CITY OF ABILENE

ITEM 791

VIDEO IMAGING VEHICLE DETECTION SYSTEM (INTERSECTION CONTROL ONLY)

791.1 DESCRIPTION.

This special specification sets forth the minimum requirements for a Video Imaging Vehicle Detection System (VIVDS) that monitors vehicles on a roadway via processing of video images and provides detector outputs to a traffic controller or similar device.

791.2 GENERAL.

A VIVDS configuration for a single intersection will consist of the following components: Four (4) variable focal length cameras, two (2) two-channel VIVDS card rack processor systems, and all associated equipment required to setup and operate in a field environment, including a video monitor and/or laptop (if required), connectors and camera mounting hardware.

The system software shall be able to detect either approaching or departing vehicles in multiple traffic lanes. A minimum of four (4) detector outputs per video processor module card and each output shall have a minimum of 48 detection zones. Each zone and output shall be user-definable through interactive graphics by placing lines and/or boxes in an image on a video or VGA monitor. The user shall be able to redefine previously defined detection zones.

The system shall be composed of these principal items: the camera(s), the field communications link between the camera and the VIVDS processor unit, and the VIVDS processor unit along with a PC, video monitor or associated equipment required to setup the VIVDS. Central control software to communicate to the VIVDS processor unit shall also be supplied.

791.3 DEFINITIONS.

(1) VIVDS Processor Unit. The electronic unit that converts the video image provided by the cameras, generates vehicle detections for defined zones and collects vehicular data as specified.

(2) VIVDS Processor System. One (1) or more VIVDS processor modular units required to handle the number of camera inputs.

(3) Central Control. A remotely located control center, which communicates with the VIVDS. The VIVDS operator at the central control has the ability to monitor the operation and modify detector placement and configuration parameters. The equipment that constitutes central control is comprised of a workstation microcomputer along with the associated peripherals as described in this special specification.

(4) Field Setup Computer. A portable microcomputer used to set up and monitor the operation of the VIVDS Processor unit. If required to interface with the VIVDS processor unit, the field setup computer with the associated peripherals described in this special specification and a video monitor, also described in this special specification, shall be supplied as part of the VIVDS.

(5) Field Communications Link. The communications connection between the camera and the VIVDS processor unit. The primary communications link media may be coaxial cable or fiber optic cable.

(6) Remote Communications Link. The communications connection between the VIVDS processor unit and the central control.

(7) Camera Assembly. The complete camera or optical device assembly used to collect the visual image. The camera assembly consists of a charged coupled device (CCD) camera, environmental enclosure, sun shield, temperature control mechanism, and all necessary mounting hardware.

(8) Occlusion. The phenomenon when a vehicle passes through the detection zone but the view from the sensor is obstructed by another vehicle. This type of occlusion results in the vehicle not being detected by the sensor.

Or

When a vehicle in one lane passes through the detection zone of an adjacent lane. This type of occlusion can result in the same vehicle being counted in more than one lane.

(9) Detection zone. The detection zone is a line or area selected through the VIVDS processor unit that when occupied by a vehicle, sends a vehicle detection to the traffic controller or freeway management system.

(10) Detection Accuracy. The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone AND shows no detection when there is not a vehicle in the detection zone).

(11) Live Video. Video being viewed and/or processed at 30 frames per second.

(12) Lux. The measure of light intensity at which a camera may operate.

(13) Video Monitor. As a minimum shall be a 9-inch black and white monitor with BNC connectors for video in and out.

791.4 FUNCTIONAL CAPABILITIES.

The VIVDS shall provide real-time vehicle detection (within 112 milliseconds (ms) of vehicle arrival).

The VIVDS processor unit shall be capable of simultaneously processing information from various video sources, including CCTV video image sensors and video tape players. The video sources may be, but are not required to be, synchronized or line-locked. The video shall be processed at a rate of 30 times per second by the VIVDS processor unit.

