Traffic Specifications

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Battery Backup System for Traffic Intersections

1 Description. Furnish an Outdoor Hardened Battery Backup System to be mounted to the side of a traffic controller cabinet or installed as a Pad Mount Stand-Alone Battery Backup System.

2 Materials. Furnish, assemble, fabricate, or install new corrosion resistant materials in accordance with specifications. Supply a "rack mounted" UPS unit, including a front panel with indicators and control switches.

3. Functional Requirements. This specification is for establishing the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode (LED) Traffic Signal Modules at intersections with NEMA, 170 or 2070 cabinets. The Battery Backup System (BBS) shall include, but not be limited to the following: Inverter/Charger, Batteries, a separate automatic and manually operated Bypass Switch and all necessary hardware and interconnect wiring. The BBS shall be capable of providing power for full run-time operation for an "LED –only" intersection (all colors: red, yellow, green and pedestrian heads) The BBS shall be designed for outdoor applications.

4. Enclosure Construction:

Enclosure. The BBS Enclosure shall be capable of being a Side Mount and Pad Mount. The enclosure will house the batteries, UPS and bypass switches. The cabinet must meet the requirements for NEMA 3R enclosures. The housing must have the dimensions so that it may easily be attached the side of a M, P or 332 Type cabinet. Dimensions of the enclosure shall not exceed 50"H x 17" W x 17" D. The UPS enclosure must not interfere with the opening of the traffic cabinet door.

A eight (8) inch Riser option shall be available for Stand-Alone Pad Mount installations.

The complete enclosure and door must be made from .125" thick aluminum. All external seams must be continuously welded. The door opening must have a double flange for weather sealing purposes.

   a.   **Door:** The cabinet must have a door to provide access to the complete cabinet interior. The door must include a continuous piano hinge made of 14-gauge stainless steel and a .120" diameter stainless steel hinge pin. The hinge must be attached to the enclosure and the door with close end pop rivets. The door must have a three (3) point locking mechanism with rollers at the ends for the latch rods. The key lock must be a Corbin cylinder lock with a #2 key. When the door is opened it must have stops at 90, and 130 degrees. A continuous neoprene gasket must be used to weatherproof the enclosure when the door is closed.

b. **Ventilation Fan:** A fan must be mounted in the air baffle at the top of the cabinet with an air outlet built into the overhang. The fan must be thermostatically controlled. The bottom of the door must be louvered to allow airflow. A removable dust filter must be located behind the vent.

c. **Finish:** The enclosure shall be part #26-026-053-80 and painted PFJ-407-A5 Statuary Bronze.

d. **Features:** An "On Battery" factory installed high impact red light option shall be available for the enclosure. The "On Battery" LED shall operate off of the DC voltage of the UPS to notify that the UPS is on batteries without opening of the door. The light will be wired to and controlled by the UPS power module. The enclosure shall be designed to rack mount the UPS and Fail Safe ATS transfer switch. When the UPS is mounted into the enclosure it must be mounted to accommodate straight-on horizontal viewing of the LCD screen on the UPS.

e. **Generator Connection:** An optional factory installed flush mount generator compartment with neoprene gaskets for weatherproofing shall be available for the enclosure. The generator compartment shall include a locking 30 amp plug, L5-30FI, for connecting of a portable AC generator. A manual transfer switch shall be mounted within the generator compartment to allow for transferring from utility power to generator power. The generator door will provide a cable slot to allow for closing of the door when the generator is plugged in and to lock the cable inside of the compartment. The door will include a Corbin Type 2 lock.

f. **Mounting:** The cabinet will be mounted to the traffic control cabinet with six 6 hex head bolts, ¼" x 20". All holes will be field drilled by the Contractor to accommodate the specific situation. A grommet must be supplied to protect the cable in a field drilled 1.5" to 2" hole for cable connection to the existing traffic controller. The Contractor will supply all the mounting hardware, bolts, washers, nuts, gaskets, bushings, grommets, caulking, etc., necessary to install the cabinet in a safe and weatherproof manner.
An optional eight (8) inch Riser shall be available for Pad Mount Stand-Alone Installations.

5. **Battery System:**

   a. Individual batteries shall be:
   - Voltage rating: 12V type
   - Amp-hour rating: 109 amp-hour minimum
   - Group size: 31 minimum
   - Batteries shall be easily replaced and commercially available off the shelf.

   b. Batteries used for BBS shall consist of 4 batteries. All batteries must meet their specifications out of the box immediately after the initial 24-hour top off charge. Batteries that require cycling to meet the AH rating specifications are not acceptable.

c. Batteries shall be deep discharge, sealed prismatic lead-calcium based GEL/VRLA Gelled Electrolyte/ Valve Regulated Lead Acid). Batteries designed for Cycle applications, such as Solar, are not acceptable. The battery must be designed for Standby Applications.

d. Batteries shall have a discharge operating temperature range of – 40 °C to +71 °C.

e. Batteries shall have a Manufactures Warranty of 4 Years Full Replacement plus 1 additional year when an AlphaGuard is used. The warranty shall cover any battery that does not meet 70% of its original reserve capability during the warranty period.

f. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays, shelf's and/or brackets appropriate for the cabinet into which they will be installed.

g. Batteries shall indicate maximum recharge data and recharging cycles.

h. Battery Harness
   1) Battery interconnect wiring shall be via two-part modular harness.

   2) Part I shall be equipped with red (+) and black (-) 30.48 cm (12") cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson style Power Pole connector or equivalent.

   3) Part II shall be equipped with the mating Power Pole style connector for the batteries and a single, insulated Power Pole style connection to the inverter/charger unit. Harness shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.

   4) Power Pole connectors may be either one-piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connectors from separating.

   5) All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.

   6) Battery terminals shall be covered and insulated with molded boots so as to prevent accidental shorting.

i. Battery Balancer: The AlphaGuard shall be provided that automatically balances the battery charge voltage on all batteries in the string to within ±100mV between any two batteries. The AlphaGuard shall allow for any single 12V battery within the battery string to be replaced without having to replace the entire battery string.

6. BBS Operation:

    a. The BBS shall provide a minimum four (4) hours of full run-time operation at 500 watts with an additional nine (9) hours of Red Flash operation at 125 watts. Typical values for a "LED-only" intersection. The inverter, when on batteries, shall operate with a minimum efficiency of 84% with a load ranging from 25% to 90% of the BBS total output rating. The BBS shall operate at 98% or higher when operating under normal condition (utility power is available).

    b. The BBS, for safety and efficiency shall operate with a nominal 48 VDC buss. A DC level higher then 56 VDC shall be considered unsafe and not acceptable.

    c. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milliseconds. The 5 milliseconds maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.

    d. The BBS shall include a rack mounted Fail Safe Automatic/Manual Bypass Switch for bypassing the UPS for maintenance. The FS-ATS bypass switch will be a 3-stage configuration, UPS Normal mode, bypass UPS On and bypass UPS Off. The FS-ATS Bypass Switch shall mount in a 19" rack inside of the BBS side mount enclosure.

    e. The BBS shall provide the user with 6-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) individually programmable dry relay contact closures, available on a front panel-mounted terminal block, rated at a minimum 120V/1A, and labeled so as to identify each contact.

        1) One set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked "On Batt."

        2) A second and third set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked "Low Batt." This setting must be adjustable from 10% to 90% via the RS232 connection.

        3) A fourth set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked "Timer." This setting must be adjustable from 1 Min. to 8 Hours via the RS232 connection.

        4) A fifth set of NO and NC contact closures shall be energized in the event that an Alarm condition occurs. Contact shall be labeled "Alarm".

        5) A 48 VDC output shall be provided for operating an external fan. This output can also be factory configured as a dry contact

        6) Relay contact activation shall be annunciated on the front panel via a visual indication. This can be either discreet LED, or part of LCD screen, etc.

    f. The BBS shall have (2) independently programmable timers 0 to 8 hours with (2) times-of-day restrictions on each timer.

g. The BBS shall provide 3 user inputs to support Intrusion Alarm, Emergency Power Off (EPO) and external Self Test (Battery Test).

h. Operating temperature for both the inverter/charger, and manual bypass switch shall be –37 °C to +74 °C with a load of 850 watts.

i. The Fail Safe ATS Bypass Switch shall be rated at 240VAC/30 amps, minimum

j. The BBS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 6.0 mV/ °C per cell. The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 2 meters (6'5") of wire.

k. Batteries shall not be recharged when battery temperature exceeds 50 °C ± 3 °C.

l. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 85VAC to 175VAC (± 2VAC). During a utility input from 85 VAC to 175 VAC the UPS shall utilize its internal double buck, double boost regulation to maintain a 108 to 131 VAC output to the controller cabinet, without the use of the batteries. The BBS shall go into Boost Mode 1 when the AC Line voltage reaches below 110 VAC, +/- 2volts. When the AC line drops below 96 VAC, +/- 2 volts the BBS shall go into Boost Mode 2. When the AC line voltage reaches 131 volts, +/- 2volts the BBS shall go into Buck Mode 1. When the AC Line voltage reaches 150 volts the BBS shall go into Buck Mode 2.

m. When utilizing battery power, the BBS output voltage shall be between 112 VAC and 128 VAC, pure sine wave output, ≤ 3% THD, 60Hz ± 3Hz.

n. BBS shall be compatible with NEMA, 170 or 2170 Controllers, and cabinet components for full time operation. All loads to the maximum rating of the BBS shall be powered through the BBS system to utilize the UPS internal Buck/Boost regulation.

o. In cases of low (below 85VAC) or absent utility line power, when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Boost Regulation Mode or the battery backed inverter mode back to utility line mode.

p. In cases of high utility line power (above 175VAC), when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Buck Regulation Mode or battery backed inverter mode back to utility line mode

q. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service. For conformation the UPS module must be UL/CSA approved and labeled. "Tested to" or "Built to" UL/CSA is not acceptable.

r. In the event of inverter/charger failure, battery failure or complete battery discharge, the Fail Safe Transfer Switch shall revert to the NC (and de-energized) state, where utility line power or generator power, if available, is connected to the cabinet.

s. Recharge time for the battery, from "protective low-cutoff" to 90% or more of full battery charge capacity, shall not exceed eight (8) hours, unless limited by the Temperature Regulated charger due to excessive battery heat that could damage the integrity of the battery string.

t. Batteries shall be Deep Discharge Gel Type Valve Regulated Lead Acid Battery and compatible with the Battery charger.

7. Maintenance, Displays, Controls and Diagnostics:

a. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
   1) The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

b. The BBS shall have lightning surge protection option.

c. The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.

d. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.

e. The BBS shall display via an LCD panel to indicate the number of times the BBS was activated and the total number of hours the unit has operated on battery power. The LCD display shall show the UPS mode, Alarm status, Input and output voltages, Output current, Battery voltage, battery charger current and last event. It shall allow for programming of the battery charger from 3, 6 and 10 amp charger setting.

f. The BBS shall include a RS-232 port for local serial communications on the front panel of the UPS. An optional factory installed internal Ethernet port for SNMP/WEB communications shall be available.

g. The BBS shall include a Microsoft Windows® Graphical User Interface for programming and monitoring the BBS. This must be provided in addition to the use of Hyper Terminal and provided at not cost.

h. Manufacturer shall include a set of operator's manuals with each BBS.

i. The BBS shall provide the ability to manage daylight savings time automatically.

j. The BBS temperature reporting shall be selectable, Celsius or Fahrenheit.

k. The BBS shall have the ability to update the firmware via the Web Pages.

l. The BBS shall be capable of reporting the date in either number or text format in any order of day, month and year.

m. The BBS shall have battery runtime reporting integration based on the current rate of consumption via a selectable collection of common batteries and via generic configuration with editable Peukert's number.

n. The BBS shall display the MAC address locally and remotely.

o. The BBS shall display the unit serial number locally and remotely.

p. The BBS shall display the record the power consumed by the load. (KW)

q. The BBS shall have a user input selectable alarm. An alarm shall be sent via SNMP when activated.

r. The BBS shall have a remote shutdown / reboot via SNMP feature.

s. The BBS shall have up to 255 COM ports available on the RS-232.

8. Acceptance:

Each BBS shall be manufactured in accordance with a manufacturer Quality Assurance (QA) program. The QA program shall include two Quality Assurance procedures: (1) Design QA and (2) Production QA. The Production QA shall include statistically controlled routine tests to ensure minimum performance levels of BBS units built to meet this specification and a documented process of how problems are to be resolved. The manufacturer, or an independent testing lab hired by the manufacturer, shall perform Design Qualification Testing on new BBS system(s) offered, and when any major design change has been implemented on an existing design. A major design change is defined as any modification, either material, electrical, physical or theoretical, that changes any performance characteristics of the system, or results in a different circuit configuration.

Production Quality Control tests shall be performed on each new system prior to shipment. Failure to meet this requirement shall be cause for rejection. Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.

9. Materials Warranty:

Manufacturers shall provide a two (2) year factory-repair warranty for parts and labor on the BBS from date of acceptance but not more then 6 months from ship date. Batteries shall be warranted for full replacement for four (4) years from date of purchase with an additional 1-year added when a battery balancer is installed at time of initial installation. A battery shall be considered bad should it not deliver 70% of its original capability within the stated warranty period.

The warranty shall be included in the total bid price of the BBS.

SPECIAL SPECIFICATION

A9001

Hardened Ethernet Switch

1. **Description.** Furnish, install, and make fully operational a Hardened Ethernet Switch at designated locations as shown on the plans and as detailed in accordance with these specifications. Use the same manufacturer and model for each Hardened Ethernet Switch.

2. **Materials.** Provide a Hardened Ethernet Switch unit that meets the following requirements.

    A. **General Requirements.** Provide only equipment that is new, corrosion resistant and in strict accordance with the details shown on the plans and in the specifications.

    B. **Ethernet Port Configuration.** Provide a Hardened Ethernet Switch with four Ethernet ports that have the following features:
    - 10/100Base-TX
    - RJ-45 female connector
    - Automatic and user-selectable speed setting
    - Automatic and user-selectable half/full duplex setting
    - Non-blocking full wire-speed forwarding rate
    - Drives up to 100 m of Category 3, 4, or 5 unshielded twisted-pair (UTP) cable at 10 Mbps
    - Drives up to 100 m of Category 5 UTP cable at 100 Mbps
    - Minimum of 4K Media Access Control (MAC) addresses
    - Minimum of 2 MB buffer memory
    - MAC-based trunking
    - Port Mirroring

    C. **Protocols Supported.** Provide a Hardened Ethernet Switch that supports the following protocols:
    - Institute of Electrical and Electronic Engineers (IEEE) 802.3
    - IEEE 802.3u
    - IEEE 802.3x Flow Control
    - IEEE 802.1Q Virtual Local Area Network (VLAN) Tagging
    - IEEE 802.1D Spanning Tree Algorithm
    - IP Multicast Filtering through Internet Group Management Protocol (IGMP) version 2 snooping

D. Management: Provide a Hardened Ethernet Switch that provides the following management capabilities:

- Hyper Text Transport Protocol (HTTP)/Web Browser device configuration interface

- Telnet device configuration interface

- Allow multiple simultaneous management sessions or automatically terminate existing session when a new session is requested

- Simple Network Management Protocol (SNMP) version 2 device status, diagnostic, and alarm monitoring and remote configuration

- Remote Monitoring (RMON) network monitoring

- Trivial File Transfer Protocol (TFTP) remote firmware upgrades

- Request for Comments (RFC)-1213-compliant Management Information Base (MIB) files

- Standard and device specific MIB2 files

- Command Line Interface (CLI)

E. Regulatory Approvals. Provide a Hardened Ethernet Switch that has been certified to the following regulatory standards:

- Product Safety: Underwriters Laboratories (UL) Standard 1950 or 60950

- Electromagnetic Emissions: Federal Communications Commission (FCC) Part 15, Class A

- National Electrical Manufacturers Association (NEMA) TS-1/2

F. Operating Power: Provide a Hardened Ethernet Switch that is designed to operate with the following power requirements:

- 120 V AC

- 60 Hz

- 15 W maximum power consumption

G. Environmental. Provide a Hardened Ethernet Switch that is designed to operate in the following environmental conditions:

- -30°C to 70°C operating temperature range

- -45°C to 90°C storage temperature range

- 10% to 95% relative humidity (non-condensing)

3. Construction Methods.

A. General. Provide equipment that utilizes the latest available techniques for design and construction with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Design the equipment for ease of maintenance. Provide component parts that are readily accessible for inspection and maintenance. Provide test points that are for checking essential voltages and waveforms.

B. Electronic Components. Provide electronic components in accordance with Special Specification, "Electronic Components".

C. Mechanical Components. Provide external screws, nuts and locking washers that are stainless steel; no self-tapping screws will be used.

Provide parts made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

Protect materials from fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

4. Documentation Requirements. Provide five complete sets of operation and maintenance manuals. Include the following:

- Complete and accurate schematic diagrams.

- Complete installation procedures.

- Complete performance specifications (functional, electrical, mechanical and environmental) on the unit.

- Complete parts list including names of vendors for parts not identified by universal part number such as JEDEC, RETMA, or EIA.

- Pictorial of component layout on circuit board.

- Complete maintenance and trouble-shooting procedures.

- Complete stage-by-stage explanation of circuit theory and operation.

5. Testing Requirements. It is the policy of the Texas Department of Transportation to require performance testing of all materials and equipment not previously tested and approved. If technical data are not considered adequate for approval, samples may be requested for test by the Engineer. The contract period will not be extended for time loss or delays caused by testing prior to final Texas Department of Transportation approval of any items.

The equipment referenced to this specification is subject to Design Approval Tests and Factory Demonstration Tests at the equipment manufacturer's facility to determine conformance with all the specification requirements except that the Engineer may accept certification by an independent testing laboratory in lieu of the design Approval Tests, to verify that the Design Approval Tests have previously been satisfactorily completed. The Contractor must arrange for and conduct the tests in accordance with the specification requirements stated herein.

Unless otherwise specified, the Contractor is responsible for satisfying all inspection requirements prior to submission for the Texas Department of Transportation's inspection and acceptance. The Engineer reserves the right to have his/her representative witness all Design Approval Tests and Factory Demonstration Tests.

Compare the results of each test with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect, and equipment shall be subject to rejection by the Engineer. Rejected equipment may be offered for retest provided all non-compliances have been corrected and retested by the Contractor and evidence thereof submitted to the Engineer.

6. **Warranty.** Guarantee that equipment furnished and installed for this project will perform according to the manufacturer's published specifications. Warrant equipment against defects and/or failure in design, materials and workmanship in accordance with the manufacturer's standard warranty. Assign to the Department all manufacturers' normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace defective equipment, at the manufacturer's option, during the warranty period at no cost to the Department. Provide equipment with 95% of the manufacturer's standard warranty remaining on the date that equipment invoices are submitted by the Contractor for payment. Any equipment with less than 95% of its warranty remaining will not be accepted by the Department.

7. **Experience Requirements.** Personnel involved in the installation and testing of the "Hardened Ethernet Switch" must meet the following requirements:

   • Three years experience in the installation and testing of Ethernet Switches.

   • Two installed systems where Ethernet Switches, as described within these specifications, are installed and the systems have been in continuously satisfactory operation for at least 2 years.

   • One system with Ethernet Switches (which may be one of the two in the preceding paragraph) which the Contractor can arrange for demonstration to the Engineer and/or his representatives.

8. **Training.** Conduct a training class (minimum of 4 hours) for up to 2 representatives designated by the Town of Addison on procedures of installation, operations, testing, maintenance and repair of all equipment specified within these specifications. Submit to the Engineer for approval 10 copies of the training material at least 30 days before the training begins. Conduct training within the local area unless otherwise authorized by the Engineer.

9. **Measurement.** This Item will be measured as each unit furnished, installed, and tested.

10. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Hardened Ethernet Switch". This price is for equipment, cables and connectors; documentation and testing; and labor, materials, warranty, training and incidentals.

SPECIAL SPECIFICATION

6086

Preparation of Existing Conduits, Ground Boxes, or Manholes

1. **Description.** Prepare conduits, ground boxes, or manholes; replace conduits, ground boxes, or manholes, when necessary; replace conduit fittings with junction boxes; replace damaged ground box or manholes covers; adjust ground box or manholes covers; install pull lines in conduits; install cable racks in ground boxes or manholes.

2. **Materials.** Provide new materials that comply with the details shown on the plans, the requirements of this Item, and to the pertinent requirements of the following Items:
   - Item 624, "Ground Boxes,"
   - Item 465, "Manholes and Inlets,"
   - Special Specification, "Ground Box for Surveillance, Communication, and Control (SC&C)," and
   - Special Specification, "Multi-Duct Conduit System."

   When conduit replacement is required, provide conduit meeting the requirements of Item 618, "Conduit." Use conduit of same size and type of that being replaced or as directed.

   Provide 24 in. by 24 in. by 12 in. (L x W x D) minimum size NEMA 4X junction boxes with screw covers.

   Provide polyester tapes or rope pull cords with a tensile strength of at least 1200 lb.

   Provide heavy duty, non-metallic, non-corrosive cable racks that can support a minimum dead load of 300 lbs. Ensure cable racks are resistant to the affects of oils, hydrocarbons, common esters, ketones, ethers, or amides. Ensure cable racks are adjustable between 8 in. and 14 in. wide. Do not provide grounding or insulators for cable racks.

3. **Construction.** Check existing conduit and ground boxes.

   A. **Preparation of Conduit, Ground Box or Manhole.** Pull a mandrel through empty conduits. Use a mandrel with a diameter greater than 70% of the inside diameter of the conduit and 2 in. length. Repair or replace conduit runs that will not allow passage of the mandrel. Replace conduit deemed impractical to repair or remains unsuitable in accordance with Item 618, "Conduit." Clean the conduit by pulling a rubber swab slightly larger in diameter than the conduit.

   Blow compressed air through conduits that contain wires. Remove debris from the conduit by pushing a fish tape through the conduit. Do not use water to clear debris. Retest the conduit by blowing compressed air.

Install 1 pull cord in each conduit for use in installing the conductors, cables, or innerduct. Leave 1 pull cord in each conduit after the conductors, cables, or innerduct have been installed.

Remove silt and debris from ground boxes or manholes prior to installing cable.

B. Installation of Ground Box or Manhole. Furnish new ground boxes or manholes as directed. Install ground boxes or manholes as shown the plans or as directed.

Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

C. Installation or Adjustment of Ground Box or Manhole Covers. Remove, dispose, and install ground box or manhole covers as shown on the plans or as directed. Adjust ground box or manhole covers as shown on the plans or as directed. Adjustment may include welding, raising, or lowering.

Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

D. Installation of Junction Box. Locate conduit fittings in conduits carrying fiber optic cables. Replace the conduit fitting and associated section of conduit with a junction box. Install junction boxes as shown on the plans.

E. Installation of Cable Rack Assembly. Install cable racks to permit coiling of conductors or cables without violating the manufacturer's minimum bending radius. Install 2 cable rack supports and 4 adjustable levels on each support, at a minimum, on each wall of the ground box or manhole as shown on plans or as directed. Anchor the cable rack support permanently to the ground box wall with mechanical or powder actuated fasteners. Use fasteners with an ultimate pull out strength of at least 2500 lb. and ultimate shear strength of at least 3000 lb. Provide sufficient cable supports for the particular number of conductors or cables coiled or passing through the ground box or manhole as shown on the plans or as directed.

4. **Measurement.** This Item will be measured by the foot of conduit cleared, tested, replaced and repaired, by each cable rack, junction box, ground box, or manhole installed or prepared, and by each ground box or manhole cover replaced or adjusted.

5. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Conduit (Prepare)," "Junction Box (Install)," "Manhole (Install)," "Ground Box (Install)," "Manhole (Prepare)," "Ground Box (Prepare)," "Cover (Replace)" of the sizes specified, "Cover (Adjust)," and "Cable Rack Assembly (Install)". This price is full compensation for cleaning and testing conduit, ground boxes, and manholes; furnishing and installing pull cords, ground boxes, manholes, junction boxes, and cable racks; excavating and backfilling; adjusting ground boxes and manholes covers; disposal of unsalvageable material; and equipment, materials, labor, tools, and incidentals.

New conduits will be paid for under Item 618, "Conduit."

SPECIAL SPECIFICATION

A9005

System Support Equipment

1. **Description.** Furnish, assemble, fabricate, or install system support equipment.

2. **Materials.** Provide new materials that conform to the details shown on the plans, the requirements of this Item, and to the pertinent requirements of the parent Special Specifications.

    A. **Operational Support Equipment.** Provide operational support equipment as shown in the bid documents. Provide equipment and documentation in accordance with the pertinent requirements of the parent Special Specifications.

    B. **Test equipment.** Provide Test equipment as shown in the bid documents. Furnish probes and test leads with each unit. Furnish a carrying case with portable equipment. Furnish batteries with battery-operated equipment. Furnish a battery charger for equipment with rechargeable batteries. Provide a complete set of documentation including operations manuals with each unit of test equipment.

3. **Testing, Training, Documentation, and Warranty.** Test material in accordance with Article 2, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

    Provide training in accordance with Article 3, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

    Provide material documentation in accordance with Article 4, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

    Provide warranties in accordance with Article 6, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

4. **Measurement and Payment**

    The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this Item, will be paid for at the lump sum price for "System Support Equipment."

