**Purchase Specification**

**for a Solar Powered**

**Connected Radar Speed Sign (CRSS)**

1. **Overview**

**A Connected Radar Speed Sign (CRSS) shall be used to alert drivers to their current vehicle speed. If the vehicle speed exceeds the posted speed limit the sign shall have the ability to warn drivers by flashing their vehicle speed, display an optional “SLOW DOWN” message, and/or flash optional strobes. Each CRSS shall be modular and available with a self-contained “display cabinet” with external solar panel mounted separately. Solar panel shall be available with top of pole or side of pole configurations. The self-contained display cabinet houses the charge controller, flash controller, display LEDs, Bluetooth communications, GPS/cellular communications, DC relay, knockdown sensor, battery(s) and optional strobe(s).** **The CRSS** shall conform to MUTCD legibility standards for color, character, and letter height.

1. **Mechanical and Electrical**

**The CRSS shall be modular without a centralized controller. Adding other Flasher Modules or accessories shall not necessitate a change in system configuration.** A solar simulation shall be provided to verify the additional load(s) can be supported by the CRSS for reliable year-round operation.

CRSS shall be equipped as standard with an integrated knockdown sensor, **purpose-built by the CRSS manufacturer**. The sensor shall detect a knockdown or impact if the display cabinet is more than 30° off-axis in any direction.

**CRSS shall be equipped as standard with an integrated 5 A DC power supply**, **purpose-built by the CRSS manufacturer**, **with fault protection against short circuits.**

**CRSS shall have an externally mounted (on the display enclosure) antenna for local communications and an externally mounted GPS antenna (on the display enclosure) for remote communications.**

**CRSS wiring shall be available off-the-shelf and non-proprietary.**

**CRSS shall be capable of being wired via a “centralized” or “distributed” approach for optional LED beacons:**

* **Centralized – all component wiring from Flasher Modules (LED beacons) shall be terminated to the display cabinet circuit board.**
* **Distributed – one Flasher Module shall be terminated to the display cabinet circuit board. Additional Flasher Modules may be terminated to any Flasher Module available.**

**CRSS display cabinet circuit board shall be conformally coated.**

**CRSS display cabinet shall be rated to a minimum of NEMA 3R.**

Fasteners shall be stainless steel.

**Mounting**

Mounting adapter hardware for the CRSS display cabinet shall be available for the following side of pole configurations using a universal mount:

* 2**"** – 2.5**"** perforated square post
* 2.38**"** – 2.88**"** diameter round pole
* 3.5**"** – 5.5**"** diameter round pole
* 6**"** – 8.25**" diameter round pole**

Standard mounting options shall not require specialized tools for installation.

Optional tilt bracket shall be available to allow up to +/- 5° of pan and +/- 4.3° (3.6° for **15" LED display)** of tilt range.

**Radar Module**

Radar shall be Doppler radar. Radar shall meet specifications for an FCC part 15 Low Power Device - 24.150 GHz (K-band) and shall not require an operating license.

Radar shall have a reporting accuracy of ±1 MPH and shall be set to detect approaching vehicles only.

Radar shall have a detection range of up to 800 ft., output power of 20 dBm, and a beam angle of 9 x 18°.

**Solar Charge Controller**

**The solar charge controller shall use maximum power point tracking (MPPT).**

**Charge controller shall be purpose-built by the CRSS manufacturer and feature 3-stage charging with temperature-compensation to prevent battery overcharging in hot weather. Charge controller shall not be an external module or device.**

**Charge controller shall be reverse polarity protected on the battery and solar inputs.**

**Charge controller shall be field replaceable.**

**Solar Panel**

**CRSS** shall include one 18 V solar panel rated at 50 W, 80 W, or 170 W. Nominal voltage of the solar panel shall be 12 V. Electrical connections on the back of the solar panel shall be contained within an IP65 enclosure that prevents accidental contact with either of the power leads.

Module shall be supplied with a fixed tilt angle of 45° and shall have the ability to be oriented toward the equator with no additional mounting hardware.

Module shall be affixed to the top of pole or side of pole.

**Batteries**

**Display cabinet shall house up to two 18 Ah 12 V nominal sealed valve-regulated AGM lead-acid maintenance free batteries. Each battery connection at the charge controller shall be protected with a 15 A mini blade fuse.**

Batteries, in conjunction with recommended CRSS performance, shall be designed for a demonstrable service life of 5 years.

The operating temperature range of the battery shall be -40° to 140 °F (-40° to 60 °C).

Batteries shall have quick connections to facilitate installation and be readily available from multiple suppliers and non-proprietary.

Individual batteries shall be supported by a spring loaded retaining system and separated by a metal bracket.

