

DEPARTMENT OF TRANSPORTATION**STATE OF GEORGIA****SUPPLEMENTAL SPECIFICATION****Section 936—Closed Circuit Television (CCTV)**

936.1 General Description

This work includes furnishing and installing closed circuit television (CCTV) systems, any specified type, which is a CCTV video surveillance camera, including but not limited to color CCTV cameras, lenses, housing, pan/tilt drive, camera system assembly, cabling, mounting hardware, interface panel, camera control receiver, and cabinet wiring. This CCTV system includes both fixed and PTZ cameras as called for in the plans, provides operator control, and video imaging to the Department's NaviGator Intelligent Transportation System (ITS), or other camera operating software indicated on the plans or in the contract documents.

Provide all equipment, materials, and work in accordance with all manufacturers' recommendations, including but not limited to all mounting, wiring and cabling, power supply, surge suppression, and communications equipment and materials. Use only equipment and components that meet the requirements of these minimum specifications and are listed on the Department's Qualified Products List (QPL).

936.1.01 Definitions

CCTV System, Type B – The Type B PTZ Dome CCTV System uses a self-contained camera system assembly with an analog NTSC video output and RS-232 or RS-485 serial data control interface. This camera shall be compatible with the legacy NaviGator System and should be used for additions/replacement within existing system segments.

CCTV Camera Type C – The Internet Protocol (IP) PTZ Dome Camera System (IP) camera uses a built in encoder to provide H.264 or Moving Picture Experts Group's MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2014 standard. This camera shall be compatible with the legacy NaviGator System. . Ensure that the camera is capable of unicast and multicast operation. Ensure the encoded video can be transmitted utilizing programmable bit rates. Ensure the camera supports, at a minimum, fixed bit rate mode. Ensure that the camera supports the National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08 Amendment 1(2014). Ensure that the camera is capable of communication with other devices using transmission control protocol (TCP)/IP. Ensure that the camera supports the communication links shown in the Plans. The camera must be capable of remote firmware upgrade via the communication interface.

CCTV Camera Type D – The Internet Protocol (IP) Fixed Camera System uses a built in encoder to provide H.264 or Moving Picture Experts Group's MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard and is for locations where fixed views are desired. Ensure that the camera is capable of unicast and multicast operation. Ensure the encoded video can be transmitted utilizing programmable bit rates. Ensure the camera supports, at a minimum, fixed bit rate mode. Ensure that the camera supports the National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08 Amendment 1 (2104). Ensure that the camera is capable of communication with other devices using transmission control protocol (TCP)/IP. Ensure that the camera supports the communication links shown in the Plans. The camera must be capable of remote firmware upgrade via the communication interface.

CCTV Camera Type H – The Internet Protocol (IP) High Definition Camera System uses a built in encoder to provide H.264 or Moving Picture Experts Group's MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard and with a minimum pixel resolution of 1920 x 1080 and an aspect ratio of 16:9 which is able to support simultaneous broadcast of lower resolutions. It must be compatible with the NaviGator System and provides enhanced features for digital zoom.

CCTV Camera Type N – The Internet Protocol (IP) PTZ Camera System for Night (low light) viewing may be provided in an outdoor external positioner or dome. Night vision will be provided by thermal imaging. Images shall be provided in 640 X 480 resolution with dual output stream digital video in H.264, MPEG-4, or M-JPEG formats.

CCTV Camera Type Tc – The Internet Protocol (IP) Turret Camera System uses a built in encoder to provide H.264 or Moving Picture Experts Group’s MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2014 standard. This camera shall be compatible with the legacy NaviGator System. Ensure that the camera is capable of unicast and multicast operation. Ensure that the encoded video can be transmitted utilizing programmable bit rates. Ensure the camera supports, at a minimum, fixed bit rate mode. Ensure that the camera supports the National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08 Amendment 1 (2014). Ensure that the camera is capable of communication with other devices using transmission control protocol (TCP/IP). Ensure that the camera supports the communication links shown in the Plans. The camera must be capable of remote firmware upgrades via the communication interface.

CCTV Camera Type Th – The Internet Protocol (IP) High Definition Turret Camera System uses a built in encoder to provide H.264 or Moving Picture Experts Group’s MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard and with a minimum pixel resolution of 1920 x 1080 and an aspect ratio of 16:9 which is able to support simultaneous broadcast of lower resolutions. It must be compatible with the NaviGator System and provides enhanced features for digital zoom.

CCTV Camera Type Tn – The Internet Protocol (IP) Turret Camera System for Night (low light) viewing may be provided in an outdoor external positioner. Night vision will be provided by thermal imaging. Images shall be provided in 640 x 480 resolution with dual output stream digital video in H.264, MPEG-4, or M-JPEG formats.

Video Encoder, Type B – Type B is a standalone, environmentally hardened encoder for a single video signal, suitable for field cabinet use and providing H.264 or Moving Picture Experts Group’s MPEG4 part 10 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard.

Video Encoder, Type C – Type C is a high density unit that supports multiple video signals and is suitable for control center use and providing the Moving Picture Experts Group’s MPEG4 part 10 (H.264) video compression technology in with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 14496-10:2009 standard.

Video Encoder, Type D – This encoder is a standalone, environmentally hardened encoder for a single video signal, suitable for field cabinet use that is compatible with the existing legacy encoder and decoder video systems, is capable of providing H.264 or MPEG4 part 10 along with part 2, and otherwise would not meet Type B requirements.

Video Encoder, Type E – This encoder is a high density encoder card unit for multiple video signals, with one encoder per video signal, suitable for control center use with the existing legacy encoder and decoder video systems and otherwise would not meet Type B requirements.

Video Encoder, Chassis Type E – This chassis is a high density mount unit that supports multiple Video Encoder Type C or Video Decoder Type C cards suitable for control center use with the existing legacy encoder and decoder video systems.

936.1.02 Related References

A. Standard Specifications

Section 639 – Strain Poles for Overhead Sign and Signal Assemblies

Section 680 – Highway Lighting

Section 682 – Electrical Wire, Cable and Conduit

Section 922 – Electrical Wire and Cable

Section 923 – Electrical Conduit

Section 925 – Traffic Signal Equipment

Section 939 – Communication and Electronic Equipment

B. Referenced Documents

- American National Standards Institute (ANSI)
- American Society of Testing and Materials (ASTM)
- Electronic Industries Association (EIA)
- FCC Rules Part 15, Sub-part J
- Insulated Cable Engineers Association (ICEA)
- International Electrotechnical Commission (IEC) ISO/IEC 14496-10:2009
- International Municipal Signal Association (IMSA)
- MIL-HDBK-454A
- MIL-STD-810F(3) Method 509 Procedure 1 – exterior salt atmospheres
- National Electric Code (NEC)
- National Transportation Communications for ITS Protocol (NTCIP) 1205 v1.08
- National Electrical Manufacturers Association (NEMA)
- NEMA-4
- Underwriter’s Laboratory Incorporated (UL)

National Television Standards Committee (NTSC) **936.1.03 Submittals**

This subsection and the following chart provide the Contractor with an outline of the submittal requirements for the equipment and components for all pay items in this Section 936. This chart is to be used as a guide and does not relieve the Contractor from submitting additional information to form a complete submittal package.

Section 936 Submittal Requirements									
Material	Specification Reference	Catalog Cuts	Mfg. Spec.	Materials Cert.	Lab Test	Install. Proced.	Test Plan	Maint. Proced.	Submittal Due Date (Cal. Days after NTP)
Training Plan	936.3.08		X			X	X	X	60 Days

Submit test procedures required for these items within sixty (60) calendar days after the Notice to Proceed and prior to any installation, unless noted otherwise in the Contract Documents.

Submit to the State ITS Engineer for approval one (1) electronic copy of service and maintenance documentation for all equipment, components and all other materials required within these specifications.

