ITEM 680.940101AL – VIDEO IMAGING VEHICLE DETECTION SYSTEM, 1 CAMERA

ITEM 680.940102AL – VIDEO IMAGING VEHICLE DETECTION SYSTEM, 2 CAMERAS

DESCRIPTION
This work shall consist of furnishing and installing Install 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.

A VIVDS configuration for a single intersection will consist of either 1 or 2 ultra-wide-angle lens cameras and the VIVDS processor.

The system is composed of these principal items: the camera(s), mounting hardware, extension or riser arms (as required), field communications link between each camera and the VIVDS Processor, and the VIVDS processor along with a PC, video monitor or associated equipment required to setup the VIVDS processor and software to communicate to the VIVDS processor.

MATERIALS
1. FUNCTIONAL CAPABILITIES

The system software must be able to detect either approaching or departing vehicles in multiple traffic lanes. Each zone and output must be user definable through interactive graphics by drawing arbitrarily shaped polygons using the Field Setup Computer or Central Control. The user must be able to redefine previously defined detection zones.

The VIVDS processor must provide real time vehicle detection.

The system must be able to detect the presence of vehicles in up to 24 detection zones.

The VIVDS PROCESSOR unit must compensate for minor camera movement (up to 2% of the field of view at 400 ft.) without falsely detecting vehicles. The camera movement must be measured on the unprocessed video input to the VIVDS PROCESSOR.

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

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

When the monitoring equipment is directly connected to the VIVDS processor, it must 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.

The VIVDS processor must support 1 or 2 ultra-wide-angle lens cameras. If equipped with 1 ultra-wide-angle view camera, the VIVDS processor must also be capable of simultaneously supporting up to four (4) more traditional view cameras for special needs such as advance detection or underpass detection.
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2. VEHICLE DETECTION

A. Detection Zone Programming: placement of detection zones must be by means of a graphical interface using the video image of the roadway. The monitor must show images of the detection zones superimposed on the video image of traffic while the VIVDS processor is running. The displayed zones, when operating, must be able to be displayed outlined or filled, with a visible change indicating detection.

The detection zones must be created by using the mouse or keypad to draw detection zones on the monitor. The detection zones must be capable of being sized and shaped to provide optimal road coverage and detection. It must be possible to upload detector configurations to the VIVDS processor and to retrieve the detector configuration that is currently running in the VIVDS processor.

The mouse or keypad may 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 must provide a graphic display of the new configuration on its monitor. While this fine-tuning is being done, the detection must continue to operate from the detector configuration that is currently called.

When a vehicle occupies a detection zone, the detection zone on the live video must indicate the presence of a vehicle, thereby verifying proper operation of the detection system. With the absence of video, the VIVDS processor must have a display that will indicate proper operation of the detection zones.

Detection zones must be provided that are sensitive to the direction of vehicle travel. The direction to be detected by each detection zone must be user programmable. The vehicle detection zone should not activate if a vehicle traveling any direction other than the one specified for detection occupies the detection zone. Cross-street and wrong way traffic shall not cause a detection.

Detection zones must have the option for the user to define that calls can be made with a side entrance (90° or less angled entrance).

B. Design Field of View: the video detection system must reliably detect vehicle presence in the design field of view. The design field of view must be defined as the sensor view when the image sensor is mounted 30 ft. or higher above the roadway, when the camera is adjacent (within 15 ft.) to the edge of the nearest vehicle travel lane, and when the length of the detection area is not greater than 5 times the mounting height of the image sensor. Within this design field of view, the VIVDS processor unit must be capable of setting up a single detection zone for point detection (equivalent to the operation of a 6 ft. by 6 ft. inductive loop). A single camera, placed at the proper mounting height, must be able to monitor up to and including 5 traffic lanes simultaneously. A single ultra-wide-angle lens camera, placed at
C. Detection Performance. Detection accuracy of the video detection system must be comparable to properly operating inductive loops. Detection accuracy must include the presence of any vehicle in the defined detection zone regardless of the lane, which the vehicle is occupying. Occlusion produced by vehicles in the same or adjacent lanes must not be considered a failure of the VIVDS processor, but a limitation of the camera placement. Detection accuracy (a minimum of 95%) must be enforced for the entire design field of view on a lane by lane and on a time period basis.

