

## APPENDIX C: SUGGESTED REQUIREMENTS VERIFICATION METHODS

Requirements Document Reference Number	System Requirements Sample Statements	Verification Method
3.1.1.1	The DMS Management System shall enforce access control of all users.	Demonstration
3.1.1.2	The DMS Management System shall allow the DMS System Manager to assign access control credentials to DMS System Users.	Demonstration
3.1.1.3	The DMS Management System shall allow the DMS System Manager to assign access control credentials to DMS System Maintainers.	Demonstration
3.1.1.4	The DMS Management System shall allow the DMS System Manager to select the DMS Field Equipment.	Demonstration
3.1.1.5	The DMS Management System shall allow the DMS System Manager to control the DMS Field Equipment.	Demonstration
3.1.1.6	The DMS Management System shall allow the DMS System Manager to control external devices attached to the DMS Controller.	Demonstration
3.1.1.7	The DMS Management System shall allow the DMS System Manager to access its logged data.	Demonstration
3.1.1.8	The DMS Management System shall allow the DMS System Manager to grant access to the DMS Management System by the DMS System User.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.1.9	The DMS Management System shall allow the DMS System User to select DMS Field Equipment.	Demonstration
3.1.1.10	The DMS Management System shall allow the DMS System User to control DMS Field Equipment.	Demonstration
3.1.1.11	The DMS Management System shall allow the DMS System User to control external devices.	Demonstration
3.1.1.11.1	The DMS Management System shall control external devices such as flashers or beacons when directed by the DMS System User. Note: Agency policy may dictate when flashers and/or beacons may be used (e.g., lane blockage only).	Demonstration
3.1.1.11.2	The DMS Management System shall allow the DMS System User to specify automatically including flashers or beacons based on message type.	Demonstration
3.1.1.12	The DMS Management System shall allow the DMS System Manager to grant access to the DMS Management System by the DMS System Maintainer.	Demonstration
3.1.1.13	The DMS Management System shall allow the DMS System Maintainer to select DMS Field Equipment.	Demonstration
3.1.1.14	The DMS Management System shall allow the DMS System Maintainer to control DMS Field Equipment.	Demonstration
3.1.1.15	The DMS Management System shall allow the DMS System Maintainer to control external devices.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.1.16	The DMS Management System shall allow the DMS System Maintainer to run system diagnostics and testing.	Demonstration
3.1.1.17	The DMS Management System shall provide access to the DMS System Maintainer to repair it.	Demonstration
3.1.1.18	The DMS Management System shall organize DMS System Users into groups.	Demonstration
3.1.1.18.1	Membership in the group shall be defined by the DMS System Manager.	Demonstration
3.1.1.18.1.1	The DMS Management System shall allow the DMS System Manager to specify named user groups and place those users in the group.	Demonstration
3.1.1.18.1.2	The DMS Management System shall allow the DMS System Manager to specify which signs will be shared with individual users or user groups.	Demonstration
3.1.1.18.1.3	The DMS Management System shall allow the DMS System Manager to specify which individual users or user groups can access the archived logged data.	Demonstration
3.1.1.18.2	The DMS Management System shall assign which signs are shared by individual users or groups of users.	Demonstration
3.1.1.18.3	Access to archived data shall be assigned by the DMS System Manager to users or groups.	Demonstration
3.1.1.19	The DMS Management System shall not allow archived data to be altered.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.2.1	The DMS Management System shall allow the DMS System Manager to configure the DMS Management System data logging parameters.	Demonstration
3.1.2.2	The DMS System Management System shall accommodate [specify number] users at different physically accessed terminals as configured by the DMS System Manager.	Demonstration
3.1.2.3	The DMS System Management System shall accommodate [specify types of] users as configured by the DMS System Manager.	Demonstration
3.1.2.4	The DMS System Management System shall arbitrate competing requests for access, including providing automatic timeouts, transfer of access, and other DMS Field Equipment user access issues as configured by the DMS System Manager. [Describe the desired operation, and choose the requirements relevant to the desired operation. Options: DMS Field Equipment ownership, last user control, first-come-first-served, etc.]	Demonstration
3.1.2.5.1	The DMS Management System shall allow the DMS System Manager to configure message priority for each DMS.	Demonstration
3.1.2.5.2	The DMS Management System shall allow the DMS System User to create schedules assigning messages to particular DMS according to a start time, duration and message priority.	Demonstration
3.1.2.5.3	The DMS Field Equipment shall display the message with the highest priority or the message with the latest start time if at the same priority as the message being displayed.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.2.5.4	The DMS Management System shall give the highest priority to messages being manually engaged by the DMS System User.	Demonstration
