B-1 System Functional Requirements

This section defines the software features and functions that the Centralized Traffic Signal Control System (CTSCS) must provide. System functional requirements were developed using a systems engineering process. Requirements were organized into 18 logical functions as illustrated in Figure B-1.1 on the following page. The detailed requirements for each functional area are listed below.

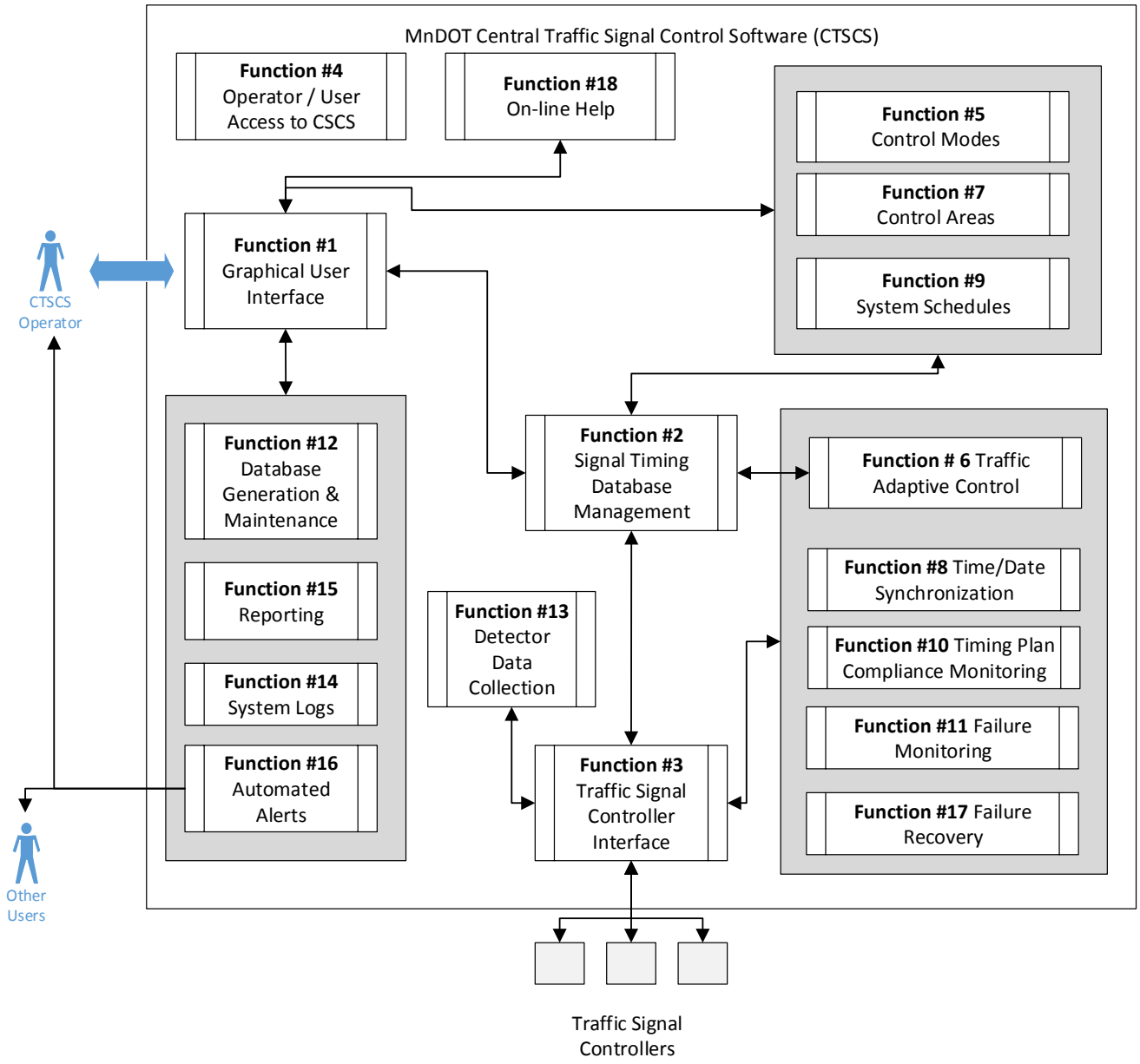


Figure B-1.1 Logical Drawing of MnDOT CTSCS Functional Requirements

B-1.0 Overall System Requirements

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.0.1.	Support the initial implementation of 600 intersections, with the option of future expansion in incremental sizes.	☐ Yes ☐ No ☐ N/A	
1.0.2.	Be capable of managing up to 2,500 field devices (controllers) with no reduction in processing speed.	☐ Yes ☐ No ☐ N/A	
1.0.3.	Multi-user commercial database software.	☐ Yes ☐ No ☐ N/A	
1.0.4.	Client/server design based on a distributed open architecture concept.	☐ Yes ☐ No ☐ N/A	
1.0.5.	CTSCS processing be distributed and "open" communications protocols used.	☐ Yes ☐ No ☐ N/A	
1.0.6.	Able to be added to the existing MnDOT operating platform: Windows Domain structure or Red Hat.	☐ Yes ☐ No ☐ N/A	
1.0.7.	Database shall be compliant with PostgreSQL, Microsoft SQL, or Oracle	☐ Yes ☐ No ☐ N/A	
1.0.8.	Able to work in a virtual server environment. *Describe how your system supports this operation.*	☐ Yes ☐ No ☐ N/A	
1.0.9.	Allow for exchange of files with common spreadsheet products Geographic Information Systems, Computer Aided Design, and databases. *Identify exchanges that are supported by the system.*	☐ Yes ☐ No ☐ N/A	
1.0.10.	Provide a primary system consisting of software and databases for operators to access on a daily basis.	☐ Yes ☐ No ☐ N/A	
1.0.11.	Provide a backup system consisting of software and databases that mirror the primary system for operators to access when the primary CTSCS is not operational	☐ Yes ☐ No ☐ N/A	
1.0.12.	Synchronize data between the primary and backup CTSCS.	☐ Yes ☐ No ☐ N/A	
1.0.13.	Expansion requires only the addition of off-the-shelf hardware components, software replication, software reconfiguration, and/or an expanded database without additional licensing (up to contract limits).	☐ Yes ☐ No ☐ N/A	

B-1.1 Graphical Operator Interface

B-1.1.1 General

No.	Description	Meets and Will Comply with Requirement	Describe
1.1.1.1.	Provide the operator with a graphical user interface (GUI).	☐ Yes ☐ No ☐ N/A	
1.1.1.2.	Include a GUI that responds to mouse clicks or key commands in one second or less.	☐ Yes ☐ No ☐ N/A	
1.1.1.3.	Incorporate the following: • Pop-up multiple display objects and windows; • Menu icons and controls; • Dialog boxes; • Push button and other active commands; • Visual and audio alarms for various events that are user definable; and • Use of object characteristics such as colors, highlighting, and flashing to alert operators of status changes.	☐ Yes ☐ No ☐ N/A	
1.1.1.4.	Prompt the user by a window to confirm that the changes will be saved.	☐ Yes ☐ No ☐ N/A	

B-1.1.2 Map Display

No.	Description	Meets and Will Comply with Requirement	Describe
1.1.2.1.	Provide a mechanism for operators to view a statewide map.	☐ Yes ☐ No ☐ N/A	
1.1.2.2.	Detailed screen captures and annotated text.	☐ Yes ☐ No ☐ N/A	
1.1.2.3.	Include area maps that enable operators to zoom to a selected area showing status of every signalized intersection within the zoom area, including: 1. State-wide view, 2. Metro District area zoom; 3. Ability for MnDOT to configure additional zoom areas in the future.	☐ Yes ☐ No ☐ N/A	
1.1.2.4.	Each signalized intersection controlled by the CTSCS should be displayed on the map.	☐ Yes ☐ No ☐ N/A	
1.1.2.5.	Signalized intersections not connected to the CTSCS should appear as icons on a separate layer on the map. Clicking on the icon establishes a link to the software	☐ Yes ☐ No ☐ N/A	

No.	Description	Meets and Will Comply with Requirement	Describe
	(Aries) that controls the signalized intersection.		
1.1.2.6.	Pan and zoom capabilities.	☐ Yes ☐ No ☐ N/A	
1.1.2.7.	Enable MnDOT to configure what status indicators are displayed when the cursor is placed over an icon (phase status, overall status, etc.).	☐ Yes ☐ No ☐ N/A	
1.1.2.8.	Enable individual operators to customize what status indicators are displayed when the cursor is placed over an icon specific to their preference.	☐ Yes ☐ No ☐ N/A	
1.1.2.9.	Real-time intersection information presented on the map automatically adjusted to avoid clutter based on "zoom level".	☐ Yes ☐ No ☐ N/A	
1.1.2.10.	Display only signal status information at the furthest zoom levels	☐ Yes ☐ No ☐ N/A	
1.1.2.11.	Display an increasing amount of information provided on the main map display as the operator zooms in to an area.	☐ Yes ☐ No ☐ N/A	
1.1.2.12.	Display intersection mode of control shown on one of the zoom levels.	☐ Yes ☐ No ☐ N/A	
1.1.2.13.	Enable MnDOT to configure zoom level ranges.	☐ Yes ☐ No ☐ N/A	
1.1.2.14.	Provide tools that enable operators to quickly access a geographic area/operating agency of the map.	☐ Yes ☐ No ☐ N/A	
1.1.2.15.	Provide a mechanism for operators to select a geographic area/operating agency from a pull-down menu.	☐ Yes ☐ No ☐ N/A	
1.1.2.16.	Provide a mechanism for operators to move quickly from main map to a geographic area/operating agency selected.	☐ Yes ☐ No ☐ N/A	
1.1.2.17.	Store the map zoom level and area visible on the screen upon logging off, and return to this zoom level when the operator next logs in.	☐ Yes ☐ No ☐ N/A	
1.1.2.18.	Enable operators to monitor 'control areas' with up to 200 signalized intersections.	☐ Yes ☐ No ☐ N/A	
1.1.2.19.	Support multiple background map options (satellite imagery, shape files, and DGN format).	☐ Yes ☐ No ☐ N/A	

B-1.1.3 Intersection Display

No.	Description	Meets and Will Comply with Requirement	Describe
1.1.3.1.	Provide on-screen displays of intersections controlled by the CTSCS. Graphics based upon the library of intersection drawings provided as part of the CTSCS software or aerial photographs.	☐ Yes ☐ No ☐ N/A	
1.1.3.2.	Provide a mechanism for operators to view intersection diagrams that are geometrically correct for the selected intersection based on the library of intersection diagrams.	☐ Yes ☐ No ☐ N/A	
1.1.3.3.	Provide a mechanism for operators to view aerial photographs of the intersections, with recent aerial photographs available (e.g. through a sources such as google maps).	☐ Yes ☐ No ☐ N/A	
1.1.3.4.	Provide a mechanism for operators to view intersection lines placed over aerial photographs.	☐ Yes ☐ No ☐ N/A	
1.1.3.5.	Display System inputs and outputs on the selected intersection graphic (e.g. diagrams, aerial photographs, etc.)	☐ Yes ☐ No ☐ N/A	
1.1.3.6.	Able to click on a signalized intersection on the main map to access an intersection map display.	☐ Yes ☐ No ☐ N/A	
1.1.3.7.	Provide a mechanism for operators to display multiple individual intersection displays simultaneously as separate displays or tiled windows. *Describe the system's capability.*	☐ Yes ☐ No ☐ N/A	
1.1.3.8.	Provide real time information on up to 40 phases plus up to 20 overlaps.	☐ Yes ☐ No ☐ N/A	
1.1.3.9.	Provide real time detector information, including vehicles, pedestrians, bicycle, bus, rail, and emergency vehicle pre-emption.	☐ Yes ☐ No ☐ N/A	
1.1.3.10.	Provide a minimum of 64 detectors per intersection.	☐ Yes ☐ No ☐ N/A	
1.1.3.11.	Capability to view the locations and status of all field controllers laid over the background maps or aerial photographs. Status of field controllers to be represented by color coding the intersections displays and the color selection shall be configurable by MnDOT.	☐ Yes ☐ No ☐ N/A	
1.1.3.12.	Provide signal controller information that provides at a minimum:	☐ Yes ☐ No	