Provide submittal data that is neat, legible, and orderly. Neatly organize each package of submittal data and separate by hardware item. Use the “Materials Certification Package Index and Transmittal Form” for each pay item to document and list all material and components that are included in the submittal package. Any submittal data submitted without the Index/Transmittal form or that is incomplete will be rejected.

Products appearing on the Qualified Products List (QPL) are exempt from normal submittal requirements. These products have been evaluated by the Office of Traffic Operations and have proven their capability of meeting the appropriate Georgia Department of Transportation Specification. Any of these products may be used without submitting catalogue cuts, sampling or pre-testing. The Contractor shall submit a letter to the Engineer, stating which QPL items they will use. The Engineer and/or department designee must ascertain that the construction item is the same material identified on the appropriate QPL and will acknowledge receipt of these items in the project diary or as required by the Construction manual.

A. CCTV System; CCTV System, Retrofit Assembly; CCTV System, Retrofit Assembly (Furnish Only)

- 1. Camera System Assembly

Submit complete physical, performance, and operational materials submittal data for the camera system assembly and all associated components.

2. Camera System Assembly Mount

Submit complete physical, performance, and operational materials submittal data for the camera system assembly mount and all associated components and hardware.

3. Cabinet Interface Assembly

Submit complete physical, performance, and operational materials submittal data for the cabinet interface assembly and all associated components and hardware. Submit complete physical, performance and operational materials, submittal data for all cables, wire and connectors required for a complete and operational CCTV system. Submit cables and connectors as specified here and as recommended by the CCTV system manufacturer.

4. Submittal Review Demonstration Test Set

Submit demonstration test set(s) for Department evaluation after the Engineer approves the submittal materials for the equipment and materials listed below. The demonstration test sets shall be connected to and operated through the NaviGATOR system by the Engineer. Deliver the test set to the Department at the location specified by the Engineer. Request a delivery and test time a minimum of 30 days in advance. For projects with multiple camera installations, provide demonstration test sets of the materials, types and quantities as shown below:

- a. CCTV System (quantity 2)
- b. CCTV System, Retrofit Assembly (quantity 2)

A demonstration test set shall include all materials, components, assemblies, control software, and documentation of a CCTV system and shall be a complete, fully functional CCTV system.

B. Acceptance Testing

Submit acceptance test procedures and a desired acceptance test schedule.

C. Warranties and Guarantees

Submit materials submittal data providing complete example documentation on all manufacturers' warranties or guarantees on all CCTV system equipment and hardware components furnished, as required in Subsection 936.3.07.

D. Training

Prior to training, submit resume and references of instructor(s). Obtain approval from the Engineer that the instructor is qualified in his/her respective field. Submit the Training Plan within 120 days of the Notice to Proceed. Include in the training plan an outline of the training course. Obtain approval of the Training Plan from the Engineer. The Training Plan shall explain in detail the contents of the course and the time schedule of when the training shall be given. Coordinate actual training with installation schedules as approved by the Engineer.

936.2 Materials

936.2.01 CCTV Systems

Camera types are as specified on the plans, and may vary by location within project limits. Ensure that the individual components and assemblies of the CCTV System conform to the requirements specified in the following sections. Ensure that all equipment, materials, components and assemblies of the CCTV System conform to the CCTV manufacturer's requirements and recommendations.

A. Camera System Assembly

Follow these minimum requirements for a camera system assembly including the camera, dome assembly, lens, pan/tilt drive, and control electronics.

- 1. For dome enclosure cameras (Types B, C, and H)
 - a. Provide a downward-looking circular dome-shaped enclosure assembly. The enclosure shall have a maximum diameter of 14 in (356 mm) at its widest point and a maximum height of 22 in (559 mm) from the top of the housing assembly to the bottom point of the dome. The upper housing shall be constructed of a non-metallic UV-stabilized material of a light color, or constructed of an aluminum material with a heat-cured paint coating of an equivalent color. The lower housing shall be constructed of a UV-stabilized

- optically-correct acrylic material. The maximum weight of the complete and fully functional camera system assembly, including the camera, lens, pan/tilt drive, control electronics, environmental control components, housing assembly, and hub adapter shall be 25 lbs (11.4 kg).
- b. Use an enclosure assembly that secures to the mounting bracket arm with a 1-1/2 in (37.5 mm) threaded pipe nipple. Hub adapters for the threaded pipe nipple on either the enclosure or the mounting arm, or both, are permitted.
 - c. All fastening and mounting hardware on or within the enclosure assembly shall be stainless steel.
 - d. Pressurized enclosures are optional. Pressurized enclosure assemblies shall have an operating pressure range of 3-7 psi (21-48 kPa, -use extra dry nitrogen, and be outfitted with a pressure relief valve and a Schrader valve for filling and evacuating the enclosure. Non-pressurized enclosure assemblies shall have a NEMA 4/IP-66 rating and be vented with a thermostat-controlled heater and blower.
 - e. When an enclosure assembly requires a heater and a circulating blower fan for environmental (temperature and defogging) control, maximum electrical load for the heater shall be no more than 85 VA.
 - f. Ensure that the CCTV camera system performs all required functions during and after being subjected to an ambient operating temperature range of -30° to 165° F (-34° to 74° C) as defined in the environmental requirements section of the NEMA TS2 standard. Verify that the CCTV camera manufacturer certifies its device has successfully completed environmental, shock, and vibration testing as defined in the environmental requirements section of the NEMA TS2-2003 standard.
 - g. Ensure that the housing protects the camera and other internal components from rain, dust, corrosive elements, and typical conditions found at a roadside environment. Ensure that the CCTV camera, mounting hardware, and any other camera-related material that is exposed to the environment can withstand 90 mph (145 kph) wind speeds.
 - h. Electrical power for the complete camera system assembly shall be per the manufacturer's recommendations and between 12V to 120V DC or single-phase AC utilizing a two-wire (not counting ground) supply from the cabinet interface assembly in the equipment cabinet. Do not use a dual-voltage power supply. Maximum electrical load with all subsystems operational, including the heater, shall be no more than 130 VA.
 - i. For analog cameras (Type B), ensure that the camera produces an analog NTSC-compliant composite video output with a signal-to-noise ratio of 45dB or greater.
 - j. Use a camera unit with an integrated camera sensor and zoom lens assembly. The camera shall use a CCD or CMOS image sensor and have a minimum resolution of 720 horizontal by 480 Picture Elements.
 - k. The camera shall include on/off selectable automatic gain control and manual/automatic selectable white balance. The camera shall include an electronic shutter mode with user-selectable speeds of a minimum range from 1/60 second to 1/10,000 second. The camera unit shall provide an on/off selectable day/night function where the image sensing and output automatically switch between color and black-and-white imaging; fixed color or black-and-white imaging shall be user-controllable. The camera sensitivity shall be no less than 3.0 lux in color mode (1/60 second) and 0.5 lux in black-and-white mode (1/60 second, IR cut removed).
 - l. Provide a camera unit with an integrated zoom lens of a minimum of 20X optical zoom and a minimum of 4X (HD Camera Type D shall have a minimum of 12X) digital zoom. The camera shall not employ any digital zoom functionality unless the lens is at the full limit of optical zoom and the zoom command continues to be applied, in which case the camera unit shall automatically switch from optical to digital zoom. The camera unit shall include on/off selectable automatic focus and manual/automatic selectable iris control.

