



**Dynamic Message Sign
LED RETROFIT KIT**

Sample Procurement Specification

Messenger 6000 Series



21 Quinton Street, Warwick, Rhode Island 02888

Phone: (401) 232-3370 / (800) 252-6220
www.sesamerica.com

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I. INTRODUCTION

Intelligent Transportation Systems (ITS) technologies including Variable Message Sign (VMS) are a critical element of enhancing the capacity for enhancing “the capacity for rapid and flexible response and recovery to all-hazard events.”

The **insert state** Department of Transportation has a number of VMS that are in need of update to maintain ITS capabilities on the roadways. The overall purpose of the Retrofit and Technology Update is to replace existing outdated VMS optical system(s) with a state-of-the-art VMS light-emitting diode (LED) optical system(s).

II. BENEFITS

The following benefits are to be expected from a Technology Update:

- Extend the lifetime of the existing housing(s).
- Upgrade sign’s communication protocol to become NTCIP-compliant.
- Improved visibility and legibility due to better light output/contrast ratio.
- Wider viewing angle (at least 30°).
- Lower power consumption (up to 70%, depending on the message).
- Lower maintenance/operation cost, due to long-life LED technology.
- Increased functionality to ease maintenance.
- Complete fault monitoring and evaluation of every pixel.
- Fault indicators.
- Test button on each character display board.
- Graphical WYSIWYG interface which reports any alarms.
- Controller with a full color Touch Screen and full diagnostic facilities.

III. RESTRICTIONS

The signs must NOT be removed from their structures to perform the work. All work must be performed at site.

No changes in the sign or cabinet housing are allowed except those described in this document. Bucket truck, traffic control, concrete pads, etc. will be provided by others.

IV. VMS TECHNOLOGY UPDATE REQUIREMENTS

The contractor must manufacture, ship, and deliver the necessary equipment to convert each existing VMS into a state-of-the-art LED VMS. To update the VMS, the following operations / services must be performed at each sign location:

- Provide only new components that are 100% compatible with existing VMS housing.
- Provide new components that can withstand an operational temperature of 160 degrees Fahrenheit without performance degradation.
- The new system must work with the existing external power configuration. 115VAC +/- 10 % @ 30 Amps must be sufficient to supply the sign after the update.

- The new components must be compatible with the requirements of NEMA TS4. Third-party test certificates must be provided by the manufacturer.

A. Display System

- Remove the existing character support frames, and replace them with NEW aluminum character support frames. The new frames must be matte black and match the overall dimensions of the existing frame. Only minor modifications to existing hardware will be accepted to mount the frames within the existing VMS.
- The new display boards must have the following characteristics:
 - The character height must be defined as described by NEMA TS4. The horizontal and vertical pixel spacing (pitch) shall be equal and shall be 2.57 inches.
 - Interchangeability of Character Display Boards: No special tools or software shall be required to change or relocate a character display board. The address on the board must match the address shown on a label located adjacent to the board, and must be set automatically or via DIP switches.
 - Use surface-mounted amber LEDs.
 - For uniformity of messages, all the LEDs in the sign must be selected by intensity and by color, such that the source of the LED can only be from two adjacent bins of the LED manufacturer for each sign. A label must be placed on each display board indicating the intensity, color bin, and detailed reference of the LEDs used therein.
 - The hardware design of the LED driver circuitry shall be such that the LED current shall be hardware restricted so it can never exceed the 75 % of Maximum Forward Current ($I_{f\text{MAX}}$) as defined by the LED Manufacturer. These criteria must be met even if there is a software failure in the system.
 - Pulsing of LED's with instantaneous current in excess of the Maximum Forward Current is not allowed under any circumstances.
 - Change of brightness must occur simultaneously on all characters in the sign.
 - To provide a uniform display after replacing a display board with a new one, the display board must be equipped with a rotary switch or be software configurable so the user may locally adjust the brightness of the "new" character, to the same brightness as the rest of the sign.
 - The minimum operating temperature range of the LED's, as defined by the LED manufacturer, shall be -34°F to $+165^{\circ}\text{F}$.
 - The replacement of a character display board must be possible without the use of any special tools.
 - The display driving circuitry must be mounted directly on the display board; no separate driver boards are allowed.
 - All the connections between boards must be rugged, positive-locking, quick-release, and use polarized connectors.
 - Full diagnostic facilities must be available directly on the display boards:
 - A faulty character display board must be easily identified by visual indicators located on the rear of the display board.
 - When the LED display board is powered, visual indicators must show:
 - the transmit/receive status between the board and VMS Sign Controller.

