

SMART WORK ZONE SYSTEM

****From Waterbury IM 089-2(43)/NHG SGNL(43)**

xx. DESCRIPTION. This work shall consist of submitting for approval a Smart Work Zone Plan; furnishing, installing, relocating, and operating a Smart Work Zone System (SWZS) meeting the requirements specified herein; and providing a system manager to maintain the system during the duration of the project.

XX. GENERAL REQUIREMENTS. The SWZS shall be a portable, real-time, automated, solar-powered system that calculates and displays travel time through work zones and through alternate routes. The goal of this system is to provide advance traffic condition information to motorists at key decision points due to construction activity. The information reported to the public will include an accurate drive time through the work zone and through alternate routes. This system shall be in operation 24 hours per day, seven days per week, during the construction period.

The Contractor shall assume responsibility for any damaged equipment due to crashes, vandalism, adverse weather, etc. that may occur during the system's deployment.

The Contractor shall furnish and maintain this system for measuring and delivering real-time messages for the work zone.

The Contractor is responsible for coordinating any work in adjacent roadway construction projects.

The Contractor will be responsible to relocate the devices as directed by the Engineer. When the equipment is no longer required for this project, the Contractor shall remove it and retain ownership.

XX. SYSTEM REQUIREMENTS. The SWZS shall be installed on Interstate 89 northbound and southbound between MM 56.00 and 80.00. It shall consist of the following, as a minimum:

(a) Portable non-intrusive traffic sensors and video cameras.

(b) Nine (9) portable changeable message signs at the following locations:

(1) Richmond.

a. Route 2 EB prior to I-89 Exit 11 SB on-ramp.

b. Route 2 WB between Park-and-Ride access drive and I-89 Exit 11 SB on-ramp.

(2) Waterbury.

a. Route 2 EB west of intersection with Route 100.

b. Route 2 WB between Stowe Street and Union Street.

c. Route 100 SB north of intersection with Stowe Street.

- (3) Duxbury.
 - a. Route 100 NB south of intersection with Route 2.
 - b. Route 2 WB east of intersection with Route 100.

- (4) Middlesex.
 - a. Route 2 WB east of I-89 Exit 9 NB on-ramp.
 - b. Route 2 EB west of I-89 Exit 9 NB on-ramp.

- (c) Four (4) additional portable changeable message signs on I-89 to inform motorists of no delays, short delays, or long delays with stopped traffic. Signs should be located prior to Exit 9 NB and Exit 11 SB to inform motorists of alternate routes if necessary.
- (d) One (1) central computer.

XX. SMART WORK ZONE PLAN.

- (a) General. The Contractor shall submit to the Engineer for approval a written and illustrated SWZ Plan three (3) weeks prior to mobilization of any component of the SWZ System. The SWZ Plan shall include the items required in this specification. The Contractor will not be allowed to start any construction activities that will affect traffic on the project until the SWZ Plan is approved by the Engineer.
- (b) Content of the SWZ Plan. The SWZ Plan shall include, as a minimum, the following items:
 - (1) A detailed plan showing the proposed locations of all SWZ devices and equipment description, including make and model.
 - (2) A description of all proposed thresholds and proposed PCMS messages to be implemented.
 - (3) The name and contact information of the SWZ System Manager.
 - (4) A detailed description of the proposed methods of communication between SWZ devices and SWZ Central Computer.
 - (5) Proposed corrective method procedures, including response times and notification process.
- (c) Approval of Plan. Approval of the SWZ Plan by the Engineer is required prior to the placement of any SWZ devices. Approval is conditional and will be predicated on satisfactory performance during construction. The Engineer reserves the right to require the Contractor to make changes to the SWZ Plan and operations, at no additional cost to VTrans, including removal of personnel, as necessary, to obtain the quality specified. The Contractor shall notify the Engineer in writing a minimum of seven (7) calendar days prior to any proposed changes in the SWZ Plan. Proposed changes are subject to approval by the Engineer.