- m. Use a pan/tilt drive for the camera unit that is fully-contained within the enclosure assembly. The drive shall be capable of 360 degree panning and at least 0 degree horizontal to 90 degree vertical looking downward tilting. The camera unit and pan/tilt drive shall provide automatic 180-degree image output flip at the bottom of the tilt travel. The camera unit and pan/tilt drive shall provide a minimum of eight privacy blackout zones, each zone being individually programmable to be on/off by the user. The panning speed, when a pan-left or pan-right command is applied by the user, shall be between 10 and 18 degrees per second. The tilting speed, when a tilt-up or tilt-down command is applied by the user, shall be between 4 and 10 degrees per second.
 - n. Provide a system control interface to the camera system assembly that physically and logically supplies the user commands to and monitoring from the camera system assembly, including but not limited to pan, tilt, zoom, focus, position reporting, and configuration. The system control interface shall physically connect the camera system assembly to the cabinet interface. Provide a system control interface that is in compliance with NEC and all of the physical and operational requirements specified for a CCTV System. Provide the capability to set the communications through the system control interface or through the user control interface in the cabinet; do not require the opening/disassembly of the camera system enclosure to set the communications address. Store all user configurable settings in non-volatile memory that is retained indefinitely upon loss of power.
2. For Turret Cameras (Types Tc, Th, and Tn)
- a. Ensure that the CCTV camera system performs all required functions during and after being subjected to an ambient operating temperature range of -30° to 165° F (-34° to 74° C) as defined in the environmental requirements section of the NEMA TS2 standard. Verify that the CCTV camera manufacturer certifies its device has successfully completed environmental, shock, and vibration testing as defined in the environmental requirements section of the NEMA TS2-2003 standard.
 - b. Ensure that the housing protects the camera and other internal components from rain, dust, corrosive elements, and typical conditions found at a roadside environment. Ensure that the CCTV camera, mounting hardware, and any other camera-related material that is exposed to the environment can withstand 90 mph (145 kph) wind speeds.
 - c. Ensure that enclosure assemblies are environmentally rugged and compatible with the temperature, power, vibration, and shock requirements of NEMA TS-2, as well as the environmental dust and water resistance requirements of IEC 60529 IP66 and IP67 ratings.
 - d. Electrical power for the complete camera system assembly shall be per the manufacturer's recommendations and between 12V to 120V DC or single-phase AC utilizing a two-wire (not counting ground) supply from the cabinet interface assembly in the equipment cabinet. Do not use a dual-voltage power supply. Maximum electrical load with all subsystems operational, including the heater, shall be no more than 130 VA.
 - e. Use a camera unit with an integrated camera sensor and zoom lens assembly. The camera shall use a CCD or CMOS image sensor, with a minimum of 720 horizontal by 480 vertical active picture elements. The camera shall have a minimum resolution of 460 horizontal TV lines by 540 vertical TV lines.
 - f. The camera shall include on/off selectable automatic gain control and manual/automatic selectable white balance. The camera shall include an electronic shutter mode with user-selectable speeds of a minimum range from 1/60 second to 1/10,000 second. The camera unit shall provide an on/off selectable day/night function where the image sensing and output automatically switch between color and black-and-white imaging; fixed color or black-and-white imaging shall be user-controllable. The camera sensitivity shall be no less than 3.0 lux in color mode (1/60 second) and 0.5 lux in black-and-white mode (1/60 second, IR cut removed).

- g. Provide a camera unit with an integrated zoom lens of a minimum of 20X optical zoom and a minimum of 4X (HD Camera Type D shall have a minimum of 12X) digital zoom. The camera shall not employ any digital zoom functionality unless the lens is at the full limit of optical zoom and the zoom command continues to be applied, in which case the camera unit shall automatically switch from optical to digital zoom. The camera unit shall include on/off selectable automatic focus and manual/automatic selectable iris control.
 - h. Use a pan/tilt drive for the camera unit that is fully-contained within the enclosure assembly. The drive shall be capable of 360 degree panning and at least 0 degree horizontal to 90 degree vertical looking downward tilting. The camera unit and pan/tilt drive shall provide automatic 180-degree image output flip at the bottom of the tilt travel. The camera unit and pan/tilt drive shall provide a minimum of eight privacy blackout zones, each zone being individually programmable to be on/off by the user. The panning speed, when a pan-left or pan-right command is applied by the user, shall be between 10 and 18 degrees per second. The tilting speed, when a tilt-up or tilt-down command is applied by the user, shall be between 4 and 10 degrees per second.
 - i. Provide a system control interface to the camera system assembly that physically and logically supplies the user commands to and monitoring from the camera system assembly, including but not limited to pan, tilt, zoom, focus, position reporting, and configuration. The system control interface shall physically connect the camera system assembly to the cabinet interface. Provide a system control interface that is in compliance with NEC and all of the physical and operational requirements specified for a CCTV System. Provide the capability to set the communications through the system control interface or through the user control interface in the cabinet; do not require the opening/disassembly of the camera system enclosure to set the communications address. Store all user configurable settings in non-volatile memory that is retained indefinitely upon loss of power.
3. Camera Type D – Fixed Camera. Fixed cameras shall be designed for outdoor applications meeting NEMA 4X or IP-66 rating requirements and include all necessary harness and cables to extend the video, power and data from the CCTV Camera location to the field cabinet. The enclosure shall be suitable for the location and meet all requirements as denoted above for other camera types. The lens shall have a minimum F-stop of 1.4 with a variable manual zoom of 5 – 50 mm. The iris shall support automatic or set to yield optical results under various outdoor lighting conditions. The camera shall provide all other functionality as required of other types to produce a fixed view of the roadway.
4. IP Cameras (Types C, D, and Tc) shall provide the same functionality as the analog camera unit, and shall include built in integral encoders (i.e., Ethernet ready). In addition, IP cameras shall meet the following minimum requirements:
- a. Power over Ethernet (IEEE802.3af) or 24 VAC power input.
 - b. The integral video encoder in the dome assembly shall meet the exact same requirements for Video Encoder Type B, except that mounting/packaging, cable connectors, and power supply requirements shall be according to the camera manufacturer requirements. A serial console interface to the integral encoder is not required.
5. High Definition Cameras (Types H and Th) shall provide the same functionality as other IP (built in encoders) camera types, and in addition, shall meet the following minimum requirements:
- a. HD 1080p resolution at 30 images per second (ips) and support simultaneous broadcast of lower resolutions
 - b. Minimum 20x optical zoom and 12x digital zoom
 - c. 16:9 aspect ratio
 - d. Digital image stabilization

6. CCTV Camera Types N and Tn – Internet Protocol (IP) PTZ Camera System for Night (low light) viewing shall provide video surveillance imaging for reliable video images clearly in near total darkness. Images shall be provided in 640 X 480 resolution with dual output stream digital video in H.264, MPEG-4, or M-JPEG formats.

936.2.02 Camera System Assembly Mount

Provide a camera system assembly mount that includes a mounting bracket arm, camera enclosure mount and disconnect, mounting straps, and incidental fastening hardware. All fastening and mounting hardware shall be stainless steel.

The mounting bracket arm shall be suitable for pole-mounted applications using mounting straps or bolts. The bracket shall be fabricated to exactly mate with the camera enclosure mount/disconnect/pipe nipple and any needed pole-mount adapter with no drilling or welding required. The bracket shall be fabricated from aluminum alloy with an exterior polyurethane coating, stainless steel, or mild steel with a heat-cured paint coating. All bracket coatings shall be light in color and corrosion resistant in accordance with MIL-STD-810F (3) Method 509 Procedure 1 for exterior salt atmospheres.

Unless otherwise indicated on the plans, use a mounting bracket arm that locates the vertical centerline of the camera enclosure from 14 in (356 mm) to 24 in (610 mm) from the exterior surface of the support pole. The mounting bracket arm shall provide for cable entrance through the base of the bracket directly from the support pole and from the exterior through a rain tight opening on the underside of the bracket and adjacent to the support pole. The bracket arm shall provide sufficient opening to fully enclose the cables. Provide non-metallic cable protection grommets for both cable entrances. Unless otherwise shown in the Plans, mount the bracket arm to the support pole using a minimum of two ½ in (12.5 mm) or greater stainless steel mounting straps.