The system shall be able to detect the presence of vehicles in a minimum of 12 detection zones within the combined field of view of all cameras (a minimum of 12 detection zones per camera input to the VIVDS processor unit).

The VIVDS processor unit shall compensate for minor camera movement (up to 2 percent of the field of view at 400 feet) without falsely detecting vehicles. The camera movement shall be measured on the unprocessed video input to the VIVDS processor unit.

The camera shall operate while directly connected to VIVDS Processor Unit.

Once the detector configuration has been downloaded or saved into the VIVDS processor unit, the video detection system shall operate with the monitoring equipment (monitor and/or laptop) disconnected or on-line.

When the monitoring equipment is directly connected to the VIVDS processor unit, it shall be possible to view vehicle detections in real-time as they occur on the field setup computer's color VGA display or the video monitor.

791.5 VEHICLE DETECTION.

(1) Detection Zone Placement

(a) The video detection system shall provide flexible detection zone placement anywhere within the combined field of view of the image sensors. Preferred presence detector configurations shall be lines or boxes placed across lanes of traffic or lines placed in-line with lanes of traffic. A single detector shall be able to replace one or more conventional detector loops.

(b) Detection zones shall be able to be fully overlapped. In addition, detection zones shall have the capability of implementing "AND" and "OR" logical functions including presence, extension and delay timing. These logical functions may be excluded if provisions are made to bring each detector separately into the controller and the controller can provide these functions.

(2) Detection Zone Programming

(a) Placement of detection zones shall be by means of a graphical interface using the video image of the roadway. The monitor shall show images of the detection zones superimposed on the video image of traffic while the VIVDS processor is running.

(b) The detection zones shall be created by using the mouse or keypad to draw detection zones on the monitor. The detection zones shall be capable of being sized, shaped, and overlapped to provide optimal road coverage and detection. It shall be possible to save the detector configurations on disk to download detector configurations to the VIVDS processor unit and to retrieve the detector configuration that is currently running in the VIVDS processor unit.

(c) The mouse or keypad shall be used to edit previously defined detector configurations so as to fine-tune the detection zone placement size and shape. Once a detection configuration has been created, the system shall provide a graphic display of the new configuration on its monitor. While this fine-tuning is being done, the detection shall continue to operate from the detector configuration that is currently called for.

(d) When a vehicle occupies a detection zone, the detection zone on the live video shall indicate the presence of a vehicle, thereby verifying proper operation of the detection system. With the absence of video, the card shall have an LED that will indicate proper operation of the detection zones.

(e) Detection zones shall be provided that are sensitive to the direction of vehicle travel. The direction to be detected by each detection zone shall be user programmable.

(3) Design Field of View

(a) The video detection system shall reliably detect vehicle presence in the design field of view. The design field of view shall be defined as the sensor view when: the image sensor is mounted 24 feet or higher above the roadway, the camera is adjacent (within 15 feet) to the edge of the nearest vehicle travel lane, and the length of the detection area is not greater than ten (10) times the mounting height of the image sensor.

(b) Within this design field of view, the VIVDS processor unit shall be capable of setting up a single detection zone for point detection (equivalent to the operation of a 6 by 6 inductive loop). A single camera, placed at the proper mounting height with the proper lens, shall be able to monitor up to and including five (5) traffic lanes simultaneously.

(4) Detection Performance

(a) Detection accuracy of the video detection system shall be comparable to properly operating inductive loops. Detection accuracy shall include the presence of any vehicle in the defined detection zone regardless of the lane which the vehicle is occupying.

(b) Occlusion produced by vehicles in the same or adjacent lanes shall not be considered a failure of the VIVDS processor unit, but a limitation of the camera placement. Detection accuracy (a minimum of 95%) shall be enforced for the entire design field of view on a lane by lane and on a time period basis.

Equipment failure, either camera or VIVDS processor unit shall result in constant vehicle detection on affected detection zones.

791.6 VIVDS HARDWARE.

(1) Rack Mountable. The VIVDS processor unit shall be rack mountable. Single and multi-channel card rack processors shall be available as called for in the Invitation for Bid or construction projects.

