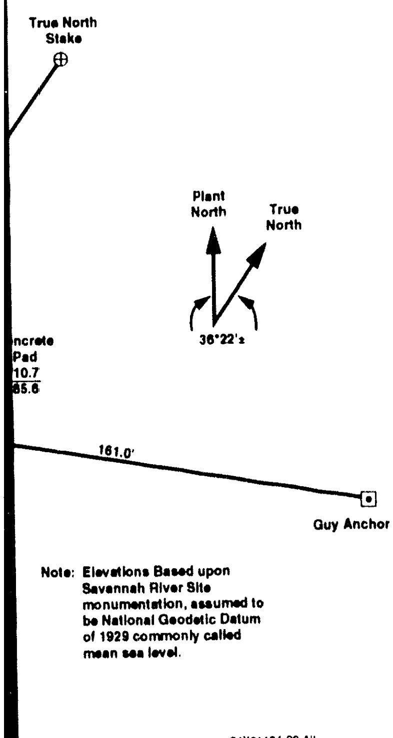
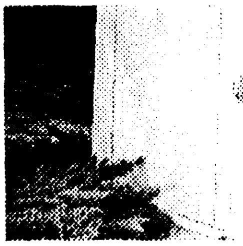


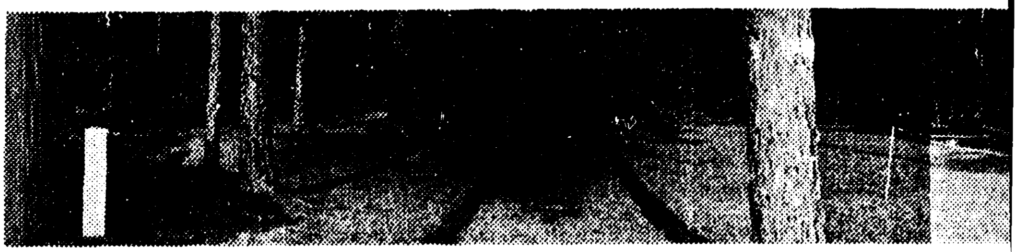

**Figure 3-18.** K-Area Tower


True North
Stake
Plant
North
True
North
36°22'±
ncrete
Pad
10.7
65.6
161.0'
Guy Anchor
Note: Elevations Based upon
Savannah River Site
monumentation, assumed to
be National Geodetic Datum
of 1929 commonly called
mean sea level.
94X01184 08 AIL

ower

L-Area Tower 1988





L-Area Tower 1993

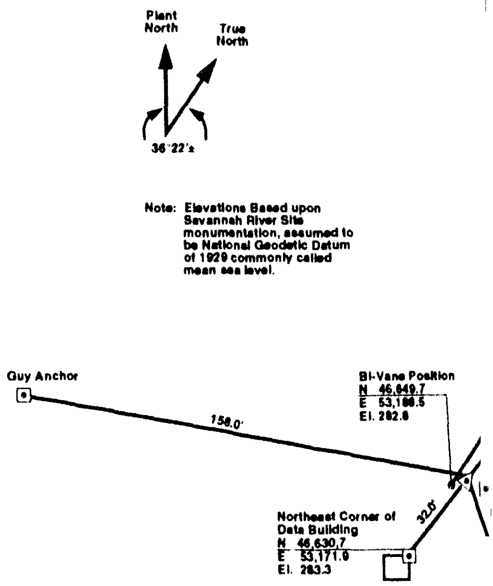
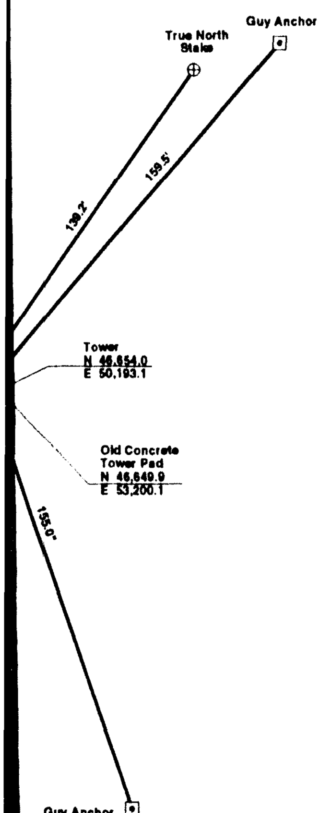



**Figure 3-19.** L-Area Tower

L-Area Meteorological


Guy Anchor
True North Stake
139.2'
159.5'
Tower
N 46,654.0
E 50,193.1
Old Concrete Tower Pad
N 46,649.9
E 53,200.1
155.0'
Guy Anchor
94X01184 07 AIL

wer

P-Area Tower 1988

P-Area Tower 1993

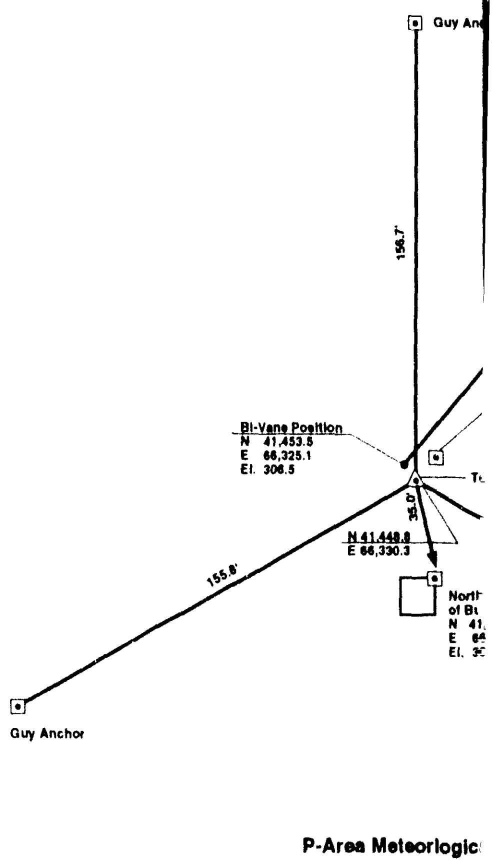
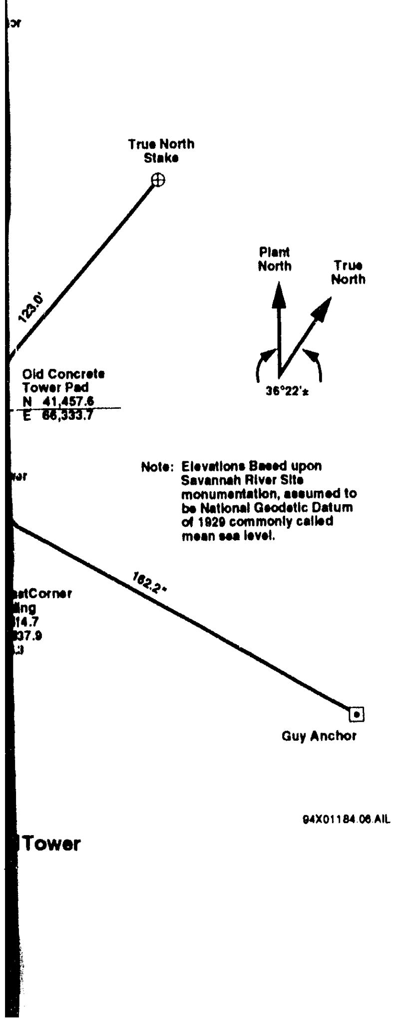



**Figure 3-20.** P-Area Tower


True North
Stake
123.0'
Plant
North
True
North
36°22'±
Old Concrete
Tower Pad
N 41,457.6
E 66,333.7
Note: Elevations Based upon
Savannah River Site
monumentation, assumed to
be National Geodetic Datum
of 1929 commonly called
mean sea level.
162.2'
Guy Anchor
94X01184.06.AIL
Tower

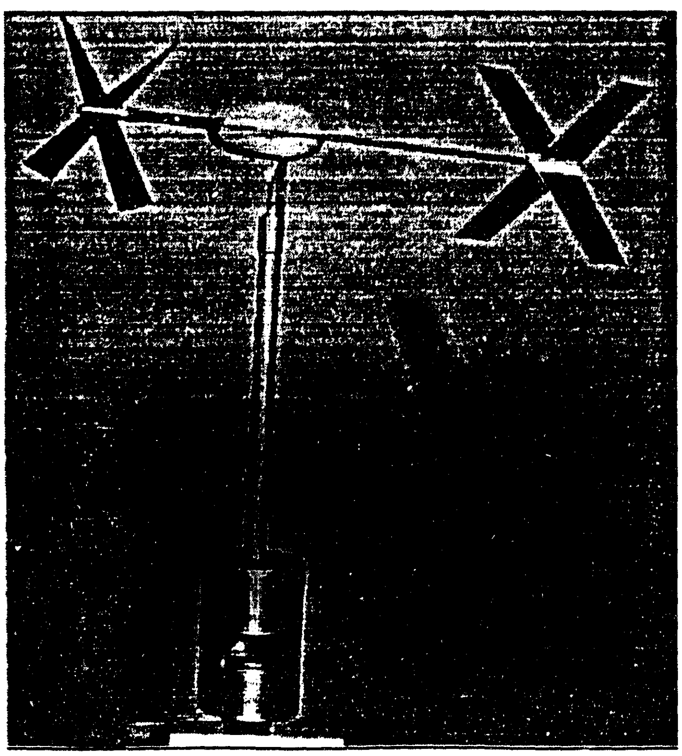
## Attachment A-1 *Description of the MRI Model 1053 III-2 Vector Vane (Area Towers 1973–1987)*

The MRI Vector Vane was used on the area towers from 1973 to 1987. The Vector Vane measured wind speed and direction, both horizontal and vertical, simultaneously. Wind speed was measured with a propeller located at the nose of this instrument. This propeller was constructed of aluminum-coated plastic and was attached to a light chopper that passed through a photodiode much like the Teledyne Geotech 1564B anemometer. Horizontal-wind direction was measured through the use of a 540° potentiometer and slip ring assembly. Vertical-wind direction was measured in the manner using a potentiometer, which covered a 120° range.

**Table 3-5.** Specifications of MRI Vector Vane Sensor Model 1053 III-2

| | |
|---|---|
| Distance constant | 2–3 ft vertical and horizontal |
| Accuracy | ±3° |
| Resolution | 1° vertical and horizontal |
| Damping ratio | 0.4–0.7 horizontal and vertical |
| Response threshold | 1.0 mph horizontal and vertical |
| Range | 0° to 540° horizontal |
| | -60° to +60° degrees vertical |
| Distance constant | 2–3 ft |
| Accuracy | 0.5 mph |
| Response threshold | 1.0 mph |
| Range | 1 to 90 mph |

Figure A-1.1 *MRI Model 1053 111-2 Vector Vane*



## Attachment A-2 *Site Use Guidelines for the Zones Surrounding the SRL/Environmental Technology Section Meteorological Towers*

### SITE USE GUIDELINES FOR THE ZONES SURROUNDING THE SRL/ENVIRONMENTAL TECHNOLOGY SECTION METEOROLOGICAL TOWERS

The Environmental Technology Section (ETS) has implemented and maintains a network of nine-meteorological towers on the SRS per DOE Order 5400.6. The primary use of the meteorological data gathered by these towers is to provide accurate and current weather information for predicting the probable path of an airborne release from a stack, should it occur, and to create a database for environmental dosimetry calculations. Other uses include forecasts for site operations and for atmospheric research. All of these uses are vital for ensuring that the mission and vision of operating the SRS in an environmentally sound manner are accomplished. Special attention must be given to maintaining the forest canopy near each of the towers so that the short- and long-term integrity of meteorological data is not compromised. Two zones surrounding the towers (except Central Climatology) have been created to differentiate between site use guidelines.

**I. 250 ft radius zone from the base of the tower.**

An undisturbed forest area is to be maintained in that no activity other than limited timber salvage will be allowed. No site construction, tree removal, or forest control of any kind will be permitted in this area without prior written approval of the Environmental Technology Section.

**II. 2000 ft radius zone from the base of the tower.**

Forest areas within 2000 ft of the base of the tower are to maintained according to the following guidelines.

1. Any activity that is proposed for any or all of the 2000 ft radius zone must be approved in writing by ETS. Accepted meteorological practices will be exercised by ETS when making decisions concerning the aerodynamic effects of proposed building(s), clear-cuts, etc. on the integrity of the wind field. ETS will review each inquiry on a case-by-case basis.
2. Priority will be given by ETS to maintain the current forest canopy. Tree removal will be avoided.
3. Forest areas are to be maintained following normal forestry practice. Savannah River Forestry Station (SRFS) personnel must notify ETS of the schedule for appropriate forest canopy maintenance. ETS will then determine whether or not the proposed activity will be detrimental to the aerodynamic flow about the tower and provide a written reply to SRFS.

# Attachment A-2 *Site Use Guidelines for the Zones Surrounding the SRL/ Environmental Technology Section Meteorological Towers (contd)*

**SITE USE GUIDELINES FOR THE ZONES SURROUNDING THE SRL/ENVIRONMENTAL TECHNOLOGY SECTION METEOROLOGICAL TOWERS (contd)**

**III. 600 ft radius zone from the base of the Central Climatology tower.**

The guidelines for the Central Climatology site differ considerably from the above 250-ft and 2000-ft radius zone guidelines due to the different mission for this particular site. This 600 ft zone is essentially devoid of trees so that several different types of meteorological data can be gathered at this site.

The guidelines for maintaining this zone are that any activity that is proposed for any or all of the 600-ft radius zone must be approved in writing by ETS. This area has been cleared of buildings and generally no construction will be allowed.

The following drawings show the tower locations and associated 2000 ft radius zones.

## Attachment A-2 *Site Use Guidelines for the Zones Surrounding the SRL/Environmental Technology Section Meteorological Towers (contd)*

February 22, 1991

To: SRTC Staff

From: John G. Irwin, Forest Manager, Savannah River Forest Station

Subject: Timber Management Policy For Wind Towers

In a meeting on February 11, 1991, with Roger Pitts, Bob Harllee, of the SRFS, and Matt Parker and Rob Addis of SRTC, there was agreed the policy or management guides to be followed when working around the swindle Towers. It is stated on Site Use SV-91-22-0 that SRFS and SRTC will agree on this policy.

SRTC has not told us how to accomplish management in these areas, but the conditions they need maintained. This condition is that of a nearly unbroken canopy of trees of about the same height. They have said that this condition needs to be maintained for a 2,001 foot radius around each of the eight meteorological towers. The 609 foot radius around the Climatology Tower at Central Shops will be maintained in its existing cleared condition.

