



INTELLIGENT TRANSPORTATION SYSTEMS

PROJECT SPECIAL PROVISIONS

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1. GENERAL REQUIREMENTS

1.1 DESCRIPTION

A. General

Conform to these Project Special Provisions, Project Plans, and the *2012 Standard Specifications for Roads and Structures* (also referred to hereinafter as the “Standard Specifications”). The current edition of these specifications and publications in effect on the date of advertisement will apply.

In the event of a conflict between these Project Special Provisions and the Standard Specifications, these Project Special Provisions govern.

B. Scope

The scope of this project includes the following major tasks:

1. Furnish and install new CCTV camera assemblies, CCTV camera lowering devices, Microwave Vehicle Detector (MVD) assemblies, Ethernet switches, and digital video encoders at the following locations along I-40 and I-77 in Iredell county, North Carolina:
 - I-77 south of US-70, one CCTV camera (CCTV-1) assembly, a CCTV camera lowering device, and two MVD assemblies (MVD-1&2) on a 60-foot wood pole. Modify the existing DMS electrical service to provide power for these devices.
 - I-77 at East Broad Street, one CCTV camera (CCTV-2) assembly and two MVD assemblies (MVD-3&4) on a 60-foot wood pole. Install new electrical service.
 - I-40 at US-64 (MM148), one CCTV camera (CCTV-3) assembly and two MVD assemblies (MVD-5&6) on a 60-foot wood pole. Install new electrical service.
 - I-40 at NC-115, one CCTV camera (CCTV-4) assembly and two MVD assemblies (MVD-7&8) on a 60-foot wood pole. Install new electrical service.
 - I-40 and I-77 interchange on I-77 south of I-40, one CCTV camera (CCTV-5) assembly and two MVD assemblies (MVD-9&10) on a 60-foot wood pole. Install new electrical service.
 - I-40 and I-77 interchange on I-40 east of I-77, one CCTV camera (CCTV-6) assembly and two MVD assemblies (MVD-11&12) on a 60-foot wood pole. Install new electrical service.
 - I-40 at US-64 (MM154), one CCTV camera (CCTV-7) assembly and two MVD assemblies (MVD-13&14) on a 60-foot wood pole. Install new electrical service.
 - I-40 east of US-64 (MM154), one CCTV camera (CCTV-8) assembly and two MVD assemblies (MVD-15&16) on a 60-foot wood pole. Modify the existing DMS electrical service to provide power for these devices.
 - I-77 at Jane Sowers Road, one CCTV camera (CCTV-9) assembly and two MVD assemblies (MVD-17&18) on a 60-foot wood pole. Install new electrical service.

- I-77 at US-21, one CCTV camera (CCTV-10) assembly on a 60-foot wood pole and two MVD assemblies (MVD-19&20) on a 30-foot wood pole. Install new electrical service.
- 2. Install an Ethernet switch and digital video decoders in Metrolina Regional Transportation Management Center (MRTMC) as directed by the Engineer. The MRTMC is located at 2327 Tipton Drive, Charlotte, NC 28406.
- 3. Integrate all devices with the MRTMC Traffic Management System.
- 4. Modify the existing video management software and MVD software application Graphical User Interfaces (GUI) for the successful integration and operation of the new devices.
- 5. Perform unit and system tests.

Determine the exact location of all devices and obtain Engineer's approval prior to starting any work at these locations.

Center-to-field communication will be provided by others.

C. Plan of Record Documentation

Before final acceptance, furnish plan of record documentation of all fieldwork. Plan of record documentation will be subject to approval before final acceptance. Store documentation in a manila envelope placed in a weatherproof holder mounted within each cabinet or housing for easy access.

Except for standard bound manuals, bind all 8 1/2" x 11" documentation, including 11" x 17" drawings folded to 8 1/2" x 11", in logical groupings in either 3-ring or plastic slide-ring loose-leaf binders. Permanently label each grouping of documentation.

Provide manual, electrical schematic diagram, and cabinet wiring diagram for each control equipment cabinet and piece of equipment in cabinet. Place manuals and prints in weatherproof holder. For wiring diagrams and electrical schematic diagrams not bound into printed manuals, provide copies at least 22" x 34".

Provide Operator's Manuals containing detailed operating instructions for each different type or model of equipment. Ensure manuals contain instructions for possible modification to equipment.

Provide maintenance procedures manuals containing detailed preventive and corrective maintenance procedures for each different type or model of equipment.

Provide real world coordinates for all junction boxes and field devices installed under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer. For equipment cabinets, obtain and provide the location of the cabinet.

Provide both a digital copy and hard copy of all information regarding the location (including to but not limited to manufacturer, model number, and NCDOT inventory number) in the Microsoft spreadsheet provided by the Department, shown by example below:

NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #	Comm Media	Destination
05-7009	Cam 1	I-540/I-40	35.8625	-78.8123	Pelco	Spectravision	60 SMFO	TRTMC
05-7010	Cam 2	NC 54/I-40	35.8523	-78.7631	Pelco	Spectravision	60 SMFO	TRTMC
05-7030	HAR 1 – Johnston Co.	I-40 at NC 42 (mp 312)	35.2456	-77.952			Dial-up	TRTMC
05-7001	DMS # 1	I-85 N/I-40 E, mp 159.1			Mark IV		Dial-Up	TRTMC
05-7003	DMS # 3	I-40 W, mp 307.7			Mark IV		Dial-Up	TRTMC
05-7004	DMS # 4	I-40 E, mp 286.0			Mark IV		60 SMFO	TRTMC

D. Qualified Products

Furnish new equipment, materials, and hardware unless otherwise required. Inscribe manufacturer’s name, model number, serial number, and any additional information needed for proper identification on each piece of equipment housed in a case or housing.

Furnish factory assembled cables without adapters, unless otherwise approved by the Engineer, for all cables required to interconnect any field or central equipment including but not limited to fiber optic transceivers.

Certain equipment listed in these Project Special Provisions must be pre-approved on the Department’s ITS & Signals Qualified Products List (QPL) by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project.