3.1.2.6.1	The DMS Management System shall determine the identity of the DMS Field Equipment based on a DMS System User request.	Demonstration
3.1.2.6.2	The DMS Management System shall determine the sign type (Blank-out Sign, Changeable Message Sign, or Variable Message Sign) based on a DMS System User request.	Demonstration
3.1.2.6.3	The DMS Management System shall determine the sign technology (mostly LED) based on a DMS System User request.	Demonstration
3.1.2.6.4	The DMS Management System shall determine the manufacturer based on a DMS System User request.	Demonstration
3.1.2.6.5	The DMS Management System shall determine the model and version number for both hardware and software elements based on a DMS System User request.	Demonstration
3.1.2.6.6	The DMS Management System shall tell the DMS System User if an entered message can be displayed on a given sign.	Demonstration
3.1.2.6.7	The DMS Management System shall limit the sign types available to the DMS System User based on a given message and different sign display capabilities.	Demonstration
3.1.2.6.8	The DMS Management System shall manage variations in a given message to be displayed on signs with different capabilities.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.2.6.9	The DMS Management System shall allow the DMS System User to define and edit the appearance of fonts (i.e., type, color and size) used to display messages on DMS Field Equipment throughout the DMS Management System.	Demonstration
3.1.2.6.10	The DMS Management System shall allow the DMS System User to define the appearance of graphics used to for display on DMS Field Equipment for later use.	Demonstration
3.1.2.6.11	The DMS Management System shall allow the DMS System User to edit vendor supplied graphics.	Demonstration
3.1.2.6.12	The DMS Management System shall allow import of graphics generated independently by the DMS System User.	Demonstration
3.1.2.6.13	The DMS Management System shall allow the DMS System User to manage existing graphics.	Demonstration
3.1.2.6.14	The DMS Management System shall allow the DMS System User to determine the graphics storage capabilities throughout the DMS Management System.	Demonstration
3.1.2.6.15	The DMS Management System shall assist the DMS System User in determining which graphics are compatible with each sign type.	Demonstration
3.1.2.6.16	The DMS Management System shall allow the DMS System User to configure when the DMS Field Equipment may automatically switch between brightness levels based on changing lighting conditions.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.2.6.17	The DMS Management System shall allow the DMS System User to configure the speed limit applicable to the location of the DMS Field Equipment. Note: this requirement is typically for portable DMS Field Equipment that act a speed warning signs.	Demonstration
3.1.2.6.18	The DMS Management System shall allow the DMS System User to configure the threshold when the fuel in a generator powering a DMS Field Equipment is considered low. Note: this requirement is typically only for portable DMS Field Equipment that use generators.	Demonstration
3.1.3.1	The DMS Management System shall allow the DMS System User to select which DMS Field Equipment to view the current message displayed on the sign face.	Demonstration
3.1.3.2	The DMS Management System shall allow the DMS System Manager to monitor the DMS Field Equipment control source (e.g., central system, DMS time-based scheduler, individual physically present at the DMS site).	Demonstration
3.1.3.3	The DMS Management System performance monitoring shall conform, at a minimum, to NEMA TS 4-2016.	Demonstration
3.1.4.1	The DMS Management System shall allow the DMS System User control of the DMS Field Equipment from both remote and local locations.	Demonstration
3.1.4.2	DMS Management System shall prevent DMS System Users from interfering with one another for simultaneous control of a DMS Field Equipment.	Demonstration
3.1.4.3	Controlling the DMS Field Equipment Sign Face	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.4.3.1	The DMS Management System User shall activate a stored message to be displayed on the sign face upon request of a DMS System User.	Demonstration
3.1.4.3.2	The DMS Management System shall allow the DMS System User to specify the duration for the display of the activated message including its relative priority in order to possibly override the currently displayed message.	Demonstration
3.1.4.3.3	The DMS Management System shall allow the DMS System User to prioritize messages.	Demonstration
3.1.4.3.4	The DMS Management System shall allow the DMS System User to create a message and modify its format and content.	Demonstration
3.1.4.3.4.1	The DMS Management System shall allow the DMS System User to uniquely identify a message.	Demonstration
3.1.4.3.4.2	The DMS Management System shall assist the DMS System User in ensuring that a message is complete by viewing it in WYSIWYG (What You See Is What You Get) format.	Demonstration
3.1.4.3.4.3	The DMS Management System shall allow the DMS System User to develop an approved word list including standardized abbreviations.	Demonstration
3.1.4.3.4.4	The DMS Management System shall recommend words and abbreviations from the approved word list to the DMS System User.	Demonstration