No.	Description	Meets and Will Comply with Requirement	Describe
	• Signal ID (at least 5 digits) • Alternate Signal ID reference (e.g. street names) • Type of controller • Version of firmware • IP address of controller *Identify other inventory data elements that are available.*	☐ N/A	
1.1.3.13.	Allow the operator to monitor the current green, yellow, red, and flashing yellow displays of each signalized intersection.	☐ Yes ☐ No ☐ N/A	
1.1.3.14.	Provide a mechanism for operators to place a demand on the detectors or phase.	☐ Yes ☐ No ☐ N/A	
1.1.3.15.	Provide a mechanism for operators to construct intersection displays when configuring intersections in the system.	☐ Yes ☐ No ☐ N/A	
1.1.3.16.	Provide a library of symbols available to help construct the intersection display.	☐ Yes ☐ No ☐ N/A	
1.1.3.17.	Provide a mechanism for operators to import and export customized graphical icons to the library and to import, export, and copy/paste entire intersection drawings when constructing the intersection display.	☐ Yes ☐ No ☐ N/A	
1.1.3.18.	Provide a mechanism for operators to select a predetermined group of signalized intersections for monitoring.	☐ Yes ☐ No ☐ N/A	
1.1.3.19.	Allow the operator to monitor the current green, yellow, red, and flashing arrow displays of each signalized intersection in the group.	☐ Yes ☐ No ☐ N/A	
1.1.3.20.	Allow the operator to dynamically select signalized intersections from the GUI to be grouped.	☐ Yes ☐ No ☐ N/A	

B-1.1.4 Ability to Open and View Multiple Windows

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.1.4.1	Allow operators to open and view multiple windows, including multiple map views and multiple text displays.	☐ Yes ☐ No ☐ N/A	

B-1.1.5 Refresh Rates

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.1.5.1.	Refresh real-time dynamic data that are to be displayed on a graphic map as frequently as the data is being returned from the field equipment.	☐ Yes ☐ No ☐ N/A	
1.1.5.2.	Display a message to the operator noting a delay in receiving data, if feedback data are not received from the field because of higher priority communication.	☐ Yes ☐ No ☐ N/A	
1.1.5.3.	Have all static displays designed and developed to ensure instantaneous redraw of the graphic display.	☐ Yes ☐ No ☐ N/A	
1.1.5.4.	System map update on a real-time basis.	☐ Yes ☐ No ☐ N/A	

B-1.1.6 Ability to Access ITS Devices

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.1.6.1	Display icons or symbols that represent the locations and identification (ID #) of cameras at or near the intersections on the map interface, allowing operators to see where cameras are located and to see the ID of the camera for viewing in other systems.	☐ Yes ☐ No ☐ N/A	
1.1.6.2	Provide a mechanism for operators or administrators to populate the camera ID and location information for display on the maps.	☐ Yes ☐ No ☐ N/A	
1.1.6.3	Enable CTSCS operators to click on camera icons to open a window displaying the camera image by hyperlinking to the IP address assigned to each camera image.	☐ Yes ☐ No ☐ N/A	
1.1.6.4	Display icons or symbols that represent the locations and identification (ID #) of dynamic message signs (DMS) at or near the intersections on the map interface, allowing operators to see where DMS are located and to see the ID of the DMS to enable them to view the status in other systems.	☐ Yes ☐ No ☐ N/A	
1.1.6.5	Provide a mechanism for operators or administrators to populate the DMS ID	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	and location information for display on the maps.	☐ N/A	
1.1.6.6	Include a layer that has ITS devices associated with each signalized intersection presented as a symbol.	☐ Yes ☐ No ☐ N/A	
1.1.6.7	Briefly describe any capabilities available to Access ITS Devices.	☐ Yes ☐ No ☐ N/A	

B-1.2 Timing Database Management

B-1.2.1 Controller

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.2.1.1	Require confirmation from the operator prior to uploading and downloading data from traffic signal controllers.	☐ Yes ☐ No ☐ N/A	
1.2.1.2	Prompts the user to confirm that the user wants to download the data prior to the controller download.	☐ Yes ☐ No ☐ N/A	
1.2.1.3	Perform the download after the operator confirms that they want to download the data.	☐ Yes ☐ No ☐ N/A	
1.2.1.4	Track and store any changes made to the database by date and time stamping the change and recording the operator who implemented the change.	☐ Yes ☐ No ☐ N/A	
1.2.1.5	Enable operators to enter comments describing the changes performed	☐ Yes ☐ No ☐ N/A	
1.2.1.6	Store comments entered by operators and the operator ID of the operator who entered the comment, and make comments available to all operators.	☐ Yes ☐ No ☐ N/A	
1.2.1.7	Allow comments to include at least 256 characters.	☐ Yes ☐ No ☐ N/A	
1.2.1.8	Include a process to compare data in the central CTSCS with the field controller.	☐ Yes ☐ No ☐ N/A	
1.2.1.9	Highlight data that is different between the CTSCS and field controller and alert the user.	☐ Yes ☐ No ☐ N/A	
1.2.1.10	Provide operators with the option of selecting either the database in the CTSCS or the field controller to update the other database.	☐ Yes ☐ No ☐ N/A	
1.2.1.11	Allow operators to add notes for each	☐ Yes	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	device.	☐ No ☐ N/A	
1.2.1.12	Include the capability of permanently archiving controller databases.	☐ Yes ☐ No ☐ N/A	
1.2.1.13	Allow the operator to access and restore traffic signal control plans previously deployed through the CTSCS GUI.	☐ Yes ☐ No ☐ N/A	
1.2.1.14	Store archived data with a time stamp, operator ID, and operator report.	☐ Yes ☐ No ☐ N/A	
1.2.1.15	Allow operators to generate reports including entire or select information from the archived historical database.	☐ Yes ☐ No ☐ N/A	
1.2.1.16	Provide a mechanism for operators to save generated reports in industry standard formats (such as a PDF document).	☐ Yes ☐ No ☐ N/A	
1.2.1.17	Include safeguards to preclude unacceptable or conflicting intersection operation when generating databases of traffic control operations.	☐ Yes ☐ No ☐ N/A	
1.2.1.18	Include safeguards that, at a minimum, include range-checking, timing plan verification, and conflicting phases.	☐ Yes ☐ No ☐ N/A	
1.2.1.19	Safeguard discrepancies are easily distinguishable.	☐ Yes ☐ No ☐ N/A	
1.2.1.20	Provide a mechanism for operators to upload or download part of the controller database.	☐ Yes ☐ No ☐ N/A	
1.2.1.21	Provide a mechanism for operators to “copy” and “paste” content from one signalized intersection database to another.	☐ Yes ☐ No ☐ N/A	
1.2.1.22	Provide a mechanism for operators to insert a time of day step to an existing timing plan without recreating the entire timing plan	☐ Yes ☐ No ☐ N/A	
1.2.1.23	Include the ability to enact upload/download operation both by operator command and by schedule.	☐ Yes ☐ No ☐ N/A	
1.2.1.24	Include the ability to upload from or download to individual intersection or groups of intersection, as the operator or the schedule requires.	☐ Yes ☐ No ☐ N/A	
1.2.1.25	Provide a mechanism for the operator to select upload and download	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	to/from the field completed for the full system, by section, or by individual field equipment, and execute as selected.	☐ N/A	
1.2.1.26	Monitor on a regular basis to detect any discrepancies between the data base and the traffic signal controller are alert the operator when detected.	☐ Yes ☐ No ☐ N/A	
1.2.1.27	Execute scheduled uploads and downloads of databases to/from field controllers.	☐ Yes ☐ No ☐ N/A	
1.2.1.28	Respond to interruptions during the upload/download process by cancelling the action.	☐ Yes ☐ No ☐ N/A	
1.2.1.29	Only accept complete database uploads/downloads.	☐ Yes ☐ No ☐ N/A	
1.2.1.30	Enable operators to revert back to previous versions of the data base.	☐ Yes ☐ No ☐ N/A	
1.2.1.31	Include configurable parameters for how long databases are stored for access by operators from the GUI (i.e. to be restored or 'copied' using the GUI vs. being archived)	☐ Yes ☐ No ☐ N/A	

B-1.2.2 Timing Plan Generation

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.2.2.1	CTSCS shall have an interface with Synchro (Version 8.0) software package.	☐ Yes ☐ No ☐ N/A	
1.2.2.2	Include the ability to import .csv files containing signal timing plans in the Universal Traffic Data Format (UTDF) generated by the Synchro software package.	☐ Yes ☐ No ☐ N/A	
1.2.2.3	Provide a mechanism for new timing plans to be uploaded to CTSCS central database and in turn the CTSCS would update the local controller system timing plan databases.	☐ Yes ☐ No ☐ N/A	
1.2.2.4	Include the ability to export .csv files with signal timing data in the Universal Traffic Data Format (UTDF) to be used by the Synchro software package.	☐ Yes ☐ No ☐ N/A	
1.2.2.5	As a minimum, the following existing	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	signal timing data will be transferred to Synchro, including: intersection node number, intersection control area, phase (number and direction), phase minimum green, vehicle clearance, pedestrian clearance, and maximum phase duration.	☐ N/A	
1.2.2.6	Transfer data from Synchro to the CTSCS once optimized in Synchro.	☐ Yes ☐ No ☐ N/A	

B-1.3 Traffic Signal Controller Interface

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.3.1.1	Provide a mechanism for operators and/or administrators to enter information and configure traffic signal controllers to be controlled by the CTSCS. Once entered and configured, traffic signal controllers will appear on map displays and all control and monitoring functions enables. Information shall include the following (as a minimum): • Highway and cross street; • Latitude/longitude; • IP Address of controller; • Controller make and model; • Malfunction management unit (MMU) information; • Battery back-up information; • Ethernet switch information and • Camera ID(s).	☐ Yes ☐ No ☐ N/A	
1.3.1.2	Interface on a regular basis with traffic signal controllers configured in the CTSCS that are equipped with continuous 10/100/1000 Base Ethernet communications or continuous cellular communications connecting the CTSCS and the traffic signal controllers using the NTCIP Center-to-Field (C2F) communications protocol.	☐ Yes ☐ No ☐ N/A	
1.3.1.3	Enable operators/administrators to configure traffic signal controllers not controlled by the CTSCS (e.g. a controller controlled with Aries through dial-up connections) to appear	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	as icons on the map at the location of the controllers. When operators click the icon, the CTSCS shall launch a screen and open the Aries connection.		
1.3.1.4	NTCIP C2F protocol: NTCIP 1202, and 1202 based using custom-MIBS when available from the controller manufacturer. *Describe C2F capabilities and what controller brands are supported.*	☐ Yes ☐ No ☐ N/A	
1.3.1.5	Fully compatible with the ASC/3 controller, including upload/download of all NTCIP mandatory and proprietary MIBs.	☐ Yes ☐ No ☐ N/A	
1.3.1.6	Include interfaces designed for the specific controller.	☐ Yes ☐ No ☐ N/A	
1.3.1.7	Provided additional controller interface screens for functionality available in a specific controller.	☐ Yes ☐ No ☐ N/A	
1.3.1.8	Provide a help menu.	☐ Yes ☐ No ☐ N/A	

