CITY OF LIVERMORE

TECHNICAL SPECIFICATIONS

DIVISION 34 – TRANSPORTATION

SECTION 344100 - TRAFFIC SIGNALS AND LIGHTING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The DEVELOPER/CONTRACTOR shall provide all material, equipment, and labor necessary to furnish and install all traffic signals, all street lights, all associated hardware and equipment, and all appurtenant work to provide a functional installation, complete in place and operable, as shown on the Drawings and as specified herein. CONTRACTOR or SUBCONTRACTOR working with any part of the Traffic Signals and Lighting System including radar signs and flashing beacons shall posses a valid Class C10 or Class A license. Additionally, the DEVELOPER/CONTRACTOR's representative in charge on site shall posses an IMSA certification –Level 2 (Field Tech) or Journeyman Electrician certification with at least 3 years experience in the traffic signal technology.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 312300	Utility Earthwork.
B.	Section 311723	Traffic Stripes and Pavement Markings.
C.	Section 321300	Concrete Surface Improvements
D.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

United States Department of Transportation, Manual of Uniform Traffic Control Devices

595a	Federal Standard.
NEC	National Electric Code.
NEMA	National Electric Manufacturers Association.

B. **State of California (Caltrans) Standards:**

1. Latest version of the Standard Specifications, including (but not limited to): Section 86 - Signals, Lighting and Electrical Systems
2. Latest version of the Standard Plans
3. Latest version of the Traffic Manual

C. **Commercial Standards:**

UL	Underwriters Laboratories, Inc.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. The DEVELOPER/CONTRACTOR shall submit the controller cabinet schematic wiring diagram and intersection sketch on one sheet, at the time the controller cabinet is delivered to the CITY for testing,

or prior to any signal modifications which require modifications to the controller cabinet. The DEVELOPER/CONTRACTOR shall notify the City Maintenance Department–and City Inspector 72 hours prior to delivery of controller cabinet for testing.

C. The DEVELOPER/CONTRACTOR shall furnish a maintenance manual for all controller units; auxiliary equipment; and vehicle detectors sensor units, control units and amplifiers. The maintenance manual and the required operation manual may be combined into one manual. One set of traffic signal Drawings and traffic signal Specifications, and the maintenance manual, or combined maintenance and operation manual, for the controller shall be submitted at the time the controllers are delivered to the CITY for testing. The maintenance manual shall include, but is not necessarily limited to, the following items:

1. Manufacturer's specifications.
2. Design characteristics.
3. General operation theory.
4. Function of all controls.
5. Trouble-shooting procedure (diagnostic routine).
6. Block circuit diagram.
7. Geographical layout of components.
8. Schematic diagrams.
9. List of replaceable component parts with stock numbers.

D. The DEVELOPER/CONTRACTOR shall submit to the ENGINEER a list of equipment and materials proposed for to be used in accordance with Section 86-1.04, "Equipment List and Drawings," of the Caltrans Standard Specifications.

E. The controller cabinet and its components shall be tested and certified by the controller manufacturer prior to delivery to the CITY for testing.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. The DEVELOPER/CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the controller manufacturer or his representative, present at the time the traffic signal is turned on, when signal interconnect cable is terminated, when emergency vehicle preemption system is activated, when a new signal phase is activated, or when any modifications are required to the controller cabinet, except for termination of the field wires.

B. When video detection is used, the DEVELOPER/CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the video detection manufacturer or his representative, present at the time the traffic signal is turned on, or when any video detection is activated on an existing signal.

C. When other specialty components are used such as batter backup systems, rectangular rapid flashing beacons, or CCTV the DEVELOPER/CONTRACTOR shall arrange to have a technician, qualified to work on those components and employed by the component’s manufacturer or his representative, present at the time the traffic signal is turned on or the system is activated.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Traffic signals and street lights shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and Caltrans Standard Plans and as specified herein.

2.2 FOUNDATIONS

A. Portland cement concrete for standards, steel pedestals and posts shall be Class A, in conformance with City Standard Detail G-6.

2.3 STANDARDS, STEEL PEDESTALS AND POSTS

A. Standards, steel pedestals, and posts shall conform to Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Caltrans Standard Specifications and as specified herein.

B. All Traffic Signal standards and posts shall be galvanized steel, except in the Downtown Core where it shall be decorative and painted **Olive Drab (SC1TX/RAL6022)** as indicated on the project plans. Locations of Traffic Signal and street lighting standards and posts shall be marked in the field with marking chalk for review by the ENGINEER before beginning any installation.

C. Street light standards shall be galvanized steel or spun aluminum.

D. The decorative street light standard shall be **Lumec R80A-15-TBC1 or approved equal.** The standard shall be aluminum. All hardware shall be tamper resistant stainless steel. Anchor bolts shall be hot dipped galvanized. A 12 ½" bolt circle shall be used.

Description of Components:

Pole Shaft: Shall be made from a 4" (102mm) 8 fluted round extruded 6061-T6 aluminum tubing, having a 0.167" (4.2mm) wall thickness, welded to the pole base.

Joint Cover: One-piece round joint cover made from cast 356 aluminum, mechanically fastened with stainless steel screws.

Pole Base: Shall be made from a round fluted cast 356-T6 aluminum base having a 0.375" (9.5mm) wall thickness, complete with a cast-in anchor plate.

Maintenance Opening: The pole shall have a 4" x 9" (102mm x 229mm) maintenance opening centered 21" (533mm) from the bottom of the anchor plate, complete with a weatherproof cast 356 aluminum cover and a copper ground lug.

Base Cover: Two-piece round base cover made from cast 356 aluminum, mechanically fastened with stainless steel screws.

.**Hardware:** All exposed screws shall be stainless steel with Ceramic primer-seal basecoat to reduce seizing of the parts. All seals and sealing devices should be made and/or lined with EPDM and/or silicone.

