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781 INTELLIGENT TRANSPORTATION SYSTEMS–MOTORIST INFORMATION SYSTEMS.

(REV 4-13-10) (FA 6-22-10) (1-11)

SUBARTICLE 781-3.2.2.8 (of the Supplemental Specifications) is deleted and the following substituted:

781-3.2.2.8 Photoelectric Sensor Devices: Ensure the sign electronics monitor ambient light using a minimum of three photocells. Ensure that the photocells are placed so they measure light levels on the front and rear of the sign, and ambient light conditions at the sign location. Ensure that the devices provide accurate ambient light condition information to the sign controller for automatic light intensity adjustment. Ensure that the automatic adjustment of the LED driving waveform duty cycle occurs in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Ensure that stray headlights shining on the photoelectric sensor at night do not cause LED brightness changes.

Supply the sign with a brightness-versus-ambient light matrix table with algorithms and/or other means of calculation that enables the sign to automatically adjust LED output according to ambient light level. Ensure the sign controller monitors the photocell circuits in the sign and correlates the readings with the brightness table to convert the measured light intensity into the desired pixel brightness. Ensure that the brightness table in each individual sign controller is adjustable from remote or local control access, and can be customized according to each installation site's requirements. Ensure that the sign controller automatically controls the pixel brightness to compensate for differences in ambient light levels, such as the differences in day and night. In addition to the automatic mode, ensure that the brightness may be set from 1% to 99% in 1% increments manually from the front panel of the sign controller and remotely from the TMC.

Ensure that the brightness and color of each pixel is uniform over the sign's entire face within a 30 degree viewing angle from 100 to 600 feet in all lighting conditions. Non-uniformity of brightness or color over the sign's face shall be cause for rejection of the sign.

SUBARTICLE 781-3.3 (of the Supplemental Specifications) is deleted and the following substituted:

781-3.3 TMC Communication Specifications for all DMS: Ensure that the sign controller is addressable by the TMC through the Ethernet communication network using software that complies with the NTCIP 1101 base standard (formerly the NEMA TS 3.2 -1996 standard), including all amendments as published at the time of contract letting, and the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects as defined in the FDOT standard Global MIB in Appendix A, all mandatory objects as defined in the FDOT-standard DMS MIB in Appendix B, and all mandatory objects as defined in the FDOT-specific DMS MIB in Appendix C as published on the FDOT State Traffic Engineering and Operations Office web site at the time of contract letting. Ensure that the sign complies with the NTCIP 1201 v01, 1203 v01, 2101 v01.19,

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2103 v01.13, 2201 v01.14, 2202 v01.05, and 2301 v01.08 standards. Ensure that compliance with FDOT MIB requirements takes precedence within NTCIP implementations. Ensure that any additional objects implemented by the software do not interfere with the standard operation of any mandatory objects.

Ensure that each sign provides full, standardized range support for all objects required by these specifications unless otherwise detailed in the plans. The standardized range is defined by a size, range or enumerated listing indicated in the object's syntax field and/or through descriptive text in the relevant standard object description field. Ensure that the sign maximum response time does not exceed 100 milliseconds plus one millisecond for each byte in the response variable-bindings field. Deviances from the full ranges for objects are detailed in Table 1.

Object	Minimum Requirements
FDOT Global MIB v01c	
Maximum Event Log Configurations	50
Event Configuration Mode	2, 3, and 4
Maximum Event Log Size	200
Maximum Event Classes	7
Maximum Group Address	1
FDOT DMS MIB v01c	
Number of Fonts	4
Maximum Font Characters	255
Default Background Color	0
Default Foreground Color	9
Default Justification Line	2, 3, 4
Default Justification Page	2, 3, 4
DMS – Number of Permanent Messages	0
DMS – Maximum Changeable Messages	50
DMS – Maximum Volatile Messages	0
Nonvolatile Memory	5 KB
DMS – Control Mode	2, 3, 4, and 5
Number of Action Table Entries	15
Number of Brightness Levels	16

Ensure that the software implements the tags (opening and closing where defined) of MULTI as detailed in Table 2 and as defined in the NTCIP 1203 standard.

Opening Tag	Closing Tag	Explanation
Cbx		Color – Background – The background color for a message.
Cfx		Color – Foreground – The foreground color for a message.
fx,y		Field – The information to embed within a message that is based on data from some device, such as a clock, calendar, temperature sensor, detector, etc.