SPECIAL SPECIFICATION

A9003

Traffic Control System

1.0 Description

This Item shall govern the minimum requirements for a distributed traffic signal control system consisting of all labor, supplies, equipment and services necessary to provide the operation and functions described herein. This Advanced Traffic Management System (ATMS) shall have the capability of selecting and implementing traffic signal timing plans based on real-time traffic conditions, preset time events, and operator commands. The system shall feature a "building-block" design which enables future system expansion to its maximum capacity without major modifications to the central control system.

The system configuration consists of three (3) principal elements, namely, the local controller assembly, the spread-spectrum radio communications link, and the distributed traffic control system. The local controller assembly and the spread-spectrum radio communications requirements are detailed in other special specifications. The functional requirements of the distributed traffic control system are described herein.

2.0 Required Features and Functionality

The following sections provided the minimum requirements for the new ATMS.

2.1 Graphical User Interface.
The ATMS graphical user interface (GUI) software shall provide the operator with a graphical operating environment of the type commonly found on today's desktop computers. The GUI shall be easy to use while providing a fast and efficient way to control and monitor the ATMS in real time. The GUI shall allow the operator to intuitively select objects on the screen by point-and-click manipulation with the mouse, thereby minimizing typing and the need to memorize lengthy commands. The system shall also provide hot keys for commonly used functions. The GUI shall incorporate the following:

- ◆ Pop-up multiple display objects and windows;
- ◆ Menu icons and controls;
- ◆ Dialog boxes;
- ◆ Rollovers with automatic pop-ups
- ◆ Push button and other active commands;
- ◆ Visual and audio alarms; and
- ◆ Use of object characteristics such as colors, highlighting, and flashing to alert operators of status changes

The GUI interface shall be oriented around graphic tools and based on the principle of

direct manipulation. Several windows may be active at the same time and may overlap on the screen. The operator shall be able to easily switch from one window to another, such as by pointing with the mouse cursor to the uncovered part of another window. The operator shall be able to move any window on the screen, to change window size, and to collapse a window to an icon. When an exception condition (such as a device failure) exists, an inactive window shall attract the operator's attention by beeping and/or flashing its icon or title bar.

2.2 System Access

2.2.1 Multi-user Access Required

The Contractor-furnished operating system and ATMS software shall support a multi-terminal, multi-user interface and the ATMS software shall allow access to multiple levels of the system simultaneously. A minimum of six (6) users, each one of who can be assigned a specific level of access privilege, shall be able to access the system concurrently.

2.2.2 System Security

The ATMS software shall provide and maintain a security system to prevent unauthorized access to the system. This shall apply to executable files as well as text and database files. Operator privileges shall be definable on a functional level. Each operator shall have a privilege level mask defined for him/her by the system administrator. The mask shall define the specific functions that the particular operator is authorized to perform. For example, a particular operator may be given the ability to view all reports, but not to modify some or all levels of the database. This shall allow for any number of different levels of operator access capability. The system administrator level shall have full access to the system as well as the responsibility for maintaining account passwords and privilege level masks.

Before gaining access to the ATMS, the operator shall be required to enter an operator identification code. The ATMS software shall validate the code against an encrypted database of authorized operators. Successful completion of the log-in shall result in execution of a session start-up procedure. The start-up procedure shall establish the privileges, object menu options, windows, and tools the operator may utilize. Any functions that a particular operator is not authorized to access shall either not be shown or shall be grayed out so that the operator can easily distinguish the functions to which he/she has access.

LAN access shall be limited to those activities that support the ATMS. Any activity that hinders or does not directly support the operation of the ATMS shall be restricted or eliminated. Any executable files that are not needed in support of the ATMS shall be eliminated from the system or otherwise protected from access, thus minimizing any risk associated with unauthorized access. Operating system tasks that impede system response shall also be eliminated (i.e. clock, calendar manager, file manager, etc.).

Unsuccessful log-in attempts shall be logged to the system log.

2.2.3 Remote Access

The ATMS software shall have the capability of providing access to the system for remote operators. The remote access capability shall include workstations which are physically connected to the LAN as well as computers connected by dial-up telephone modem or the internet. All connected computers, including those connected remotely, shall be capable of concurrent operation.

The system administrator shall have the capability to reduce the access capabilities of operators while they are logged into the ATMS software from a remote computer. For example, someone who would normally have full access privileges while inside the TMC might be granted lesser capabilities if using a computer connected by means of dial-in modem.

2.2.4 Remote Computer Software

The Contractor shall furnish a version of ATMS software that runs on portable computers. Such software shall be capable of performing all operator-allowed command and monitoring functions available to operators within the TMC.

The ATMS shall provide dial-in security features designed to protect the system from unauthorized access by computer hackers capable of breaking sign-on password protection.

It will be acceptable for remote-access computers to have a scaled down version of the graphics capability. For example, generic intersection graphics would be acceptable at a remote computer even though a precise graphical file may be available within the ATMS graphic database. Each remote computer shall have any generic graphics files resident. All other database items shall reside only on the ATMS software. The remote computers shall be able to monitor real-time operations of a minimum of six intersections.

2.2.5 Direct-Connect Access to Local Controllers

The Contractor-furnished portable computer software shall enable a portable computer to be connected directly to the local intersection controller. Field technicians shall thereby have the ability to access and modify the local controller database without directly accessing the ATMS central software. This shall give the field technicians the ability to directly upload/download controller timing parameters and to set the time and date.

Field technicians shall also have remote access to the ATMS by means of a dial-up connection. This function shall allow the technician to:

♦ Download the current ATMS parameters for any controller to a controller or portable computer;
♦ Upload newly established local controller parameters to the ATMS.

2.2.6 Automatic Paging

The ATMS system software shall support report alarming events via pop-up user-based messages, pages, or emails to individuals or groups. Events that trigger the alarm pop-up, page, or email shall be set by the user. The pop-up or heads-up alarms are routed to a specific user, based on login of that user. To clear the heads-up alarm display, the user must acknowledge the alarm. The ATMS message system shall support individual or group paging/emailing as well as TOD control for each individual or group. The paging function shall be implemented using a dial-up line to connect to a local paging service that supports alphanumeric messaging. The emailing function shall be implemented to allow the system to send an email to a user's PDA device through a local email network server.

2.3   Time/Date Synchronization

2.3.1 Synchronization with Universal Time

The Contractor shall provide the means by which the system's central time clock is automatically synchronized with universal time, either through the WWV radio broadcast or by other approved means. Such automatic synchronization shall occur at least once per hour. The capability shall also be provided for the operator to disable and re-enable this function.

2.3.2 System-wide Clock Updates

The system shall provide for the automatic downloading of clock updates to each field clock. The frequency of such updates shall be operator-programmable within a minimum range of once per day to once per hour. Additionally, unless the feature has been disabled by the operator, the system shall transmit a clock update in conjunction with the command for implementation of a different timing plan.

2.3.3 Verification of Field Clocks

The ATMS software shall also upload, on a periodic basis selectable by the operator, the date/time from local controller and other field clock. If the time/date in the field clock has drifted beyond an operator-defined amount, then:

♦   The system shall automatically download the true time to the field clock; or
♦   The system shall report the clock drift to the operator.

In either case, the event and action taken shall be logged.

2.3.4 Accommodation of Daylight Savings Time, Leap Year, etc.

The ATMS software shall also have the ability to disable daylight savings functions and handle leap years.

2.4   Control Modes

2.4.1 General

The ATMS software shall operate in a distributed mode, fully making use of the intelligence in the local intersection controllers. The intelligent local controllers shall be programmed with timing plans, time-of-day/day-of-week (TOD/DOW) schedules, and all other parameters required to operate the local intersection. All intersection controllers shall be monitored on a real-time basis by the ATMS software. Upon system startup, the ATMS software shall establish communications with all intersection controllers and begin real-time monitoring. The ATMS software shall start to process both incoming data and operator requests. Any upload, download, or time/date requests shall take precedence over real-time monitoring. The ATMS shall be designed for unattended operation 24 hours per day, seven days a week, without requiring an operator to be logged into the system.

The ATMS shall provide system control by coordinating intersection operation on an individual, section, or system-wide basis. The software shall include at least the following control modes, which shall be operator-selectable from the GUI.

Upon system startup, the control mode shall always be local TOD/DOW. If the event scheduler is calling for traffic responsive mode at the time of system restart, the system shall transfer to traffic-responsive mode after an operator-selectable amount of time.

For commanding an intersection to a timing plan different than the TOD/DOW, either by manual override or through the traffic-responsive algorithm, the controller shall be commanded to the appropriate plan. In the event that, while in software-commanded override, a controller does not receive a valid timing plan number from the ATMS software within an operator-defined time frame, it shall revert back to its local TOD/DOW schedule. The central override shall be allowable on an intersection, section, or system-wide basis.

2.4.2 Manual Control

The operator shall be able to invoke manual override of the plan currently in effect for the entire system, for a subsection of the system, or for individual intersections. Manual selection of timing plans shall have a higher priority than all other modes of timing plan selection.

The operator shall have two options for implementing manual override:

♦ Setting the manual override and later releasing the override manually; and
♦ Setting the manual override with a specified time frame for automatic termination.

Under the second option, the manual override shall terminate automatically at the end of the specified time. When manual override is terminated, each affected controller shall revert to its previous mode of operation.

2.4.3 Time-Of-Day/Day-Of-Week Control

TOD/DOW mode shall be used for controlling traffic conditions that occur regularly. In this mode, each controller shall automatically select and implement traffic signal timing

plans in accordance with the defined schedule, locally stored, on a TOD/DOW basis. TOD/DOW plans shall be downloadable from the ATMS software to the controller in the field. The number of timing plans available in the ATMS database shall be limited only by the amount of disk space available. Any plan located at the ATMS shall be downloadable to any slot in the local controller's database. The timing plans that are being stored in the local controller shall be tagged in the ATMS database so that the ATMS software always knows which plans are stored at the controller. In order to download a timing plan to a controller, the operator shall select the plan from the ATMS database and the controller memory slot where the plan will reside. The user interface shall allow the operator to choose timing plans for all available memory slots at once. This shall enable the operator to initiate one download per controller to download all timing plans and time-of-day events.

2.4.5 Free Operation/Remote Flash Mode

In the free mode, the controller shall run uncoordinated. To initiate flashing operation remotely, the controller shall be commanded to flash from the ATMS software.

2.5 Signal Timing Plan Implementation and Monitoring

2.5.1 Control Sections (Subsystems)

The new ATMS shall enable the operator to define a minimum of 100 control sections, or subsystems, each of which shall be completely independent of the connection of any particular intersection to the communications network. The number of intersections in a particular subsystem shall be programmable from a minimum of one to a maximum of the total number of intersections in the system. It shall be possible to have intersections and detectors assigned to different sections by time of day, either by operator command or through the event scheduler.

2.5.2 Local Intersection Control and Control Modes

Local traffic signal control functions shall be provided by the local controller firmware. The intersection controller shall determine the coordination cycle synchronization point from the current time-of-day. All offset, split, and transition timings shall be determined and implemented locally.

Under normal operation, intersection control shall follow local controller TOD/DOW schedule. When operator or ATMS software determines that a different timing plan should be implemented, the system shall download timing plan, if required, and command intersection to that plan by sending plan number to the controller. If communication is lost between the intersection and the ATMS software, the intersection shall revert back to its original TOD/DOW schedule. The downloaded special plan shall not overwrite any plans that are used by the TOD/DOW schedule. The operator shall be able to select controller timing plan slots to be used as *temporary* locations and the remaining slots for TOD/DOW usage.

2.5.4 Number of Timing Plans Required

The new ATMS shall provide for a minimum of sixteen (16) timing plans for each intersection to be stored in the central database. At any one time, it shall be possible for a minimum of twelve (12) of these plans to be stored in the local controller's database and implemented upon command by the new ATMS. The number of available cycle lengths shall be at least six (6). Each timing plan shall include uniquely programmable values for cycle length and offset, a uniquely programmable phase sequence, and uniquely programmable split values. The software shall provide both the automatic calculation of permissive periods (based on splits values) and the ability for the operator to input desired values for the beginning and end of permissive periods.

The new system shall also provide the capability to handle special signal and/or timing plans to accommodate unusual traffic flow patterns during special events, parades, etc. These special event timing plans may be included within the thirty-two timing plans.

2.5.5 Accommodation of Phase Sequences

The new ATMS software shall provide for the independent control of each phase of an eight-phase, dual-ring controller. For example, in normal quad-left operation, it shall be possible to program the force-off for Phase 1 independently from the force-off for Phase 5. The new ATMS shall also provide for the control of lead-lag phase sequences. In conjunction with each timing plan, the software shall enable the independent programming of each odd numbered phase to be either leading or lagging with respect to its associated even numbered phase. (i.e.: for each timing plan, it shall be possible to program the lead-lag status of the 1-2 phase pair independently from that of the 5-6 phase pair, the 3-4 phase pair, and the 7-8 phase.)

2.5.6 Preemption

The new ATMS software shall recognize the occurrence of locally-initiated preemption (emergency vehicle or bus) and thereby not erroneously diagnose a coordination failure because the local controller has been preempted.

2.5.7 Accommodation of Pedestrian Services Which Violate Normal Split Times

At locations where the major street is wide, the cross-street split times (which are based on vehicular needs) may not be long enough to accommodate a pedestrian service. Accordingly, whenever a pedestrian actuation does occur, the intersection will get out of step. The ATMS software shall not fail the intersection as a result of a normal force-off time being exceeded to service a pedestrian call. It shall be permissible for such a pedestrian call to be treated as a preemption for the purpose of accomplishing this requirement.

2.5.8 Special Functions

The ATMS shall accommodate the control and monitoring of the on/off status of a minimum of four (4) special functions to be implemented by the intelligent local controller.

2.5.9 Remotely-Requested Download of Local Database

The maintenance technician shall have the ability, from the local controller, to effect a download of the local controller database from the central database without the need for an operator to be present at the TMC.

2.5.10   Timing Plan Compliance Monitoring

The ATMS software shall monitor each intersection to ensure that its operation is within proper constraints of the timing plan that is in affect.

Through compliance monitoring, the error conditions which shall be detected include the following:

◆   The controller is not using the proper timing plan;
◆   The controller time clock is out of synchronization;
◆   The controller is not sequencing;
◆   The phase sequence is improper; and
◆   Phase time compliance.

The ATMS software shall automatically inhibit monitoring if feedback is not being received from the controller.

2.5.11   Intersection Measures of Effectiveness

The ATMS software shall collect and store data on intersection measures of efficiency (MOEs). The software shall process and maintain intersection MOE data on a continuous basis to be used for various timing analysis and reporting tasks. Intersection feedback shall be stored on a per-phase basis. The intersection MOEs which shall be stored include, but not be limited to, the following:

◆   Percent of green time used versus split;
◆   Percent of detector calls (relative to a threshold value);
◆   .Number of times the phase maxes out or is forced off prior to gap-out; and
◆   Number of pedestrian calls.

The system software shall automatically record intersection data in the ATMS database, and periodically archive the data onto removable optical media. Up to four (4) weeks of intersection data for each intersection shall be stored on the ATMS database by the database program. If bad data or no data are received from the intersection, the data will be tagged as questionable or not available in the ATMS database.

In case of failure during a database write process, the database program shall not leave a partially written block. Any missing blocks shall be tagged as unavailable. The operator shall have the capability to enable or disable data collection on an individual intersection basis.

The time increment between writing of data to the optical disk drive and start time shall be operator-selectable with defaults of 24 hours and midnight, respectively. Data shall be automatically compressed when written to the removable optical media. Each history file shall be date and duration tagged via file naming convention. The data storage feature shall have the ability to append intersection data to the removable optical media, enabling full usage of the media. When the removable optical media does not have enough storage space left for a full time interval of intersection data, the system shall notify the operator that a new storage disk is required. The operator shall have the ability to enable and disable archiving on an individual intersection basis.

Intersection data shall be retrievable from the removable optical media for use with the relational database and traffic modeling packages. Upon retrieval, the intersection data from the optical disk shall be automatically expanded from the compressed format.

2.6   ATMS Database

2.6.1 Database Generation and Maintenance

The Contractor shall furnish and implement an Engineer-approved, off-the-shelf database package. The Contractor shall provide a database interface, which shall be integrated into the ATMS software to provide seamless operation for the operator. The resulting combination of ATMS software and database software shall provide for off-line and online database generation and maintenance.

This shall include loading, modifying, examining, copying, and retrieving the data used to operate the system. These data include traffic system configuration, timing plans, TOD/DOW schedules, operator databases, and alarm databases. Traffic system configuration shall include channel assignments, communication parameters, included intersections, etc. Any database changes shall be achievable without having to restart the ATMS software.

Data entry forms shall be designed for easy data preparation by the operators. Electronic copies of these forms shall be placed on each workstation, laptop, and personal data assistant (PDA). All tables in the database shall be printable in the proper format for use by the traffic engineers and maintenance technicians in the field. In order to alleviate repetitive data entry, the system shall allow the operator to copy data tables for use with other devices.

Database generation of traffic control operations shall include safeguards to preclude dangerous or undesirable intersection operation. These safeguards shall, as a minimum, include range-checking and timing plan verification.

2.6.2 Database Recovery

All database backup and recovery shall be through the ATMS software user interface. The operator shall be able to do the following:

♦   Automatically compress and back-up the database on an operator-specified time-of-

day setting or upon operator command; and

♦ Restore the back-up copy of the database to the ATMS database.

2.6.3 Database Reports

The operator shall be able to generate custom reports using the relational database custom report utility supplied with the database package. The ATMS shall provide a seamless interface to this utility.

2.7 Reporting Capabilities

2.7.1 General

The reporting capability and monitor screen displays shall be obtainable from the same menu options. The operator shall be able to click on a menu of report names and choose the display to be shown on the monitor screen. The operator shall be able to print any of these screens to any network printer or to a file at any time during the process by simply clicking a button on the report screen. If sending to the printer, the text shall be reformatted as necessary in order to be produce a legible printout. Unnecessary information shall not be printed. All report formats shall be approved by the TOWN.

Unless noted below, the displays/reports shall be available system-wide, by section, by channel, or by single device.

2.7.2 Types of Reports Required

As a minimum, the following displays/reports shall be available.

♦ System Status. This display shall be an overview of the present condition of all devices in the traffic system. This shall include intersection controllers, detectors, communication channels, and other categories of devices. The conditions shall include all possible status conditions (e.g., on-line, failed, etc.) and modes (e.g., TOD/DOW, On Flash, etc.) as described in this specification. By clicking on a particular category on the system status report, the operator shall be able to initiate the display of an associated detailed report screen. For example, by clicking on the field which indicates the number of intersections failed, the operator would initiate the display of a detailed screen listing the failed intersections and other details (e.g., time of failure).

♦ Real-Time Monitor. This display/report will show the request and reply to and from a single intersection. This monitor shall display the command being sent to an intersection along with the feedback data received back from the intersection. The display shall be continuous until stopped by the operator. The data shall be displayed in an easily understood format. The data displayed shall not be displayed in hex format. This display is required on an intersection basis only.

♦ Communication Statistics. This display/report shall show the communications throughput. The display shall include number of communication attempts, number of successes, number of failures, and percentage of successful communications per intersection, per channel, and per system.

- ◆ <u>Intersection Operation</u>. This display/report shall show the detailed intersection operation in real-time mode. This display shall be available on an intersection basis only.
- ◆ <u>Detailed Intersection Failure Status</u>. This display/report shall display the failure information for all failed intersections. This information shall include as a minimum: intersection location, reason for failure, and time of failure.
- ◆ <u>Detailed Detector Failure Status</u>. This display/report shall display the failure information for all failed detectors. This information shall include as a minimum: detector location, reason for failure, and time of failure.

2.7.3 Report Output Requirement

Reports and displays may be output to the ATMS operator station monitors or any network printer. Reports and displays may also be requested by remote computers, whether LAN-connected or dial-in.

2.8   System Log Requirements

2.8.1 Traffic System Log

The traffic system log shall record, in order of occurrence, all traffic-related messages. As a minimum, this shall include:

- ◆ Operational events (including occurrences of local preemption);
- ◆ Traffic device failures/repairs;
- ◆ Communication failures/repairs;
- ◆ Traffic data transfer messages;
- ◆ Manual override changes; and
- ◆ Operator log-on and log-off.

Unless printing has been suppressed by the operator, log messages shall be automatically output to a designated printer. The operator shall be able to filter which messages are logged to the printer and shall be able to suppress all log output to a printer. An on-line file of all log messages shall also be maintained with all messages logged to the on-line file. This file shall be of fixed length and circular format, overwriting at the beginning when reaching the end of the file.

2.8.2 Log of Current Operators

The ATMS software shall maintain a continuous record of the operators who are currently logged onto the system. The system shall add to this log any operator who logs onto the system and, upon log-off, shall delete the name of that operator from this log.

2.8.3 Operating System Log

The operating system log shall log all central system related events that occur in order of occurrence. As a minimum, it shall include the following:

- ◆ Internal system errors;
- ◆ System hardware failures;
- ◆ System network errors; and
- ◆ Software fatal errors.

Unless its printing has been suppressed by the operator, log messages shall be automatically output to a designated printer. An on-line file of all log messages shall also be maintained. This file shall be of fixed length and circular format, overwriting at the beginning when reaching the end of the file.

2.9   Graphic Display Subsystem (GDS)

2.9.1 General

The Graphical Display System (GDS) shall follow the same graphical user interface guidelines as the ATMS software. The interface to the GDS shall be an integrated module of the ATMS software. All commands for manipulating the GDS shall be available directly from the ATMS user interface. All graphic file generation shall occur within the ATMS. Any remotely stored graphic files shall be automatically updated by the system.

The graphic system shall have a base map that covers the entire extent of the City limits. The base map will be a TOWN-furnished CAD or GIS-generated graphic file serving as a static background map. The dynamic layers of the GDS shall be incorporated onto the base map by the Contractor. As a minimum, the base map will show the roadway centerlines of arterials and collector streets, freeway centerlines, rail lines, and major landmarks.

2.9.2 Pan/Zoom Requirements

It is desired that the dynamic mapping provided by the Contractor incorporate full pan/zoom capability. In such case, the operator shall be able to set up both dynamic and static informational layers that are displayed at different view scale levels by defining the view scale levels in a zoom level set-up configuration database table. By setting up the zoom scale range and appropriately enabled/disabled layers, the operator shall be able to control which layers display at different zoom scales. For example, at the citywide scale level the operator might enable roadway centerlines (static information) as well as a communication status indication (dynamic information) for each intersection controller across the city. When zooming in to a group of intersections (i.e. changing the view scale), the roadway centerlines would be disabled from view and the roadway curb lines would be enabled (become visible), and perhaps all phases of all the intersections in the displayed group shall become visible.

An alternative which would be considered as meeting the minimum required functionality (in lieu of full zoom capability) would be to provide a minimum of three discrete levels of displays:

◆ <u>System-wide display</u>, which shall include the entire City. This level shall include, as a minimum, centerlines of major roadways (including all which include a signal), freeway centerlines, rail lines, and major landmarks. At this level, signalized intersections, system detector stations, and other field devices shall be depicted as dynamic symbols (e.g., circles, squares, etc.). The operator shall have pan/zoom capability within the system-wide display.

◆ <u>Area displays</u>, which shall include portions of the system-wide display. (An example would be an area display of the central business district.) At this level, roadways may still be depicted as centerlines but all minor streets shall be included. At this level, it shall be possible to view the green status of the coordinated phase green. The operator shall have pan/zoom capability within each area display.

◆ <u>Intersection displays</u>, which shall depict roadway curb lines and lane lines and shall include static displays of the following (as a minimum):

    a. Street names;
    b. Intersection number;
    c. Phase numbering;
    d. Special function definition; and North arrow.

The intersection display shall also include dynamic indicators as follows (as a minimum):

    a. Controller operational mode (e.g., TOD/DOW, traffic responsive, manual, free, or remote flash);

    b. Controller status (e.g., in transition, preempted, conflict flash, etc.);

    c. Communications status (e.g., on-line, bad communication, or no communication);

    d. Timing parameters currently effect (e.g., control mode, transition status, control section assignment, timing plan number, cycle length, offset, and split values);

    e. Color status of all vehicular phases and overlaps (including the circular red, yellow and green indications and all arrows);

    f. Color status of all pedestrian phases (including walk, flashing don't walk, and steady don't walk);

    g. Actuation status of all local detectors (vehicular and pedestrian) and all system detectors associated with the intersection;

    h. Special function status;

    i. Count-up of cycle clock; and

    j. Countdown of the number of seconds remaining for the split of the phase in service.

Common icons shall be used as much as possible for all display levels. All colors shall be selectable by the operator. The same colors and icons shall also be used in display/report screens. A legend shall be available within the display window, defining the meaning of each icon and color.

If discrete display levels are used in lieu of full zoom capability, icons shall be provided on each level's display to select the view of the other levels.

The Contractor-furnished software shall include a library of standard intersection drawings (e.g., standard four-legged intersection, standard tee intersection, etc.).

2.9.3 Graphics Generation

As mentioned above, the system-wide base map will evolve from TOWN-furnished databases. The Contractor shall provide a user-friendly utility for import and generation of these graphic images for the GDS. Detailed intersection displays representative of AutoCAD-based and Microstation DGN design files shall also be able to be imported and generated for the GDS. From this graphic generation utility, the operator shall be able to create and revise all the maps and intersection drawings displayed by the GDS.