B-1.4 Operator / User Access to CTSCS

B-1.4.1 System Access

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.4.1.1	Support a multi-terminal, multi-user interface from multiple locations.	☐ Yes ☐ No ☐ N/A	
1.4.1.2	Allow each individual user to control their specific devices and view and/or control activity of other user controllers as allowed.	☐ Yes ☐ No ☐ N/A	
1.4.1.3	Allow operators to control another jurisdiction's devices only if authority is granted by the owning jurisdiction and changes would be made only with permissions, per local agency agreements.	☐ Yes ☐ No ☐ N/A	
1.4.1.4	Provide the ability to control and limit user access. Apply to executable files as well as text files and database files.	☐ Yes ☐ No ☐ N/A	
1.4.1.5	Allow operator privileges to be definable for a geographic area, time of day, and by device ownership.	☐ Yes ☐ No ☐ N/A	
1.4.1.6	Allow operator privileges to be definable for a functional level. Allow	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	for different levels of user access to system features and functions.	☐ N/A	
1.4.1.7	Include a system administrator level that has full access to the system as well as the capability for maintaining user account passwords and privilege level masks.	☐ Yes ☐ No ☐ N/A	
1.4.1.8	Require operators to enter an operator identification code (ID) and password before gaining access to the CTSCS.	☐ Yes ☐ No ☐ N/A	
1.4.1.9	Validate the operator ID and password against an encrypted database of authorized operators.	☐ Yes ☐ No ☐ N/A	
1.4.1.10	Execute a session start-up procedure upon operators successfully completing the login process.	☐ Yes ☐ No ☐ N/A	
1.4.1.11	Establish the privileges, object menu options, windows, and tools an operator may utilize during the start-up procedure using the operator ID.	☐ Yes ☐ No ☐ N/A	
1.4.1.12	Restrict access to any functions that an operator does not have access.	☐ Yes ☐ No ☐ N/A	

B-1.4.2 System Operators

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.4.2.1	Provide a mechanism for operators to view and/or control signalized intersections operated by other MnDOT Districts.	☐ Yes ☐ No ☐ N/A	
1.4.2.2	Enable privileges to view and control signalized intersections operated by other MnDOT Districts to be granted or restricted to individual operators.	☐ Yes ☐ No ☐ N/A	
1.4.2.3	Include the following operator access categories as a minimum: - System Administrator - System Operators - Field Maintenance Personnel - System Engineers - Report Only	☐ Yes ☐ No ☐ N/A	

B-1.4.3 Remote Access

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.4.3.1	Capability of providing access to the	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	system for remote operators through a virtual private network (VPN).	☐ N/A	
1.4.3.2	Support VPN access through the MnDOT firewall and the firewall operated by the Regional Transportation Management Center (RTMC).	☐ Yes ☐ No ☐ N/A	
1.4.3.3	Include workstations that are physically connected to the LAN as well as browser-based remote web access computers.	☐ Yes ☐ No ☐ N/A	
1.4.3.4	Enable all connected computers to perform concurrent operation.	☐ Yes ☐ No ☐ N/A	
1.4.3.5	Replicate user access categories and restrictions defined in other areas for remote access.	☐ Yes ☐ No ☐ N/A	

B-1.4.4 Mobile Device Access

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.4.4.1	Provide a mechanism for operators to access the CTSCS through mobile devices such as tablets and mobile phones (Android and iOS) with Internet access. *Identify which mobile devices are supported and what operational constraints devices have.*	☐ Yes ☐ No ☐ N/A	
1.4.4.2	Include a 'lite' version of the CTSCS that operators will access through mobile devices that provides quick data downloads and a limited operator interface that is suitable to mobile devices.	☐ Yes ☐ No ☐ N/A	
1.4.4.3	Provide the full functionality offered in the CTSCS through mobile devices.	☐ Yes ☐ No ☐ N/A	
1.4.4.4	Record and log all actions performed from mobile devices in the same manner actions are logged when performed using a computer interface (e.g. date, time, operator stamped).	☐ Yes ☐ No ☐ N/A	
1.4.4.5	Replicate user access categories and restrictions defined in other areas for mobile device access.	☐ Yes ☐ No ☐ N/A	

B-1.4.5 Portable Computer Software

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.4.5.1	Enable operators to access and use all functions of the CTSCS from desktop or portable (laptop) computers with LAN connections to the CTSCS server.	☐ Yes ☐ No ☐ N/A	
1.4.5.2	Enable operators to access and use all functions of the CTSCS from desktop or portable (laptop) computers from other MnDOT locations with Intranet (Internet access inside the MnDOT firewall) connections to the CTSCS server.	☐ Yes ☐ No ☐ N/A	

B-1.5 Control Modes

B-1.5.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.1.1	Communicate to the traffic signal controllers at the signalized intersections on an individual, section, or system-wide basis.	☐ Yes ☐ No ☐ N/A	
1.5.1.2	Capture and store commands manually entered from CTSCS operators, specifically recording what change was made, who made the change, when it was done, and operator comments.	☐ Yes ☐ No ☐ N/A	
1.5.1.3	Monitor each traffic signal controller connected to the CTSCS using continuous Ethernet communications no less frequent than once per second.	☐ Yes ☐ No ☐ N/A	
1.5.1.4	Enable operators to configure the CTSCS to communicate with and monitor individually selected traffic signal controllers less frequently.	☐ Yes ☐ No ☐ N/A	
1.5.1.5	Provide operator alerts each time changes are made to databases from the field (e.g. operator making a change at the cabinet).	☐ Yes ☐ No ☐ N/A	
1.5.1.6	Operate unattended 24 hours per day, seven days a week, without requiring an operator to be logged into the system.	☐ Yes ☐ No ☐ N/A	

B-1.5.2 Manual Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.2.1	Be able to manually override the plan that the system, section or the individual traffic signal controller is currently operating.	☐ Yes ☐ No ☐ N/A	
1.5.2.2	Assign manually selected timing plans a higher priority than all other modes of plan selection.	☐ Yes ☐ No ☐ N/A	
1.5.2.3	Terminate automatically at the end of the operator specified time or be capable of being set as manual with no specified termination time.	☐ Yes ☐ No ☐ N/A	
1.5.2.4	Revert to its normally scheduled operation after the manual override is terminated.	☐ Yes ☐ No ☐ N/A	
1.5.2.5	Enable operators to create control areas where operator can implement a plan at all intersections within a defined control area simultaneously.	☐ Yes ☐ No ☐ N/A	
1.5.2.6	Log and time stamp manual commands automatically, including operator ID.	☐ Yes ☐ No ☐ N/A	

B-1.5.3 Time-of-Day (TOD)/Day-Of-Week (DOW)

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.3.1	Include a TOD/DOW mode that is used for controlling traffic conditions that occur regularly.	☐ Yes ☐ No ☐ N/A	
1.5.3.2	Automatically select and implement traffic signal timing plans in accordance with the defined schedule, locally stored, on a time-of-day (TOD), day-of-week (DOW) basis.	☐ Yes ☐ No ☐ N/A	
1.5.3.3	Enable operators to copy and paste entire TOD/DOW plans from one signal controller to another.	☐ Yes ☐ No ☐ N/A	
1.5.3.4	Enable operators to insert and/or edit TOD details without needing to re-enter the TOD plan.	☐ Yes ☐ No ☐ N/A	
1.5.3.5	Download TOD/DOW plans from the CTSCS to the local traffic signal controller.	☐ Yes ☐ No ☐ N/A	

B-1.5.4 Traffic Responsive Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.4.1	Select the timing plan that is best suited to the existing traffic conditions from a list of optional timing plans authorized for the given time period.	☐ Yes ☐ No ☐ N/A	
1.5.4.2	Allow operators to assign time periods for timing plans (e.g. timing plan 111 might be assigned to only be selected during the AM peak).	☐ Yes ☐ No ☐ N/A	
1.5.4.3	Command the Signal Timing Plan number to the intersections on a continuous basis until the traffic-responsive process recognizes a change in the traffic condition.	☐ Yes ☐ No ☐ N/A	
1.5.4.4	Include logic to avoid 'loops' (hysteresis) where the CTSCS implements several consecutive timing plan changes in rapid manner.	☐ Yes ☐ No ☐ N/A	
1.5.4.5	Provide detailed description of the traffic-responsive algorithm.	☐ Yes ☐ No ☐ N/A	

B-1.5.5 Signal Priority Operation

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.5.1	Support signal priority operation.	☐ Yes ☐ No ☐ N/A	

B-1.5.6 Flash Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.6.1	Provide a mechanism for the operator to command the traffic signal to flash.	☐ Yes ☐ No ☐ N/A	
1.5.6.2	Allow flash commands from the CTSCS to individual intersections, but prohibit flash commands to the system as a whole.	☐ Yes ☐ No ☐ N/A	
1.5.6.3	Display precautionary and confirmation messages to the operator and require response before the control is implemented.	☐ Yes ☐ No ☐ N/A	

B-1.5.7 Free Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.7.1	Be able to operate the signalized intersection without coordination.	☐ Yes ☐ No ☐ N/A	

B-1.5.8 Event Scheduling Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.8.1	Capability of scheduling any system command.	☐ Yes ☐ No ☐ N/A	

B-1.5.9 Action Plans

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.9.1	Able to implement Action Sets using a structure similar to the existing i2 system. *Describe how to implement Action Sets.*	☐ Yes ☐ No ☐ N/A	

B-1.5.10 Default Control Mode

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.5.10.1	Always be on local TOD/DOW at the system start-up.	☐ Yes ☐ No ☐ N/A	
1.5.10.2	Determine the appropriate timing plan for the current day of year, day of week, and time of day based on reading the scheduler.	☐ Yes ☐ No ☐ N/A	

B-1.6 Traffic Adaptive Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.6.1	Include a traffic adaptive logic option. *Describe the traffic adaptive logic provided.* This is for information purposes only. Traffic Adaptive Control is not part of this procurement.	☐ Yes ☐ No ☐ N/A	
1.6.2	*Describe the type of detection technologies that have successfully been used with their traffic adaptive logic.*	☐ Yes ☐ No ☐ N/A	
1.6.3	*Identify non-intrusive detection technologies.*	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.6.4	Able to optimize the signalized intersection offset and splits.	☐ Yes ☐ No ☐ N/A	
1.6.5	Able to optimize the signalized intersection cycle length.	☐ Yes ☐ No ☐ N/A	
1.6.6	Integrated with the traffic adaptive signal control system logic.	☐ Yes ☐ No ☐ N/A	
1.6.7	Common CTSCS commands entered in the CTSCS affect the adaptive logic.	☐ Yes ☐ No ☐ N/A	
1.6.8	Phase changes monitored from the CTSCS while a signalized intersection is in traffic adaptive control.	☐ Yes ☐ No ☐ N/A	
1.6.9	Able to override the traffic adaptive control through the CTSCS and implement an "action set".	☐ Yes ☐ No ☐ N/A	
1.6.10	Able to turn on/off traffic adaptive control from the CTSCS at a signalized intersection, and at a control area of signalized intersections.	☐ Yes ☐ No ☐ N/A	
1.6.11	Able to perform these functions without logging in to the adaptive system separately.	☐ Yes ☐ No ☐ N/A	
1.6.12	Able to place a phase on "recall" from the CTSCS software, at a signalized intersection operating under traffic adaptive control.	☐ Yes ☐ No ☐ N/A	
1.6.13	The operator does not have to log into the adaptive logic to perform function.	☐ Yes ☐ No ☐ N/A	
1.6.14	Continue to optimize the remaining intersection phases at the affected signalized intersections.	☐ Yes ☐ No ☐ N/A	

B-1.7 Control Areas

B-1.7.1 System Wide Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.7.1.1	Capable of system wide control.	☐ Yes ☐ No ☐ N/A	
1.7.1.2	Be able to upload and download signal timing databases and monitor functions for all field signal controllers connected to the CTSCS by continuous Ethernet communications, and configured in the CTSCS.	☐ Yes ☐ No ☐ N/A	

B-1.7.2 Section Control

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.7.2.1	Able to divide the traffic signals into logical control areas that group signalized intersections for coordination and control purposes.	☐ Yes ☐ No ☐ N/A	
1.7.2.2	Have capacity to include, as a minimum, 200 signalized intersections per control area	☐ Yes ☐ No ☐ N/A	
1.7.2.3	Allow grouping by operator command or the TOD/DOW command.	☐ Yes ☐ No ☐ N/A	
1.7.2.4	Capable of assigning or re-assigning a particular intersection to more than one control area by operator or time of day command.	☐ Yes ☐ No ☐ N/A	