Management will be as follows:

- Salvage of insect, fire, or disease killed trees will be permitted. In cases where this involve more than 1 acre, SRTC should be contacted and advised and/or shown what needs to be done.
- Prescribed burning will be permitted to within 100 feet of the tower or any associated structure. This 100 feet is only for the protection of the tower or it associated structures, and has no climatological significance. Prescribed burning Site Uses will have to be coordinated specifically and personally with SRTC to be sure that the burning parameters in the Site Use are adequate. There will be no mechanical line plowing within 100 feet of the towers.
- Planned timber management with the 2000 foot radius of the towers will be emphasizing uneven-aged management, using different techniques to achieve this structure. Types of management will be different combination of group selection and also single tree selection. The size of the openings in group selection will be a maximum of 1/2 acre. Basal areas for thinning between the openings will be no less than 40 square feet/acre. Target basal areas for single tree selection areas will be 58 to 65 square feet/acre of pine species. The Site Uses for all timber operations will be coordinated specifically and personally with SRTC.
- If species conversion is prescribed to regeneration i.e., Slash-Pine to be converted to Longleaf Pine, there will still have to be 40 square feet of basal area per acre left of the existing species, or as stated above, openings not exceeding 1/2 acre may be created and the species to be converted to will have to be under planted, and the young trees cared for and released until they can take over the stand.

Attachment A-3 *WIND Data Facilities Seminar Package.*

# Savannah River Plant

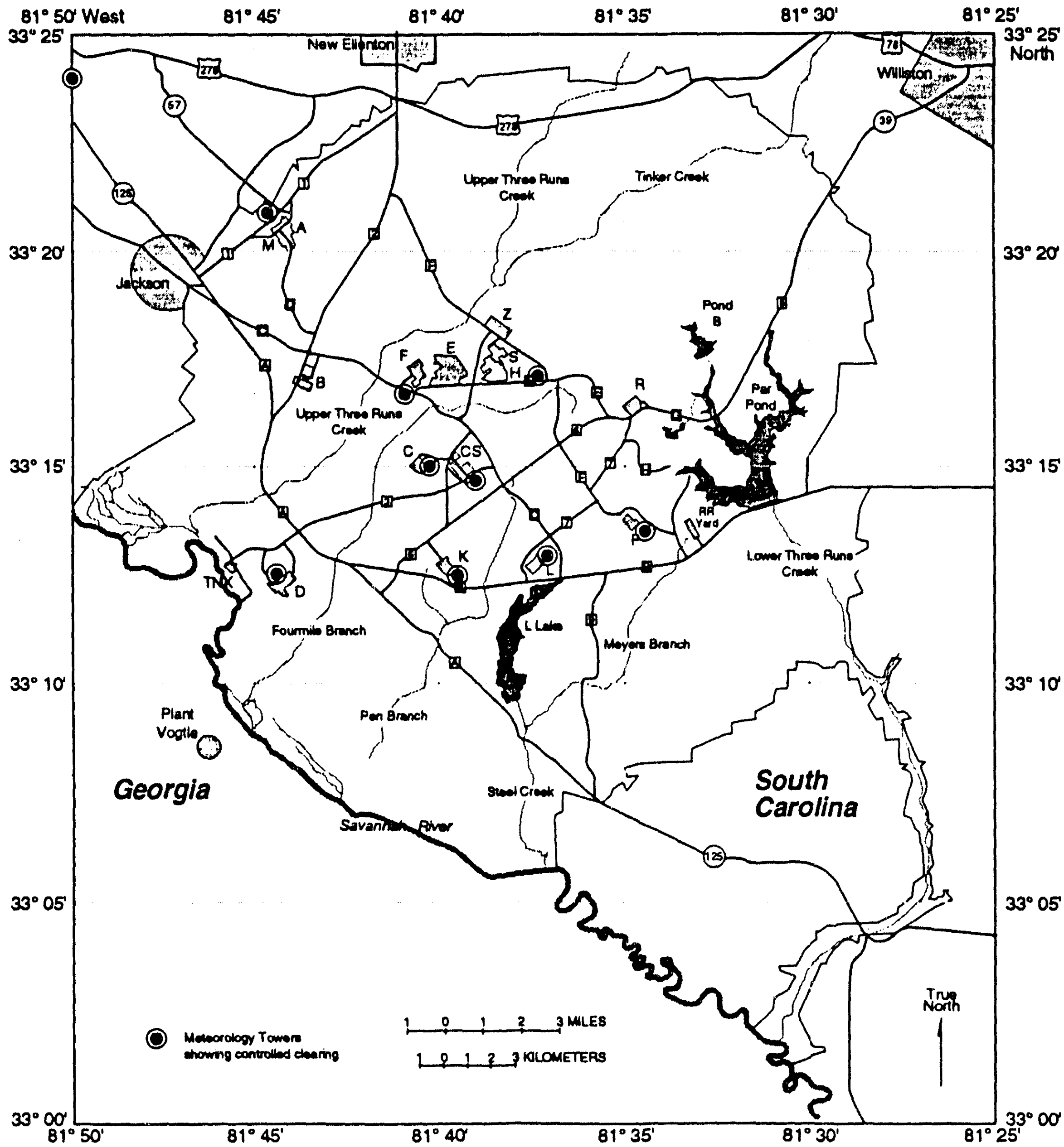
# E & I Department –100 Division

# Project No. S-1316

# Wind Data Facilities Seminar

## Attachment A-3 *WIND Data Facilities Seminar Package (contd)*

# SRP Map




M9300379.01 SRS

## Attachment A-3 *WIND Data Facilities Seminar Package (contd)*

Savannah River Plant

E&I Department – 100 Division

Project No. S-1316

Wind Data Facilities

## General Information

Presently, at various building locations on the Plant site, horizontal wind direction and wind speed are measured and recorded to assist in predicting the dispersal of airborne releases and for selecting evacuation routes in the event of a nuclear incident.

Studies have shown that present sensor locations, within fenced areas on top of buildings, do not provide representative wind data for the area. Wind measurements should be made over terrain comparable to the average terrain of the Savannah River Plant. In this case, the desired locations are in pine forests away from building complexes which cause unnatural wind currents. Predictions can be further improved by including the vertical wind direction in relation to the horizontal direction and speed.

NEW FACILITIES are being installed at seven locations on the plant site for wind data (P, K, C, F, H, D and A Areas). Each location has a 200-foot tower located in a pine forest away from area buildings. A wind sensor, which can be lowered to ground level for calibration and repair, is mounted on top of each tower, In addition, D Area tower has a mid-level sensor for use in $H_2S$ and $SO_2$ diffusion studies. Wind properties measured are direction of flow, both vertical and horizontal, and rate of flow.

Electrical output signals form each wind sensor are transmitted through shielded cable to nearby facilities where telephone lines and electrical power are available. At these locations, signals from the sensors are converted to D. C. voltages for direct readout (A and H Areas) or for telemetering to recorders in control rooms (P, K, C, F and D Areas).

In A Area, a Weather Center–Analysis Lab is located in building 773-12A for data logging and analysis. Wind data from the A Area tower is monitored at this location as well as data from the other areas.

## Vector Vane Sensor

The primary source of wind data is the Meteorology Research Inc. Model 1053-III-2 Vector Vane Sensor mounted on top of each 200-foot tower. The Vane swings horizontally through a full circle, pivoting on it upright shaft. Vertically it can deflect + 60°, turning the shaft of a microtorque potentiometer under the streamlined plastic weathershield. This potentiometer provides a resistance change proportional to elevation angle. A miniaturized photocell-and-light-source unit is enclosed under the shield. A light-beam chopper attached to the propeller generates a pulsed output which is linearly related to true wind speed. The tail fins are light weight plastic with a protective aluminum covering. The windmill-propeller has four light magnesium blades. All tubing is aluminum.

The tube extending from the base houses the pivot shaft which operates a microtorque potentiometer under the cover at the base, giving a resistance change proportional to the azimuth angle of the Vane. The wires carrying signals from the elevation and speed sensors pass down this shaft. These signals pass through a low-drag slip-ring and brush assembly under the cover. The wind speed booster circuit board is attached to the vertical rods under the cylindrical cover at the base of the instrument. This booster allows trouble-free operation over distances in excess of one mile when using MRI-type shielded cable between sensor and transmuter.

Extending below the base of the instrument is a 12-pin cannon plug for mechanically mounting and electrically connecting the sensor. A unique friction locking swivel plate, allowing approximately 320° rotation, has been adapted to this plug for fast and efficient field orientation. At SRP the vanes have been nulled with the connector keyway at North.

## Transmuter

The MRI Vector Vane, Model 1023, Transmuter provides the power supply to operate the Vector Vane Sensor and monitors the response of the vanes three signals (wind speed, wind azimuth and elevation angles.)

The Vector Vane Transmuter consists of a monitoring circuit for each of the vane's parameters. The wind speed output is an analog voltage generated by an ultralinear solid state tachometer circuit driven by the pulse signal from the vector vane's light chopper. The tachometer can handle wind speeds up to 80 mph. The azimuth and elevation outputs are analog voltages developed form the vane's potentiometers. The elevation potentiometer measures wind angle from -60° to +60°. The sensor has dual azimuth potentiometers to measure wind azimuth over a full 540° giving continuous output in even the most erratic wind conditions.

The transmuter operates on 110 volt, 60 cycle power. A shielded cable connects the Vector Vane Sensor the transmuter. The transmuter provides output voltages for each of the three functions in the form of a linearized 0-5 VDC signal.

## Theory of Operation

The elevation channel is composed of a potentiometer and amplifier circuit.

The potentiometer is located in the Vector Vane Sensor. It is a single turn 360° pot with taps at 120° and 240°, and the section between 120° and 240° is normally used. The pot is used in the feedback loop of the amplifier.

The amplifier is an operational amplifier used in a differential mode. R2 and R3 are the input resistors and have the same voltage applied through R4 and R5. R5 is used to control this voltage, which determines the maximum output voltage.

The feedback loop is formed by the elevation pot in the vane with R1 in series. R6 and R7 are used to balance the amplifier. When the wiper of the elevation pot is at its maximum CCW position, or zero ohms, the amplifier is balanced by adjusting R7 to give zero volts output. As the elevation pot wiper rotates CW, the amplifier is unbalanced and the output voltage goes in the positive direction proportioned to the resistance change.

## 540° Azimuth Sensor

The 540° Azimuth channel is composed of a ganged two-section potentiometer, an amplifier, a pulse sensing circuit, a time delay, a bi-stable multi-vibrator, and two field effect transistors acting as switches.

## Attachment A-3 *WIND Data Facilities Seminar Package (contd)*

The ganged two-section potentiometer is located in the Vector Vane sensor. The coils of the two potentiometers are aligned to be in phase with one another while the two wipers are positioned 180° apart. One section is referred to as Pot A and the other as Pot B. These pots are used in the feedback loop of the amplifier.

This amplifier is also used in a differential mode. R5 and R6 are the input resistors and have the same voltage applied through R7 and R9. R9 is used to control this voltage and determines the maximum output voltage. The feedback loop is formed by Pot A in series with R4 if Q1 is conducting, or Pot B in series with R1, R47 and R4 if Q2 is conducting. R10 in series with R8 is used to balance the amplifier. With Q1 conducting and the wiper of Pot A at the full CCW position, the amplifier is balanced for 0 volts output. As the wiper of Pot A moves CW, the circuit becomes unbalanced and the voltage on the output of the amplifier moves in the plus direction proportional to the resistance change. If Q2 is conducting and the wiper of Pot B is at the full CCW position, the amplifier is unbalanced by approximately 10K ohms because of R1 and R47 and, therefore, the output of the amplifier will be approximately 1/3 of full scale. As the wiper of Pot B moves CW, the amplifier becomes more unbalanced and the output becomes more positive.

The pulse sensing circuit is used to sense the transient when either one of the wipers cross the open space in the potentiometer. when this happens, the output of the amplifier changes rapidly by approximately 3.3 volts. This change causes a pulse through C9. This pulse is then amplified by Q5 and fed through Q6, an emitter-follower, to obtain a lower impedance. The positive pulses at this point are then fed through C11 and CR4 to trigger the mono-stable multivibrator. The negative pulses are fed through Q7 to get an inversion and then through Q8, an emitter follower, to obtain a lower impedance. This pulse which is now positive, is fed through C12 and CR5 to trigger the mono-stable multivibrator. Therefore, either a positive or negative change from the amplifier will trigger the mono-stable multivibrator.

The mono-stable multivibrator serves as a time delay. This circuit consists of Q9 and Q10. Q10 is normally conducting and its collector, near ground potential, keeps Q9 turned off. A positive pulse is introduced at the base of Q9, turning it on. When this occurs, its collector goes almost to ground potential, causing current to flow through C15 and C16 and causing the base of Q10 to go almost to ground, thereby turning Q10 off. Q10 will remain off until the current through C15 and C16 decreases to the point that the voltage on the base of Q10 increases sufficiently to turn Q10 back on. When Q10 turns on, the voltage on its collector drops to near ground potential again causing the voltage on the base of Q9 to drop and, therefore, turning Q9 off or back to the original state. The time Q9 is on is determined by the values of C15 and C16, and R43. When Q9 first conducts, a negative pulse is seen at its collector. This pulse is sent to the next stage, as a trigger, and because of the built-in delay no additional negative pulses will be seen until after the mono-stable multivibrator has reset.

The bi-stable multivibrator serves as the control circuit to determine which pot is in use at any given time. This circuit consists of Q3 and Q4. When power is applied to the circuit, either Q3 or Q4 may conduct. We will assume that Q3 starts out conducting and, therefore, Q4 must not be conducting. When a negative pulse is introduced at the junctions of C6 and C7, it passes through both of these points and also through CR2, which is forward biased, but not through CR3, which is reverse biased. When Q3 turns off, its collector goes positive, pulling the base of Q4 positive, thereby, turning Q4 on and leaving the bi-stable multivibrator in the opposite state to which it was originally. If another negative pulse is introduced, the same thing happens, but on the opposite transistors. The state of Q3 and Q4 determines which field effect transistor (Q1 or Q2) will conduct, therefore, determining which pot is in use. If Q3 on the multistable is conducting, it will make the voltage on the gate of Q2 slightly negative causing Q2 to be off or non conducting. At the same time, Q4 is not conducting, thereby applying a positive voltage to the gate of Q1 and allowing it to

## Attachment A-3 *WIND Data Facilities Seminar Package (contd)*

conduct, thus putting Pot A in the circuit. If Q3 and Q4 reverse state, then Q1 and Q2 must reverse state to put Pot B in the circuit.

## Wind Speed Sensor

The Wind speed channel is composed of a light bulb-photocell assembly, a light chopper, a signal booster circuit, a pulse conditioning circuit, a mono-stable multivibrator, and a precision integrating amplifier.

The light bulb, photocell, and chopper are located in the Vector Vane Sensor. The chopper is placed between the light bulb and photocell so that, upon rotation, it chops the light beam to vary conductance of the photocell.

The variation in photocell conductance causes current to vary through R5 in the booster circuit, located in the Vector Vane, thus varying the voltage on the base of Q2. This voltage change is amplified by a factor of approximately 10 in Q2 and is then fed into Q1 which is an emitter-follower circuit. Q1 serves to give a relatively low output impedance for transmission over long cable lengths.