The QPL is available on the Department’s website. The QPL website is:

<http://www.ncdot.org/doh/preconstruct/traffic/ITSS/SMS/qpl/>

E. Warranties

Provide manufacturer’s warranties on Contractor-furnished equipment for material and workmanship that are customarily issued by the equipment manufacturer for a period of one year in length from successful completion of the 30-day observation period. Include unconditional coverage for all parts and labor necessary or incidental to repair of defective equipment or workmanship and malfunctions that arise during warranty period.

Ensure all contractor-furnished equipment, including pieces and components of equipment, hardware, firmware, software, middleware, internal components, and subroutines which perform any date or time data recognition function, calculation, or sequencing will support a four digit year format for a period of at least 50 years.

Upon successful completion of the 30-day observation period, transfer manufacturer’s warranties with proper validation by the manufacturer to the Department or its designated maintaining agency.

2. WOOD POLES

2.1 DESCRIPTION

Furnish and install wood poles and guy assemblies at locations shown in the Plans and in accordance with these Project Special Provisions.

2.2 MATERIALS

Furnish 30-foot Class IV wood poles for electrical service and installation of MVD assemblies. Furnish 60-foot Class III wood poles for CCTV camera/MVD installations. Comply with the Standard Specifications:

Article 1098-2, "Structural Timber and Lumber"

Article 1098-6, "Pole Line Hardware"

Article 1098-7, "Guy Assemblies"

2.3 CONSTRUCTION METHODS

Install wood poles and guy assemblies as shown in the Plans. Comply with the Standard Specifications:

Section 1720, "Wood Poles"

Section 1721, "Guy Assemblies"

2.4 MEASUREMENT AND PAYMENT

Wood Pole (30') will be measured and paid as the actual number of Class IV wood poles furnished, installed and accepted.

Wood Pole (60') will be measured and paid as the actual number of Class III wood poles furnished, installed and accepted.

Guy Assembly will be measured and paid as the actual number of guy assemblies furnished, installed and accepted.

No measurement will be made for installing grounding systems as these will be considered incidental to furnishing and installing wood poles.

No separate measurements will be made for guy assembly types.

No measurement will be made of guy cable, guy guard, anchors, clamps, or fittings as these will be considered incidental to furnishing and installing guy assemblies.

Payment will be made under:

Pay Item

Wood Pole (30').....	Each
Wood Pole (60').....	Each
Guy Assembly.....	Each

3. RISER ASSEMBLIES

3.1 DESCRIPTION

Furnish and install riser assemblies as shown in the Plans. Comply with Standard Specifications:
Section 1722, "Riser Assemblies"

3.2 MATERIALS

Comply with Standard Specifications:
Article 1722-2

3.3 CONSTRUCTION METHODS

Comply with Standard Specifications:
Article 1722-3

3.4 MEASUREMENT AND PAYMENT

___" *Riser with* ___ will be measured and paid as the actual number of risers of each type and size furnished, installed and accepted. No separate payment will be made for weatherheads, heat shrink tubing, or pole attachment fittings as these will be considered incidental to furnishing and installing risers.

Payment will be made under:

Pay Item

1-1/4" Riser with Weatherhead.....Each

4. ELECTRICAL SERVICE

4.1 DESCRIPTION

Install new electrical service equipment as shown in the Plans. Comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the NCDOT 2012 Standard Specifications, the Project Special Provisions and all local ordinances. All work involving electrical service shall be coordinated with the appropriate utility company and the Engineer or his designated representative.

It is the Contractor's responsibility to apply and pay for all fees associated with any electrical permits and inspections required by the local utilities. The Contractor will apply for power service in the Department's name. The Department will be responsible for monthly fees associated with the power service. No contract time extensions will be granted for delays associated with installing new electrical service.

4.2 MATERIAL

A. Meter Base/Disconnect Combination Panel

Furnish and install new meter base/disconnect combination panels as shown in the Plans. Provide meter base/disconnect panels that have a minimum of eight (8) spaces in the disconnect. Furnish 15 ampere single pole circuit breakers at the CCTV locations. Furnish circuit breakers with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure meter base/disconnect combination panels are listed as meeting UL Standard UL-67 and marked as being suitable for use as service equipment. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals with minimum wire capacity range of number 12 through number 3/0 AWG.

Furnish NEMA Type 3R meter base rated 100 Ampere minimum that meets the requirements of the local utility. Provide meter base with sockets' ampere rating based on sockets being wired with minimum of 167 degrees F insulated wire. Furnish 4 terminal, 600 volt, single phase, 3-wire meter base that complies with the following:

- Line, Load, and Neutral Terminals accept number 4/0 AWG Copper/Aluminum wire
- With or without horn bypass
- Made of galvanized steel
- Listed as meeting UL Standard UL-414
- Overhead or underground service entrance specified

Furnish 1.25" watertight hub for threaded rigid conduit with meter base.

B. Modify Electrical Service Equipment

At the locations shown in the Plans, remove and replace the existing service disconnect assembly. Furnish and install a disconnect panels that have a minimum of eight (8) spaces. Furnish a double pole 50 ampere circuit breaker for the existing Dynamic Message Sign (DMS) and a single pole 15 ampere circuit breaker for the new CCTV camera and MVDs. Furnish circuit breakers with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure service disconnects are listed as meeting UL Standard UL-489. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals with minimum wire capacity range of number 14 through number 3 AWG.

C. Equipment Cabinet Disconnect

Furnish and install new equipment cabinet disconnects rated 60-Amp minimum at the locations shown in the Plans. Provide equipment cabinet disconnects that have a minimum of four (4) spaces. Furnish disconnects with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure at locations shown in the Plans. Ensure equipment cabinet disconnects are listed as meeting UL Standard UL-489. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus

with a minimum of four terminals and a minimum wire capacity range of number 12 through number 3/0 AWG.

Furnish one single pole 15A circuit breaker in the equipment cabinet.

D. 3-Wire THWN # 3 AWG Copper Service Entrance Conductors

Furnish 3 #3 AWG stranded copper service entrance conductors with THWN rating for electrical service connections. Provide conductors with black, red and white insulation. Provide conductors intended for power circuits at 600 Volts or less and comply with the following:

- Listed as meeting UL Standard UL-83
- Meets ASTM B-3 and B-8 or B-787 standards.