B-1.8 Time/Date Synchronization

B-1.8.1 Synchronization with Universal Time

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.8.1.1	Provide the means by which the system's central time clock is automatically synchronized using Network Time Protocol.	☐ Yes ☐ No ☐ N/A	
1.8.1.2	Automatically synchronize at least once per hour.	☐ Yes ☐ No ☐ N/A	
1.8.1.3	Allow operator to disable and re-enable this function.	☐ Yes ☐ No ☐ N/A	
1.8.1.4	Enable operators to re-sync the time through a manual command.	☐ Yes ☐ No ☐ N/A	

B-1.8.2 System-wide Clock Updates

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.8.2.1	Provide for the automatic downloading of clock updates to the field clocks integrated in each controller.	☐ Yes ☐ No ☐ N/A	
1.8.2.2	Allow operators to program the frequency of updates within a minimum range of once per day, to once per hour.	☐ Yes ☐ No ☐ N/A	
1.8.2.3	Be able to place a command to update the clock in a field controller.	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.8.2.4	Be able to specify which controllers receive universal time updates and which other controllers run on local time.	☐ Yes ☐ No ☐ N/A	

B-1.8.3 Verification of Field Clocks

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.8.3.1	Upload, on a periodic basis selectable by the operator, the date/time from a local controller.	☐ Yes ☐ No ☐ N/A	
1.8.3.2	Automatically download the true time to the field clock if the time/date in the field clock has drifted beyond an operator-defined amount.	☐ Yes ☐ No ☐ N/A	
1.8.3.3	Report the clock drift to the operator.	☐ Yes ☐ No ☐ N/A	

B-1.9 System Schedules

B-1.9.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.9.1.1	Include the capability of scheduling any system command, with no limitations on the number of commands issued at a particular time.	☐ Yes ☐ No ☐ N/A	
1.9.1.2	Include time-of-day/day-of-week schedules with a one-minute resolution.	☐ Yes ☐ No ☐ N/A	
1.9.1.3	Automatically assign the schedule for each day to its corresponding day of week.	☐ Yes ☐ No ☐ N/A	
1.9.1.4	Use a calendar scheduler to define which day of week or generic holiday schedule will be used in lieu of the normal day of week schedule for a particular day of the year.	☐ Yes ☐ No ☐ N/A	

B-1.9.2 Permanent and Temporary Schedules

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.9.2.1	Have the capability to schedule permanent schedules, and temporary schedules.	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.9.2.2	Allow permanent schedules contain the schedule of events for each day of the week and several generic holidays, as defined by the operator.	☐ Yes ☐ No ☐ N/A	
1.9.2.3	Functions are stored in the permanent schedule and remain unchanged after they have been executed.	☐ Yes ☐ No ☐ N/A	
1.9.2.4	Include temporary schedules that provide the capability of scheduling one-time events in addition to the events scheduled for the current day.	☐ Yes ☐ No ☐ N/A	
1.9.2.5	Delete functions stored in the temporary schedule following their execution.	☐ Yes ☐ No ☐ N/A	
1.9.2.6	Include the ability to create a one-time event scheduled to execute any time in the future.	☐ Yes ☐ No ☐ N/A	
1.9.2.7	Temporary schedules govern over the permanent schedule upon execution.	☐ Yes ☐ No ☐ N/A	

B-1.10 Timing Plan Compliance Monitoring

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.10.1	Remotely monitor the real-time phase returns from each intersection.	☐ Yes ☐ No ☐ N/A	
1.10.2	Utilize the CTSCS database timing parameters to check against the real-time phase returns and detect any errors.	☐ Yes ☐ No ☐ N/A	
1.10.3	The error conditions that are detected through compliance monitoring include the following: • The traffic signal controller is not using the proper signal timing plan, • The traffic signal controller time clock is out of synchronization, • The traffic signal controller is not sequencing, • The phase sequence is improper, • Phase time compliance, and • Split time compliance	☐ Yes ☐ No ☐ N/A	
1.10.4	Alert the operator(s) and record the error each time an error is detected.	☐ Yes ☐ No ☐ N/A	

B-1.11 Failure Monitoring

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.11.1	Include communications and controller hardware monitoring that cause the system to fail individual components when operator-definable error thresholds are exceeded.	☐ Yes ☐ No ☐ N/A	
1.11.2	Include intersections and detectors in the set of components monitored and potentially failed.	☐ Yes ☐ No ☐ N/A	
1.11.3	Log the event and also display a visual alarm or alert to the operator upon failure.	☐ Yes ☐ No ☐ N/A	
1.11.4	Display failure alerts such that they are visible without the operator interaction (e.g. operators should not need to move the mouse or select to view 'alerts' for alerts to be visible).	☐ Yes ☐ No ☐ N/A	
1.11.5	Continue to attempt communication with the failed component.	☐ Yes ☐ No ☐ N/A	
1.11.6	Consider a failed component operational if the failed component communicates successfully for an operator-specified amount of time.	☐ Yes ☐ No ☐ N/A	
1.11.7	Log all failure events, along with the clearing of the alarm for the failed component.	☐ Yes ☐ No ☐ N/A	
1.11.8	Be able to disable any component in the system through the user interface.	☐ Yes ☐ No ☐ N/A	
1.11.9	Does not control or communicate with the disabled component.	☐ Yes ☐ No ☐ N/A	
1.11.10	Have the ability to communicate with the Malfunction Management Unit.	☐ Yes ☐ No ☐ N/A	
1.11.11	Describe the failure monitoring capabilities of the system. *Describe the failure monitoring capabilities of the system.*	☐ Yes ☐ No ☐ N/A	

B-1.12 CTSCS Database

B-1.12.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.12.1.1	Automatically record signal operations data in the database and	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	periodically archive the data based on operator controllable configurations.		
1.12.1.2	Store a minimum of four weeks of intersection data for each intersection stored on the CTSCS database such that the data are accessible and usable by operators accessing the GUI.	☐ Yes ☐ No ☐ N/A	
1.12.1.3	Enable MnDOT administrators to define what 'intersection data' are stored. Categories include: • Detector logs; • Event logs; and • Signal timing data	☐ Yes ☐ No ☐ N/A	
1.12.1.4	Tag bad data or no data received from the intersection as questionable or not available in the CTSCS database.	☐ Yes ☐ No ☐ N/A	
1.12.1.5	The database program will not leave a partially written block in case of failure during a database write process.	☐ Yes ☐ No ☐ N/A	
1.12.1.6	Tag any missing blocks as unavailable.	☐ Yes ☐ No ☐ N/A	
1.12.1.7	Include the capability to enable or disable the data collection on an individual intersection basis.	☐ Yes ☐ No ☐ N/A	
1.12.1.8	Function such that the time increment between writing of signal operations data to the database server and start time is operator selectable with a weekly default.	☐ Yes ☐ No ☐ N/A	
1.12.1.9	Include the ability to enable or disable archiving on an individual intersection basis.	☐ Yes ☐ No ☐ N/A	
1.12.1.10	Function such that the intersection data is retrievable from the database server.	☐ Yes ☐ No ☐ N/A	

B-1.12.2 Database Generation and Maintenance

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.12.2.1	Provide database generation and maintenance.	☐ Yes ☐ No ☐ N/A	
1.12.2.2	Include loading, modifying, examining, copying, and retrieving the data used to operate the system.	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.12.2.3	Achieve system configuration changes without having to restart the CTSCS software or services.	☐ Yes ☐ No ☐ N/A	
1.12.2.4	Include data entry formats and fields that are designed for ease of use, by the system operator.	☐ Yes ☐ No ☐ N/A	
1.12.2.5	Function such that all tables in the database are printable in a legible format.	☐ Yes ☐ No ☐ N/A	

B-1.13 Detectors

B-1.13.1 Detector Data Collection

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.1.1	Support both system and local detectors.	☐ Yes ☐ No ☐ N/A	
1.13.1.2	Support traffic counting, traffic adaptive operation, traffic-responsive operation, and computation of measures of effectiveness.	☐ Yes ☐ No ☐ N/A	
1.13.1.3	Be capable of handling all the detectors associated with a controller.	☐ Yes ☐ No ☐ N/A	
1.13.1.4	Process and maintain detector count data and occupancy data on a continuous basis.	☐ Yes ☐ No ☐ N/A	
1.13.1.5	Support the capability of assigning local detectors as system detectors.	☐ Yes ☐ No ☐ N/A	
1.13.1.6	Include the capability to generate standard set of reports.	☐ Yes ☐ No ☐ N/A	
1.13.1.7	Alert the operator of any discrepancies between the Central Controller Database and the infield database for each controller.	☐ Yes ☐ No ☐ N/A	

B-1.13.2 Detector Data Types

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.2.1	Detector data types are as follows within the capabilities of the individual detector: - Volume - Occupancy - Speed	☐ Yes ☐ No ☐ N/A	

B-1.13.3 Detector Data Collection and Retrieval

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.3.1	Record system detector activity.	☐ Yes ☐ No ☐ N/A	
1.13.3.2	Store detector data in a raw data format (not smoothed).	☐ Yes ☐ No ☐ N/A	
1.13.3.3	Store the following data: volume, occupancy, and speed.	☐ Yes ☐ No ☐ N/A	
1.13.3.4	Provide a mechanism for operators to retrieve and export the data using the GUI.	☐ Yes ☐ No ☐ N/A	
1.13.3.5	Collect and store failure information for all failed detectors.	☐ Yes ☐ No ☐ N/A	
1.13.3.6	Collect the following failure information, at a minimum: detector location, reason for failure, and time of failure.	☐ Yes ☐ No ☐ N/A	

B-1.13.4 Detector Monitoring

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.4.1	Continuously monitor detector feedback.	☐ Yes ☐ No ☐ N/A	
1.13.4.2	Classify detector status as acceptable, marginal, disabled, and failed.	☐ Yes ☐ No ☐ N/A	
1.13.4.3	Report detector failures to the system log, alert the operators, and display failures on the system map, each time a detector failure is detected.	☐ Yes ☐ No ☐ N/A	
1.13.4.4	Include operator-selectable filters that define the thresholds that a detector must exceed to be considered failed.	☐ Yes ☐ No ☐ N/A	
1.13.4.5	Allow the operators to select the filter values on a TOD basis.	☐ Yes ☐ No ☐ N/A	
1.13.4.6	Include a minimum of three (3) TOD settings available.	☐ Yes ☐ No ☐ N/A	
1.13.4.7	Allow operators to select detector diagnostics to be used to determine failures and to set thresholds for failure.	☐ Yes ☐ No ☐ N/A	
1.13.4.8	Allow detector diagnostics to analyze individual detectors, as well as phases, when determining failures.	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.4.9	Allow detector diagnostics to evaluate both data and status of detectors when determining failures.	☐ Yes ☐ No ☐ N/A	
1.13.4.10	Include the following failure types at a minimum: • Maximum Presence • No Activity • Erratic Output • Failed Communication • Constant call on pedestrian buttons	☐ Yes ☐ No ☐ N/A	
1.13.4.11	Allow operators to select filters that are definable at a detector level.	☐ Yes ☐ No ☐ N/A	
1.13.4.12	Detector levels include thresholds that must be exceeded by a detector for it to be considered failed.	☐ Yes ☐ No ☐ N/A	
1.13.4.13	Capability for disabling some detector monitoring features by TOD.	☐ Yes ☐ No ☐ N/A	

B-1.13.5 Measures of Effectiveness (MOE)

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.13.5.1	Have the ability to collect high resolution data.	☐ Yes ☐ No ☐ N/A	
1.13.5.2	Record high resolution data that is recorded in 0.1 second increments in the controller.	☐ Yes ☐ No ☐ N/A	
1.13.5.3	Record high resolution data through enhanced traffic signal controller functionality.	☐ Yes ☐ No ☐ N/A	
1.13.5.4	Describe approach to collect high resolution data.	☐ Yes ☐ No ☐ N/A	
1.13.5.5	Support the Signal Performance Measures/Metrics developed by Indiana DOT, by providing high-resolution data logging capability, as defined in Indiana Traffic Signal High Resolution Data Logger Enumerations.	☐ Yes ☐ No ☐ N/A	