The signal is then introduced to the input of the tachometer located in the transmuter. The signal is introduced through a low-pass filter, consisting of L1 and C2, which rejects any radio frequency interference. The signal is run through R15 which is used to adjust the sensitivity level. The signal is then run through Q1 and Q2 which comprise a feedback stabilized amplifier having a gain of approximately 10. Q3 and Q4 form a Schmitt trigger which, in conjunction with an emitter-follower, Q5 ensures reliable triggering of the mono-stable multivibrator, regardless of the input frequency.

The pulse is then coupled through C7 and CR5 to the base of Q8 which is part of a 125 microsecond mono-stable multivibrator. Q8 normally not conducting, does conduct when a negative pulse is introduced at its base. When this occurs, the Q8 collector is pulled toward ground potential making current flow through C12 to cause the base of Q7 to go toward ground, turning Q7 off. When Q7 is turned off, its collector goes toward -15V., turning Q6 on. Q6 is an emitter-follower with a relatively low-output impedance. When the emitter of Q6 goes negative, it causes Q8 to be biased on and stay on until the current though C12 decreases, allowing Q7 to turn back on. When Q7 turns back on, Q6 turns off, which turns Q8 off. The time Q6 is on is determined by the value of C12 on R24 and R25. This results in a fixed width and fixed amplitude pulse out of Q6 regardless of frequency.

The pulses from Q6 are fed through R31 into the integrating amplifier. The integrating amplifier gain is controlled by R33 and R34 for 0-80 range and by R35 and R36 for the 0-20 range. The capacitor, C8 along with SQ2 amplifier form the precision integrating amplifier. The integrating amplifier will give a DC voltage proportional to the input frequency.

## Calibration

The MRI MOdel 2046 calibration set consists of an electronic calibrator for wind speed and fixtures which clamp on the vane's vertical shaft for calibration of wind direction (azimuth) and angle of wind elevation. These units are used in aligning the vane. Procedures are included in VPF 8438 and in the Project information.

## Attachment A-3 *WIND Data Facilities Seminar Package (contd)*

## Maintenance

There are no parts of the sensor or circuitry that require special attention of lubrication. The unit is furnished with sealed precision bearings and weather-tight enclosures for protection. The sensor has been designed for easy and convenient servicing and trouble shooting.

Although units have been matched for calibration, all units are interchangeable.

## References

| | |
|---|---|
| Project S-1316 | Theory and Calibration" 10-3-73 by E. J. Holgate and E. D. Crawley |
| VPF 8438 | Meteorology Research Inc. |
| VPF 8439 | RFL Industries (Telemetering) |

## Wind Data Facilities Drawings:

| | |
|---|---|
| S5-G.300 | Voltage Output Simulator |
| S5-G-301 | Diagram and Cable Schedules |
| S5-G-302 | Sensor Alignment Post, Assembly and Weldment |
| S5-G-303 Through 311 | Tower Details |
| S5-1-4194 | 100-C Area, Plot Plan |
| S5-1-4195 | 100-K Area, Plot Plan |
| S5-1-4196 | 100-P Area, Plot Plan |
| S5-1-4197 | Powerhouse Transmuter and Transmitter |
| S5-1-4198 | Powerhouse Transmuter and Transmitter |
| S5-1-4199 | 100-C Area, Process Area Receiver and Recorders |
| S5-1-4200 | 100-K Area, Process Area Receiver and Recorders |
| S5-1-4201 | 100-P Area, Process Area Receiver and Recorders |
| S5-4202 | Powerhouse Transmuter and Transmitter |
| S5-1-4203 | 100 Areas - Single Line Diagram |

R. C. Ashmore
RCA:

# Section 4—WJBJ-TV Tower Monitoring System

## Introduction

In order to create a detailed atmospheric boundary layer profile, the Environmental Technology Section (ETS) maintains meteorological instrumentation at seven levels on a nearby local television communication tower (WJBF-TV). This tower (Figure 4.1) was originally equipped with meteorological instrumentation in the mid 1960s as part of a reactor safety study related to tall-stack-effluent monitoring. Since the early 1970s, the meteorological measurements taken at the tower have been incorporated into the meteorological monitoring program used for emergency response by the ETS. All maintenance and installation of the instrumentation is performed by a contracted tower climber. Refurbishment and calibrations are performed by ETS in the 735-7A meteorological engineering facility and wind tunnel.

## Historical Perspective

Meteorological instrumentation was first installed on the WJBF TV Tower in October 1965 (Cooper and Rusche, 1968) (see Figure 4.2). Reliable and continuous data were retrieved between 1966 and 1968 (Pendergast, 1975) for reactor safety studies involving effluent monitoring from a proposed 850 ft stack. Data was collected intermittently up to May 1972 when a fire temporarily halted collection. Initial sampling was done with "punch tape", but by May 1973 a Datacom digital data acquisition system was installed. Present day data acquisition is accomplished in much the same manner, although with newer equipment that was installed in 1983.

Climet cup anemometers, vanes, and bivanes along with Rosemont temperature probes have been and are currently in use. Original measuring levels for the 1960s reactor safety studies were as follows:

- Temperature probes: 10 ft, 120 ft, 300 ft, 450 ft, 600 ft, 700 ft, 800 ft, 900 ft, 1000 ft, 1100 ft, 1200 ft

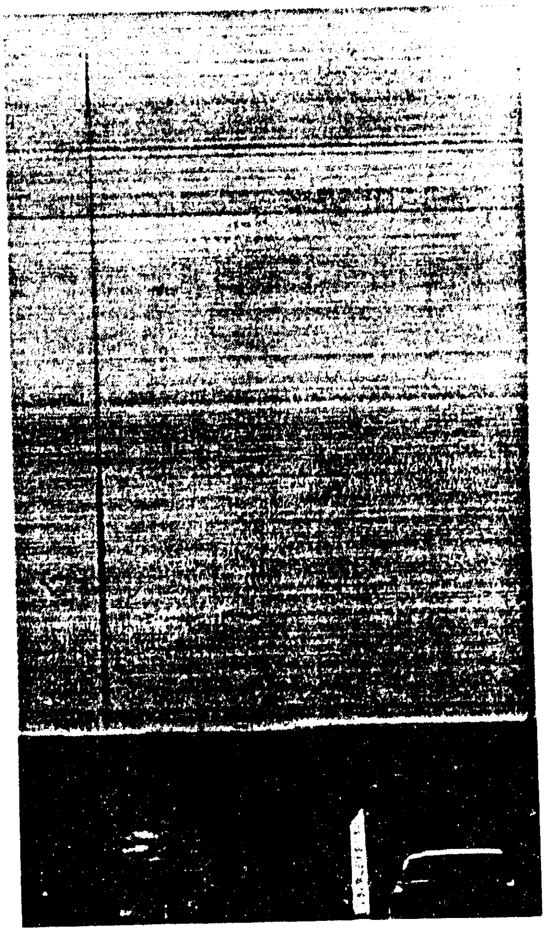


**Figure 4.1** ***WJBF-TV Tower***

- Cup anemometers: 120 ft, 300 ft, 450 ft, 600 ft, 800 ft, 1000 ft
- Bivanes: 300 ft, 450 ft, 800 ft, 1000 ft
- Vanes: 120 ft, 600 ft.

A "sister" tower to the TV Tower was the Cassels Fire Tower (Site coordinates N 70212.75, E 33404.55) that was instrumented from March 1966 to December 1967 as part of the same reactor safety studies mentioned above. Measuring levels were as follows:

- Temperature probes: 15 ft, 75 ft, 110 ft
- Dew Point: 15 ft
- Cup anemometers: 15 ft, 75 ft, 110 ft
- Bivanes: 15 ft, 75 ft, 110 ft.

A rain gauge was also located at the base of the towers.

In 1973, the instrument configuration of the TV Tower was modified. The following is a listing of the instruments and measuring levels.

- Temperature probes: 7 ft, 33 ft, 120 ft, 300 ft, 450 ft, 800 ft, 1000 ft, 1100 ft
- Cup anemometers and bivanes: 33 ft, 120 ft, 300 ft, 450 ft, 600 ft, 800 ft, 1000 ft.

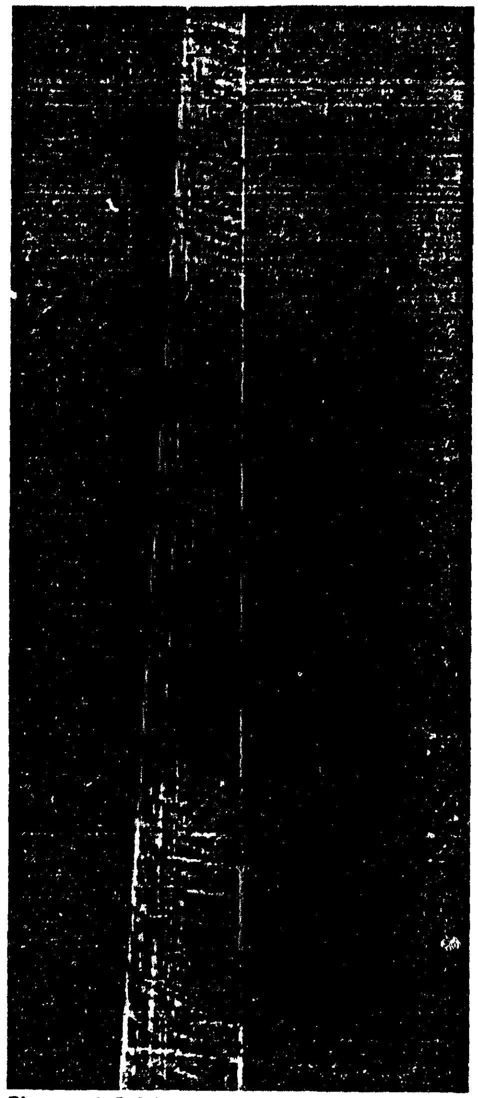


**Figure 4.2** *Multiple levels of instrumentation*

The 33-ft (10-m) temperature and wind measurements were taken from a tower located about 250 ft from the base of the TV Tower in a clearing.

In November 1983, the TV Tower meteorological instrumentation configuration was modified again. A more uniform system of measurement was created by installing identical instruments at six levels up to 1000 ft (304 m). A 10-m tower that was in-service since the 1973 modification was replaced because of tree growth by an 18 m tower located at the data building. The data acquisition system and signal cable wiring of the tower were also upgraded. A bivane, cup anemometer, and temperature probe are located at 18 m (59 ft), 36 m (120 ft), 91 m (300 ft), 137 m (450 ft), 182 m (600 ft), 243 m (800 ft), and 304 m (1000 ft). A separate temperature probe is mounted at 2 m (7 ft). This configuration is used today.

## Tower Description and Facility Layout

The TV Tower is located near Beech Island, SC about 10 miles to the northwest of SRS at 33° 24' N, 81° 50' W (Plant Coordinates N 142,009.66, E 40.032.46). The tower is oriented with one face pointing east with the other two aligned northwest and southwest. The tower structure is triangular and consists of 4.5-in. diameter structural tubing. Each tower face is 10 ft wide. The tower is protected from lightning strikes, as much as possible, by an upgraded grounding system that was installed in the summer of 1992.

Figure 4.3 shows the facility layout at the WJBF-TV Tower. A trailer used for sheltering signal processing and transmission equipment is located about 20 ft from the TV Tower. A protective supplementary roof has been erected over the trailer to ensure safety from falling objects. Another smaller Rohn tower is located adjacent to the front of the trailer (Figure 4.4) and supports instrumentation levels at 18 m and 2 m (temperature probe only). The entire facility is surrounded by a security fence.

## Instrumentation

### *Configuration and Orientation*

Meteorological instrumentation at the WJBF-TV Tower is located at 2 m, 18 m, 36 m, 91 m, 137 m, 243 m, and 304 m (Figure 4.4). All levels, except 2 m, are equipped with a Climet Model 012-8A bivane, Climet Model 011-1 cup anemometer, and Rosemont Model

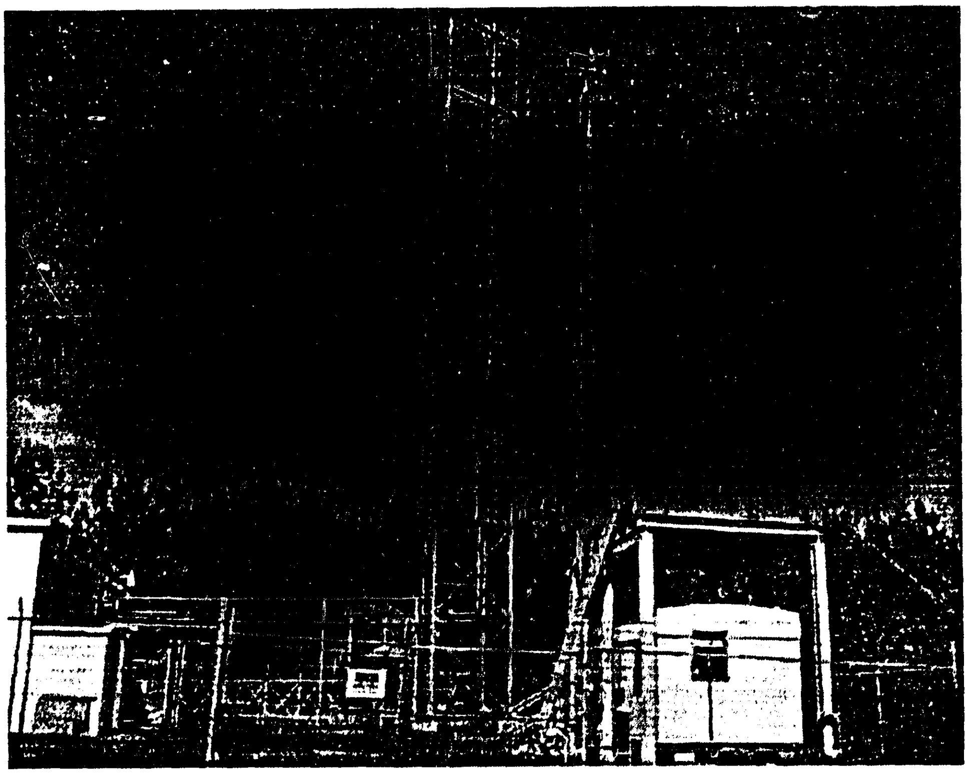


Figure 4.3 *Layout of WJBF-TV Tower*

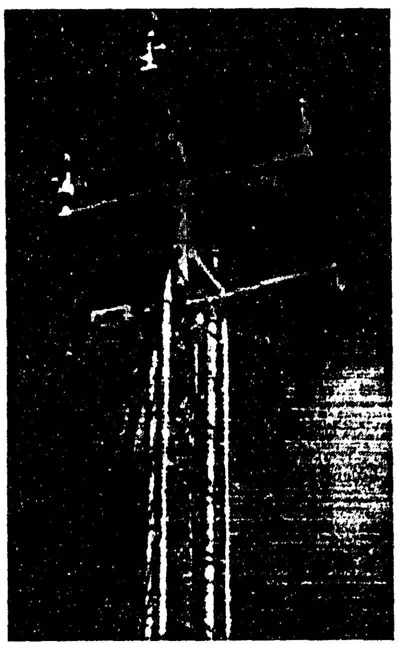


Figure 4.4 *Instruments on 18m Rohm Tower*

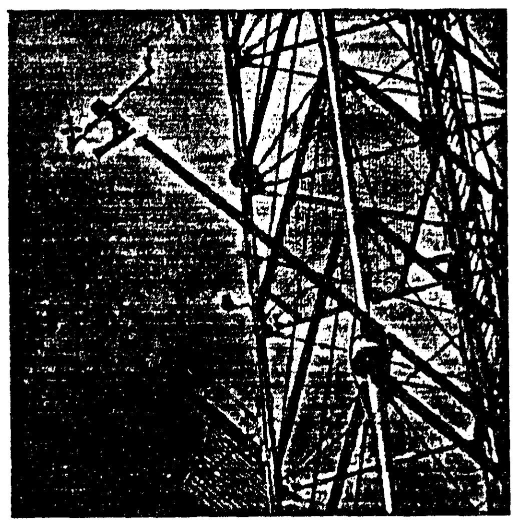


Figure 4.5 *WJBF-TV Tower instruments at 36m and above*

78 temperature sensor. The 2-m level is instrumented with an aspirated temperature sensor only. The instruments are mounted on a boom that extends 10 ft away from the tower in the direction of southwest (225°). Signal cables at each level pass from each instrument through the support boom to a junction box where connections to a centrally mounted and protected signal cable are made. This central signal cable extends down to the base of the TV Tower then underground to the trailer where the cable ascends inside for signal conditioning and processing.