E. 3-Wire THWN # 12 AWG Copper Feeder Conductors

Furnish 3 #12 AWG stranded copper conductors with THWN rating for feeder conductors. Provide conductors with black, white and green insulation. Provide conductors intended for power circuits at 600 Volts or less and comply with the following:

- Listed as meeting UL Standard UL-83
- Meets ASTM B-3 and B-8 or B-787 standards.

F. Grounding System

Furnish 5/8"x10' copper clad steel grounding electrodes (ground rods), #4 AWG solid bare copper conductors, and exothermic welding kits for grounding system installations. Comply with the NEC, Standard Specifications, these Project Special Provisions, and the Plans.

4.3 CONSTRUCTION METHODS

Permanently label cables at all access points using nylon tags labeled with permanent ink. Ensure each cable has a unique identifier. Label cables immediately upon installation. Use component name and labeling scheme approved by the Engineer.

A. Meter Base/Disconnect Combination Panel

Install meter base/disconnect combination panels as called for in the Plans including riser assemblies and service entrance conductors. Route the feeder conductors from the meter base/disconnect to the field equipment cabinet/disconnect. Provide rigid galvanized steel conduit for above ground and PVC for below ground installations.

Ground the new electrical service in accordance with the Project Special Provisions, Standard Specifications and Standard Drawings, and the Plans.

B. Modify Electrical Service Equipment

Coordinate with the Engineer and utility company to de-energize the service temporarily prior to starting the modification.

Measure the existing grounding system ground resistance. If the ground resistance is greater than 25 ohms, abandon the existing grounding system and install a new grounding system as described in this section. Ensure the existing grounding electrode conductor is removed or disconnected from the system.

Install a new 1.25-inch rigid galvanized steel conduit system between the existing meter base and the new service disconnect. Install 3 THWN #3 AWG (minimum) stranded copper conductors from the existing meter base to the new service disconnect. Install 1.25" rainproof conduit hub on top of the disconnect if installed below the meter base.

Modify the existing conduit system and conductors between the new service disconnect and existing DMS cabinet to accommodate installation of the new disconnect such that existing conductors' length is sufficient. Splicing of conductors is not allowed.

Install a new conduit system between the new service disconnect and the new CCTV equipment cabinet disconnect as shown in the Plans. All above ground conduits, conduit bodies, and fittings must be rigid galvanized steel. Underground conduits and fittings can be PVC. Transition from rigid galvanized steel to PVC using a rigid galvanized steel sweeping elbow. Install stranded copper feeder conductors from the new service disconnect to the new CCTV equipment cabinet disconnect sized as shown in the Plans.

C. Equipment Cabinet Disconnect

At locations shown in the Plans, furnish and install an equipment cabinet disconnect. Bond the equipment cabinet disconnect in accordance with the NEC.

Install THWN stranded copper feeder conductors as shown in the Plans between the new service disconnect and the equipment cabinet disconnect. Route the conductors from the equipment cabinet disconnect to the CCTV field equipment cabinets in rigid galvanized steel conduit. Ensure that the grounding system complies with the grounding requirements of these Project Special Provisions, the Standard Specifications and the Plans.

D. 3-Wire THWN #3 AWG Copper Service Entrance Conductors

At locations shown in the Plans furnish and install 3 THWN #3 AWG copper service entrance conductors to supply 240/120 VAC service to the meter base/disconnect. Comply with the Standard Specifications and Standard Drawings and all applicable electrical codes. Splicing of conductors is not allowed.

E. 3-Wire THWN #12 AWG Copper Feeder Conductors

At locations shown in the Plans furnish and install 3 THWN #12 AWG copper feeder conductors to supply 120 VAC to the CCTV field equipment cabinet. Comply with the Standard Specifications and Standard Drawings and all applicable electrical codes. Splicing of conductors is not allowed.

F. Grounding System

Connect the #4 AWG grounding conductor to ground rods using an exothermic welding process. Test the system to ensure a ground resistance of 20-ohms or less is achieved. Drive additional ground rods as necessary or as directed by the Engineer to achieve the proper ground resistance.

4.4 MEASUREMENT AND PAYMENT

Meter base/disconnect combination panel will be measured and paid as the actual number of complete and functional meter base/disconnect combination panel service locations furnished, installed and accepted. Breakers, exposed vertical conduit runs to the cabinet, 6"x6" wood pedestal, and any remaining hardware and conduit will be considered incidental to meter base/disconnect combination panels.

Modify electrical service equipment will be measured and paid as the actual number of complete and functional modified electrical service equipment furnished, installed and accepted. New breakers, new conduit between the meter base and new service disconnect, new stranded copper conductors between the meter base and new service disconnect, above ground rigid galvanized steel conduit from new service disconnect to below ground, and any remaining hardware, fittings, and conduit bodies to modify the existing service as described above will be considered incidental.

Equipment cabinet disconnect will be measured and paid as the actual number of complete and functional equipment cabinet disconnects furnished, installed and accepted. Breakers, exposed vertical conduit runs to the cabinet, ground rods, ground wire and any remaining hardware and conduit to connect the equipment cabinet disconnect to the cabinet will be considered incidental to the equipment cabinet disconnect.

3-Wire #3 AWG copper service entrance conductors will be measured and paid as the actual linear feet of 3-wire #3 AWG copper service entrance conductors for each service entrance furnished, installed and accepted. Payment is for all three conductors. Measurement will be for the actual linear footage of combined conductors after all terminations are complete. No payment will be made for each individual conductor.

3-Wire #12 AWG copper feeder conductors will be measured and paid as the actual linear feet of 3-wire #12 AWG copper feeder conductors furnished, installed and accepted. Payment is for all three conductors. Measurement will be for the actual linear footage of combined conductors after all terminations are complete. No separate payment will be made for each individual conductor. No payment will be made for excess wire in the cabinets.

5/8" X 10' grounding electrode (ground rod) will be measured and paid as the actual number of 5/8" copper clad steel ground rods furnished, installed and accepted. No separate payment will be made for exothermic welding kit as they will be considered incidental to the installation of the ground rod.

#4 solid bare grounding conductors will be measured and paid as the actual linear feet of #4 AWG solid bare copper grounding conductor furnished, installed and accepted. Measurement will be along the approximate centerline from the base of the electrical service disconnect to the last grounding electrode.