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Opening Tag	Closing Tag	Explanation
		The following field tag values (IDs) are REQUIRED to be supported: 1 – the time in a 12-hour format; 2 – the time in a 24-hour format; 4 – the ambient temperature in degrees Fahrenheit; 7 – the day of the week; 8 – the date of the month; 9 – the month of the year; 10 – the year in two digits; and 11 – the year in four digits.
Fltxoy	/fl	Flash – Activate flashing of the text; define the flash-on and flash-off times; and the flash order (i.e., on/off or off/on).
Fox		Font – Select a font number (as specified in the font table) for the message display.
Jlx		Justification – Line – Specify line justification: left, center, right, or full. However, full justification is not required.
Jpx		Justification – Page – Specify page justification: top, middle, or bottom.
mvtdw,s,r,text		Moving – Text – Specify the parameters of a horizontal moving (scrolling) text.
Nlx		New – Line – Specify the start of a new line.
Np		New – Page – Specify the start of a new page.
Ptxoy		Page – Time – Specify the page times (t = on, o = off).
Scx	/sc	Spacing – Character – Specify the spacing between characters.
* The letters “x” and “y” are character placeholders, usually for numbers, that specify the tag parameter(s). See the NTCIP 1203 standard and its amendments for further definitions.		

Ensure that the controller’s internal time clock can be configured to synchronize to a time server using the Network Time Protocol (NTP). NTP synchronization frequency must be user configurable and permit polling intervals from once per minute to once per week in 1-minute increments. The controller must allow the user to define the NTP server by Domain Name System (DNS) and IP address. Provide each sign controller with error detection and reporting features that will be used to guard against incomplete or inaccurate transmissions including cyclic redundancy checking of all data received from the TMC, with positive acknowledgment for all valid transmissions; status monitoring for communication line malfunctions or breakages; and content validation for all transmissions received for logic or data errors.

Provide communication line circuits that are point-to-point or multipoint, and that provide full duplex asynchronous data transmissions at the rate shown in the contract documents or directed by the Engineer.

Assign each sign controller a unique address. Where applicable, encode all data transmitted between the TMC and the sign controller using 1 start bit, 8 data bits, and 1 stop bit.

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ARTICLE 781-5 (of the Supplemental Specifications) is deleted and the following substituted:

781-5 Road Weather Information System.

781-5.1 Description: Furnish and install a road weather information system (RWIS) as shown in the plans and as directed by the Engineer.

781-5.2 Materials: Provide an RWIS consisting of environmental sensor stations (ESS) installed at specified locations. Provide an ESS as shown in the plans that includes environmental sensors mounted on an approved structure (typically a concrete pole), other sensors mounted in the roadway, and a remote processing unit (RPU) at the base of the structure. Ensure that the RPU can collect, store, and process sensor data to describe current weather conditions.

Provide any ancillary equipment or incidental items required, including mounting hardware, power supplies, grounding, surge suppression devices, and communication equipment, at each ESS location to make a complete and fully operational RWIS. Ensure that the system provides real-time, accurate, reliable data on all system parameters to the degree of precision defined in this specification.

781-5.2.1 Sensors: Provide an RWIS that can collect and store data from various sensors including, but not limited to:

1. Roadway sensors located in or under the pavement.
2. Atmospheric sensors.

Ensure that all RWIS sensors and other field equipment are made of materials able to withstand wet, corrosive, dusty and humid weather conditions characteristic of the Florida climate.

Provide hardware and fasteners that meet the requirements of 603-2.

Provide ultrasonic anemometers and other sensors that are electronic devices which do not rely on moving parts to create electrical signals for processing.