B-1.14 System Log

B-1.14.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.14.1.1	Create and store an event log report of what actually occurred on-street, not just what the scheduler requested.	☐ Yes ☐ No ☐ N/A	
1.14.1.2	Record all software functions executed by the system in the system log.	☐ Yes ☐ No ☐ N/A	
1.14.1.3	Identify the source of the executed function as being the scheduler or user.	☐ Yes ☐ No ☐ N/A	
1.14.1.4	Record all traffic related messages that occur in order of occurrence.	☐ Yes ☐ No ☐ N/A	
1.14.1.5	As minimum, include the following: - Operational events - Operator Plan - Traffic Responsive Plan - Action Sets - Traffic device failures/repairs - Communication failure/repairs - Traffic data transfer messages - Manual override changes - Operator log-on and log-off	☐ Yes ☐ No ☐ N/A	

B-1.14.2 Logging Storage Requirements

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.14.2.1	Automatically recorded on the CTSCS database servers.	☐ Yes ☐ No ☐ N/A	
1.14.2.2	Allow operators to filter the messages to view the logs.	☐ Yes ☐ No ☐ N/A	
1.14.2.3	Ensure that online files of all log messages are un-editable, permanent, and printable.	☐ Yes ☐ No ☐ N/A	

B-1.14.3 Current Operator Log

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.14.3.1	Create and store a real-time log of the operators that have logged into or out of the system.	☐ Yes ☐ No ☐ N/A	

B-1.15 Reporting Requirements

B-1.15.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.1.1	Provide functionality for operators to request reports from the CTSCS and either: • View the reports on the screen of the CTSCS (Displays); or • Print the report; or • Save the report.	☐ Yes ☐ No ☐ N/A	
1.15.1.2	Enable operators to access the CTSCS reporting and view screen displays from the same menu options as other functions.	☐ Yes ☐ No ☐ N/A	
1.15.1.3	Include a set of 'stock' industry standard reports that operators may select (stock reports to include, as a minimum, the reports in the following subsections).	☐ Yes ☐ No ☐ N/A	
1.15.1.4	Enable administrators to create additional reports (defining the data and report formats, and naming the reports). Once created, any operator is able to execute a 'created' report.	☐ Yes ☐ No ☐ N/A	
1.15.1.5	Enable operators to click on a menu that has the available report names displayed and choose the display to be shown on the monitor screen.	☐ Yes ☐ No ☐ N/A	
1.15.1.6	Enable operators to print any of the screens to any network printer or a file at any time during the process by simply clicking a button on the report screen.	☐ Yes ☐ No ☐ N/A	
1.15.1.7	Format the text as necessary to produce a useable and legible printout.	☐ Yes ☐ No ☐ N/A	
1.15.1.8	Enable operators to save reports in standard formats (e.g. Microsoft Excel, Word, CSV, PDF) and export reports.	☐ Yes ☐ No ☐ N/A	
1.15.1.9	Enable operators to generate the displays/reports on a system-wide basis, by section, by channel, or by single field device.	☐ Yes ☐ No ☐ N/A	
1.15.1.10	Enable operators to schedule report generation.	☐ Yes ☐ No ☐ N/A	
1.15.1.11	Be able to generate all reports with the permanent and temporary scheduler and selectively output these reports to a printer and/or file and/or email.	☐ Yes ☐ No ☐ N/A	
1.15.1.12	Enable operators to generate custom	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	Database Reports by utilizing the relational database custom report utility supplied with the database package.	☐ N/A	
1.15.1.13	Enable operators to access Database Reports seamlessly.	☐ Yes ☐ No ☐ N/A	
1.15.1.14	Enable operators to export any data from the database to Microsoft Excel, PDF, HTML, or any other editable formats, such as CSV.	☐ Yes ☐ No ☐ N/A	
1.15.1.15	Provide an XML feed of real-time, raw data from all detectors monitored by all traffic signal controllers connected to the CTSCS. Data stream should include location, coverage, direction of travel, volume, occupancy, and user-defined timeframes.	☐ Yes ☐ No ☐ N/A	

B-1.15.2 System Status

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.2.1	Include a System Status Display/Report that is an overview of the present condition of all devices in the traffic system.	☐ Yes ☐ No ☐ N/A	
1.15.2.2	Include intersection controllers, detectors, and communication systems in the System Status Display/Report	☐ Yes ☐ No ☐ N/A	
1.15.2.3	Include all possible status conditions and modes as described in the System Status Display Report.	☐ Yes ☐ No ☐ N/A	
1.15.2.4	Organize report by section control areas.	☐ Yes ☐ No ☐ N/A	

B-1.15.3 Intersection Operation

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.3.1	Include Intersection Operation Reports that show the selected intersection operation in detailed real-time mode.	☐ Yes ☐ No ☐ N/A	
1.15.3.2	Only offer Intersection Operation Reports on an intersection basis.	☐ Yes ☐ No ☐ N/A	
1.15.3.3	Include the following components of information in the Intersection	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	Operations Report: • Identification, physical location, communication status, mode of operation, plan number, and offset of cycle • Interval, timer and phase number of current phase(s). • A matrix showing the phase service, current split, vehicle detection status, pedestrian call status, next phase, phase omit, and termination for each of the phases present at the intersection.	☐ N/A	

B-1.15.4 Real Time Split Monitor Report

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.4.1	Include a real-time Split Monitor Display/Report that includes the real time split usage information for an operator-selected intersection.	☐ Yes ☐ No ☐ N/A	
1.15.4.2	Include real-time Split Monitor Display/Report that consist of an on-line report, updated every cycle.	☐ Yes ☐ No ☐ N/A	
1.15.4.3	Display the following in the split monitor report show, as a minimum: • Intersection number and location • Time and date report was started • Programmed split times for each phase (seconds) • Cycle/split/offset in effect • Actual split time used per phase, for each cycle in the reporting period (seconds)	☐ Yes ☐ No ☐ N/A	
1.15.4.4	Enable operators to select Split Monitor Reports on a scheduled basis.	☐ Yes ☐ No ☐ N/A	

B-1.15.5 Time Space Diagrams

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.5.1	Include Time Space Diagrams	☐ Yes ☐ No ☐ N/A	
1.15.5.2	Convert the data received from the traffic signal controllers and detectors, and creates programmed and real-time Time Space Diagram Reports and	☐ Yes ☐ No ☐ N/A	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	Displays.		
1.15.5.3	Enable operators to make offset adjustments to the TSD and save adjustments directly from TSD display to the CTSCS database and download to the controller.	☐ Yes ☐ No ☐ N/A	
1.15.5.4	Be able to support TSD during free operations.	☐ Yes ☐ No ☐ N/A	
1.15.5.5	Include Purdue Coordination Diagram	☐ Yes ☐ No ☐ N/A	

B-1.15.6 Measures of Effectiveness (MOE)

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.6.1	Collect and store intersection MOE data.	☐ Yes ☐ No ☐ N/A	
1.15.6.2	Process and maintain intersection MOE data on a continuous basis.	☐ Yes ☐ No ☐ N/A	
1.15.6.3	Store intersection feedback on a per phase basis.	☐ Yes ☐ No ☐ N/A	
1.15.6.4	Store at least the following intersection MOEs: • Seconds of green time used versus split • Percent of green time used versus split • Percent of detector calls that are currently active • Number of times maxed out or forced off of phase • Number of times phase was skipped • Number of transitions • Number of pedestrian calls • Number of emergency vehicle requests (high priority) • Number of transit priority request (low priority)	☐ Yes ☐ No ☐ N/A	
1.15.6.5	Allow the operator to enable the MOE monitoring at an intersection level or for a signal control area (up to 200 intersections) for up to four (4) hours.	☐ Yes ☐ No ☐ N/A	
1.15.6.6	Allow operators to adjust signal operations, including percent arrivals	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	on green, turning movement counts and active time-space diagrams.	☐ N/A	
1.15.6.7	Describe MOE capability and reporting.	☐ Yes ☐ No ☐ N/A	

B-1.15.7 Real-Time Communications Monitor

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.7.1	Show the request and reply to and from an operator-selected intersection.	☐ Yes ☐ No ☐ N/A	
1.15.7.2	Display the command being sent to an intersection along with the feedback data received back from the intersection.	☐ Yes ☐ No ☐ N/A	
1.15.7.3	Display the communications continuously until stopped by the operator.	☐ Yes ☐ No ☐ N/A	
1.15.7.4	Display the communications in an easily understandable format that also notes when communications has failed.	☐ Yes ☐ No ☐ N/A	

B-1.15.8 Communication Statistics

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.8.1	Include Communication Statistics Reports.	☐ Yes ☐ No ☐ N/A	
1.15.8.2	Include the number of communication attempts, number of successes, number of failures, and percentage of successful communications per intersection, and across the entire system.	☐ Yes ☐ No ☐ N/A	
1.15.8.3	Include the following types of information about communication failures at a minimum: address, associated intersection, reason for failure, and time of failure.	☐ Yes ☐ No ☐ N/A	
1.15.8.4	Provide the operator the capability of viewing the historical communications statics for particular intersections.	☐ Yes ☐ No ☐ N/A	
1.15.8.5	Log the communication failures of the controllers to the database.	☐ Yes ☐ No ☐ N/A	

B-1.15.9 Preemption / Signal Priority History

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.15.9.1	Include a Pre-emption/Signal Priority History Report.	☐ Yes ☐ No ☐ N/A	
1.15.9.2	Include the beginning and ending times of all pre-emption and signal priority events for a selected period in the Pre-emption/Signal Priority History Report.	☐ Yes ☐ No ☐ N/A	
1.15.9.3	Differentiate types of pre-emption in the report.	☐ Yes ☐ No ☐ N/A	
1.15.9.4	Report Emergency vehicle pre-emptions by intersection approach.	☐ Yes ☐ No ☐ N/A	

B-1.16 Automatic Alerting of Maintenance Personnel

B-1.16.1 General

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.16.1.1	Include the capability to automatically send alert messages to designated mobile devices upon detecting critical problems with or within the system.	☐ Yes ☐ No ☐ N/A	
1.16.1.2	Maintain a database of at least 100 system event messages.	☐ Yes ☐ No ☐ N/A	
1.16.1.3	Notify the designated operator(s) and present alarm message(s) upon detection of a critical event.	☐ Yes ☐ No ☐ N/A	
1.16.1.4	Be able to recognize the responsible agency when configured, and contact the appropriate maintenance personal for the agency.	☐ Yes ☐ No ☐ N/A	
1.16.1.5	Enable full programming of the feature to allow designation of operator using a schedule, by TOD/DOW of operator on-call shifts, and critical event to trigger.	☐ Yes ☐ No ☐ N/A	
1.16.1.6	Determine whether the alarm is critical or non-critical.	☐ Yes ☐ No ☐ N/A	
1.16.1.7	Have a function to acknowledge the alert remotely via email.	☐ Yes ☐ No ☐ N/A	
1.16.1.8	Capability to provide notification to alternative personnel, if the alarm is not acknowledged within a specified range of time.	☐ Yes ☐ No ☐ N/A	
1.16.1.9	Enable the operators to configure the alerts by designated individuals who	☐ Yes ☐ No	

No.	Requirement	Meets and Will Comply with Requirement	Describe
	will receive alerts, to avoid receiving an overload of messages.	☐ N/A	

B-1.16.2 Automatic Notification of System Changes

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.16.2.1	Provide automatic notification via email to the appropriate personnel when changes are made to the controller database.	☐ Yes ☐ No ☐ N/A	
1.16.2.2	Send notifications for automatic action sets to the appropriate party.	☐ Yes ☐ No ☐ N/A	

B-1.17 Failure Recovery

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.17.1	Alert the operator via an alarm and log a message to the system log.	☐ Yes ☐ No ☐ N/A	
1.17.2	Attempt an orderly shutdown of the system.	☐ Yes ☐ No ☐ N/A	
1.17.3	Include a software/hardware watchdog timer (WDT) process to control time critical tasks.	☐ Yes ☐ No ☐ N/A	
1.17.4	Describe how the system monitors for fatal failure and notification of the fatal failure to external monitoring systems. *Describe how the system monitors for fatal failure and notification of the fatal failure to external monitoring systems.*	☐ Yes ☐ No ☐ N/A	
1.17.5	Upon restoration of power and/or server operation the CTSCS will restart and return to normal operation according to the system configuration prior to failure and current time of day without user intervention.	☐ Yes ☐ No ☐ N/A	
1.17.6	Include a backup server (e.g. operated in a remote location or on-site with the primary server) that could be used in situations of system/server failure.	☐ Yes ☐ No ☐ N/A	
1.17.7	Describe how the system recovers from failures. *Describe how the system recovers from failures.*	☐ Yes ☐ No ☐ N/A	