D. Equipment failure, either camera or VIVDS processor, must result in state of “recall” to the controller.

3. VIVDS PROCESSOR

A. Cabinet Mounting - The VIVDS processor is shelf mountable.

B. Hardware - The VIVDS processor must be either NEMA TS 2 TYPE 1 or TYPE 2. TYPE 2 must have RS 485 SDLC. The VIVDS processor must have at least four (4) processing cores of 2.8GHz or greater, a minimum of 3GB random access memory (RAM), and at least 32GB of onboard storage A minimum of 24 detector outputs per VIVDS processor

C. Environmental Requirements - The VIVDS processor must be designed to operate reliably in the adverse environment found in the typical roadside traffic cabinet. It must 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. Operating temperature must be from -30°F to +165°F at 0% to 95% relative humidity, non-condensing.

D. Electrical - The VIVDS processor must operate within a range of 89 to 135 VAC, 60 Hz single phase. Power to the VIVDS processor must be from the transient protected side of the AC power distribution system in the traffic control cabinet in which the VIVDS processor is installed.

It must be possible for the field setup computer to download the real time detection information needed to show detector actuations via direct Ethernet connection to the VIVDS processor.

The VIVDS processor must have both LAN and WAN RJ-45 ports. The camera(s) will be installed to the processor via a Power-over-Ethernet (PoE) connection.
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The unit must be equipped with a minimum of one VGA video output. This output must be capable of displaying the operation and detections of the VIVDS processor.

The change log for all Software upgrades and/or changes MUST be presented on a readily assessable internet site with unencumbered public access.

The unit software and the supervisor software must include diagnostic software to allow testing the VIVDS functions. This must include the capability to set and clear individual detector outputs and display the status of inputs to enable setup and troubleshooting in the field.

4. CAMERA ASSEMBLY

A. Camera. The video detection system must use high resolution, color image sensors as the video source for real time vehicle detection. The cameras must be approved for use with the VIVDS processor unit by the supplier of the VIVDS. As a minimum, each camera must provide the following capabilities:

1. Images must be produced with a CMOS sensing element with horizontal resolution of at least 2580 lines and vertical resolution of at least 1920 lines. Images must be output in digital format as MJPEG image.

2. Useable video and resolvable features in the video image must be produced when those features have luminance levels as low 1.0 lux for color, for night use.

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

4. The camera must include an electronic shutter control based upon average scene luminance and must be equipped with fixed field of view and fixed focus lens which does not require opening the camera enclosure. The fixed focus lens must be always in focus without any required end-user adjustments.
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B. Camera and Lens Assembly. The camera and lens assembly must be housed in an environmental enclosure that provides the following capabilities:

1. The enclosure must be waterproof and dust tight to the latest NEMA 4 specifications. The camera shall meet FCC class B requirements for electromagnetic interference emissions. Vibration and shock resistance shall meet the requirements of Sections 2.1.9 and 2.1.10, respectively, of NEMA TS 2.

2. The enclosure must allow the camera to operate satisfactorily over an ambient temperature range from -30°F to +165°F at 0 to 95 percent relative humidity, non-condensing, while exposed to precipitation as well as direct sunlight.

3. The enclosure must include a provision for connection of the Ethernet cable. Input power to the environmental enclosure must be included in the Ethernet interface.

4. A thermostatically controlled heater must be provided to prevent the formation of ice and condensation. The heater must not interfere with the operation of the camera electronics, and it must not cause interference with the video signal.

5. The enclosure must be designed to minimize solar heating. Any plastics used in the enclosure must include ultra violet inhibitors.