The TV Tower is not equipped with an elevator like the SRS Area Towers. Consequently, installation, maintenance, and sensor exchanges are performed on the tower by professional tower climbers. Calibrations are conducted twice annually, usually in December and May unless repairs are required in the interim. Occasional maintenance is necessary between calibrations, at that time tower climbers are employed to make repairs.

The proximity of buildings near the base of the tower influences the temperature measurements made at the 2 m level and wind speed and direction measurements made at the 18 m level. Data from the 2 and 18 m instruments will not be used as part of any site date base unless explicitly requested. Such data shall be suitably flagged to indicate the suspect exposure of the instrument.

## Sensors

### *Climet Model 012-8A Bivane*

The bivane used at the WJBF-TV Tower is a Climet Model 012-8A (Figure 4.6). Although this model dates back to the 1960s, many modifications have been made (Table 4.1) to upgrade the performance of the sensor. The potentiometers, which are used in conjunction with slip rings to detect the vane's

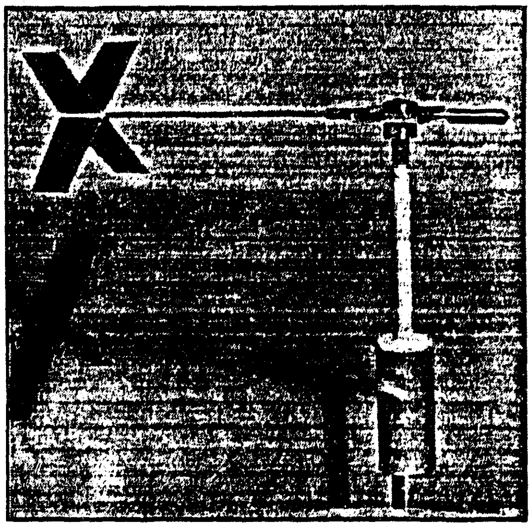


**Figure 4.6** *Climet Model 012-8A Bivane*

location, have been replaced with a plasticized version that makes them exceptionally durable during extended exposure to inclement conditions. The vane from the original sensor has been replaced with a model that has been adapted from the MRI VectorVane (Pendergast, 1975). The responsiveness of the replacement vanes has been improved through the use

**Table 4-1.** Specifications for the Climet Model 012-8A bivane.

| | |
|---|---|
| Distance constant | 3 ft vertical and horizontal |
| Accuracy | ±3° |
| Resolution | - - - |
| Damping ratio | 0.6 horizontal and vertical |
| Response threshold | 0.75 mph horizontal and vertical |
| Range | 0° to 540° horizontal |
| | -60° to +60° vertical |

of light-weight compressed styrofoam covered by an aluminum foil as opposed to the original thicker, heavier, and unprotected styrofoam vanes. The replacement vanes also are resistant to ultraviolet sun damage whereas the original vanes often were damaged heavily from exposure to sunlight during normal operation.

For more information on specifications, circuitry, or maintenance, please refer to Instruction Manual for Climet Instruments Model 012-8A.

## *Climet Model 011-1 Cup Anemometer*

For wind-speed measurements, a Climet Model 011-1 anemometer with a three-cup assembly is used at the WJBF-TV Tower (Figure 4.7, Table 4-2). The measurement method employed by the model 011-1 is very similar to the Teledyne Geotech 1564B anemometer method. Readings of wind speed are made by relating the rate of rotation of the cups through the use of a light chopper attached to the support shaft of the cup assembly. The light chopper rotates due to the movement of the cups and passes through a photo-diode. The light chopper creates "breaks" in the light passing through the photo-diode. The frequency of the breaks is converted to a voltage by a signal processor card. The resulting voltage is directly related to the wind speed. The only major modification made to the components of the Model 011-1 is the replacement of an incandescent light with a photo-diode for light chopper rotation measurements.

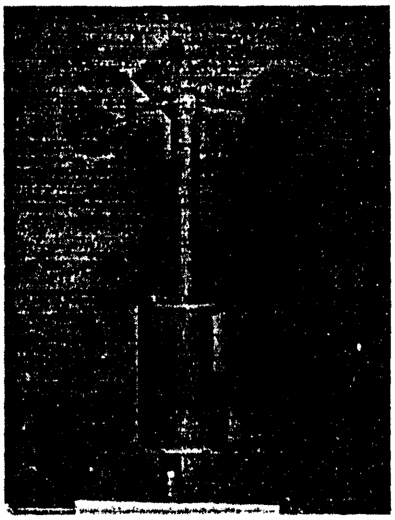


**Figure 4.7** *Climet Model 011-1 Cup Anemometer*

For more information on specifications, circuitry, or maintenance, please refer to the Instruction Manual for Climet Instruments Model 011-1.

## *Rosemont Model 78 Temperature Probe*

Air temperature at all levels of the WJBF-TV Tower is measured by a Rosemont Model 78 temperature probe (Table 4-3). Temperature is sensed by relating electrical resistance

**Table 4-2.** Specifications for the Climet anemometer.

| | |
|---|---|
| Distance constant | <5 ft |
| Accuracy | ±1% or 0.15 whichever is greater |
| Response threshold | 0.6 mph |
| Range | 0.6 to 90 mph |

**Table 4-3.** Specifications of Rosemont Model 78 temperature probe.

| | |
|---|---|
| Time constant | 5 sec in moving air |
| Accuracy | ±0.5°C |
| Range | -50°C to 100°C |
| Aspiration rate | prevailing wind speed |
| Shielding | error <0.1°C |

measured by the probe to air temperature. The probes, except 2 and 18 m, are housed in passive, protective vanes that align into the prevailing wind and act as a solar-radiation shield and aspiration device. The 2 and 18 m level-temperature probes are housed inside motor aspirated solar radiation shields.

## Data Collection and Transmission

The data collection and transmission processes performed at the TV Tower are very similar to the same processes performed at the area towers. In the data building, continuous voltages are received from each sensor via the main signal-cable that passes from the tower to the data building (see Configuration and Orientation, p 3) The signal cable from each instrument is connected to the appropriate signal processor card which conditions, modifies, and/or amplifies the instrument signal voltage. After the instrument voltage is processed, the data transmission is conducted in an identical manner as described for the Area Tower instrumentation.

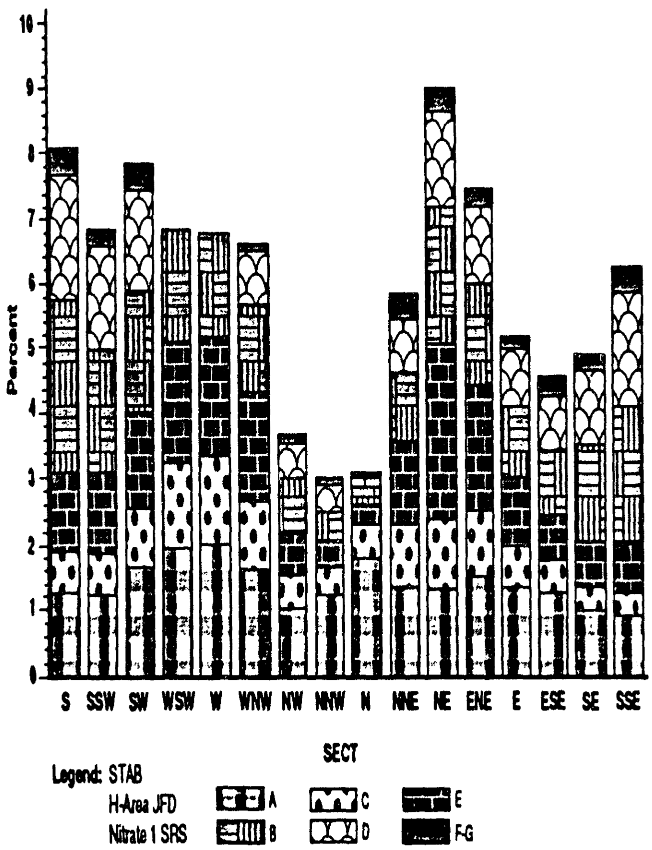



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Figure 4.8 *WJBF-TV Tower Grounding Schematic (not to scale)*

## Lightning Suppression

Lightning related damages are inherently problematic for tall towers in the southeastern US. The grounding network for the TV Tower structure that was installed during initial construction often provided less than ideal protection. Phone line equipment used by Southern Bell was especially vulnerable to lightning related surges. In 1992, a new grounding network was installed at the WJBF-TV Tower (see Figure 4.8). This new network protects the TV Tower structure, data building equipment (including Southern Bell's equipment), and the adjacent security fence that surrounds the facility.

Additional lightning protection is used for each signal processor card. A metal oxide varistor (MOV) is located at the signal input port to protect against power surges. The MOV operates by acting as a switch to redirect surges that may damage processor-card components.

## Electrical Power Supply

Electrical power is supplied to the TV Tower by South Carolina Electric and Gas. A back-up diesel generator that is used to power the TV station equipment is also available for the ETS to use for the meteorological equipment during power outages. All meteorological instrumentation and associated equipment on the tower or within the data building operate with 12-VDC power. Transformers which convert 120-VAC power to 12-VDC power are mounted in the same racks that hold the signal-processor cards.

## Routine Facility Maintenance

Maintenance of the tower structure and grounds is coordinated by the owner, Pegasus Broadcasting of Augusta, Inc. A rental contract between the owner and Westinghouse Savannah River Company is renewed every calendar year to allow use of the tower structure for meteorological instrumentation.

## References

Cooper, R. E. and B. C. Rusche, 1968: *The SRL Meteorological Program and Offsite Dose Calculations*. DP-1163. Savannah River Laboratory, E. I. du Pont de Nemours & Co., Aiken, SC.

Pendergast, M. M., 1975: *A Cautionary Note Concerning Aerodynamic Flying of Bivane Wind Direction Indicators*. Journal of Applied Meteorology, vol. 14, No. 4. American Meteorological Society, Boston, MA.

# Section 5—Central Climatology Monitoring Facility

## Introduction

The mission of the Central Climatology facility is to supplement the local climatological database and the operation of the emergency response component of the WIND System. Central Climatology was created to measure several meteorological variables which are not available from the area tower network. These include measurements of solar radiation, atmospheric pressure, rainfall, evaporation, and soil temperature.

The Central Climatology facility includes instrumentation at four levels on the tower and acoustic sounder equipment to measure the atmospheric boundary layer structure. Sodar echoes provide mixed layer depth determinations.

## Historical Perspective

In 1985, the Central Climatology facility was built. This site was the first to test the Teledyne Geotech bivane at SRS.

## Facility Layout, Location, and Description

Central Climatology is located near the geometric center of SRS at 33° 14' 43" N, 81° 39' 0" W (Plant Coordinates N 61295, E 51500). The tower has been erected in an open field that is clear of trees. A small concrete pad located about 25 ft from the base of the tower is used as a level mount for a tipping-bucket rain gauge. An evaporation gauge and several radiometers are mounted within 20–30 ft of the concrete pad. A data building and adjacent storage shed are located 75 ft from the base of the tower. The data building is approximately 10 by 20 ft and houses signal processing and communication equipment as well as ample work space. The storage building is used for spare parts and equipment.

The terrain near the tower is flat with grass extending out to a surrounding four-foot chain-link fence. The area beyond the fence extending out to 600 ft is composed of a low-profile (< 5 ft) storage yard, railroad, and scattered stands of pine trees. These stands of pines are about 500 ft from the tower.

## Instrumentation

### *Configuration*

The Central Climatology Tower is shown in Figure 5.1. Instrumentation is mounted to face to the southeast. Each level of instrumentation is mounted identically to the Area Tower instruments. Instruments are mounted (see picture) on a 2-m boom with a 1-m supporting crossarm used for the bivane and cup anemometer. The temperature probe is housed in an aspirated shield which extends below the crossarm. The aspirated dew point probe housing is mounted to the support boom.

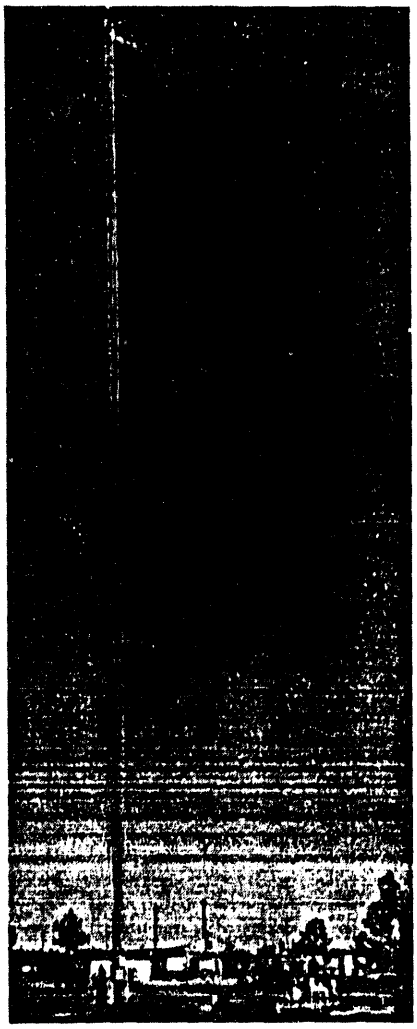


Figure 5.1 *Central Climatology Tower*

The Central Climatology tower is instrumented identically to the 61m level of the Area Towers with three additional levels at 2m, 18m, and 36m. The instrumentation at each level includes a Teledyne Geotech model 1585 bivane, model 1564B cup anemometer, model T-210 temperature probe, and a model DP-200B dew point sensor. Profiles of wind and temperature are made with this instrumentation to observe local boundary layer structure. Atmospheric radiation and pressure, rainfall, and evaporation, and soil temperature measurements are made to create a database of the local climatology of SRS. Sodar data is also collected at Central Climatolgy (as well as elsewhere at SRS) to determine the local mixed layer depth.