XX. MATERIALS.

(a) Changeable Message Signs. The SWZS shall utilize VTrans approved portable changeable message signs (PCMS). Each PCMS shall be capable of displaying eight characters on each of three rows. Each PCMS power supply shall be properly sized to allow continuous operation for up to ten days during periods of darkness and inclement weather.

(1) Each PCMS shall be integrated with a radio/modem, and/or a traffic sensor or other equipment (e.g. controller) mounted on it and shall act as a single "device" for the purpose of communicating with similarly integrated "devices" and displaying real-time traffic condition information. Each device shall be capable of communicating through radios/modems with other device(s) at upstream or downstream locations. VTrans TOC staff must have the ability to override messages displayed on any CMS in the system. This feature must be password protected and on a website separate from VTrans' public website.

(b) Portable Non-Intrusive Traffic Sensors. The SWZS traffic sensors shall be side-fired microwave radar type whose accuracy is not degraded by inclement weather and visibility conditions, including precipitation, fog, darkness, excessive dust, and road debris. These sensors shall be capable of acquiring traffic data from up to six (6) lanes of traffic on a lane-by-lane basis.

(c) Video Cameras. SWZS video cameras shall be included to allow remote viewing of construction work zone approaches and areas where traffic is merging on and off I-89. Each video camera shall be capable of displaying video in real-time to the central computer. Video shall be capable of being backed up to provide VTrans with the ability to document and analyze the effectiveness of the Traffic Management Plan (TMP) implemented.

Cameras shall be a Pan-Tilt-Zoom (PTZ) monochrome/color camera capable of providing JPEG video compression of images. Image size and quality shall be remotely controlled from the central computer.

(d) Central Computer. The central computer shall provide the functionality described below:

(1) General.

a. Alerts to VTrans TOC staff and the Engineer shall be provided via pagers, text messages, and/or e-mail. Alerts shall be sent in the event of device failure or traffic delays over 15 minutes.

b. Provide a Graphical User Interface that is compliant with Windows standards.

c. Communication between the central computer and any device shall be independent and *non-reliant* upon communications with any other CMS or sensor.

(2) Data Processing Software.

- a. The capability to collect and store sensor data.
- b. The capability to compare traffic data collected from sensors to user-defined thresholds and automatically update one or more PCMS's.
- c. The capability to estimate travel times and automatically update one or more portable PCMS's consistent with user-defined thresholds.
- d. The capability to display alternate route messages consistent with user-defined thresholds.

(3) Data Management.

- a. Storage of speed, volume, occupancy, PCMS message history, video, and travel times as well as appropriate sensor status for each day.

(4) Website.

- a. The Contractor will be responsible for hosting the website and obtaining domain names. Possible domain names and overall website design shall be submitted to the Engineer for approval prior to being made available.
- b. The website shall contain an accurate map of the area affected by the work zone, including State highways or routes that may be used as alternates.
- c. Icons or hyperlinked text should accurately depict the current location of the system components and give real-time information provided by each component. In the event components are moved to a new location, the website must reflect these changes to the system layout.
- d. Historical data should be password protected and stored on the website for each day the system is in use, with date and time stamps included. The above data shall be available to VTrans staff at all times for the duration of work zone activity. An electronic copy of all data, including date and duration of system malfunction, shall be provided to VTrans staff after all work zone activity is completed and the SWZS has been removed.
- e. The VTrans TOC staff and the Engineer shall have the capability to override messages, via password protection, from the website.
- f. Device information shall be provided to VTrans TOC staff through icons or hyperlinked text representing each device. Detectors should provide real-time

speeds at the respective locations and PCMS's should provide the current message of each sign.