6. Use waterproof, quick disconnect connectors to the camera for the Ethernet connection.

A camera interface panel capable of being mounted to sidewalls of a controller cabinet must be provided for protection of the VIVDS processor, camera Ethernet connection. The panel must consist of, as a minimum, 2 Ethernet cable surge protection connections.

When the connection between the camera and the VIVDS processor is Ethernet cable, the cable used must be suited for outdoor installation.

Camera mounting hardware must allow for vertical or horizontal mounting to the camera enclosure.

5. FIELD COMMUNICATION LINK

The field communications link must be a two way communications connection from the camera to the VIVDS processor. The primary communications link media shall conform to the requirements specified by the VIVDS manufacturer.

All connection cables must be continuous from the equipment cabinet to the camera connector.
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Install lightning and transient surge suppression devices on the processor side of the field communications link to protect the peripheral devices. The suppression devices must be all solid state. The devices must present high impedance to, and must not interfere with, the communications lines during normal operation. The suppression devices must not allow the peak voltage on any line to exceed 300% of the normal operating peak voltage at any time. The response time of the devices must not exceed 5 nanoseconds.

6. CAMERA RISER ARM

As called for on the plans or detailed herein, the Contractor shall furnish and install a camera riser arm to be mounted on the mast arm at each location as shown on the plans or specified herein. The riser arm shall provide a minimum mounting height of 30’ above the pavement. The color of the riser arm shall be the same color as the Steel Mast Arm Assembly.

7. CAMERA EXTENSION ARM

As called for on the plans or detailed herein, these camera extension arms shall be furnished by the video camera manufacturer or an acceptable manufacturer and shall be mounted on the side of vertical steel signal poles as shown on the plans or detailed herein. The Contractor’s engineer shall coordinate with the manufacturer of the camera assembly, extension arm and signal pole to provide a complete design in accordance with current AASHTO requirements. The camera extension arm shall provide a minimum mounting height of 30’ above the pavement. The Contractor shall submit detailed shop drawings showing the proposed

8. CAMERA CABLE

The camera cable shall conform to the requirements specified by the camera video detection system manufacturer.

CONSTRUCTION DETAILS

1. Camera Installation

The camera assemblies shall be set up by the manufacturer for accurate detection. The minimum VIVDS set-up system shall consist of a field setup computer with application software and/or a video monitor with interface software built-in to the VIVDS processor unit. The field-setup computer as a minimum shall have an Ethernet port for connection to the VIVIDS processor. The system shall be installed by technicians that have been trained and certified by the manufacturer. Prior to installation, the Contractor shall provide certifications to the Engineer for review and approval.
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2. VIVDS System Set-Up.

The minimum VIVDS set-up system, as needed for detector setup and viewing of vehicle detections, must consist of a field setup computer and Windows based interface software (if required) or a video monitor with interface software built-in to the VIVDS processor. Live video must be available on the field setup computer to determine proper operation of detectors. The field set-up computer as a minimum must have a network connection.

The field setup computer shall be supplied by the supplier of the VIVDS processor.

The field setup computer must include all necessary cabling and a Windows based program to interface with the VIVDS processor. The software must 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.

The supplier of the video detection system must supervise the installation and system set-up of the video and computer equipment.

3. Performance Measures

A. System software shall operate as defined under Section 1 in the Materials section.

B. Detection Zone programming shall be in accordance with Section 2.A in the Materials section.

C. The camera(s) shall have capabilities as defined under Section 3.A in the Materials section.

D. Design Field of View shall be in accordance with Section 2.B in the Materials section.

E. Vehicle Presence Detection Accuracy: selectable detection zones must provide a minimum detection accuracy of 95% (excluding any failures due to Occlusion). Sample data collected from the vehicle detection system will be compared against ground truth data for each site collected during the same time period. Ground truth data can be collected by human observation or method approved by the Engineer.

