IM 073-397
Subaccount: 19197

REVISION OF SECTION 630
SMART WORK ZONE (SWZ) System

Section 630 of the Standard Specifications is hereby revised for this project as follows:

Subsection 630.01 shall include the following:

This work shall consist of all labor and materials to furnish, install, relocate, operate, service, maintain and remove various components of an automated, portable, real time ***Smart Work Zone (SWZ)*** system meeting the requirements noted herein and to provide the maintenance of the complete system during the duration of the project or as directed by the project engineer.

Add subsection 630.032 immediately following subsection 630.031 as follows:

630.032 Smart Work Zone (SWZ) System. The components of the *Smart Work Zone (SWZ) system* include PMSP's, portable non-intrusive traffic sensors, portable blue tooth traffic sensors, portable pan-tilt-zoom cameras, a central control system for various data processing and communication functions and a website for user interface and data display.

The main purpose of the *Smart Work Zone (SWZ) system* is to collect real time vehicle data at various locations, in advance of and within the work zone and inform the CTMC (Colorado Transportation Management Center) personnel, SWZ Project Engineer and Region 1 Traffic Engineer of operational conditions and historical data and performance while alerting drivers of traffic delays, stopped conditions, and other pertinent traffic information in order for them to react accordingly and/or plan their travel through the work zone. Traffic thresholds (e.g. slow speeds, delay and queuing) to be relayed by the system accordingly shall be determined during the work. The real time traffic data shall be input into a control software which would communicate with the PMSP's to display these messages. These messages shall be in real time and dynamic based on collected data at the SWZ system monitoring points. In addition, the SWZ system shall have the ability to inform the CDOT Region 1 Traffic Office of traffic delays via the project website and e-mail notification.

This work includes all the components of the Smart Work Zone System, related licenses and fees and all work necessary to install these devices including but not limited to traffic control management, flagging, et.al.

REFERENCES:

Attached to the bid submittal, the Contractor/manufacturer shall provide a minimum three (3) references related to previous or currently installed similar ***Smart Work Zone (SWZ)*** system across the country. The Contractor shall provide contact information for the user agency for each reference. Include names and telephone numbers of the owner representative for verification. The Department reserves the right to withhold award of the contract based on feedback received from previous owners.

MATERIALS

Provide materials that comply with the requirements of this item and the details shown on the plans. All materials used as applicable, shall be NTCIP (National Transportation Communications for ITS Protocol) compliant and shall meet the manufacturers' specifications and recommendations. The Contractor shall maintain an adequate **inventory of parts** to support timely maintenance and repair of the entire ***Smart Work Zone (SWZ)*** system.

The portable units and communications requirements listed below are to ensure successful performance of the ***Smart Work Zone (SWZ)*** system.

Dynamic Messaging (i.e. Lane Closures, Construction Delay, Queuing, et.al.): The ***Smart Work Zone (SWZ)*** system must be capable of displaying AUTOMATED and REAL TIME dynamic messages at one or multiple locations.

SWZ System Field Devices: The components of the SWZ System include PMSP's, portable non-intrusive traffic sensors and portable pan-tilt-zoom cameras (collectively known as SWZ System Field devices). All components of the SWZ System field devices furnished by the Contractor shall be crash worthy as defined by the NCHRP 350 or otherwise shall be protected by an NCHRP 350 approved device if placed within the clear zone. Devices placed on existing facilities (e.g. existing light poles) shall be exempt from this requirement; however, the Contractor shall be responsible for all costs to secure permission to attach devices to others' facilities. The Contractor shall also hold harmless and indemnify the Department, its employees and its agents for any damages caused by using other's facilities. The SWZ System Field Devices shall be independent of all local or regional power unless approved by the Engineer. The SWZ System Field devices shall communicate independently.

SWZ System Requirements: The ***Smart Work Zone (SWZ)*** system shall monitor and display real time messages for the I70 Twin Tunnel project as shown on the plans or as directed by the SWZ Project Engineer. The SWZ System shall be capable of displaying current traffic condition information on the upstream PMSP's and calculating real time speed and/or travel time to the nearest minute. These information shall be updated every two (2) minutes. The website and the PMSP's shall then be automatically updated simultaneously.

The SWZ System equipment and software shall be NTCIP (National Transportation Communications for ITS Protocol) compliant. The system shall autonomously restart in case of power failure in any part of the system.