(2) VIVDS Processor Unit – Environmental Requirements.

(a) The VIVDS processor unit shall be designed to operate reliably in the adverse environment found in the typical roadside traffic cabinet. It shall meet the environmental requirements set forth by the latest NEMA (National Electrical Manufacturers Association) TS1 and TS2 standards as well as the environmental requirements for Type 170, Type 179 and 2070 controllers.

(b) Operating temperature shall be from –34 (-30°F) to +74 (+165°F) degrees C at 0 percent to 95 percent relative humidity, non-condensing.

(3) VIVDS Processor Unit – Electrical.

(a) The VIVDS shall have a modular electrical design.

(b) The VIVDS shall be powered by 89-135 VAC, 60 Hz single phase. Power to the VIVDS shall be from the transient protected side of the AC power distribution system in the traffic control cabinet in which the VIVDS is installed.

(c) Serial communications to the field setup computer shall be through an RS-232 serial port. This port shall be able to download the real-time detection information needed to show detector actuations. A connector on the front of the VIVDS processor unit shall be used for serial communications.

(d) The equipment shall be provided with both TS1 and TS2 interfaces.

(1) TS1 Interface: The two-channel VIVDS processor cards shall be equipped with a NEMA TS1 detector interface for a minimum of four (4) detector outputs. Logic output levels shall be compatible with the NEMA TS1. (If required for additional

detector outputs, a "D" subminiature connector on the front of the VIVDS processor card or extension modules can be used for interfacing to these outputs).

(2) TS2 Interface: the VIVDS processor unit shall be equipped with a NEMA TS2 Type 1 detector interface, where detector information is transmitted serially via an RS-485 data path. The two-channel VIVDS processor card shall plus into existing TS2 detector racks for a minimum of four (4) detector outputs. (If required for more detector outputs, a "D" subminiature connector on the front of the VIVDS processor card or extension modules can be used for interfacing to these outputs).

(e) The VIVDS processor unit shall be equipped with RS-170 (monochrome) composite video inputs, so that signals from image sensors or other synchronous or asynchronous video sources can be processed in real-time. BNC Connectors on the front of the VIVDS processor unit or video patch panel shall be used for all video inputs.

(f) The VIVDS processor unit shall be equipped with a single RS-170 composite video output. This output shall be capable of being switched to correspond to any one of the two-video inputs, as selected remotely via the field setup computer or front panel switch. Multiple video outputs requiring external cable connections to create a combined single video output shall not be acceptable. A BNC or RCA connector shall be used for video output on the front of the processor unit.

(g) The VIVDS processor unit software and/or the supervisor software shall include diagnostic software to allow testing the VIVDS functions. This shall include the capability to set and clear individual detector outputs and display the status of inputs to enable setup and troubleshooting in the field.

791.7 CAMERA ASSEMBLY.

(1) Image Sensors and Video Images. The video detection system shall use medium resolution, monochrome image sensors as the video source for real-time detection. The cameras shall be approved for use with the VIVDS processor unit by the supplier of the VIVDS. As a minimum, each camera shall provide the following capabilities:

(a) Images shall be produced with a Charge Coupled Device (CCD) sensing element with horizontal resolution of at least 380 lines and vertical resolution of at least 350 lines. Images shall be output as a video signal conforming to RS-170.

(b) Useable video and resolvable features in the video image shall be produced when those features have luminance levels as low as 0.1 lux at night.

(c) Useable video and resolvable features in the video image shall be produced when those features have luminance levels as high as 10,000 lux during the day.

(d) The camera shall include an electronic shutter or auto-iris control based upon average scene luminance and shall be equipped with an electronic shutter or auto-iris lens with variable focal length and variable focus that can be adjusted without opening up the camera housing to suit the site geometry. The variable focal length shall be adjustable from 6 mm to 34 mm.