936.2.03 Camera Lowering System Assembly Mount

Where specified on the plans, provide a camera lowering system that includes a mounting bracket arm, self-aligning docking system, video and power surge protection. The unit will be self-contained, suitable for pole-mounted applications using straps or bolts. All fastening and mounting hardware shall be stainless steel. The lowering cable(s) shall be stainless steel. All bracket coatings shall be light in color and corrosion resistant in accordance with MIL-STD-810F (3) Method 509 Procedure 1 for exterior salt atmospheres. The lowering device shall have a support capacity of 55 lbs. (25 Kg.), and shall provide for camera systems at varying heights above ground level to match the height of the mounting structure. Electrical power for the complete camera lowering system assembly shall be per the manufacturer's recommendations and 120 VAC.

936.2.04 Cabinet Interface Assembly

Use a cabinet interface assembly that provides electrical service for the camera system assembly and provides the user control interface connection to the NaviGator system and/or user personnel. Install the cabinet interface assembly in the equipment cabinet. All fastening and mounting hardware shall be stainless steel. The cabinet interface panel assembly includes the following:

- CCTV Interface Enclosure
- Camera System Assembly Power Supply with surge suppression
- Terminal blocks and video cable surge suppression for camera system assembly cabling
- User control interface to the NaviGator system and/or user personnel with surge suppression

The NaviGator Standard CCTV Control Protocol (hereinafter called the "CCTV Standard Protocol") is specified below and shall connect to the user control interface unit through an RS-232 serial data interface directly from the NaviGator system. Provide the control software with an unrestricted, non-cancelable user license for the Department's use with any NaviGator equipment at any location. Furnish three (3) copies each of the software, license, appropriate RS-232 cable, and user documentation per project.

A. CCTV Standard Protocol

1. General

For all camera types, use the NaviGator Standard CCTV Control Protocol (hereinafter called the "CCTV standard protocol" or "standard protocol") for CCTV system control communications between the camera unit and the GDOT NaviGator central system to achieve a fully functional communications interface to utilize all of the capabilities and functions of the camera. Implement the standard protocol for all CCTV equipment installed on this project. The CCTV standard protocol governs all control communications between the NaviGator central system (hereinafter called the "host") and the CCTV system.

2. Interface

For Type B cameras, the CCTV System (hereinafter called the “remote”) shall communicate using the CCTV standard protocol over an RS-232 serial interface. Data is transmitted using 1 start bit, 8 data bits, and 1 stop bit (no parity) at a baud rate of 9600.

Each remote shall be identified by a unique integer address between 1 and 233. This address is set during installation and shall not be altered using the standard protocol. The address is included in messages to identify the intended recipient of commands from the host and responses from the remote.

936.2.05 Cabling and Connectors

Provide cabling and connectors between the camera system assembly and the cabinet interface assembly as shown in the CCTV system detail drawings and in the Plans. Label all cables. All cables shall meet industry and manufacturer recommendations.

When required for the camera application, coaxial video signal cables will be provided with labels attached at both ends of each cable. Coaxial cables will use BNC connectors with gold-plated center pins on the video signal cables; use only connectors recommended by the cable manufacturer.

Provide control cable with labels attached at both ends of the cable. Terminate control cable in the equipment cabinet as shown in the CCTV system detail drawings in the plans and as recommended by the CCTV system manufacturer. Ground or bond any pair shielding and any unused conductors in accordance with the CCTV system manufacturer’s recommendations.

For IP Cameras, provide communications cabling (Outside Plant Category 5) as recommended by the CCTV system manufacturer. Label all cables. Separate power cables must be clearly labeled as such and meet manufacturer recommendations. When Power over Ethernet cameras are provided, cabling must be sized and rated in accordance with manufacturer recommendations and clearly labeled as such.

936.2.06 Video Encoder (All Types)

Provide a Video Encoder in accordance with the minimum requirements below for the encoding of analog video inputs and transmission as digital streams over a network.

A. Video Encoder, Type A

Not Used

B. Video Encoder, Type B

Video Encoder, Type B is a standalone, environmentally hardened encoder for a single video signal, suitable for field cabinet use.

1. General

- a. All encoders provided by the Contractor shall be new and shall be from the same manufacturer and be fully compatible and interoperable with each type provided.
- b. All encoder types provided by the Contractor shall be fully compatible and interoperable with the GDOT existing network equipment.
- c. Mean Time Between Failures (MTBF): Encoders shall have a minimum MTBF of 20,000 hours.
- d. Latency: The end-to-end system latency between the Encoder and Decoder appliances shall be no more than 300 ms, not including network delays. The encoders shall support various frame adjustments to minimize latency.
- e. Remote Control: Encoders shall be remotely adjustable via a video management system or command set so that a technician can adjust image quality controls for contrast, brightness, hue and color levels.
- f. Video equipment shall support the NTSC signal format.
- g. Furnish rack-mountable or shelf-mountable units.
- h. Rack-mountable units shall include integrated brackets for mounting in standard EIA 19-inch rack rack-mountings.

2. Physical and Environmental Requirements.

- a. The Video Encoder shall have the following ports as a minimum:
 - Network: 10/100 Mbps RJ-45 or as directed by Engineer.
 - Video Connector: BNC
 - Serial Data Interface: One (1) minimum RJ-45 port/connector.
 - Serial port may utilize D-sub connectors or terminal block connections as approved by the Engineer.
- b. In locations where there is more than one video source and Encoders with multiple video ports are approved by Engineer, each video input port shall meet all the video and data requirements of Video Encoder Type B independently.
- c. The video input performance measures shall comply with NTSC and EIA requirements, including the EIA-170 standard, with a nominal composite video of 1 volt peak-to-peak (Vp-p). The equipment shall have an electrical impedance of 75 ohms.
- d. Operating temperatures and humidity shall comply with the NEMA TS2-2003 standard
- e. Ventilation fans are not permitted.
- f. Encoders shall be installed in a field cabinet with protection from moisture and airborne contaminants, blowing rain, wind, blowing sand, blowing dust, humidity, roadside pollutants, vandalism, and theft.
- g. Encoders shall be resistant to vibration and shock, and conform to Sections 2.1.9 and 2.1.10, respectively, of the NEMA TS2-2003 standard.
- h. Encoders for field site locations shall be PCB conformal coated to provide a level of protection from humidity, contaminants, dust, pollution, etc.
- i. Encoders shall provide LED status indicators for local status display of analog video input, serial data interface activity, network interface activity and power.
- j. Cable connections (data/video/power) shall require no tools for installation or removal and be designed with positive locking devices such that they will not vibrate loose.
- k. Provide external markings for all connectors and indicators. Replaceable components shall be permanently marked and traceable to the supplied documentation, including schematics and parts list.
- l. The external markings shall include the product function name, model number, serial number, and manufacturer's name.
- m. All parts required for a completed video system shall be made of corrosion-resistant materials, such as stainless steel, anodized aluminum, brass, or gold-plated metal.
- n. All individual Encoders shall be shelf, rack (19")/module, or DIN rail mountable. Other mounting options may be submitted for review and approval by the Engineer.
- o. Nominal power input voltage of 120 VAC, 60 Hz. ± 3 Hz.
 - a. Maximum power consumption of 20 watts.
 - b. If the device requires operating voltages of less than 120 VAC, the appropriate voltage converter shall be supplied. All voltage conversion devices shall also be temperature hardened as specified herein for location (field or central).
 - c. The equipment or its voltage converter shall operate within a voltage range of 90 VAC to 135 VAC.
 - d. Encoders shall provide for automatic recovery from an over or under voltage condition when prime power has returned to the tolerance values specified herein. All configuration parameters shall be stored in non-volatile memory and no reprogramming or manual adjustments shall be required upon power recovery.