1. **Display Cabinets**

**CRSS display cabinets shall** be available **in two sizes:**

* **12" LED display**
* **15" LED display**

**CRSS shall be capable of displaying the numeric readout value within one second of detection of a vehicle and shall hold the detected speed for approximately one second after the vehicle passes outside the detection area and return to standby mode with a blank display when no vehicles are present.**

**CRSS, with the LEDs illuminated at full intensity, shall typically consume 6 W or less of DC power during the day; with a typical night power requirement of 2.78 W and shall consume less than 0.37 W in standby.**

**Display shall use an ambient brightness sensor for automatic nighttime dimming.**

**Display Cabinet Overview**

Display cabinet shall be constructed from 11-gauge aluminum. The battery(s) shall be mounted inside the display with no external control cabinet or battery cabinet required. Optional external battery cabinet shall be available to relocate access to the battery to above or below the display cabinet (see Section 4).

**Display window shall be made of 3/16" (4.78 mm) thickness impact-resistant UV-protected polycarbonate.**

**Display window shall have clear LED windows and a black surround matrix of less than or equal to 25% reflectance in accordance with the MUTCD, to maximize viewing contrast in all lighting conditions.**

**Display window must not use anti-glare sheeting that would reduce the display’s visibility and contrast.**

**Display window shall be designed with LED safety masking to reduce driver distraction. The display view shall be limited to the forward viewing angle approximately 30° from the roadside.**

**Non-illuminated portions of the display’s LED grid must not have visible “88” ghosting when a mix of on and off segments is displayed or if display is off.**

Access to the interior of the display cabinet shall be provided by a door that is hinged on the left edge and is fitted with a foam gasket. The door shall have two integrated padlockable latches for use with lock shackles up to ¼". Optional industry standard #2 padlock available.

Display cabinet shall include three drill indentations to facilitate various conduit fitting locations for running wiring external or internal of a pole or post.

Display cabinet shall have exposed spring-loaded push button terminal blocks for final electrical connections.

**Display cabinet shall consist of modular components that are field-replaceable without complete removal of the product assembly from the mounting post or pole. The static sign/plaque, radar unit, polycarbonate window, controller board, LED display boards, battery(s), and fuse(s) shall all be field-replaceable.**

**Display cabinet shall be a non-sealed, ventilated NEMA 3R type design. Internal components shall be easily accessible without having to remove any fasteners.**

**12" LED Display**

**Display shall consist of 216 yellow LEDs (displaying numbers 01 – 99) in a grid. Optional 99 yellow LEDs, displaying SLOW DOWN message, shall be available for a total of 315 LEDs. Viewing angle shall be approximately 15°. LEDs shall be aligned to concentrate light distribution within the drivers viewing area and to provide consistent cut-off of the display at the edge of the viewing cone.**

**LED grid height shall measure 12".**

Dimensions of the display enclosure, not including static “YOUR SPEED” sign/plaque, shall be 21.8**"** W x 17**"** H x 4.8**"** D (55.37 cm W x 43.18 cm H x 12.19 cm D).

Display enclosure shall be available in unfinished aluminum.

**CRSS shall include an MUTCD 11th Edition approved static sign or plaque:**

**W13-20aP (Plaque)**

* 30**"** W x 24**"** H
* 36**"** W x 30**"** H

**Plaque shall have a black border around the perimeter of the LED grid, and shall have very high contrast between LEDs and their immediate background, to maximize visibility in direct sunlight, fog and nighttime conditions. Border shall varies with sign size compliant to MUTCD 11th Edition. “YOUR SPEED” text shall be printed in one line using at least 4" high letters. The sign background surface shall be fluorescent yellow-green, yellow, or white high intensity or 3M Diamond Grade DG3 sheeting.**

**W13-20 (Sign)**

* **30" W x 36"** H
* **36" W x 48"** H

**Sign shall have a black border around the perimeter of the LED grid, and shall have very high contrast between LEDs and their immediate background, to maximize visibility in direct sunlight, fog and nighttime conditions. Border shall varies with sign size compliant to MUTCD 11th Edition. “YOUR SPEED” text shall be printed in two lines using at least 5" high letters. The sign background surface shall be fluorescent yellow-green, yellow, or white high intensity or 3M Diamond Grade DG3 sheeting.**

**15" LED Display**

**Display shall consist of 216 yellow LEDs (displaying numbers 01 – 99) in a grid. Optional 99 yellow LEDs, displaying SLOW DOWN message, shall be available for a total of 315 LEDs. Viewing angle shall be approximately 15°. LEDs shall be aligned to concentrate light distribution within the drivers viewing area and to provide consistent cut-off of the display at the edge of the viewing cone.**

**LED grid height shall measure 15".**

Dimensions of the display enclosure, not including static “YOUR SPEED” sign, shall be 25.8**"** W x 20**"** H x 4.8**"** D (65.53 cm W x 50.8 cm H x 12.79 cm D).