B-1.18 Online Help

No.	Requirement	Meets and Will Comply with Requirement	Describe
1.18.1	Include a robust online help feature.	☐ Yes ☐ No ☐ N/A	
1.18.2	Provide context sensitive information for the page currently being viewed by the operator.	☐ Yes ☐ No ☐ N/A	
1.18.3	Enable the operator to search the online help using keywords.	☐ Yes ☐ No ☐ N/A	

B-2 MnDOT's Infrastructure Standard(s)

The Proposer must conform to MnDOT's Infrastructure Standards. Version 0.7; 9/19/13

Hardware and Device Standards

Standard Name	Product Name	Version	Owner	Last Updated

OS and Software Standards

Standard Name	Product Name	Version	Owner	Last Updated
Server OS	**Windows Server 2008 64-bit**	**R2**		**2/23/2012**
	Red Hat Linux	**5.7 Prod** **6.x Test**		**4/18/2012** **4/18/2012**
Desktop OS	**MS Windows XP** ***MS Windows 7**	**SP3** **SP1**		**2/23/2012** **in Q3-2012*
OS Virtualization	**VMWare**	**VSphere 5.x**		**2/23/2012**
Enterprise DB (Development)	**Oracle**	**11g**		**2/23/2012**
Enterprise DB (When required for COTS)	**SQL**	**2008 x64**		**2/23/2012**
Enterprise Reporting and Analytics	**Business Objects Enterprise**	**BOE XI 3.x**	**Requires exception by Management**	**9/19/2013**
	Oracle Business Intelligence Enterprise Edition (OBIEE)	**11g**	**Preferred**	**9/19/2013**
ETL	**Full Convert**	**5.6**		**8/9/2012**
	MS SSIS	**SQL 2008 9.0.3.30729.1**		**8/9/2012**
	Oracle Business Intelligence Enterprise Edition	**11.1.1**		**8/9/2012**
Modeling Tools	**Power Designer**	**16**		**3/20/2013**
AntiVirus	**McAfee Virusscan**	**8.7x**		**2/23/2012**
	ePO Agent	**4.5**		**2/23/2012**
Search Engines	**Google Mini Search Appliance (internal)**	**5.0**		**2/23/2012**
Web Servers	**Microsoft IIS -Server 2003**	**6**		**2/23/2012**

	-Server 2008 -Server 2008 R2	7 7.5		2/23/2012 2/23/2012
	Apache -Red Hat Linux	V2		2/23/2012
	Web Logic JBOSS	4.3.1 4.5, 5.1		2/23/2012 9/15/2011

Process Standards and Services

Standard Name	Product Name	Version	Owner	Last Updated
Backup Services	CommVault	9.x		2/23/2012
Email Standard	Outlook 2010	2010		2/23/2012
Messaging Standard	Exchange 2010	2010		2/23/2012

Configuration Standards

Standard Name	Product Name	Version	Owner	Last Updated
DB Standard	Oracle	11g		2/23/2012
Print	Windows Print Queues	2003		2/23/2012
Patch Management	System Center	2007 R2 SP2		8/9/2012
Software Distribution	System Center	2007 R2 SP2		8/9/2012
Antivirus policy and update management	McAfee ePo	4.5		2/23/2012

Supporting Infrastructure Standards

Standard Name	Product Name	Version	Owner	Last Updated
Network Standards	TCP/IP	4		2/23/2012
	SNMP	2		2/23/2012
	Ethernet -Copper	Cat 6		2/23/2012
Authentication (internal) *Kerberos or SLDAP supported	*Active Directory (2008 forest level)			2/23/2012
Authentication (external)	Oracle IAM			2/23/2012

B-3 MN.IT Security Requirements

Please complete the following questions regarding MN.IT Security Requirements.

Question	Requirement	Meets & will Comply with Requirement	Describe
1.	An individual has been designated as being responsible for security within the organization.	YES ☐ NO ☐ N/A ☐	
2.	An information security policy, based on industry acceptable standards and frameworks, is in place, has been approved by management and has been communicated to employees, contractors and individuals working on behalf of the organization.	YES ☐ NO ☐ N/A ☐	
3.	Security roles and responsibilities of employees, contractors and individuals working on behalf of the organization are defined and documented in accordance with the organization's information security policy.	YES ☐ NO ☐ N/A ☐	
4.	An information security awareness and training program has been established and provides general awareness and role specific (e.g., secure coding, CJIS, etc.) security training to all employees.	YES ☐ NO ☐ N/A ☐	
5.	Background screenings of employees, contractors and individuals working on behalf of the organization are performed to include criminal, credit, professional / academic, references and drug screenings.	YES ☐ NO ☐ N/A ☐	
6.	The organization will: (1) locate all production and disaster recovery data centers that store, process or transmit State of Minnesota data only in the continental United States, (2) store, process and transmit State of Minnesota data only in the continental United States, and (3) locate all monitoring and support of all the cloud computing or hosting services only in the continental U.S.	YES ☐ NO ☐ N/A ☐	

B-4 MN.IT Security Requirements (continued)

Question	Requirement	Meets & will Comply with Requirement	Describe
7.	The system/solution/service provides password protection and security controls to prevent unauthorized access to or use of the system, data, and images. Proposed system solutions will ensure Industry best practices for security architecture & design.	YES ☐ NO ☐ N/A ☐	
8.	The system/solution/service has capability to integrate with the State of Minnesota's Identity and Access Management (IAM) system.	YES ☐ NO ☐ N/A ☐	
9.	No data of any kind shall be transmitted, exchanged or otherwise passed to or accessed by other vendors or interested parties except on a case-by-case basis as specifically agreed to in writing by the State of Minnesota.	YES ☐ NO ☐ N/A ☐	
10.	The system/solution/service will encrypt sensitive data in transit and at rest using industry standard encryption protocols; encryption keys will be managed at least in part by the State of Minnesota.	YES ☐ NO ☐ N/A ☐	
11.	All data will be stored, processed, and maintained solely on designated servers and that no data at any time will be processed on or transferred to any portable or laptop computing device or any portable storage medium, unless that storage medium is in use as part of the organization's designated backup and recovery processes.	YES ☐ NO ☐ N/A ☐	
12.	All Information systems will be configured to industry security best practices (e.g., CIS, NIST, etc.).	YES ☐ NO ☐ N/A ☐	
13.	Anti-Malware software will be installed, running and maintained on all systems.	YES ☐ NO ☐ N/A ☐	

B-4 MN.IT Security Requirements (continued)

Question	Requirement	Meets & will Comply with Requirement	Describe
14.	All physical access to information systems will be controlled and restricted to only those with a need to physically access these systems.	YES ☐ NO ☐ N/A ☐	
15.	The system/solution/service will be developed according to secure software development best practices (e.g., OWASP, etc.).	YES ☐ NO ☐ N/A ☐	
16.	All source code must be made available to be scanned for vulnerabilities by the State of Minnesota or results of the organizations testing must be made available to the State of Minnesota.	YES ☐ NO ☐ N/A ☐	
17.	The system/solution/service has capability to integrate with the State of Minnesota's Security Incident Event Management (SIEM) system.	YES ☐ NO ☐ N/A ☐	
18.	The system/solution/service's storage processes, backup storage processes, and security procedures being implemented ensure that there is no loss of data or unauthorized access to the data.	YES ☐ NO ☐ N/A ☐	
19.	Firewalls are in place at the network perimeter and between the internal network segment and any DMZ.	YES ☐ NO ☐ N/A ☐	
20.	Systems and applications are patched in a timely manner to ensure critical security and operational patches and fixes are in place to ensure the confidentiality, integrity and availability of the information system.	YES ☐ NO ☐ N/A ☐	
21.	Vulnerability tests (internal/external) are performed on all applications and platforms.	YES ☐ NO ☐ N/A ☐	

B-4 MN.IT Security Requirements (continued)

Question	Requirement	Meets & will Comply with Requirement	Describe
22.	Online transactions must conform to reasonable commercial security standards and measures. Temporary files for all secure online transactions must be securely and permanently deleted when said transaction is complete	YES ☐ NO ☐ N/A ☐	
23.	The system/solution/service will comply with the State of Minnesota Security Policy and Standards.	YES ☐ NO ☐ N/A ☐	
24.	The system/solution/service will comply with the National Institute of Standards and Technology (NIST) Recommended Security Controls for Federal Information Systems and Organizations, Special Publication 800-53 revision 4, for Moderate systems.	YES ☐ NO ☐ N/A ☐	
25.	Independent Security audits of the system/solution/service, processes and data centers used to provide the services/solution are conducted at least annually. Audits are performed in accordance to SSAE16 SOC 2 or equivalent (e.g. FedRAMP) industry security standards. Contracted vendor will provide the most recent independent physical and logical audit results to the State of Minnesota.	YES ☐ NO ☐ N/A ☐	
26.	The organization will coordinate disaster recovery and business continuity processes and plans with the State of Minnesota and will provide the State of Minnesota with a detailed disaster recovery continuity of operations plan as part of their response.	YES ☐ NO ☐ N/A ☐	
27.	The proposal must provide a detailed explanation of the security features that are built into the proposed system/solution/service.	YES ☐ NO ☐ N/A ☐	

B-4 MN.IT Security Requirements (continued)

Question	Requirement	Meets & will Comply with Requirement	Describe
28.	The vendor and system/solution/product/ service/proposal will comply with the requirements of the Minnesota Government Data Practices Act/Minnesota Statutes chapter 13 and applicable federal laws/regulations (e.g., HIPAA, FERPA, IRS Publication 1075, FBI/CJIS)?	YES ☐ NO ☐ N/A ☐	
29.	If Federal, state or industry compliance requirements pertain to the data (e.g. CJI, IRS 1075, PHI (HIPAA), SSA, PCI, Etc.) the system/solution/service will comply with the said security policy and industry best practice.	YES ☐ NO ☐ N/A ☐	
30.	If CJI is in scope, organization staff (including employees, contractors and individuals working on behalf of the organization) that come in contact with CJI will pass an FBI fingerprinted background check and sign the FBI/CJIS Security Addendum/ Certification agreement	YES ☐ NO ☐ N/A ☐	
31.	All data received from the State of Minnesota or created, collected or otherwise obtained as part of this agreement will be owned solely by the State of Minnesota and all access, use and disclosure of the data shall be restricted to only that which is required to perform the organization's duties under this agreement.	YES ☐ NO ☐ N/A ☐	
32.	Processes will be in place to securely destroy or delete State of Minnesota data according to the standards enumerated in D.O.D. 5015.2 from systems or media no longer being used to fulfill the terms of this agreement or upon request from the State of Minnesota.	YES ☐ NO ☐ N/A ☐	

B-4 MN.IT Security Requirements (continued)

Question	Requirement	Meets & will Comply with Requirement	Describe
33.	In the event of termination of the agreement, the organization shall implement an orderly return of State of Minnesota assets and the subsequent secure disposal of State of Minnesota assets. During any period of suspension, the organization will not take any action to intentionally erase any State of Minnesota Data.	YES ☐ NO ☐ N/A ☐	
34.	An incident response plan is in place which includes notifying the State of Minnesota immediately of a known or suspected security or privacy incident involving State of Minnesota data.	YES ☐ NO ☐ N/A ☐	

B-4 Proposer Controller Requirements

While this project will not require new controllers, future projects may require replacement of controllers. The Proposer must provide a list of all controllers that are compatible with the CTSCS. At a minimum, the controllers must have:

- General compliance with specification similar to the Econolite ASC/3;
- Full communications with all controller features, including upload/download of all NTCIP mandatory and proprietary MIBs (Management Information Base).
- Action Plan functionality (ability to replicate functionality similar to the Econolite ASC/3);
- Detector data (ability to provide Indiana Traffic Signal High Resolution Data Logger Enumerations per http://docs.lib.purdue.edu/jtrpdata/3/); and
- Provides comprehensive and user friendly manual

B-5 Testing Requirements

The following sections describe the testing requirements:

1. Proof of Concept Test (During Procurement)
2. System Server Installation (by MnDOT)
3. Systems Installation Test
4. Database Transfer Test
5. Initial System Acceptance Test
6. Initial Operability Test
7. Final System Acceptance Test
8. Final Operability Test
9. System Acceptance Test

The project implementation schedule is shown in ***Figure B-5.1*** on the next page.