3. Video Data Requirements

- a. The Encoder shall be capable of streaming a minimum of the following Video Compression Technology types:
 -
 - Stream 1: H.264 (Video Coding Experts Group (VCEG)/Moving Picture Experts Group)
 - Stream 2: H.264 (Video Coding Experts Group (VCEG)/Moving Picture Experts Group)
 - Snapshot: JPG full-frame capture
- b. The Encoder shall be capable of streaming multiple bandwidth and compression types simultaneously per video input channel.
- c. The Encoder shall support streaming multicast and unicast streams simultaneously.
- d. The Encoder shall have the ability to automatically initiate and stream a multicast stream upon starting without any remote request to join the multicast group.
- e. The Encoder shall support multiple simultaneous Real Time Streaming Protocol (RTSP) requests.
- f. The Encoder shall be able to supply multiple unique and independent video streams with frame rate, bit rate, and image size settings adjustable through an RTSP request.
- g. The encoder shall support a minimum of 2 simultaneous unique and independent H.264 video streams with frame rate, bit rate, and image size settings adjustable per video input channel.
- h. Encoders shall be a hardware-based network device able to accept a minimum of one analog National Television System Committee (NTSC) video input and encode for transport across IP networks.
- i. Encoders shall be specifically designed for network operation, and adhere to ISO standards.
- j. Support the following minimum encoded resolutions:
 - Stream 1: NTSC – Full D1
 - Stream 2: CIF/SIF
 - Snapshot: NTSC – Full D1
- k. Dynamic bandwidth control: Provide, at the minimum, the following rates (The data rate shall be defined as the maximum committed bandwidth to be utilized, which includes data bursting.).
 - Stream 1: 3 Mbps at D1
 - Stream 2: 1 Mbps at CIF/SIF
- l. Bandwidth increments shall be user configurable via the network, independently per stream and snapshot. The minimum bandwidth setting shall be 56Kbs or less.
- m. Encoder streams shall be capable of being set to variable or constant bit rates.
- n. The default bandwidth for the Encoders as furnished shall be set to 2Mbps when communicating over fiber and 56kbs when communicating otherwise.
- o. Provide on-board buffered video memory for protection against potential network disruptions.
- p. Encoders shall be capable of providing JPG snapshots and transfer image via FTP either by push or pull at a user-defined interval between 60 and 300 seconds.
- q. Encoded streams shall be fully compatible with the NaviGator software decoding system and with VLC (Video LAN Client.)
- r. The encoder system, including processor, internal memory access and all data paths, shall operate with the following stream settings running simultaneously with no performance degradation of any stream, serial data interface, or device management interface:
 - Stream 1: 2Mbps/NTSC – Full D1/30 frames per second/RTP
 - Stream 2: 192Kbps/SIF/15 frames per second/RTP

- Snapshot: NTSC – Full D1/120 second capture interval

4. Network Requirements

- Encoders shall meet the following minimum network requirements:
- Network connection shall be Ethernet Compliant IEEE 802.3, 802.3u, and 802.3x; 10/100 Mbps or higher, auto sensing full/half-duplex operations.
- Encoders shall provide encapsulation of each of the video streams in UDP packet and TCP packets, depending on stream configuration, for network transmission.
- Encoders shall connect to a network device (i.e., Ethernet switch/router, IP wireless device, etc.) via a RJ-45 connector through Category 5e or higher quality stranded patch cords.
- All network RJ-45 ports shall be standard EIA/TIA-568-A pin-outs and shall be rated at 10/100Mbps or greater.
- All Encoders provided by the Contractor shall be fully interoperable without customization or the addition of appliances within either the remote or primary communications network. All devices shall be fully interoperable with the backbone communications network.
- Static management interface IP Addressing (class A, B, and C).
- Static IP addressing of the multicast group individually and independently for each stream.
- RTP, UDP, Unicast and IP Multicast (Internet Group Multicast Protocol / IGMP V2) features for digital video transmission, individually and independently for each stream.
- Encoders shall support Real Time Streaming Protocol (RTSP) over RTP, individually and independently for each stream.
- Encoders shall support multiple stream requests, individually and independently for each stream.

5. Serial Data Interface Requirements

The Encoder shall meet the following minimum serial data interface requirements:

- The Encoder shall provide bi-directional serial communications over Ethernet 10/100 Base-TX via the following methods:
 - Encoder serial port to Decoder serial port data stream.
 - IP socket to Encoder serial port by TCP protocol.
- Each serial port shall provide full-duplex serial interface and data rates up to 115.2 Kbps (minimum).
- Serial port shall be software configurable, locally or over the network, to EIA-232/422/485 mode of operation as defined by the EIA for data format, data rate, and data structure (e.g., baud rate, the number of bits, parity, stop bits, flow control, etc.) via the management software provided.
- No serial adaptors or interface converters shall be permitted.
- Encoders shall be capable of using the serial interface port to support PTZ camera control functions.
- Encoder serial port shall provide IP addressing and socket number selection and provide the capability to establish an IP connection directly from an operator workstation or server to any Encoder IP address and socket number to transport serial data, independent of whether or not any video stream for that encoder is being viewed.

6. On Screen Display Requirements

The Encoder shall provide the following On-Screen Display (OSD):

- a. Encoders shall support a static text insertion capability on all streams and shall be capable of inserting a minimum of two (2) user configurable text messages of at least 20 characters in length on separate lines, in user-configurable positions anywhere on the image.
 - b. Encoders shall support JPG image insertion on all streams in either the upper left or upper right positions in the image, using a JPG file(s) stored in the Encoder's configuration.
 - c. JPG image insertion shall be scalable per stream according to the stream resolution, or there shall be the capability to insert a different JPG image file for each stream.
 - d. Encoders shall have the option to display or not display the OSD.
7. Management Requirements
- a. Encoders shall be manageable through SNMP (v2), HTTP, FTP/TFTP, and/or Telnet/CLI.
 - b. Encoders shall have a NTP or SNTP client.
 - c. The management system shall be provided to remotely configure and diagnose the Encoder.
 - d. Have capability to reset/reboot and firmware upload via the methods listed above.
 - e. Have the capability to remotely change any of the device configuration settings including bit rates, image resolution and compression settings and serial interface type.
 - f. Provide pre-defined optimized video compression and streaming settings for various bit rates.
 - g. Provide update capability for the firmware in the Encoder from the central site. Ability to access the serial number, firmware number, IP address and equipment configuration.
 - h. Have the capability to upload firmware to multiple units automatically.
 - i. Provide ability for remote firmware upgrades.
 - j. Provide a command-line interface on the console port for local management.
 - k. Provide administrative access control via a configurable password.
 - l. Provide support for managing the administrative security parameters via both the Local Management and Remote Management interfaces required herein.
 - m. Provide support for managing the following video streaming parameters via the Remote Management functionality required herein.
 - Target address and port (per stream)
 - TTL parameter
 - Resolution (per stream)
 - Frame rate (per stream)
 - I/P ratio (per stream)
 - Encoding bit rate (per stream)
 - On-screen display

C. Video Encoder, Type C – Card

Video Encoder, Type C- Card is a high density encoder unit (card) for multiple video signals, with one encoder per video signal, suitable for control center use in a slot based chassis.

1. General
 - a. Each encoder of a Video Encoder Type C- Card shall meet all the Video Encoder, Type B requirements except the physical requirements as noted in section 936.2.06.B.

- b. All Contractor provided Video Encoder Type C- Cards shall be compatible with, and of the same make as Video Encoder, Type C – Chassis provided by the Contractor.
- c. All Contractor provided Video Encoder Type C- Cards shall be compatible with, and of the same make as standalone Video Encoder, Type B provided by the Contractor.