## *Sensors Indigenous to the Central Climatology Facility*

### Solar and Long Wave Radiation Sensors

Eppley Black and White Pyranometer Model 8-48

The total short-wave radiation from the sun is measured by a Eppley Black and White Pyranometer Model 8-48 (Figure 5.2). Its detector is a differential thermopile with the hot-junction receivers blackened and the cold-junction receivers whitened. The element is of radial wire-wound plated construction with the black segments coated with 3M black and the white segment with barium sulfate. Built-in temperature compensation with thermistor circuitry is incorporated to free the instrument from ambient temperature effects. It also has a precision ground optical glass hemisphere of Schott glass that uniformly transmits energy from 0.285 to 2.800 mm. This hemispherical envelope seals the instrument from the weather, but is readily removable for instrument repair.

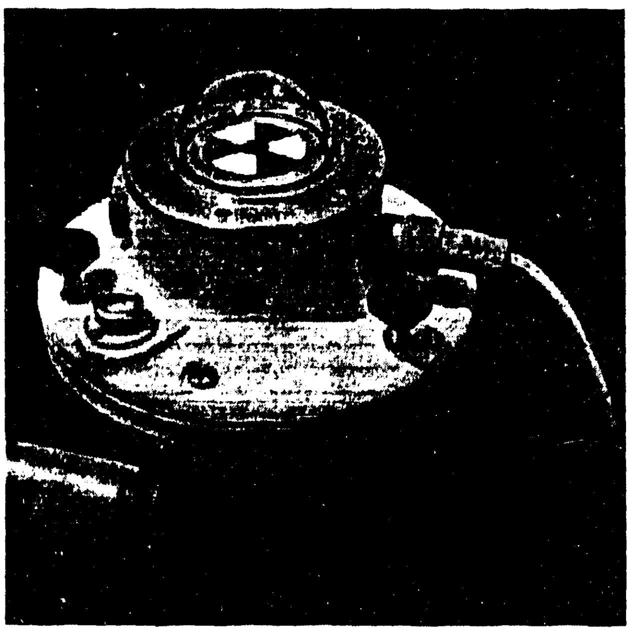


Figure 5.2 *Eppley Black and White Pyranometer Model 8-48*

For more information concerning the specifications, circuitry, or maintenance refer to *Instrumentation for the Measurement of the Components of Solar and Terrestrial Radiation* by the Eppley Laboratory, Inc. Direct current voltages are processed by a Teledyne Geotech Model 21.62 signal processor.

Eppley Pyrheliometer (WEATHERtronics Model 3060)

At the SRS an Eppley normal incidence pyrheliometer (WeatherMeasure/ Weathertronics Model 3060) is used for measuring direct-beam solar radiation. In this instrument, a wire wound copper-constantan thermopile is mounted at the base of a brass tube with a 10:1 ratio of length to aperture, which provides a 5°43' field of view that meets World Meteorological Organization standard . The inside of the tube is blackened and contains a diaphragm. The tube is filled with dry air and sealed at the viewing end by a quartz window 1 mm thick. The thermopile has a 3/8 inch square receiver. The receiver is painted with 3M velvet black. When pointed directly at the solar disc, solar radiation energy entering the pyrheliometer will be parallel to the housing and normal to the thermopile. The thermopile stores the energy in the black surface causing a rise in temperature. The rise in temperature is sensed by the copper-constantan junctions creating a millivolt output signal. The thermopile output is related to solar energy through comparisons with established standards.

The pyrheliometer is mounted on a WeatherMeasure/WEATHERtronics Model 30601 solar tracker for continuous readings.

### Soil Temperature Sensors

Soil temperature is measured at one, six, and twelve inches at the base of the Central Climatology Tower. The probes that are used are Teledyne Geotech Model T-200 platinum resistance temperature probes that are identical to the ones used on the Area Towers (see Teledyne Geotech model T-200 Temperature

Sensor). Each probe is protected by an outer covering of heat-treated plastic.

**Belfort Model 5-405HAX-1 Tipping Bucket Precipitation gauge**

Precipitation is measured at the Central Climatology site with a Belfort Instrument Company No. 5-405HAX-1 heated tipping-bucket rain gauge (Figure 5.3). In this gauge rain enters through the upper funnel into one compartment of the bucket until 0.1 mm of rainfall has accumulated. The weight of this amount of rain unbalances the bucket, causing the unit to tip on its pivots, dumping the accumulated rain water and moving the other compartment directly under the funnel. The tipping motion of the bucket actuates a mercury switch on the casting. Each time 0.1 mm of rainfall is measured, an electrical impulse is transmitted. The impulses drive an event counter to provide a measure of the total accumulation during a given time period. The water discharged by the bucket is not accumulated in the gauge but passes out of the gauge through a hole in the lower funnel.

This tipping-bucket gauge is equipped with two heaters. An upper heater is wrapped around the underside of the collector to melt snow or hail in the collector. A thermostat senses the temperature of the collector and maintains the temperature above 40° ±5°F. A lower heater, controlled by its own thermostat, prevents ice from forming in the lower housing and maintains the bucket mechanism above freezing temperature.

The rain gauges at Central Climatology issurrounded by a metal curtain to lessen the effect of wind on the measured precipitation.

For information concerning circuitry, specifications, or maintenance, refer to Instruction Book for the Heated Tipping-Bucket Rain gauge, catalog No. 5-405 HA (inches), catalog No. 5-405 HA-a (millimeters) by Belmont. Output voltages are pro-

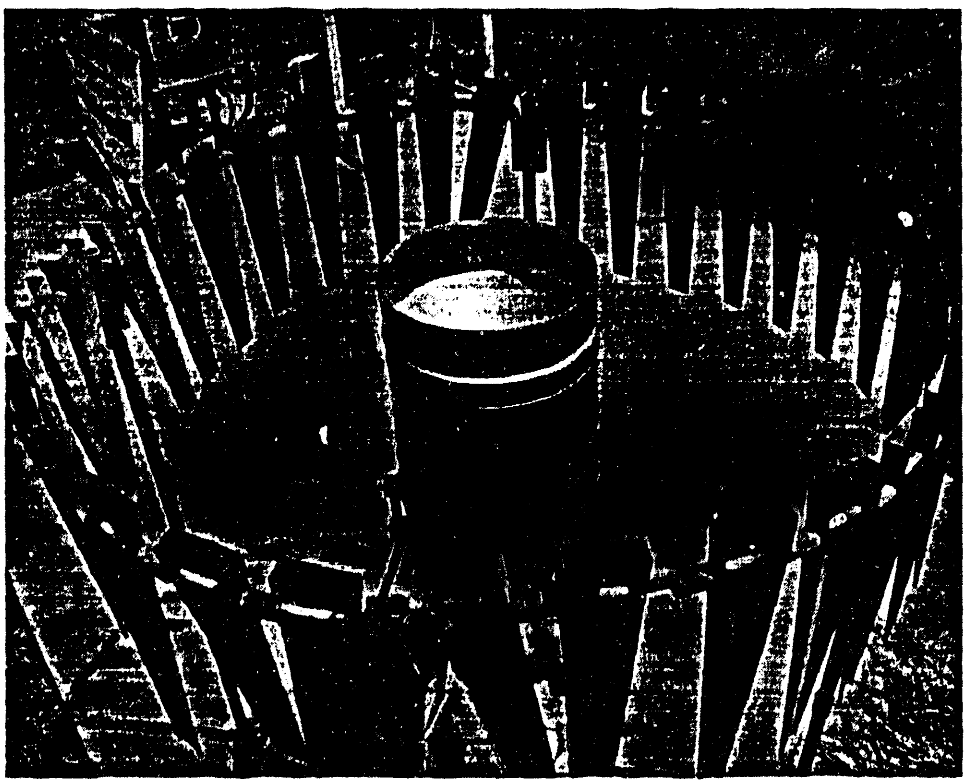


Figure 5.3 *Belfort Instrument Company No. 5-405HAX-1*

cessed by a Teledyne Geotech model 21.52 processor.

**Qualimetrics Analog Output Evaporation gauge model 6844-A**

At the SRS, evaporation is measured by observing the change in level of the free water surface in an above-ground analog output evaporation gauge. The level of floats in this gauge follow the level of the liquid in the pan. The floats are attached to a recording system that provides a continuous record of the fluid level changes. A wind baffle has been installed around the gauge to minimize the effects of wind on the amount of precipitation collected. This unit measures water levels to a ± 0.015 in. accuracy. For more information concerning the circuitry, specifications, or maintenance, refer to the Manual for Analog Output Evaporation gauge model 6844-A. Output signals are processed by a Teledyne Geotech 990-52960-0102 processor.

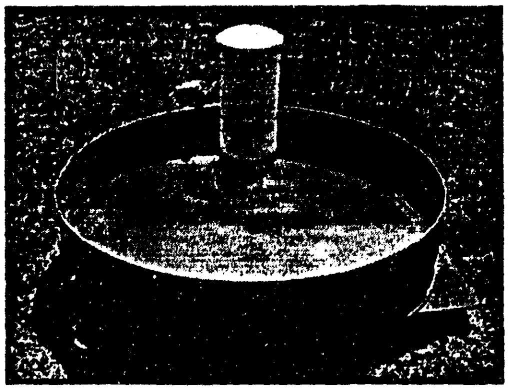


Figure 5.4 *Qualimetrics gauge Model 6844-A*

## Data Collection and Transmission

Data collection and transmission at the Central Climatology facility is identical to the Area Towers except that additional meteorological instrumentation signals are also processed. The collection and transmission hardware is configured to accommodate the four levels of instrumentation and specialized equipment (i.e. radiometers, evaporation gauge, etc.), however the system mimics the Area Towers (see Area Towers—Data Collection and Storage).

A Hewlett-Packard 3852A computer is currently being installed to replace a SUM-X model 405 data acquisition unit. The Hewlett-Packard unit will be used as a back-up data-storage unit and research tool for boundary layer studies.

## Lightning Suppression

The grounding network at Central Climatology was improved in the fall of 1990. New cable was laid in the general same pattern as the Area Towers (see Area Towers—Lightning Suppression). This new grounding system is necessary since the Central Climatology site is particularly susceptible to lightning strikes.

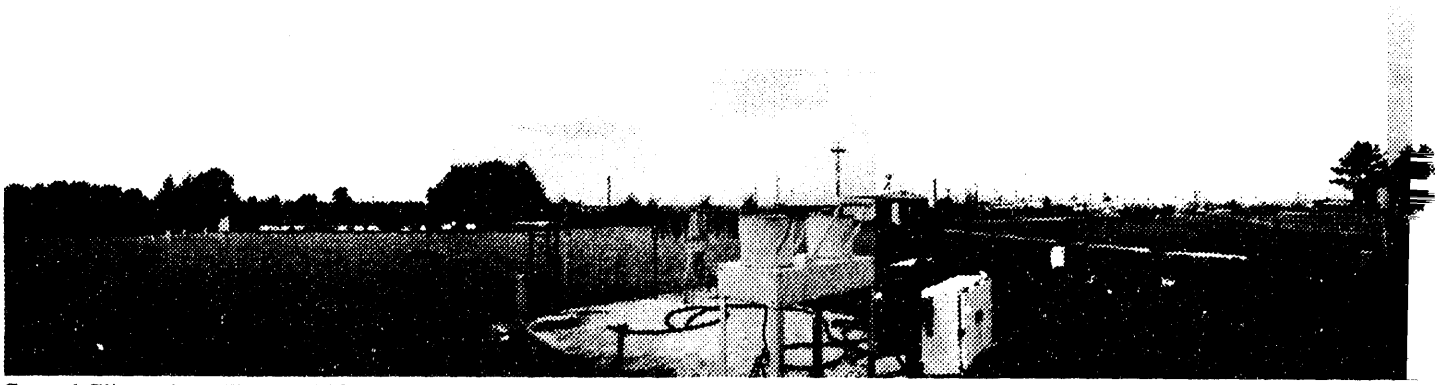
Lightning suppression circuitry, in the form of surge protectors, has been installed in much the same manner as the Area Towers (see Area Towers—Lightning Suppression). These surge protectors utilize resistors or zener diodes or combinations of the two. In contrast to the Area Towers, surge suppression circuitry can be disconnected from the system if necessary due to damage or for repair purposes.

## Electrical Power Supply

Electrical power is supplied to the Central Climatology tower via the SRS grid. In the event of a power outage, a portable diesel or gasoline generator is used to supply the tower electricity. Normal 110-VAC is converted to usable 12-VDC by transformers.

## Routine Facility Maintenance

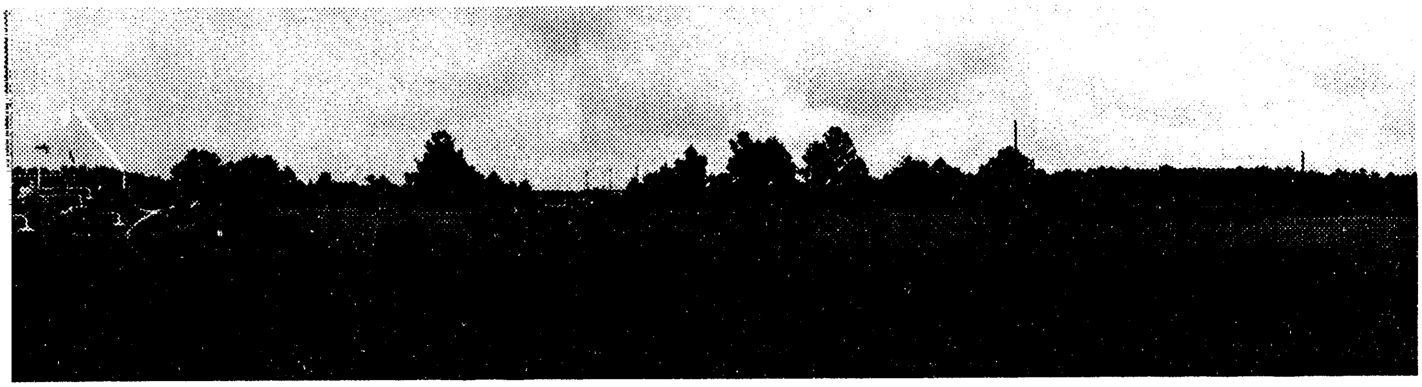
Facility maintenance of the Central Climatology site follows the same plan as for the Area Towers (see Area Towers—Facility Maintenance).