B-5.1 Proof of Concept Test (During Procurement)

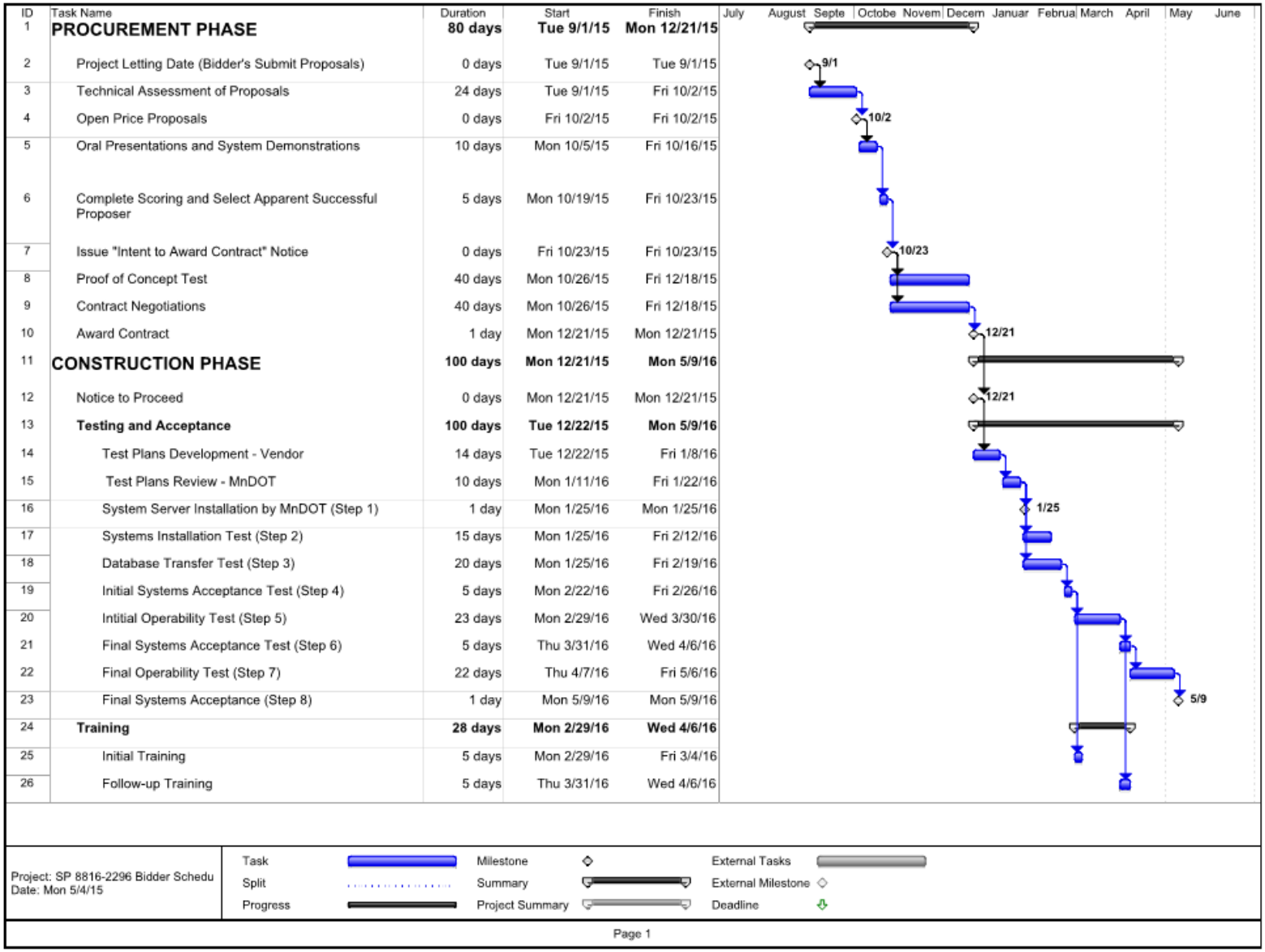
There is one test that must be completed during the Procurement Process, namely the Proof of Concept Test. The following sections describes the test in more detail.

The objective of the Proof of Concept Test is to confirm, prior to system selection, key system functionality meets the project requirements. Elements of the Proof of Concept Test may vary depending on the system selected. The test will occur at MnDOT's Water's Edge facility.

A Proof of Concept Test must be completed by the Proposer following the notification of being the preferred supplier of the system. The purpose of the test is to demonstrate the feasibility of the proposed product and solution with the existing controllers. The Proposer must, at a minimum, demonstrate communications to the existing controllers (provided by MnDOT).

The Proposer must submit a testing plan for the Proof of Concept Test for MnDOT review within ten (10) days of notification of being the preferred supplier. MnDOT and the Proposer must arrange the dates, location, and resources needed to undergo this test. MnDOT reserves the right to not proceed further beyond this stage of the procurement with the Proposer, if the Proof of Concept Test results are unacceptable at the sole discretion of MnDOT. In the case of unacceptable results, the State of Minnesota will initiate negotiations with the second-ranked Proposer. If acceptable, contract negotiations will begin.

Figure B-5.1 Project Implementation Schedule



ID	Task Name	Duration	Start	Finish
1	**PROCUREMENT PHASE**	**80 days**	**Tue 9/1/15**	**Mon 12/21/15**
2	Project Letting Date (Bidder's Submit Proposals)	0 days	Tue 9/1/15	Tue 9/1/15
3	Technical Assessment of Proposals	24 days	Tue 9/1/15	Fri 10/2/15
4	Open Price Proposals	0 days	Fri 10/2/15	Fri 10/2/15
5	Oral Presentations and System Demonstrations	10 days	Mon 10/5/15	Fri 10/16/15
6	Complete Scoring and Select Apparent Successful Proposer	5 days	Mon 10/19/15	Fri 10/23/15
7	Issue "Intent to Award Contract" Notice	0 days	Fri 10/23/15	Fri 10/23/15
8	Proof of Concept Test	40 days	Mon 10/26/15	Fri 12/18/15
9	Contract Negotiations	40 days	Mon 10/26/15	Fri 12/18/15
10	Award Contract	1 day	Mon 12/21/15	Mon 12/21/15
11	**CONSTRUCTION PHASE**	**100 days**	**Mon 12/21/15**	**Mon 5/9/16**
12	Notice to Proceed	0 days	Mon 12/21/15	Mon 12/21/15
13	**Testing and Acceptance**	**100 days**	**Tue 12/22/15**	**Mon 5/9/16**
14	Test Plans Development - Vendor	14 days	Tue 12/22/15	Fri 1/8/16
15	Test Plans Review - MnDOT	10 days	Mon 1/11/16	Fri 1/22/16
16	System Server Installation by MnDOT (Step 1)	1 day	Mon 1/25/16	Mon 1/25/16
17	Systems Installation Test (Step 2)	15 days	Mon 1/25/16	Fri 2/12/16
18	Database Transfer Test (Step 3)	20 days	Mon 1/25/16	Fri 2/19/16
19	Initial Systems Acceptance Test (Step 4)	5 days	Mon 2/22/16	Fri 2/26/16
20	Intitial Operability Test (Step 5)	23 days	Mon 2/29/16	Wed 3/30/16
21	Final Systems Acceptance Test (Step 6)	5 days	Thu 3/31/16	Wed 4/6/16
22	Final Operability Test (Step 7)	22 days	Thu 4/7/16	Fri 5/6/16
23	Final Systems Acceptance (Step 8)	1 day	Mon 5/9/16	Mon 5/9/16
24	**Training**	**28 days**	**Mon 2/29/16**	**Wed 4/6/16**
25	Initial Training	5 days	Mon 2/29/16	Fri 3/4/16
26	Follow-up Training	5 days	Thu 3/31/16	Wed 4/6/16

B-5.2 Test Plan (After Award)

After project award, the Proposer must prepare detailed Testing Plans for review by MnDOT following the requirements identified in this bid document. A Test Plan for System Testing is needed to demonstrate and verify that the installed System and associated Services meet all the Requirements under the Contract. The Test Plan must clearly state the objectives, test scenarios, and success criteria of each level of testing.

This Test Plan must be provided in writing, to MnDOT, no later than thirty (30) days after the successful completion of the contract execution. For each test, procedures must be prepared describing the function being tested, test equipment, personnel required, and the step-by-step instructions for carrying out the test. The criteria for establishing whether the test was successful must be an integral part of each test procedure. The Test Plan must also address the following:

- Overall schedule of testing,
- Sequencing and interdependency of test,
- Test simulators,
- Sources and generation of test data,
- Reporting procedures,
- Process for failure tracking,
- Analysis, and
- Resolution.

MnDOT must approve the Test Plan and must include a process to document and sign each test in a tabular format similar to what is shown below.

Test	Expected Result	Pass/Fail	Comment	Signature

B-5.3 Test Procedures

Upon written Approval from MnDOT, the Test Plan must be used by the Proposer to compile the detailed test procedures of each required test. These detailed test procedures must subsequently be submitted to MnDOT for review and Approval. The Proposer must not begin any test activities prior to receiving Approval of the Test Plan from MnDOT.

The following elements must be included in the test procedures:

1. Test number
2. Description of Requirement
3. Resources and equipment needed
4. Prerequisites for each test
5. Initial status and conditions
6. Triggering action
7. Expected process
8. Expected result (end state)

The Proposer must prepare test procedures that outline the steps for each function or group of functions and their ability to record the outcome of each step. This includes the entry and exit criteria, the required test equipment, instruments, Facilities and labor necessary, and the expected results.

The Proposer must prepare the criteria for entry and exit of each test and must take into account that any deficiencies identified during the tests must not trigger any loss in information. These include the need for extra Work or extra cost to MnDOT.

The Proposer must submit all test procedures to MnDOT for review and Approval, at least two (2) weeks in advance of the scheduled start date of the test. Any revised test procedures must be approved by MnDOT one (1) week in advance of the commencement of any test.

The Proposer must provide all tests in editable electronic format.

The Proposer must provide at least two (2) weeks of notification before the commencement of any test.

The Proposer must conduct all formal tests in the presence of MnDOT or their representative.

B-5.3.1 Traffic Signal Control System

B-5.3.1.1 System Installation Test (Step 2)

Upon installation of the servers by MnDOT *(Step 1)*, the traffic signal control system must be installed on the servers at the designated MnDOT facilities by the Proposer.

The required functionality for the system will then be tested.

Specific tasks must include:

- Verify that install and uninstall procedures are documented;
- Document installation parameters required for optimal performance;
- Demonstrate that there is no conflict with other installed software; and
- Demonstrate no conflicts between hardware and software.

B-5.3.1.2 Database Transfer and Test (Step 3)

The existing i2 database must be transferred to the selected Proposer's system. This transfer includes the controller database. MnDOT will provide the Proposer with a spreadsheet containing the intersection names, IP addresses, system ID numbers, and location coordinates. The Proposer will be responsible for transferring 10 intersections of data as part of the initial acceptance test. MnDOT and the Proposer must validate the success of the database transfer before moving forward.

B-5.3.1.3 Initial System Acceptance Test (ISAT) (Step 4)

The initial acceptance test must be conducted to verify the system functionality for a select group of intersections. The initial test group must consist of approximately 30 signalized intersections and will be defined by MnDOT. MnDOT will be responsible for reviewing and approving the provided document. Additionally, MnDOT will witness the test and approve the test results report.