Payment will be made under:

Pay Item

Meter Base/Disconnect Combination Panel	Each
Modify Electrical Service Equipment.....	Each
Equipment Cabinet Disconnect.....	Each
3-Wire #3 AWG Copper Service Entrance Conductors	Linear Feet
3-Wire #12 AWG Copper Feeder Conductors.....	Linear Feet
5/8"X10' Grounding Electrode.....	Each
#4 Solid Bare Copper Grounding Conductor.....	Linear Foot

5. CONDUIT AND JUNCTION BOXES

5.1 DESCRIPTION

As shown in the Plans, furnish and install PVC or **solid wall** (in & out) high-density polyethylene (HDPE) conduit for underground installation, miscellaneous fittings, all necessary hardware, marker tape, backfill, graded stone, paving materials, and seeding and mulching at the locations shown in the Plans and in accordance with these Project Special Provisions.

Furnish and install standard size junction boxes at the locations shown in the Plans and in accordance with these Project Special Provisions for the installation of electrical conductors. Furnish and install junction box cover with "NCDOT Electric" logo.

5.2 MATERIALS

Material, equipment, and hardware furnished under this section shall be pre-approved on the Department's QPL.

Comply with the Standard Specifications:

Section 1091, "Electrical Materials"

Article 1018-2, "Backfill"

Article 545-2 & 545-3, "Graded Stone"

Article 1098-5, "Junction Boxes"

5.3 CONSTRUCTION METHODS

Install HDPE conduit and oversized heavy-duty junction boxes as noted in the Plans. Comply with the Standard Specifications:

Section 1715, "Underground Cable Installation"

Section 1716, "Junction Boxes"

5.4 MEASUREMENT AND PAYMENT

Unpaved trenching (qty) (size) will be measured horizontal linear feet of trenching for underground conduit installation furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be in linear feet.

Directional Drill (qty) (size) will be measured horizontal linear feet of trenching for underground conduit installation furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be in linear feet.

Junction box (_____) will be measured and paid in actual number of junction boxes of each size and type furnished, installed, and accepted. No measurement will be made of covers and grounding systems.

No separate measurement will be made of vertical segments, non-metallic conduit, metallic conduit, sealing devices, backfill, graded stone, paved materials, miscellaneous fittings, pull lines excavation of rock, seeding and mulching, or any other hardware or materials required for installation of underground conduit, and junction boxes as these will be considered incidental to the items listed above.

Payment will be made under:

Pay Item

Unpaved Trench (2)(2").....	Linear Foot
Directional Drill (2)(2").....	Linear Foot
Junction Box (Standard Size)	Each

6. MICROWAVE VEHICLE DETECTOR FIELD EQUIPMENT

6.1 DESCRIPTION

Furnish and install non-intrusive microwave or radar vehicle detectors (MVD) in accordance with the Plans and these Project Special Provisions. Provide MVDs that are compatible, interoperable, and completely interchangeable with existing Image Sensing Systems RTMS currently in use by NCDOT in this Region. Provide MVD units with RS-232/485 and TCP/IP ports and lead-in cable. The MVD devices will collect traffic data such as traffic volume, vehicle speed, average speed, lane occupancy, vehicle classification and presence.

Furnish new equipment and component parts, of the latest design and manufacture, and in operable condition at the time of delivery and installation. No part or attachment can be substituted or applied contrary to the manufacturer's recommendations and standard practices.

Provide equipment design that prevents reversed assembly or improper installation of connectors, fasteners, etc. Design each item of equipment to protect personnel from exposure to high voltage during equipment operation, adjustments, and maintenance.

Program, configure, and integrate all MVDs with the MRTMC software currently in use.

6.2 MATERIALS

A. Microwave Vehicle Detector (MVD)

Furnish MVDs with all necessary hardware, mounting brackets and outdoor rated cabling to provide a complete, integrated and fully functional system. The MVD must meet the following minimum functional requirements:

- Measured Quantities Volume, speed, occupancy, classification
- Detection Zone Up to 12 traffic lanes
- Zone Width 7 – 20 feet
- Detection Range 0 to 250 feet
- Zone Resolution 1.5 feet or less
- Communications TCP/IP and RS-232 / RS-485
- Configuration Automatic
- Management Supports local and remote management
- Storage 8 Mb built-in memory, min.
- Power 12 – 24 VAC or DC
- Operating Temperature -40°C to 75°C
- Humidity Up to 95%, relative

- Vibration 0.5 g up to 300MHz
- Enclosure NEMA 4X IP-65 polycarbonate
- MTBF 10 years min.

B. Power and Communications Cables

Furnish and install power and data cable as recommended by the MVD manufacturer. Provide outdoor rated power and communications cable adequate for underground installation in conduit.

6.3 CONSTRUCTION METHODS

A. Microwave Vehicle Detector

Mount the MVDs in a side-fired configuration on the wood poles at the locations shown in the Plan using the manufacturer supplied mounting brackets. Attach with stainless steel bands.

Install the MVDs at a height above the road surface so that the masking of vehicles is minimized and that all detection zones are contained within the specified elevation angle as suggested by the manufacturer. Install, configure and calibrate one MVD unit per direction of traffic. A manufacturer’s representative should determine the height of each detector unit to ensure best performance.

Set up each MVD detection zone using configuration software and a Notebook PC to collect and report vehicle count, speed, occupancy, and four vehicle classifications.

Using the TCP/IP port, connect the MVDs to the Ethernet switch installed in the CCTV field equipment cabinet for communication with the MRTMC.

Install grounding system for the stand-alone MVD assemblies according to the CCTV Camera Typical Grounding System shown in the Plans.

B. Power and Communications Cables

Install outdoor rated power and communications cables per the manufacture recommendation.

6.4 MEASUREMENT AND PAYMENT

MVD assembly will be measured and paid as the actual number of MVD assemblies furnished, installed, configured, integrated, tested, and accepted. No separate measurement will be made for power and communications cables, connectors, attachment assemblies, conduit, condulets, grounding equipment, surge protectors, or any other equipment or labor required to install the MVD assembly.