- whether or not the display board is properly powered.
- if there is a fault on the display board.
- Each display board must be equipped with a board Test Button. The test button must activate a test sequence that illuminates all LEDs to identify the faulty pixel and to confirm the individual board's address. When such a manual test procedure is complete, the pattern displayed prior to the test is redisplayed.
- Each display board must be equipped with a separate Diagnostic Port. This port must be available for real-time diagnostics and configuration of the display board, either in the sign while the sign is operating, or outside of the sign for maintenance/repair. As a minimum the following functions shall be available:
 - Determine firmware version.
 - Upload new version of firmware.
 - Determine exact faulty pixel strings.
 - Determine the address of the board.

1. Display Performance

- The cone of vision must be at least 30 degrees in horizontal and vertical directions.
- The minimum Luminance must be 12,000 candelas per square meter when measured under the conditions defined by NEMA TS4.
- The chromaticity limits shall be in accordance with NEMA TS 4, Section 5.5 and Table 5-16, for yellow, Light Emitting VMS. The LED wavelength must be chosen to comply with 590nm +/-5 nm. Furthermore, the VMS manufacturer must provide a test certificate to demonstrate that the light emitted by the VMS is still within the limit of the standard when the LED's are illuminated in the display module.
- Display Change Time: The sign must meet or exceed NEMA TS4 Section 5.7 requirements; the display shall change from one page of text to another in less than 100 ms, based on an OFF time of zero seconds. Changes from one message to another shall take place so that the motorist visualizes only the complete and intended message on the sign face, at any one time. No other message interpretations other than the intended message shall be possible during transitions from one message to another. All lines of text shall energize and de-energize simultaneously.
- Install new communication wires between the display boards and between the display board and the controller if the controller is installed within the Walk-in housing. If the controller is installed within a separate controller cabinet, re-use the existing communication cable.

B. VMS Controller

- Supply a new VMS controller specified as follows:
 - NTCIP 1203 compliant.
 - Capable of communicating with the existing central computer by using the existing wired or wireless communication network.
 - Intel PCA PXA 255 processor or equivalent.
 - 32-Megabytes of SDRAM.
 - 16-Megabytes of flash memory.
 - Internal real time clock.
 - Two (2) Ethernet 10/100 full duplex ports.
 - Two (2) RS-232 serial ports.
 - Two (2) RS-485 serial ports.
 - Two (2) USB ports.
 - Four (4) 2-wire digital outputs.
 - Four (4) 2-wire digital inputs.
 - One (1) controller reset push button.
 - Controller power switch.
 - Polarized controller power connector.
 - One full-color screen to display the following overall status information, as a minimum, on a single screen:
 - Sign luminance, temperature and humidity status,
 - Power supply status.
 - Display overall status.
 - Brightness control status.
 - Communication status.
 - Local/Remote status.
 - WYSIWYG display viewer
 - The following operations must be possible from the controller front panel:
 - Display faulty pixel location.
 - Display pre-programmed messages.
 - Display current date, time.
 - Display test message that uses all font characters.
 - Display “Sign in test” message.
 - Display 16 locally-stored predetermined messages.
 - Navigate through menus to access diagnostics information described above and must:
 - Indicate brightness mode (fixed or automatic).
 - Indicate ambient brightness level.
 - Indicate message currently displayed.
 - Indicate message validity.
 - All connections between the new controller rack and subassemblies in the VMS Sign Controller Cabinet must be achieved through the front panel to avoid maintenance access problems at the rear of the controller.
 - Variations in connector pinouts, polarization and type (i.e., male or female), must be used to avoid misplacement of the connectors.
 - A means (battery/charger) must be optionally provided to guarantee the continued operation of the controller and modem (if powered by battery) for at least four hours after a main power interrupt.
 - The controller must be capable of accepting modifications to its own firmware