F. Traffic Data Detection: Accuracy for the total roadway segment shall be 95% for volume, 90% for occupancy and 90% for speed for all lanes up to the maximum number of lanes that can be monitored per camera. Sample data collected from the vehicle detection system will be compared against ground truth data for each site collected during the same time period. Ground truth data can be collected by human observation or other method approved by the Engineer.
4. System Acceptance Testing

A. System Software: Verify functionality as described in Section 3.A of Construction Details.

B. Camera: Verify functionality and performance as described in Section 3.B of Construction Details.

C. Detection Zone Programming: Verify functionality and performance as described in Section 3.C of Construction Details.

D. Design Field of View: Verify that all traffic lanes are being monitored simultaneously and maximum detection areas are satisfied as defined under Section 3.D of Construction Details.

E. Vehicle Presence detection and Traffic Data Accuracy: collect samples and ground truth data for each site during the following time periods and durations:

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Time Frame Represented</th>
<th>Data Sample Duration</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00AM – 6:00AM</td>
<td>Early Morning</td>
<td>15 Minutes</td>
<td>24</td>
</tr>
<tr>
<td>6:00AM – 7:00AM</td>
<td>Dawn</td>
<td>15 Minutes</td>
<td>4</td>
</tr>
<tr>
<td>7:00AM – 9:00AM</td>
<td>AM Peak Hour</td>
<td>30 Minutes</td>
<td>8</td>
</tr>
<tr>
<td>9:00AM – 12:00PM</td>
<td>AM Off-Peak</td>
<td>15 Minutes</td>
<td>12</td>
</tr>
<tr>
<td>12:00PM – 3:00PM</td>
<td>Afternoon Off-Peak</td>
<td>15 Minutes</td>
<td>12</td>
</tr>
<tr>
<td>3:00PM – 6:00PM</td>
<td>PM Peak Hour</td>
<td>30 Minutes</td>
<td>12</td>
</tr>
<tr>
<td>6:00PM – 7:00PM</td>
<td>Dusk</td>
<td>15 Minutes</td>
<td>4</td>
</tr>
<tr>
<td>7:00PM – 12:00AM</td>
<td>Evening</td>
<td>15 Minutes</td>
<td>20</td>
</tr>
</tbody>
</table>

Hours to be adjusted as necessary based on time of year.

For presence detection at intersections a minimum of three (3) detections per cycle phase will be required during AM and PM peak hours periods. The above data shall be weighted based on the time period and data sample duration and a total vehicle presence detection accuracy, expressed in percentage, shall be calculated for all detectors. Accuracy percentages shall meet or exceed those listed in Section 3.D and 3.E of Construction Details. All data (VIVDS and Ground Truth) and calculations shall be provided to the Engineer for review.
5. Training

The supplier of the video detection system must provide factory authorized training for the installers, contractors and system operators. All instruction personnel shall be certified by the equipment manufacturer.

6. Warranty and Maintenance

The VIVDS shall be warranted free of defects in material and workmanship for at least three (3) years following the date of intersection acceptance and warranty registration. During the warranty period, the supplier shall repair with new or materials, or replace at no charge to the City of Albany. All costs associated with the removal, handling, processing and shipment shall be borne by the supplier. Product repair or replaced under warranty by the supplier will be returned with transportation prepaid. Ongoing software support by the supplier shall include updates of the application software and detection algorithms. These updates shall be provided free of charge during the warranty period. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of all systems under warranty or extended warranty agreement.

METHOD OF MEASUREMENT

This work will be measured as the number of complete Video Imaging Vehicle Detection Systems installed, tested made fully operational.

BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work including the system camera(s), processor, surge protection, cabling, riser arm or extension arm, system setup, acceptance testing, training and warranty and maintenance.

Progress payment will be made as follows:
Fifty percent (50%) of the bid price for each item will be paid when the equipment is installed.

Twenty percent (20%) of the bid price for each item shall be paid upon successful completion of VIVDS System setup and system operator training.

Thirty percent (30%) of the bid price for each item shall be paid upon completion of System Acceptance testing.