**W13-20aP (Plaque)**

* 30**"** W x 29**"** H
* 36**"** W x 30**"** H
* 48**"** W x 36**"** H

**Plaque shall have a black border around the perimeter of the LED grid, and shall have very high contrast between LEDs and their immediate background, to maximize visibility in direct sunlight, fog and nighttime conditions. Border shall varies with sign size compliant to MUTCD 11th Edition. “YOUR SPEED” text shall be printed in one line using at least 4" high letters. The sign background surface shall be fluorescent yellow-green, yellow, or white high intensity or 3M Diamond Grade DG3 sheeting.**

**W13-20 (Sign)**

* **30" W x 36"** H
* **36" W x 48"** H
* **48" W x 60"** H

**Sign shall have a black border around the perimeter of the LED grid, and shall have very high contrast between LEDs and their immediate background, to maximize visibility in direct sunlight, fog and nighttime conditions. Border shall varies with sign size compliant to MUTCD 11th Edition. “YOUR SPEED” text shall be printed in two lines using at least 5" high letters. The sign background surface shall be fluorescent yellow-green, yellow, or white high intensity or 3M Diamond Grade DG3 sheeting.**

**4.0 Operation and Configuration**

**Operation**

**The CRSS, once powered up, will immediately begin detecting vehicles in a 24-7 mode. CRSS shall be operational upon** **power-up without any on-site configuration required.** **Operating mode shall be adjustable for optional scheduled (time of day based) or stealth (display off) operation.**

**CRSS shall be capable of displaying numbers from 01 to 99 with display in MPH or KPH as selected.**

**CRSS display shall optionally flash upon breach of the violation threshold at a flash rate of 109 flashes per minute (FPM).**

**CRSS shall be capable of adhering to MUTCD 11th Edition** by displaying static numerical vehicle speed values only. System shall disable:

* Flashing numerical digits
* Static or flashing SLOW DOWN message
* Optional flashing beacon(s)
* Optional flashing strobe(s)

CRSS shall have integrated data collection and scheduling capabilities. Data collection function shall have the capacity to record over 200,000 individual data points which include date, time, unit of speed, vehicle speed, and roadway speed limit as a baseline statistic.

**Vehicle data from the CRSS shall be able to be downloaded from a compatible mobile device and distributed via SMS or email. A formal report shall be automatically generated on-demand on the compatible mobile device.**

**Vehicle data shall be formatted as a .zip file that can be imported into a browser-based tool purpose-built by the CRSS manufacturer (see Section 6).**

**CRSS shall have low voltage disconnect (LVD) protection to aid in preventing fully discharging the battery(s). When in LVD the radar speed sign shall cease functioning.**

**Configuration**

**The CRSS shall contain a button to activate a multi-colored status LED for on-site troubleshooting. Status LED shall be capable of displaying:**

* **No fault detected**
* **Fault detected**

**CRSS shall use integrated Global Positioning System (GPS) for determining location and time. GPS shall be used to determine day or night status. The CRSS shall determine dusk and dawn times based on location and time of year. Day or night status shall be used for option LED beacons to apply daytime or nighttime intensity values.**

**Options**

**The CRSS shall be available with one or more options:**

* **LED beacons (one or more)**
* **Strobes (up to two)**
* **External radar**
* **External battery cabinet**

**LED Beacons**

**CRSS shall be capable of driving one or more LED beacons. System shall detect when beacons are equipped and enable its configuration.**

**The LED beacons shall conform to the Standard of the Manual of Uniform Traffic Control Devices (MUTCD) 2009 with May 2012 Revisions 1 and 2 or TAC guidelines within the MUTCDC.**

**LED beacons shall only require an input of 12 VDC nominal for operation and shall contain its own active electronics including an LED driver and flasher. LED beacons shall operate out-of-the-box with applicable flash pattern, daytime intensity and nighttime intensity settings. Configuration switch shall be available to adjust between unison and alternating flash patterns.**

**LED beacons shall flash using an MUTCD-compliant flash pattern at a rate of not less than 50 nor more than 60 times per minute.**

**CRSS shall provide configurable daytime and nighttime intensity settings ranging from 10% to 100% of factory defaults.**

Module shall have exposed spring-loaded push button terminal blocks for final electrical connections.