The Contractor furnished devices shall consist of the following as a minimum:

a) Portable Message Sign Panel (PMSP) – Shall conform to the attached **Revision 630** Specification - Portable Message Sign Panels. The purpose is to display automated real time queue/stopped traffic warnings, dynamic messaging based on traffic user defined thresholds and other user generated messaging.
b) Portable Non-Intrusive Traffic Sensors – Shall conform to Wavetronix or approved equal and shall be non-intrusive type unless otherwise approved by the Engineer. Purpose is to detect slowing and stopped traffic, queues and collect real time traffic data (speed, volume, occupancy) and including travel times.

c) Portable Pan-Tilt-Zoom Cameras – The video from the cameras shall be provided in a format capable of being displayed on the project website at a minimum frame rate of 1 frame per second. The web page provided shall allow at least 100 users to access the video on the web page without having the frame drop to less than 1 frame per second. The Department shall be able to control the pan-tilt-zoom capabilities of the camera with their respective username and password credentials. The cameras shall be dome-style and have a minimum of 20X optical zoom and have the ability to pan and tilt without restriction except for the vertical tilt limit caused by the housing. A minimum of ten (10) user definable presets shall be available to manipulate camera controls. Cameras shall be able to return to a user definable "home" position after a user definable number of minutes. Cameras shall have auto focus and auto iris adjustments - Purpose is to supplement traffic monitoring capabilities through visual coverage of the traffic conditions.

d) Central Server at Contractor/Vendor location and a Project website – Purpose is to process all data from SWZ Field Devices, send messages to the PMSP's , CMTC and send e-mail alerts, and update website.

e) 2 Vendor provided laptops with 4G broadband internet access from a provider with 4G accessibility at the project site. The Engineer may accept 3G service if 4G is unavailable. The computers shall have all the software necessary to configure SWZ System Field Devices installed and configured. – Purpose is to give field and construction office staff access to the project website.

f) Website – The website shall be configured to have public access and an internal control accessibility. Internal users are project personnel identified by CDOT who shall have access capability by providing a password protected link. These approved personnel shall have access to the operational characteristics of the system (including traffic data such as traffic volumes, speeds, travel time, et.al.). Named project personnel shall be able to manually override errant messages on the PMSP's due to communication interruptions or other systems failures.

   The website shall be configured to assess any type of malfunction that has occurred. This assessment includes communication disruption between any device in the system configuration, PMSP's malfunctions, speed sensor malfunction, loss of power, low battery, etc. The SWZ website shall provide full color maps via the internet and the dedicated website using Google maps, or CDOT approved equal, depicting the project area with the locations of the traffic sensors and VMS's. The map shall reflect the current average speed at each traffic sensor, and display the entire information message being shown by each VMS. The map shall automatically refresh every two (2) minutes to display any changes.

   The Contractor shall be responsible for developing, providing, hosting and maintaining the SWZ website. Possible domain names and overall website design shall be submitted to the CDOT Traffic Engineer for approval prior to the website going live. The website shall contain an accurate and interactive map (e.g. with pan/zoom capabilities) of the area affected work zone. Icons or hyperlinked text shall accurately depict the current location of the system components and give real time information provided by each component. Each component shall be equipped with GPS (Global Positioning System) such that in the event components are moved to a new location, the website shall reflect these changes to the system layout within 4 hours.

The website shall contain a link to the Twin Tunnel project website to be named by CDOT and/or the CDOT Traveler website (www.CoTrip.org) as directed.

Historical data shall be stored on the website and accessible from a password protected site for each day the system is in use. The above data shall be available to CDOT and their designees at all times during the project. The CDOT Traffic Engineer or his designee shall have the capability to override PMSP's messages via password protection from the website.

Color coded roadway segments shall display the current congestion levels as derived from the traffic sensors. PMSP's shall display the current messages of each sign and PTZ cameras shall display the snapshots of preset camera images no more than 10 minutes old. The website shall be designed to allow up to 250 users to access to access the site at one time.

Central Server: At a minimum, the central server shall provide the functionality described below.