Finish: Color to be **Olive Drab (SC1TX/RAL6022)** within the Downtown Core per Downtown Specific Plan Area, and **Black (SC1TX/BKTK)** elsewhere, through an application of a polyester powder coat paint (4 mils/100 microns). The chemical composition provides a highly durable UV and salt spray resistant finish in accordance to the ASTM-B117-73 standard and humidity proof in accordance to the ASTM-D2247-68 standard.

Cast components: All cast aluminum components shall **contain 0.2% copper or less.**

2.4 CONDUIT

A. Conduit shall conform to the provisions of Section 86-2.05, "Conduit," of the Standard Specifications and this Section.

B. Conduit and fittings to be installed underground shall be rigid non-metallic type, unless otherwise noted in the project plans. Conduits designated for traffic signal interconnect shall be installed satisfying the requirements for both twisted pair and fiber optic cables (e.g., sweeps/bends for fiber optic should be used).

C. Conduit installed in concrete base shall be the same type size and quality used for the underground conduit runs.

D. The size of conduit used shall be as shown on the Drawings, but in no case shall conduit be less than 2 inches in diameter. In addition, the DEVELOPER/CONTRACTOR may, at his option and expense, use conduit of larger size than that shown or specified, provided the larger size is used for the entire length of the run from pull box to pull box. Reducing couplings will not be allowed.

E. The fourth sentence in the third paragraph in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications is amended to read as follows:

> When a standard coupling cannot be used for coupling metal type conduit, a UL-listed threaded union coupling, concrete-tight split coupling, or concrete-tight set screw coupling shall be used.

F. All fiber optic and signal interconnect pull boxes shall employ a maximum of 30 degree conduit sweeps. Conduit shall be rigid. All new fiber optic or signal interconnect conduit shall be a minimum of 3 inches unless otherwise noted on the project plans. Conduit shall be installed so that a straight cable pulling path may be maintained.

G. **DETECTABLE Muletape** or approved equal shall be installed in empty conduits with minimum 10 feet coiled in the end pull box. The detectable muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and a corrosion-resistant metallic conductor used for installing fiber optic, copper, and coaxial cables in underground conduits. It shall be pre-lubricated for easy pulling and reduced friction, durably printed with sequential footage markings for accurate measurement, lightweight and easily blown into conduit or innerduct.

2.5 PULL BOXES

A. Pull boxes shall conform to the provisions in Section 86-2.06, "Pull Boxes," of the Caltrans Standard Specifications and this Section.

B. Pull box size shall be No. 5 for traffic signals, No. 3-1/2 for street lights, No. 6 for homeruns, No. 6E for fiber optic and signal interconnect cable, and 30”x48” “double lid” for fiber optic splice enclosures, unless otherwise noted on the project plans. The cover shall be reinforced concrete.

C. Interconnect pull boxes shall have lids embossed with “INTERCONNECT,” street light pull box lids with “STREET LIGHTING,” and traffic signal pull boxes with “TRAFFIC SIGNAL.”

D. All 6E pull boxes shall employ a 10 inch extension. A minimum of 10 inches of space shall be maintained between the lid of the 6E pull box and material at the bottom of the box.

2.6 CONDUCTORS AND WIRING

A. Wiring shall conform to the provisions in Section 86-2.09, "Wiring," of the Caltrans Standard Specifications and this Section. Splices shall be insulated by "Method B."

B. Street light conductors shall be copper type TW or THW. Conductors between pull boxes shall be No. 10 or larger and conductors in street light standards shall be No. 12 or larger, unless otherwise noted on the project plans.

C. The voltage drop in any street light circuit shall not exceed 4 volts. The following formula shall be used to calculate the current needed for selecting the conductor size:

$$\text{Current (amperes)} = \frac{\text{Total wattage of fixtures served x 1.5}}{\text{Service Voltage}}$$

D. Fuse holders shall be non-compression type, and shall be **BUSS HEB-AA** or equal.

E. The fiber optic cable requirements are as follows:

Fiber Optic Cable

Fiber Cable shall be all dielectric, loose tube with 12 single strand fibers per loose tube. No ribbon fiber shall be utilized. Fiber optic cable shall be single mode. Where available, within contract, water protection tape rather than gel filling shall be utilized. Fiber and fiber cable construction shall adhere to RUS PE-90 and Bellcore GR-20. Cable shall adhere to standard industry fiber and loose tube color coding, as defined by RUS PE-90 and Bellcore GR-20. The Cable shall be constructed to provide a minimum of 30 years useful life when installed in conduit. Fiber shall be 8.3 microns (normal) diameter with mode field diameters for depressed cladding being 8.8 microns ± 0.5 microns at 1310 nm and 10.0 ±1.0 microns at 1550 nm; for matched cladding mode field shall be 9.3 microns ± 0.5 microns and 10.5 ± 1.0 microns for respective wave lengths. (Cladding types shall not be mixed during fiber deployment). The fiber shall be protected with a cladding with diameter of 125.0 ±1.0 microns.

The fiber within the cable shall have an attenuation of no greater than 0.35 dB/Km (0.56 dB/Mile) at 1310 nm and 0.25 dB/Km (0.40 dB/Mile) at 1550 nm. Water peak attenuation 1385 nm (±3 nm) shall not exceed 2.5 dB/Km (4.02 dB/Mile). The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no localized discontinuities in excess of 0.1dB at either 1310 nm or 1550 nm as determined by TIA 455-59 Fiber Optic Test Procedures (FOTP).

The Fibers shall have a maximum dispersion of 2.8 picoseconds/nanometer – km (ps/nm-km) over an optical wavelength range of 1290 to 1330 nm and a maximum value of zero dispersion slope of 0.093 ps/(km-nm^2). Dispersion tests are in accordance with TIA 455-17S FOTP. The manufacturers shall have tested for dispersion as required by Bellcore GR – 20 or RUS PE-90. New factory tests are required only if the fiber has not been pre-tested and qualified to standards.

The Construction of the cable shall follow referenced standards for construction of dielectric, loose tube fiber cable with the exception that water-blocking tape is acceptable and preferred. The dielectric strength member shall support a tensile force of 2700 Newtons during cable installation and shall protect fiber attenuation change during installation allowing no greater than 0.31 dB/Km (0.50 dB/Mile) increase over manufacturer's specified fiber attenuation.