The actual creation of the graphic displays shall be a shared responsibility. As part of the required training:

♦ The Contractor shall develop the system-wide display and demonstrate how it can be edited in the future;
♦ The Contractor shall develop at least one area display and oversee the creation, by TOWN staff, of other area displays; and
♦ The Contractor shall develop approximately 20 intersection displays (encompassing a range of different intersection types) and shall oversee the creation, by TOWN staff, of approximately 20 other intersection displays.

The creation of the remaining area and intersection displays shall be the responsibility of the City. The Contractor shall, however, provide telephonic guidance and support as needed by the City. All custom and commercially available software required for operation and modification of the graphics generation utility package shall be supplied by the Contractor, who shall also supply any additional hardware required for use of the graphics generation utility package.

2.9.4 Refresh Rates

All real-time dynamic data that are to be displayed on a graphic map shall be refreshed as frequently as the feedback data are being returned from the field equipment. If feedback data are not received from the field because of higher priority communication, a message shall be displayed to the operator of the affected display.

All static graphic displays shall be designed and developed in such a way as to ensure instantaneous redraw of the graphic display. This display includes the background map and the real-time feedback data. For example, if the operator pans to the left, the entire screen needs to be redrawn. All displays shall be drawn as quickly as possible. The draw time for the largest map (system-wide) shall not take longer than two (2) seconds. All other displays shall not take longer than one (1) second.

2.10 Scratch Pad Capability. The system shall have a method to leave messages electronically on the operator stations for personal reminders or messages to other operators. The scratch pad facility shall be available in a separate window integrated with the ATMS interface.

2.11 System Installation and Failure Recovery

2.11.1 Software Installation

The installation of the ATMS software from storage media shall be completely automated. From the operating system command line, no more than two typed commands shall be required to fully install all software required onto the computers. Once the software is installed, configuration screens shall allow the system administrator to set distinct operating features of the system.

2.11.2 System Startup and Shutdown

The ability of the ATMS components to interact with each other shall not be governed by a structured start-up order. That is, if a component fails to operate or is powered down, the remainder of the system shall not have to be shut down and restarted to re-establish a working system. The unaffected components should simply wait for the missing component to be returned to the system. When returned, all components should automatically revert to normal operations.

The system shall be designed such that it will not need to be shut down. Hardware that is removed from active duty by power-down or cable-disconnect shall be reported by other components of the system to be non-responsive. When such equipment is powered up or reconnected, the system should respond by recognizing the return to normalcy and resume regular operations without operator interaction.

The Contractor-furnished documentation shall include published procedures for accomplishing, in a logical fashion, a complete, system-wide power-down (such as for purposes of moving the system).

2.11.3 System Failure and Recovery

The beginning and ending of the following system failures should be signified by paging appropriate personnel in addition to other reporting requirements detailed below.

♦   Power Failure. Each lifeline and non-essential component of the ATMS and central communications apparatus shall be configured with automatic shutdown software which shall, upon switch-over to UPS, initially allow for up to one minute of blackout before non-essential components begin an automatic shutdown procedure. After ten (10) minutes of blackout, the lifeline communication and ATMS components shall initiate their shutdown procedures. When power is restored, the system shall return to duty.

♦   Non-fatal Failure. If the ATMS software detects a non-fatal error within one or more of its processes, it shall alert the operator via an alarm and log a message to the system log. The ATMS shall continue to operate in a degraded state. The operator shall have final determination on what is considered a non-fatal failure.

♦   Fatal Failure. If the ATMS detects a fatal error within one or more of its processes, it shall alert the operator via an alarm on and log a message to the system log. The

ATMS shall then attempt an orderly shutdown of the system.

2.12 Software Documentation

2.12.1 General

The delivered ATMS software shall be fully documented. This documentation shall consist of pertinent technical documentation and operator documentation including the following:

- Proprietary source code escrow option;
- Database definitions and file structures;
- Variable descriptions, variable cross-references and subroutine calling sequences;
- Interface specifications;
- Requirements traceability matrix;
- Communication protocols including field device protocol;
- Security documentation;
- System backup and recovery procedures;
- System operational procedures and error handling;
- Hard copy user manual segregated into chapters (or volumes) which group topics according to whether the software is used from TMC operator stations, from remote computers, and from either of the above;
- On-line user manual or help facility;
- Warrantees on software; and
- Licenses and liens.

The Contractor may use different methods for documentation if it provides sufficient information as determined by TOWN staff. All documentation shall be submitted to the TOWN for final approval.

2.13 Testing

2.13.1 System Software Acceptance Test

All software furnished shall be subject to monitoring and testing to determine conformance with all applicable requirements and to ensure an orderly implementation of the system. The Contractor shall provide a proposed acceptance test procedure to the TOWN for approval at least thirty (30) days before the acceptance test is to begin. The test procedures shall be structured to exercise each element of the system and to verify the successful implementation of each required feature and element of functionality.

Based on the approved procedures, the TOWN shall perform an extensive test of the delivered software. The Contractor shall correct any problems which may be encountered and resolve any omissions discovered during the software acceptance tests.

2.13.2 NTCIP Verification/Testing

The test procedures shall verify conformance with all of the NTCIP standards and objects identified in this specification. Verification shall be established by two means. Each means shall be based on written test plans developed by the Contractor and approved by the TOWN, within the parameters described herein. The test plans shall provide a means of documenting each standard element and a means of indicating its proper operation.

The first means shall be the development of a test plan that incorporates the use of a third party testing suite and/or protocol analyzer to determine if a specific object is transmitted from and can be received by the central software. The test suite shall also be required to determine the value that is being passed and be capable of testing the complete range of values called for in the NTCIP standards and the PICS form completed by the Contractor and submitted as part of his/her proposal. The testing plan must test under conditions that replicate the physical plant (twisted pair copper), subnetwork, transport, application, and information level standards utilized by the central software furnished under this Project.

2.13.3   60-day Observation Period

A 60-calendar day observation period shall be required. This observation period shall commence upon successful completion of the system software acceptance test and all hardware components are operational. The observation period shall be a minimum of 60 calendar days in duration. Any major software component deficiency can (negotiable based upon type of failure) reset the calendar to day number 1.

2.14 Software and System Operational Training. The Contractor shall provide a minimum of forty (40) hours of training for TOWN personnel on the functional application and operation of the system software supplied. As a minimum this shall include the following:

- ◆   Use of operator interface;
- ◆   Use of graphical map generation and animation;
- ◆   Database use and manipulation;
- ◆   System parameter and database entry;
- ◆   Error messages and troubleshooting techniques;
- ◆   Database custom report generation;
- ◆   Overview of system structure and interfacing;
- ◆   Priority scheme setup;
- ◆   Configuration setup;
- ◆   System maintenance;
- ◆   System startup and shutdown; and
- ◆   System backup and recovery procedures.

The training shall include the creation of area and intersection graphic displays. The training shall also include integration of additional intersection/subsystems in to the ATMS. The training shall discuss integration of intersections currently connected directly by direct fiber optic communication links as well as intersections currently connected by dial-up modem communications.

The training shall consist of both formal classroom presentation and hands-on workshops.

The training shall be provided after full installation of the ATMS and publication of an approved user manual, but before the system software acceptance test procedure. Each training program shall be scheduled at the mutual convenience of the Contractor and the TOWN. All training shall be conducted during the normal TOWN business hours unless specifically noted otherwise. The TOWN shall reserve the right to videotape any and all training sessions. All training courses, lectures, and demonstrations shall be presented in person by qualified instructors. The training shall be conducted at a facility provided by the TOWN. The Contractor shall assume for budget purposes that the training will be conducted in blocks of not more than six (6) hours per day and on not more than three (3) consecutive days in any one calendar week.

2.15 Automatic Detection of Changes in Field Databases

2.15.1 Monitoring of Controller Access

Because field technicians have access to the intersection controllers, there is the opportunity for the local controller database to be changed without such change being commanded from the TMC. It is desired that the local intersection controller report four (4) feedback bits (door open, portable computers connected, front panel accessed, and power out) that communicate to the TMC when there is such activity at the controller. When the ATMS detects any of these bits, it shall automatically respond as follows.

♦ <u>Power Out</u> - Upon restoration of power, log that a power outage occurred and the time at which power was restored.

♦ <u>Door Open</u> - Log that the door is open and when the door returns to a closed position.

♦ <u>Door Open and either the portable computer is connected or the front panel is accessed</u> – The ATMS software shall log the event. After door closed signal is received, the ATMS software shall upload and compare the local controller's database with the ATMS's central database, which shall be considered to be the master database.

2.15.2 Periodic Upload of Field Databases

It is desired that the ATMS perform periodic, automatic upload of all field databases and compare such field databases with the ATMS's central database, which shall be considered to be the master database.

2.15.3 Correction of Database Discrepancies

Whenever a discrepancy is discovered between a field database and the ATMS's central database, it is desired that the ATMS software shall initiate one of two actions as defined by the operator:

♦ Automatically download the ATMS database, overwriting the local controller; or
♦ Alert the operator of discrepancy.

When comparing field and central database parameters, the ATMS software shall display

the two data sets side by side and highlight the discrepancies between the two data sets. Alternately, the new ATMS software shall highlight the discrepancies in the currently displayed database (central or field) and enable the operator to toggle to the other database. The operator shall have the option of saving the uploaded field database or downloading the central database to the field.

2.16 Generation and Display of Time-Space Diagrams. The new ATMS software shall enable the operator to generate time-space diagrams based on the timing stored in the central database and to display such time-space diagrams on-screen. The operator should then be able to perform on-screen fine-tuning, using click and drag methods to adjust the offsets, with the resulting changes in the widths of the progression bands being displayed. The operator should then be able to save to the database the resulting changes in offset for that timing plan.

To fine-tune crossing arterial progression, it is desired that the operator be able to generate and display the time-space diagram for each street in a separate window. The on-screen adjustment of the offset of the common window should result in changes in the widths of the progression bands in both windows.

2.17 Automatic Generation of Timing Plans. It is desired that the new ATMS software provide automatic generation, editing, and downloading of timing plans. Desirably, this would include the following:

♦ A Windows-based analysis package such as Synchro 5.0 (or later version);

♦ The means by which the generated timing plans can be edited on-screen in a manner similar to that described above in Subsection 2.3.4.

♦ The means by which an edited timing plan can be automatically downloaded to the ATMS database.

2.18 Graphical Reports. The new ATMS software shall include graphical reports. As an option, the following graphic reports should be available:

♦ Detector MOE Report. This graphic reports both real-time and archived measure of efficiency (MOE) data and should include the following:

    a. Present volume versus historical volume;
    b. Present occupancy versus historical occupancy; and
    c. Present speed versus historical speed.

Time frames for display should be operator-selectable.

♦ Intersection MOE Report. This graphic should report both real-time and archived MOE data and include the following:

    a. Percent of green time used;
    b. Percent of detector calls (relative to a threshold value);
    c. Number of max-outs (or force-offs); and

d. Number of pedestrian calls.

2.19 Detailed Graphics Displays. The system shall accommodate the following detailed graphics displays:

2.19.1 System-wide Display

The system-wide display shall be part of the static base map. At the top level, all intersections shall be displayable within one window. The operator shall be able to configure the different displayable layers along with the displayed map scale that these layers become visible. If real-time information is not available for display at certain top level displays the default condition for that layer shall be disabled.

The GDS software shall be capable of displaying system detector (or link) icons at the area wide level. When the zoom level allows for the display of system detectors, the data shall be displayed instead of the corresponding link data. Note that when traffic conditions are requested for the area-wide display, decisions shall be based upon link parameters rather than detector parameters. The operator shall be able to select the time interval to display the detector data. These data shall be displayable in either raw or smoothed form (operator-selectable).

The operator shall be able to display all detector measures of efficiency (MOEs) available at the area-wide map level. These include volume, occupancy, speed, and delay. A legend shall be displayed showing which MOE is being displayed, the time interval and the thresholds that the displayed colors are based on.

The operator shall specify which MOE is to be displayed and the time interval and thresholds that shall be used for projected averages. A minimum of four conditions shall be defined as unfavorable, intermediate, favorable, or unknown (i.e. detector failed). The condition shall be determined by comparing the stored data against the default high and low thresholds set by location and time-of-day.

The operator shall also be able to display detector status. The detector status classifications which shall be depicted include the following:

♦ Not failed;
♦ No activity;
♦ Erratic output;
♦ Maximum presence;
♦ Failed communication; and
♦ Real-time feedback preempted.

2.19.2 Detailed Intersection Display

By double clicking on the intersection icon on the overview map at any zoom level, the operator shall be able to display an individual detailed intersection in a window of the traffic display. The window size shall default to one-quarter size of the available display

screen size. The operator shall be able to change this default. The intersection display shall depict the intersection in an easy to understand display. Multiple intersection display windows shall be available for the operator, without restriction to communications channels. The number of display windows shall only be restricted to the number that can be feasibly displayed on the monitor. The operator shall be able to minimize and maximize a detailed intersection display. This shall enable the operator to have multiple displays available. The information available for intersection displays shall include all information available for that intersection.

The MOE information displayed on a detailed intersection window shall be operator-selectable. Thresholds shall be dynamically operator-changeable. A legend shall be displayed depicting what MOE is being displayed, the threshold values, and the color definition. If real-time feedback is not available because of higher priority communications, the graphic shall display an appropriate color and/or a message notifying the operator.

3.0 Documentation

3.1 General. Manuals shall be bound, and consist of minimum 8-1/2" x 11" with 11" x 17" minimum schematics. Operating instructions and maintenance manuals shall be provided for all Contractor-furnished equipment. Four (4) sets of manuals shall be provided for each item of Contractor-furnished equipment.

Four (4) copies of draft documentation shall be submitted to the TOWN for written approval no later than the delivery of the corresponding Contractor-furnished equipment. Upon written approval by the TOWN, final documentation for field hardware shall be submitted by the Contractor prior to the end of the 60-day Observation Period.

3.2 Computer/Peripheral Hardware (Contractor-furnished). The Contractor shall furnish four (4) copies of manuals detailing routine maintenance requirements, troubleshooting procedures, interface drawings and parts lists for each piece of Contractor-furnished equipment. This documentation material shall be submitted to the TOWN for review and approval a minimum of sixty (60) days prior to the beginning of the 60-day Observation Period.

3.3 Computer/LAN/Peripheral Manufacturer Supplied Software. The Contractor shall submit four (4) copies of standard documentation for the operating system and all Contractor-furnished computer/LAN/peripheral manufacturer-supplied software. This documentation shall be submitted to the TOWN a minimum of sixty (60) days prior to the start of the 60-day Observation Period.

3.4 ATMS Software. The Contractor shall provide and submit to the TOWN for written approval, full and complete documentation of the ATMS Software that has been furnished and installed by the Contractor.

New flow charts and descriptive graphics shall be prepared and furnished as necessary, indicating connection to and relationship to existing program modification, additions and changes to the base software and their programs or routines.

The Contractor shall supply four (4) copies of the traffic control applications software documentation to the TOWN 60 days before the initial applications software test. Until acceptance of the project, the Contractor shall be responsible for updating the software documentation within two (2) weeks of performing any software changes. If the software documentation does not reflect the current software operation, the TOWN may stop all work on the project until the software documentation is updated. Once initially delivered and installed, the Contractor shall maintain on-site at all times, on CD-ROM or DVD, one (1) debugged and current backup version of the software. Failure to maintain this documentation shall be grounds for the TOWN to halt the project until it is provided. The Contractor must demonstrate that source code has been properly escrowed.

Prior to acceptance of the project, the Contractor shall provide four (4) final ATMS software documentation manuals, two (2) copies of the ATMS software on CD-ROM or DVD, and two (2) copies of program listings. The Contractor shall also demonstrate to the TOWN that the backup version of the program on CD-ROM or DVD is debugged and current. This backup version shall remain after acceptance of the project.

3.5 Color Graphics Subsystem Software. The Contractor shall provide and submit to the TOWN for written approval, full and complete documentation of the color graphics subsystem software that has been furnished and installed by the Contractor.

New flow charts and descriptive graphics shall be prepared and furnished as necessary, indicating connection to and relationship to existing program modification, additions and changes to the base software and their programs or routines.

The Contractor shall prepare and supply complete and fully debugged assembled listings of all source coding provided with and used by the Contractor in the development of this system.

The Contractor shall supply two (2) copies of the current color graphics subsystem software documentation to the TOWN thirty (30) days before the central hardware is delivered on-site. From the date of initial delivery until acceptance of the project, the Contractor shall be responsible for updating the software documentation within two (2) weeks of performing any software changes. If the software documentation does not reflect the current software operation, the TOWN may stop all work on the project until the software documentation is updated. The Contractor shall maintain on-site at all times, one (1) debugged and current backup version on CD- ROM or DVD. Failure to maintain this documentation shall be grounds for the TOWN to halt the project until it is provided.

Prior to acceptance of the project, the Contractor shall supply to the TOWN three (3) final color graphics subsystem software documentation manuals and two (2) copies of program listings. The Contractor shall also demonstrate to the TOWN that the backup version of the program on CD- ROM or DVD is debugged and current. This backup version shall remain after project completion.

3.6 ATMS User's Manual. The Contractor shall submit four (4) copies of the system user's manual for review and approval by the TOWN 60 days prior to the initial acceptance test.

These manuals shall consist of two (2) volumes:

♦ Procedures for equipment setup, program loading, operating procedures, operational options, program monitoring, recovery procedures, and error message definition and corrections.
♦ Procedures for preparing, updating, and troubleshooting the database and pattern histories.

The operation of the LANs, file servers, microcomputers, workstations, and peripheral devices shall be described in detail with respect to display of program information and parameters, changing of input parameters, and operation of special keys and other equipment.

Sample output formats shall be provided. They shall be reproductions of laser printer and display outputs. The computer information required to provide such a display shall be illustrated with the appropriate output format.

A complete list of error messages associated with the software operation shall be provided for both the system operation and the database and pattern history. Each error message that could appear during system operation shall be defined as to the actual meaning, cause, and corrective action to be taken. This information shall be in addition to the basic troubleshooting and malfunction information that shall be provided.

Throughout the project, the system user's manual shall be continually updated on a monthly basis to reflect the current applications software. Failure by the Contractor to perform this task shall allow the TOWN to halt work on the project until this task is corrected and demonstrated to the satisfaction of the TOWN.

Immediately prior to the acceptance of the project, the Contractor shall submit to the TOWN four (4) final copies of the system user's manuals. These manuals shall be updated to reflect the current system operation and the TOWN's comments. The TOWN shall approve in writing these manuals before final acceptance is complete.

3.7 Training Manuals. The Contractor shall prepare a set of training manuals individually ring-bound for use during the training sessions. The manuals shall be developed for each of the training sessions and shall be specifically directed at the subject matter required to be covered. Each training manual shall specifically state the purpose of the manual. The manuals shall be revised following the training sessions as required to correct any major errors or deficiencies noted in the training effort.

Two (2) copies of each manual shall be submitted to the TOWN for review sixty (60) days prior to the preliminary scheduled start of the appropriate training session. The appropriate training session shall not start until two (2) weeks after approval by the TOWN of the training manual and the training dates. The number of manuals furnished for each training session shall be not less than the maximum number of participants for that session up to a maximum of ten (10).

The TOWN shall reserve the right to reproduce additional copies of manual(s) for future use of TOWN employees or TOWN contractors engaged in the operation and/or maintenance of the ATMS.

4.0 Warranty

The traffic control system software and all peripheral devices shall be fully warranted for parts and labor for a minimum of two (2) years from the date of acceptance.

5.0 Measurement and Payment

1.0 The work performed, materials furnished and all labor, tools, equipment and incidentals necessary to complete the work under this Item, will be paid for at the lump sum price for "Traffic Control System." This price is for installation of software and hardware, cables and connectors; documentation and testing; and labor, materials, warranty, training and incidentals necessary for operation of a complete Advanced Traffic Control System.

SPECIAL SPECIFICATION

A9004

TS2 Controller Cabinet Assembly

1.0 Controller Cabinet Assembly

1.1 These specifications set forth the minimum requirements for a TS2 Type 1 traffic control cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS2-1998 and all subsequent revisions to date. Where differences occur, these specifications shall govern.

1.2 The cabinet shall be constructed from Type 5052-H32 aluminum with a minimum thickness of 0.125 inches. The top, doors, and each side of the cabinet shall each be a single sheet of aluminum. Welding pieces together to form any of these surfaces shall not be permitted. The cabinet shall be provided with a front and rear door.

1.3 The welds shall be neatly formed, smooth and continuous. Spot welding of the cabinet exterior seams and sealing the remainder of the seams with sealant is not acceptable.

1.4 The cabinet exterior shall be painted **Dark Bronze** and the cabinet interior shall be painted **Semi-Gloss White.**

1.5 The top of the cabinet shall incorporate a slope from front to rear to prevent rain accumulation.

2.0 Size and Mounting

2.1 The cabinet shall be a Size 6 with the following minimum dimensions: 54" H x 44" W x 27" D.

2.2 The cabinet shall be designed for mounting on a concrete foundation or raised aluminum base using anchor bolt flanges inside the cabinet adjacent to the sidewalls. Slotted anchor bolt holes 2" long (front to back) by 1" wide shall be provided for securing the cabinet to the foundation.

2.3 The raised aluminum is to have minimum dimensions: 18" H x 44" W x 26" D.

2.4 The bolt pattern for cabinet mounting shall be 40 5/8" wide by 18 ½" deep. (These measurements are center-to-center of the anchor bolt holes.)

3.0 Cabinet Doors

3.1 Both cabinet door openings shall be at least 80 percent of the front and rear surface of the cabinet. A stiffener plate shall be welded across the inside of the door to prevent flexing.

3.2 A rain channel shall be incorporated into the design of the door openings of the cabinet to prevent water from entering the cabinet enclosure.

3.3 Both main doors shall be equipped with three-point latching mechanisms to firmly secure the door at the top, bottom, and center of the cabinet.

3.4 Both main doors shall be hinged on the right side of the cabinet as viewed facing the cabinet door opening. The door hinge shall be a one-piece, continuous stainless steel piano hinge, with a stainless steel pin, running the entire length of the door.

3.5 Both main doors shall include a doorstop mechanism capable of holding the door open at approximately 90, 125, and 150 degrees under windy conditions. The field technician shall not require manual placement of the mechanism. The doorstop shall be designed to minimize the accidental release of the door from any of the stop positions.

3.6 Both main doors shall be equipped with a Corbin No. 2 lock. Two keys shall be supplied.

3.7 Both main doors shall contain a weatherproof and dust-tight, closed-cell neoprene gasket seal residing in a channel mounted to the inside of the door. The gasket material shall be a minimum of 0.375 inches thick by 1.0 inches wide. The gasket shall be attached to the channel in the door using a permanent adhesive bond. The mating surfaces of the gasket shall be coated with a silicon lubricant to prevent sticking to the cabinet flange.

4.0 Police Compartment

4.1 A hinged police compartment door shall be provided on the outside face of the front main door only to permit access to a switch panel. There shall be no exposed

electrical terminals accessible from the police compartment and no dust or liquid shall be able to enter the main cabinet compartment from the police compartment. The size of the police compartment and door shall be as needed to accommodate the required switches, plug, and/or jacks and to provide for storage of the manual push button switch.

4.2 The police compartment door shall be provided with a Corbin Police lock and one key.

4.3 The police compartment door shall close against a weatherproof and dust-tight, closed-cell neoprene gasket seal. The gasket material shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be attached to the cabinet with a permanent adhesive bond. The mating surface of the gasket shall be coated with a silicon lubricant to prevent sticking.

5.0 Ventilation and Fans

5.1 The lower section of the cabinet front door shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient airflow for the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R-ventilated enclosures.

5.2 A 14" x 25" x 1" non-corrosive, vermin and insect-proof, removable, replaceable air filter shall be secured to the air entrance and shall fit snugly against the inside of the door.

5.3 The cabinet shall be provided with two (2) individually thermostat-controlled (adjustable between 80 and 150 degrees Fahrenheit) ventilation fans in the top of the cabinet plenum. The fans shall be a ball bearing-type and each shall be rated at 100 CFM.

6.0 <u>Shelves/Drawer</u>

6.1 All cabinets shall be supplied with two (2) removable and adjustable shelves manufactured from 5052-H32 aluminum. The shelves shall be a minimum of 10 inches deep.

6.2 It shall be possible to position the shelves to within 20 inches of the bottom of the cabinet and to within 8 inches of the top of the cabinet.

6.3 The two shelves shall be installed prior to the cabinet delivery. In order to facilitate future equipment maintenance, the bottom shelf shall be positioned to provide at least .75 inch clearance between the top of the detector rack and cabinet power supply and the lowest point of the top shelf. The Controller Unit and the MMU will be placed on the top shelf when the cabinet is prepared for installation.

6.4 A 1.5 inch drawer shall be provided in the cabinet, mounted directly beneath the controller support shelf. The drawer shall have a hinged top cover and shall be capable of storing documents and miscellaneous equipment. This drawer shall support up to 50 pounds in mass when fully extended. The drawer shall open and close smoothly. Drawer dimensions shall make the maximum use of available depth offered by the controller shelf and be a minimum of 23.5 inches wide.

