

**ENHANCING THE QUALITY, VALIDITY AND RECOVERY OF METEOROLOGICAL  
DATA AT NUCLEAR PLANTS THROUGH THE USE OF DIGITAL RECORDERS**

Mark T. Carroll, Murray and Trettel, Inc.

Meteorological data and sensor problems are not always identifiable through daily data review.

Routine methods of data review include visual review of hourly or 15 minute average data, review of paper or computer generated traces and comparison with other monitoring locations (National Weather Service or other). Review of the data by a trained meteorologist provides greater recognition of data patterns.

The real advantage to traces, either analog or digital, is the ability to show things that cannot be seen in the digitally averaged data. Things such as significant bearing wear, the onset of icing on the sensors, intermittent short lived problems, etc., that are lost in the digital averages can be identified easily. By identifying these problems early, maintenance can be performed before sensors fail and significant data loss is incurred. The ability to access data in real time also enhances the ability to identify problems and/or verify proper operation.

Grouping data from multiple sites in close proximity can assist in determining data problems. Although temperature, wind speed, wind direction, change in temperature with height, dew point and precipitation will vary from site to site, the general trends should remain similar between nearby sites. This is especially true in the Midwest where topography is generally not a factor.

While a trace from an individual site may appear to be representative for that site, comparing it to a trace from a nearby site, or sites, may indicate discrepancies. Data can be reviewed to see if any meteorological reason exists for the data to vary between the two (or more) sites.

Wind speed and wind direction traces from multiple levels of a single site may also be overlaid. If wind direction values vary significantly between levels for prolonged periods of time, a siting or sensor problem may exist. If upper level wind speeds are less than a lower level, a bearing problem may exist.

By utilizing as many means as possible to determine data integrity, valid data recovery is enhanced.

**ROUTINE DATA REVIEW**

The Nuclear Regulatory Commission requires that meteorological data be measured and archived at all nuclear facilities. Murray and Trettel, Inc., a private meteorological consulting company, has the responsibility for collecting and reviewing meteorological data at several nuclear power plants in the United States.

As a part of routine data review process, Murray and Trettel retrieves hourly data from the meteorological monitoring tower erected in close proximity to the nuclear plant. This data is collected on a daily basis. After the data is collected, computer programs review the data and flag data that appears to be inconsistent. The data is also manually reviewed by as many as four professional meteorologists.

For nuclear facilities that are in close proximity to one another (multiple sites), the data can be compared to other nearby sites. Although data from two meteorological monitoring towers is seldom identical, similar data trends are generally found.

Meteorological data from the closest (or most representative) National Weather Service or FAA site (normally an airport) to the nuclear facility is saved and reviewed daily. This is another means of data comparison and validation. Hourly averaged data from the meteorological tower at the nuclear facility can be compared to the hourly data (referred to as Metars). Data trends such as wind direction shifts, wind speed changes, rising or falling temperatures, etc. can be compared between the two sites.

Meteorologists will become familiar with differences between locations (due to topography, proximity to large bodies of water, and other local effects) and will be able to discount differences that may normally exist between the two monitoring locations.

Once a meteorologist becomes familiar with a particular site (or sites), they tend to have a greater recognition of data patterns or data trends during specific meteorological conditions. If data appears to be inconsistent with previous trends, the meteorologist may review synoptic patterns that existed at the time of data collection to help determine the validity of the data.

The following are the data review steps completed on a daily basis:

- a) Data Collection - collect hourly averaged data from previous 24 hours.
- b) Potential erroneous data is flagged by computer program.
- c) Data is manually reviewed by at least two meteorologists.
- d) Compare sites that are in similar geographic locations.
- e) Compare data to data available from nearby airports (several times each week).
- f) If data is questionable, collect digital recorder data and review data trace.
- g) If sensor problems are evident, dispatch technician(s).

#### **DATA LOGGING AND DIGITAL RECORDING**

The primary source of data collection is a data logger. The data logger samples the data at one second intervals. The data logger also averages the data over 15 minute and one hour time intervals. Meteorologists generally review the one hour averaged data, although the one minute averages and instantaneous data are available for review if data validity is questionable.

A secondary source of data collection at several sites is a digital recorder. The digital recorder saves data at 10-second intervals. Software allows data from the digital recorder to be reviewed as a trace (much like paper chart recorders). The trace allows one to discover potential problems with the data collection that may not be readily discernible from 15 minute or one hour averaged data. If only brief periods of invalid data (spikes in the trace as an example) occur over a one hour period, the one hour average would likely mask the potential data errors.

Some problems that may be determined from the digital trace include slowly decreasing wind speed values when icing conditions exist, problems with a dew point sensor (dew point exceeds temperature for brief periods), erroneous precipitation gauge data, and wind speeds that are below threshold values.

Through the use of communications software packages, the digital recorder can be accessed remotely to review data in real time. The communications software allows a meteorologist or field technician to troubleshoot a potential problem and to determine if a site visit is required. If equipment problems are evident from the digital trace or from the real time data review, the field technician can be dispatched to the site to perform corrective maintenance.

#### **DATA VALIDATION USING DIGITAL RECORDERS**

A means of data validation is grouping data from multiple sites that are relatively close to one another. This can be performed by overlaying multiple traces of single parameters (wind speed, wind direction, temperature, etc.). Actual values will vary, however the general tendencies should be consistent.

Data may also be validated by overlaying multiple levels of individual parameters from individual sites. As an example, a tower may have three levels of wind direction measurements. The three levels will routinely vary, however if large differences between levels exist for long periods of time, a sensor or siting problem may be evident. While the individual trace of a single level may not readily indicate a problem, the overlay may make evident a problem that requires technician involvement.

Wind speeds will also vary (in some cases greatly) with height. By overlaying multiple levels of wind speed measurements, one may see that an upper level wind speed is less than a lower level speed for prolonged periods. This may indicate bearing or icing problems at the site.

Some meteorological monitoring towers have multiple delta T (change in temperature with height) measurements. When these measurements are overlayed, they should generally trace similarly (lower to middle delta T as compared to a lower to upper delta T). If large discrepancies exist over long periods of time, a maintenance call may be warranted.

#### **DIGITAL RECORDER DATA REVIEW**

Data from the digital recorder is routinely collected on a weekly basis (more frequently if warranted). The traces for all parameters are reviewed by a meteorologist. Any apparent problems with the data are logged. The logging of potential problem data includes the parameter or parameters in question and the date and the time that the questionable data was recorded. These logs are reviewed by the meteorologist performing the final data edits to help determine what data should be invalidated and what data can be edited (corrected).

#### **DATA ARCHIVAL**

Generally, hourly averaged data from the primary source (data logger) is archived. If data from the primary source is missing or found to be invalid and valid data from the secondary source (digital recorder) is available, the digital recorder data will be utilized to fill data gaps.

#### **CONCLUSION**

Digital recorders have been utilized by Murray and Trettel for meteorological monitoring programs at several nuclear plants. These recorders have been in place since 1998. The use of the digital recorders has allowed Murray and Trettel to maintain a high level of valid data recovery. Average annual valid data recovery exceeds 98% for all measured parameters.