The cable shall include a ripcord under the sheath to support easy removal of the sheaths. The sheaths shall be marked in accordance with National Electric Safety Code 350 G. The Cable Sheath shall also be permanently marked with the manufacturer's name, type cable and "Fiber Optic Cable." There shall also be sequential length markers that are accurate within 1%. Marking size shall be such as to the easily read by a technician. The DEVELOPER/CONTRACTOR shall submit cut sheets for cable approval to the Construction Manager identifying the marking size, repetition and symbol per National Electrical Safety Code (i.e., Telephone Symbol).

Cable diameter for up to 72 fibers should be approximately 13mm. Cable shall be rated for an operating temperature of -40^{0}C to +75^{0}C. The cable shall contain no metal and shall conform to the National Electric Code's definition of fiber.

Cable shall be shipped from the factory with protective wrapping and with sealed ends. The cable shall include a waterproof tag with the results of factory OTDR attenuation test as well as:

Contract Number/Identification
Manufacturer's Name/Address
Manufacturer's Part Number
Type of Cable
Number of Loose Tubes and Fiber
Beginning and Ending Length Marks
Reel Number
Ship Date
Weight of Cable and Reel

Cable shall be of a continuous length on the reels. The Cable runs are as shown on plans. Slack cable requirements shall be considered by the DEVELOPER/CONTRACTOR, based on normal industry installation practices, in computing required cable length.

12-Fiber drop cables with 12-fiber jumper cables shall be utilized from splice closures to Ethernet Switches located in traffic signal controller cabinet. All traffic signal controller cabinets shall employ a fiber termination panel or tray for fiber optic termination with SC (female) connectors. Each jumper cable shall be 900 microns and terminated with an SC (male) connector having integral strain relief.

The fiber optic patch cable shall comply with the fiber cable special provisions of this document. The length of the patch cable shall be 2 meters (minimum). The patch cable shall have SC (male) connectors, simplex and single mode. The jumper cable will interface with the SC (female) connectors on the optical transceivers installed in field equipment cabinets.

The DEVELOPER/CONTRACTOR is responsible for interfacing the SC (Male) connectors to test optical-to-electrical communications performance between the Ethernet Switch, other installation locations, and the Traffic Operations Center (if applicable). The DEVELOPER/CONTRACTOR is responsible for correct splicing of the drop cable onto the backbone cable in accordance with splice tables provided by the City. Only fusion splicing method shall be accepted. DEVELOPER/CONTRACTOR is responsible for point-to-point continuity in accordance with splice tables and assuring point-to-point optical path loss (attenuation) is within specifications. Fiber drop cables and patch cables shall be marked R-1, R-2, T-1, T-2 or SPARE.

Tracer Wires or **Detectable Muletape** shall be included with all fiber optic cable installation projects. The detectable muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and a corrosion-resistant metallic conductor. The tracer wires or Muletape shall be installed in such a way so that underground fiber optic utilities can be identified and located in the future by maintenance staff.

Fiber Optic Splice Closures

The DEVELOPER/CONTRACTOR shall deploy splice closures compatible with the single mode fiber cable selected for deployment and which are compliant with these special provisions. The splice closure shall include a fiber organizer following the guidelines of Bellcore GR-769. The basic splice closure shall also follow the guidelines of Bellcore GR771, "Generic Requirements for Fiber Optic Splice Closures."

The construction of the splice closure shall be such that it:

- Provides a protective mechanism for organizing the fiber strands and protecting individual fiber splices

- Waterproof design supporting continued submergence in water at normal burial depths (1 meter)
- Support main fiber backbone splices to a minimum of two drop/branch cables of 12-24 fiber each.
- Any metal parts shall be protected against corrosion
- Shall be easy to disassemble and reassemble by a fiber maintenance person
- Provided with hanging provisions from the side of a pull/across box
- Permanently marked with: “Fiber Communications” or similar wording to identify its function

Splice closures to be placed in pull boxes shall be attached to the side of the pull box with nylon ties. Slack shall be provided to allow the splice closure to be removed from the pull box for maintenance.

The DEVELOPER/CONTRACTOR shall prepare and submit Record Drawings of each splice closure installed, showing each fiber enclosed, fiber color, splices, and unconnected fibers. Record drawings shall be labeled to indicate the splice closure location.

All fiber optic splices shall be completed using the fusion splice method. All splices shall be tested, and the results of those tests shall be provided to the CITY by the DEVELOPER/CONTRACTOR.

2.7 BONDING AND GROUNDING

A. Bonding and grounding shall conform to provisions in Section 86-2.10, "Bonding and Grounding," of the Caltrans Standard Specifications and this Section.

B. Street lights shall be grounded by the use of a 5/8-inch diameter by 8 foot copper weld ground rod installed in the pull box adjacent to the street light.

2.8 SERVICE

A. Service shall conform to the provisions in Section 86-2.11, "Service," of the Caltrans Standard Specifications and this Section except that the CONTRACTOR shall pay all costs and fees required by the utility company for the connection of both temporary and permanent service.

B. The service equipment cabinet shall be Type III 120/240-volt and shall be painted with graffiti-resistant paint to match the controller cabinet color. All service cabinets installed in the “Downtown Core” shall be painted to match the controller cabinet color (Olive Drab -RAL 6022). Outside of the Downtown Core, the paint shall match the controller cabinet color. Battery Backup System (BBS) shall be required on all new traffic signal service equipment installation. The service cabinet shall house both PG&E equipment and BBS equipment including batteries. The base for the Type III service equipment enclosure shall meet Caltrans Standard Plan ES-2D. The service cabinet for traffic signals shall be a **Tesco 27/22-000BBS Type III-AF** or equivalent.