Payment will be made under:

Pay Item

MVD AssemblyEach

7. CCTV CAMERA FIELD EQUIPMENT

7.1 DESCRIPTION

Furnish and install CCTV camera field equipment described in this Section. Furnish equipment that is compatible, interoperable, and completely interchangeable with existing Pelco Spectra IV high-performance dome equipment currently in use by NCDOT in this Region. Ensure that the equipment is fully compatible with all features of the existing video matrix switch at the MRTMC and the existing *VideoPro* video management software currently deployed.

Perform bucket truck surveys of each CCTV site identified in the Plans to establish the exact location and mounting height for each camera that maximizes the cameras field of view. The Contractor shall survey up to two (2) specific placement options at each CCTV location. Take digital photographs in a minimum of four (4) directions from the bucket truck at the recommended camera location and mounting height. Assemble the digital photographs for each location and submit to the Engineer for approval.

7.2 MATERIAL

A. General

Furnish and install new CCTV camera assemblies at the locations shown on the Plans. Each assembly consists of the following:

- One Dome CCTV camera that contains in a single enclosed unit the following functionality and accessories:
 1. CCTV color digital signal processing camera unit with zoom lens, filter, control circuit, and accessories
 2. Motorized pan, tilt, and zoom
 3. Pole-mount camera attachment assembly
 4. All necessary cable, connectors and incidental hardware to make a complete and operable system
- A lightning arrestor installed in-line between the CCTV camera and the equipment cabinet components.
- A NEMA Type 4 enclosure constructed of aluminum with a clear acrylic dome or approved equal Camera Unit housing.

B. Camera and Lens

1. Cameras

Furnish new charged-coupled device (CCD) color cameras. Furnish cameras with automatic gain control (AGC) for clear images in varying light levels. The camera must meet the following minimum requirements:

- Video signal format: NTSC composite color video output, 1 volt peak to peak
- Automatic Gain Control (AGC): 0-20 dB, peak-average adjustable
- Automatic focus: Automatic with manual override
- White balance: Automatic through the lens with manual override
- Electronic-Shutter: dip-switch selectable electronic shutter with speed range from 1/60 of a second (off) to 1/30,000th of a second

- Overexposure protection: The camera must have built-in circuitry or a protection device to prevent any damage to the camera when pointed at strong light sources, including the sun
- Sensitivity: 1.5 lux at 90% scene reflectance
- Signal to noise ratio: Greater than 48-dB
- Video output Connection: 1-volt peak to peak, 75 ohms terminated, BNC connector
- Power: 24 VAC or less

2. Zoom Lens

Furnish each camera with a motorized zoom lens that is high performance integrated dome system or approved equivalent with automatic iris control with manual override and neutral density spot filter. Furnish lenses that meet the following optical specifications:

- Focal length: 0.16” – 3.45”, 35X optical zoom, and 12X electronic zoom
- Preset positioning: 64 Presets

The lens must be capable of both automatic and remote manual control iris and focus override operation. The lens must be equipped for remote control of zoom and focus, including automatic movement to any of the preset zoom and focus positions. Mechanical or electrical means must be provided to protect the motors from overrunning in extreme positions. The operating voltages of the lens must be compatible with the outputs of the camera control.

C. Camera Housing

Furnish new dome style enclosure for the CCTV assemblies. Equip each housing with mounting assembly for attachment to the CCTV camera pole. The enclosures must be equipped with a sunshield and be fabricated from corrosion resistant aluminum and finished in a neutral color of weather resistant enamel. The enclosure must meet or exceed NEMA 4X ratings. The viewing area of the enclosure must be tempered glass.

D. Pan and Tilt Unit

Equip each new dome style assembly with a pan and tilt unit. The pan and tilt unit must be integral to the high performance integrated dome system. The pan and tilt unit must be rated for outdoor operation, provide dynamic braking for instantaneous stopping, prevent drift, and have minimum backlash. The pan and tilt units must meet or exceed the following specifications:

- Pan: continuous 360 Degrees
- Tilt: up/down 180 degrees minimum
- Input voltage: 24 VAC 50/60Hz
- Motors: Two-phase induction type, continuous duty, instantaneous reversing
- Preset Positioning: 64 PTZ presets per camera

E. Control Receiver/Driver

Provide each new camera unit with a control receiver/driver that is integral to the CCTV dome assembly. The control receiver/driver will receive serial asynchronous data initiated from a camera control unit, decode the command data, perform error checking, and drive the pan/tilt unit, camera controls, and motorized lens. As a minimum, the control receiver/drivers must provide the following functions:

- Zoom in/out

- Automatic focus with manual override
- Tilt up/down
- Automatic iris with manual override
- Pan right/left
- Minimum 64 preset positions for pan, tilt, and zoom

In addition, each control receiver/driver must accept status information from the pan/tilt unit and motorized lens for preset positioning of those components. The control receiver/driver will relay pan, tilt, zoom, and focus positions from the field to the remote camera control unit. The control receiver/driver must accept “goto” preset commands from the camera control unit, decode the command data, perform error checking, and drive the pan/tilt and motorized zoom lens to the correct preset position. The preset commands from the camera control unit will consist of unique values for the desired pan, tilt, zoom, and focus positions.

F. Camera Lowering Device

At locations shown in the Plans, furnish and install a pole mounted camera lowering device with a minimum of 60-foot reach. The device must be a self-encased motorized system and factory wired with power and video surge protection. The device must meet the following minimum requirements:

- Aluminum alloy body with stainless steel junction boxes,
- Heavy duty motor for lowering and raising,
- Secured keyed lowering/raising operation,
- Self-aligning docking system,
- Stainless steel lifting wire and wire pulley,
- Weather seal at all access points,
- Operating current: 5Amp max. at 120 VAC,
- UL listed and RoHS compliant,
- Compatible with digital and analog camera systems,
- Weather proof cabling system (power/communications) for exposed or in riser installation.

G. CCTV Camera and Lowering Device Attachment to Pole

At locations shown in the Plans where new CCTV cameras or camera lowering devices are to be installed on new poles, furnish an attachment assembly for the unit(s). Use stainless steel banding approved by the Engineer. Submit shop drawings for review and approval by the Engineer prior to installation.