**The CRSS shall be capable of driving beacons at ITE-compliant intensities if solar conditions and programming configuration permit.**

**LED beacons shall be available in yellow and in 12" (305 mm).**

**LED beacon optics shall be premium, UV-resistant polycarbonate.**

**Signal Housing**

**The signal housing shall meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2.**

**The signal head’s bracket assembly shall be constructed such that the signal head can be removed easily in the field.**

**The signal housing must be able to rotate** **independently from the display cabinet or bracket for lens alignment.**

**The signal housing shall be** **constructed from either UV-resistant polycarbonate or aluminum. The signal housing shall be available in yellow and black.**

**Signal housing shall be rated to a minimum of NEMA 3R.**

Signal heads shall be capable of being mounted to a post or pole using a separate bracket assembly to facilitate mounting multiple beacons in either vertical, horizontal, or back-to-back (bi-directional) arrangements.

**Strobes**

**CRSS shall be capable of driving up to two strobes in either combination of:**

* **Two white strobes**
* **One red and one blue strobe**

**Strobes shall be modular, “plug-and-play”, independent circuit boards that mate directly to display circuit board, which require no additional system disassembly or wiring. Strobes shall be able to be installed on the left and/or right side of the display circuit board.**

**System shall detect when one or more strobes are installed and enable its configuration. Strobes shall be triggered at a speed threshold from 5 to 99 MPH or KPH.**

**External Radar**

Optional external radar shall be available to allow greater control over the vehicle detection zone using a pan/tilt system.

Radar shall a be self-contained unit, housed in impact-resistant, outdoor-rated plastic, with a single multi-conductor cable connecting it to the display cabinet and system controller.

* Radar dimensions: 4.1" x 3.7" x 1.1"
* Weight: 0.6 lbs.

Radar shall be furnished with a mounting bracket that will enable aiming of the radar beam in the direction of approaching vehicles independent of the display cabinet or mounting pole orientation. Radar can be adjusted left-to-right and up-and-down to suit the roadway.

The system shall be configurable such that the radar can be mounted remotely from the system controller and display cabinet via a wired connection.

Radar shall be IP68 with an operating temperature range of -40° to 185 °F (-40° to 85 °C).

**External Battery Cabinet**

**Optional external battery cabinet shall be available for relocating the battery higher or lower on the pole in relation to the display cabinet.**

**External battery cabinet shall include one 35 Ah, 55 Ah, or 100 Ah 12 V nominal sealed valve-regulated AGM lead-acid maintenance free battery. Battery connection shall be protected with a 15 A blade fuse.**

**External battery cabinet shall be non-sealed, ventilated NEMA 3R enclosure in natural aluminum to reflect sunlight for increased battery life.**

**External battery cabinet shall be side of pole mounted using industry standard banding.**

External battery c**abinet shall have tamper-proof hinged door with an integrated padlockable latch for use with lock shackles up to ¼". Optional industry standard #2 padlock available.**

**5.0 Local Connectivity**

**The** **CRSS shall have integrated Bluetooth Low Energy (BLE) local communications for on-site configuration and diagnostics via a purpose-built mobile app by the CRSS manufacturer.** The mobile app shall be available free of charge on the Apple App Store or Google Play Store for compatible devices.

Mobile app, in conjunction with CRSS, shall contain “bank-level” security. The mobile app shall “pair” with the CRSS using a “digital key” via one of two methods:

* Pairing button **shall** be pressed inside the display cabinet, or
* System has a valid existing remote connectivity plan (see Section 6). Digital key is sent automatically, for authorized account users, to the app with a cellular connection.

If the pairing button is used the mobile app shall retain the digital key for 14 days. After 14 days has elapsed the user automatically reacquires the digital key through the login procedure in the mobile app.

Mobile app shall not require a system password, passcode or any default method of security for system access.

Mobile **app shall display all CRSSs within Bluetooth range that can establish a connection.**

Mobile app shall have the functionality to identify the presently connected system by temporarily activating the **display LEDs and any optional strobe(s) or LED beacon(s)** with a unique quick flash. If the **LED beacon(s)** is actively flashing, the **LED beacon(s)** shall temporarily stop and initiate the unique quick flash for system identification before resuming normal operations.