C. The service enclosure shall meet the requirements of PG&E, and shall conform to Section 86-1.02, "Regulations and Code," of the Caltrans Standard Specifications. The enclosure shall be factory pre-wired and tested to meet NEMA 3R standards. A copy of the wiring diagram for the integrated system shall be enclosed in plastic and mounted inside the enclosure. Name plates shall be provided for each control component. The name plates shall be phenolic, black background with white lettering except the main breaker, which shall be red with white lettering. All name plates shall be fastened in the enclosure by screws. I.D. numerals as shown on Standard Detail ST-14A, “Standard Street Light,” shall be used to show the address for the meter below the meter window or the front of the enclosure.

D. The traffic signal service enclosure shall have a separate disconnect for the traffic signal, safety lighting, and sign lighting circuits. Separate disconnects shall be provided for any other separate circuit, such as street lighting or irrigation systems, when shown on the plans. Lighting contactors shall be mercury displacement type conforming to the functional and operational requirements of

Section 86-6.07B(2), "Contactor," of the Caltrans Standard Specifications. The top half of the service cabinet shall be equipped with 19” rack mountable rails.

E. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.

F. It shall be the responsibility of the CONTRACTOR to coordinate a field meeting with representatives from PG&E and notify the City inspector to ascertain the exact service connection point prior to beginning work.

2.9 UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

A. A system for a fully functional BBS shall operate LED, incandescent or any combination of both lighting technologies for a period of at least two hours and run an additional two hours (minimum) on Red Flash only. The UPS/BBS shall have a minimum Power Rating of 1.1 KVA (1100 Watts). BBS shall be **Tesco 1400XLwith Ethernet Interface** or approved equal.

B. Individual batteries shall be easily replaced and commercially available off the shelf. Batteries shall be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat/ Valve Regulated Lead Acid) batteries. Recharge time for the battery, from protective low cutoff to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.

C. Maximum transfer time due power outage shall be 150 milliseconds.

D. Batteries shall be certified (by the manufacturer) to operate normally in harsh conditions (-25C to +74C and 20% to 95% humidity).

E. Battery output voltage shall be 110 VAC and 125 VAC, pure sine wave output, $\leq$ 3% THD, 60Hz $\pm$ 5Hz.

F. BBS shall bypass the utility line power whenever the utility line voltage is outside the following voltage range: 100VAC to 130 VAC ($\pm$ 2 VAC).

G. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

H. Batteries shall be provided with appropriate interconnect wiring and corrosion resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.

I. Battery interconnect wiring shall be via modular harness. Batteries shall be shipped with positive and negative terminals pre-wired with red and black cabling that terminates into a typical power-pole style connector. Harness shall be equipped with mating power-pole style connectors for batteries and a single, insulate plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed and wired to insure proper polarity and circuit configuration. Battery terminals shall be covered and insulated so as to prevent accidental shorting.

J. Batteries shall have a warranty for full replacement for two (2) years from the date of installation.

K. The Complete UPS system including batteries shall fit inside the Type III service cabinet with the required PG&E equipment. The Type III service enclosure shall be specifically designed for the UPS/BBS with batteries, as required for the specified run time, and equipped with photoelectric unit mounted inside the cabinet. The service enclosure shall be painted with graffiti-resistant paint to match the controller cabinet color. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.

L. All necessary hardware for mounting (shelf angles, rack, shelving, harness, etc.) shall be included in the bid price of the UPS.

M. UPS shall be easily installed and replaced (complete turnkey system with all necessary hardware) and shall not require any special tools for installation.

N. UPS shall include a resetable front-panel event counter display to indicate the number of times the UPS was activated and a front-panel hour meter to display, the total number of hours the unit has operated on battery power.

O. UPS inverter module shall include a serial port allowing field programmability of input/output voltage values, self-testing, communication and diagnostics. Software to retrieve data, troubleshoot and program the UPS system shall be ASCII format and be included as a part of the system.

P. The UPS shall include a display (status monitor) and/or meter to indicate current battery charge status and conditions.

Q. The UPS shall have an Ethernet port interface to allow user programming of certain operational parameters in order to ensure compatibility with the specific intersection control equipment as deployed. Remote diagnostics and unit modification shall be enabled between the battery backup system and the Traffic Operations Center.

R. UPS Manufacturer shall provide a two (2) year factory-repair warranty for parts and labor on the UPS. Manufacturer shall provide 24 hour technical support via toll-free telephone service.

S. UPS-BBS Manufacturer shall have field service technician trained in Traffic Control Technology present during signal turn on or activation of new BBS system to make certain the system is correctly installed, and Ethernet communication established between the field and the TOC.

T. See Part 3 - Execution, Item 3.9 of this section for more details on the required installation of the UPS-BBS.

2.10 CONTROLLER ASSEMBLIES

A. This specification sets forth the minimum requirements for a TS-2 Type 1 controller assembly with a 16 position load bay, wired for eight phases and fully operational with all the components and plug-ins, malfunction management unit, bus interface unit, cabinet power supply, load switches, flashers and detectors including the controller unit. The controller assembly shall meet all applicable sections of the NEMA TS-2 1998 Standards and Caltrans Standard Specifications and Standard Plans.

B. The controller cabinet shall be a new fully-wired Type “P” unless otherwise specified, aluminum cabinet shall be painted Signal Grey - RAL 7004. All new controller cabinets in the “Downtown Core” shall be painted Olive Drab – RAL 6022. The cabinet shall conform to Caltrans Standard Specifications and Standard Plans. The interior of the cabinet shall be painted powder coat white. The cabinet door shall be fitted with a No. 2 Corbin lock, and stainless steel handle with a 16mm (minimum) diameter shaft and three-point latch. The lock and latch design shall not allow the handle to open the cabinet unless the lock is engaged. A locking auxiliary police door shall be included to allow limited controller function access to switch the traffic controller between normal and flash operation. The cabinet shall be “plug and play” ready with a 2070 lite controller using latest version of the Apogee Version NTCIP based Naztec Intersection Control Software. The cabinet layout shall be configured to provide adequate shelf space for all shelf-mounted required equipment (e.g., EVP rack, power supply, detector racks, BIU, video detection equipment, video monitor, MMU, video multiplexer, Ethernet Switch, and Controller). At least one **day before the scheduled “signal turn-on”**, the controller assemblies including video detection system, shall be fully wired, programmed, tested, and organized with no unnecessary loose cables or conductors. The wiring in the cabinet

shall be tie-wrapped and labeled in a neat/orderly fashion to the satisfaction of a City Traffic Signal technician.