<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.4.3.4.5	The DMS Management System shall assist the DMS System User in ensuring that the message does not contain offensive language.	Demonstration
3.1.4.3.4.6	The DMS Management System shall assist the DMS System User in defining the exact contents of the message to be displayed on the sign face.	Demonstration
3.1.4.3.4.7	The DMS Management System shall provide the capability for the DMS System User to define if the display of a message activates beacons. [Specify if supported]	Demonstration
3.1.4.3.5	The DMS Management System shall store a newly created or modified message by the DMS System User in a library of messages.	Demonstration
3.1.4.3.6	The DMS Management System shall blank or remove any messages displayed on a sign upon request by the DMS System User.	Demonstration
3.1.4.3.7	The DMS Management System shall allow the DMS System User to schedule when messages are displayed on DMS Field Equipment. These are the stored messages that are displayed unless overridden by a manually activated message.	Demonstration
3.1.4.3.7.1	The DMS Management System shall allow the DMS System User to set a series of times when a stored message, including a blank message, will be activated.	Demonstration
3.1.4.3.8	The DMS Management System shall allow the DMS System User to set which message will be displayed when certain non-scheduled events occur such as loss of communications or power.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.4.3.9	The DMS Management System shall allow the DMS System User to directly control the sign brightness.	Demonstration
3.1.4.3.10	The DMS Management System shall allow the DMS System User to configure automated algorithms that can adjust brightness levels based on the ambient light levels.	Demonstration
3.1.5.1	The DMS Management System shall allow the DMS System User to control external devices through the auxiliary ports of the sign controller.	Demonstration
3.1.5.1.1	The DMS Management System shall allow the DMS System User to control High Occupancy Vehicle (HOV) Lane Gates attached to the DMS Field Equipment.	Demonstration
3.1.5.1.2	The DMS Management System shall allow the DMS System User to control Beacons attached to the DMS Field Equipment.	Demonstration
3.1.5.1.3	The DMS Management System shall allow the DMS System User to monitor any speed detectors attached to the DMS Field Equipment.	Demonstration
3.1.5.1.4	The DMS Field Equipment shall detect speed and display speed threshold limits with detected speed.	Demonstration
3.1.5.1.5	The DMS Management System shall allow the DMS System User to monitor and control environmental sensors attached to the DMS Field Equipment.	Demonstration
3.1.5.1.6	The DMS Field Equipment shall detect environmental conditions and display environmental conditions.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.5.1.7	The DMS Management System shall allow the DMS System User to control other external devices. [Specify other types of external devices]	Demonstration
3.1.6.1	The DMS Management System shall allow the DMS System Maintainer access to the DMS Management System log(s).	Demonstration
3.1.6.2	The DMS Management System shall allow the DMS System Maintainer to specify what DMS Management System events are logged.	Demonstration
3.1.6.3	The DMS Management System shall allow the DMS System Maintainer to specify, for each log, the log size and/or duration for the DMS Management System.	Demonstration
3.1.6.4	The DMS Management System shall allow the DMS System Maintainer to access and review a history (log) of the following diagnostic information [specify] and alarms [specify] for a period of [specify] days.	Demonstration
3.1.7.1	The DMS Management System operations shall be maintainable by the DMS System Maintainer.	Demonstration
3.1.7.1.1	The DMS Field Equipment shall be durable to support operations. [Specify description of what this means]	Inspection