7.0 <u>Shelf/Panel Mounting</u>

7.1 One set of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet shelves. The channels shall accommodate spring-mounted nuts or studs and shall be continuously adjustable from top to bottom of mounting rails.

7.2 One additional set of vertical "C" channels shall be provided on each sidewall of the cabinet with center-to-center spacing as needed to provide secure support for panels and/or any other mounted equipment.

8.0 Back Panel Design

8.1 The back panel shall be constructed from 5052-H32 aluminum of 0.125 inches minimum thickness and formed so as to minimize flexing when plug-in components are installed.

8.2 Access to the rear of the back panel shall be via the rear door of the cabinet as defined in Section 3.0, Cabinet Doors.

8.3 The back panel shall be fully wired for the following:

1. Sixteen (16) load switch sockets
2. Six (6) flash transfer relays
3. Two (2) wired BIU rack slots
4. One (1) Type 16 MMU
5. Terminals for the Controller input-output functions
6. Terminals for field circuit connections (signal circuits, pedestrian detector circuits, OPTICOM preemption circuits, etc.)
7. Harness with connector for NEMA TS2 cabinet Power Supply
8. Four pedestrian detector test switches, toggle, 3-position (on, off, locked call)
9. Sixteen (16) vehicle detector test switches, toggle, 3-position (on, off, locked-call)
10. Four (4) EVP detector test switch, toggle, 3-position (on, off, momentary)

8.4 Rack style mounting shall be provided to accommodate the required BIUs. A dual-row, 64-pin female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides inside the BIU enclosure shall be provided for both edges of the BIU. Terminal and facilities BIU mounting shall be an integral part of the main panel.

8.5 All pedestrian pushbuttons inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

8.6 The sixteen (16) load switch sockets shall be mounted in one horizontal row.

8.7 A bracket shall provide support for all load switches and the flasher.

9.0 Terminal Blocks

9.1 Load switch outputs shall be routed to terminals on a series of Marathon A4813-12 or equivalent terminal blocks with solder connections on the rear. These blocks shall be installed on the back panel. All vehicular and pedestrian signal field circuits shall be connected to these terminals. Compression type terminal blocks are not acceptable.

9.2 Load switches shall be assigned on a per-phase basis in the Controller Unit. All three load switch outputs shall be assigned to the same controller phase, and any unused load switch outputs shall not be reassigned to a different phase.

9.3 All Controller and Malfunction Management Unit input and output terminations on the back panel shall be permanently labeled. Cabinet prints shall identify the function for each terminal position.

10.0 Flasher/Flash Operation

10.1 The cabinet shall be wired for one (1) dual-circuit flasher unit, separate from the Controller Unit that shall permit the flashing of the field circuits.

10.2 The flasher socket shall be designed for a 15-amp dual-circuit NEMA solid-state flasher. The flasher shall be mounted to the back panel and supported by a bracket.

10.3 All field red and yellow flash color selection shall be accomplished at the field terminals with the use of a screwdriver only. It shall also be possible to select, through terminal connection, which of the two flasher circuits is connected to each phase.

10.4 The coil of the flash transfer relay shall be de-energized for flash operation.

10.5 One RC network shall be wired parallel for each flash-transfer relay and any other AC relay coils in the cabinet.

10.6 Flash Relays shall be Mid-TEX (PART NO. 1326062T3A1) or exact equivalent.

11.0 Connector Cables

11.1 All Controller Unit and Malfunction Management Unit cables shall be of sufficient length to allow the units to be placed on either shelf.

11.2 Each cabinet shall be provided with four RS-485 Port 1 SDLC communication cables to allow full capabilities of the cabinet. Each communication cable connector shall be a 15-pin metal shell "D" type subminiature type. The cable shall be a shielded cable suitable for RS-485 communications.

11.3 All wiring shall be neat in appearance. All cabinet wiring shall be continuous from point of origin to termination point. Butt-type connections/splices are not acceptable.

11.4 All wires going to the door shall be routed to protect against damage from repetitive opening and closing of the door.

12.0 Grounding

12.1 The grounding system in the cabinet shall be divided into three separate circuits (AC neutral, Earth Ground and Logic Ground).

13.0 Power Panel

13.1 The power panel shall be securely fastened to the lower right side wall of the cabinet. The power panel shall be wired to provide the necessary power to the cabinet, Controller, Malfunction Management Unit, cabinet power supply and auxiliary equipment. It shall be manufactured from 0.125 inch 5052-H32 aluminum with a removable clear plastic front cover.

13.2 The power panel shall contain the following components:

   1. A 40-amp main circuit breaker. This breaker shall supply power to the Controller, MMU, signals, cabinet power supply and auxiliary panels. All circuit breakers shall be thermal type, UL listed for HACR service, with a

minimum of 10,000 amp interrupting capacity. The breakers shall be Square-D QUO-150 SERIES, or exact equivalent.

2. A 10-amp equipment circuit breaker. This breaker shall supply power to the Controller, MMU and cabinet power supply.

3. A 15-amp auxiliary circuit breaker. This breaker shall supply power to the fans, light and GFI outlet.

4. An EDCO model SHA-1250 pluggable surge arrester shall protect the Controller, MMU and cabinet power supply.

5. A 50-amp, 120 VAC radio interference line filter.

6. A 75 amp solid state power relay with a heat sink.

7. A neutral buss bar capable of connecting one #6 stranded wire in each position, minimum 15-position.

8. A ground buss bar capable of connecting one #6 stranded wire in each position, minimum 7-position.

9. A NEMA Type 5-15R GFI convenience outlet.

10. A barrier terminal block with a minimum of three (3) compression fitting terminals designed to accept up to a No. 4 AWG stranded wire shall be provided for connection of the AC power lines. The block shall be rated at 50 amperes.

14.0   Cabinet Lights

14.1 One fluorescent lighting fixture mounted in the top of the cabinet and one flex arm incandescent fixture mounted in the bottom of the cabinet, which can be adjusted and be operated from a normal power factor UL or ETL listed ballast shall be provided. They shall be mounted on the inside top near the front and rear of the cabinet. The lights shall be automatically illuminated when the cabinet door is opened but shall also be equipped with an on-off switch mounted on a fixture that shall permit the lights to be turned off when the door is in the open position.

15.0   Cabinet Plans/Document Storage

15.1   Two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.

15.2   A sealable print pouch shall be mounted to the front door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of cabinet prints.

16.0   Technician Switches

16.1   A technician switch panel shall be mounted on the inside of the main door.

16.2   A test switch panel shall be provided with the following:

1. AUTO/FLASH SWITCH. When placed in the "flash" (up) position, the vehicular signal heads shall all display the programmed flashing red or amber indications generated by the flasher unit. The pedestrian indications, if any, shall be dark. Power shall not be removed from the controller. Stop time shall not be applied.

2. SIGNAL POWER. This switch shall control AC power to the signals. The "up" position is signals "on", and the down position is signals "off".

3. EQUIPMENT POWER ON/OFF SWITCH. This switch shall control the Controller, MMU, and the cabinet power supply 120 VAC power. The "up" position shall be power "on" and the "down" position shall be power off.

4. STOP TIME SWITCH.

17.0   Police Compartment Switches

17.1   The following switches shall be installed in the police compartment:

1. EMERGENCY FLASH SWITCH. When placed in the "flash" (up) position, the vehicular heads shall display the programmed flashing red or amber indications generated by the flasher unit. Pedestrian indications, if any, shall be dark. Power shall not be removed from the controller. Stop time shall be

applied. When this switch is returned to the "off" (down) position, the controller shall initiate the start-up sequence.

2. SIGNALS ON/OFF SWITCH.
3. AUTO/MANUAL SWITCH.
4. MANUAL PUSHBUTTON JACK.
5. PUSHBUTTON HAND CORD, MINIMUM TEN (10) FEET EXTENDED

18.0 Switches-General

18.1 All door mounted toggle type switches shall be heavy duty and rated at 10 amps minimum. Single, double or triple pole switches shall be provided as required.

19.0 Malfunction Management Unit

19.1 The cabinet assembly shall be wired for one Type 16 Malfunction Management Unit (MMU) as defined by the requirements of Section 4 of the NEMA TS2-1998 Standard.

19.2 The Malfunction Management Unit shall be Type 16 Model MMU-16.

20.0 Bus Interface Unit (BIU)

20.1 All BIUs shall meet the requirements of Section 8 of the NEMA TS2-1998 Standard.

21.0 Cabinet Power Supply

21.1 The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2-1998 Standard with the following exception; the 12 VDC output shall be rated at 5 amps.

22.0   Cabinet Detector Card Rack

22.1 Each cabinet shall contain a 14-position (single slots) card rack mounted to the lower shelf, and wired as follows:

    1.   Slots 1-2 shall be wired for one Bus Interface Unit.

    2.   Slots 3-10 shall be wired to accept four-4 channel TS2 card rack detectors using TS2 slot convention.

    3.   Slots 11-12 to be wired to accept 2-2channel cards or 1-4 channel card.

    4.   All card rack slots shall be labeled on the front flange.

23.0   Loop Detector Panel

23.1 The cabinet shall have a loop detector panel mounted on the lower left wall of the cabinet.

23.2 The detector panel shall provide all connections between the detector loops and the detector amplifiers.

23.3 The panel shall be constructed from 0.125 inch aluminum.

23.4 All field loop loops shall be wired to 10-32 x 5/16 inch binder head screw terminals.

23.5 Each loop pair shall be protected by an EDCO Model number SRA-6LC lightning surge suppressor. A minimum of sixteen suppressors shall be provided on the detector panel.

23.6 The panel shall be provided with the test switches described in Section 8.3, paragraphs 8, 9, and 10.

23.7 All wiring to the card rack shall be labeled and neatly run to other parts of the cabinet and detector panel. All loop inputs shall be wired with shielded twisted pair leads (Belden 9451, 2 conductor, 22 AWG w/24 AWG drain wire, shielded cable (or approved equivalent) to improve signal isolation. All grounds within the twisted pair leads shall be connected at the detector terminal panel.

23.8 A chassis ground bar bus shall be provided on the panel and connected to the cabinet by an insulated braided copper ground strap and shall be tied to the loop lead-in grounds. The strap shall be bonded to the cabinet. An additional neutral bus bar shall be provided on the panel and tied to the pedestrian commons.

23.9 Sufficient terminals shall be provided on the panel for terminating the emergency vehicle sensor inputs to the EVP modules in the card rack. These terminals shall be minimum 10-32 x 5/16 inch binder head screws.

23.10 The panel shall be provided with a plug-in four circuit pedestrian call isolation card. The module shall be a Genesis Technologies Part Number PT98121-4.

24.0 Video Detection Interface

The cabinet shall be completely wired for and provided with all the necessary ancillary equipment to allow Autoscope Solo Pro Camera/Video Processor Units (C/VPU) to be added later by simply wiring in the cables from the sensor units.

24.1 Each cabinet shall be provided with a Camera Interface Module (CIM) that plugs directly into the Card Rack. The CIM shall provide detector inputs to the Controller from up to eight C/VPU's. The communication link with the Controller shall be via a DB-15 SDLC connector on the front of the module.

24.2 Each cabinet shall be provided with one or more four sensor Communication Interface Panel(s) (CIP) depending on the number of sensors required at the intersection. The CIP shall contain terminal blocks for attaching the cable from the sensor. All communication lines between the CIP and the Solo Pro sensor in the field shall be provided with the lighting protection. This panel shall also provide an RS-232 Port with a DB-9 connector for interfacing to a Laptop Computer or remote communication via some type of modem.

24.3 Each cabinet shall be provided with a Lightning Protection Panel (LPP) containing, as a minimum; one (1) EDCO ACP-340, 1-10 amp circuit breaker, a 10 position terminal block, and a dual convenience outlet. This LPP shall be dedicated to protecting the Autoscope Solo Pro sensors in the field.

25.0 Testing

25.1 The cabinet shall be assembled and tested by the manufacturer to ensure proper component integration and operation before delivery to the Town of Addison.

25.2 Each Assembly shall be delivered with a signed document detailing the cabinet tests performed.

25.3 The supplier, or his representative, shall be available within 24 hours to assist in locating and correcting any operation problems with the cabinets during test operations.

26.0   Cabinet Configuration

26.1 Each TS2 Type 1 cabinet shall be provided with the following components:

1. One each Size 6 (P-44) Cabinet with **TWO (2) doors,** sixteen (16) position back panel, one (1) 14-position detector card rack, and one (1) drawer.

2. One each NEMA TS2 Type 1 Controller Timer with removable EEPROM card and RS-232 Communication Module.
   Econolite ASC/3-1000 Controller

3. One each Type 16 Malfunction Management Unit (MMU)
   Econolite MMU16-E-BS Malfunction Management Unit.

4. Four each Bus Interface Units (BIU)
   Econolite Part Number 32860G1

5. One each TS2 card rack Camera Interface Module (CIM).
   Econolite Part Number 34905G1

6. One (or more) four camera Communication Interface Panel (CIP).
   Econolite Part Number 34930G1

7. One each video detection lighting protection panel. (LPP).

8. One each TS2 Cabinet Power Supply.
   EDI Model PS250

9. Sixteen (16) NEMA Load Switches with 3-LED's on input side and 3-LEDs on output side.

10. One each NEMA 2-Circuit Flasher.

11. Six each Flash Relays.

MID-TEX (Part No 136-62-T3AI) or equivalent

12. One each, Four Circuit Pedestrian Isolation Card.
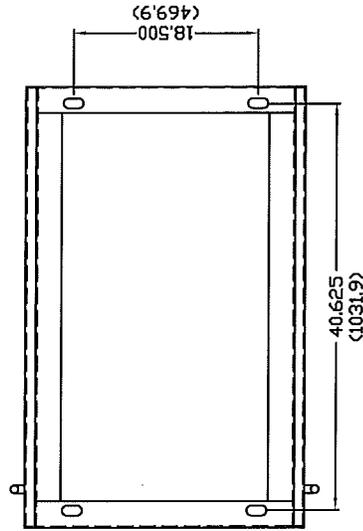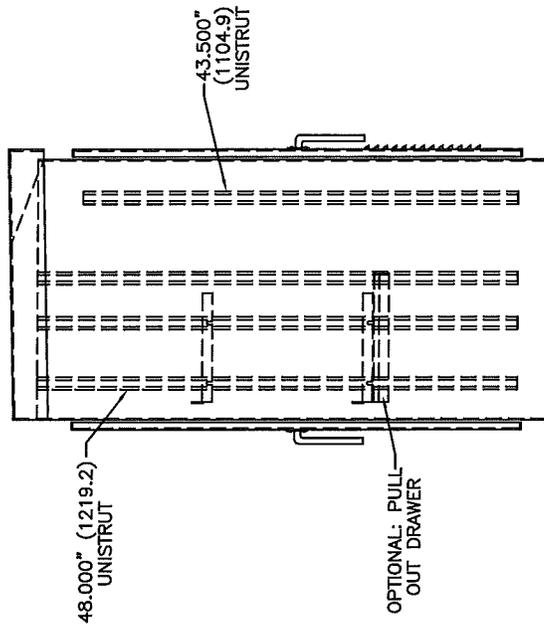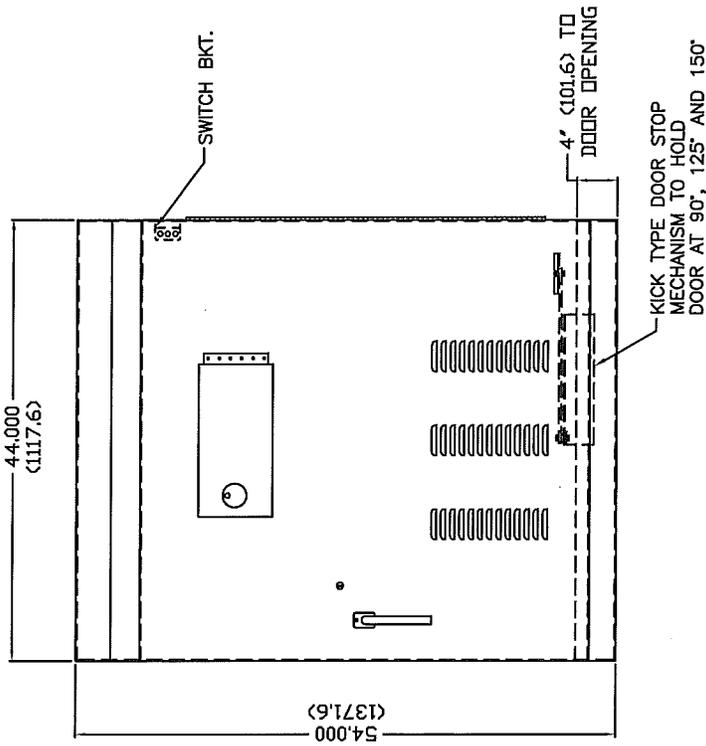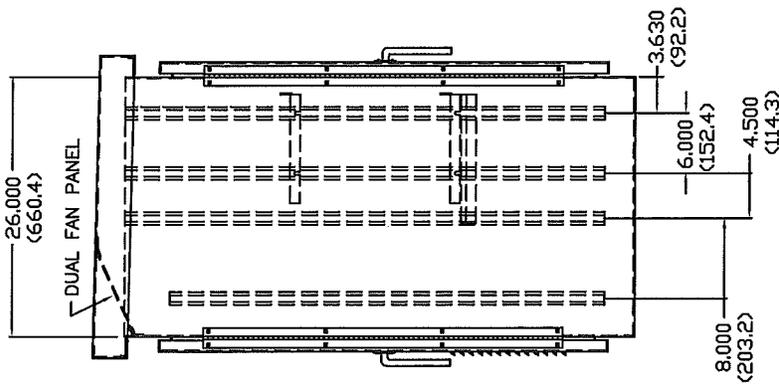
NOTES:
1. MATERIAL: 0.125 (3.18) THK. 5052 ALUMINUM.
2. FULL LENGTH SST HINGE.
3. FULL PERIMETER 1/2" X 2" (12.7 X 50.8) CLOSED CELL NEOPRENE GASKET.
4. TWO 11.000" (279.4) DEEP ADJUSTABLE SHELVES TO BE PROVIDED.
5. MAIN DOOR LOCK IS A #2 CORBIN LOCK
6. POLICE DOOR LOCK IS A #1 CORBIN LOCK
7. 3-POINT LATCHING SYSTEM WITH PADLOCKABLE SST HANDLE.
8. FILTER SIZE TO BE 14" X 25" (355.6 X 635.0)
9. CONTINUOUSLY WELDED EXTERNAL SEAMS.
10. SHIPPED ON A PLYWOOD PALLET WITH 4 X 4 RUNNERS.
11. FINISH: MILL IF REQUIRED.
    PAINT IF REQUIRED: REECE SUPPLY
    (313 DARK BRONZE AKZO METAFLEX) OUTSIDE, WHITE INSIDE.
12. OPTIONAL: 13" X 24" PULL OUT DRAWER ASSEMBLY.

DUAL FAN PANEL

26.000
(660.4)

3.630
(92.2)

6.000
(152.4)

4.500
(114.3)

8.000
(203.2)

SWITCH BKT.

44.000
(1117.6)

54.000
(1371.6)

4" (101.6) TO DOOR OPENING

KICK TYPE DOOR STOP MECHANISM TO HOLD DOOR AT 90°, 125° AND 150°

18.500
(469.9)

40.625
(1031.9)

48.000" (1219.2) UNISTRUT

43.500" (1104.9) UNISTRUT

OPTIONAL: PULL OUT DRAWER

FRONT CONNECTION
REAR CONNECTION

T1 T2 T3 T4 T5 T6

FL

LS

K1 K2 K3 K4 K5 K6 K7 K8

FLASH PROGRAMMING
RED FLASH   YELLOW FLASH   PED Ø

CIRCLED INDICATION FLASHES
FIELD LOOPS
DETECTOR
CUST.
CONT. B/MMU CH

GB1 EARTH GROUND
GB2 REMOVE JUMPER TO ISOLATE AC NEUTRAL FROM EARTH GROUND

AC NEUTRAL

CMA (MMU A CABLE)
CMB (MMU B CABLE)
CU (CONTROLLER)
PS (POWER SUPPLY)
PORT 1
B1 (BIU 1)
B2 (BIU 2)
PL1
P1 P2

		GEJ	12/02/06		
		BY	DATE		
REV.	DESCRIPTION				
A	RELEASE				

CHKD. BY: | | DATE: | | APP. BY: | | DATE:

FULL SEAM WELD DOWN SIDES

MIG WELD TOP AND BOTTOM
SEAMS ON INSIDE

18.000

44.000

40.625

18.500

26.000

NOTES:
1. FULL WELD CONSTRUCTION.

SPECIAL SPECIFICATION

6266

Video Imaging Vehicle Detection System (Install Only)

1. **Description.** Install a Video Imaging Vehicle Detection System (VIVDS) that monitors vehicles on a roadway via processing of video images and provides detector outputs to a traffic controller or similar device.

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

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

   The VIVDS Card Rack Processor must be either NEMA TS 2 TYPE 1 or TYPE 2. TYPE 2 must have RS 485 SDLC.

2. **Definitions.**

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

   B. VIVDS Processor System. One or more VIVDS processor modular units required to handle the number of camera inputs.

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

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

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

F. Remote Communications Link. The communications connection between the VIVDS processor unit and the central control.

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

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

Or

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

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

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

K. Live Video. Video being viewed or processed at 30 frames per second.

L. Lux. The measure of light intensity at which a camera may operate. A unit of illumination equal to one lumen per square meter or to the illumination of a surface uniformly one meter distant from a point source of one candle.

M. Video Monitor. As a minimum must be a 9-in. black and white monitor with BNC connectors for video in and out.

3. Functional Capabilities.

The system software must be able to detect either approaching or departing vehicles in multiple traffic lanes. A minimum of 4 detector outputs per video processor module card and each card must have a minimum of 24 detection zones. Each zone and output must be user definable through interactive graphics by placing lines and/or boxes in an image on a video or VGA monitor. The user must be able to redefine previously defined detection zones.

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

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

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

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

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

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

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

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

4. Vehicle Detection.

    A. Detection Zone Placement. The video detection system must provide flexible detection zone placement anywhere within the combined field of view of the image sensors. Preferred presence detector configurations must be lines or boxes placed across lanes of traffic or lines placed in line with lanes of traffic. A single detector must be able to replace one or more conventional detector loops. Detection zones must be able to be fully overlapped. In addition, detection zones must have the capability of implementing "AND" and "OR" logical functions including presence, extension and delay timing. These logical functions may be excluded if provisions are made to bring each detector separately into the controller and the controller can provide these functions.

    B. Detection Zone Programming. Placement of detection zones must be by means of a graphical interface using the video image of the roadway. The monitor must show images of the detection zones superimposed on the video image of traffic while the VIVDS processor is running.

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

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

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

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

C. Design Field of View. The video detection system must reliably detect vehicle presence in the design field of view. The design field of view must be defined as the sensor view when the image sensor is mounted 24 ft. or higher above the roadway, when the camera is adjacent (within 15 ft.) to the edge of the nearest vehicle travel lane, and when the length of the detection area is not greater than 10 times the mounting height of the image sensor. Within this design field of view, the VIVDS processor unit must be capable of setting up a single detection zone for point detection (equivalent to the operation of a 6 ft. by 6 ft. inductive loop). A single camera, placed at the proper mounting height with the proper lens, must be able to monitor up to and including 5 traffic lanes simultaneously.

D. Detection Performance. Detection accuracy of the video detection system must be comparable to properly operating inductive loops. Detection accuracy must include the presence of any vehicle in the defined detection zone regardless of the lane, which the vehicle is occupying. Occlusion produced by vehicles in the same or adjacent lanes must not be considered a failure of the VIVDS processor unit, but a limitation of the camera placement. Detection accuracy (a minimum of 95%) must be enforced for the entire design field of view on a lane by lane and on a time period basis. When specified in the plans, furnish up to 24 continuous hours of recorded video of all installed intersection cameras within the 30 day test period for verification of proper camera placement, field of view, focus, detection zone placement, processor setup and operation. The video from each camera must show vehicle detections for all zones.

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

5. **VIVDS Processor Unit.**

A. Cabinet Mounting- The VIVDS processor unit must be rack mountable.

B. Environmental Requirements - The VIVDS processor unit must be designed to operate reliably in the adverse environment found in the typical roadside traffic cabinet. It must meet the environmental requirements set forth by the latest NEMA (National Electrical Manufacturers Association) TS1 and TS2 standards as well as the environmental requirements for Type 170, Type 179 and 2070 controllers. Operating temperature must be from -30°F to +165°F at 0% to 95% relative humidity, non condensing.

C. Electrical - The VIVDS must have a modular electrical design.

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

Serial communications to the field setup computer must be through an RS 232, USB or Ethernet port. This port must be able to download the real time detection information needed to show detector actuations. A connector on the front of the VIVDS processor unit must be used for serial communications.

The unit must be equipped with RS 170 (monochrome) or RS170A (color) composite video inputs video inputs, so that signals from image sensors or other synchronous or asynchronous video sources can be processed in real time. BNC connectors on the front of the VIVDS processor unit or video patch panel must be used for all video inputs.