C. The controller shall be a Type 2070 with the latest version of the Apogee NTCIP based Naztec Intersection Control Software, and conforming to the following specifications:

Controller
The controller shall be the "lite" version Model 2070 ATC traffic controller per California Department of Transportation's (Caltrans) specifications, and shall conform to the Transportation Electrical Equipment Specifications (TEES) dated August 2002 or newer. The controller model and manufacturer shall be registered on the Caltrans Qualified Products List (QPL). The controller shall be equipped with the following modules:

- 2070-1B
- 2070-2B
- 2070-2NZ
- 2070-3B
- 2070-4B (VME Cage Assembly)
- 2070-7A
- 2070-8

Ethernet Port
The 2070-1B shall be equipped with an Ethernet port. The controller software operating on the 2070-1B shall be capable of utilizing the Ethernet port for data transfers. The operating system shall allow the user FTP and Telnet access via the Ethernet port.

SDLC Communications
The 2070 controller software shall be capable of communicating to TS-2 BIUs via SP3S on the 2070-2B. The 2070-2B shall be optically isolated.

2070-7A
The 2070-7A shall conform to the latest TEES specification, and shall be optically isolated.

Operating System
The 2070 controller software shall operate on the 2070-1B using Microware OS9 v3.2 or higher.

Software
The controller software shall be the latest version of the Apogee NTCIP based Naztec Intersection Control Software.

D. The cabinet shall be supplied with two 8-position detector racks. The detector racks shall meet all applicable sections of the NEMA TS-2 standards. Detector input field panel shall have SRA-6LC surge arrestors installed for each loop input for lightning protection.

E. The loadbay shall be wired for full 8-phase operation and shall accommodate a minimum of 16 loadswitch positions. The loadbay shall also be wired for a 16-channel malfunction management unit. All field wiring terminals for vehicle phases, pedestrians, and overlap outputs shall be present on the loadbay panel. Penn-Union Corp.'s copper "Solder-less" lugs or approved equal shall be used with the terminal strips in the loadbay where more than one forked connector needs to be landed to the terminal screw on the load-bay.

F. The cabinet shall be provided with the following auxiliary equipment:

- Roll out powder coated stainless steel document drawer under the second shelf. This drawer shall have a hinged top cover, and it shall be of sufficient size and strength to hold a complete set of cabinet wiring drawings and equipment programming manuals for all

modules applicable to each cabinet. When the cover is closed, the drawer shall double a resting place for documents or a laptop computer.

- Thermostatically controlled ventilation fan system per Caltrans Standard Specifications.
- LED lighting fixture mounted on the inside top of the cabinet near the front edge.
- Police panel and technician test panel - This test panel shall be equipped with switches for each vehicle and pedestrian phases. The switch for each phase when activated shall trigger a call for the corresponding phase.
- The cabinet shall include a splice terminal block, dedicated for the interconnect cable, and/or a fiber termination panel for fiber optic drop cable termination unless otherwise shown on the plans. The number of termination channels shall match the pairs of wires for at least a 12-pair interconnect cable.
- The cabinet shall include empty shelf space to accommodate third party video detection processing units and Ethernet communications equipment.
- The cabinet shall be equipped with fully wired Opticom phase selectors model M752, or approved equal. There shall be a termination panel to land Opticom interface cables from the detector units. No field wiring modification allowed unless approved by the Engineer.

G. The cabinet shall be equipped with 2 Bus Interface Unit (BIU) cards for the load bays, plus 2 BIU cards for the detector racks. The BIU shall meet, as a minimum, all applicable sections of the NEMA Standards Publication TS2-1998. The BIU shall be rack-mountable and solid-state. The BIU unit shall be constructed with discrete component circuitry in order to allow repair and maintenance of the unit by use of standard tools. The BIU shall utilize machine tooled integrated circuit (IC) sockets for all IC's of 14 pins or greater, for ease of repair. One IC-BIU spare shall be provided with the cabinet. The use of BIU units utilizing surface mount technology (SMT) shall be acceptable, provided the vendor supply one spare unit for every two SMT-BIU supplied with the cabinet (i.e., if the cabinet comes with four SMT-BIUs, there shall be two spare SMT-BIUs).

H. The cabinet power supply shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS-2 1998.

I. The loadswitches shall be solid state, meet all applicable sections of the NEMA TS-2 standards. Units shall be the dual indicating I/O type, and shall have indicator lights that show both the input and output side of the loadswitch. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 200 Switch Packs.

J. The flasher shall meet all applicable sections of the NEMA TS-2 standards. It shall be a Type III, dual circuit rated at 15 Amperes per circuit. LED or neon output indicators shall be utilized for each circuit. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 204 flashers.

K. The magnetic flash transfer relay shall meet all applicable sections of the NEMA TS-2 standards, and Caltrans Standard Plans & Specifications §86-4.09C(6) "Heavy Duty Relays" and shall be **Magnecraft & Struthers-Dunn W12ACPX-2/W21ACPXD-5 -Coil: 120V 50/60 Hz** or approved equal.

L. The number of inductive vehicle detector channels provided shall match the number of detector lead in cables shown on the plans, plus 2 additional 2-channel detector units as spares. All detectors shall be configured as a rack mounted printed circuit board for insertion into a NEMA TS-2 detector rack. Detector units shall be in full compliance with NEMA standards TS-2-1998. Detectors shall be two-channel programmable with front LCD display. Detectors shall be EDI Oracle/2, Reno A&E Model C, or approved equal.

