RWIS STANDARDS

Siting Standards

Calibration Standards

Communication Standards

AN INTRODUCTION
TO
STANDARDS
FOR
ROAD WEATHER INFORMATION SYSTEMS (RWIS)

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Weather and roads. An age-old battle pitting road maintenance, traffic, and emergency operations against the elements. Transportation agencies are all too familiar with the operational and logistical challenges brought on by adverse weather conditions. Now, many agencies have begun to level the playing field by using advanced technologies to make decisions that reduce the negative effects of adverse weather conditions on mobility and safety.

These advanced technologies, known as road weather information systems (RWIS), have become a critical component of many agencies' maintenance efforts. Agencies are now considering ways to integrate RWIS with their other intelligent transportation systems (ITS) so weather information can support a broader range of ITS services. Attention is turning to identifying standards that can help ensure the fidelity of weather data being collected as agencies begin to share weather data with a wider audience.

This brochure describes three categories of standards being considered for RWIS applications: siting standards, calibration standards, and communication standards. Note that the term "standard" is used in this brochure to simplify the presentation of the material. It refers to guidelines, recommended procedures, protocols, and other practices that formalize some of the processes involved in deploying and maintaining RWIS sensors. The standards described here are still being developed and are not mandated by the U.S. Department of Transportation. The U.S. DOT encourages agencies to use this brochure as a starting point to learn about RWIS standards and to consider how they might use these standards to reinforce their own RWIS operations.

RWIS Overview

A road weather information system (RWIS) is a combination of technologies that collects, transmits, models, and disseminates weather and road condition information. The component of an RWIS that collects weather data is the environmental sensor station (ESS). An ESS is a suite of sensors that collects and transmits pavement and meteorological data. Sensors measure a range of weather-related conditions, including pavement temperature and status (wet, dry, snow), subsurface pavement temperature, wind speed and direction, precipitation (amount, occurrence, type), water level conditions, humidity, and visibility. These data are transmitted to automated warning systems, traffic operations centers, emergency operations centers, and road maintenance facilities for decision support. Weather service providers also use the data to develop tailored road weather products (for example, pavement temperature forecasts). All of these activities make for safer roadway conditions for motorists.

What's Driving RWIS Standards?

RWIS: It's Not Just for Winter Maintenance

In the past, RWIS were used almost exclusively by maintenance departments to make better operational decisions. Weather data collected by agencies allowed them to coordinate the pre-treating of roads via anti-icing practices; efficiently plan winter maintenance routes; reduce the amount of chemicals, sand, and salt used in roadway clearing operations; and reduce wear and tear on maintenance vehicles. Now, state and local transportation agencies are sharing weather data with a broader audience of public and private users of weather data, recognizing the inherent value of a better-informed traveling public. Therefore, it is even more important that agencies take measures to improve the accuracy of their data. Using standards in RWIS deployments can support this effort.

There are three categories of RWIS standards being researched and developed—siting standards, calibration standards, and communication standards. The following sections describe each category and provide information about where more detailed information about each can be obtained.

Siting Standards

What are Siting Standards?

Siting standards are used to install ESS pavement and meteorological sensors in locations that generate the most accurate and appropriate weather condition observations. Siting standards take into account the function of the sensor (forecasting, detecting, or monitoring) and conditions that affect a sensor's performance (including variations in terrain, weather patterns, road classification, and crew experience). Siting standards also provide guidance on sensor spacing and practices for siting ESS in rural and urban areas.

Why are Siting Standards Important?

Siting standards help agencies obtain the full value of RWIS investments by ensuring that sensors measure the weather condition they were designed to measure, and that they are installed in locations that optimize the ability to generate detailed and accurate forecasts. Siting standards compel agencies to examine their road weather information needs and identify the sensor types and siting practices that best generate the desired information.

What are the Benefits of Siting Standards?

Proper siting of RWIS sensors leads to the following benefits:

- More representative weather condition measurements, which leads to more-informed decisions with respect to maintenance, traffic, and emergency operations
- Higher accuracy in environmental data that are being provided to public and private weather users, as well as to meteorological databases used for computer weather forecast models
- Improved public service resulting from higher accuracy in road condition reports to the public via dynamic message signs, 511, the Internet, and other road weather information dissemination tools
- Enhanced planning of RWIS network requirements, which results in more effective operations

Siting Standards

IN ACTION

Minnesota DOT (Mn/DOT) deployed 76 ESS by using siting procedures developed in conjunction with a meteorologist from the University of North Dakota. Locations for the sensors were determined by the sensor's function, whether for maintenance operations or forecasting. Meteorologists were then able to assess local weather conditions at each location and determine the siting method that would provide representative readings of weather data. According to Mn/DOT, having a clear idea of what weather conditions they want their sensors to measure, and then taking steps to site them properly, brings home the full value of its RWIS.

Learn More

- Two reports published under the Strategic Highway Research Program provide a comprehensive study of RWIS implementation, including siting standards: Road Weather Information Systems Volume 1: Research Report and Road Weather Information Systems Volume 2: Implementation Guide. Both are available online at www4.trb.org/trb/onlinepubs.nsf/web/shrp_publications. (References from these reports are used in the section "Siting Standards" above.)
- A report by the Office of the Federal Coordinator for Meteorology (OFCM), titled Federal Standard for Siting Meteorological Sensors at Airports FCM-S4-1994 (August 1994), provides information about siting standards used in airport operations. Although not written specifically for the surface transportation community, these standards provide information applicable to siting sensors for surface transportation use. Available online at www.ofcm.gov/siting/text/a-cover.htm.

CALIBRATION STANDARDS

What are Calibration Standards?