781-5.2.2 Sensor Performance: Each environmental sensor and its associated transducers shall record the following attributes to the listed degree of accuracy:

Roadway Data		
Surface Temperature	±0.36° F between -40° and 176° F	
Precipitation	Type:	Dry, wet at >32° F; wet at <32° F; frozen, frost and dew
	Percent of Ice:	From 0 to 100%
	Depth/Amount:	From 0 to 0.5 inch
Atmospheric Data		
Temperature	±1° F between -40° and 176° F; resolution of 0.1 degree	
Relative Humidity at 70° F	±5% between 10 and 100%	
Barometric Pressure	Accurate to ±0.02 inch of mercury (in. Hg) between 27.2 and 31.9 in. Hg; resolution of 0.005 inches Hg	
Precipitation	Type:	Light rain, rain and ice
	Intensity:	±20% between 0.02 to 200 inches per hour

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Wind	Visibility:	±10% from 0.005 to 1 mile
	Direction:	±3 degrees between 0 and 360 degrees
	Speed:	±1 mph between 0 and 150 mph, with gusts up to 180 mph
Solar Radiation	±5% between 0 and 1,400 watts per square meter	

Ensure that pavement sensors function as specified above when installed at a maximum of 2,000 feet from the RPU.

781-5.2.3 ESS: Install an ESS having the sensors necessary to collect, store, and transmit the following data:

1. Roadway data, including:
 - A) Temperature
 - B) Surface data that includes ice and precipitation depth/amount.
2. Atmospheric data, including:
 - A) Temperature
 - B) Relative humidity
 - C) Barometric pressure
 - D) Precipitation data that includes type and intensity
 - E) Visibility as affected by fog, smoke, or a combination thereof
 - F) Wind data, including direction and average speed
 - G) Solar radiation (optional)

781-5.2.4 Communications: Use an RPU capable of transmitting all collected data to the transportation management center (TMC) using the National Transportation Communications for ITS Protocol (NTCIP) over any of the following media, as detailed in the plans:

1. Microwave communications, specifically, Florida's statewide Motorist Aid System (MAS) microwave communication infrastructure.
2. Ethernet communications over single-mode fiber optic cable that transfers data at a minimum rate of 10 megabits per second (Mbps).
3. Twisted-pair copper wire capable of transferring data at a rate of up to 128 kilobits per second (kbps).
4. Cellular mobile telephone service with data transmission rates of up to 56 kbps.

Ensure that all communications, including those between sensors and the RPU, are nonproprietary and compatible with the Department's SunGuide® Software System.

In certain cases, provide peer-to-peer wireless communication between RPUs at a maximum distance of 5 miles. Ensure that the RPU is capable of, or adaptable to, providing this type of communication.

781-5.2.5 Remote Processing Unit: Furnish an RPU that supports a minimum of four pavement sensors and eight atmospheric sensors. Use an RPU that supports EIA 232/485 serial communication and TCP/IP.

Provide a unit having a minimum of 28 analog inputs and 2 EIA-232 serial ports. Ensure that the RPU has a maximum serial data transmission rate of 128 kbps.

Ensure that the RPU issues and communicates an alarm whenever a user-defined threshold is exceeded. Ensure that the RPU is also capable of producing an output through contact closure or a digital output that imitates a contact closure.

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D At minimum, the RPU shall be able to store internally the last 24 readings over a user-defined time interval of up to 5 minutes.

The RPU shall be capable of collecting, storing, and transmitting single-frame, black-and-white images from a closed-circuit television (CCTV) camera mounted on the RWIS tower.

Ensure that the RPU operates using a nominal input voltage at the cabinet of 110 to 120 V_{AC}, and also be capable of operating on 12 V_{DC} of solar battery power. The RPU shall issue an alarm to the TMC if the AC power supply is low or if there has been a complete power loss. Ensure that the system sends a message when the unit returns to normal conditions.

781-5.2.6 RPU Enclosure: The RWIS cabinet and RPU are listed on the APL as a package. Use the cabinet listed on the APL for the specified RWIS to house and protect the RPU and all field electronics associated with the RWIS.

781-5.2.7 RWIS Software: Ensure that the RWIS software enables the system operator to derive environmental measurements, such as the dew point, wind chill, and heat index, from sensor data received. Ensure that the RWIS software can be used to report minimums, maximums, averages, cumulative values, and standard deviations for all data over a prescribed time period.

Ensure that the RWIS software provides English-to-metric unit conversions, when applicable, and lets the operator choose which unit of measure to report if more than one unit is common for a particular measurement.

A When the software supplied with the RWIS is installed on a laptop computer or a remote workstation, ensure that the operator is able to access, either remotely through the workstation or at the site with the laptop computer, all user-defined parameters and stored data within the RPU, including the ability to view, download, and delete stored data.