The unit must be equipped with a single RS 170 composite video output. This output must be capable of corresponding to any one of the video inputs, as selected remotely via the field setup computer or front panel switch. Multiple video outputs requiring external cable connections to create a combined single video output must not be acceptable. A BNC or RCA connector must be used for video output on the front of the processor unit. Any other video formats used must prior approval by TxDOT TRF Signal Operation Engineer.

Software upgrades and/or changes MUST be presented to and approved by TXDOT TRF-TM division, before being used. Failure to do so will be grounds for termination of contract and probation for responsible party(s).

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

6. **Camera Assembly.**

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

      1. Images must be produced with a Charge Coupled Device (CCD) sensing element with horizontal resolution of at least 480 lines for black and white or 470 lines for color and vertical resolution of at least 350 lines for black and white or color. Images must be output as a video signal conforming to RS170.

      2. Useable video and resolvable features in the video image must be produced when those features have luminance levels as low as 0.1 lux for black and white, and as low as 1.0 lux for color, for night use.

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

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

B. Camera and Lens Assembly. The camera and lens assembly must be housed in an environmental enclosure that provides the following capabilities:

1. The enclosure must be waterproof and dust tight to the latest NEMA 4 specifications.

2. The enclosure must allow the camera to operate satisfactorily over an ambient temperature range from -30°F to +165°F while exposed to precipitation as well as direct sunlight.

3. The enclosure must allow the camera horizon to be rotated in the field during installation.

4. The enclosure must include a provision at the rear of the enclosure for connection of power and video signal cables fabricated at the factory. Input power to the environmental enclosure must be nominally 115 VAC 60 Hz.

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

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

7. The total weight of the image sensor in the environmental enclosure with sunshield must be less than 10 lb.

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

The video output of the cameras must be isolated from earth ground. All video connections for the cameras to the video interface panel must also be isolated from earth ground.

Use waterproof, quick disconnect connectors to the image sensor for both video and power.

A camera interface panel capable of being mounted to sidewalls of a controller cabinet must be provided for protection of the VIVDS processor unit, camera video and power inputs/outputs. The panel must consist of, as a minimum, 4 Edco CX06 coax protectors, a

Edco ACP-340 for the cameras and VIVDS processor unit power, a 10 amp breaker, a convenience outlet protected the ACP-340 and a terminal strip with a minimum of sixteen 8-32 binder head screws. The terminal strip must be protected by a piece of 1/8 in. Plexiglas.

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

Camera mounting hardware must allow for vertical or horizontal mounting to the camera enclosure. Pelco AS-0166-4-62 or equivalent is acceptable.

7. **Field Communication Link.** The field communications link must be a one way communications connection from the camera to the equipment cabinet. The primary communications link media may be coaxial cable or fiber optic cable accompanied by a 3 conductor minimum 18 AWG, 24 VDC or 115 VAC camera power cable, or appropriate cable as approved.

The following requirements must govern for the various types of field communications link media described on the plans:

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

B. Fiber Optic Cable. If specified by the plans, furnish fiber optic cable in accordance with the special specification for fiber optic cable.

C. Twisted Wire Pairs. Must be Belden 9556 or equivalent 18 AWG TWP control cable.

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

Install lightning and transient surge suppression devices on the processor side of the field communications link to protect the peripheral devices. The suppression devices must be all solid state. Lightning protection is not required for fiber optic communication lines. The devices must present high impedance to, and must not interfere with, the communications lines during normal operation. The suppression devices must not allow the peak voltage on any line to exceed 300% of the normal operating peak voltage at any time. The response time of the devices must not exceed 5 nanoseconds.

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

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

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

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

9. **Temporary Use and Retesting.**

   A. Temporary Use. When shown on the plans, the VIVDS equipment must be used to provide vehicle detection on a temporary basis. When the permanent vehicle detection system and related equipment are installed and made operational, the VIVDS equipment must be carefully removed and delivered to the location shown on the plans.

   B. State Retesting and Acceptance. Prior to acceptance, all VIVDS equipment may be retested by the State, even if the system was operating properly before removal. Repair or replace any equipment damaged during removal or transport and any equipment that does not meet the various test requirements.

10. **Operation from Central Control.** The central control must transmit and receive all information needed for detector setup, monitor the vehicle detection, view the vehicle traffic flow at a rate of 2 frames per second or greater for telephone, or 5 frames a second or greater for ISDN lines (as specified by the plans), and interrogate all required stored data. The remote communications link between the VIVDS processor unit and central control may be dial-up (telephone or ISDN lines) or dedicated twisted wire pair communications cable which may be accompanied with coaxial cable or fiber-optic cable, as shown on the plans. Communications with the central control must not interfere with the on-street detection of the VIVDS processor. Quality of the video at 2 frames per second rate must be such that the view with the traffic flow is clear and in focus.

11. **Installation and Training.** The supplier of the video detection system must supervise the installation and testing of the video and computer equipment. A factory certified representative from the supplier must be on site during installation.

   In the event that the field setup computer is furnished by TxDOT, such installation and testing must be done at the time that training is conducted.

   Provide up to 2 days of training to personnel of TxDOT in the operation, setup and maintenance of the video detection system. Provide instruction and materials for a maximum of 20 persons and conduct at a location selected by TxDOT. TxDOT will be responsible for any travel and room and board expenses for its own personnel.

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

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

12. **Warranty, Maintenance and Support.** The video detection system must be warranted to be free of defects in material and workmanship for a period of 5 years from date of shipment from the supplier's facility. During the warranty period, the supplier must repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect provided the product is returned FOB to the supplier's factory or authorized repair site. Return product repair or replaced under warranty by the supplier with transportation prepaid. This warranty does not apply to products damaged by accident, improperly operated, abused, serviced by unauthorized personnel or unauthorized modification.

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

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

The supplier must maintain a program for technical support and software updates following expiration of the warranty period. Make this program available to TxDOT in the form of a separate agreement for continuing support.

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

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

13. **Measurement.** The VIVDS will be measured as each major system component installed, made fully operational, and tested in accordance with this special specification or as directed by the Engineer.

The VIVDS communication cable will be measured by the linear foot of the appropriate media type furnished, installed, made fully operational, and tested in accordance with this specification, other referenced Special Specifications or as directed by the Engineer.

When the VIVDS is used on a temporary basis, the VIVDS must be measured as each system furnished, installed, made fully operational, including reconfiguration and removal if required by the plans, and tested in accordance with this special specification or as directed by the Engineer.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

When recorded video is required by the plans it will be paid for by each camera recorded.

14. **Payment**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "VIVDS Processor System", "VIVDS Camera Assembly", "VIVDS Central Control",

"VIVDS Set-up System", "VIVDS Temporary", "VIVDS Communication Cable (Coaxial)," "VIVDS Communication Cable (Fiber Optic)", "VIVDS Video Recording", and all accompanying software. These prices are full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software package(s), supplies, support, personnel training, shop drawings, documentation, and incidentals. A 3-conductor power cable must be included with the communication cable.

These prices also include any and all interfaces required for the field and remote communications links along with any associated peripheral equipment, including cables; all associated mounting hardware and associated field equipment; required for a complete and fully functional visual image vehicle detection system component.

SPECIAL SPECIFICATION
A9002
Video Server

1. Description. Furnish and install Video Server field equipment in designated field locations and equipment cabinets as shown on the plans and as detailed in the Special Specifications.

2. Materials. Provide new, corrosive resistant materials in accordance with the details shown on the plans and this Item.

Provide Video Server equipment including, but not limited to, the following:

- Four channel video server (location specific).

- Video server housing and mounting hardware.

- Video, camera control, Ethernet and power cable harnesses, connectors.

- Software and PTZ driver software for specified camera in use.

3. Functional Requirements. The video server shall allow the transmission of CIF-sized images at up to 25 fps per channel when connected to PAL devices, and up to 30 fps per channels when connected to NTSC devices, using standard Motion JPEG format and with no modification of images. When transmitting images from a single channel, the video server shall allow the transmission of up to 25 fps when connected to PAL devices, and up to 30 fps when connected to NTSC devices, this for all resolutions.

The video server shall also provide Advanced Simple Profile (ASP) and Simple Profile (SP) MPEG-4, and shall support both unicast and multicast over RTP, controlled by RTSP. It shall also be possible to tunnel the MPEG-4 unicast stream over RTSP and HTTP. It shall be possible to configure the camera to provide ISMA-compliant MPEG-4. The video server shall provide support for simultaneous Motion JPEG and MPEG-4 streams.

A. Resolution Requirements. Video shall be available in a minimum of 5 different resolutions, each supporting a minimum of 11 different compression levels. Supported video resolutions shall include:
- QCIF
- CIF
- 2CIF
- 2CIF Expanded
- 4CIF

The video server shall be capable of providing video at bit rates of up to 8Mbit/sec per video stream.

B. Networking Requirements. The video server shall contain a built-in web server to make video and configuration available in a standard browser environment, with no need for additional software. The video server shall allow the user to view each video signal in full screen mode, in a sequence with individually definable dwell times, or to view one to four video signals simultaneously in so-called quad mode.

When accessed from a browser, the built-in web server shall provide users with online, context-sensitive help.

The video server shall support both fixed IP addresses and dynamically assigned IP addresses (provided by a DHCP server). It shall also allow automatic detection of the video server based on UPnP™, when using a PC with an operating system that supports this feature.

The video server shall provide the ability to control network traffic by limiting the maximum bandwidth to a selected value. Furthermore, it shall be possible to limit the frame rate per viewer to a selected value, as well as the duration of each viewing session.

The video server shall provide the ability to send operational and technical information using a standard SMTP mail server.

The video server shall provide embedded on-screen text in the video, with support for date & time, and a customer-specific text, video server name, of at least 32 ASCII characters. It shall also allow for the overlay of a graphical image, such as a logotype, into the image.

The video server shall provide local time & date, including support for daylight saving time. To ensure accuracy, the video server must accept external time synchronization from an NTP (Network Time Protocol) server.

The video server shall support simultaneous viewing by up to 20 clients. To avoid improper use and configuration, the video server must provide support for defining users and passwords, for a minimum of three different types of users.

The video server shall support the use of HTTPS and the ability to upload signed certificates to provide an encrypted and secure communication of both administration and video streams. It shall also provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.

To improve functionality, the video server shall allow the user to write scripts, controlling events and other user functions.

C. PTZ Control Requirements. The video server shall be able to connect to and control third party domes and Pan Tilt Zoom devices via RS-232 or RS-485. The drivers for these devices shall be possible to upload to the video server. The uploading of drivers, and the changing of the driver type shall be possible without having to replace the video server's firmware.

LED's shall indicate the video server's operational status and provide information about power, communication with receiver, the network status and the video server status.

Customer-specific settings, including the IP address, the local time & date, event functionality and video configuration, shall be stored in a non-volatile memory and shall not be lost during power cuts or soft resets.

4. Electrical and Mechanical Requirements. The video server shall provide one to four analogue video inputs, each compatible with black and white (EIA and CCIR) and colour (PAL and NTSC) composite video signals.

The video server shall deliver high speed, high quality video at resolutions up to 768x576 (PAL) / 704x480 (NTSC) pixels over IP networks, by using Motion JPEG compression. It shall be capable of simultaneously delivering up to 30 frames (CIF resolution) per second per channel. When viewing a single video source, the frame rate shall be up to 30 frames per second in all resolutions. The video server shall support both IP address filtering and HTTPS to secure transmission of video and configuration data. The video server shall not require any additional software to operate.

The video server shall also support MPEG-4 Advanced Simple Profile (ASP) and Simple Profile (SP), with simultaneous Motion JPEG support.

The video server shall be equipped with at least 1 to 4 alarm inputs and one to four outputs. It shall be capable of receiving external triggers from third party devices, as well as triggers from the built-in Video Motion Detection. In response to these triggers, the video server will be able to initiate alarms and/or image transmission. Notification will be provided over TCP, email and HTTP, while image upload will be available via FTP, email and HTTP. The video server shall connect to a network using 10baseT Ethernet or 100baseTX Fast Ethernet, via a standard RJ-45 socket.

The video server shall be equipped with 1 to 4 video inputs of BNC UG/U type. Termination of the inputs shall be independent for each input, using dip switches located on the front of the video server (standalone version) or on the Blade (blade version). The video server shall automatically detect the video format used (PAL or NTSC).

The video server shall be equipped with 2 serial ports, one RS-232 and one RS-422/485 serial port.

The video server shall be equipped with a minimum of 1 to 4 control (alarm) inputs and 1 to 4 outputs, accessible via a removable terminal. A mating connector shall be supplied with the video server. The control input shall be configurable to respond to normally open (NO) or normally closed (NC) dry contacts, or to active low or active high TTL/CMOS compatible electronic outputs. The alarm mating connector shall provide alarm outputs to TTL/CMOS compatible alarm inputs on peripheral devices, such as a device for processing alarms. These functions shall be configurable via the web interface. The video server shall also, via the same connector, provide suitable control voltage for these inputs.

The video server shall connect to a network using 10baseT Ethernet or 100baseTX Fast Ethernet via a standard RJ-45 socket, and shall support auto sensing of network speed.

The video server shall be equipped with a minimum of three LED's, capable of providing visible status information in green, red and amber.

The standalone video server shall be manufactured in a solid all-metal casing and be provided with mounting ears for wall mounting. The blade version shall be fitted with an aluminum front plate for use in suitable 19 in. Video Server Racks, supporting hot-swap of blades.

The stand alone video server shall support DC-based power supplies.

5. **Software Requirements.** The video server shall be compatible with the existing City of Allen Video Imaging Vehicle Detection equipment in the field and the new Advanced Traffic Management System.

The video server shall use an embedded non-PC-based solution, running on an open source, non-Windows based platform. It shall incorporate TCP/IP, HTTP, HTTPS, SSL/TSL, FTP, RTP, RTSP, SMTP, NTP, ARP, DCHP, and UPnP protocol support.

The video server shall be monitored by a Watchdog, which shall automatically re-initiate processes or restart the video server if a malfunction is detected.

It shall be possible to update the software (firmware) over the network, using FTP or HTTP.

The video server shall include support for Shell scripting, allowing customer-specific functions to be created.

The video server shall support full functionality when operating in the following environment:

Operating Systems: Windows 2000, Windows XP

Browsers: MS Explorer 6.x and higher

The video server shall be supported by a fully open and published API (Application Programmers Interface), providing all the necessary information required for integrating functionality into third party applications.

6. **Environmental Requirements.** The video server shall operate in a temperature range of +5° to +50°C (41° to 122° F). The video server shall operate in a humidity range of 20–80% RH (non condensing).

7. **Measurement.** This item will be measured as each unit complete in place.

8. **Payment.** The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for each "Video Server" of the type specified. This price includes all equipment described under this Item with all documentation and testing; and will include the cost of furnishing all labor, materials, warranty, equipment and incidentals.

TOWN OF ADDISON
SPECIAL SPECIFICATION

A9007

Wireless Ethernet Radio Equipment for Traffic Signal System

1. **Description.** Install Wireless Ethernet Radio (WER) equipment for traffic signal system.

2. **Materials.** Supply complete manufacturer specifications for radios, reflectors, cables, connectors, power supply, mounting hardware, and lightning surge protector, including the exact gain of the radio.

3. **Access Point and Subscriber Unit Radios.** Install access point and subscriber unit radios on top of the water tower and in the field with the following operating minimum characteristics:

FREQUENCY	5725-5850 MHz
RANGE	124 Miles line of sight
REPEAT CAPABILITIES	Store and Forward Repeater Capabilities
ANTENNA BEAM WIDTH	3 dB Antenna Beam Width 60 degrees, Azimuth and Elevation
TYPICAL AGGREGATE USEFUL THROUGHPUT	14 Mbps to 1 Mi
EQUIVALENT ISOTROPINC RADIATING POWER (EIRP)	1W (63W with reflector)
ENVIRONMENT	Temperature -40°F to 131°F
FCC APPROVAL	No License Requirements Type acceptance under FCC Part 15.247
DATA CHARACTERISTICS	Half or Full Duplex Operation Interface 10/100 Base T Ethernet
ACCESS METHOD	Time Division Duplex / Time Division Multiple Access (TDD/TDMA)
GAIN	7 dBi
WIND RATING	118 miles/hour
REGULATED POWER SUPPLY	Voltage 24 VDC Amperage 0.3 Amp Power 7.2 W

Install the access point and subscriber unit radios as shown on the plans or as directed.

Supply radios with diagnostic software capable of testing the link between the access point radio and the subscriber unit. Provide software capable of detecting channels which are not adequate for the transmission of data and allow for the exclusion of these frequencies in the selection of frequencies to be scanned.

Mount the radio on a traffic signal pole, mast arm with extension, or a separate steel pole as directed by the plans. Ground the radio to the metal support. Do not use a wood pole or support.

If adequate signal strength cannot be attained, provide a reflector to enhance signal strength. The reflector is considered subsidiary to "Wireless Ethernet Radio".

4. **Backhaul Radio.** Install point-to-point backhaul radios with the following minimum characteristics:

FREQUENCY	5.725-5.850 GHz
RANGE	124 Miles line of sight
SINGALING RATE	60 Mpbs
CHANNEL WIDTH	12 MHz
TYPICAL AGGREGATE USEFUL THROUGHPUT	3.0 to 43 Mbps
EQUIVALENT ISOTROPINC RADIATING POWER (EIRP)	Adjustable to 12.0 W
ENVIRONMENT	Temperature -40°F to 140°F
FCC APPROVAL	No License Requirements Type acceptance under FCC Part 15.247
DATA CHARACTERISTICS	Auto MDI/MDIX switching 10/100 Base T Ethernet
ACCESS METHOD	Time Division Duplex (TDD) Time Division Multiple Access (TDMA)
ANTENNA GAIN	28 dBi
NETWORK MANAGEMENT	Web Server and SNMP
WIND RATING	150 miles/hour
REGULATED POWER SUPPLY	Voltage 36-60 VDC Amperage 0.34 Amp Power 55 W max

Mount the antenna on a separate steel pole as directed by the plans. Ground the radio to the metal support. Do not use a wood pole or support.

5. **Cluster Management Module.** Install cluster management module with the following minimum characteristics:

Furnish cluster management modules for locations with two (2) or more radio devices. Install module in accordance with manufacturer's recommendations and as shown on the plans or as directed. Any one radio shall not exceed 328 cable feet from the cluster management module. Cluster management module shall meet CE IP44 according to EN60529.2000

6. **Cable.** Install Category 5E cable that includes power over Ethernet. Cable shall be rated for outdoor application.

7. **Experience Requirements.** The Contractor or designated subcontractors involved in the installation and testing of the signal system, as a minimum, must meet the following requirements:

- Two years experience in the installation of the above specified radio equipment for the purpose of traffic signal communications.

- Two installed traffic signal communication systems where units have been in continuously satisfactory operation for at least 1 year. Submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the system.

Provide all necessary documentation of subcontractor qualifications pursuant to contract award.

8. **Additional Equipment.** Any additional materials not specifically mentioned, but required to successfully operate the traffic signal system shall be considered subsidiary to this Item. Materials may include, but are not limited to, additional Ethernet equipment, couplers, connectors, mounting hardware, pole extensions, computers, and solar equipment.

9. **Testing, Training, and Warranty.** Provide a factory certified representative for installation and testing of the equipment. Conduct a test site survey prior to the installation of the equipment.

Provide up to 2 days of training to personnel of the Town in the operation, setup and maintenance of the wireless broadband radio system. Provide instruction and materials for a maximum of 5 persons and at a location selected by the Town. Provide instruction personnel certified by the manufacturer. The User's Guide is not an adequate substitute for practical classroom training and formal certification.

Provide equipment with no less than 95% of the manufacturer's standard warranty remaining when equipment invoices are submitted for payment. Any equipment with less than 95% of its warranty remaining will not be accepted.

Provide updates of the wireless broadband radio software free of charge during the warranty period, including the update to NTCIP compliancy.

10. **Measurement.** This Item will be measured by each WER radio, cluster management module, and by the linear foot of cable installed.

11. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Wireless Ethernet Radio (Subscriber Unit)", "Wireless Ethernet Radio (Access Point)", "Cluster Management Module", and "CAT 5E Ethernet Cable". The price is full compensation for assembling, installing the radios, antennas, and the cable; for mounting attachments; for testing, labor, tools, equipment and incidentals.

ADDISON

Cable Termination Chart

20 Conductor Cable

Red   _____ Through red

Orange   _____ Through yellow

Green   _____ Through green

Red/Black tracer   _____ Left turn red ball when used as overlap

Orange/Black tracer   _____ Left turn yellow ball when used as overlap

Green/Black tracer   _____ Left turn green ball when used as overlap

White/Black tracer   _____ Spare

Blue/Black tracer   _____ Pedestrian Call

Blue/White tracer   _____ Walk

Black/White tracer   _____ Don't Walk

Black   _____ Left turn yellow arrow

Green/White tracer   _____ Walk

Red/White tracer   _____ Don't Walk

Blue   _____ Left turn green arrow

White   _____ Neutral

Black/Red tracer   _____ Pedestrian Call

White/Red tracer   _____ Spare

Orange/Red tracer   _____ Spare

Blue/Red tracer   _____ Spare

Red/Green tracer   _____ Spare

SPECIAL SPECIFICATION

6013

Electronic Components

1. **Description.** Use electronic components to manufacture electronic equipment.

2. **Materials and Construction Methods.** Use electronic components that comply with Electronic Industries Association (EIA) and Joint Electronic Device Engineering Council (JEDEC) Specifications. Provide industry standard electronic components available from several manufacturers. When special monolithic integrated circuits are necessary for cost-effective designs, waiving the multi-source requirements will be as directed.

    Design the electronic circuitry to ensure an adjustment range from normal adjustment settings of variable components. Provide a range of adjustment to compensate for composite variations in the associated circuitry due to changes in part values during the normal or specified life of the device. Ensure the range of adjustment can compensate for variations in replacement parts within the specified tolerances. Unless otherwise shown on the plans, design the components to be under operating conditions 24 hr. a day for 10 yr. Derate electronic components by 20% with regard to ambient temperature, applied voltage, and power dissipation.

    On electronic components weighing more than 2 oz., use supports other than the component's pins or electrical connectors. Solder electronic components of 2 or more leads in place. Mark the circuit reference symbol next to the component.

    Meet the above requirements and satisfy the following specific requirements for the different components:

    A. **Capacitors.** Provide industrial grade capacitors. Insulate the capacitors. Mark capacitors with their capacitance value, working voltage, and polarity.

        Provide capacitor encasements resistant to cracking, peeling, and discoloration due to humidity and changes in temperature. Provide electrolytic capacitors capable of operating at least 185°F. Do not use electrolytic capacitors of less than 1.0 microfarad.

        Use a clamp or fastener to support a capacitor to avoid damage by shock or vibration. Use a capacitor with a specific ripple or AC voltage rating, if possibly subjected to a ripple voltage in excess of 10% of the actual DC voltage across the capacitor. Use an aluminum electrolytic capacitor only when continually energized.

    B. **Diodes.** If low forward drop is required in logic circuit applications, furnish justification for use of Germanium diodes prior to incorporation in the design. Mark diodes with the JEDEC part number, using an industry approved color code or clearly legible printing. Indicate the diode polarity on the diode case by the use of the diode symbol, by the 360° band on the cathode end, or by the shape of case.

C. Indicators. Use solid-state (LED) indicators with a useful life at least 25,000 hr.

D. Integrated Circuits. Print the manufacturer's part number and any information required to install the integrated circuit assembly upon the package. Test integrated circuits with at least 1 test from each group below:

   1. Group 1
   - Stabilization Bake
   - Temperature Cycling
   - Power Burn-in

   2. Group 2
   - Functional test with the device at the manufacturer's maximum specified temperature
   - Static and dynamic test per manufacturer's data sheet

E. Potentiometers and Rheostats. Use industrial grade potentiometers. Use potentiometers with a power rating at least 100% greater than the maximum power requirements of the circuit.

F. Printed Circuit Boards.

   1. Design, Fabrication and Mounting. Use NEMA Grade G-10 glass epoxy or equivalent for printed circuit boards (refer to NEMA Publications No. L1 1-1982, Industrial Laminated Thermosetting Products). Provide a nominal thickness of 1/32 in. for circuit boards not exceeding 2 in. in any dimension. Provide a nominal thickness of 1/16 in. for circuit boards exceeding 2 in. in any dimension.

   Coat the printed circuit board assembly with a protective coating to combat mildew, moisture, and fungus. Plate the through holes that carry electrical connections from one side of the board to the other. Use 1 oz./sq. ft. of copper to plate through holes. Use non-corrosive material for electrical mating surfaces.

   Design and fabricate printed circuit boards and the mounting of parts and assemblies in accordance with MIL-STD-275 (latest revision) except as follows:
   - Mount semiconductor devices on spacers or transipads if the device dissipates more than 250 mW. or if the case temperature will rise 20°F above ambient.
   - Remove residual flux from the printed circuit board.
   - Provide a resistance between any 2 isolated, independent conductor paths of at least 100 megohms when a 500 VDC potential is applied.

   Mark operating circuit components mounted on the circuit boards. Reference the identifying characters to their respective components in the schematic diagram and in the parts list.

   2. Soldering. Hand solder in accordance with MIL-STD-55110. Use of automatic flow soldering is acceptable.

G. **Relays.** Install diodes across the coils for transient suppression in DC relays. Provide replaceable relays that do not require special tools for replacement.