2. Physical

- a. Each Video Encoder Type C- Card shall include a minimum of 4 encoders per card with a corresponding number of BNC ports per encoder.
- b. Each Video Encoder Type C- Card shall include one RJ-45 Network port: 10/100 Mbps.
- c. Video Encoder Type C- Card shall be fully contained and obtain power from the Video Encoder, Type C Chassis.

D. Video Encoder, Type C – Chassis

Video Encoder, Type C - Chassis is a high density rack mount unit that supports multiple Video Encoder Type C or Video Decoder Type C cards suitable for control center use.

1. General

All Contractor provided Video Encoder Type C- Chassis shall be compatible with, and of the same make as Video Encoder, Type C – Cards provided by the Contractor

2. Physical

Chassis shall support a minimum of 12 Video Encoder, Type C cards, or 12 Video Decoder, Type C cards, or a combination thereof up to the minimum total cards.

- a. Chassis shall be 7U or less and be 19” rack mountable.
- b. Each Chassis shall be capable of operating on 1 internal power supply.
- c. Each Chassis shall be capable of supporting a minimum of 2 internal power supply.

E. Video Encoder, Type D

Video Encoder, Type D is a standalone, environmentally hardened encoder for a single video signal, suitable for field cabinet use that is compatible with the existing legacy encoder and decoder video systems and otherwise would not meet Type B requirements.

1. General

Encoders of this Type shall be of the same make and model of encoder(s) that it shall replace, share communication in a drop and add link with, or with the decoder that shall decode it’s video, unless otherwise approved by the Engineer.

F. Video Encoder, Type E – Cards

Video Encoder, Type E-Cards is a high density encoder unit for multiple video signals, with one encoder per video signal, suitable for control center use with the existing legacy encoder and decoder video systems and otherwise would not meet Type B requirements.

1. General

Encoder Cards of this Type shall be of the same make and model of the Encoder Card(s) that it shall replace, or with the Encoder Card(s) that resides in the same chassis that it shall be added to unless otherwise approved by the Engineer.

G. Video Encoder, Type E – Chassis

Video Encoder, Type E - Chassis is a high density rack mount unit that supports multiple Video Encoder Type C or Video Decoder Type C cards suitable for control center use with the existing legacy encoder and decoder video systems and otherwise would not meet Type B requirements.

936.2.07 Video Decoder (All Types)

A. Video Decoder, Type A

Not Used

B. Video Decoder, Type B

Video Decoder, Type B is a standalone decoder for the decoding of IP streams of the formats compatible of the Video Encoder Type B streams into a standard NTSC analog video stream output.

1. General

- a. All Video Decoder Type B shall meet all the requirements of a Video Encoder Type B unless otherwise stated.
- b. Video Decoder Type B shall be new, from the same manufacturer, and be fully compatible and interoperable with each type of encoder and decoder provided.

2. Physical and Environmental

Video Output Connector: BNC

- a. The video output performance measures shall comply with NTSC and EIA requirements, including the EIA-170 standard, with a nominal composite video of 1 volt peak-to-peak (Vp-p). The equipment shall have an electrical impedance of 75 ohms.

3. Video Data Requirements

- a. The Decoder shall be capable of decoding a minimum of the following Video Compression Technology types:
 - H.264 (Video Coding Experts Group (VCEG)/Moving Picture Experts Group)
 - MPEG -4 (Moving Picture Experts Group)
 - MJPEG Motion JPEG (Moving Picture Experts Group)
 - b. The Decoder shall support joining multicast groups and decode the streams of the Type and video Compression technology listed above.
 - c. The Decoder shall support decoding unicast streams of the Type and video Compression technology listed above.
 - d. The Decoder shall support decoding of streams from RTSP requests of the Type and video Compression technology listed above
 - e. The Decoder shall be able to decode unique and independent video streams with frame rate, bit rate, and image size settings adjustable through an RTSP request.
 - f. Decoders shall be a hardware-based network device able to provide a minimum of one analog National Television System Committee (NTSC) video output and decode IP video transported across IP networks.
 - g. Decoders shall be specifically designed for network operation, and adhere to ISO standards.
 - h. Support the following minimum encoded resolutions:
 - NTSC - Full D1
 - CIF/SIF
 - QCIF/QSIF
 - Decoder streams shall be capable of decoding streams set to variable or constant bit rates
4. Network Requirements. Decoders shall meet the following minimum network requirements:
Network connection shall be Ethernet Compliant IEEE 802.3, 802.3u, and 802.3x; 10/100 Mbps or higher, auto sensing full/half-duplex operations.
- #### 5. On Screen Display Requirements
- a. Decoders shall support a static text insertion capability and shall be capable of inserting a minimum of one (1) user configurable text messages of up to 20 characters in length.

- b. Decoders shall be able to generate a date and time stamp in the video stream and shall be synchronized to a time-server on the network.
- c. Decoders shall be able to display camera title in the video stream.
- d. Decoders shall have the option to display or not display the on-screen text.

6. Management Requirements

- a. Decoders shall be manageable through SNMP (v2), HTTP, FTP/TFTP, and/or Telnet/CLI.
- b. The management system shall be provided to remotely configure and diagnose the Decoder.

C. Video Decoder, Type C – Card

Video Decoder, Type C- Card is a high density Decoder unit (card) for multiple video signals, with one Decoder per video signal, suitable for control center use in a slot based chassis.

1. General

- a. Each Decoder of a Video Decoder Type C- Card shall meet all the Video Decoder, Type B requirements except the physical requirements as noted in section 936.2.06.B.
- b. All Contractor provided Video Decoder Type C- Cards shall be compatible with, and of the same make as Video Decoder, Type C – Chassis provided by the Contractor
- c. All Contractor provided Video Decoder Type C- Cards shall be compatible with, and of the same make as standalone Video Decoder, Type B provided by the Contractor

2. Physical

- a. Each Video Decoder Type C- Card shall include a minimum of 4 Decoders per card with a corresponding number of BNC ports per Decoder.
- b. Each Video Decoder Type C- Card shall include one RJ-45 Network port: 10/100 Mbps.
- c. Video Decoder Type C- Card shall be fully contained and obtain power from the Video Decoder, Type C Chassis.

D. Video Decoder, Type C – Chassis

Video Decoder, Type C - Chassis is a high density rack mount unit that supports multiple Video Decoder Type C or Video Decoder Type C cards suitable for control center use.

1. General

- a. All Contractor provided Video Decoder Type C- Chassis shall be compatible with, and of the same make as Video Decoder, Type C – Cards provided by the Contractor

2. Physical

- a. Chassis shall support a minimum of 12 Video Decoder, Type C cards, or 12 Video Decoder, Type C cards, or a combination thereof up to 12 total cards.
- b. Chassis shall be 7U or less and be 19” rack mountable.
- c. Each Chassis shall be capable of operating on 1 internal power supply.
- d. Each Chassis shall be capable of supporting a minimum of 2 internal power supply.

E. Video Decoder, Type D

Video Decoder, Type D is a standalone, environmentally hardened Decoder for a single video signal, suitable for field cabinet use that is compatible with the existing legacy Decoder and decoder video systems and otherwise would not meet Type B requirements.

1. General

Decoders of this Type shall be of the same make and model of Decoder(s) that it shall replace, share communication in a drop and add link with, or with the decoder that shall decode it's video, unless otherwise approved by the Engineer.

F. Video Decoder, Type E – Cards

Video Decoder, Type E-Cards is a high density Decoder unit for multiple video signals, with one Decoder per video signal, suitable for control center use with the existing legacy Decoder and decoder video systems and otherwise would not meet Type B requirements.

1. General

Decoder Cards of this Type shall be of the same make and model of the Decoder Card(s) that it shall replace, or with the Decoder Card(s) that resides in the same chassis that it shall be added to unless otherwise approved by the Engineer.