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3.1.7.1.2	The DMS Field Equipment shall conform to the environmental conditions specified in NEMA TS 4-2016. [Description needs to include conditions under which the equipment will be operated. Reference NEMA TS 4-2016. Does it need to withstand rain? Inundation? High-pressure hose-down? High wind? High (or low) temperatures? IPC67? IEC 60529? NEMA (Type R, Type X, etc.)? Ground cabinets versus signs.]	Test
3.1.7.1.3	The DMS Field Equipment shall be serviceable. [Specify how to access for maintenance, crane, bucket truck, requirements for maintainer to be protected by elements]	Inspection
3.1.7.1.4	The DMS Field Equipment shall have readily available replacement parts for the life of the system [specified period of time].	Inspection/Analysis
3.1.7.1.5	The DMS Management System shall allow the DMS System Maintainer to remotely test DMS Field Equipment via IP protocol.	Demonstration
3.1.7.1.6	The DMS Management System shall provide diagnostic information via NTCIP 1203 protocols that the DMS Field Equipment collects about itself, defined in Section 9 of NEMA TS4-2016 at the direction of the DMS System Maintainer.	Demonstration
3.1.7.1.7	The DMS Management System shall allow the DMS System Maintainer to enable or disable the periodic exercise of pixels (activated either manually or via a schedule) to ensure they are performing reliably.	Demonstration

Requirements Document Reference Number	System Requirements Sample Statements	Verification Method
3.1.7.1.8	<p>The DMS Management System shall allow the DMS System Maintainer to troubleshoot the following failure conditions to trigger alarms visible to the DMS System User. [It is only necessary for the DMS Field Equipment to support information about capabilities actually present in the DMS Field Equipment. For example, a matrix sign does not provide the drum-rotor status items, and a drum sign does not provide the pixel status items.]</p> <ul style="list-style-type: none"> <li>a. Power Sources</li> <li>b. Power Supplies</li> <li>c. Lamps</li> <li>d. Pixels</li> <li>e. Light Level Sensors</li> <li>f. Sign Controller</li> <li>g. Temperature Sensors</li> <li>h. Humidity</li> <li>i. Internal Environmental Systems (Fans and/or Heaters)</li> <li>j. Drum Sign Rotors</li> <li>k. External Device Errors</li> </ul>	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.7.1.9	The DMS Management System shall allow the DMS System Maintainer to obtain detailed information about a reported warning or error condition within a subsystem (detailed-level diagnostics).	Demonstration
3.1.7.1.10	The DMS Management System shall allow the DMS System User to monitor errors associated with defining or activating a particular message.	Demonstration
3.1.7.1.11	The DMS Management System shall allow the DMS System Maintainer to monitor the temperature within the sign housing. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.12	The DMS Management System shall allow the DMS System Maintainer to monitor the temperature within the control cabinet. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.13	The DMS Management System shall allow the DMS System Maintainer to monitor the humidity within the sign housing. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.14	The DMS Management System shall allow the DMS System Maintainer to monitor the humidity within the control cabinet. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.15	The DMS Management System shall allow the DMS System Maintainer to monitor for any errors related to the attached external devices to the DMS Field Equipment. [Specify external devices.]	Demonstration
3.1.7.1.16	The DMS Management System shall allow the DMS System Maintainer to monitor the status (opened, closed) of the doors to the sign housing.	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.7.1.17	The DMS Management System shall allow the DMS System Maintainer to monitor the status (opened, closed) of the doors to the control cabinet.	Demonstration
3.1.7.1.18	The DMS Management System shall allow the DMS System Maintainer to monitor whether the DMS Field Equipment controller software is operating properly through the use of watchdog timers. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.19	The DMS Management System shall allow the DMS System Maintainer to monitor the automatic display of a blank message when diagnostics detect that too many pixels are non-operational or that the light outputs are faulty. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.20	The DMS Management System shall allow the DMS System Maintainer to monitor the source of power that is being used to operate the DMS sign face. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.21	The DMS Management System shall allow the DMS System Maintainer to monitor the voltage level of the power that is being used to operate the DMS sign face. [Reference NEMA TS 4-2016]	Demonstration
3.1.7.1.22	The DMS Management System shall allow the DMS System Maintainer to monitor the level of fuel within the tank of a generator that is being used to operate the DMS Field Equipment.	Demonstration
3.1.7.1.23	The DMS Management System shall allow the DMS System Maintainer to monitor the engine RPM when a generator is being used to operate the DMS Field Equipment.	Demonstration

Requirements Document Reference Number	System Requirements Sample Statements	Verification Method
3.1.7.1.24	The DMS Management System shall allow the DMS System Maintainer to run complete diagnostics and store the results for review.	Demonstration
3.1.7.2	The DMS Field Equipment connected with a DMS Management System shall be uniquely identifiable.	Inspection
3.1.7.3	The DMS Field Equipment connected with a DMS Management System shall be locatable.	Inspection
3.1.7.4	The DMS Management System shall be designed by the DMS System Designer to provide the DMS System Maintainer with safe access to DMS Field Equipment locations for maintenance.	Inspection
3.1.7.5	The DMS Management System shall provide the DMS System Maintainer with the ability to remotely update DMS Field Equipment controller software and firmware.	Demonstration
3.1.8.1	The DMS Management System shall provide the capability for the Traveling Public to read messages on the sign face in reduced visibility conditions. Note: Reference the NEMA TS 4 viewing cone.	Demonstration