H. **Resistors.** Use fixed composition insulated resistors in accordance with the performance requirements of MIL-R-11. Provide industrial grade resistors with a 15 yr. design life. Mark with their resistance value, using EIA color codes or industry approved marking technique.

Use resistors with a 10% tolerance or better and a resistance variation of no more than 5% over the temperature range 0°F to 165°F. Do not use resistors with a power rating greater than 2 w., unless special ventilation or heat sinking is provided. Insulate these resistors from the printed circuit board.

I. **Transistors.** Use JEDEC registered transistors. Mark the JEDEC part number on the case. Designate the emitter or collector by use of an industry approved marking technique.

J. **Transformers.** Mark transformers with the manufacturer's part number on the case or frame, using a Radio-Electronics-Television Manufacturers Association (RETMA) color code or numbered in a manner to facilitate proper installation.

K. **Switches.** Derate switch contacts 50% from their maximum current ratings.

3. **Measurement and Payment.** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to the bid items of the Contract.

Special Specification

6016

ITS Field Equipment Cabinet

1. **Description.** Furnish, install, and test equipment cabinets.

2. **Materials.** Furnish new, corrosion resistant materials. Furnish, assemble, fabricate and install materials as shown on the plans, the requirements of this Item, and with the pertinent requirements of the following:

   - Special Specification, "CCTV Field Equipment,"

   - Special Specification, "Local Control Units,"

   - Special Specification, "Lane Control Signal Head," and

   - Special Specification, "Digital Card Rack Detector Assembly."

   Provide cabinets of identical size, shape, and quality for the same type of cabinet. Equip cabinets internally as specified herein. Provide materials that meet NEMA Standards and the requirements of ASTM designation B209 for 5052-H32 aluminum sheet.

   A. **Functional Requirements.** House the field equipment inside cabinets as shown on the plans or as directed. Provide cabinets with fully wired equipment panels, terminal blocks, wiring, harnesses, connectors, and attachment hardware for each cabinet.

   Provide waterproofed fused and unfused breakaway connectors on the power service conductors. Use a fused breakaway connector for the ungrounded (line) wire. Use an unfused breakaway connector for the grounded (neutral) wire. Install the breakaway connectors prior to the main power panel of the cabinet.

   Supply each field cabinet with the following:
   - Fan and Thermostat
   - Power Distribution Panel
   - Adjustable Shelves, as Required
   - Cabinet Light
   - Surge Protection
   - Terminal Blocks
   - Conductor Guides
   - Interconnect Harnesses with Connectors
   - "Door Open" Connection to Equipment Panel
   - All Necessary Installation and Mounting Hardware

Furnish additional panels as required by the specific field cabinet type shown on the plans and with the pertinent requirements of the parent special specification.

B. **Electrical Requirements.**

1. **Primary Input Power Interruption.** Use material that meets the requirements of Section 2.1.4 "Power Interruption" of the NEMA Standard TS 2, latest revision.

2. **Power Service Transients.** Use material that meets the requirements of Section 2.1.6 "Transients, Power Service" of the NEMA Standard TS 2, latest revision.

3. **Power Service Protection.** Use readily accessible and either manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

4. **Uninterruptible Power Supply.** Use uninterruptible power supplies as required in Special Specification, "Uninterruptible Power Supply."

5. **Fail Safe.** Design the material so that the failure of the equipment will not cause the failure of any other unit of equipment.

6. **Power Distribution Panel.** Furnish cabinets with a 115 VAC power distribution panel. Provide the following components on the panel:

   a. **Duplex Service Outlets.** Provide 115 VAC service outlets with integral ground fault interrupt and protected by a circuit breaker. Provide NEMA Type 5-15R duplex receptacles or as required to match connecting electrical equipment as shown in the plans and specifications.

      Locate receptacles to minimize electrical hazards to service personnel. Provide at least one outlet for use of service equipment. Other equipment in the cabinet must obtain power from other approved sources.

   b. **Circuit Breakers.** Provide Underwriters Laboratories (UL) listed circuit breakers. Enclose operating mechanisms and mark the switches to indicate whether closed or open. Provide silver alloy contacts and enclose in an arc-quenching chamber.

      Provide main circuit breakers as shown on the plans. Provide a single pole 20 A. circuit breaker in each cabinet to protect the lamp, vent, fan, and duplex outlets.

      Provide properly rated equipment circuit breakers for the configuration of equipment in each cabinet. Provide circuit breakers capable of operating in accordance with Section 2, "Environmental Standards and Test Procedures" of NEMA TS 2, latest revision. Provide circuit breakers with an interrupt capacity of 5,000 A. and insulation resistance of 100 Megohms at 500 VDC.

      Furnish breakers, which are in addition to any auxiliary fuses, with the electronic equipment to protect component parts. Provide an EDCO Model

SHP-300-10S or equivalent 3 terminal lightning arrestor to protect the load side of all circuit breakers. Connect the arrestor into the circuit with No. 8 AWG or larger stranded copper conductors. Connect arrestor to the line filter as recommended by the manufacturer.

c. **Radio Interference Suppressor.** Equip cabinets with a UL and EIA listed radio interference suppressor on the load side of the circuit breaker. Provide suppressors in series with the incoming AC power line before it is distributed to any equipment in the cabinet. Provide a suppressor with a minimum attenuation of 50 dB. over a frequency range of 200 kilocycles to 75 megacycles. Hermetically seal the suppressor in a substantial metal case, filled with a suitable insulation compound.

Suppressor terminals must be nickel plated brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and must be mounted so that the terminals cannot be turned in the case. Provide suppressors that operate on 120 V, 60 Hz, at the current rating shown on the plans.

d. **Power Line Surge Protection.** Provide and install power line surge protectors as described below:

(1) Provide one 3 electrode gas tube type surge protector with the following ratings:

- Impulse breakdown: Less than 1,000 V in less than 0.1 microseconds at 10 kV per microsecond.

- Standby current: Less than 1 mA.

- Striking voltage: Limit any voltage greater than 212 VDC.

- Capable of withstanding 15 pulses of peak current, each of which must rise in 8 microseconds and fall in 20 microseconds to one half the peak voltage, at 3 min. intervals. Peak current rating must be 20,000 A.

(2) Use both metal oxide varistors and silicon avalanche diodes in surge protectors to protect against transients having a single surge energy level up to 70 joules, voltage transients up to 6 kV, and current transients up to 6 kA. Provide protection for line to neutral, line to ground, and neutral to ground terminals

Provide protectors with the following ratings:
- Recurrent peak voltage 212 V.

- Energy rating minimum 120 joule.

- Power Dissipation - average 0.85 W.

- Peak Current for pulses for less than 6 microseconds 20,000 A.

- Standby current less than 1 mA.

e. **Power Cable Input Junction Terminals.** Provide power distribution blocks suitable for use as a power feed and junction points for 2 and 3 wire circuits. Provide terminals capable of handling 2 size 1/0 AWG conductors.

Electrically isolate the AC neutral and equipment ground wiring from the line wiring by an insulation resistance of at least 10 megohms when measured at the AC neutral. Color code the AC neutral and equipment grounding wiring as white and green respectively.

7. **Wiring.** Identify cabinet wiring where connected to terminal strips, flashers, relays, switches, radio interference suppressors, etc., by the use of preprinted labels of insulated, heat shrinkable, white, polyolefin, sleeving slipped over the wire before attachment of the lug or making the connection.

Print labels using a mechanical device specifically designed for this purpose. Provide labels and a printing device capable of recording and printing at least 15 characters. Print labels using black ink. Provide a legend for labels.

Cut wires to the proper length before assembly. Do not double back wires to take up slack. Cover harnesses to connectors with "Chinese Finger" woven braid. Secure cables with nylon cable clamps. Rack wire runs in conductor guides.

Provide service loops to facilitate removal and replacement of assemblies, panels, and modules. Use insulated parts and wire rated for a minimum of 600 V. Color code harnesses and wiring. Hot-stamp wires every 4 in. indicating the pin number of the connector and terminal number. Do not hot-stamp individual conductors in detector harnesses.

Label harnesses with connectors and pins identified by letters with numbers that correspond to the alphabetic sequence of the pins. Cross-reference each harness to a wiring diagram. Enclose each harness in PVC sheathing, woven braid or braided. Do not use tie wraps, tape, or other cable ties.

Provide sufficient clearance between each terminal and the cabinet to prevent a leakage path or physical contact under stress for electrical connections in the cabinet, including relays, flashers, terminal blocks, etc. Provide barriers for insufficient clearances.

Run equipment grounds directly and independently to the ground bus. Provide sufficient length of cable to reach the electronic equipment on the shelves.

Route and bundle or shield low voltage wiring from AC line voltage wiring. Cover conductors and live terminals or parts with suitable insulating material.

Size AC service lines in accordance with the N.E.C. Use white insulated conductors for AC common. Use green insulated conductors for equipment ground. Use any color different from the foregoing on other conductors. For equipment that requires grounding, use grounding conductors, do not use conduit for grounding. Size the ground conductor in accordance with the N.E.C.

Use No. 22 AWG or larger with a minimum of 19 strands conductors for cabinet wiring. Provide conductors conforming to MIL SPEC MIL-W-168780, Type B or D. Provide insulation with a minimum thickness of 10 mils. Use No. 14 AWG or larger conductors for line voltage wiring. Attach lugs or other approved terminal fittings to wires that attach to binding posts, except when wires are soldered to the post.

Assign the color scheme adopted by Western Electric Telephone standards to all termination points for the 12, 25, or 50 pair cables to insure uniformity within the cabinet.

8. **Terminal Blocks.** Locate terminal blocks on the panels to minimize interference between connecting wires and the cabinet electronic equipment. Locate all terminal blocks below the shelves. Identify terminals by legends permanently marked on the terminal blocks. Bring no more than 3 conductors to any 1 terminal screw. Protect electrically energized components or connectors by a barrier.

   Use No. 10-32 nickel or cadmium plated brass binder head screw terminals for field connections. Use No. 5-32 nickel plated brass binder head screw terminals for interwiring connections. Terminate all connections to and from the electronic equipment to an interwiring type block.

9. **Cabinet Internal Grounding.** Provide at least 1 ground bus bar permanently affixed to the cabinet and connected to the grounding electrode for the cabinet internal ground. Use bare stranded No. 6 AWG copper wire between the bus bar and grounding electrode. Provide 20 connector points on each ground bus bar, each capable of securing at least one No. 10 AWG conductor. Use these bus bars for AC neutral and equipment ground wiring.

10. **Transient Suppression.** Provide diodes across the coils for transient suppression in DC relays, solenoids, and holding coils. Provide snubbers in AC contactors.

11. **Communication Interface Panel.** Provide a fully wired communication interface panel as shown on the plans or as directed. Design panels as one integral unit. Provide a 2 conductor, RJ11 phone jack on the panel. Insulate the jack electrically from the panel. Connect phone jack for cabinet pair assignment as shown in Table 1. Connect phone jack for voice pair assignment as shown in Table 2. Connect the phone jack for local limited distance modem assignment as shown in Table 3. Connect phone jack for voice jack assignment as shown in Table 4.

    Include the following components on the panel:

    a. **Power Distribution.** Obtain 115 VAC power from the power distribution panel.

    b. **Surge Protection.** Mount surge protection for incoming communication pairs on a distribution panel.

Table 1
Cabinet Pair Assignment

2 Pair to RJ11 Adapter Slot	RJ11 Pin Number	Insulation Color	Input to Surge Protector Terminal Number
1	2	Black	1
2	3	Red	2
3	4	Green	3
4	5	Yellow	4

Table 2
Voice Pair Assignment

2 Pair to RJ11 Adapter Slot	RJ11 Pin Number	Insulation Color	Input to Surge Protector Terminal Number
1	3	Black	5
2	4	Red	6

Table 3
Limited Distance Modem Assignment

Insulation Color	Output from Surge Protector Terminal Number	Modem Connection
Black	1	LCU received data
Red	2	LCU received data
Green	3	LCU transmit data
Yellow	4	LCU transmit data

Table 4
Voice Jack Assignment

Insulation Color	Output from Surge Protector Terminal Number	Modem Connection
Red	5	Voice Jack
Green	6	Voice Jack

C. Mechanical Requirements.

1. Size and Construction. Design cabinets with dimensions shown in Table 5.

Table 5
Minimum Cabinet Internal Dimensions

	Depth (in.)	Width (in.)	Height (in.)
CCTV	15	20	36
ISDN Compressed Video	24	36	44
Surveillance	26	59	75
DMS	24	30	36
Ramp Meter	27	44	55
LCU TY 3	16 ¾	30	47 ¾
LCU TY 5	26	38 ½	75
LCU TY P	26	54	54
Intermediate Amplifier	16	25	51
Detector Amplifier	15	20	36

Determine the suitability of the listed cabinet for the equipment complement shown at each field location on the plans. Furnish and install a larger size cabinet, if required, at no additional cost. Other than size, the selected cabinet must fully meet the requirements of this Item.

Provide four 1 in. diameter holes centered in the bottom for cabinet mounts on a concrete foundation or as shown on the plans. Provide attachment hardware for cabinets mounted on a pole.

2. **Ventilation.** Do not install openings on the sides or roof of the cabinet. Provide a 16 in. wide by 12 in. high intake vent openings on the lower portion of the cabinet door. Use a filtered intake, a fan, and a screened exhaust for cabinet ventilation.

Provide a thermostatically controlled fan. Provide a thermostat that is adjustable with an adjustment range of 70°F to 110°F. Provide a press-to-test switch to test the operation of the fan. Provide a fan with a capacity of at least 100 cu. ft./min.

Filter the intake with a 16 in. wide by 12 in. high by 1 in. thick air conditioning filter. Securely mount the filter to ensure air enters the cabinet through the filter. Screen the exhaust vent to prevent entry of insects. Use screens with openings no larger than 0.0125 sq. in. Provide total free air openings large enough to prevent excessive back-pressure on the fan.

3. **Lighting.** Mount a fluorescent light above the door inside the cabinet. Position the light in order to provide illumination to the face of the equipment in the cabinet and not into a technician's eyes. Install 2 momentary, pin type door switches in the cabinet or on the door. Wire 1 switch to turn on the cabinet lights when the door is open and off when the door is closed. Wire the other in parallel to a terminal block to detect a cabinet intrusion condition.

4. **Exterior Finish.** Smooth the aluminum and leave the exterior in its unpainted natural color.

5. **Serial Number.** Provide cabinets with a 5 digit serial number unique to the manufacturer. Place a 2 letter manufacturer's code prior to the serial number. Permanently affix the serial number to the upper right hand cabinet sidewall either by a metal plate riveted to the cabinet, by stamping it directly on the cabinet, or by engraving it on a metalized Mylar plate.

6. **Shelves.** Provide adjustable shelves in each cabinet as shown on the plans to support the appropriate equipment. Provide 2 in. intervals for shelf adjustment. Position shelves from the top of the cabinet in accordance with the actual equipment complement of the particular cabinet.

Provide a minimum of 1 in. between the rear and front edge of the shelf and the back inside wall and door of the cabinet.

7. **Mounting Hardware.** Furnish cabinets with the appropriate mounting plates, anchor bolts, and any other necessary hardware to mount the cabinet.

8. **Equipment Panels.** Construct panels of 0.125 in. aluminum. Provide a 3 in. horizontal slot in each corner of the panel for a 0.25 in. mounting bolt. Provide clamps or straps to hold cables on the panel. Mount panels in the cabinet on mounting studs. It must not be necessary to remove a panel to replace any mounted equipment. Panels must support the following when the panels are mounted on the studs:

- Terminal Blocks

- Load Switches

- Relays

- Switches

- Miscellaneous Equipment - All Necessary Mounting Hardware

9. **Modular Design.** Design the material to be modular for ease of replacement. Mechanically key modules of unlike function in order to prevent insertion into the wrong socket or connector. Identify modules and assemblies with name, model number, serial number and any other pertinent information to facilitate equipment maintenance.

10. **Connectors and Harness.** Make all external connections by means of connectors. Key connectors to preclude improper hookups. Color code or appropriately mark all wires to and from the connectors in accordance with this Item.

D. **Surge Protection.**

1. **Protector and Cabinet Configuration.** Provide surge protectors for all ungrounded conductor wires entering or leaving an equipment cabinet. Keep the conductor leads and the surge protector leads as short as possible with all conductor bends formed to the maximum possible radius. Locate the protector units 6 in. from the entry or exit point, and as far as possible from any electrical equipment. Connect the protector ground lead directly to the ground bus.

   Surge protector utilized for AC power must not dissipate any energy and must not provide any series impedance during standby operation. Unit must return to its non-shunting mode after the passage of any surge and must not allow the shunting of AC power.

2. **Power Line Surge Protector.** Install a power line surge protector in each cabinet between both line conductors and equipment ground.

3. **Signal Head Lamp Wires.** Provide surge protectors for signal lamp interconnect conductors at the equipment cabinet. Surge protector must have the same characteristics as specified for power lines.

4. **Detector Loop Lead-In.** Provide surge protection for each detector lead-in cable. Connect drain wire of the lead-in cable to the cabinet ground bus.

5. **Communication Cable.** Provide lightning arrestor for each pair of connectors for the 6, 12, 18, 25, or 50 pairs.

6. **Signal Wires.** Provide two-stage surge protection for signal wires entering or leaving the cabinet with the following characteristics:

- Input, output and ground connections;

- Peak surge handling capability: 4,000 A., 8 X 20 microsecond waveform;

- Protector life: Must withstand a minimum of fifty 2,000 A., 8 X 20 waveform surges.

- Response time: Calculated element speed of 1 X 10-12 sec., measured speed of less than 20 nsec.

- Protector clamp voltage: Specified by the Contractor to be consistent with the equipment being protected and submitted for approval.

E. **Environmental Design Requirements.** Provide cabinets that meet the functional requirements of this item during and after subjection to any combination of the following requirements:

- Ambient temperature range of -30°F to 165°F.

- Temperature shock not to exceed 30°F per hr., during which the relative humidity shall not exceed 95%.

- Relative humidity range not to exceed 95% over the temperature range of 40°F to 110°F.

- Moisture condensation on all surfaces caused by temperature changes.

F. **Vibration.** Material used must show no degradation of mechanical structure, soldered components, plug in components or satisfactory operation in accordance with the manufacturer's equipment specifications after being subjected to the vibration test as described in Section 2.2.5 "Vibration Test" of the NEMA standard TS 2, or the latest revision.

3. **Construction Methods.**

A. **General.** Utilize the latest available techniques to minimize the number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Design equipment for ease of maintenance. Component parts must be readily accessible for inspection and maintenance. Tools and test instruments required for maintenance by maintenance personnel must be simple hand held tools, basic meters and oscilloscopes.

B. **Fabrication.** Fabricate and weld in accordance with Item 441, "Steel Structures". Continuously weld all exterior seams for cabinet and doors. Fill edges to a radius of 0.03125 in. minimum. Smooth exterior welds.

Weld aluminum cabinets using the gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Use electrodes conforming to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

Use qualified procedures, welding machines and operators for welding on aluminum in accordance with the requirements of AWS B3.0, "Welding Procedures, and Performance Qualification" and to the practices recommended in AWS C5.6.

1. **Cabinet.** Construct all cabinets of welded sheet aluminum with a minimum thickness of 0.125 in., unless otherwise shown on the plans. Do not use wood, wood fiber product, or flammable products in the cabinet. Seal cabinet structure to prevent the entry of rain, dust, and dirt. Permanently attach aluminum lifting eyes, ears, or build them into the cabinet to permit lifting the cabinet with a sling. Provide an unused space of 12 in. in height, 15 in. in width, and 14 in. in depth for future expansion.

2. **Door.** Provide sturdy and torsionally rigid cabinet doors that substantially cover the full area of the front of the cabinet. Attach cabinet door by a minimum of 2 heavy duty hinges.

   Fabricate the doors and hinges to withstand a 100 lb. per vertical ft. force applied to the outer edge of the door when open without permanent deformation or impairment of the door or cabinet body when the load is removed.

   Equip cabinets equal to or greater than 48 in. in width with 2 doors in front and 2 doors in back to provide access to the cabinet. Provide each door with 5 hinges, or a full length stainless steel piano hinge, with stainless steel pins spot welded at the top. Mount the hinges so that it is not possible to remove them from the doors or cabinet without first opening the doors. Place a removable center support in the middle of each set of doors to ensure cabinet rigidity.

   Fit the cabinet doors with Number 2 Corbin lock and aluminum or chrome plated handle with a minimum 3/8 in. drive pin and a 3 point latch. Design the lock and latch so that the handle cannot be released until the lock is released. Provide a locking ring for a padlock. Provide 2 keys for each cabinet. Locate the lock clear of the arc of the handle. Keys must be removable in the locked position only. Mount locks with 2 stainless steel machine screws. Provide cabinet doors with a catch mechanism to hold the door open at 2 positions – 90° and 180°.

   Fabricate the door and door stop mechanism to withstand a simulated wind load of 5 lb./sq. ft. applied to both inside and outside surfaces without failure, permanent deformation, or compromising of door position.

   Provide an auxiliary police door on the cabinet when shown on the plans. Provide a lock on the auxiliary police door. Provide 1 brass key for each police door lock. Provide a gasket around the doors to prevent entry of moisture or dust. Use a non-absorbent gasket material that is resilient to the outdoor environment Provide a gasket with a minimum thickness of 0.375 in. Locate the gasket in a channel or an "L" bracket on either the cabinet or door.

C. **Shop Drawings.** Submit details of the cabinet design prior to fabrication. Submit a cabinet layout for each cabinet, including site location plan and detailed panel layouts. Submit drawings for only 1 cabinet for cabinets of identical design and dimension.

D. **Electronic Components.** Provide electronic components in accordance with Special Specification, "Electronic Components."

E. **Mechanical Components.** Provide stainless steel external screws, nuts, and locking washers. Do not use self tapping screws unless approved. Provide corrosion resistant materials and materials resistant to fungus growth and moisture deterioration. Separate dissimilar metals with an inert dielectric material.

F. **Installation.** Install cabinet foundations in accordance with Item 656, "Foundations for Traffic Control Devices."

Install pedestal pole assemblies in accordance with Item 687, "Pedestal Pole Assemblies." Install conduits as shown on the plans and in accordance with Item 618, "Conduit." Place wiring in a neat and orderly manner and grouped together with nylon tie-downs.

Install the cabinet as shown on the plans or as directed. Install a 0.625 in. diameter x 8 ft. long copper clad steel ground rod with the cabinet. Ground the cabinet to the ground rod.

1. **Connection of Lead-In Cable.** Connect the detector lead-in cable to the detector terminal blocks in the following manner:

   - Dress each cable into position in accordance with the approved lead-in cable position on the panel (bundle cables together and broken out by their position on the terminal boards).

   - Place cable as close to the terminal points as possible and left floating.

   - Ground the cable shield after testing and in accordance with the detector manufacturers' specifications.

2. **Connection of Miscellaneous Cables.** Terminate connection of signal wires, sign control wires and any other wires required to complete connections for an operational system on terminal blocks.

4. **Documentation.** Provide cabinet documentation in accordance with Article 4, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

Include the connector pin letter or number, the wire number, the terminal number and the function of the wire on the wiring diagram. Place 1 copy of the wiring diagram in the cabinet.

5. **Testing.** Test cabinets in accordance with Article 2, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

6. **Measurement.** This Item will be measured by each cabinet furnished, installed, and tested.

7. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement", will be paid for at the unit prices bid for "Equipment Cabinet" of the type specified and installation method specified as applicable. This prices is full compensation for cabinets installation; cables and connectors; documentation, and testing; and for labor, equipment, materials, training, and incidentals.

GOVERNING SPECIFICATIONS AND SPECIAL PROVISIONS

ALL SPECIFICATIONS AND SPECIAL PROVISIONS APPLICABLE TO THIS PROJECT ARE
IDENTIFIED AS FOLLOWS:

STANDARD SPECIFICATIONS: ADOPTED   BY   THE   TEXAS   DEPARTMENT   OF
                            TRANSPORTATION   JUNE   1,   2004.   STANDARD
                            SPECIFICATIONS   ARE   INCORPORATED   INTO   THE
                            CONTRACT BY REFERENCE.

ITEM 416   DRILL SHAFT (36 IN) (420)(421)(440)(448)
ITEM 500   MOBILIZATION
ITEM 502   BARRICADES, SIGNS AND TRAFFIC HANDLING
ITEM 506   TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS
            (432) (556)
ITEM 618   CONDUIT (400)(445)(476)(622)
ITEM 620   ELECTRICAL CONDUCTORS
ITEM 624   GROUND BOXES (421) (440)
ITEM 628   ELECTRICAL SERVICES (441)(445)(449)(618)(620)(627)(656)
ITEM 680   INSTALLATION OF TRAFFIC SIGNALS (610)(625)(627)(634)(636) (656)
ITEM 682   VEHICLE AND PEDESTRIAN SIGNAL HEADS
ITEM 684   TRAFFIC SIGNAL CABLES
ITEM 686   TRAFFIC SIGNAL POLE ASSEMBLIES (STEEL) (416) (421) (441) (442)
            (445) (449)

SPECIAL PROVISIONS: SPECIAL PROVISIONS WILL GOVERN AND TAKE PRECEDENCE
                       OVER THE SPECIFICATIONS ENUMERATED HEREON WHEREVER
                       IN CONFLICT THEREWITH.