M. The MMU shall meet all applicable sections of the NEMA Standards Publication No. TS2-1998. The MMU shall be shelf-mountable, sixteen channel solid-state with an RS-232 communications port (or Ethernet Port if available) and data cable. The MMU card shall be programmed/prepared to match

the intended signal operation of the intersection as shown on the plan. The MMU shall be ready to transmit event log data to the City's Streetwise ATMS Central Software via controller communications. The MMU shall log and store three report categories:

- Indications, power fluctuations, cycles missed, and power outages
- Past twenty conflicting conditions
- Event trace of the past twenty events recorded in .01-second resolution. This report is required to display conditions, which led to the conflicting condition.

The MMU shall be a Naztec MMU-516, or approved equal.

N. All cabinet wiring shall be incorporated into one schematic drawing. Each cabinet shall be provided with three schematic drawings **specific** for the cabinet to be used in this specific project. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result in the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. Operational/repair manuals for each component and plug-in shall be provided with each cabinet.

O. Prior to delivery, each controller assembly shall be tested by the supplier as a complete unit with a 2070 controller under signal load for a minimum of 24 hours. Each assembly shall be delivered with a signed checklist detailing the results of the test performed on the controller assembly. The cabinet shall be "plug and play" ready with a 2070 lite controller using the latest Apogee Version NTCIP based Naztec Intersection Control Software.

After delivery, the City will conduct a separate testing of the cabinet. If the City requires technical support during its testing period, the cabinet supplier shall provide on site technical support within 48 hours after the City makes the request.

The City of Livermore reserves the right to reject a controller assembly covered by these specifications if the assembly is found to be defective within a sixty (60) day period after shipment or if the controller assembly fails any performance test.

P. A factory certified representative from the manufacturer shall be on-site during signal pre-turn on and turn-on for support. The factory representative if requested by the City shall assist in having the cabinet fully operational as indicated on the intersection drawings and this specification.

The supplier shall provide a maximum of four hours of technical training for City Staff within four weeks after cabinet delivery. The training session should at least include a discussion on the differences between TS2 and TS1 cabinets, identify components unique to the TS2 cabinets, and cover the troubleshooting and testing of the TS2 controller cabinet.

Q. The controller assembly including all the electronic components shall be warranted by the manufacturer against mechanical and electrical defects for a period of 1 year. The manufacturer's warranty shall be supplied in writing with each cabinet and unit within the cabinet.

R. The supplier shall correct any defects in design, workmanship or material during the warranty period at no cost to the City of Livermore. All cost of labor, parts and transportation to and from the vendor shall be borne by the vendor for the duration of the warranty period. The vendor shall provide all revisions to any equipment furnished under these specifications, at no cost to the City of Livermore.

S. Necessary communications cables shall be installed to allow MMU communications with the 2070 controller, other Ethernet devices, and the Traffic Operations Center.

T. See Section 2.16 "Inductive Loop Detectors" for information regarding video and loop detection operations during fog and other inclement weather conditions.

U. Minor holes left on an existing controller cabinet due to the removal of equipment (e.g., an attached Type II service is removed) shall be repaired by using industry standard metallic hole plugs. The

plug shall be rust resistant, and pliable sealing compound shall be used between the metallic hole plug and the cabinet to prevent water, dust, and dirt from entering the cabinet. The resulting outside surface of the repaired cabinet shall be smooth so as not to cause injury.

2.11 MODULATED SIGNAL DETECTION SYSTEM

A. The modulated signal detection system shall be able to interface with the CITY'S **"Opticom"** detection system as manufactured by **3M**. The controllers shall be equipped with internal circuitry to provide programmable channels of emergency vehicle preemption. The detector shall have a minimum range of 2500 feet.

B. The modulated signal detection system shall consist of **"Opticom"** phase selector model M752; **"Opticom"** detector model 721 for 1-channel or 722 for 2-channel detection; and **"Opticom"** interface cable model M138, or approved equal.

C. The controller cabinets shall be wired with a "D" connector or special function cable to provide all necessary controller connections for emergency vehicle preemption. The phase selectors or discriminators shall be wired to provide emergency vehicle preemption for the emergency vehicle phases as shown on the Drawings.

D. Necessary communications cables shall be installed to allow **"Opticom"** communications with the 2070 controller and the Traffic Operations Center, if applicable.

2.12 EDGE LIT LED STREET NAME SIGNS

If required on the plans Edge Lit LED street name signs shall:

A. Edge-Lit LED street name signs (SNS) shall conform to Section 86-6.065 "Internally Illuminated Street Name Signs" of the Caltrans Standard Specifications. Bullet item 5 in Section 86-6.065 shall be amended to say "Signs shall be the LED Type".

B. Edge-Lit LED SNS installed on signal mast arms shall be the LED type per the Project Plans and these Specifications.

C. Edge-Lit LED SNS shall operate maintenance-free for over 50,000 hours, with no ballasts to replace.

D. The technology consists of LEDs mounted along the top and bottom edge of the sign, concealed in the frame. The Edge-Lit sign shall use high-flux LEDs.

E. Edge-Lit Light shall be emitted vertically from the top and bottom through a clear acrylic sheet and refracted outwards horizontally through the sign legend.

F. Edge-Lit technology shall allow for an ultra-slim, unobtrusive frame that can be mounted in any arrangement. Edge-Lit SNS mounted shall be mounted on the Signal Mast Arm unless otherwise noted. Edge-Lit SNS signs shall be double sided signs installed using an underhang mounting per the manufacturer's specifications.

G. Edge-Lit LED SNS shall be White on a standard MUTCD Color 1177 (Green) background. Edge-Lit LED SNS installed in the "Downtown Core" shall be standard MUTCD Color 1177 (Green) on a White background. All SNS lettering shall meet minimum MUTCD requirements.

H. The Edge-Lit LED SNS shall be the **Carmanah Edge-Lit LED SNS Model 409** or approved equal.

2.13 VEHICLE SIGNAL FACES AND SIGNAL HEADS

A. Vehicle signal faces and signal heads shall be in conformance with Section 86-4, "Traffic Signal Faces and Fittings" of the Caltrans Standard Specifications and as shown on the Drawings.