**Mobile app** shall have the functionality to **perform a system reboot without needing physical access to the system.**

Mobile **app shall report any faults in human readable form. If more than one fault is detected, each fault shall be listed separately. Fault messages shall clear automatically if the fault condition has been resolved.**

Mobile **app shall be capable of over-the-air software updates.**

Mobile **app shall be capable of over-the-air firmware updates to display cabinets and Flasher Modules.**

Mobile **app shall be capable of modifying the following parameters:**

* **System name for on-site and remote identification**
* **Application mode**
* **Operation mode**
* **Speed limit**
* **Minimum speed**
* **Violation alert on/off**
* **Violation alert speed**
* **Slow down message on/off (if equipped)**
* **Slow down message speed (if equipped)**
* **Strobe on/off (if equipped)**
* **Strobe speed (if equipped)**
* **High speed cutoff speed**
* **Unit of speed (MPH or KPH)**
* **Daytime LED beacon intensity**
* **Nighttime LED beacon intensity**
* **Rotate digital key (for security purposes)**

Mobile **app shall be capable of displaying the following read-only parameters:**

* **System status**
* **System voltage**
* **Solar panel voltage**
* **Charge current**
* **CPU temperature**
* **System date and time**
* **Vehicle count yesterday**
* **Average vehicle speed yesterday (MPH or KPH)**
* **85th percentile vehicle speed yesterday (MPH or KPH)**
* **Radar speed sign part number**
* **Radar speed sign serial number**
* **Radar speed sign first activation date (date first powered up)**
* **Radar speed sign firmware version**
* **Latitude and longitude of system**
* **Flasher Module part number**
* **Flasher Module serial number**
* **Flasher Module first activation date (date Flasher Module first powered up)**

Mobile **app shall be capable of providing in app fault alerts:**

* **System communication error**
* **Overcurrent/short circuit detected**
* **Flasher Module open/short circuit detected**
* **No battery detected**
* **Battery voltage very low**
* **Low voltage disconnect (LVD)**
* **Cellular communication error**
* **Status wire communication error**
* **Flasher Module removed from system**
* **System knockdown**
* **Accelerometer communication error**
* **No charging for >24 hours**
* **High temperature alarm**
* **Synchronize wire short**
* **Memory full error**
* **Internal memory corrupt**
* **External memory corrupt**
* **Flasher memory corrupt**
* **Radar communications receive fault**
* **Radar communications request fault**
* **Radar config fault**
* **Display communications fault**
* **Display LED short fault**
* **Display LED open fault**
* **Strobe fault**

Mobile **app shall have access to digital user guides.**

**Local Scheduling**

**Local scheduling shall allow for management of schedule-based programming.** Schedules shall be based on a seven-day period from Sunday to Saturday. Schedules shall not be date restricted and shall run in perpetuity when assigned to a system.

**Schedules shall be able to be created, edited and deleted at any time without requiring on-site access to the CRSS.**

**Schedule dashboard shall provide:**

* **List of created schedules**

**Local scheduling shall be available regardless of whether the system** has a valid existing remote connectivity plan.

**Schedule Creation**

**Schedules shall be created from scratch or downloaded from a system that has an existing schedule. Once a schedule has been created it shall be able to be renamed or deleted.**

**Schedules shall have the following settings:**

* **Operating modes**
* **Daily timetables**
* **Weekly schedule**

**The CRSS shall allow for multiple operating modes per schedule. Operating modes determine how the system operates. Each operating mode shall be customizable based on user requirements with the following parameters:**

* **Operation mode**
* **Unit of speed (MPH or KPH)**
* **Speed limit**
* **Minimum speed**
* **Violation alert on/off**
* **Violation alert speed**
* **Slow down message on/off (if equipped)**
* **Slow down message speed (if equipped)**
* **Strobe on/off (if equipped)**
* **Strobe speed (if equipped)**
* **High speed cutoff speed**
* **Beacon mode (on/off)**

**For each day of the week, a “timetable” consisting of a collection of “events” shall be created to designate periods of time when the operating mode changes.**

**Timetables shall be assignable to each day of the week, creating a weekly schedule.**

**Exceptions**

**Exceptions shall be available to designate an alternate timetable on any given date which differs from the standard weekly schedule. Exceptions shall be generated by selecting a date or date range and choosing the appropriate timetable.**

**Uploading Schedule**

**Completed schedules shall be available to upload to an individual system. Schedules that are assigned to systems via local scheduling function shall override a remotely programmed schedule, if applicable (see Section 6).**

1. **Remote Connectivity**

**Overview**

The CRSS shall be equipped as standard with integrated remote connectivity. Subscription **shall** include 3 years of premium-level features.

Connectivity solution **shall** be purpose-built by the CRSS manufacturer, not require any external/third-party control box or device and shall include a SIM card. Remote connectivity shall be cloud-hosted software with web-based user access. Other software or IT infrastructure shall not be required for installation or maintenance.