SPECIAL PROVISION "PARTNERING" (000---002)
SPECIAL PROVISION "NOTICE TO ALL BIDDERS" (000---003)
SPECIAL PROVISION "NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO
            ENSURE EQUAL EMPLOYMENT OPPORTUNITY" (000---004)
SPECIAL PROVISION "STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
            CONSTRUCTION CONTRACT SPECIFICATIONS" (000---006)
SPECIAL PROVISION "CERTIFICATION OF NON-DISCRIMINATION IN
            EMPLOYMENT" (000---009)
SPECIAL PROVISION "DISADVANTAGED BUSINESS ENTERPRISE IN FEDERAL-AID
            CONSTRUCTION" (000---461)
SPECIAL PROVISION "ON-THE-JOB TRAINING PROGRAM" (000---807)

SPECIAL PROVISION TO ITEM   001   (001---005)
SPECIAL PROVISION TO ITEM   005   (005---004)
SPECIAL PROVISION TO ITEM   007   (007---213,445)
SPECIAL PROVISION TO ITEM   009   (009---009)
SPECIAL PROVISION TO ITEM   416   (416---001)
SPECIAL PROVISION TO ITEM   420   (420---002)

SPECIAL PROVISION TO ITEM   421   (421---031)
SPECIAL PROVISION TO ITEM   440   (440---001)
SPECIAL PROVISION TO ITEM   441   (441---002)
SPECIAL PROVISION TO ITEM   500   (500---005)
SPECIAL PROVISION TO ITEM   502   (502---033)
SPECIAL PROVISION TO ITEM   620   (620---001)
SPECIAL PROVISION TO ITEM   682   (682---001)

REQUIRED CONTRACT SPECIAL PROVISIONS:

FORM FHWA 1273, DECEMBER, 1993 (FEDERAL-AID CONSTRUCTION CONTRACTS)
CHILD SUPPORT STATEMENT
JOB CLASSIFICATION AND WAGE RATES
DISCLOSURE OF LOBBYING ACTIVITIES
WORKERS COMPENSATION INSURANCE

SPECIAL SPECIFICATIONS:

6007 REMOVING TRAFFIC SIGNALS
6011 TESTING, TRAINING, DOCUMENTATION, FINAL ACCEPTANCE, AND WARRANTY
6013 ELECTRONIC COMPONENTS
6016 ITS FIELD EQUIPMENT CABINET
6086 PREPARATION OF EXISTING CONDUITS, GROUND BOXES, OR MANHOLES
6266 VIDEO IMAGING VEHICLE DETECTION SYSTEM (VIVDS) (INSTALL ONLY)
A9001 HARDENED ETHERNET SWITCH
A9002 VIDEO SERVER
A9003 TRAFFIC CONTROL SYSTEM
A9004 TRAFFIC SIGNAL CONTROLLER ASSEMBLY (TS-2)
A9005 SYSTEM SUPPORT EQUIPMENT
A9006 SERIAL PORT SERVER
A9007 WIRELESS ETHERNET RADIO

THE ABOVE-LISTED SPECIFICATION ITEMS ARE THOSE UNDER WHICH PAYMENT IS TO BE
MADE OR THAT GOVERN PERTINENT WORK ELEMENTS THAT ARE SUBSIDIARY TO OTHER
PAY ITEMS. THESE, TOGETHER WITH SUCH OTHER PERTINENT ITEMS, IF ANY, AS MAY
BE REFERRED TO IN THE ABOVE-LISTED SPECIFICATION ITEMS, CONSTITUTE THE
COMPLETE SPECIFICATIONS FOR THIS PROJECT. SPECIAL SPECIFICATION A9001
THROUGH A9007 ARE SPECIFIC TO THE TOWN OF ADDISON.

BACKGROUND:

THE TOWN OF ADDISON IS PROCURING THE EQUIPMENT AND SERVICES NECESSARY TO
CONSTRUCT AN ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS) THAT WILL BE USED TO
MONITOR AND CONTROL 34 INTERSECTIONS AND ALL VIVDS CAMERAS EXISTING AND

PROPOSED TO BE INSTALLED AS PART OF THIS PROJECT. SOME EQUIPMENT WILL BE PROCURED UNDER A PROPRIETARY PURCHASE AGREEMENT AND INSTALLED BY A LICENSED CONTRACTOR, WHILE OTHER EQUIPMENT WILL BE FURNISHED AND INSTALLED BY THE SAME OR SEPARATE CONTRACTOR. WORK PACKAGES HAVE BEEN IDENTIFIED FOR THE PURPOSES OF ESTABLISHING CLEAR AREAS OF RESPONSIBILITIES OF THE DIFFERENT PARTIES.

THE TOWN OF ADDISON WILL PROCURE SEPARATELY THE FOLLOWING EQUIPMENT AND THE CONTRACTOR OF THIS PROJECT WILL INSTALL AND MAKE OPERATIONAL:
    a. VIDEO IMAGING VEHICLE DETECTION SYSTEM (VIVDS)
    b. TRAFFIC SIGNAL CONTROLLER ASSEMBLY (TS-2)
    c. WIRELESS ETHERNET RADIO SYSTEM

THE TOWN OF ADDISON WILL PROCURE THE COMPLETE SERVICES FOR THE FOLLOWING EQUIPMENT TO BE PROVIDED BY OTHERS:
    a. TRAFFIC CONTROL SYSTEM (ADVANCED TRAFFIC CONTROL SOFTWARE)

SCOPE OF WORK:

UNDER THIS CONTRACT, THE CONTRACTOR'S WORK WILL CONSIST OF THE FOLLOWING PRINCIPAL ITEMS;

1) INSTALLING, INTEGRATING, AND/OR TESTING WIRELESS ETHERNET RADIO SYSTEM. THE CONTRACTOR MUST BE CERTIFIED BY THE MANUFACTUER TO INSTALL THE WIRELESS ETHERNET RADIO SYSTEM AND PROVIDE DOCUMENTATION TO THE TOWN FOR VERIFICATION.

2) INSTALLING AND TESTING OF TRAFFIC SIGNAL CONTROLLERS (NEMA TS2 TYPE 1), TRAFFIC CABINET ASSEMBLIES, INCLUDING RAISED ALUMINUM BASE.

3) REMOVING AND SALVAGING TRAFFIC SIGNAL HARDWARE AND CONTROL EQUIPMENT.

4) VERIFYING THE USABILITY OF THE EXISTING CONDUIT INFRASTRUCTURE.

5) FURNISHING AND INSTALLING GROUND BOXES AND CONDUIT AT LOCATIONS SHOWN IN THE PLANS.

6) FURNISHING AND INSTALLING NEW TRAFFIC SIGNAL CABLE AT LOCATIONS SHOWN IN THE PLANS.

7) PROVIDING ALL REQUIRED CONSTRUCTION WORK ZONE TRAFFIC CONTROL.

8) FURNISHING AND INSTALLING ALL CONCRETE AND REINFORCING STEEL FOR TRAFFIC SIGNAL CONTROLLER CABINET AND POLE FOUNDATIONS.

9) INSTALLING VIDEO VEHICLE DETECTION HARDWARE AND SOFTWARE AT VARIOUS

LOCATIONS.

10) FURNISHING, INSTALLING, INTEGRATING, AND/OR TESTING HARDENED ETHERNET
SWITCHES, VIDEO SERVERS, AND SERIAL PORT SERVERS NECESSARY FOR
COMMUNICATION TO TRAFFIC SIGNAL CABINETS FROM THE ADVANCED TRAFFIC
CONTROL SOFTWARE THROUGH THE WIRELESS ETHERNET RADIO SYSTEM.

11) FURNISHING AND INSTALLING ALL OTHER MISCELLANEOUS ITEMS ESSENTIAL FOR
A COMPLETE AND FULLY OPERATIONAL TRAFFIC SIGNAL CONTROL SYSTEM.

GENERAL:

THE CONSTRUCTION, OPERATION AND MAINTENANCE OF THIS PROPOSED PROJECT WILL
BE CONSISTENT WITH THE STATE IMPLEMENTATION PLAN AS PREPARED BY THE TEXAS
AIR CONTROL BOARD.

THE CONTRACTOR'S REPRESENTATIVE WHO WILL BE DIRECTLY RESPONSIBLE FOR
CONSTRUCTION OF THIS PROJECT WILL NEED TO ATTEND THE PRE-CONSTRUCTION
CONFERENCE.

THE CONTRACTOR WILL ONLY BE ALLOWED TO WORK ON THIS PROJECT DURING DAYLIGHT
HOURS (DAWN TO DUSK).

UNLESS DIRECTED BY THE ENGINEER, THE SIGNAL SHALL BE PLACED IN OPERATION
BETWEEN 9:00 A.M. - 12:00 (NOON) WEEKDAYS.

FOR THE PURPOSE OF CLARIFICATION, ANY REFERENCE TO TXDOT AND/OR DEPARTMENT
WITHIN THE SPECIAL PROVISIONS OR SPECIAL SPECIFICATIONS SHALL MEAN THE TOWN
OF ADDISON.

TEST PERIOD FOR SIGNALS:
ONCE THE SIGNALS HAVE BEEN INSTALLED AND PLACED IN OPERATION, THEY SHALL
OPERATE CONTINUOUSLY FOR A MINIMUM OF 30 CALENDAR DAYS IN A SATISFACTORY
MANNER. EQUIPMENT FAILURES DURING THIS 30 DAYS WILL CAUSE THE TEST PERIOD
TO START OVER.

PHASES OF SIGNAL OPERATION:
ALL CONTROLLER/MMU PROGRAMMING, SETTINGS, TIME INTERVALS, AND TIME-BASE
COORDINATION PARAMETERS SHALL BE ADJUSTED AND SET BY THE CONTRACTOR AS
DIRECTED BY THE ENGINEER.

WIRING:
EXTRA CABLE LENGTH SHALL BE INCLUDED IN EACH RUN TO PROVIDE ADEQUATE SLACK,
AS DETERMINED BY THE ENGINEER, AT EACH GROUND BOX OR FOUNDATION.

UTILITIES:
THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL

UTILITIES AND UNDERGROUND STRUCTURES BEFORE MAKING ANY EXCAVATIONS. THE
CONTRACTOR SHALL TAKE EXTREME CARE WHEN EXCAVATING OR DRILLING IN THE
VICINITY OF UTILITIES. THE CONTRACTOR MAY BE REQUIRED TO PROBE OR
EXPOSE THESE FACILITIES. THE CONTRACTOR WILL BE RESPONSIBLE FOR DAMAGES
TO UTILITIES.

ITEM 416, DRILL SHAFTS:

THE CONTRACTOR SHALL COORDINATE WITH THE TOWN OF ADDISON WHEN PLACING
CONCRETE FOR NEW FOUNDATIONS TO ENSURE THE PROPER CABINET ORIENTATION AND
ANCHOR BOLT PLACEMENT MATCH TOWN REQUIREMENTS.

THE TOP 2 IN. OF THE DRILL SHAFTS SHALL BE FORMED TO PROVIDE A SMOOTH
FINISH SATISFACTORY TO THE ENGINEER. THE COST OF THE WORK SHALL BE INCLUDED
IN THE UNIT BID PRICE FOR THIS ITEM.

A 3/4 IN. CHAMFER SHALL BE FORMED ON THE TOP EDGE OF EACH TRAFFIC SIGNAL
FOUNDATION.

THE CONTRACTOR SHALL PROBE BEFORE DRILLING FOUNDATIONS TO DETERMINE THE
LOCATION OF UTILITIES AND STRUCTURES. FOUNDATIONS SHALL BE PAID FOR ONCE
REGARDLESS OF EXTRA WORK CAUSED BY OBSTRUCTIONS.

THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE BOLT PATTERNS OF EXISTING
FOUNDATIONS TO BE REUSED AND FOR FURNISHING THE HARDWARE TO FIT THESE
FOUNDATIONS. SOME OF THESE BOLT PATTERNS ARE SHOWN IN THE PLANS.

THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE DIMENSIONS OF POLE
ASSEMBLIES AND FINALIZING THE TOP ELEVATION OF POLE FOUNDATIONS TO ENSURE
THAT THE TRAFFIC SIGNAL HEAD MEETS THE DESIRED HEIGHT ABOVE THE ROADWAY.

ITEM 502, BARRICADES, SIGNS AND TRAFFIC HANDLING:

THE TRAFFIC CONTROL PLANS (TCP) FOR THIS PROJECT SHALL BE AS DETAILED ON
TRAFFIC CONTROL PLAN SHEETS, WZ(BTS-1),(2)-99, AND AS DIRECTED BY THE
ENGINEER.

THE CONTRACTOR IS FULLY RESPONSIBLE FOR THE TRAFFIC CONTROL AND WILL BE
RESPONSIBLE FOR FURNISHING ALL THE NECESSARY SIGNS, CONES, AND
BARRICADES.

THE CONTRACTOR IS FULLY RESPONSIBLE FOR CONTROLLING TRAFFIC (INCLUDING
POLICE IF NEEDED), TEMPORARY STOP SIGNS, IF IT SHOULD BECOME NECESSARY
FOR A SIGNAL TO BECOME INOPERATIVE DUE TO THE NATURE OF THE WORK
INVOLVED. IF AT ANY TIME THE EXISTING TRAFFIC SIGNALS BECOME
INOPERABLE, THE CONTRACTOR SHALL PROVIDE PORTABLE STOP SIGNS WITH TWO

ORANGE FLAGS, AS APPROVED BY THE ENGINEER, TO BE USED FOR TRAFFIC CONTROL.

FLAGGERS, WHEN USED, SHALL BE EQUIPPED WITH AN APPROVED FLAGGING VEST AND HARD HAT. THEY SHALL USE A "SLOW-STOP" PADDLE.

THE CONTRACTOR SHALL PLAN HIS WORK SEQUENCE IN A MANNER THAT WILL CAUSE THE MINIMUM INTERFERENCE WITH TRAFFIC DURING CONSTRUCTION OPERATIONS. BEFORE BEGINNING WORK ON THIS PROJECT, THE CONTRACTOR SHALL SUBMIT, FOR APPROVAL BY THE ENGINEER, A PLAN OF CONSTRUCTION OPERATIONS OUTLINING IN DETAIL A SEQUENCE OF WORK TO BE FOLLOWED, SETTING OUT THE METHOD OF HANDLING TRAFFIC ALONG, ACROSS, AND ADJACENT TO THE WORK.

BARRICADES AND SIGNS SHALL BE PLACED IN SUCH A MANNER AS TO NOT INTERFERE WITH THE SIGHT DISTANCE OF DRIVERS ENTERING THE HIGHWAY FROM DRIVEWAYS OR SIDE STREETS.

THE CONTRACTOR SHALL PROVIDE AND MAINTAIN FLAGGERS AT SUCH POINTS AND FOR SUCH PERIODS OF TIME AS MAY BE REQUIRED TO PROVIDE FOR THE SAFETY AND CONVENIENCE OF PUBLIC TRAVEL AND CONTRACTOR'S PERSONNEL, AND AS SHOWN ON THE PLANS, OR AS DIRECTED BY THE ENGINEER.

THE CONTRACTOR WILL NOT BE PERMITTED TO COMMENCE WORK ON THE ROAD BEFORE SUNRISE AND SHALL ARRANGE HIS/HER WORK SO THAT NO MACHINERY OR EQUIPMENT SHALL BE CLOSER THAN 30 FT. TO THE TRAVELLED ROADWAY AFTER SUNSET, EXCEPT AS AUTHORIZED BY THE ENGINEER.

THE CONTRACTOR SHALL KEEP TRAVELLED SURFACES USED IN HIS/HER HAULING OPERATION CLEAR AND FREE OF DIRT OR OTHER MATERIAL.

THE USE OF RUBBER-TIRED EQUIPMENT WILL BE REQUIRED FOR MOVING DIRT AND OTHER MATERIALS ALONG OR ACROSS PAVED SURFACES.

NO LANE CLOSURES WILL BE ALLOWED PRIOR TO 8:30 A.M. OR AFTER 4:00 P.M., MONDAY THRU FRIDAY UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

ITEM 506, TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS:

THROUHOUT THE PROJECT LIMITS, EROSION CONTOL EMELENTS CONSISTING OF SAND BAGS AND SEDIMENT FENCES WILL BE USED TO MITIGATE RUNOFF OF PROJECT MATERIALS INTO STORM INLETS OR RECEIVING WATERS. DUE TO THE MINIMAL DISTRURBANCE OF SOIL AS PART OF THIS PROJECT, THE CONTRACTOR WILL BE ALLOWED TO RELOCATE EROSION CONTROL ELEMENTS AS NEEDED. THE NEED AND PLACEMENT OF EROSION CONTROL ELEMENTS WILL BE THE RESPONSIBILITY OF THE CONTRACTOR. EROSION CONTROL ELEMENTS MUST REMAIN IN PLACE AT INTERSECTIONS UNTIL WORK IS FINISHED PRIOR TO REMOVAL.

QUANTITIES FOR SAND BAGS AND SEDIMENT FENCES ARE NOT SHOWN WITHIN THE LAYOUT SHEETS BUT HAVE BEEN INCLUDED WITHIN THE QUANTITY SUMMARY DUE TO THE CONTRACTORS DISCRETION AS TO PLACEMENT AS NEEDED.

ITEM 618, CONDUIT:

THE LOCATION OF CONDUCTOR, CONDUIT AND GROUND BOXES ARE DIAGRAMMATIC ONLY AND MAY BE SHIFTED BY THE ENGINEER TO ACCOMMODATE FIELD CONDITIONS.

CONDUIT SHALL BE PLACED UNDER EXISTING PAVEMENT BY AN APPROVED JACKING OR BORING METHOD UNLESS OTHERWISE DIRECTED BY THE ENGINEER. PITS FOR JACKING OR BORING SHALL NOT BE CLOSER THAN 2 FT. FROM THE EDGE OF THE PAVEMENT UNLESS OTHERWISE DIRECTED BY THE ENGINEER. WATER JETTING WILL NOT BE PERMITTED.

WHEN BORING IS USED FOR UNDER PAVEMENT CONDUIT INSTALLATIONS, THE MAXIMUM ALLOWABLE OVERCUT SHALL BE 1 IN. IN DIAMETER.

WHEN CONDUITS ARE BORED, THE VERTICAL AND HORIZONTAL TOLERANCES SHALL NOT EXCEED 18 IN. AS MEASURED FROM THE INTENDED TARGET POINT.

THE USE OF A PNEUMATICALLY DRIVEN DEVICE FOR PUNCHING HOLES BENEATH THE PAVEMENT (COMMONLY KNOWN AS A "MISSILE") WILL NOT BE PERMITTED ON THIS PROJECT.

THE CONTRACTOR SHALL INSTALL A PULL ROPE IN CONDUIT RUNS IN EXCESS OF 50 FT.

A CLEANER-PRIMER SHALL BE USED ON ALL PVC TO PVC JOINTS BEFORE APPLICATION OF PVC CEMENT.

CONDUIT INSTALLED FOR FUTURE USE SHALL HAVE NON-METALLIC PULL ROPES INSTALLED AND SHALL BE CAPPED USING STANDARD WEATHER TIGHT CONDUIT CAPS, AS APPROVED BY THE ENGINEER. THIS WORK SHALL NOT BE PAID FOR DIRECTLY BUT SHALL BE CONSIDERED SUBSIDIARY TO THIS ITEM.

HIGH-DENSITY POLYETHYLENE (HDPE) PIPE MAY BE THREADED AND USED WITH THREADED PVC CONNECTORS OR COUPLINGS.

PVC CONDUIT SYSTEMS THAT SNAP OR LOCK TOGETHER WITHOUT GLUE THAT ARE DESIGNED AND UL LISTED TO BE USED FOR BORED PVC ELECTRICAL CONDUIT APPLICATIONS WILL BE ALLOWED FOR BORED PVC SCHEDULE 40 OR SCHEDULE 80, WHEN APPROVED BY THE ENGINEER.

NO ADDITIONAL COMPENSATION WILL BE PAID TO THE CONTRACTOR WHEN THESE SPECIFIC PURPOSE CONDUIT SYSTEMS ARE SUBSTITUTED FOR THIS PURPOSE.

ALL CONDUIT ELBOWS AND RIGID METAL EXTENSIONS REQUIRED TO BE INSTALLED ON PVC CONDUIT SYSTEMS WILL NOT BE PAID FOR SEPARATELY, BUT WILL BE

CONSIDERED SUBSIDIARY TO VARIOUS BID ITEMS.

THE CONTRACTOR'S ATTENTION IS CALLED TO THE FACT THAT CERTAIN EXISTING
CONDUIT IS PROPOSED FOR REUSE. IF THE EXISTING CONDUIT CANNOT BE USED THE
CONTRACTOR WILL BE REQUIRED TO REPAIR AND/OR REPLACE THIS CONDUIT AS
DIRECTED BY THE ENGINEER. REPAIR OF THIS CONDUIT WILL BE PAID FOR AS "EXTRA
WORK" ON A "FORCE ACCOUNT BASIS". THE CONTRACTOR SHALL PROBE THE EXISTING
CONDUIT WHEN LOCATING DRILL SHAFTS SO THAT ITS CONDITION WILL BE KNOWN
BEFORE IT IS NEEDED. UP TO TEN PERCENT OF THE UNUSABLE CONDUITS WILL BE
RANDOMLY SELECTED BY THE ENGINEER FOR RETESTING.

ITEM 620, ELECTRICAL CONDUCTORS:

A CONTINUOUS BARE OR GREEN INSULATED COPPER WIRE NO. 8 AWG OR LARGER
SHALL BE INSTALLED IN EVERY CONDUIT THROUGHOUT THE ELECTRICAL SYSTEM, AS
DETAILED IN THE PLANS, IN ACCORDANCE WITH ITEM 620, THE ELECTRICAL
DETAIL SHEETS, AND THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE.

GROUNDING CONDUCTORS THAT SHARE THE SAME CONDUIT, JUNCTION BOX, GROUND
BOX OR STRUCTURE SHALL BE BONDED TOGETHER AT EVERY ACCESSIBLE POINT IN
ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE.

ITEM 624, GROUND BOX:

ALL GROUND BOXES USED FOR SIGNALS SHALL HAVE "DANGER HIGH VOLTAGE" AND
"TRAFFIC SIGNALS" IMPRINTED ON THE COVER.

ITEM 680, INSTALLATION OF HIGHWAY TRAFFIC SIGNALS:

THIS PROJECT SHALL CONSIST OF FURNISHING, INSTALLING, INTEGRATING, AND
TESTING ALL MATERIALS AND EQUIPMENT NECESSARY FOR A COMPLETE AND FULLY
FUNCTIONAL TRAFFIC SIGNAL SYSTEM. IN ADDITION TO THESE ITEMS, UNDER ITEM
680 THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE FOLLOWING:

1.   SUBMITTAL LITERATURE SHALL BE PROVIDED FOR ALL NEW TRAFFIC SIGNAL AND
COMMUNICATIONS EQUIPMENT FURNISHED BY THE CONTRACTOR PRIOR TO INSTALLATION.

2.   DURING THE THIRTY DAY TEST PERIOD, THE CONTRACTOR SHALL UTILIZE
QUALIFIED PERSONNEL TO RESPOND TO ALL TROUBLE CALLS AND TO REPAIR ANY
MALFUNCTIONS TO NEW CONTROL EQUIPMENT. A LOCAL TELEPHONE NUMBER (NOT
SUBJECT TO FREQUENT CHANGES) WHERE TROUBLE CALLS ARE TO BE RECEIVED ON A
24-HOUR BASIS SHALL BE PROVIDED TO THE ENGINEER BY THE CONTRACTOR. THE
CONTRACTOR'S RESPONSE TO REPORTED CALLS SHALL BE WITHIN A REASONABLE TRAVEL
TIME, BUT NOT MORE THAN TWO (2) HOURS MAXIMUM. APPROPRIATE REPAIRS SHALL BE
MADE WITHIN 24 HOURS. THE CONTRACTOR SHALL PLACE A PERMANENT LOG BOOK IN

EACH CONTROLLER CABINET AND KEEP A RECORD OF EACH TROUBLE CALL REPORTED. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF EACH TROUBLE CALL. THE ERROR LOGIN IN THE CONFLICT MONITOR SHALL NOT BE CLEARED DURING THE THIRTY DAY TEST PERIOD WITHOUT THE APPROVAL OF THE ENGINEER.

3.   THE CONTRACTOR SHALL PLACE DUCT SEAL AT THE ENDS OF ALL CONDUITS AFTER CABLES HAVE BEEN INSTALLED.

4.   WHERE WORK REQUIRES THE REMOVAL OF POWER FROM THE CONTROLLER AND CABINET ASSEMBLY, THE CONTRACTOR SHALL ERECT TEMPORARY STOP SIGN PANELS, AS DIRECTED BY THE ENGINEER. THE STOP SIGN PANELS SHALL BE REMOVED AFTER THE TRAFFIC SIGNALS ARE IN OPERATION.