B. Signal section housing shall be metal type and shall have 12-inch sections. Signal housings and mounting hardware shall be painted gloss black, except in Downtown Core where they shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated. The backplates for mast arm mounted heads shall be ventilated. All backplates shall be such that they can be removed and reinstalled without requiring the removal of the traffic signals. Signal head visors shall be tunnel type.

C. The second sentence in the third paragraph in Section 86-4.04, "Backplates," of the Caltrans Standard Specifications is amended to read:

> Sections shall be joined using 1) aluminum rivets and washers painted or permanently colored to match the backplate, or 2) No. 10 machine screws with washer, lock washer and nut, painted to match the backplate.

D. All vehicle signals shall be **Dialight ITE Compliant "X" and "XL"** 12-inch LED indications or approved equal and furnished by the DEVELOPER/CONTRACTOR. This specification LED modules to be used in place of the incandescent lamp, reflector, socket, gasket, and lens assembly of the vehicle signal sections. Vehicle type LED modules shall fit in all standard, incandescent vehicle traffic signal housings. Each module shall also incorporate a printed circuit board inclusive of all of the LEDs and required circuit components, 36 inch 16 AWG wire leads with strain relief and spade terminals, a rigid housing for protection in shipping, handling and installation, and a one piece neoprene gasket. *Screw-in* type products are not allowed for vehicle signals.

E. All LED shall meet the latest ITE specifications and current Caltrans standards and measurement criteria for LED traffic signal modules, and shall conform to the following specifications:

LED (Light Emitting Diode) Traffic Signal Modules - Specifications

The following specification shall apply to all LED modules unless otherwise specified.

General Description

Ball type signals shall utilize the *LumiLeds* (1) light engine as their source of illumination.
Lenses for ball type modules shall be made of ultraviolet stabilized polycarbonate, and incorporate facets that serve to enhance the optical efficiency of the LED traffic signal module. Individual *lens-lets* are specifically not allowed. The ball type signals shall incorporate an inner lens that is sealed to the lamp housing, and serves to collimate the light emitted by the *LumiLeds* (1) light engine. An outer lens shall also be incorporated, that serves to focus the collimated light, so as to meet ITE intensity and distribution standards. Additionally, the LED shall almost perfectly, approximate to the motorist, the appearance of an incandescent traffic signal. This means that the face of the ball LED lamp shall appear to the motorist as nearly totally uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards or single-tethered span wire. This also means that it shall not be apparent that LEDs are used as the light source for the traffic signal ball. The external lens surface for all vehicle signals shall be smooth, with no raised features, so as to minimize the collection of dirt, diesel smoke, and other particulate contaminates, and to facilitate periodic cleaning. External lens facets are not allowed. The lens shall be keyed to the housing of the LED signal module to insure the proper orientation and to avoid possible rotation during any handling. External lenses shall be hard-coated in compliance with Caltrans specifications.

The LEDs shall be mounted and soldered to a printed circuit board. The LED signal module shall be watertight when properly installed in a traffic signal housing. The LED signal module shall

utilize the same mounting hardware used to secure the incandescent lens and gasket assembly, and shall only require a screwdriver or standard installation tool to complete the mounting. The LED signal module assembly shall weigh less than 5 pounds. For vehicle signals, the incandescent lamp sockets and reflectors shall be removed from the signal head housings. So as to minimize possible maintenance problems, the LED lamp module may not protrude into the signal visor area more than three-quarters of an inch in depth.
The housing of the LED signal module shall be marked 'TOP' to designate the proper orientation of the LED signal module in the traffic signal housing. The housing of red LED ball type traffic signal modules shall utilize a *partial*, *embedded and integral metal layer*, in its design and construction. Manufacturers part number, date code, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly. A label shall be affixed to back of the all ball type modules, that certifies their complete compliance with the latest ITE VTCSH, Part II specification for LED traffic signal modules.

The LED traffic signal manufacturer shall be ISO 9001 certified.

Optical

The light intensity and distribution from red LED signal modules shall as a minimum, meet the July, 1998 ITE VTCSH Part II, and current CALTRANS standards and measurement criteria for LED traffic signal modules. Test data to verify the performance for red and green ball signals as meeting the July 1998 ITE VTCSH, Part II intensity requirements @ 74 degrees Centigrade, shall be supplied from either:

Lighting Sciences
7630 East Evans Road
Scottsdale, AZ 85260

ETL Testing Laboratories
3933 US Route 11
Cortland, NY 13045-0950

or, other certified **independent** test lab. The light output of all LED vehicle signal modules shall meet ITE specifications for chromaticity.

The LEDs shall be connected in series parallel strings. No more than 1% of the total luminosity of the entire signal module may be lost in the event of a single string failure. For red LED ball type signals, the failure of a single LED shall cause loss of light from only that LED. No loss of light output from the complete module assembly shall occur as a result of a single LED failure in a red LED ball lamp.

The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and *evening* hours. The LED traffic signal module shall be operationally compatible with NEMA TS - 1 and NEMA TS - 2 *conflict monitoring* parameters. The intensity of the LED signal module shall not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

Red balls shall maintain required intensity, as defined by the July, 1998 ITE VTCSH, Part II intensity standards for LED traffic signal modules, over the temperature range of -40 degrees centigrade to +74 degrees centigrade, at 120 volts A.C., when new, and also after 3 years.

Electrical

Power factor shall be 90% or greater, at nominal rated voltage, at 25°C, after 60 minutes of operation. Total harmonic distortion (THD) shall be less than 20% at rated voltage, at 25°C.

All LED traffic signal modules shall be in compliance with FCC noise regulations.

The red LEDs shall utilize exclusively AlInGaP technology, either AS (Absorbing Substrate) or TS (Transparent Substrate), and shall not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 85 degrees C and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

The LED signal modules shall be connected directly to line voltage, **120 Volts AC nominal**, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

The 8" and 12" red ball units shall consume no more than a nominal 7 and 10.5 watts respectively, at 120 VAC, at 25 degrees centigrade. Maximum power consumption shall not exceed 9 and 12 watts respectively, at 120 VAC, at 25 degrees centigrade.