- The controller must be capable of updating display board firmware version
- The controller must be capable of updating display peripheral board firmware versions

1. VMS Controller Installation

Two approaches are possible: For ease of maintenance, it is preferable to install the controller cabinet at a nearby location exterior to the sign. However, if this is not possible, then the new controller and all associated components shall be installed within the existing VMS housing.

If the controller is installed within the VMS, the following tasks must be performed:

- Remove the existing controller and associated equipment.
- Replace with a new 19" controller with touch screen color screen as described above.
- Install all associated components near the controller.
- Perform all necessary wiring between controller and associated equipment.

C. Other Equipment

1. Optional New Controller Cabinet

If the controller cabinet is to be installed exterior to the sign, the following requirements must be met:

- The cabinet shall protect all the electronic components that are not located in the sign housing.
- The cabinet shall comply with NEMA 250, Type 3R and shall be made of aluminum.
- The environmental characteristics of this specification shall be met without exhaust fans or air conditioning.

The cabinet shall include the following:

- A 19-inch rack-mounted microprocessor-based VMS Controller with WYSIWYG color touch screen as described above.
- One permanently-mounted communications cable.
- Communication interface (modem).
- The main power supply and energy distribution system (including the main input power disconnect).
- One (1) work lamp to illuminate the work area, when the cabinet door is open.
- One (1) 15-amp, 120 VAC GFCI-protected duplex service outlet
- Lightning protection and terminations for the communication and control cables.
- Transient protection and RFI filtering on the incoming power lines.
- Termination blocks for the control cables to and from the VMS sign housing.
- Key locks with two (2) identical keys for each cabinet.
- Permanently-mounted document holder.
- Electrical drawings printed on water/tear-resistant material.
- A laptop tray for the placement of a laptop computer.
- 200-watt thermostatically-controlled heater (if required).

2. Power Supply System

- Power distribution inside the VMS housing shall be re-wired from the power distribution box. If existing circuit breakers are not adequate for the new components, they shall be replaced.
- Any power circuits which will remain unchanged after the update should be kept intact (for example, internal lighting-suppression system and ventilation system).
- Remove the existing power supply units, day/night switching relay, and/or any other components that will no longer be utilized. Existing cables that are no longer in use may be left in place.
- Provide new power supply system in the VMS housing to feed all new components.
- The new power supply units used to feed the display boards must be individually equipped with a cooling fan.
- The LED power supply system shall be designed to illuminate every character on the sign with any allowable alphanumeric character at full power, at +165° F. Power supplies shall be switching power supplies, which must be at least 80% efficient at nominal voltage, and include a self-resetting internal thermal protection device that switches off the output in case of an overload.
- Install new and improved surge protector to better protect the new equipment.
- Replace any cabinet worklight that is faulty (optional).

3. Brightness Control

- Install two (2) new photocells and a new photo-sensor board on top of the sign. If the existing sensor must be removed, make sure no weather leaks are created.
- Easily removable photo-sensors shall be back-to-back, on the sign housing. They shall have a minimum range between 2 and 100,000 lux.
- The VMS Controller shall automatically control the dimming, with a minimum of 16 and a maximum of 256 brightness levels.
- The system shall provide the ability to adjust the relationship between the degree of dimming and external light conditions, and shall ensure that the luminance output of the sign provides the maximum luminance for the background lighting, without eye discomfort to viewers.
- The dimming system shall not be affected by variations in the AC supply voltage and shall maintain a constant light output at all brightness levels.