G. Video Decoder, Type E – Chassis

Video Decoder, Type E - Chassis is a high density rack mount unit that supports multiple Video Decoder Type C or Video Decoder Type C cards suitable for control center use with the existing legacy encoder and decoder video systems and otherwise would not meet Type B requirements.

1. General

Encoder Chassis of this Type shall be of the same make and model of the Encoder Chassis that it shall replace unless otherwise approved by the Engineer.

936.2.08 Delivery, Storage, and Handling

For Furnish Only items, provide all materials in protective packaging suitable for shipping and storage. Label all boxes with contents, including manufacturer name, model, serial numbers, and project number. Package each product/system in individual boxes as units of one complete unit. Multiple boxes for one assembly is acceptable, but multiple assemblies in the same box is not. Deliver assemblies to the Department at the location specified by the Engineer. Deliver at one time the full quantity of complete assemblies as shown in the Plans; multiple deliveries are not acceptable.

936.3 Construction Requirements

Ensure that all construction for the equipment, materials, components and assemblies of the CCTV System specified conform to the CCTV manufacturer's requirements and recommendations.

936.3.01 Personnel

Not applicable

936.3.02 Equipment

Not applicable

936.3.03 Preparation

Not applicable

936.3.04 Fabrication

Not applicable

936.3.05 Construction

A. General Requirements

Request that the Department establish the utility service(s) required for a CCTV installation as described in Section 682.

B. CCTV System, All Types

1. Installation Requirements

Mount the camera system assembly and the mounting bracket arm at the cardinal direction and height as shown in the Plans, and so the pole is not obstructing the camera's view of the roadway or traffic signals.

Install cables between the camera system assembly and the equipment cabinet inside new hollow metal or concrete support poles unless otherwise specified. Where devices are installed on existing wood poles, install cabling on the

wood poles in rigid metal conduit risers of minimum 2 in (50.8 mm) diameter. Use weather heads on all nipple and conduit openings. Neatly install and route cabling to minimize movement in the wind and chafing against the pole, device or bracket. Form a drip loop at the weather head and route cabling to prevent water entry into the weatherhead or mounting bracket arm. Install the mounting bracket arm no more than 8 in (204 mm) above the weatherhead, and install a drip loop that is no more than 6 in (152 mm) below the weatherhead at the loop's lowest point.

Install the cabinet interface assembly components in the equipment cabinet as shown in the CCTV system detail drawings. Neatly arrange and dress all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Route all CCTV cables separate from any 120VAC power wiring or surge suppressor ground wiring. Neatly coil and dress between 3 ft (1 m) and 5 ft (1.5 m) of cables in the bottom of the cabinet. Dress and route grounding wires separately from all other cabinet wiring and with the minimum length possible between the suppressor and the ground bussbar. Do not splice any cable, shield or conductor used for video, control, communications signaling, power supply, or grounding.

Fasten all components of the cabinet interface assembly to be mounted on the equipment cabinet side panel or on the CCTV Interface Enclosure with stainless steel hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. Fasten stud-mounted components to a mounting bracket providing complete access to the studs and mounting nuts. All fastener heads and nuts (when used) shall be fully accessible within the equipment cabinet, and any component shall be removable without requiring removal of other components, panels, or mounting rails. Do not use self-tapping or self-threading fasteners.

2. CCTV System Configuration

Program and configure the CCTV system in accordance with the procedure below. Provide all required documentation in writing with all data recorded in the format of the NaviGator Standard CCTV Control Protocol. Perform the CCTV system configuration in accordance with the acceptance procedures in subsection 936.3.06. Configure each CCTV system with the communications address specified by the Department, prior to any acceptance testing at a given CCTV system site. Configure the communications address as "001" unless otherwise shown in the Plans or directed by the Engineer.

GDOT's "ITS Surveillance Camera Control Integration and Calibration Procedure" is as follows:

- a. Record the position status setting for the full pan left and pan right stops. The pan left and pan right stops are defined as the camera positions when the pole initially comes into view from either direction at maximum zoom.
- b. Record the position status setting and angle (degrees from horizon) for maximum tilt up and maximum tilt straight down (90 degrees down from horizontal).
- c. Record the position status settings for each end of maximum focus range.
- d. Record the position status settings for maximum zoom out and zoom in.
- e. Provide to the Department the following information from each field installation site:
 - Location (as shown in Plans)
 - Height of camera (ft) above travel lanes
 - Azimuth (compass heading in degrees at camera's right stop as defined above)
 - Azimuth (compass heading in degrees at camera's left stop as defined above)
 - Device ID as shown on the Plans (example: CAM001)
 - CCTV system communications address (example: 001)
 - IP address, Subnet mask, Gateway port/socket of serial port on Encoder
 - UDP Ports
 - Multicast address
 - Video switch input port (when connected)
 - Comments

3. As-Built Drawings

Furnish as-built CCTV system wiring diagrams, identified by location. Include all wiring, cabling, conductor function, connector type and connector pinouts in an electronic (PDF) format.

936.3.06 Quality Acceptance

A. General

Acceptance testing of CCTV System, all Types consists of three phases: 1) field installation testing; 2) CCTV system site testing; and 3) burn-in period. After the Engineer's granting of burn-in period completion, obtain CCTV system acceptance. Perform acceptance testing for all equipment, hardware and work provided under this Contract, including each CCTV video surveillance field installation assembly and all associated communications hardware at a control center or communications hub. Perform all testing in the presence of the Engineer. Notify the Engineer of a desired acceptance test schedule no less than fourteen calendar days prior to beginning the testing except for testing using the NaviGator software and existing NaviGator control center and communications equipment. For acceptance testing using the NaviGator software and existing NaviGator control center and communications equipment, coordinate this testing with the Engineer no less than 30 days prior to the start of this testing.

Except as provided herein regarding the Department's NaviGator software, develop, provide all equipment for, and perform all acceptance testing for all CCTV system equipment, hardware and work. Develop detailed and thorough test procedures with full test plan descriptions, test and measurement equipment listings, and test results data sheets. Submit these test plans to the Engineer for approval. The Engineer will notify the Contractor of the approval or disapproval of the test procedures; only test procedures approved by the Engineer can be used. Provide all necessary testing and measurement equipment.

Make the acceptance testing plan a detailed and thorough procedure for both the field installation test and the CCTV system site test. Demonstrate that the CCTV system equipment, hardware and work meet all requirements of the Contract. These requirements include but are not limited to all design, construction, materials, equipment, assembly, documentation of manufacturer's certification of assembly and configuration, environmental, performance, communications, video and data communications signal strength and clarity, compatibility with the NaviGator software, and documentary requirements of the Contract.

Prior to the beginning of any acceptance testing at a given CCTV system site, complete all configuration and documentation associated with GDOT's "ITS Surveillance Camera Control Integration and Calibration Procedure," described in Subsection 936.3.05.B. Be prepared to demonstrate such work.

B. Field Installation Test

Perform the Field Installation Test as an onsite test of the complete field installation assembly less the communications components; no acceptance testing at a given site can begin until all work associated with that site is complete, not including the communications components. For the field equipment installation test, use a PC system, CCTV Embedded Protocol control software, and a color video monitor to demonstrate full operation of the CCTV site. Demonstrate operation to include pan, tilt, focus, zoom, iris, position feedback, and communications address configuration. Measure the video signal strength at the video connector of the communications equipment.

C. CCTV System Site Test

For the CCTV System Site Test, demonstrate proper CCTV system performance at the TMC or other control center determined by the Department. Perform the CCTV System Site Test only after successful completion of the field installation acceptance test. Demonstrate the complete video image, camera/lens control, and communications operation from each CCTV site to the TMC. Use the NaviGator software and existing NaviGator control center and communications system to demonstrate the compatibility of the CCTV equipment and installation in its permanent NaviGator configuration. Verify data communications (pan, tilt, focus, zoom, iris, position feedback) from the TMC as defined in the Department-approved test procedures.