**Remote connectivity shall use the LTE-M wireless broadband network. SIM card shall be network provider agnostic and support major wireless carriers in the United States and Canada. LTE-M modem shall automatically connect to the best available network for the installation location. If cellular service is interrupted or unavailable, LTE-M modem shall automatically connect to the next available network provider.**

User interface shall be web-based and viewable using any modern browser on a PC, laptop or mobile device with a cellular or Wi-Fi connection. **Remote connectivity shall be mobile friendly and operate without requiring a static IP address.**

**Each CRSS shall have an externally mounted (on the display enclosure), combination GPS/cellular antenna for geolocation and date/time. Date and time shall not drift or require manual updating.**

**Remote connectivity shall be capable of over-the-air software updates without requiring user interaction.**

**The CRSS shall be capable of receiving over the air updates for both display controller and Flasher Modules.**

**Basic level subscription, with limited feature set, shall be included for 3 years at no cost. Optional extended premium-level subscription plans shall be available.**

**Features, Operation and Configuration**

**Premium-level subscription shall include the following additional features:**

* **Remote scheduling**
* **System performance charting for previous 180 days**
* **System knockdown alerts via SMS and/or email**
* **5-year historical raw data for system performance that can be downloaded, shared, and analyzed**
* **Enhanced system security with ability to lock out local on-site pairing with mobile app**
* **Remote programming**

The user interface dashboard shall provide an overview of all systems without having to leave the page. Dashboard shall provide the following information:

* System name
* System application identifier
* System serial number
* System status
* Subscription type
* Operation mode
* Local pairing lockout status

Dashboard **shall** have a filter to show:

* All systems
* Systems with alerts only
* Systems with critical alerts only
* Systems with expired subscriptions only

Dashboard **shall** include a scrollable, zoomable map display, with the CRSS shown as a representative icon on the map. The map display **shall** have the option of satellite view or standard street view. The map shall include the ability to see the CRSS icons using Google Maps, with the ability to view the location with Google Street View. Icons **shall** change color based on system status with green indicating system is operational, yellow indicating an abnormal condition, and red indicating a critical fault. Map shall automatically adjust to show a geofenced area with a view of all systems.

**CRSS shall report in every fifteen minutes with the following information:**

* **Most recent battery voltage**
* **Most recent solar voltage**
* **Most recent charge current**
* **Vehicle count yesterday**
* **Average vehicle speed yesterday (MPH or KPH)**
* **85th percentile vehicle speed yesterday (MPH or KPH)**
* **Most recent CPU temperature**
* **Most recent cellular signal strength**
* **Most recent cellular signal to noise ratio**
* **Charting with 180 previous days of data for the items above**

**CRSS shall have a purpose-built cloud-based analysis tool, which shall require no installation package and be free of charge. Vehicle data shall be imported via locally downloaded data (see Section 4) or remotely downloaded data for the purpose of advanced analytics.**

**User shall have the ability to request updated system data at any time on a self-serve basis. Dashboard shall reflect the time since last report.**

**User shall have the ability to refresh system GPS location or manually override via a map view.**

**User shall have the ability to manually log system notes for record keeping purposes.**

User shall have the ability to change the following system parameters on a self-serve basis:

* **System name for on-site and remote identification**
* **Application mode**
* **Operation mode**
* **Speed limit**
* **Minimum speed**
* **Violation alert on/off**
* **Violation alert speed**
* **Slow down message on/off (if equipped)**
* **Slow down message speed (if equipped)**
* **Strobe on/off (if equipped)**
* **Strobe speed (if equipped)**
* **High speed cutoff speed**
* **Unit of speed (MPH or KPH)**
* **Daytime intensity (optional beacons only)**
* **Nighttime intensity (optional beacons only)**
* **Local pairing lockout**

When a fault occurs, real-time alerts shall be published via SMS and/or email. The alert shall be immediately sent to all users who have opted into one or both delivery methods.

**Remote Scheduling**

**Remote scheduling shall allow for management of schedule-based programming.** Schedules shall be based on a seven-day period from Sunday to Saturday. Schedules shall not be date restricted and shall run in perpetuity when assigned to a system.

Schedule dashboard shall provide:

* **List of created schedules, how many systems are assigned to each schedule and when they were last modified**
* **Schedule details with its operating modes, daily timetables, and weekly schedule**
* **List of created exceptions (days when a schedule runs on a different set of parameters) with each start date and end date**
* **List of systems assigned to each schedule**

**Schedule Creation**

**Schedules shall be created from scratch or cloned from an existing schedule. Once a schedule has been created it shall be able to be cloned, renamed or deleted.**

**Schedules shall have the following settings:**

* **Operating modes**
* **Daily timetables**
* **Weekly schedule**

**The CRSS shall allow for multiple operating modes per schedule. Operating modes determine how the system operates. Each operating mode shall be customizable based on user requirements with the following parameters:**

* **Sign mode**
* **Unit of speed (MPH or KPH)**
* **Speed limit**
* **Minimum speed**
* **Violation alert on/off**
* **Violation alert speed**
* **Slow down message on/off (if equipped)**
* **Slow down message speed (if equipped)**
* **Strobe on/off (if equipped)**
* **Strobe speed (if equipped)**
* **High speed cutoff speed**
* **Beacon mode (on/off)**