- Communication between the central server and the any device shall be independent and non-reliant on communications with any other detector.
- In the event of any device failure, alerts shall be provided via text messages and e-mails.
- Ability to calculate and display on the respective PMSP's actual traffic queuing (backups).
- Ability to calculate and relay to the respective PMSP's of stopped traffic ahead.
- Ability to calculate and relay to the respective PMSP's of spot speeds less than 25 MPH.

The actual message legends and number of messages shall be submitted to the SWZ Project Engineer for his approval prior to use.

Data Processing software: At a minimum, the software shall have the capability as described below:

- Communication software configuration shall be able to communicate with all detectors and PMSP's simultaneously to ensure real time data and real time messages to the motoring public.
- Collect data from detectors and sensors to develop accurate real time queues and traffic delay.
- Automatically update PMSP's messages .
- Calculate performance measures including Travel Time Index (TTI) and Congestion Duration.
    - TTI = Current Measured Travel Time/Free Flow Travel Time (between MP 240 to MP 244).

Data Management: The following data shall be archived in a format that can be accessed by CDOT via secure access to the project website:

- Daily recorded Speeds, volume, occupancy, travel time, PMSP message history, Congestion duration, as well as detector status for the day.
- Device installation date in case of malfunction.

CONSTRUCTION REQUIREMENTS

Subsection 630. XXX is hereby revised to include the following:

General: All installation of SWZ system devices (sensors, cameras, portable message signs, etc.) shall be temporary and shall require no drilling nor excavation except as approved by the Engineer.

The Smart Work Zone system described above shall monitor the travel time and traffic delays through the Twin Tunnel project's work zone and disseminate real time construction related information to the traveling public using PMSP's, website(s) and other media as required. This information shall also be made available to the CDOT CTMC (Colorado Transportation Management Center) and the CDOT Region 1 Traffic Engineer (or his designee). It is anticipated that traffic conditions will deteriorate due to high volumes and reduced speeds especially during weekends. This recurrence may result into long delays, extensive queuing and potential of rear end collisions.

System Technician On-Call:

The Contractor is required to provide a **System Technician On-Call** who shall provide a local phone number to the SWZ Project Engineer (or his designee) and shall be available by phone 24X7 and can be on site within 24 hours of the phone call from the SWZ Project Engineer (or his designee). The System Technician shall have a minimum 2 years of experience maintaining this type of system and shall be available on site to service and maintain system components, move portable devices as necessary and respond to emergency situations as required. The System Technician shall coordinate with the CDOT Traffic Engineer (or his designee) any necessary modification to the placement of the devices in the project. The System Technician will not be paid for separately but shall be included in the work ; i.e. Smart Work Zone System (Furnish and Install).

Automated Notification:

The Smart Work Zone System shall automatically notify the Region 1 Traffic Engineer and his designee, Twin Tunnel Project Engineer, CTMC, EJMT and CDOT PR Officer once the average speeds on the I70 mainline between MP235 to MP 248 through the work zone drops below 25 MPH (on either direction). This automated and instantaneous notification shall be provided to all of the above via texting and e-mail.

The Smart Work Zone System shall display traffic messages as directed by the SWZ Project Engineer. The decision to deploy, rest or remove any devices or the entire Smart Work Zone system shall be made by the SWZ Project Engineer.

The Smart Work Zone system shall perform with no major malfunctions throughout the entire contract unless the CDOT Traffic Engineer (or his designee) requests the system to be removed. Major malfunctions include, but are not limited to, the inability of the equipment to provide traffic delay or travel time information, inability to withstand construction roadside environment, weather conditions, et.al. The SWZ Project Engineer reserves the right to terminate these items at any time if he determines the system is not performing in accordance with this specification (refer also to penalties subsection).

Electrical Power:

The Smart Work Zone system shall be capable of withstanding winter and inclement weather conditions while providing adequate solar, battery or electrical power. Electrical power sources may be available at no cost to the Contractor, but all expenses required to obtain power shall be borne by the Contractor and

at no cost to CDOT. If generators are needed to re-charge the batteries, they shall only operate 8AM to 8PM unless otherwise approved by the SWZ Project Engineer.

Smart Work Zone System Schedule: The SWZ plan shall be approved prior to actual mobilization, as noted below, the Contractor shall submit to the CDOT Traffic Engineer for approval, a written and illustrated SWZ system plan no later than three (3) weeks prior to mobilization of any component of the SWZ system.