- g. The website shall be designed and operated to allow multiple users to access the site at one time, as determined by VTrans.
- (e) System Manager. The Contractor shall employ a system manager for the SWZS. The system manager shall be locally available to maintain system components, maintain the website, move portable devices as necessary, and respond to emergency situations. The system manager shall be responsible for coordinating the placement of devices in the project areas. It is the responsibility of the system manager to move system components that interfere with construction operations and relocate the components to another area. The system manager shall supply a local phone number and/or a toll free number to the Engineer to contact the system manager or other system representative at any time. The system manager shall not perform any other duties on the jobsite.
- (f) Operational Test. Once the SWZS is installed, it shall undergo a five-day operational test. The operational test shall include a test of the system in operation during a lane closure to ensure that all SWZS equipment (including the portable changeable message signs, traffic sensors, central computer, communication devices, and website) is operating in a fully functional manner and in accordance with the SWZ Plan for a duration of at least five (5) calendar days. The Contractor shall provide for complete operations support from the vendor during the operational test, and the Contractor shall provide verification that the reported drive time through the work zone accurately reflects actual field conditions. If any equipment malfunctions occur for a combined period of four (4) hours or more during this operational test on any day, no credit will be given for that day for the operational test period, and the five-day operational test will reset.
 - (1) The Contractor shall maintain records of equipment stoppages and resumptions during the five-day operational test for submission to the Engineer for the Engineer's approval. In the event that ten percent or more of the time similar malfunctions occur that affect the proper operation of the SWZS, the Engineer may declare a system component defective and require replacement of the equipment at no additional cost. When a system component defect is declared, the five-day operational test shall begin again after all defective equipment is replaced and the system is fully operational.
 - (2) Report. The Contractor shall submit a report to the Engineer detailing the daily activity of the system during the operational test. The report shall indicate the date and time of any activity necessary to maintain operation of the SWZS during the operational test period. Each entry shall include the following information:

- a. Time required to repair equipment malfunction.
- b. Identity of the equipment on which work was performed.
- c. Cause of equipment malfunction (if known).
- d. A description of the type of work performed.

Once the operational test report is received and approved by the Engineer, the SWZS will be considered operational and the system will be accepted for use.

(g) Manufacturers. The following manufacturers are capable of providing a SWZS that meets the requirements of these specifications:

- (1) ASTI Transportation
18 Blevins Drive
New Castle, DE 19720
Tel.: (302)328-3220
- (2) PDP Associates Inc.
P.O. Box 81549
Atlanta, GA 30366
Tel.: (770)451-5186
- (3) Worksafe Traffic Control Industries
115 Industrial Lane
Barre, VT 05641
Tel.: (802)223-8948

Requests for substitutions for the above shall be submitted to the Agency's Office of Contract Administration a minimum of 10 days in advance of the bid opening date. Substitutions for the above after award shall be approved by the Agency's Project Manager.

XX. METHOD OF MEASUREMENT. The quantity of Special Provision (Smart Work Zone System) at the location specified to be measured for payment will be on a lump sum basis in the complete and accepted work.

A percentage of the lump sum will be deducted should the system malfunction for three (3) or more consecutive calendar days or any total of five (5) calendar days in any one calendar month after the approval of the operational test. This deduction will be based on a ratio of calendar days of unsuccessful operation to total calendar days of operation following the approval of the operational test. This deduction will not reduce the total system payment to less than 60 percent of the lump sum.

XX. BASIS OF PAYMENT. The accepted quantity of Special Provision (Smart Work Zone System) will be paid for at the Contract lump sum price. Payment will be full compensation for performing the work specified, including preparing, submitting, and revising, if necessary, the Smart Work Zone Plan; furnishing, installing, relocating, operating, maintaining, testing, monitoring, and removing the Smart Work Zone

System; providing a website; providing historical data; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made as follows:

- (a) 35 percent of the Contract lump sum price will be paid when all of the SWZS equipment is delivered to the jobsite.
- (b) 25 percent of the Contract lump sum price will be paid when the Engineer approves the Operational Test Report.
- (c) 20 percent of the Contract lump sum price will be paid after 30 calendar days of full system operation.
- (d) The final 20 percent of the Contract lump sum price will be paid after traffic is in its final position, the Contractor's equipment has been removed from the project, and historical data has been provided to the Engineer.

Payment will be made under:

| <u>Pay Item</u> | <u>Pay Unit</u> |
|--|-----------------|
| 900.645 Special Provision (Smart Work Zone System) | Lump Sum |