4. Existing Ventilation System

The contractor must verify the operation of the exhaust fans and leave them in the same status. (If applicable)

5. Environment Control

Provide sensors to measure the internal temperature and humidity of the sign. If the temperature is higher than +165 F, the sign must be switched off.

V. CENTRAL CONTROL SOFTWARE (IF REQUIRED)

- Provide central control software: 32-bit Windows-based VMS control software compatible with existing computer system.
- Develop the maps and graphical interface screen.
- Test the software with signs to ensure all functions operate correctly.
- Provide License for one desktop PC and one laptop (for maintenance software)
- The central control software must be NTCIP-compliant
- The following functionalities will be provided:
 - Display VMS messages.
 - Blank signs in one action.
 - Change VMS brightness level.
 - Log file and error history recording.
 - Read sign's actual pixel status.
 - Remotely reset the controller.
 - Automatically poll the sign at any user-definable interval.
 - Contextual help screens.
 - Graphical interface with a floating dynamic tool bar.

VI. TRAINING

Provide operational and maintenance training. After installation of the individual VMS assemblies, the VMS representative shall conduct training in the operation and maintenance of the sign, VMS Controller, and computer equipment. This training shall be for a maximum of ten (10) people, for two (2) consecutive days, at a facility supplied by the End-User or installing Contractor.

VII. PREVENTIVE MAINTENANCE / WARRANTY

- Include two year warranty for parts and material. The supplier must be able to provide a toll free number for technical support during Eastern Time working hours.
- Optional: Include preventive maintenance for TWO years. Provide one site visit per year to verify the status of the VMS. During preventive visit, perform a full check of the VMS and replace defective equipment without extra cost.

VIII. DOCUMENTATION

- Provide sufficient documentation to reflect "as-built" configuration and to facilitate operation, maintenance, modification, and expansion of the system or any of its individual components. Manufacturer-supplied documentation which covers the intent of this requirement may be sufficient if approved by the Engineer.
- Provide NTCIP MIB file.

A. Submittal Documentation- Document each applicable equipment item or component in a manual, and submit it for approval. Include the following information in the manual:

- The Bidder shall furnish a compliance matrix listing each paragraph of this entire specification with an appropriate statement indicating whether the Bidder will comply with that part of the specification.
- A general description of the equipment including all information necessary to describe the basic use or function of the system components and a general “block diagram” presentation of the equipment.
- Where auxiliary equipment is required, include the nomenclature, physical and electrical characteristics, and functions of the auxiliary equipment in tabular charts. If shown elsewhere in the manual, refer to the location of the information pertaining to the auxiliary equipment.
- The routine of operation from necessary preparations for placing the equipment into operation, to securing the equipment after operation. Include appropriate illustrations, with the sequence of operations presented in tabular form wherever feasible. Include a list of applicable test instruments, aids, and tools required in the performance of necessary measurements and techniques, for each system component. Describe test set-up and calibration procedures.
- The manufacturer's recommended procedures and checks necessary for preventive maintenance. Specify for pre-operation, weekly, monthly, quarterly, semi-annual, annual, and “as required” checks as necessary to assure reliable equipment operation. Include tolerances, for all electrical, mechanical, and other applicable measurements, adjustments, or both.
- Data necessary for isolation and repair of failures or malfunctions, assuming the maintenance technicians to be capable of analytical reasoning using the information provided in above subsection. Describe accuracies, limits, and tolerances for all electrical, physical, or other applicable measurements. Include general instructions for disassembly, overhaul, and reassembly, including shop specifications or performance requirements.
- Detailed instructions where failure to follow special procedures would result in damage to the equipment, improper operation, danger to operating or maintenance personnel, consumption of excessive man-hours, etc. Such instructions and specifications must be included only for such maintenance as may be accomplished by specialized technicians and engineers in a modern electromechanical shop. Describe special test setup, component fabrication, and the use of special tools, jigs, and test equipment.
- A detailed physical description of size, weight, special mounting requirements, electrical connections, and all other pertinent information necessary for proper installation and use of the equipment.
- A parts list with all information required to describe the characteristics of the individual parts, as required for identification. It must include a list of all equipment within a group and list of all assemblies, subassemblies, and replacement parts of units. The tabular arrangement must be in alphanumeric order of the schematic reference symbols, and must give the associated description, manufacturer's name, and part number. A table of contents or some other convenient means, e.g., appropriate grouping, must be provided for the purpose of identifying major components, assemblies etc.