(2) Camera Lens Assembly. The camera lens assembly shall be housed in an environmental enclosure that provides the following capabilities:

(a) The enclosure shall be waterproof and dust-tight to the latest NEMA-4 specifications.

(b) The enclosure shall allow the camera to operate satisfactorily over an ambient temperature range from –34°C (-30°F) to +60°C (+165°F) while exposed to precipitation as well as direct sunlight.

(c) The enclosure shall allow the camera horizon to be rotated in the field during installation.

(d) The enclosure shall include a provision at the rear of the enclosure for connection of power and video signal cables fabricated at the factor. Input power to the environmental enclosure shall be nominally 115 VAC 60 Hz.

(e) A thermostatically controlled heater shall be at the front of the enclosure to prevent the formation of ice and condensation, as well as to assure proper operation of the lens' iris mechanism. The heater shall not interfere with the operation of the camera electronics, and it shall not cause interference with the video signal.

(f) The enclosure shall be light-colored or unfinished and shall include a sun shield to minimize solar heating. The front edge of the sunshield shall protrude beyond the front edge of the environmental enclosure and shall include provision to divert water flow to the sides of the sunshield. The amount of overhang of the sun shield shall be adjustable to block the view of the horizon to prevent direct sunlight from entering the lens. Any plastics used in the enclosure shall include ultra violet inhibitors.

(g) The total weight of the image sensor in the environmental enclosure with sunshield shall be less than 10 pounds.

(h) When operating in the environmental enclosure with power and video signal cables connected, the image sensor shall meet FCC class B requirements for electromagnetic interference emissions.

(3) Video Output and Connections. The video output of the cameras shall be isolated from earth ground. All video connections for the cameras to the video interface panel shall also be isolated from earth ground.

(4) Power and Video Connections. Connections for both video and power shall be made to the image sensor using waterproof, quick disconnect connectors.

(5) Camera Interface Panel. A camera interface panel capable of being mounted to sidewalls of a controller cabinet shall be provided for protection of the VIVDS processor unit, camera video and power inputs/outputs. The panel shall consist of, as a minimum, four (4) EDCO CX06 coax protectors, an EDCO ACP-340 for the cameras and VIVDS processor unit power, a 10 amp breaker, a convenience outlet protected ACP-340, and a terminal strip with a minimum of sixteen (16) 8-32 binder head screws. The terminal strip shall be protected by a piece of 1/8-inch Plexiglas.

(6) Coaxial Cable. When the connection between the image sensor and the VIVDS processor unit is coaxial cable, the coaxial cable used shall be a low loss, 75 ohm, precision video cable suited for outdoor installation, such as Belden 8281 or TxDOT approved equal.

(7) Camera Mountain Hardware. Camera mounting hardware shall, allow for vertical or horizontal mounting to the camera enclosure, Pelco AS-0166-4-62 or equivalent is acceptable.

791.8 FIELD COMMUNICATIONS LINK.

The field communications link shall be a one-way communications connection from the camera to the equipment cabinet. The primary communications link media may be coaxial cable or fiber optic cable

accompanied by a three (3) conductor minimum 18 AWG, 24 VDC or 115 VAC camera power cable, or appropriate cable as approved by the engineer.

(1) Field Communications Link Media. The following requirements shall govern for the various types of field communications link media described on the plans:

(a) Coaxial Cable – In locations where the plans indicate coaxial cable is required as the primary communications link, this cable shall be of the RG-59 type with a nominal impedance of 75 ohms. All cable shall have a polyethylene dielectric with copper braid shield having a minimum of 98 percent shield coverage and not greater than 0.78 dB attenuation per 100 feet at 10 MHz with a minimum 18 AWG external three (3) conductor power cable or approved equivalent as directed by the engineer.

(b) Fiber Optic Cable – If specified by the plans, shall be in accordance with the special specification for fiber optic cable.

(c) Twisted Wire Pairs – Shall be Belden 9556 or equivalent 18 AWG TWP control cable.

All connection cables shall be continuous from the equipment cabinet to the camera. No splices of any type will be permitted.