781-5.2.8 Electrical Specifications: Provide RWIS equipment and components installed at the ESS that operate at 110 to 120 V_{AC} from a commercial utility company or, alternatively, 12 V_{DC} from a solar-powered or battery-powered system. In cases where the ESS are mounted on the Department's MAS towers, ensure that the devices can utilize the 48 V_{DC} power supply available at the site.

Ensure that solar- and battery-powered units operate continuously for 14 days without requiring battery recharging. Provide an appropriate means of conversion for any device that requires a different power source.

F Equip each ESS installation with provisions for emergency backup power in the event of primary power loss. Ensure that backup power is capable of continuing the ESS' operations for a minimum of 12 hours.

781-5.2.9 Foundation and Tower Specifications: Provide a supporting tower or pole as shown in the plans. Ensure the tower or pole provides a mounting platform for atmospheric sensors free of influences from topography, buildings, and vehicles. Ensure that the tower also supports any lightning protection devices (e.g., grounding rods) for the site. Provide a support structure that is self-supporting without guy wires, using a 50-year design life, and in accordance with the current Structures Manual.

T If the field site is solar powered, ensure that the structure provides the mounting platform for the solar array and the control cabinet that houses the battery bank and charger.

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D Place a concrete work pad measuring 4 feet wide by 3 feet long by 4 inches deep in front of the RPU control cabinet if the cabinet is ground mounted. Construct the pad using concrete meeting the requirements of Section 347.

781-5.3 Applicable Standards: Ensure that the RWIS complies with all applicable standards from the National Weather Service.

Ensure that the RWIS complies with the latest revisions of all applicable NTCIP standards, including NTCIP-1201 and NTCIP-1204. Ensure that all RWIS field equipment complies with the environmental requirements of section A615 of the MSTCSD.

781-5.4 Installation Requirements: Ensure that all equipment and materials furnished, assembled, fabricated, or installed are commercial off-the-shelf products.

R Unless detailed otherwise in the plans, mount all atmospheric sensors except anemometers at cabinet-top height, approximately 10 feet above grade. Mount anemometers at the top of the tower or as shown in the plans. Locate pavement sensors as shown in the plans.

Install all wiring so that it is either internal to a pole or in conduit.

Install all buried lead-in cable to pavement sensors in conduit.

Mount all roadway sensors flush with the roadway surface.

781-5.5 Testing: Utilize a testing procedure that includes a remote field sensor and RPU test, a remote-to-central communication test, and a systems operational test. Conduct the following tests and submit the results to the Engineer:

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1. Perform and document laboratory tests verifying proper sensor calibration.
 2. Calibrate instrument alignment with true north.
 3. Furnish sensor calibration protocols and adjustment procedures.
 4. Verify and ensure that sensors are reporting proper field data.
 5. Detail regular site maintenance procedures and calibration training.
 6. Provide block diagrams, schematics, catalogs, and line drawings.
 7. Program source codes in both printed and digital form.
 8. Verify proper orientation of wiring and cabling.
 9. Ensure that above-ground conduit is straight, neat, and properly secured.
 10. Verify that the grounding system is installed per the requirements of 785-2.

Contractor shall perform any and all maintenance, recalibration, and data verification required by the Engineer.

F Certify anemometers by wind tunnel tests. Submit test results to the Engineer for review and approval. Upon request, furnish independent laboratory testing documentation certifying adherence to the stated wind force criteria using a minimum effective projected area (EPA), the actual EPA, or an EPA greater than that of the device to be attached.

Perform local field operational testing at each RWIS field site according to the test plans detailed in this section. After the environmental sensor and RPUs, and other RWIS hardware, power supplies, and connecting cables have been installed, perform the following:

- T**
1. Verify that physical construction has been completed as specified in the plans.
 2. Inspect the quality and tightness of ground and surge protector connections.
 3. Check power supply voltages and outputs.
 4. Connect devices to the power sources.
 5. Verify installation of specified cables and connections between the environmental sensor and RPUs, and the control cabinet.
 6. Test local operation of all environmental sensor and RPU components.

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D Within three days of successful test completion, deliver to the Engineer a written completion notice and a copy of all test results. Include in the completion notice the documentation of any discrepancies found during testing, along with environmental sensor and RPU serial numbers. Include assembly installation locations and successful test completion dates.

If the Engineer rejects the work, promptly remedy the defect or failure specified in the Engineer's notice. Upon completion of the remedy, again provide the Engineer with a completion notice.

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