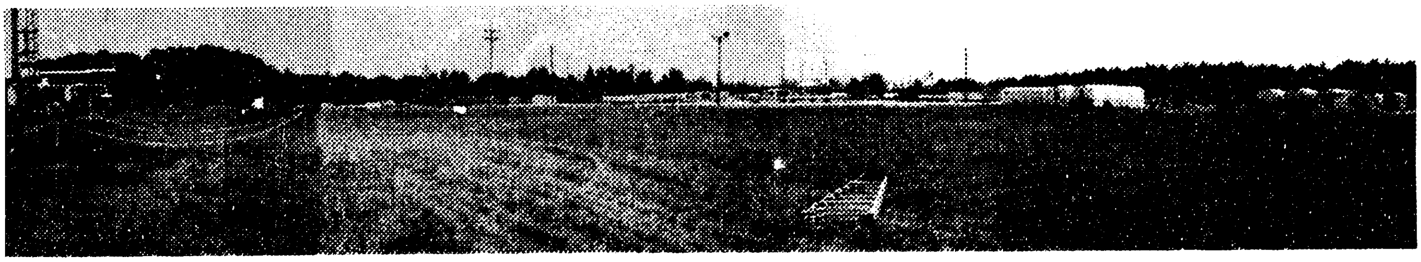


Central Climatology Tower 1988

Central Climatology Tower 1993

**Figure 5-5.** Central Climatology Tower





# Section 6—Supplemental Instrumentation

## Introduction

Meteorological instrumentation which supplements the automated WIND System equipment is used by the Environmental Technology Section (ETS). There are three distinctly different modes dur[illegible]g which the supplemental instrumentation is used; daily operational, calibration, and experimental. The equipment used everyday consists of a rain gauge network, an instrument shelter with a hygrothermograph and high/low temperature thermometers, barometers, and microbarographs. The instrumentation used for the calibration of meteorological instrumentation consists of torque watches, gram scales, constant RPM motors, thermistor thermometers, and relative humidity probes that are all traceable to the National Institute for Standards and Testing (NIST). Instrumentation used during atmospheric boundary layer experiments consists of acoustic sounding, air samplers, air balloons, a tethered balloon, and an ozone meter.

## Historical Perspective

The following sections describe the history of the three modes of supplemental instrumentation described above.

### *Daily Operational Mode*

Precipitation data has been collected by rain gauges (see Figure 6.1) since 1952. Rain gauges are located in A, C, D, F, H, K, L, and P Areas as well as Barricades 2, 3, and 5. Retired rain gauge locations include R Area, Forest Service headquarters, and CMX.

The A-Area precipitation data has been recorded at different locations. Data collected from January 1952 until December 1974 was collected near 735-A. However, another rain gauge located near the present location of 773-41A was in operation during an over-lapping time period from April 1968 through December 1974. From January 1975 to the present, only one rain gauge has been used to measure rainfall near the instrument shelter described in the hygrothermograph description below.

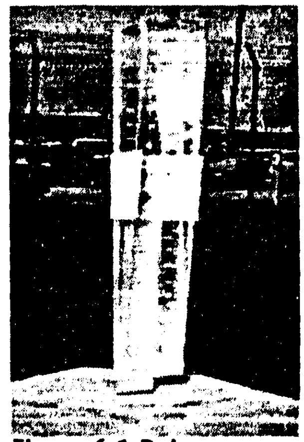


**Figure 6.1** ***Rain gauge***

Hygrothermograph data has been collected in A Area since 1964. Data was collected in a standard National Weather Service "cotton region" instrument shelter (Figure 6.2). The shelter was first located near Building 735-A, then near the Aiken parking lot, and is presently near 773-A by the 708-A security gate. The last location near the 708-A security gate has been in existence since June 25, 1991. These three locations are within a few-hundred feet of each other. More fragmentary hygrothermograph data was collected near 735-A back to 1956, but the calibration records for those measurements are unknown.

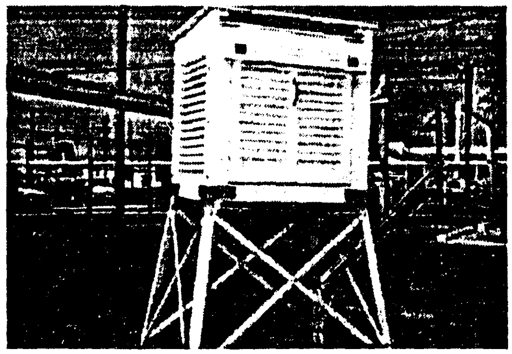


**Figure 6.2** ***NWS "cotton region" instrument shelter***

Microbarograph data collected in Building 773-A is available from 1972 to the present. Fragmentary microbarograph data collected in 735-A is available back to 1956, but, like the pre-1964 hygrothermograph data cited above, little is known about the calibration records for this data set.

### *Calibration Mode*

Current calibration equipment used by the ETS has been in service since about 1990. This time roughly corresponds to the dates of implementation for the calibration procedures in WSRC Procedure manuals L15.3 and 1Q for Measuring and Test Equipment. Previous calibration equipment was maintained and operated by electrical support groups at the SRS.

### *Research Mode*

ETS has conducted tracer gas studies over a period of about fifteen years at the SRS. The first studies involved local measurements of $^{85}Kr$ (a by product of nuclear processes at the SRS), which was used as a tracer. A database of tracer and meteorological data was compiled for the March 1975 to August 1976 period (Pendergast et al., 1979). Similar data was gathered from 1982–83 for the broader middle Atlantic coastal region (Schubert, et al., 1983). These data sets were used to validate WIND System codes and were made available for public distribution.

A series of experiments called the Mesoscale Atmospheric Transport Studies (MATS) (Weber, et al., 1992) were conducted from 1983 through 1986. The basic experiment was to monitor a release of $SF_6$ tracer gas from a 200 ft stack during daytime convective turbulence conditions. The first MATS samples were taken by up to 28 portable samplers which were placed at ground level in an arc downwind of the release. Up to 10 grab samples, taken by each sampler, were made in sequence during times of the probable maximum concentration. Later MATS utilized a continuous trace gas analyzer (Figure 6.3) on the mobile Tracking Radioactive Atmospheric Contamination (TRAC) vehicle for continuous $SF_6$ monitoring. TRAC made repeated passes through the plume which provided a better understanding of the plume's characteristics. During these sampling periods, computer simulations (models) of the $SF_6$ plumes were completed.

Another experiment, the project STAble Boundary Layer Experiment (STABLE) (Weber and Kurzeja, 1991) was conducted to observe tracer releases in the stable nocturnal boundary layer. Instrumentation by ETS during these experiments included the emergency response meteorological instrumentation of the WIND System as well as specialized equipment including portable air samplers, the mobile sampling capability of the TRAC vehicle, air balloons, a tethered balloon, and an ozone meter. The equipment that is still available for use at SRS is described in Research Instrumentation.

Many of the tracer studies listed above were conducted with the assistance of other government or university entities. Other documents describing these and other tracer studies at SRS are given by Bench et al. (1978), Flythe and Amlicke (1983), and Parker and Raman (1993).

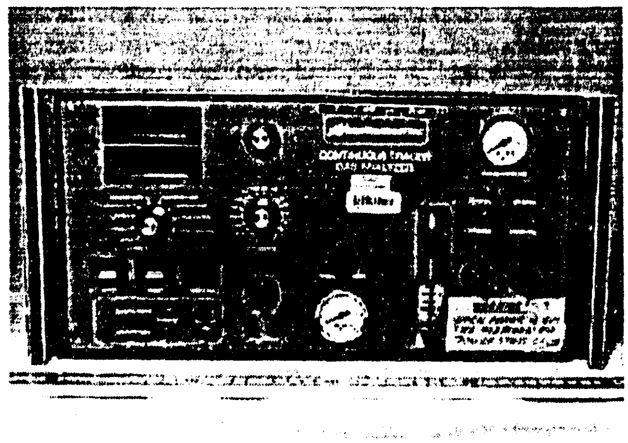


**Figure 6.3** *Continuous Tracer Gas Analyzer*

## Instrumentation

### *Rain gauge Network*

The ETS tabulates SRS rainfall data via a rain gauge network (Figure 6.4). Measurements are taken once a day, usually at 6 am, using a Tru Check plastic wedge rain gauge. Generally, these rain gauges are maintained by SRS security personnel. This data is stored on both magnetic and paper media.

### *Instrument Shelter near 773-A*

A Qualimetrics Model 8120 instrument shelter (Figure 6.5) is used to house the instrumentation listed below. The shelter is a standard National Weather Service "cotton region" shelter. The shelter consists of a 30 x 20 x 32-in louvered box that is supported by metal

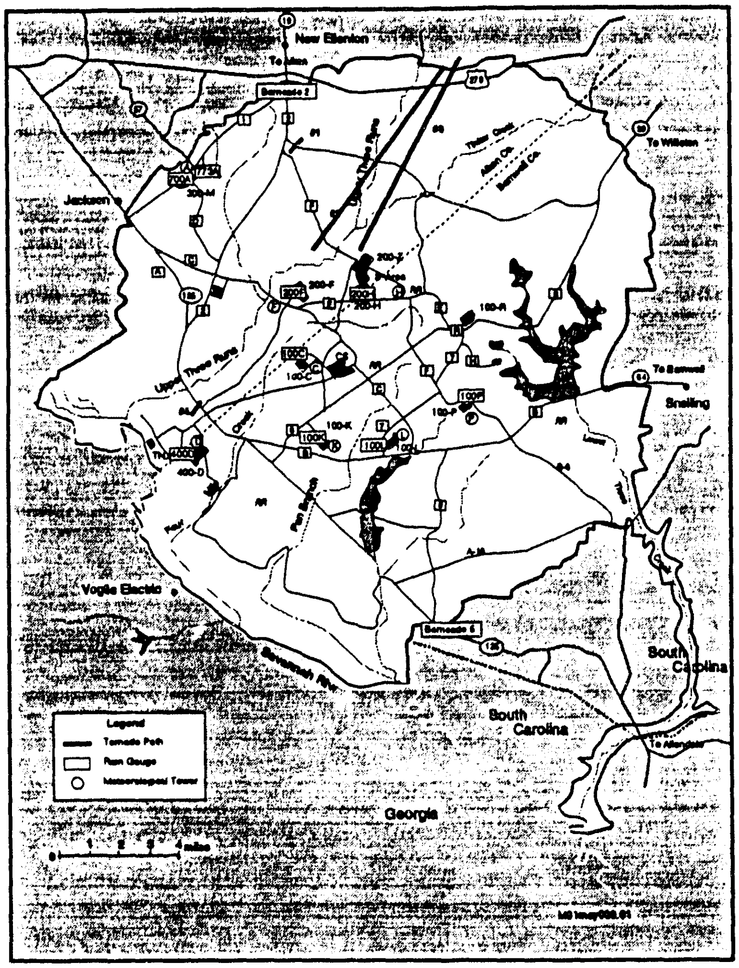



**Figure 6.4** *Map showing location of rain gauges and meteorological towers*

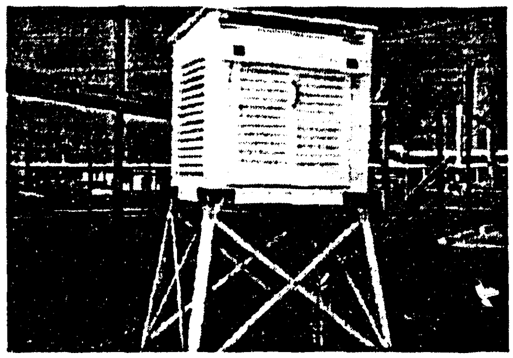


**Figure 6.5** *Qualimetrics Model 8120 instrument shelter*

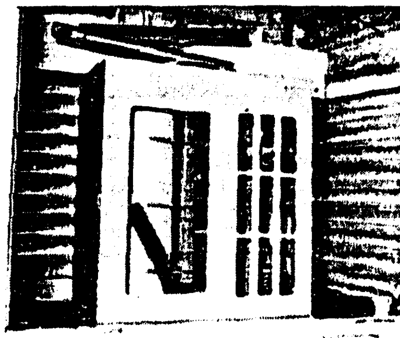


**Figure 6.6** *Belfort Model 594 Hygrothermograph*

legs. The effect of solar radiation is minimized by the white color of the shelter and the louvers that allow air to readily flow through the shelter. The shelter is approximately 4 ft above the ground.

### Hygrothermograph

A Belfort Model 594 Hygrothermograph (Figure 6.6) is used for continuous temperature and relative humidity measurements that are recorded onto a seven-day-strip chart. The temperature sensing device is a bi-metal strip, which moves an attached ink pen due to changes in air temperature. Relative humidity is sensed by a bundle of hair that expands or contracts due to the amount of water vapor present in the atmosphere. The value of the relative humidity is also recorded by an ink pen attached to the bundle. Temperature readings are accurate to ±1%, and the relative humidity readings are accurate to ±1% between 20–80% relative humidity and to ±3% at the extremes.

### High/Low Thermometers

These Weathertronics high and low thermometers (Figure 6.5) are made for standard national Weather Service "cotton region" shelters. The minimum-temperature thermometer records the lowest-temperature reading by using a thin weight submerged in an alcohol column. The weight will move with the column downward toward lower temperature readings but will not move upward since the column is tilted slightly upward. Therefore, the lowest-temperature between settings will be recorded by the location of the thin weight. The maximum-temperature thermometer records the highest temperature by allowing a mercury column to expand downward toward higher temperatures. When the air temperature cools, the mercury column is unable to move against the pull of gravity, and therefore the highest temperature is recorded.

## *Barometers*

### Mercury Reference Barometer (Central Climatology)

A Princo mercurial barometer is used for reference barometric measurements at the Central Climatology site. This barometer uses an adjustable cistern and an ivory peg as a zero-point to compensate for the changing level of mercury in the cistern as column height varies in response to atmospheric pressure fluctuations. The height of the mercury column is read with the aid of a brass scale attached to the barometer-supporting assembly. Corrections are applied for the height above mean sea level, temperature, and acceleration due to gravity.

### Aneroid Barometer (735-7A)

A Weather Measure Model BM 70 wall mount aneroid barometer (Figure 6.7) is used in conjunction with the wind tunnel in the Meteorological Engineering Facility (735-7A) for pressure readings needed for air-flow density measurements. The pressure sensor is an evacuated circular volume bounded by two-thin-metal disks. As the external atmospheric pressure acting on the disks changes, the disks flex and change their relative spacing. Readings are displayed on the face of the instrument.

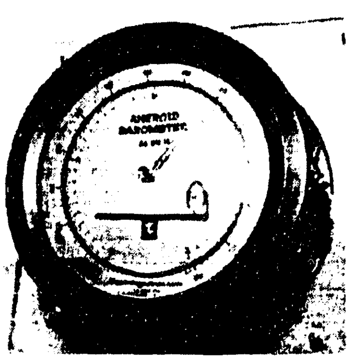


Figure 6.7 *Aneroid Barometer*

### Microbarograph (773-A)

A Belfort Instruments microbarograph (Figure 6.8) is used for keeping continuous atmospheric pressure records via a trace in Building 773-A. This sensor is an aneroid barometer which operates in a similar manner as the 735-7A aneroid barometer described above. However, the display mechanism operates by using an "arm" and ink pen which responds to the flex of the disks that change size as the atmospheric pressure changes. Seven-day strip charts are kept as records of the atmospheric pressure. Changes as small as ±0.005 in Hg can be detected.