- Complete and accurate schematic diagrams as required to supplement textual material and to allow the books to be self-contained technical information sources. Limit the size of these diagrams to allow their use in close proximity to the equipment, in the classroom, etc. Part reference symbols; test voltages, waveforms, and other aids to the understanding of the circuit's function must be included on the diagrams. Test voltages, waveforms, and other aids to understanding of the circuit's function may be shown on either the simplified schematics or other drawings (as required in the above sections), on theory of operation or maintenance, or on the schematic diagrams required for this section. The overall scope of information must not be less, however, than that stated for the schematic diagrams.

B. Final Documentation- Provide as-built final documentation for approval, reflecting all field changes and software modifications.

- Provide software, documentation, and intellectual property rights for the computer software system and components.
- Provide License: Grant the Department a non-exclusive unrestricted license that will allow the Department to use all of the stated communication protocols and documentation.

IX. TECHNICAL ASSISTANCE

- Require manufacturer's representative presence to assist the Contractor's technical personnel at each sign installation site to provide technical assistance in following areas:
 - Field equipment Technology Update and installation.
 - Sign-to-controller cabling.
- Do not execute the initial powering up of the sign(s) without the permission of the manufacturer's representative.
- The VMS Supplier shall provide on-site supervisory assistance to the installing Contractor and/or End-User. This shall consist of supervision of the sign-to-structure mounting, VMS controller and cabinet mounting, wiring terminations, and equipment start-up.

V. MANUFACTURER'S EXPERIENCE

- It is the intention of this specification to receive a reliable VMS system that is proven by a record of low maintenance requirements, low power consumption, and overall reliable service at actual field installations elsewhere.
- It is also the intention of this specification to be reasonably assured that the high level of support mentioned throughout this document, shall continue to be available for the equipment throughout the equipment's normal lifetime. This support shall include, but not be limited to, in-house spare and replacement parts availability; in-house field services for repairs, modifications, and paid upgrades; and in-house software support for any custom software supplied by the VMS Supplier or VMS Manufacturer.
- The Bidder shall furnish a letter from the VMS Manufacturer or VMS Supplier listing the compliance to the provisions of this Section, with a toll free phone number, that the End-User may use for operational questions or for resolving any maintenance problems during the term of this contract and thereafter, or as agreed upon by all Parties.

A. Experience Requirements

- The Bidder shall include a certification from the VMS Manufacturer that has:
 1. At least five (5) years experience in manufacturing, supplying, and supporting fully assembled VMS systems and retrofit systems.
 2. tTexas based field service staff, phone support, and sufficient stocked spare parts are available from a US location.
- The Bidder shall furnish a list of five (5) US transportation agencies that have operated and maintained the VMS Supplier's retrofitted DMS systems, for no fewer than three (3) years. This list shall include the names, addresses, and telephone numbers of the agency's responsible contact person. If requested by the End-User, the Bidder shall also furnish photographs of the installations.
- The Bidder shall identify any projects or circumstances where the Bidder and/or the VMS Supplier were required to pay liquidated damages, or defend themselves against liquidated damages in the last five years. Failure to supply this information shall be cause for rejection.