Requirements Document Reference Number	System Requirements Sample Statements	Verification Method
3.1.8.2	The DMS Management System shall allow the DMS System User to store the following information in the DMS Management System: * DMS Field Equipment Owner * DMS Field Equipment Unique Identifier * DMS Field Equipment Text Description [Specify number of characters of text] * DMS Field Equipment Location (physical, part of a corridor) * DMS Field Equipment Type (Blank Out Sign (BOS), Changeable Message Sign (CMS), or Variable Message Sign (VMS) as defined in NTCIP 1203) * DMS Field Equipment Technology (Fiber Optic, Light Emitting Diode (LED), Flip disk or shutter, Lamp Matrix, or Drum) * DMS Field Equipment Display Matrix Configuration (No Matrix (i.e., not a pixel matrix sign), Matrix Sign, Full Matrix, Line Matrix or Character Matrix) * DMS Field Equipment Fixed versus Portable * [Specify other DMS Field Equipment characteristics]	Inspection/Analysis
3.1.9.1	The DMS Field Equipment shall be placed by the DMS System Designer at locations that provide travelers with actionable information to support the agency's operational objectives.	Inspection/Analysis
3.1.9.2	The DMS Field Equipment sign placement shall conform, at a minimum, to NEMA TS 4-2016.	Inspection/Analysis
3.1.9.3	The DMS Field Equipment siting by the DMS System Designer shall take into account maintenance needs. [specify]	Inspection/Analysis
3.1.10.1	The DMS Management System shall interface with DMS Field Equipment from different manufacturers within the same system in accordance with NTCIP 1203v03 or later at a minimum. [specify NTCIP 1203 mandatory requirements and what optional requirements needed, and what DMS Field Equipment are being used]	Demonstration

<b>Requirements Document Reference Number</b>	<b>System Requirements Sample Statements</b>	<b>Verification Method</b>
3.1.10.2	The DMS Management System shall support the replacement by the DMS System Maintainer of existing DMS Field Equipment with DMS Field Equipment from different manufacturers. [specify existing system interface in accordance with NTCIP 1203].	Demonstration
3.1.10.3	The DMS Management System shall be designed to support the integration of new DMS Field Equipment with the existing DMS Management System [specify existing system interface in accordance with NTCIP 1203].	Demonstration
3.1.10.4	The DMS Management System shall be designed to accommodate existing communications interfaces [specify].	Demonstration
3.1.10.5	The DMS Management System shall be designed based on agency IT policies [specify].	Analysis
3.1.11.1	The DMS Management System shall accommodate [specify] users at any one time.	Demonstration
3.1.11.2	The DMS Management System shall accommodate a minimum of [specify] signs.	Demonstration
3.1.11.3	The DMS Management System shall provide confirmation that a new message is placed on the DMS Field Equipment within [specify] seconds.	Demonstration
3.1.12.1	The DMS Management System shall detect suspected system faults and report them to the DMS System User.	Demonstration
3.1.12.2	The DMS Management System shall allow the DMS System User to run diagnostics for suspected system faults.	Demonstration

Requirements Document Reference Number	System Requirements Sample Statements	Verification Method
3.1.12.3	The DMS Management System shall allow the DMS System User to log and report suspected system faults to the DMS System Maintainer.	Demonstration
3.1.12.4	The DMS Management System shall detect suspected communications faults and report them to the DMS System User.	Demonstration
3.1.12.5	The DMS Management System shall allow the DMS System User to run diagnostics for suspected communications faults.	Demonstration
3.1.12.6	The DMS Management System shall allow the DMS System User to log and report suspected communications faults to the DMS System Maintainer.	Demonstration
3.1.12.7	<p>The DMS Field Equipment shall display a user defined indication of the following conditions:</p> <ul style="list-style-type: none"> <li>· Communications fault</li> <li>· [specify other faults]</li> </ul> <p>[Specify the specific indicators to be used, e.g., *, 1, +, - at a specific position on the sign display]</p>	Demonstration