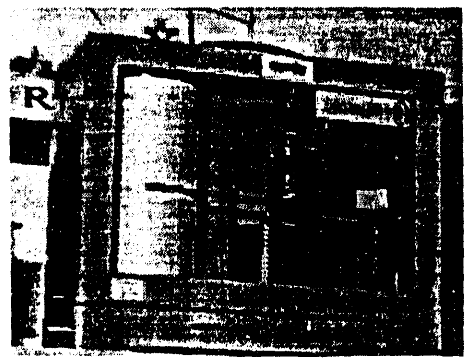


Figure 6.8 *Belfort Instruments microbarograph*

## *Calibration Instrumentation*

Descriptions of the calibration instrumentation used by the ETS are given in the following sections. Each piece of equipment is calibrated and traceable to the NIST.

### Torque Watch

The ETS uses a Teledyne Geotech Model 170.52-TW torque watch (Figure 6.9) to measure the starting threshold of the Teledyne Geotech Model 1564B cup anemometer. The

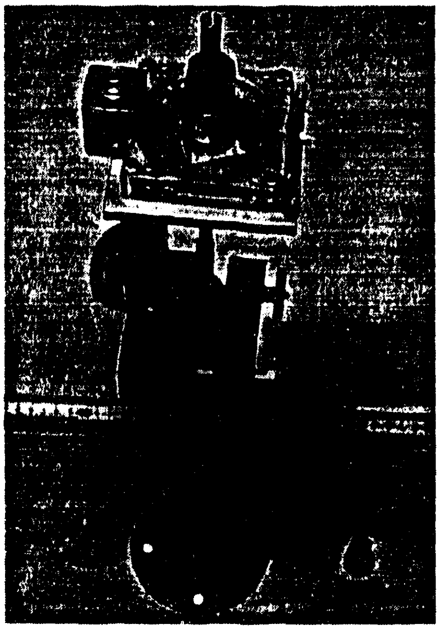


**Figure 6.9** ***Teledyne Geotech Model 170.52-TW torque watch***

torque watch consists of a coiled spring that resists compression at a known, measurable rate. Special adapters allow the starting threshold of the anemometer ball bearings to be measured. The torque watch measures torque in gm-cm, which can be converted to meters per second.

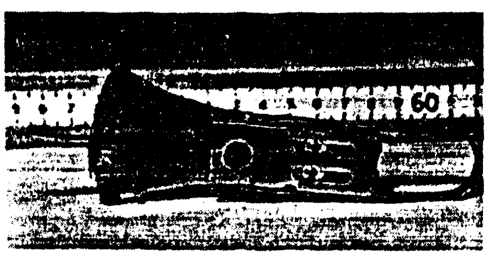


**Figure 6.10** ***Jonard 0–10 gram scale***

### Gram Scale

Measurements of the starting threshold of the Teledyne Geotech Model 1585 bivane are made with a Jonard (Tuckahoe, NY) 0–10 gram scale (Figure 6.10). The instrument is simple in design with a thin-metal-strip, which bends in a known (calibrated) manner in response to a force applied by the user. The metal strip is placed on the shaft of the bivane to measure the amount of force required to make the bivane respond.

### Constant RPM Motor

A constant revolution per minute (RPM) motor is used to calibrate the Teledyne Geotech Model 1564B cup anemometer. The constant RPM motor used is the R.M. Young

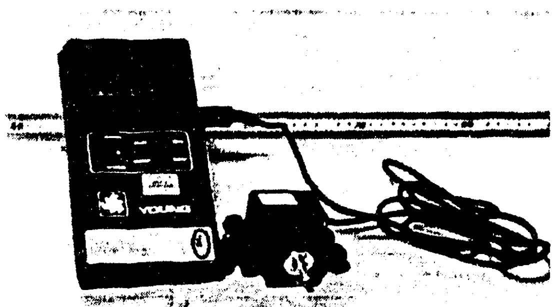


**Figure 6.11** ***R. M. Young model 18801 anemometer drive***

model 18801 (Figure 6.11) anemometer drive which operates in the 100–10,000 RPM range. The motor is portable and can operate on batteries or with a wall outlet adapter. The constant RPM motor fits above the Model 1564B anemometer with the cup housing removed and controls the rate of rotation of the anemometer shaft. The resulting anemometer voltage output is checked against expected values.

### Thermistor Thermometer

Calibrations of the Teledyne Geotech Model T-200 platinum resistance temperature probes are made with a Cole Parmer Model 8523-00 thermistor thermometer (Figure

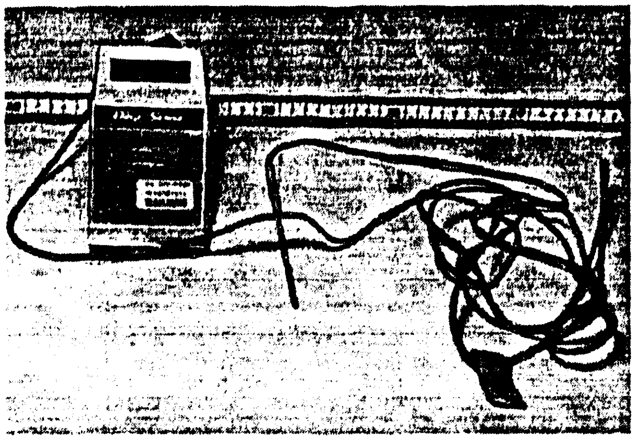


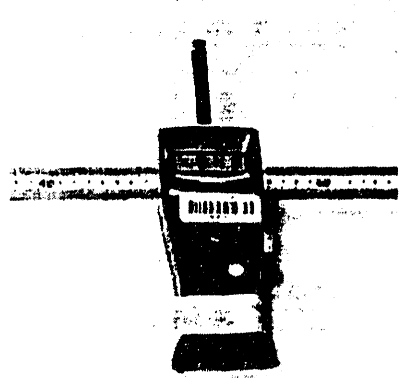
**Figure 6.12** ***Cole Parmer Model 8523-00 thermistor thermometer***

6.12). The probe which is used with the Model 8523-00 is the Yellow Springs Instrument model 406 liquid immersion probe that is accurate to 0.1°C. The probe operates in a manner similar to Teledyne Geotech Model T-200 RTD except that a non-platinum semiconductor is used to measure changes in probe resistance. In general, themistors provide more accuracy in a smaller temperature range than RTDs, but the thermistor is not as durable as the RTD. For these reasons, the thermistor can be used as a calibration reference for an RTD.

**Relative Humidity Probe**

Teledyne Geotech Model DP-200B dew-point sensors are calibrated with Rotronic GT-L relative humidity probes (Figure 6.13). The GT-L measures relative humidity by comparing changes in capacitance of a hygroscopic dielectric material "sandwiched" between two-porous electrodes. The GT-L generally maintains a ±2% accuracy over the rather broad 5–100% range whereas common psychrometers have difficulty taking reliable measurements below 40% relative humidity. The GT-L is a hand held portable unit, which is very durable for fieldwork. Calibration of the Hygroskop GT is performed by comparing instrument output against known lithium-chloride solution mixtures.

**Figure 6.13** ***Retronic GT-L relative humidity probe***



## *Research Instrumentation*

The following equipment has been used for obtaining specialized meteorological data during tracer gas release studies at SRS.

**Profile Measurements**

The ETS maintains the capability of making profile measurements of wind speed, direction, temperature, humidity, and pressure. An AIR Tethersonde can be used for detailed measurements of the boundary layer up to 1000 m. AIR Airsonde radiosondes are used for temperature, humidity, and pressure measurements up to 30 km. Both systems utilize AIR's own Automatic Data Acquisition System for data retrieval and storage. Profiles at SRS are usually made only during intensive observation periods such as during MATS or STABLE.

**AIR Tethersonde**

The AIR Tethersonde operates by taking measurements with a sensor that is suspended below a helium filled tethered balloon. The advantage of the tethersonde is that detailed measurements within the boundary layer can be made by adjusting the rate of balloon ascent or descent. However, wind speeds above 6 m/s greatly inhibit the use of the Tethersonde.

Wind direction is measured by the use of a magnetic compass. A potentiometer senses direction as the tethered balloon orients itself with the prevailing wind direction. Details of the wind direction sensor are listed in Table 6-1.

**Table 6-1.** Specifications of AIR Tethersonde wind direction measuring capability

| | |
|---|---|
| Accuracy | ±5° |
| Resolution | 1° |
| Range | 2°–358° |

Wind-speed measurements are made with a cup anemometer that correlates rate of rotation to light-chopper output. The Table 6-2 describes the specifications of the Tethersonde anemometer.

**Table 6-2.** Specifications of the AIR Tethersonde cup anemometer

| | |
|---|---|
| Distance constant | --- |
| Accuracy | 0.25 m/s |
| Response threshold | --- |
| Range | 0 to 20 m/s |

A precision bead thermistor and aspirator are used to make Tethersonde temperature measurements. A radiation shield protects the sensor from solar radiation. Specifications of the Tethersonde temperature probe are listed in Table 6-3.

**Table 6-3.** Specifications of the Air Tethersonde bead thermistor

| | |
|---|---|
| Time constant | 12 sec |
| Accuracy | ±0.5°C |
| Range | -70°C to 50°C |

Wet-bulb temperature is measured by the Tethersonde by using a precision bead thermistor. This is the same type as the precision bead thermistor used for dry-bulb-temperature measurements. A wetted wick covers the thermistor and a fan aspirates the probe. A tube leading from a water reservoir to the wick allows for continuous measurements. Specifications of the probe are listed in Table 6-4.

**Table 6-4.** Specifications of the AIR Tethersonde humidity probe

| | |
|---|---|
| Time constant | <5 sec |
| Accuracy | 3% |
| Range | 3% to 100% |

**AIR Airsonde**

The AIR Airsonde radiosonde measures temperature by the use of a bead thermistor mounted on a 15-cm outrigger. This structure minimizes radiation errors by utilizing white reflective paint on the bead and heat conduction errors by utilizing the outrigger mount (Table 6-5).

**Table 6-5.** Specifications of AIR Airsonde temperature probe

| | |
|---|---|
| Time constant | <5 sec |
| Accuracy | ±0.5°C |
| Range | -80°C to 50°C |

A carbon hygristor is used for measuring relative humidity. A duct provides adequate ventilation as well as protection from moisture and solar radiation (Table 6-6).

**Table 6-6.** Specifications of AIR Airsonde relative humidity sensor

| | |
|---|---|
| Time constant | <5 sec |
| Accuracy | 5% relative humidity |
| Range | 10%–100% relative humidity |

The Airsonde radiosonde measures atmospheric pressure via an aneroid capacitance pressure sensor that is automatically temperature corrected (Table 6-7).

**Table 6-7.** Specifications of AIR Airsonde pressure probe

| | |
|---|---|
| Time constant | <5 sec |
| Accuracy | 1 mb |
| Range | 1050 mb to 5 mb |
| Resolution | 0.1 mb |

## *Air Sampling Equipment*

**Stationary Samplers**

The DeMaray Scientific Instrument Model SS 12A-60 Sequential Syringe Environmental Sampler (Figure 6.14) is used to take atmospheric grab samplers during tracer gas studies. The sampler uses a set of 12 syringes that can be programmed to automatically take a sample at a prescribed time. Each syringe can take one sample that is analyzed in a laboratory setting by a gas chromatograph, etc. The ETS uses about 30 samplers that can be arranged in an array downwind of an oncoming plume.

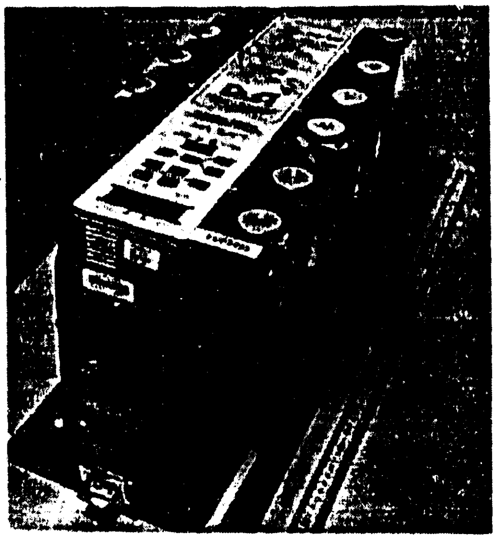


**Figure 6.14** ***DeMaray Scientific Instrument Model SS 12A-60 Sequential Syringe Environmental Sampler***

**Mobile Continuous Sampler**

In the Tracking Radioactive Atmospheric Contaminants Vehicle (TRAC), an AeroVironment Model CTA-1000 Continuous Tracer Analyzer (Figure 6.15) is used to measure concentrations of an atmospheric tracer gas. The Model CTA-1000 operates in the continuous mode on a mobile platform such as TRAC and has been developed to specifically measure SF6. The analyzer filters particulate by combining hydrogen and oxygen through combustion and scavenging chlorocarbons, flourocarbons, and nitrogen compounds. The remaining constituents exhibit various levels of electron activity that can be measured, and the known range of the $SF_6$ activity can be monitored to detect percent composition or concentration.

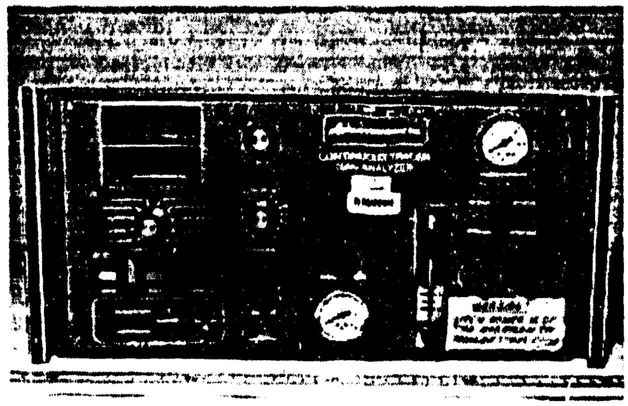


**Figure 6.15** ***AeroVironment Model CTA-1000 Continuous Tracer Analyzer***

**Ozone Analyzer**

A Dasibi Model 1008 Ozone Analyzer (Figure 6.16) is used to measure concentrations of atmospheric ozone. In the instru-

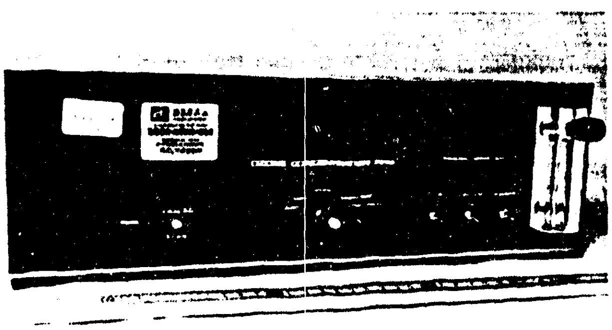


**Figure 6.16** ***Dasibi Model 1008 Ozone Analyzer***

ment's sampling chamber, a wavelength of ultraviolet light that is susceptible to absorption by the ozone molecule is emitted through an air sample. The amount of attenuated light determines the amount of ozone present in the air sample. The instrument utilizes a tube to draw air into the measurement chamber. The instrument can be transported easily but should be sheltered, and the air tube should be placed away from obstructions.