Furnish CCTV attachments that allow for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather tight, seal that does not allow moisture to enter the enclosure.

Furnish an attachment assembly that is able to withstand wind loading at the maximum wind speed and gust factor of 90 mph and can support a minimum camera unit dead load of 45 pounds and camera lowering device deal load of 110 pounds.

H. Surge Suppression

Protect all equipment at the top of the pole by grounded metal oxide varistors connecting each power conductor to ground.

Protect coaxial cable from each camera by a surge protector at each end of the cable.

I. Digital Video Encoder

Furnish and install a digital video encoder to allow video-over-IP transmission. The encoder units may be shelf or rack mounted. Furnish encoders with the following features:

- Network Interface Ethernet 10/100Base-T (RJ-45 connector)
- Protocols RTP/IP, UDP/IP, TCP/IP, multicast IP DNS and DHCP client
- Security SSL-based authentication
- Video Output 1 composite (NTSC/PAL), 1 Vpp, 75 ohms, BNC connector
- Compression MPEG-4
- Resolution Scalable; 176x128 to 704x480 NTSC (176x144 to 704x576 PAL)
- Frame Rate 1-30 FPS programmable (full motion)
- Bandwidth 30 kbps – 6 Mbps configurable
- Serial Ports 1 RS-232, 1 RS-422/485; Supports any asynchronous PTZ serial protocol
- Environment 32°F to 122°F, 95% non-condensing humidity at 22°F
- Connectors 5 position terminal strip

J. Field Ethernet Switch

Furnish and install a field hardened managed Ethernet switch with the following minimum features:

- Eight (8) Fast Ethernet ports (10/100BaseTx)
- 24-48 VDC or 120VAC Power Supply, 10 Watts max.
- -40 – 185 °F temperature range
- Galvanized steel enclosure
- DIN rail or panel mounted
- Store & Forward switching mode with $\leq 10 \mu$ Sec. latency
- ≥ 5 Gbps switching bandwidth
- 128, 256, 512 kbps, 4, 8 Mbps port rate limiting
- ≥ 32 kbytes MAC table
- ≥ 2 Mbit Frame buffer memory
- ≥ 4 Priority queues
- ≥ 255 Vlans
- Network management through graphical web-based HTTP with SSL 128-bit encryption, SNMP v3 with 56-bit encryption, Telnet, VT100, SSH/SFTP with 128-bit encryption, Command Line Interface, RSA Key Management with 1024 bit key
- TACACS+, RADIUS client, PPP Authentication and Accounting

Ensure the switch complies with all applicable IEEE networking standards, including but not limited to:

- IEEE 802.3
- IEEE 802.3u, .3x, .3z
- IEEE 802.3ab, .ad
- IEEE 802.1d MAC Bridges, and STP
- IEEE 802.1p, .1w, .1x
- IEEE 802.1Q, .1Q-2005

Ensure the switch complies with the following IETF RFCs:

- RFC768, 783, 791, 792, 793, 826, 854, 894, 1112, 1519, 1541, 2030, 2068, 2236, 2284, 2475, 2865, 3414, 3415
- RFC1493, 1907, 2012, 2013, 2578, 2579, 2819, 2863

7.3 CONSTRUCTION METHODS

A. General

Mount CCTV camera units/lowering device at a height sufficient to adequately see traffic in all directions and as approved by the Engineer. The minimum attachment height is 45 feet above ground level.

Mount the CCTV camera units/lowering device such that a minimum 5 feet of clearance is maintained between the camera and the top of the pole.

Mount CCTV cameras/lowering device on the side of poles nearest intended field of view. Avoid occluding the view with the pole. Obtain approval of camera orientation from the Engineer.

Install a separate riser on the pole for power to the camera lowering device.

B. Digital Video Encoder

Install and integrate the video encoder at the CCTV camera sites shown in the Plans. Connect the video output of the CCTV camera to the input of the video encoder. Use standard coax cable with BNC (gold-plated center pin) connectors. Connect the PTZ control wires from the camera to the video encoder in accordance with manufacturer's recommended instructions.

C. Field Ethernet Switch

Install an Ethernet switch at the CCTV camera sites shown in the Plans. Connect the video encoder, MVDs, and 3G/4G modem (provided by others) to the switch using outdoor rated CAT 5e LAN cable. Determine and assign proper IP addresses to all field devices. Verify communication with MRTMC over the 3G/4G network.

D. Electrical and Mechanical Requirements

Ground all equipment as called for in the Standard Specifications, these Special Provisions, and the Plans.

Install surge protectors in the CCTV field equipment cabinet on all ungrounded conductors entering the CCTV enclosure.

Install all cables as required to interconnect cameras, encoders, and Ethernet switches. Ensure that all connections are tight and fully secure.

7.4 MEASUREMENT AND PAYMENT

CCTV Assembly will be measured and paid as the actual number of CCTV assemblies furnished, installed, integrated, and accepted. No separate measurement will be made for cabling, connectors, CCTV camera attachment assemblies, conduit, condulets, grounding equipment, surge and lightning protection, or any other equipment or labor required to install the CCTV assembly.

No separate payment will be made for coaxial cable. Coaxial cable, furnished and installed in the quantities required, will be incidental to the "CCTV Assembly" pay item.

Camera Lowering Device will be measured and paid as the actual number of camera lowering devices furnished, installed, integrated, and accepted. No separate measurement will be made for cabling, power surge protection, connectors or any other equipment or labor required to install the camera lowering devices.

Digital Video Encoder will be measured and paid as the actual number of digital video encoders furnished, installed, integrated, and accepted. No separate measurement will be made for cabling, connectors or any other equipment or labor required to install the digital video encoders.

Field Ethernet Switch will be measured and paid as the actual number of field Ethernet switches furnished, installed, integrated, and accepted. No separate measurement will be made for cabling, connectors or any other equipment or labor required to install the switch.

Payment will be made under:

Pay Item

CCTV Assembly	Each
Camera Lowering Device	Each
Digital Video Encoder	Each
Field Ethernet Switch.....	Each

8. CCTV FIELD EQUIPMENT CABINET

8.1 DESCRIPTION

Furnish 336 stretch cabinets to house CCTV/MVD control and communications equipment. The 336 stretch field cabinet must consist of a cabinet housing, 19-inch EIA mounting cage, and power distribution assembly (PDA #3 as described in the CALTRANS TSCES).