Lightning and transient surge suppression devices shall be installed on the processor side of the field communications link to protect the peripheral devices. The suppression devices shall be all solid state. In the event fiber optics communications are used, then no lightning protection is required for that communication line. The devices shall present a high impedance to, and shall not interfere with, the communications lines during normal operation. The suppression devices shall not allow the peak voltage on any line to exceed 300 percent of the normal operating peak voltage at any time. The response time of the devices shall not exceed five (5) nanoseconds.

791.9 VIVDS SET-UP SYSTEM.

The minimum VIVDS set-up system, as needed for detector setup and viewing of vehicle detections, shall consist of a field set-up computer and Windows-based interface software (if required) and/or a video monitor with interface software built-in to the VIVDS processor unit. Live video (30 frames per second) shall be available on the field set-up computer to determine proper operation of detectors. The field set-up computer as a minimum, shall have a NTSC video input port or equivalent.

If a field set-up computer is required for system setup, it shall be supplied by the VIVDS supplier.

The field set-up computer shall include all necessary cabling and a Windows-based program to interface with the VIVDS processor unit. This software shall provide an easy to use graphical user interface and support all models/versions of the supplied VIVDS.

Live video with the detection overlaid is required for field verification of the system.

791.10 OPERATION FROM CENTRAL CONTROL.

The central control shall transmit and receive all information needed for detector setup, monitor the vehicle detection, view the vehicle traffic flow at a rate of two (2) frames per second or greater for telephone, or five (5) frames per second or greater for ISDN lines (as specified by the plans), and interrogate all required stored data.

The remote communications link between the VIVDS processor unit and central control may be dial-up (telephone or ISDN lines) or dedicated twisted wire pair communications cable, which may be

accompanied with coaxial cable or fiber-optic cable, as shown on the plans. Communications with the central control shall not interfere with the on-street detection of the VIVDS processor.

791.11 INSTALLATION AND TRAINING.

The supplier of the video detection system shall supervise the installation and testing of the video and computer equipment. A factory-certified representative from the supplier shall be on-site during installation.

In the event that the field set-up computer is furnished by the contracting agency, such installation and testing shall be done at the time that training is conducted.

Up to two (2) days of training shall be provided to personnel of the City of Abilene in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be provided for a maximum of 20 persons and shall be conducted at a location selected by the City of Abilene.

Instruction personnel are required to be certified by the equipment manufacturer. The User's Guide is not an adequate substitute for practical, classroom training and formal certification by an approved agency.

Formal levels of factory-authorized training are required for installers, contractors and system operators. All training must be certified by the manufacturer.

791.12 WARRANTY, MAINTENANCE AND SUPPORT.

The video detection system shall be warranted to be free of defects in material and workmanship for a period of five (5) years, from date of shipment from the supplier's facility. During the warranty period, the supplier shall repair with new or refurbished materials, or replace at no charge any product containing a warranty defect provided the product is returned FOB to the supplier's factory or authorized repair site. Product repaired or replaced under warranty by the supplier will be returned with transportation prepaid. This warranty does not apply to products damaged by accident, improper operation, abused, serviced by unauthorized personnel or unauthorized modification.

During the warranty period, technical support shall be available from the supplier via telephone within four (4) hours of the time a call is made by a user, and this support shall be available from factory certified personnel or factory certified installers.

Ongoing software support by the supplier shall include updates of the VIVDS processor unit and supervisor software (if a field set-up computer is required for setup). These updates shall be provided free of charge during the warranty period. The update of the VIVDS software to be NTCIP compliant shall be included.

The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to the City of Abilene in the form of a separate agreement for continuing support.

The supplier shall maintain an ongoing program of technical support for the wireless camera system. This technical support shall be available via telephone or personnel sent to the installation site.

The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the wireless camera system.

791.13 MEASUREMENT AND PAYMENT

Work performed and materials furnished as prescribed by this special specification will be paid for on a per VIVDS basis.