## References


Bench, H. L., R. W. Bench, W. P. Elliot, G. J. Ferber, R. N. Dietz, S. Barr, W. E. Clements, M. M. Fowler, P. R. Guthals, W. A. Sedlacek, C. D. Kern, D. W. Pepper, and A. L. Turkevich, 1978: *Heavy Methane-$SF_6$ Tracer Test Conducted at the Savannah River Plant*, December 10, 1975. DP-1469. E. I. duPont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

Flythe, M. C. and B. B. Amlicke, 1983: *Catalogue of the Existing Short Range Experiment (SRE) Data Base (addendum to the NOAA Technical Manual ERL ARL-80).* Air Resources Laboratory, Rockville, Maryland.

Parker, M. J. and S. Raman, 1993: *A Case Study of the Nocturnal Boundary Layer Over a Complex Terrain*. Boundary-Layer Meteorology. Vol. 66, pp 303–324. Klawer Academic Publishers, The Netherlands.

Pendergast, M. M., A. L. Boni, G. J. Ferber, and K. Telegadas, 1979: *Measured Weekly $^{85}Kr$ Concentrations within 150 km of the Savannah River Plant* (March, 1975–August, 1976). DP-1486. E. I. duPont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

Schubert, J. F., J. L. Heffner, and G. A. Mead, 1983: *Atlantic Coast Unique Regional Atmospheric Tracer Experiment (ACU-RATE) Interim Report*. DP-1661. E. I. duPont de Nemours and Company, Savannah River Laboratory, Aiken, SC.

Weber, A. H., and R. J. Kurzeja, 1991: *Nocturnal Planetary Layer Structure and Turbulence Episodes during the Project STABLE Field Program*. Journal of Applied Meteorology, Vol. 30, no. 8. American Meteorological Society, Boston.

Weber, A. H., S. Berman, R. J. Kurzeja, and R. P. Addis, 1992: *The MATS Experiments—Mesoscale Atmospheric Transport Studies at the Savannah River Site*. Nuclear Safety, Vol. 33, no. 1. US DOE, Oak Ridge National Laboratory.

WSRC, 1991: *Meteorological Monitoring Procedures*. Procedure Manual L15.3 (U). Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

WSRC, 1990: *Westinghouse Savannah River Company Quality Assurance Manual (U)*. Procedure Manual 1Q. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

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# Section 7—Calibration and Instrument Maintenance

## Introduction

The following sections describe the methods of meteorological instrumentation calibration and maintenance used by the Environmental Technology Section (ETS). The history, personnel requirements, and procedures of meteorological instrumentation calibrations are covered in the following sections. Each individual procedure can be found in WSRC Procedure Manual L15.3 *Meteorological Monitoring Procedures*.

## Historical Perspective

Before the mid 1980s, calibration of meteorological instruments was completed by the ETS in the wind tunnel located in Building 735-7A, but the instruments were installed in the field by SRS electronic technicians (DuPont, 1977). Maintenance between calibration periods also was performed by the electronic technicians, however, frequent schedule conflicts prevented adequate maintenance of the instruments in the field. Currently, the calibration, installation, and maintenance of meteorological instrumentation is conducted solely by the ETS. This ensures that proper attention is given to the instrumentation to optimize instrumentation in-service time at each tower. The ETS now operates its meteorological facilities at a greater than 90% annual availability as required by regulatory standard (DOE, 1991).

## Calibration and Maintenance Personnel

The following is the job description for the WIND System Meteorological Instrumentation Maintenance and Calibration Project Technicians who calibrate and maintain the meteorological instrumentation of the WIND System.

### *Job Description*

The tasks performed by the Meteorological Instrumentation Maintenance and Calibration Project Technicians vary considerably. Installation, maintenance, and/or calibration of meteorological instrumentation, associated signal conditioning, and transmission equipment are performed as scheduled or as required. Instrumented towers are located in the 8-production areas (A, C, D, F, H, K, L, P), near Central Shops, and at the WJBF-TV Tower in Beech Island, SC. Maintaining this network requires the use of a fully equipped step-van for executing field work activities. The types of instrumentation located at these facilities are diverse. Measurements are made of very minute voltages (±0.001V) that require sensitive electrical and mechanical measuring devices. Maintenance, calibration, and troubleshooting of these sensitive instruments requires diligent attention to detailed procedures and a working knowledge of electrical test equipment (i.e., volt meters, oscilloscopes, etc.).

For selected instruments, wind tunnel calibrations are made in 735-7A, which is part of the project technicians work area. Initialization and programming of a back-up data logger system at each tower is performed on an as needed basis. Documentation of quality assurance records associated with Category 1 instrumentation and Category 2 procedures is necessary. Ordering spare parts and shipping equipment offsite for repair is performed as part of the tasks of the position. Operation of electric winches and associated tower equipment is performed to enable hands-on work of instrumentation at ground level. Diagnostic monitoring of data and system status is performed routinely through the use of modems, available WIND System software, and back-up data logging systems. An assessment of the status of all aspects of the entire system are made by a meteorologist on a daily basis. As time permits, when the system is operating satisfactorily, research and development projects dealing with the system and/or its components are conducted independently by project technicians with input from their supervisor and/or a meteorologist.

### *Qualifications*

A strong electronic/electrical background is necessary for the position of WIND System Meteorological Instrumentation Maintenance and Calibration Project Technician. Individuals should have a 2-year associate degree in electronics or the equivalent in SRS Electrical & Instrumentation (E&I) electrical training course work. Individuals should have five years of hands-on electrical field work experience (E&I or the equivalent). Individuals should be able to read electrical prints, schematics, and have experience in troubleshooting and repairing electrical circuits. The individual must be able to read, learn, and be able to apply information provided in manuals. The individual must be able to attend and successfully complete course work dealing with the instrumentation and equipment which comprise the Meteorological Monitoring Program of the WIND System. The individual must be able to interact with members of the Environmental Transport Group as well as other onsite support groups and be able to independently work on troubleshooting, record keeping, ordering, inventories, shipping, and small-scale projects.

## Description of Procedures

The following sections describe the specific procedures, which are used for the meteorological instrumentation of the WIND System. The number of each procedure as it appears in WSRC Procedure Manual L15.3 *Meteorological Monitoring Procedures* is listed in parentheses after the section title.

### *Performance Calibration Procedures for Meteorological Instrumentation (ETSP T-100B)*

The ETS uses procedures for conducting dynamic performance calibrations that verify the capability of the sensor design to meet required regulatory specifications. These procedures are carried out, usually only once for each generic sensor type, in the laboratory or in the wind tunnel. These procedures have been written in a universal format so that any brand of instrument may be tested for applicability to the system that the ETS has in place.

Measurements of the starting threshold, distance constant, transfer function, and off-axis response are made for a cup anemometer. Measurements are made for the following characteristics of both the azimuth and elevation functions of a bivane: starting threshold, delay distance, overshoot (damping ratio), and vane position accuracy (transfer function). These procedures also provide all of the necessary steps to perform laboratory calibrations on aspirated radiation shields containing platinum resistance thermal devices (RTDs) connected to a signal conditioning circuit and of a dewpoint temperature instrument by comparison to a collocated transfer standard in the free atmosphere.

### *Standard Installation Procedures for Meteorological Instrumentation (ETSP T-101)*

Installation of wind, temperature, and humidity sensing devices are described in a written procedure. Sighting of true North, sensor leveling, and minimization of solar radiation errors are the primary aspects of correct sensor installation. These procedures are written in a generic format so as to apply to the initial installation of any brand of instrument. These particular procedures are followed only when initially installing an instrument, not for reinstallation that is covered in the field calibration procedures (see Other Calibration Methods). Documentation of sensor orientation is made while performing field calibration procedures.

### *Field Calibration Procedures for Meteorological Instrumentation (ETSP T-100A)*

Field calibrations are conducted for the Teledyne Geotech instrumentation used by ETS. Detailed procedures have been written for the cup anemometer, bivane, temperature probe, and dewpoint sensor used on the Area and Central Climatology Towers. These procedures begin with documentation of the sensor's as-found conditions. Then, a thorough check of the entire system is made from sensor, signal-processor card, communication hardware, to algorithms on the WIND System. If any adjustments are made, then the resultant as-left conditions are recorded. This process provides a starting and stopping point for each calibration period with a comprehensive check of the entire system.

Multiple challenges are made for each different type of sensor. The cup anemometer is checked for bearing condition (threshold) and rate of rotation measurements against a traceable constant RPM motor. The bivane also is checked for bearing condition (threshold) as well as horizontal and vertical wind direction accuracy. Temperature probes and dew point sensors are checked against traceable standards. An additional measurement of the level of the instrument platform also is made.

If possible, adjustments of a sensor are made in the field during calibration. However, irreparable instruments are sent back to Teledyne Geotech for refurbishing. Common field adjustments range from anemometer bearing replacement, adjusting the zero degree elevation on the bivane, to setting the high and low range on a signal-processor card. Leveling of the instrument platform also is done if necessary.

### *Standard Maintenance Procedures for Meteorological Instrumentation (ETSP T-102)*

These procedures provide methods used for maintaining the integrity of the meteorological data for the WIND System. Records of data checks are accomplished through the use of site log books, and daily data evaluations. Any visit to a tower facility must be documented in a site log book including the reason for the visit and any action taken. Every working day, a 24-hour average of the previous day's data is created and evaluated according to specific criteria that consider all Area Towers and all levels of the TV Tower. An evaluation of the above records, in conjunction with tower repair priority policy, is made every working day so as to determine the appropriate action. This evaluation is made in a morning meeting of the instrument meteorologist, project assistants and their supervisor.

### *Other Calibration Methods*

The majority of the calibration of WIND System meteorological instrumentation is done onsite by the ETS. However, in certain cases, instrumentation is sent offsite to be refurbished to factory conditions. Some common examples include severe electrical lightning damage to instruments or processor cards and bivane cam damage.

Measuring and test equipment used by the ETS is calibrated by the Savannah River Standards Laboratory (SRSL). This equipment includes voltage meters, reference temperature probes, and dewpoint sensors. Calibrations performed by SRSL are conducted once a year or as necessary. SRSL calibrations are important because they provide a means of traceability to the National Institute of Standards and Testing (NIST).

## Calibration and Maintenance Facilities

In order to calibrate and maintain the meteorological monitoring system of ETS, the facilities described below are used for equipment support.

### *Meteorological Engineering Facility*

The meteorological engineering facility is located in Building 735-7A (Figure 7.1). Troubleshooting and wind-tunnel calibrations are conducted in this facility. Additionally, offices for personnel involved with maintenance or research on WIND System equipment are located in Building 735-7A. Daily meetings are held to discuss the current WIND System status and to determine appropriate actions to be taken (see Standard Maintenance Procedures). A mobile lab is equipped to act as an extension of the meteorological engineering facility and is located and ready for dispatch outside Building 735-7A.

Figure 7.1 *Meteorological engineering facility*

**Equipment**

In-house repair of meteorological instrumentation such as signal processor cards and instrument refurbishment is normally conducted in the meteorological engineering facility. Test equipment such as oscilloscopes, soldering irons, and special hand tools are available for diagnostic and repair use. Manuals and schematics are stored and available for reference. Spare equipment and parts are centrally located in Building 735-7A (Figure 7.2) to maintain a current inventory. Maintenance or fabrication that requires heavy duty equipment such as a drill press or grinder also can be performed in Building 735-7A.

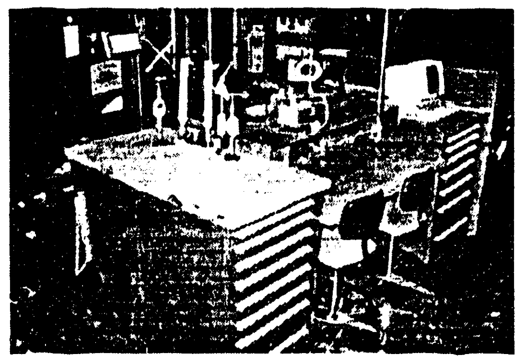

Figure 7.2 *Spare equipment and parts*

**Wind Tunnel**

The ETS uses an Aerolab Subsonic Low Turbulence Wind Tunnel (Figure 7.3) for calibration and research of meteorological instrumentation. The tunnel operates by utilizing a

Figure 7.3 *Aerolab Subsonic Low Turbulence Wind Tunnel*

15-horse-power constant-speed motor that turns a fan to draw air through a honeycomb grid. This air is drawn through the test section and exhausted beyond the fan blades. The test section is 36" x 36" x 60". Airflow is regulated by a variable-tachometer control unit that has been calibrated by T. J. Lockhart (Weber, 1990) and is traceable to the NIST. Airflow rate can be measured with a manometer or with a hot-wire airmeter. An adjacent cabinet has been equipped with the full compliment of signal-processor cards and power units identical to those used in the WIND System. These are used for wind tunnel tests of ETS' meteorological equipment. In addition, a high-speed data-acquisition system utilizing a personal computer and Labtech Notebook (ver 6.0) software has been adapted for use with the wind tunnel.

### Mobile Laboratory (step-van)

Field repair and maintenance such as semi-annual calibrations are conducted with the assistance of a mobile-lab step-van (Figure 7-4). This vehicle is equipped with storage cabinets and a work bench so as to provide

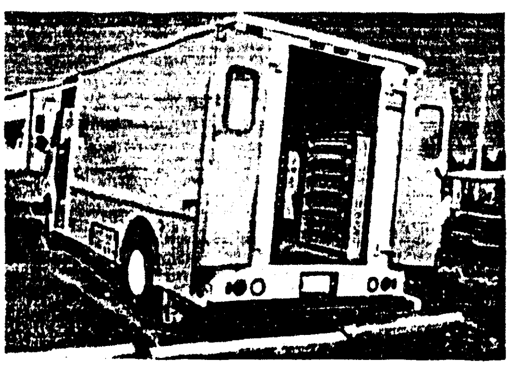

Figure 7.4 *Mobile-Lab Step Van*

similar capabilities, on a smaller scale, as the meteorological engineering facility. This mobile lab enables basic repair and maintenance to be conducted in the field rather than only at the meteorological engineering facility. That is particularly important considering the 300-square-miles area of the SRS.

## References


DOE, 1991: *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. DOE/EH-0173T. U.S. Department of Energy. Washington, DC.

DuPont, 1977: *Wind Data Facilities Maintenance and Checkout*. DPSOL 6-10515. E. I. DuPont de Nemours and Co. Inc. Savannah River Laboratory, Aiken, SC.

Weber, A. H., 1990: *Recommended Calibration Constants for the SRL Wind Tunnel (U)*. WSRC-TR-90-168. Savannah River Technology Center, Westinghouse Savannah River Company, Aiken, SC.

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