The cabinet housing must conform to sections 6.2.2 (Housing Construction), 6.2.3 (Door Latches and Locks), 6.2.4 (Housing Ventilation), and 6.2.5 (Hinges and Door Catches of the CALTRANS TSCES. Do not equip the CCTV cabinet housings with a police panel.

The cabinet cage must conform to section 6.3 of the CALTRANS TSCES.

Terminal blocks on the PDA #3 Assembly have internal wiring for the Model 200 switch pack sockets. Do not use terminal blocks on PDA #3 as power terminals for cabinet devices. Do not furnish cabinet with "Input Panels" described in section 6.4.7.1 of the TSCES. Do furnish cabinet with "Service Panels" as described in section 6.4.7.1 of the TSCES and as depicted on drawing TSCES-9 in the TSCES. Use service panel #2.

Furnish terminal blocks for power for CCTV/MVD and communications devices as needed to accommodate the number of devices in the cabinet.

Do not furnish cabinets with C1, C5, or C6 harnesses, input files, output files, monitor units, model 208 units, model 430 units, or switch packs.

Furnish all conduits, shelving, mounting adapters, and other equipment as necessary to route cabling, mount equipment, and terminate conduit in equipment cabinet.

Obtain the Engineer's approval of all CCTV cabinets prior to furnishing for use on this project.

8.2 MATERIALS

A. Shelves

Provide one fixed and one pull out, hinged-top drawer, having sliding tracks, with lockout and quick disconnect feature in the equipment cabinet. Furnish a pullout drawer that extends a minimum of 14 inches that is capable of being lifted to gain access to the interior of the drawer. Minimum interior dimensions of the drawer are to be 1 inch high, 13 inches deep, and 16 inches wide. Provide drawers capable of supporting a 40-pound device or component when fully extended.

B. Cabinet Light

Include two (2) fluorescent lighting fixtures (one front, one back) mounted horizontally inside the top portion of the cabinet. The fixtures should include a cool white lamp, and must be operated by normal power factor UL-listed ballast. Install a door-actuated switch to turn on the applicable cabinet light when the front door or back door is opened. Mount the lights not to interfere with the upper door stay.

C. Surge Protection for System Equipment

Provide each cabinet with devices to protect the CCTV/MVD and communications equipment from electrical surges and over voltages as described below.

1. Main AC Power Input

Furnish and install each cabinet with a hybrid-type, power line surge protection device mounted inside the power distribution assembly. Install the protector between the applied line voltage and earth ground. The surge protector must be capable of reducing the effect of lightning transient voltages applied to the AC line. Mount the protector inside the Power Distribution Assembly housing facing the rear of the cabinet. The protector must include the following features and functions:

- Maximum AC line voltage: 140 VAC.
- Twenty pulses of peak current, each of which must rise in 8 microseconds and fall in 20 microseconds to ½ the peak: 20000 Amperes.
- The protector must be provided with the following terminals:
 - Main Line (AC Line first stage terminal).
 - Main Neutral (AC Neutral input terminal).
 - Equipment Line Out (AC line second state output terminal, 19 amps).
 - Equipment Neutral Out (Neutral terminal to protected equipment).
 - GND (Earth connection).
- The Main AC line in and the Equipment Line out terminals must be separated by a 200 Microhenry (minimum) inductor rated to handle 10 AMP AC Service.
- The first stage clamp must be between Main Line and Ground terminals.
- The second stage clamp must be between Equipment Line Out and Equipment Neutral.

- The protector for the first and second stage clamp must have an MOV or similar solid state device rated at 20 KA and must be of a completely solid state design (i.e., no gas discharge tubes allowed).
- The Main Neutral and Equipment Neutral Out must be connected together internally and must have an MOV similar solid state device or gas discharge tube rated at 20 KA between Main Neutral and Ground terminals.
- Peak Clamp Voltage: 350 volts at 20 KA. (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together).
- Voltage must never exceed 350 volts.
- The Protector must be epoxy-encapsulated in a flame-retardant material.
- Continuous service current: 10 Amps at 120 VAC RMS.
- The Equipment Line Out must provide power to cabinet CCTV/MVD and communications equipment and to the 24V power supply.

2. Ground Bus

Provide a neutral bus that is not connected to the earth ground bus anywhere within the cabinet. Ensure that the earth ground bus and the neutral ground bus each have ten compression type terminals, each of which can accommodate wires ranging from number 14 through number 4.

8.3 CONSTRUCTION METHODS

For each field cabinet installation use stainless steel banding or other method approved by the Engineer to fasten cabinet to pole.

Install all conduits, condulets, and attachments to equipment cabinets in a manner that preserves the minimum bending radius of cables and creates waterproof connections and seals.

8.4 MEASUREMENT AND PAYMENT

Field equipment cabinet will be measured and paid as the actual number of field equipment cabinets furnished, installed and accepted.

No separate payment will be made for the cabling, connectors, cabinet attachment assemblies, conduit, condulets, grounding equipment, surge protectors, or any other equipment or labor required to install the field equipment cabinet as these are considered incidental to field equipment cabinet installation.

Payment will be made under:

Pay Item

Field Equipment Cabinet :.....Each

9. SYSTEM INTEGRATION

9.1 DESCRIPTION

Furnish and install Ethernet switches, digital video decoders, and all labor necessary for the successful integration of the new field devices into MRTMC Traffic Management System (TMS).

9.2 MATERIAL

A. Central Ethernet Switch

Furnish and install a rack mountable 16-port Ethernet switch (sixteen Fast Ethernet 10/100BaseTx RJ-45 ports) in the MRTMC that meet the requirements listed in CCTV Camera section of these Project Special Provisions.