**For each day of the week, a “timetable” consisting of a collection of “events” shall be created to designate periods of time when the operating mode changes.**

**Timetables shall be assignable to each day of the week, creating a weekly schedule. Schedules that have no systems assigned shall be modifiable. If a schedule has at least one system assigned, its daily event table shall become read-only, and the schedule cannot be deleted.**

**Exceptions/Alternate Schedules**

**Exceptions shall be available to designate an alternate timetable on any given date which differs from the standard weekly schedule. Exceptions shall be generated by selecting a date or date range and choosing the appropriate timetable.**

**Exceptions, once created, will automatically be applied to each system that is assigned to the schedule.**

**Exceptions shall be able to be “shared” with all existing schedules created, eliminating the need to manually create exceptions for each individual schedule.**

**Assigning Systems**

**Unassigned systems shall be able to be assigned to any available schedule. Systems with a premium-level subscription shall be able to be added to an available schedule.**

**Systems shall be individually, or bulk selected, for assigning to a schedule. Schedules that are assigned to systems via the remote scheduling function shall override a locally programmed schedule, if applicable (see Section 5).**

**Once assigned to a schedule, systems shall be individually or bulk selected to move to a different available schedule. Assigned systems may be individually removed from a schedule.**

**System, Subscription and User Management**

**System Management**

**System Management shall be restricted to administrators only and provide the following functions:**

* **View a list of all systems by system name/serial number showing status,** local pairing lockout status and last checked in date. System and serial number shall be searchable.
* **Transfer system ownership to another account’s administrator.**
* **Reset system “digital key”, which shall remove local on-site mobile app access to anyone who is not an authorized account user.**
* **Enable a lockout for local pairing, which disables the on-site pairing button for local access. Mobile app users** **will need to be an authorized user in order to receive the “digital key” to connect to the system.**
* **Disable a lockout for local pairing, which enables the on-site pairing button for local access. Mobile app users require access to pairing button to receive the “digital key” to connect to the system.**
* **Download a log of all system alerts and events from the past 180 days.**

**Subscription Management**

**Subscriptions shall be self-serve managed with the following functions:**

* **View a list of all systems with their current subscription level and expiry date**
* **View all available subscriptions that have yet to be applied to a system**
* **Apply an available subscription of the same level or higher to a system**
* **Transfer available subscriptions from one account to another**

**User shall have full access to the state of their system, which system subscriptions are expiring soon and inventory of available subscriptions.**

**User shall be able to procure additional subscriptions and hold in a “digital inventory”. A subscription may be applied to a system at the discretion of the user at any time.**

**Administrators shall receive an automated email notification for upcoming pending expiring subscriptions.**

**Upon expiration of connectivity subscription, the CRSS shall continue normal operation without interruption or change in performance. Local connectivity shall remain available for on-site configuration and diagnostics.**

**User Management**

**The initial account administrator shall be automatically assigned by the CRSS manufacturer. Additional users shall be invited by the administrator for account access. Administrators shall have the ability to invite additional users with the following roles:**

* **Administrator – highest level of account authority. Can manage all account aspects including adding/removing users and transferring system ownership.**
* **Operator – can manage and edit all systems**
* **Field Technician – can access the system on-site with a “digital key” and without need to “pair” with the system, for use with mobile app (see Section 4). Field Technician role shall not have the ability to view systems remotely.**
* **Observer – read-only access**

**All user roles, aside from Field Technician, shall have the following functions:**

* **Self-serve password change**
* **Self-serve SMS and/or email alert preferences**
* **Two-factor authentication**

**User Management shall be restricted to administrators only and** **shall provide the following functions:**

* **View a list of all user’s names, emails, user’s roles and last login date**
* **Change user’s role**
* **Invite a user**
* **Delete a user**

**Providing an invitation to new user shall require only a valid email address and required user role.**

1. **Solar Simulations (If Applicable)**

Detailed solar simulations shall be provided as evidence that the system is capable of year-round performance at a specific location. Solar simulations shall be composed of three calculations: Energy Balance, Array-to-Load Ratio (ALR), and Autonomy. The manufacturer or bidder shall provide a detailed analysis of these three calculations in a “Solar Power Report” (SPR).

Monthly average sunlight (insolation), night length and temperature data for a specific location shall be from recognized public sources such as the NASA Atmospheric Sciences Data Center.

**Energy Balance**

During a normal 24-hour cycle of operation, a system shall take energy in from the sun and consume energy through the display LEDs and general quiescent power draw. Energy Balance refers to the evaluation of these energy values to determine system sustainability with respect to variances in sunlight and system load.