D. Burn-in Period

1. General Requirements

Provide a 30-day burn-in period for all work and equipment included in the Contract. The burn-in period shall consist of the field operation of the CCTV system in a manner that is in full accordance with the CCTV system requirements of the Plans and Specifications. An acceptance test procedure is not required for the system burn-in.

Conduct only one (1) burn-in period on the entire Contract. Commence with the burn-in period only after meeting all of the following requirements:

- a. All work required in all Contract documents for CCTV (may be combined with construction contract) (except this burn-in period) has been completed and inspected by the Engineer.
- b. Successfully complete all Acceptance Testing.

Commence with the burn-in period upon written authorization by the Department to commence. Terminate the burn-in period 30 consecutive days thereafter unless an equipment malfunction occurs. Stop the burn-in period for the length of time any equipment is defective. After repairing the equipment so that it functions properly, resume the burn-in period at the point it was stopped.

Successful completion and acceptance of the burn-in period will be granted on the 30th day unless any equipment has malfunctioned during the 15th through 30th day of the burn-in period. If any equipment has failed during the 15th through 30th day, final acceptance will be withheld until all the equipment is functioning properly for 15 days after repair.

When one specific piece of equipment has malfunctioned more than three times during the 30 day burn-in period, replace that unit with a new unit at no cost to the Department. Multiple failures of equipment in different locations shall constitute a failure of the 30 day burn-in period. The Contractor shall investigate the equipment failure and shall give a full report to the Engineer. The Contractor shall replace the failed devices and shall restart the burn-in period at Day 1, once those devices have been replaced and retested.

2. Contractor Responsibilities

During the burn-in period, maintain all work under this Contract in accordance with the Specifications. Restore any work or equipment to proper operating condition within 48 hours after notification.

3. Department Responsibilities

Department responsibilities during the burn-in period will be as follows:

- a. Expedient notification of Contractor upon failure or malfunction of equipment
- b. In the event that the Contractor does not provide the services enumerated above under his Contract responsibilities, the Department or its authorized agents may in the interest of public safety take emergency action to provide for adequate traffic control. Pay any costs incurred as a result of these emergency actions. Such action by the Department will not void any guaranties or warranties or other obligations set forth in the Contract.

4. Burn-In Period Acceptance

The Department will make burn-in period acceptance after satisfactory completion of the required burn-in period and on the basis of a comprehensive field inspection of the complete CCTV system in accordance with the specifications. Upon burn-in period acceptance but prior to Final Acceptance of the entire Contract, maintain the complete CCTV system in accordance with the requirements of Subsection 936.3.07.

E. Bench Acceptance Test

For retrofit assemblies, perform the bench acceptance test as an onsite test for all assemblies furnished as shown in the Plans. Furnish a benchtop stand and associated hardware for the camera system assembly mount that securely holds the camera system assembly while the camera is being operated. For the bench acceptance test, use a PC system, CCTV Embedded Protocol control software, and a color video monitor to demonstrate full operation of the CCTV site. Demonstrate operation to include picture quality, pan, tilt, focus, zoom, iris, position feedback, and communications address configuration.

936.3.07 Warranty and Maintenance

Equipment provided under this specification shall be warranted by the manufacturer to be free from defects in materials and workmanship for a minimum of three (3) years from Maintenance Acceptance.

The manufacturer's and supplier's warranties shall be transferable to the agency or user that is responsible for maintenance and shall be continuous throughout their duration.

During the warranty period, the manufacturer shall repair or replace any faulty equipment without cost to the purchaser, State of Georgia, or maintaining agency for all incidentals to the repair or replacement, including but not limited to parts, labor, or shipping.

The manufacturer shall be responsible for providing firmware or software updates associated with the CCTV system at no cost to the State of Georgia or maintaining agency during the warranty period. Further, the manufacturer is also responsible for ensuring that any updates will not degrade the original functionality of the product warranted.

The manufacturer and/or supplier shall provide consultation to the Department or user that is responsible for maintenance as needed at no cost during the warranty period for operating questions or problems that arise.

936.3.08 Training

Provide installation, operations, and maintenance training on the CCTV equipment at a site in the project area. Personnel trained by the various equipment manufacturers and authorized by said manufacturers shall perform the training. Include in the cost of training all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training. Furnish a training notebook in a labeled 3-ring binder to each trainee.

Provide installation, operations and maintenance training for up to twelve (12) people. Include in this training both classroom training and hands-on training. Limit in-shop and in-field training to group sizes of four (4) people at a time. Conduct all training in half-day sessions. Two half-day sessions may be held on the same day. The total of the training shall consist of at least six (6) clock hours of training for each participant. Provide a course content of, at a minimum, the following:

- Installation of all CCTV equipment
- Operations of all CCTV equipment
- Explanation of video quality
- Maintenance of all CCTV components
- Use of the CCTV embedded protocol control software
- Measurement of video signals
- Discussion of all warranty clauses
- Hands-on use of CCTV equipment in signal shop environment for each trainee
- In-field maintenance training
- Video Encoders and Decoders
- Installation of all digital video compression system equipment
- Explanation of MPEG-4 digitized video
- Maintenance of all digital video encoder and decoder system components including software
- Measurement of digital video signals
- Hands-on use of digital video transport system equipment for each trainee

CCTV and Encoders/Decoders training shall be provided in conjunction with the digital video transport system training specified in Section 939. The total of the CCTV and video transport system training shall consist of at least eight (8) clock hours of training for each participant. Meet all video transport system training requirements of Section 939.

936.4 Measurement

936.4.01 CCTV System

CCTV systems, Type B, are measured for payment by the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a CCTV system:

- Camera system assembly including the camera, lens, pan/tilt drive (except for Type D), control electronics and environmental enclosure.
- Pole-mounting hardware.
- Cabinet equipment, including but not limited to the cabinet interface assembly and all associated wiring, conductors, terminal blocks, and surge suppression.
- All weather heads, vertical conduit risers and conduit hardware on the CCTV support pole for power service, grounding, communications and control.
- All cables, connectors, hardware, interfaces, supplies, and any other items necessary for the proper operation and function of any CCTV system component with any other CCTV system component.

936.4.02 Encoders/Decoders

A. Video Encoders, Type B

Video Encoders, Type B, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

B. Video Encoders, Type C

Video Encoders, Type C, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

C. Video Decoders, Type B:

Video Decoders, Type B, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

D. Video Decoders, Type C:

Video Decoders, Type C, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

E. Video Decoders, Type D

Video Decoders, Type D, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

F. Video Decoders, Type E:

Video Decoders, Type E, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

936.4.03 Testing

Testing as described in section 936.3.06 is considered incidental to the cost of the camera systems and installation and shall not be paid for separately.

936.4.04 Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training. **All provided equipment shall become property of the Department.**

936.4.05 Limits

Not applicable

936.5 Payment

936.5.01 CCTV System

CCTV systems of the Type specified in the Plans are paid for at the Contract Unit Price. Payment is full compensation for furnishing and installing or delivering the CCTV system.

Payment for CCTV systems is made under:

Item No. 936	CCTV System, Type ____	Per each
Item No. 936	CCTV System, Type B, Retrofit Assembly	Per each
Item No. 936	CCTV System, Type ____, Retrofit Assembly (Furnish Only)	Per each
Item No. 936	CCTV Camera lowering system	Per each
Item No. 936	Video Encoder, Type ____	Per each
Item No. 936	Video Decoder, Type ____	Per each

936.5.02 Training

The Department will pay twenty-five (25%) of the total contract bid amount for training upon approval of the Training Plan. The Department will pay the remaining seventy-five (75%) after completion of all training as described in Subsection 936.3.08. The total sum of all payments cannot exceed the original contract amount for this item.

Payment for training is made under:

Item No. 936	Training	Lump Sum
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936.5.03 Adjustments

Not applicable