B-5.3.1.4 Initial Operability Test (Step 5)

This initial operability test must involve the use of the system for a period of 30 days by MnDOT. The objective of the test is to have MnDOT staff use the system on a daily basis, to help identify system issues.

During the operability period, the Proposer must provide a contact person that is available 24-hours a day to respond to emergency situations.

MnDOT and the Proposer must log all failures and issues during this period. The Proposer must provide a consolidated log of all failures to MnDOT staff on a daily basis. During the operability period, the Proposer must immediately address all CTSCS components/modules that put at risk the performance or stability of the system. Only failures due to activities of others, power failures or traffic accidents are exempted.

The operability period will restart at the beginning of the 30 day period if the CTSCS is turned off because of a failure in one of its components or modules as defined in the testing plan. At MnDOT's discretion, the initial operability test may be repeated. If determined by MnDOT, issues and failures not deemed critical may be added to a punch list to be addressed and remedied before system acceptance.

B-5.3.1.5 Final System Acceptance Test (Step 6)

The Proposer will then proceed with full system deployment. The final system acceptance test must be conducted after full system deployment. MnDOT will be responsible for reviewing and approving the provided document. Additionally, MnDOT will witness the test and approve the test results report.

B-5.3.1.6 Final Operability Test (Step 7)

The operability test must be completed after full system deployment. MnDOT will operate the system for a period of 30 days with the Proposer on standby to ensure full functionality.

B-5.3.1.7 System Acceptance (Step 8)

Upon completion of the operability test and pending resolution of the punch list, the full system must be accepted by MnDOT.

B-6 Training Requirements

The Proposer will be responsible to train Minnesota Department of Transportation-designated personnel according to the requirements specified herein.

Training must take place at Minnesota Department of Transportation-designated facilities in the Metro area.

The training presentations and material must be in English. The Proposer must supply an electronic copy of the training material in a "native file format" so that MnDOT can update the training material based on their experience, and reproduce the training material.

Instruction must cover equipment familiarization and systems operation. The minimum training is that necessary to bring those employees designated to the level of proficiency required for performing their respective duties.

The Proposer must provide experienced and qualified instructors to conduct all training sessions.

The Proposer must be responsible for ensuring that the instructors teaching these courses are not only familiar with technical information, but are able to utilize proper methods of instruction, training aids, audiovisuals and other materials to provide for effective training.

The Proposer must be responsible for providing all instructional materials, training materials, training aids, audiovisual equipment, and visual aids for the conduct of these courses.

Instructional materials consisting of applicable equipment operation and maintenance manuals, and supplemental notebooks consisting of additional drawings, procedures, and descriptive information must be provided.

Student guides must be provided and include full topic descriptions, illustrations as needed to enhance content presentation, and common problems with comprehensive solutions given. Student guides must mirror the instructor guides.

All training materials must become the property of MnDOT at the conclusion of training.

The Proposer must submit the training curricula, presentations, and material for review and approval by MnDOT. Training curricula must be provided to MnDOT for review a minimum thirty (30) days prior to commencement of equipment installation. No training must commence until these items have been approved by MnDOT.

Training curricula must meet all training requirements and indicate course content, training time requirements, and who should attend.

As a minimum, training should be provided on the following systems:

- Central Traffic Signal System Software (2 sessions, 20 people each);
    - This training should include instruction on data analysis and report generation.
- Central Traffic Signal System Software Review (2 sessions, 20 people each);

  - This training must review the material presented in the initial course, allowing people to learn and ask questions after having used the software for a period of time. The course can be half as long as the first course, and should be 2 to 3 weeks later.

- System Administration and Maintenance Training (1 session, 5 people).

B-6.1 Intersection Maps

The training shall include a section on creating an intersection controller database and signalized intersection maps. The Proposer shall create the detailed controller databases and maps for 30 intersections required for the Initial Systems Testing (B-5.3.1.3) as part of the training. MnDOT, or their designate, will be responsible for preparing the maps for the remaining intersections.

B-6.2 Users Manuals

The Proposer must provide twenty (20) user manuals and an electronic copy in PDF format unless specified otherwise. The manuals must provide sufficient detailed installation and maintenance instructions to allow MnDOT, the Signal Partners, or their representatives to properly and safely install, connect and commission the equipment supplied and to operate and maintain the system.

B-7 Operational Support

MnDOT will use all supplied software in accordance with the Proposer's specific instructions in order to maintain all warranties. However, the Proposer must be responsible for repairing any damage from the use of any software resulting from Proposer's failure to provide adequate or correct training and/or complete operating manuals, software manuals complete software documentation, and other documents required to be furnished as identified.

MnDOT and Signal Partners will provide front-line maintenance of the CTSCS, including identification of the system errors

The Proposer must provide a reliable method of telephone problem notification. In the event that MnDOT's staffs are unable to correct the issue, the Proposer must respond:

- Within four (4) hours to any CTSCS faults, via call back, email, or computer (remote assistance) as necessary;

Notwithstanding the above, all CTSCS faults must be rectified and full system functionality restored within eight (8) hours from when MnDOT initially contacts the Proposer.

Communication to the Proposer will be minimized by MnDOT and Signal Partners. Most technical questions are answered by MnDOT and Signal Partners, within their user group. At this time MnDOT and Signal Partners anticipates monthly calls to the Proposer once the system is operational. The Proposer must describe their typical Proposer support provided to their system users.

The Proposer must provide costs for a minimum of five (5) years of operational support, and an additional annual cost to extend the support from five to 10 years in one-year increments.

B-8 Escrow Agreement

As part of this contract the Proposer must enter into an Escrow agreement with MnDOT. The intent of the escrow agreement is to provide MnDOT the source code for the CTSCS in the event that the Proposer no longer supports the CTSCS software. After the expiration of the initial warrantee period and assuming that the Proposer will no longer provide a warrantee for the CTSCS, MnDOT must receive a copy of the all of the source code, required software libraries, patches, documentation and the software developer environment required to build and install the CTSCS.

B-9 Warranty Requirements

The Proposer must warrant that it has good title to the system and its components and the right to sell to the State of Minnesota free of any proprietary rights of any manufacturer (if the Proposer is not the manufacturer) or other party, and free of any lien or encumbrance.

The Proposer must warrant that it has good title to all system software of that it has the right to license the use of such software, or both, free of any proprietary rights of any other party and free of any other lien or encumbrance.

The Proposer must warrant that all installation work and system software will perform according to the specifications for the warranty period.

It is recognized that the original manufacturers' or suppliers' warranties may expire before the end of the warranty period. The Proposer must therefore provide extended warranties for all such products or equipment (software, hardware, spare parts) and must assume full responsibility for replacement or repair for the duration of the warranty period, the full cost of which must be included in the contract price.

All warranties and guarantees of Proposer, manufacturers and suppliers with respect to any such work and system hardware must be obtained by the Proposer for the benefit of the State of Minnesota regardless of whether or not such warranties and guarantees have been assigned or transferred to the State of Minnesota by a separate agreement. The Proposer must fully enforce such warranties and guarantees on behalf of the State of Minnesota.

B-9.1 Software Warranty

The Proposer must develop, test, provide and install all applicable software "patches" or upgrades that become necessary to remedy system software faults or "bugs" identified during the warranty period. Included in these provisions is any required training or system orientation for MnDOT's staff to operate the system with the "upgraded" software.

The Proposer must provide at no additional cost, all version updates, software patches and error corrections available for the system software provided.

B-9.2 Warranty Period

The warranty period for all supplied components, hardware and software, will commence upon completion of the System Acceptance Test (SAT), and may not terminate for five (5) years following MnDOT approval of the SAT. Any extended warranties on specific system components that apply beyond this five (5) year period must be transferred to the State of Minnesota. The Proposer must also provide an incremental annual cost to extend the warranty from five to 10 years.

B-10 Server Hardware and Software Requirements

MnDOT will supply all server hardware necessary for the CTSCS. The Proposer must state their server requirements and software requirements to provide a full functioning system, given the existing number of controllers, and system maximum size. The Proposer must state their server allocation (e.g. database server, communication server, and application server), minimum requirements and recommended requirements. Assume a modern up to date server that meets or exceeds the Proposer's specifications. MnDOT will supply the operating environment and maintain a VPN access.

B-11 CTSCS Licensing Agreement

MnDOT and its potential partners must have access to the CTSCS. The CTSCS must be a single license for MnDOT that allows all MnDOT staff to use the CTSCS. This means that approximately 100 system users may access the system simultaneously. The Proposer must provide MnDOT with an "open" licensing agreement, so that new Signal Partners (government agencies within the State of Minnesota) can be added through the duration of the Warrantee period.

The Cost Proposal includes three levels of licensing based on number of intersections installed on the CTSCS. MnDOT will choose the appropriate level based on available funding, and may add Bid Alternate 1 and Bid

Alternate 2 at any point during the five year contract. The Bidder must provide costs for the following bid alternatives:

- Core Proposal – 600 Intersections
- Bid Alternate 1 – 1500 intersections (Additional 900 intersections beyond core proposal)
- Bid Alternate 2 – 3000 intersections (Additional 1500 intersections beyond Bid Alternate 1)

B-12 Project Management and Documentation

B-12.1 General Requirements

The Proposer must prepare a Master Schedule of Work in Gantt format using MS Project or an equivalent to be submitted following Notice to Proceed (NTP). The schedule must identify the manufacture, delivery, and installation (if specified) of equipment, training programs, test procedures, and deliver of documentation. The schedule must also show Agency and any third party responsibilities and activities in the timeline.

The schedule must be updated by the Proposer on monthly basis to reflect the progress attained in the previous month and the anticipated changes in the future.

The Proposer must convene regular progress review meetings, such as:

- Weekly or bi-weekly design/contract review meetings with Minnesota Department of Transportation(MnDOT) and Signal Partners;
- Technical and contractual interface meetings with Sub-contractors, if any.

B-12.2 Documentation Submission Requirements

The Proposer must provide detailed documentation that describes the system design, configuration, training, as-build conditions, operation and maintenance. All documentation must be in English, must utilize English measurements, and must be submitted directly to MnDOT in paper hardcopy and electronically in Word/AutoCAD/Excel/MS Project and Adobe Acrobat. Any and all communications or submissions must be submitted to MnDOT. A minimum of six bound, hard copies of the documentation and one (1) CD-ROM copy must be provided.

The Proposer must include the necessary time and resources to modify the documentation to incorporate comments from MnDOT. The Proposer must then include additional time for MnDOT to review the revised documentation.

The manuals must be complete, accurate, up-to-date, and must contain only that information that pertains to the system installed. They must contain a complete subject index.

All pages of the documentation must carry title, version number and issue date. The Proposer must be responsible for fully coordinating and cross referencing all interfaces and areas associated with interconnecting equipment and systems.

Documentation must require re-issues if any change or modification is made to the equipment proposed to be supplied. The Proposer may re-issue individual sheets or portion of the documentation that are affected by the change or modification. Each re-issue or revision must carry the same title as the original, with a change in version number and issue date.

Each volume must have a binder (stiff cover and spine), and drawings must be protected by clear plastic or withstand frequent handling. The binding arrangement must permit the manual to be laid flat when opened.

The paper used must be of good quality and adequate thickness for frequent handling.

B-12.3 Project Binder Check Font and Line Spacing

The Successful Proposer must prepare a Project Binder that consists of the following:

- Project Management/Work Plan detailing the proposed approach to completing the project, including identification of relevant tasks, and an organization chart identifying key personnel;
- Quality Management Plan detailing the successful Proposer's Quality Assurance procedures, including change management;
- Installation Plan detailing the installation procedure;
- Acceptance Test Plan detailing the approach to system testing (as relevant to Section B-3);
- Training Plan detailing course content, training time requirements, and who should attend (as relevant to Section B-4);
- Maintenance and Operations Support Plan that describes routine maintenance measures, response for repairs, communications service, and operations support (as relevant to Section B-5); and
- Statement of Warranty conforming to Section B-7.