The system must be capable of operating 24 hours a day and 7 days a week until October 31, 2013 or until such time that due to system or device malfunction, removal of any individual device or the entire STM system is required by the Department.

Smart Work Zone System plan: The Contractor shall submit an SWZ plan which shall consist at a minimum, the following items:

- A detailed plan showing actual proposed locations of all SWZ devices (please note that CDOT shall provide desired device locations on the bid plans).
- Show in the plan each device's make, model and device ID.
- A tabulated summary of device ID, description, manufacturer, model number, function, and device location.
- Name and contact number of the Contractor representative (System Technician).
- A detailed description of the proposed methods of communication between the SWZ system and the system's central computer.
- Proposed corrective method procedures, including response times and notification process.

The Contractor shall review and coordinate on-site with the SWZ Project Engineer (or his designee) the planned locations of the devices. The Contractor shall furnish and install the SWZ system devices based on the approved locations. CDOT reserves the right to make changes in the SWZ System plan and operations including removal and replacement of system devices as deemed necessary by the Engineer, in order to obtain system performance as required. The Contractor shall notify the SWZ Project Engineer in writing a minimum of three working (3) days prior to any proposed changes to the CDOT approved SWZ system plan. Proposed changes are subject to approval by the CDOT Region 1 Traffic Engineer.

Penalties:

SWZ Start Day: All of the required components of the ***Smart Work Zone (SWZ)*** system shall be 100% operational within 25 calendar days of the Notice To Proceed or as directed by CDOT. If the system is not fully operational within that period, a pay reduction per day of $800 per day will be enforced until the system is approved by the Engineer

SWZ System component Failure: To ensure a prompt response to incidents involving the integrity of the SWZ system devices, the Contractor shall be required to make all necessary corrections and/or repair to the system components within 24 hours of notification by the SWZ Project Engineer or his designee. If all corrections are made within the 24 hour period and the system is brought back on-line, no pay reduction will occur. Otherwise, pay reduction will be imposed after the 24 hour grace period per the Pay Reduction schedule below. If the system failure is caused by a server malfunction, pay reduction will be assessed on the Smart Work Zone system (Furnish and Install).

For clarification, required system components of the Smart Work Zone are:

- Portable Message Sign Panels (PMSP's)
- Portable Non-Intrusive Traffic Sensors
- Portable Pan-Tilt-Zoom Cameras
- Smart Work Zone system (control server, hardware & software)

All of the above are required to post real time information on the PMSP's and the website. If the 24 hour timeframe expires and the problem is not resolved resulting in the Contractor's inability to display required messages on any one of the PMSP's and/or the project website, daily payment for the respective component(s) will be adjusted from the time of initial notification until the component is brought back on-line. The daily pay reduction will be determined as shown below :

No. of Hours Off-Line	**System Component (Furnish, Install & Operate) Pay Reduction**
1.0 to 3.0 Hours	0.50 Day
3.1 to 5.0 Hours	0.75 Day
Over 5 hours	No Pay for the particular device for the day

Any component of the Smart Work Zone (SWZ) system that fails to comply with the contract for more than ten (10) calendar days in a month shall be replaced. The replacement component(s) will be allowed 24 hour grace period to perform according to the contract without any penalty.

In the event that any of the SWZ Field devices is/are off line, the SWZ Project Engineer or his designee may require that a similar device from the within the project be reset to replace the off line device(s). No additional compensation will be given for resets deemed necessary based on an off line status of device(s) including the reset of the off line device(s) to its/their original location.

Failure to Perform beyond 10 days:

The Contractor will be subject to liquidated damages for **incidents of failure to perform SWZ system** work as required by the contract. Incidents to which liquidated damages may apply include any single SWZ system component off line for more than **10 calendar days** either consecutive or cumulative.

The SWZ Project Engineer (or his designee) will notify the Contractor in writing, each incident of failure to perform. The Contractor will be charged **liquidated damages in the amount of $800** for each calendar day after having been notified in writing that one or more of the components are off line. The liquidated damages will accumulate for each day that one or more of the incidents remain uncorrected. The number of days to which liquidated damages are assessed will be accumulated for the duration of the project; i.e., the damages for a particular day will be added together and totaled each month throughout the duration of the project. If any liquidated damage is assessed during a particular month, the monthly liquidated damages mentioned on this subsection will be deducted from any monies due to the Contractor for that particular month. This procedure will be exercised throughout the duration of the contract.