RWIS sensors vary in accuracy and precision. Although this is an accepted condition of sensor operations, sensor errors must be minimized to ensure quality observations. Calibration standards are procedures for testing the accuracy of these observations. They compare the performance of the sensor with established criteria and performance measures. Calibration standards apply to how sensors function: in laboratory settings (initial calibration), when first installed in the field (onsite calibration), and over a period of routine maintenance (recalibration).

Why are Calibration Standards Important?

Currently, most state and local agencies use calibration procedures developed by the vendor for the sensor, or they accept sensor data without verification or validation. Calibration standards provide the agencies with guidelines for developing their own testing program, ensuring that the data being generated by their network of sensors are accurate, reliable, and uniform within an acceptable margin of error.

Calibration standards can also serve as the foundation for a quality control/quality assurance program for sensor operations. In addition, an agency can use a mesonet (mesoscale environmental monitoring network) to further bolster such a program. A mesonet defines both the technical and institutional arrangements for collecting and sharing weather data among a range of public and private end users. Information exchanged within a mesonet can help an agency identify irregularities in data collection and measurement. This can greatly enhance the quality of its calibration program.

What are the Benefits of Calibration Standards?

Calibration standards lead to the following benefits:

- Verification and validation of the level of accuracy of RWIS sensors
- Certification of results (with a common agreement and understanding of the criteria that must be met for certification)
- Better reliability of data, which should lead to wider use of the data by public and private users of weather data

Learn More

The Aurora Program (an international RWIS research consortium) recently completed a study of calibration methods. The project report, titled Standardized Testing Methodologies for Pavement Sensors, is available online at www.aurora-program.org (under "Ongoing Projects"). The report provides a comprehensive discussion on the state of the practice. (References from this report are used in the section "Calibration Standards" above.)

- Research is also being sponsored by the National Cooperative Highway Research Program (NCHRP) and can be monitored online at www4.trb.org/trb/crp.nsf/NCHRP+projects (under Area 6 Projects—Standardized Testing Methodology for RWIS Surface and Subsurface Sensors).

COMMUNICATION STANDARDS

What are Communication Standards?

There are two categories of communication standards: communication protocols, used to exchange data between RWIS devices and other ITS devices, and display and message set standards, used to communicate weather and road conditions to end-users.

- Communication protocols for RWIS are being developed under the National Transportation Communications for ITS Protocol (NTCIP) standards development effort. These are open (non-proprietary), industry-based standards that make it possible for

RWIS and other ITS devices from multiple vendors to exchange information—both with each other and with a central system—through a common communications interface. There are many NTCIP standards, each relating to one or more ITS applications. Those NTCIP standards that are used in RWIS applications are referred to as ESS standards.

- Display standards are common formats—in terms of both terminology and graphical depiction—for the dissemination of road and weather conditions to the public. Standards result in the use of consistent road and weather messages across jurisdictional boundaries, increasing the usability and effectiveness of weather dissemination conveyed to end-users. No display standards have been published, but several agencies are exploring how to develop and implement standards in this area. Message set standards, on the other hand, specify formats and the structure of messages exchanged between maintenance, traffic, and emergency management centers and end users. Message set standards related to road weather information are being developed under the U.S. DOT's ITS Standards Program.

Why Are Communication Standards Important?

Communication standards facilitate the sharing of RWIS data within a common and accepted framework. These standards enable agencies to integrate multiple vendors' systems into a single RWIS network. They also help disparate users of weather and road condition information to make similar interpretations of weather events.

What Are the Benefits of Communication Standards?

Communication standards lead to the following benefits:

- Greater interoperability of RWIS devices within an RWIS network and within an overall ITS network
- Easier sharing of weather condition data between regions

Display and message set standards lead to the following benefits:

- Common interpretation of road and weather data, which results in better-informed decision making by all types of road users
- Consistent and familiar messages on dynamic message signs, Internet weather sites, and other dissemination methods, which leads to similar interpretations of roadway conditions by travelers
- Elimination of the time and costs associated with developing unique weather and road condition symbols and terminology

Communication Standards IN ACTION

Washington State DOT (WSDOT) used NTCIP standards to bridge a communications gap between an existing network of proprietary ESS and a new installation of NTCIP-based ESS. The new sensors communicate to a proprietary central server through NTCIP, allowing the agency to run and control all of its ESS off a single server platform. This simplifies ESS administration and allows WSDOT to purchase sensors from multiple vendors.

Learn More

- The U.S. DOT's ITS Standards Program has information and resources pertaining to NTCIP ESS and message set standards available at www.its-standards.net.
- NTCIP Document 1204:1998 Object Definitions for Environmental Sensor Stations (AASHTO, ITE, NEMA) defines the ESS protocol. This document is available at www.its-standards.net/Documents/NEMA-TS3.7.pdf.
- A compilation of RWIS specifications from state DOTs is available online at www.aurora-program.org/matrix.cfm.
- An Aurora Program report on display standards, Identification and Documentation of Weather and Road Condition Dissemination Devices and Data Formats, is available at www.aurora-program.org/pdf/standardinforpt.pdf.

ADDITIONAL RESOURCES

- The Road Weather Management Program Web site at www.ops.fhwa.dot.gov/weather includes links to other RWIS and weather-related Web sites.
- Road Weather Management Program Team Leader, Paul Pisano, at (202) 366-1301 or at paul.pisano@fhwa.dot.gov.
- RWIS technical assistance is available through the ITS Peer-to-Peer Program at 1-888-700-PEER. Information is also available online at www.its.dot.gov/peer/PEER-T.htm.
- The INCH (Integrating NTCIP Compliant Hardware) Project provides guidance to public agencies on how to specify, procure, install, and test NTCIP compliant hardware, including ESS hardware. Information is available at www.enterprise.prog.org/inch3.htm.

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