B. Digital Video Decoder

Furnish and install rack mountable high-resolution digital video decoders in accordance with the Plans and these Project Special Provisions. The decoder must meet the following minimum functional requirements:

- Network Interface Ethernet 10/100Base-T (RJ-45 connector)
- Protocols RTP/IP, UDP/IP, TCP/IP, multicast IP DNS and DHCP client
- Security SSL-based authentication
- Video Output 1 composite (NTSC/PAL), 1Vpp, 75 ohm, BNC connector
- Compression MPEG-4
- Resolution Scalable; 176x128 to 704x480 NTSC (176x144 to 704x576 PAL)
- Frame Rate 1-30 FPS programmable (full motion)
- Bandwidth 30 kbps – 6 Mbps configurable
- Serial Ports 1 RS-232, 1 RS-422/485; Supports any asynchronous PTZ serial protocol
- Environment 32°F to 122°F, 95% non-condensing humidity at 122°F

9.3 CONSTRUCTION METHODS

A. Central Ethernet Switch

Install the Ethernet switch in the MRTMC at a location directed by the Engineer. Connect the video decoders to the 10/100BaseTx ports. Furnish and install the required number of Ethernet patch cords.

B. Digital Video Decoder

Install digital video decoders in a location as directed by the Engineer and connect them to the Ethernet switch as described above. Connect the video and data ports to the existing video control and display equipment. Furnish and install all required cabling.

9.4 MEASUREMENT AND PAYMENT

Digital Video Decoder will be measured and paid as the actual number of digital video decoders furnished, installed and accepted.

Central Ethernet Switch will be measured and paid as the actual number of Ethernet switches furnished, installed, integrated, and accepted.

No separate measurement will be made for coaxial cables, fiber optic and Ethernet patch cords, signal and electrical cables, rack mounting hardware, nuts, bolts, brackets, connectors, and all other work and labor required to complete the work described in this section as these will be considered incidental to the equipment pay items listed above.

Payment will be made under:

Pay Item

Digital Video Decoder	Each
Central Ethernet Switch	Each

10. SYSTEM OPERATION TEST

10.1 DESCRIPTION

After system integration is complete, perform a System Operational Test, which fully exercises all functions of the system. Submit a test plan a minimum of fifteen (15) days prior to the scheduled start of the test to the Engineer for review and approval. The Engineer will review the test plans and reply within fifteen (15) working-days from the receipt of the test plan.

A. CCTV Camera Field Equipment Test

Verify that each CCTV camera can be controlled locally at the camera site. The test should exercise all camera functionality as noted below:

- Pan 360 degrees left and right
- Tilt 180 degrees up and down
- Zoom In / Zoom Out
- Focus near / Focus far
- Auto-focus
- Iris open / Iris close
- Auto-iris
- Record and run presets
- Lowering device if present.

The Contractor should supply a Laptop or PDA loaded with the appropriate CCTV control software and a portable color monitor for use during this test.

In addition, the field test will include inspection of the cabinets, electrical service, grounding system, wire & cabling, and all other components installed at the CCTV site.

B. MVD Field Equipment Testing

All microwave vehicle detector (MVD) equipment and materials will be subject to monitoring and testing to determine conformance with all applicable requirements and to ensure proper operation of the MVD assemblies. Supply all required test equipment.

Provide forms to be used for documenting test results as an integral part of the testing procedures. These forms must specify the acceptable results of the MVD assemblies' tests, and be submitted for review and approval by the Engineer. As a minimum, provide testing procedures including the necessary documentation and satisfy the testing requirements for the MVD assembly components discussed below.

Each MVD assembly furnished and installed will be subject to the following tests:

- Verification of installation (cables and connections) between the MVD unit and the cabinet.
- Verification of detection zone setup and detection zone response including estimated speed, volume, long vehicle detection, and occupancy.
- For each MVD unit, conduct a minimum of three (3) count-test by manually counting traffic in each lane and comparing the count against the MVD unit count. The difference between manual and MVD count must be lower than 5% in 2 of the three runs to declare the test successful. If the difference is more than 5%, adjust the configuration and conduct another three rounds of testing.

Whenever any unit of equipment fails to pass the assembly tests, correct the deficiencies, either by repair or replacement (at no additional costs to the Department), as required to comply with the testing requirements. Upon notification that the deficiencies have been corrected, the equipment will be re-tested. All MVD assembly testing and re-testing will be performed in the presence of the Engineer or his designated representative. All equipment required to conduct the tests will be incidental and not paid for separately.

C. Software / Central System Test

Demonstrate that all equipment and software furnished has been installed properly and operates as specified in these Project Special Provisions.

Demonstrate all CCTV cameras installed under this project have been integrated with the VideoPro video management software. Demonstrate GUI controls and features. Exercise all CCTV functionality and PTZ control for each CCTV unit. Demonstrate selection and display of each CCTV video to available monitors and projectors.

Demonstrate that the new MVDs have been integrated with the *Protronix Traffic Melder* software, and users have the ability to add, delete, modify and configure all parameters of each detector. Demonstrate ability to view and monitor real time traffic data and speed information by roadway segments and lane by lane.

D. 30-Day Observation Period

Upon successful completion of all project work, the component tests, the System Test, and the correction of all deficiencies, including minor construction items, the 30-day Observation Period may commence. This observation consists of a 30-day period of normal, day-to-day operations of the new field equipment in operation with the new central equipment without any failures. The purpose of this period is to ensure that all components of the system function in accordance with the Plans and these Project Special Provisions.

Respond to system or component failures (or reported failures) that occur during the 30-day Observation Period within twenty-four (24) hours. Correct said failures within forty-eight (48) hours. Any failure that affects a major system component as defined below for more than forty-eight (48) hours will suspend the timing of the 30-day Observation Period beginning at the time when the failure occurred. After the cause of such failures has been corrected, timing of the 30-day Observation Period will resume. System or component failures that necessitate a redesign of any component or failure in any of the major system components exceeding a total of three (3) occurrences, will terminate the 30-day Observation Period and cause the 30-day Observation Period

to be restarted from day zero when the redesigned components have been installed and/or the failures corrected. The major system components are:

- CCTV Camera Assembly excluding cables
- MVD Assembly excluding cables
- Camera Lowering Device,
- Digital Video Encoder,
- Digital Video Decoder,
- Field and Central Ethernet Switch

10.2 MEASUREMENT AND PAYMENT

There will be no direct payment for work covered in this section. Payment at contract unit prices for the various items in the contract will be full compensation for all work covered in this section.