5.   THE CONTRACTOR SHALL INSTALL THE TRAFFIC SIGNAL CONTROLLER AND CABINET ASSEMBLY AS PER SPECIAL SPECIFICATION ITEM A9004. THE CONTRACTOR SHALL NOT ACTIVATE TRAFFIC SIGNALS WITHOUT PRIOR APPROVAL FROM THE ENGINEER IN THE FIELD. THE CONTRACTOR WILL SCHEDULE HIS/HER WORK SO THAT THE EXISTING SIGNALIZED INTERSECTIONS WILL BE OUT OF SERVICE FOR NO MORE THAN EIGHT HOURS.

6.   ALL ELECTRICAL CONDUCTORS REMOVED BY THE CONTRACTOR SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND REMOVED FROM THE PROJECT SITE.

7.   THE CONTRACTOR SHALL FURNISH AND INSTALL ALUMINUM SUB BASE (RAISED BASE) FOR ALL NEW TRAFFIC SIGNAL CABINET INSTALLATIONS. THIS RAISED BASE WILL REPLACE THE FIBERGLASS BASE AS SPECIFIED UNDER TxDOT'S TRAFFIC SIGNAL CONTROLLER CABINET BASE AND PAD (TS-CF-04) STANDARD. THE ALUMINUM BASE SHALL BE CONSTRUCTED OF .125 BRUSHED ALUMINUM SHEET. ALL CORNERS, EDGES, AND CUTOUTS SHALL HAVE ALL SHARP EDGES GROUND SMOOTH TO PREVENT HAND INJURIES. THE UNIT SHALL HAVE ALL SLAG AND WELDING FLASH REMOVED AND SHALL BE RINSED WITH ETCHING SOLUTION, PROVIDING A SMOOTH UNITFORM FINISH. SILVER SPRAY PAINT IS NOT AN ACCEPTABLE FINISH. THE UNIT SHALL BE CONSTRUCTED WITH A FIVE (5") FLANGE ON THE TOP AND BOTTOM.

8.   THE TRAFFIC SIGNAL CABINET, RAISED BASE, AND NECESSARY HARDWARE INSTALLED ON THIS PROJECT WILL BE PAINTED TO MATCH EXISTING SIGNAL HARDWARE WITHIN THE TOWN OF ADDISON. CONTRACTOR TO COORDINATE WITH THE TOWN OF ADDISON FOR EXACT COLOR.

ITEM 682, VEHICLE AND PEDESTRIAN SIGNAL HEADS:

ALL SIGNAL HEADS FURNISHED BY THE CONTRACTOR SHALL BE OF THE SAME MANUFACTURER.

ALL SIGNAL HEAD ATTACHMENTS ON NEW TRAFFIC SIGNAL MAST ARM ASSEMBLIES THAT ARE FURNISHED BY THE CONTRACTOR SHALL BE DESIGNED SUCH THAT THE WIRING TO EACH SIGNAL HEAD SHALL PASS FROM THE MAST ARM THROUGH THE SIGNAL HEAD

BRACING OR ATTACHMENT HARDWARE TO THE SIGNAL HEAD. NO EXPOSED CABLE OR WIRING WILL BE PERMITTED.

THE SIGNAL-TO-MAST ARM CONNECTION MUST ALLOW FOR ADJUSTMENT ABOUT THE HORIZONTAL AND VERTICAL AXIS. SIGNAL HEADS MOUNTED ON POLES AND MAST ARMS SHALL BE LEVEL AND PLUMB.

ALL NEWLY INSTALLED BACK PLATES SHALL BE FURNISHED WITH LOUVERS.

ALL NEWLY INSTALLED PEDESTRIAN AND VEHICLE SIGNAL HEADS WILL BE PAINTED TO MATCH EXISTING SIGNAL HARDWARE WITHIN THE TOWN OF ADDISON. CONTRACTOR TO COORDINATE WITH THE TOWN OF ADDISON FOR EXACT COLOR.

ITEM 684, TRAFFIC SIGNAL CABLE:

THE CONDUCTORS IN THE TRAFFIC SIGNAL CABLE SHALL BE STRANDED FOR THIS PROJECT. INDIVIDUAL CONDUCTORS SHALL BE NO. 12 AWG.

THE MULTICONDUCTOR SIGNAL CABLE SHOWN ON THE PLANS SHALL BE TERMINATED ON THE TERMINAL STRIP LOCATED IN THE ACCESS COMPARTMENT OF THE MAST ARM SIGNAL POLE. SPLICES IN THE CONDUCTORS FROM THE TERMINAL STRIP AT THE HAND HOLE TO THE SIGNAL HEADS WILL NOT BE PERMITTED IN THE POLE SHAFT OR IN THE MAST ARM.

A SEPARATE MULTICONDUCTOR CABLE (NO. 12 AWG) SHALL BE USED INSIDE MAST ARM SIGNAL AND PEDESTAL POLES FROM THE TERMINAL STRIP TO EACH SIGNAL HEAD AS FOLLOWS:

HEAD TYPE:	CONDUCTOR SIZE:
H3/V3	5 CNDR
H5LT	7 CNDR
143C	5 CNDR (EA)
152A	5 CNDR

EACH CABLE SHALL BE IDENTIFIED WITH PERMANENT MARKING LABELS (PANDUIT TYPE PLM STANDARD SINGLE MARKER TIE, THOMAS & BETTS TYPE 548M OR EQUIVALENT) AT EACH GROUND BOX, POLE BASE AND CONTROLLER.

A MINIMUM LENGTH OF 5 FEET FOR EACH CABLE SHALL BE LEFT IN EACH GROUND BOX AND EACH METAL POLE BASE. FOR EACH CONDUCTOR TERMINATING IN THE CONTROLLER CABINET, A MINIMUM OF 10 FEET LENGTH SHALL BE PROVIDED. ALL CONDUCTORS ARE TO BE CONTINUOUS WITHOUT SPLICE FROM TERMINAL POINT TO TERMINAL POINT, OR AS OTHERWISE APPROVED BY THE ENGINEER. NO ALUMINUM CONDUCTORS WILL BE PERMITTED ON THIS PROJECT. TRAFFIC SIGNAL CABLES SHALL BE RATED FOR 600VOLT OPERATION.

ITEM 686, TRAFFIC SIGNAL POLE ASSEMBLY (STEEL):

ALL POLE SHAFTS FOR THIS PROJECT SHALL BE MARKED WITH THE IDENTIFICATION
NUMBERS FROM THE SIGNAL LAYOUT SHEETS (POLE T-1, ETC.) TO FACILITATE
ASSEMBLY OF THESE ITEMS IN THE FIELD. THE IDENTIFICATION NUMBERS SHALL BE
MARKED ON THE POLE SHAFTS PRIOR TO THE SHIPMENT FROM THE FABRICATOR. THE
POLE SHAFTS SHALL ALSO BE IDENTIFIED BY INTERSECTION.

POLES WILL REQUIRE NUTS ON THE TOP AND BOTTOM (DOUBLE NUTS) OF THE SHAFT
BASE PLATE. ANCHOR BOLTS SHALL BE SET SO THAT TWO ARE IN TENSION AND TWO
ARE IN COMPRESSION.

THE TRAFFIC SIGNAL POLE HEIGHTS AND LENGTHS SHOWN IN THE PLANS AND IN THE
MATERIAL SUMMARY ARE TO BE USED FOR BIDDING PURPOSES ONLY.

ON EXISTING SIGNAL POLE ASSEMBLIES, THE CONTRACTOR WILL BE REQUIRED TO
INSTALL NEW CONDUCTORS FROM THE TERMINAL STRIP OR TRANSFORMER BASE INSIDE
THE POLE TO THE SIGNAL HEADS.

THE TRAFFIC SIGNAL STRAIN POLE AND NECESSARY HARDWARE INSTALLED ON THIS
PROJECT WILL BE PAINTED TO MATCH EXISTING SIGNAL HARDWARE WITHIN THE
TOWN OF ADDISON. CONTRACTOR TO COORDINATE WITH THE TOWN OF ADDISON FOR
EXACT COLOR.

ITEM 6007, REMOVING TRAFFIC SIGNALS

ONLY REMOVE ITEMS IDENTIFIED IN THE PLANS. ALL REMOVED EQUIPMENT, WITH
EXCEPTION TO GROUND BOXES, ELECTRICAL CONDUCTORS, AND TRAFFIC SIGNAL
CABLE WILL BE SALVAGED AND DELIVERED TO THE TOWN OF ADDISON SERVICE
CENTER. ITEMS INVOLVED IN THIS SPECIFICATION INCLUDE BUT NOT LIMITED TO
PEDESTRIAN SIGNAL HEADS, VEHICLE SIGNAL HEADS, TRAFFIC SIGNAL
CONTROLLERS, AND TRAFFIC SIGNAL CABINETS.

ITEM 6266, VIDEO IMAGING VEHICLE DETECTION SYSTEM

THE CONTRACTOR SHALL INSTALL AND MAKE FULLY OPERATIONAL THE VIDEO
IMAGING VEHICLE DETECTION SYSTEM AND INTEGRATE INTO THE PROPOSED TRAFFIC
CONTROL SYSTEM TO PROVIDE REMOTE CONFIGURATION OF THE SYSTEM. REMOTE
CONFIGURATION WILL INCLUDE, AT A MINIMUM, COMMUNICATION WITH THE VIVDS
SYSTEM IN ORDER TO CHANGE DETECTION ZONES, PROVIDE ALARMS WHEN THE
SYSTEM FAILS, AND PROVIDE GENERAL MAINTENANCE FUNCTIONALITY. ANY
SOFTWARE PACKAGES NEEDED TO PROVIDE REMOTE CONFIGURATION WILL BE
FURNISHED AND INSTALLED ON THE TRAFFIC CONTROL SYSTEM
SERVER/WORKSTATION. THE VIDEO IMAGING VEHICLE DETECTION SYSTEM WILL BE
PROCURED BY THE TOWN OF ADDISON.

ITEM A9002, VIDEO SERVER

CONTRACTOR TO FURNISH A VIDEO SERVER MEETING THE REQUIREMENTS UNDER

SPECIFICATION A9002. THIS VIDEO SERVER, AT A MINIMUM, MUST BE CAPABLE
OF SENDING ALL VIDEO IMAGES FROM EACH VIVDS APPROACH CAMERA AT THE
INTERSECTION BACK TO THE TRAFFIC CONTROL SYSTEM. THIS VIDEO SERVER MUST
BE COMPATIBLE WITH THE TOWN'S EXISTING VIVDS SYSTEMS AS WELL AS THE
SYSTEM BEING PROVIDED BY THE TOWN AS PART OF THIS PROJECT.

ITEM A9004, TRAFFIC SIGNAL CONTROLLER ASSEMBLY (TS-2)

THE TOWN OF ADDISON WILL FURNISH TRAFFIC SIGNAL CONTROLLERS AND TRAFFIC
SIGNAL CABINETS TO THE CONTRACTOR FOR INSTALLATION AND TESTING. THE
CONTRACTOR IS RESONSIBLE FOR INSTALLING AND TESTING ALL EQUIPMENT
LOCATED WITIN THE TRAFFIC SIGNAL CABINET AND ANY EQUIPMENT AT THE
INTERSECTION.

THE TRAFFIC SIGNAL CABINET AND NECESSARY HARDWARE INSTALLED ON THIS
PROJECT WILL BE PAINTED TO MATCH EXISTING SIGNAL HARDWARE WITHIN THE
TOWN OF ADDISON. CONTRACTOR TO COORDINATE WITH THE TOWN OF ADDISON FOR
EXACT COLOR.

ITEM A9005, SYSTEM SUPPORT EQUIPMENT
FURNISH THE FOLLOWING ITEMS, MEETING THE SPECIFICATIONS IN THIS
CONTRACT:

DESCRIPTION	QUANTITY
HARDENED ETHERNET SWITCH	2
VIDEO SERVER	2
SERIAL PORT SERVER	1
ATSI CONFLICT MONITOR TESTER MODEL #PCMT 2500	1
ATSI NEMA TS2 TYPE 1 CONTROLLER TEST BOX MODEL #920	1
ATSI DETECTOR TESTER MODEL #QC 330	1
ATSI BIU TESTER MODEL #BIUT800	1

THE FOLLOWING ITEMS WILL BE INCLUDED WITHIN THE TOWN OF ADDISON'S
PROPRIETY PURCHASE AGREEMENT AND WILL BE FURNISHED BY THE TOWN OF
ADDISON:

DESCRIPTION	QUANTITY
WIRELESS ETHERNET RADIO (AP)	2
WIRELESS ETHERNET RADIO (SU)	4
CLUSTER MANAGEMENT MODULE	1
VIVDS PROCESSOR SYSTEM	1
VIVDS CAMERA ASSEMBLY	4
VIVDS SET-UP SYSTEM	1
TRAFFIC SIGNAL CONTROLLER ASSEMBLY (TS-2)	3
GROUND MOUNTED CABINET (SIZE 6)(CONF. 3)	1
ALUMINUM RAISED CABINET BASE	1

COMPUTER EQUIPMENT (LISTED UN DMS 10101)   1

ITEM A9006, SERIAL PORT SERVER
CONTRACTOR TO INSTALL, INTEGRATE, AND/OR TEST SERIAL PORT SERVERS AT
LOCATIONS WHERE A SERIAL TO ETHERNET CONNECTION IS NEEDED FOR EXISTING
TRAFFIC SIGNAL CONTROLLER ASSEMBLIES.

ITEM A9007, WIRELESS ETHERNET RADIO EQUIPMENT FOR TRAFFIC SIGNAL SYSTEM

THE TOWN WILL FURNISH WIRELESS ETHERNET RADIO EQUIPMENT, UNDER A
SEPARATE CONTRACT AND PROVIDE TO THAT CONTRACTOR TO INSTALL AND MAKE
FULLY OPERATIONAL TO SUPPORT THE PROPOSED TRAFFIC CONTROL SYSTEM. THE
WIRELESS EHTERNET RADIO EQUIPMENT WILL BE FURNISHED BY THE TOWN OF
ADDISON AND INSTALLED BY THE CONTRACTOR. THE CONTRACTOR CONDUCTING THE
INSTALLATION WILL BE REQUIRED TO BE CERTIFIED BY THE MANUFACTURER AND
PROVIDE CERTIFICATION DOCUMENTS TO THE TOWN FOR VERIFICATION. THE
CONTRACTOR WILL INTEGRATE THE COMMUNICATIONS SYSTEM WITH THE TRAFFIC
CONTROL SYSTEM SOFTWARE AND HARDWARE AS WELL AS THE LOCAL CONTROLLERS.

SUBMITTAL LITERATURE WILL BE PROVIDED FOR ALL NEW TRAFFIC SIGNAL AND
COMMUNICATIONS EQUIPMENT FURNISHED BY THE CONTRACTOR PRIOR TO
INSTALLATION.

THE CONTRACTOR WILL BE ADVISED OF A PRELIMINARY INVESTIGATION THAT HAS
BEEN CONDUCTED AND THAT THE LINE-OF-SIGHT SHOULD EXIST BETWEEN THE
MASTER RADIO LOCATION (ACCESS POINTS) AND THE OTHER INTERSECTIONS WITH
SUBSCIRBER UNIT RADIOS. THE CONTRACTOR WILL CONDUCT THEIR OWN
INVESTIGATION TO DETERMINE WHETHER ADDITIONAL APPARATUS, SUCH AS LONGER
THAN STANDARD ANTENNA MASTS, REFLECTOR DISHES, OR REPEATER SUBSCRIBER
UNIT RADIOS WILL BE REQUIRED AND SHALL INCLUDE THE COST OF FURNISHING
AND INSTALLING ANY SUCH APPARATUS AS MAY BE REQUIRED TO PROVIDE A
PROPERLY FUNCTIONING SYSTEM.

SUBSCIRBER UNIT RADIOS SHALL BE MOUNTED ON BY ANTENNA MASTS TO EXISTING
SIGNAL POLES OR ON SIGNAL MAST ARMS. ANTENNA MASTS SHALL BE ATTACHED TO
THE POLE USING PELCO "ASTRO-BRAC", OR EQUIVALENT TYPE ASSEMBLY. THE
CONTRACTOR SHALL MAKE HIS INVESTIGATION TO DETERMINE THE APPROPRIATE
LENGTH OF THE ANTENNA MAST.

THE MASTER COMMUNICATIONS ANTENNA (ACCESS POINTS) AS SHOWN IN THE PLANS
SHALL BE LOCATED AT PRESTIGE CIRCLE ELEVATED TANK. THE ORIENTATION OF
THE ACCESS POINTS WILL BE ESTABLISHED BY THE CONTRACTOR IN ORDER TO
DISTRIBUTE BANDWIDTH EQUALLY ACROSS THE SYSTEM IN ORDER TO MAXIMIZE

SYSTEM THROUGHPUT.   ACCESS POINT RADIOS MAY OVERLAP IN COVERAGE TO
DISTRIBUTE BANDWIDTH AND THROUGHPUT NEEDS IN ORDER TO MAXIMIZE
EFFICIENCY OF THE SYSTEM.

THE CONTRACTOR SHALL PROVIDE SEPARATE LIGHTNING PROTECTION (POLYPHASER
IS-50NX-C2 OR EQUAL) FOR ALL WIRELESS BROADBAND RADIO EQUIPMENT,
INCLUDING THE EQUIPMENT AT THE SERVICE CENTER.   THIS SHALL NOT BE PAID
FOR DIRECTLY, BUT CONSIDERED SUBSIDIARY TO THE TOWN SPECIAL
SPECIFICATION, "WIRELESS EQUIPMENT FOR TRAFFIC SIGNAL SYSTEM".

ALL CATEGORY 5E ETHERNET CABLES SHALL BE SHEILDED AND RATED FOR OUTDOOR
USE AND CARRY POWER OVER ETHERNET TO WIRELESS EQUIPMENT.   CATEGORY 5E
CABLES WILL BE BELDEN 1300A OR EQUIVALENT.

SPECIAL SPECIFICATION

6007

Removing Traffic Signals

1. **Description.** Remove, store, and salvage traffic signals.

2. **Construction.** Traffic signals must remain in operation during construction until their removal as directed. The Contractor will not be responsible for maintenance of the signals during this period of operation.

   Remove existing electrical services, pedestal poles, strain poles, mast arm pole assemblies, luminaires, signal heads, controllers, cables, and other accessories. Remove materials so that damage does not occur. Remove and store items designated for reuse or salvage at locations shown on the plans or as directed.

   Remove abandoned concrete foundations to a point 2 ft. below final grade. Backfill hole with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

   Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

3. **Measurement.** This Item will be measured as each signalized intersection salvaged. A signalized intersection is a group of signals operated by a single controller.

4. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Removing Traffic Signals." This price is full compensation for removing the various traffic signal components; removing the foundations; disposal of unsalvageable material; hauling; and equipment, labor, tools, and incidentals.

SPECIAL SPECIFICATION

6011

Testing, Training, Documentation, Final Acceptance, and Warranty

1. **Description.** Perform or furnish testing, training, documentation, final acceptance, and warranty on the applicable equipment or systems.

2. **Testing.** Unless otherwise shown on the plans, perform the following tests on the applicable equipment or systems.

   A. **Test Procedures Documentation.** Provide 5 copies of the test procedures and blank data forms 60 days prior to testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will approve test procedures prior to submission of equipment for tests. Conduct all tests in accordance with the approved test procedures.

   Record test data on the data forms, as well as quantitative results. Ensure the data forms are signed by an authorized representative (company official) of the equipment manufacturer. Submit 1 copy of the completed and signed data forms for acceptance or rejection of the test or equipment.

   B. **Design Approval Test.** Conduct a Design Approval Test on randomly selected units from the prototype design manufacturing run. If only 1 design prototype is manufactured, perform this test on that unit. If supplying multiple types of the equipment, provide and test a sample of each type.

   Certification from an independent testing laboratory of a successfully completed Design Approval Test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

   Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

   1. **Power Service Transients.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to the power service transients as specified in Section 2.2.7.2, "Transient Tests (Power Service)" of the NEMA TS 2 standard, latest edition.

   2. **Temperature and Condensation.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to the following conditions in the order specified below:

- Stabilize the equipment at -30°F and test as specified in Sections 2.2.7.3, "Low-Temperature Low-Voltage Tests" and 2.2.7.4, "Low-Temperature High-Voltage Tests" of the NEMA TS 2 standard, latest edition.

- Allow the equipment to warm up to room temperature in an atmosphere having relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure.

- Stabilize the equipment at 165°F and test as specified in Sections 2.2.7.5, "High-Temperature High Voltage Tests" and 2.2.7.6, "High-Temperature Low-Voltage Tests" of the NEMA TS 2 standard, latest edition.

3. **Relative Humidity.** The equipment shall meet the performance requirements, specified in the parent specification, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

4. **Vibration.** The equipment shall show no degradation of mechanical structure, soldered components, or plug-in components and shall operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in Section 2.2.8, "Vibration Test" of the NEMA TS 2 standard, latest edition.

5. **Power Interruption.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to nominal input voltage variations as specified in Section 2.2.10 "Power Interruption Test" of the NEMA TS 2 standard, latest edition.

C. **Demonstration Test.** Conduct a Demonstration Test on applicable equipment at an approved Contractor facility. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

1. **Examination of Product.** Examine each unit carefully to verify that the materials, design, construction, markings and workmanship comply with the requirements of the parent specification.

2. **Continuity Tests.** Check the wiring to determine conformance with the requirements of the appropriate paragraphs in the parent specification.

3. **Operational Test.** Operate each unit for at least 15 min. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements of the parent specification.

D. **Stand-Alone Tests.** Conduct a Stand-Alone Test for each unit after installation. The test shall exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test. The Department may witness all the tests.

E. **System Integration Test.** Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Supply 2 copies of the System Operations manual before the

System Integration Test. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests.

F. **Final Acceptance Test.** Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitor, and communication requirements for 90 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test. The completion of the Final Acceptance Test occurs when system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects as required in Article 2.G.5.

G. **Consequences of Test Failure.** If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation prior to modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the contract period.

1. **Consequences of Design Approval Test Failure.** If the equipment fails the Design Approval Test, correct the fault and then repeat the Design Approval Test until successfully completed.

2. **Consequences of Demonstration Test Failure.** If the equipment fails the Demonstration Test, correct the fault and then repeat the Demonstration Test until successfully completed.

3. **Consequences of Stand-Alone Test Failure.** If the equipment fails the Stand-Alone Test, correct the fault and then repeat the Demonstration Test until successfully completed.

4. **Consequence of System Integration Test Failure.** If the equipment fails the System Integration Test, correct the fault and then repeat the Systems Integration Test until successfully completed.

5. **Consequences of Final Acceptance Test Failure.** If a defect within the system is detected during the Final Acceptance Test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a consecutive 30 day period free of defects is achieved.

   If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the

downtime in excess of 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

3. **Training.** When required on the plans, provide a minimum of 24 hr. of instruction to 10 designated personnel in the operation and maintenance procedures of equipment or systems installed. Provide the training during installation, testing, and integration. Provide the training through practical demonstrations, seminars, and other related technical procedures.

   Furnish a training session agenda, a complete set of training material (manuals and schematics), and the names and qualifications of proposed instructors for approval 60 days before the training. Provide a training location. Provide 1 copy of the course material for each person. Provide training in the following areas of interest and as shown on the plans:

   - The "Hands-on" operation for each type of equipment.
   - Explanation of all system commands, their function and usage.
   - Required preventative maintenance procedures.
   - All equipment servicing procedures.
   - System "troubleshooting"/problem identification procedures.

4. **Documentation.** Provide "as-built" documentation for the entire system and all of its individual components. Supply 1 mylar reproducible copy of the wiring diagrams. Supply 3 copies of the following in a manual for each equipment component:

   - Complete and accurate schematic diagrams.
   - Complete and accurate cabinet, enclosure, and building wiring diagrams.
   - Complete installation procedures.
   - Complete performance specifications (functional, electrical, mechanical and environmental) on the unit.
   - Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
   - Pictorial of component layout on circuit board.
   - Complete maintenance and trouble-shooting procedures.
   - Complete stage-by-stage explanation of circuit theory and operation.
   - Complete and detailed system operations manuals.

   Furnish additional information as shown on the plans.

5. **Final Acceptance.** Final acceptance is made when all work is complete, the system has successfully completed all test requirements, and the Engineer, in writing, accepts all work for the work locations in the Contract in accordance with Item 5, Article 8, "Final Acceptance." Final acceptance relieves the Contractor from further Contract responsibilities.

6. **Warranty.** Guarantee equipment furnished and installed to perform according to the manufacturer's published specifications. Warrant equipment against defects or failure in design, materials, and workmanship in accordance with the manufacturer's standard warranty. Supply equipment with no less than 95% of the manufacturer's warranty

remaining on the date that equipment invoices are submitted for final payment. Any equipment with less than 95% warranty remaining will be rejected.

The Contractor shall warrant or guarantee all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished and installed for a period of 1 year after final acceptance of the project by the Department. The Contractor's warranty or guarantee shall provide for the "on-site" repair or replacement, at the Contractor's option, within 2 working days and at no cost to the Department.

Once the Contractor's warranty or guarantee expires, assign to the Department any manufacturer's standard warranty or guarantee coverage still remaining on all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace defective equipment, at the manufacturer's option, at no cost to the Department.

7. **Measurement and Payment.** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be considered subsidiary to bid items of the Contract.