The CDOT Region Traffic Engineer reserves the right to remove any component or even the entire the SWZ system if he determines that the system is not performing on accordance with this specification, at which no further payment would be made and no additional liquidated damages would be accumulated

METHOD OF MEASUREMENT

Subsection 630.xxx is hereby revised to include the following:

Portable Message Sign Panel (Furnish and Install). This item will be paid per each at the contract unit price per day for mobilization, one installation, operation and one removal of each Portable Message Sign Panel.

Payment for this item is per calendar day that this system component is capable and in compliance with the contract. If at the discretion of the SWZ Project Engineer, this device is required to be dimmed and/or turned off, payment will be made as if this device is fully functional.

Operation and maintenance (including any traffic control if required) of all Portable Message Sign Panels will not be paid for separately but shall be included in the work.

Portable Message Sign Panel (Reset). This item will be paid at the contract unit price for each approved reset of one portable changeable message sign used in the project. All necessary work including traffic control needed to accomplish this reset item, will not be paid for but included in the payment for reset of this item.

Portable Non-Intrusive Traffic Sensor (Furnish and Install). This item will be paid per each at the contract unit price per day for mobilization, one installation and one removal of each Portable Non-Intrusive Traffic Sensor.

Payment for this item is per calendar day that this system component is capable and in compliance with the contract. If at the discretion of the SWZ Project Engineer, this device is required to be turned off, payment will be made as if this device is fully functional.

Operation and maintenance (including any traffic control if required) of all Portable Non-Intrusive Sensors will not be paid for separately but shall be included in the work.

Portable Non-Intrusive Traffic Sensor (Reset). This item will be paid at contract unit price for each approved reset of one portable non-intrusive traffic sensor used in the project. All necessary work including traffic control needed to accomplish this reset item, will not be paid for but included in the payment for reset of this item.

Pan-Tilt-Zoom Camera (Furnish and Install). This item will be paid per each at the contract unit price per day for mobilization, one installation and one removal of each Portable Pan-Tilt-Zoom Camera.

Payment for this item is per calendar day that this system component is capable and in compliance with the contract. If at the discretion of the SWZ Project Engineer, this device is required to be turned off, payment will be made as if this device is fully functional.

Operation and maintenance (including any traffic control if required) of all Pan-Tilt-Zoom Cameras will not be paid for separately but shall be included in the work.

Pan-Tilt-Zoom Camera (Reset). This item will be paid at the contract unit price for each approved reset of one pan-tilt-zoom camera used in the project. All necessary work including traffic control needed to accomplish this reset item, will not be paid for but included in the payment for reset of this item.

Smart Work Zone system. This item will be paid at the contract unit price per day. This item includes the central server, website, Bluetooth technology backend service, capability to be integrated with CDOT CTMS, 2 laptops with high speed mobile broadband, software package and all other costs associated with furnishing, installing and operating a real time Smart Work Zone system meeting the requirements noted herein.

Included in the operational responsibilities is the assumption of all communication costs for Contractor furnished ***Smart Work Zone (SWZ)*** system devices such as cellular telephones, wireless data networks, FCC licensing, satellite and internet subscription charges, solar system support, battery charging and maintenance. In addition to this requirement, the Contractor shall assume all responsibility for any damaged Contractor-furnished equipment included in the system due to vehicle crashes, vandalism, adverse weather, etc. that may occur during the system deployment. This work shall be performed in accordance with the specifications, as detailed in the plans, as described herein and/or as directed by the SWZ Project Engineer.

BASIS OF PAYMENT

Subsection 630.xxx is hereby revised to include the following:

The accepted quantities will be paid at the unit bid price for each of the pay item listed below:

Pay Item	**Pay Unit**
Portable Message Sign Panel (Furnish and Install)	Day
Portable Message Sign Panel (Reset)	Each
Portable Non-Intrusive Traffic Sensor (Furnish and Install)	Day
Portable Non-Intrusive Traffic Sensor (Reset)	Each
Portable Pan-Tilt-Zoom Camera (Furnish and Install)	Day
Portable Pan-Tilt-Zoom Camera (Reset)	Each
Smart Work Zone system (Furnish and Install)	Day