Energy Balance compares Energy-In and Energy-Out. Calculations shall be performed for the “worst month” of the year where worst month is determined by the lowest value of Energy-In divided by Energy-Out.

**Energy-In**

Energy-In is the total amount of sunlight energy in watt-hours *available* to the system over a 24-hour period. Energy-In is available to operate the **CRSS**, charge the battery(s), or both. Energy-In shall be determined as follows:

* Insolation X panel wattage X shading X charging efficiency X battery charge acceptance
	+ The energy from the solar panel shall be based on available solar radiation at the installation location for the panel’s inclination angle. The solar radiation (insolation) values used shall be for the worst-case month of the calendar year.
	+ Shading from nearby trees, buildings, or other structures unique to a particular location are to be factored-in and the calculations shall clearly show and justify the de-rating of the solar panel energy input. A photograph showing the sun’s path and obstructions it encounters shall be included.
	+ Battery(s) shall be returned to full or close to full charge by sunset at the end of each day.

**Energy-Out**

Energy-Out is the total amount of energy in watt-hours consumed by the system in a 24-hour period of normal operation.

Energy-Out is the sum of quiescent and operating loads, measured in watt-hours, in all circuitry over 24 hours, including:

* Radar “detection mode” and idle quiescent draw
* Wireless quiescent draw calculated over 24 hours
* System “active” load when vehicles are being detected and display is active – in both day and night modes.
* The simulations shall clearly detail both the number of sign display activations due to vehicle volume and any third-party device load variations based on scheduling.

**ALR (Array-to-Load Ratio)**

System Array-to-Load (ALR) ratio shall be calculated as:

* Daily Available Energy-In divided by daily Energy-Out, as defined above

Solar simulations shall be calculated demonstrating a minimum Array-to-Load (ALR) ratio of 1.2:1 (1.2).

**Autonomy**

Autonomy is the number of days that the CRSS can continue to operate normally in the absence of any solar charging. Autonomy shall be calculated as follows:

* (Nominal battery capacity de-rated for temperature minus battery capacity unavailable due to Low Voltage Disconnect) divided by (daily total energy consumption at the specified operational duty cycle)

CRSS autonomy shall be determined based on regional requirements – at a minimum of 7 consecutive days.

1. **Custom Build**

**Fill out the table below to create a CRSS custom build:**

|  |  |  |
| --- | --- | --- |
| **Section 2 – Mechanical and Electrical** | Optional Mount  | [ ]  Tilt Bracket  |
| **Section 2 – Mechanical and Electrical** | Solar Panels | [ ]  50 W[ ]  80 W[ ]  170 W |
| **Section 2 – Mechanical and Electrical** | Batteries | [ ]  1x 18 Ah  [ ]  2x 18 Ah  |
| **Section 3 – Display Cabinets** | **LED Display Cabinets** | [ ]  12" LED Display  [ ]  15" LED Display  |
| **Section 4 –Operation and Configuration** | Option (beacons) | [ ]  1x 12" yellow LED beacon [ ]  2x 12" yellow LED beacons [ ]  3x 12" yellow LED beacons  |
| **Section 4 –Operation and Configuration** | Option (strobes) | [ ]  Dual white strobes[ ]  One red and blue strobe  |
| **Section 4 –Operation and Configuration** | Option (external radar) | [ ]  External radar  |
| **Section 4 –Operation and Configuration** | Option (external battery cabinet) | [ ]  External battery cabinet[ ]  1x 35 Ah [ ]  1x 55 Ah[ ]  1x 100 Ah |
| **Section 6 – Remote Connectivity** | Extended Premium Subscription Plans | [ ]  1 year [ ]  6 years  [ ]  2 years [ ]  7 years [ ]  3 years [ ]  8 years  [ ]  4 years [ ]  9 years [ ]  5 years [ ]  10 years   |

1. **Packaging**

Packaging shall consist of only recyclable corrugated cardboard and soft plastic bags.

1. **Qualifications**

The CRSS shall be FCC certified to comply with all 47 CFR FCC Part 15 Subpart B Emission requirements.

The CRSS shall be manufactured in the USA and shall be Buy American and Build America, Buy America (BABA) compliant.

The Manufacturer shall provide a 3-year Limited Warranty, with the exception of the battery(s) which shall be covered by a 1-year warranty.

The Manufacturer shall be ISO 9001 certified.

The CRSS shall be manufactured by Carmanah Technologies.

Manufacturer: Carmanah Technologies Inc.

Model: SPEEDCHECK-MX solar Connected Radar Speed Sign

Toll-Free: 1-877-722-8877

[www.carmanah.com](http://www.carmanah.com)