Red arrow type LED traffic signal modules shall be temperature-compensated so as to maintain intensity at elevated temperatures. Red arrow type LED traffic signal shall be tested and documented by CALTRANS as being in compliance with CALTRANS intensity standards for red arrows at elevated temperatures.

Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

WARRANTY

All LED traffic signal modules supplied shall be warranted for 5 years against manufacturing defects.

Red ball and red arrow traffic signal modules shall be performance warranted to be in compliance with July, 1998 ITE VTCSH, Part II, and CALTRANS minimum intensity standards for LED traffic signal modules, at 74 degrees centigrade, for a period of three (3) years.

2.14 PEDESTRIAN SIGNALS

A. Pedestrian signals shall be in conformance with Section 86-4.06 "Pedestrian Signal Faces" of Caltrans Standard Specifications.

B. Pedestrian LED shall be 16" x 18" Full Hand/Fullman. The Countdown Module shall be standard for pedestrian LED signals. Alternate pedestrian LED signals shall be approved by the Engineer. The displayed messages shall be "UPRAISED HAND" and "WALKING PERSON" symbols. The unit "counts down", or exhibits to the pedestrian a digital numerical display, as well as the Caltrans international graphic display, to communicate how much time remains to clear the intersection. The units shall have two optional operational modes; total countdown and clearance count down. The units shall be set to clearance count down unless otherwise directed by the project engineer. The units shall be capable of "learning" automatically the walk time interval and the pedestrian clearance intervals whenever pedestrian timing changes are made. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. Additionally, the LED display shall almost perfectly, approximate to the pedestrian, the appearance of an incandescent pedestrian signal, or the UPRAISED HAND and WALKING PERSON symbols shall be LED filled. Outline of the symbols shall not be acceptable. The count-down display shall utilize Double LED rows.

C. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. Pedestrian signal housings and mounting hardware shall be painted gloss

black, except in Downtown Core where it shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated.

2.15 PEDESTRIAN AND BIKE PUSH BUTTONS

A. Pedestrian and bike push buttons shall conform to the provisions in Section 86-5.02, "Pedestrian Push Button Assemblies," of the Caltrans Standard Specifications and this Section.

B. Pedestrian and bike push button frames shall be Type B with appropriate signs. Pedestrian push button frames and switch housing shall be painted gloss black, except in Downtown Core where it shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated.

C. Push buttons signs shall be installed using theft-proof screws **PDL, Pro-Tech't machine screws, or equal**. An installation tool shall be furnished to the CITY by the DEVELOPER/CONTRACTOR.

D. The switching unit shall be **Synchronex, part No. ADA-2; or equal**. The switching unit shall be a precision snap-acting type, single pole, single throw unit, pressure type terminals, and rated at 120-volt AC. The switching unit shall be UL listed. The switching unit shall be such a size as to permit recessed mounting in existing standard Type B frame without any modifications to either unit.

D. The actuator shall be conical in shape with cone extending 7/16-inch to 1/2-inch beyond the bezel of the switch housing, and shall be 2 inches in diameter.

E. Pedestrian push buttons installed on traffic signal poles located in the sidewalk shall be within 5 feet of the adjacent curb ramp. Pedestrian push buttons installed on traffic signal poles located behind the sidewalk shall be within 1 1/2 feet of the back of sidewalk. If a traffic signal pole cannot meet either of the above criteria, the associated pedestrian push button shall be installed on a separate pedestrian push button post.

F. The pedestrian and bike push buttons shall comply with the Americans with Disabilities Act (ADA). In the event that a conflict exists between the ADA guidelines and City Specifications, the ADA guidelines shall take precedent.

G. For **new signal installation** and where Accessible Pedestrian Signal (APS) is required, the 2" audible push buttons shall be integrated with the APS and vibrotactile features. The APS compliant pedestrian push button shall have a rated life of 100 million (minimum) activations and shall:

1. Consist of from 2-12 push button stations (maximum of 3 per phase) controlled by a single base unit at/in the traffic control cabinet.
2. System must be able to provide the following audible features:
   - A locating tone
   - 5 walk sound choices (field selectable)
   - 3 Ped-clearance sound choices (field selectable)
   - Direction of travel (as standard feature with extended push)
   - Information message (custom feature with extended push)
3. All audible sounds must emanate from push button station.
4. Each audible feature must have independently settable minimum and maximum volume limits.
5. All sounds must automatically adjust to ambient noise levels over a 60 dB range.
6. All sounds for all push button stations must be synchronized throughout the intersection to reduce noise clutter.
7. System must be able to provide audible countdown during ped clearance phase.
8. Push button stations must require only two wires coming from the traffic control cabinet for each phase / crosswalk.
9. Each push button station must have a 2" button with a tactile raised directional arrow on the button.
10. The arrow must be able to be changed to one of four directions.

11. The arrow/button must vibrate during the walk period, following a button push.
12. Push button station frame shall be made of cast aluminum with mounting holes to hold a 5”x7¾” or larger pedestrian sign.
13. All volumes and optional features are to be settable at the intersection from a single push button station (Global updating).
14. System must be able to mute sounds on all crosswalks except activated crosswalk (selectable feature).
15. System must be able to have multiple language capability, selectable by user.
16. System shall be able to play emergency preemption message.
17. System shall be able to self test and report any faults to traffic controller.

The APS compliant pedestrian push button shall be the **POLARA 2-wire Navigator** or approved equal.

2.16 INDUCTIVE LOOP DETECTORS

A. Detectors shall conform to the provisions in Section 86-5, "Detectors," of the Caltrans Standard Specifications and this Section. Detector handholes shall be Type A. Type E loop detectors 6 foot in diameter may be installed in lieu of Type A loops. All front loop detectors shall be Type D. When front loop detectors are used to supplement video detection, Type D loops shall be used.

B. Sensor units shall be **Detector Systems Digital Loop Model 910, or equal**.

C. Loop wire shall be Type 1 or Type 2. Loop detector lead-in cable shall be Type B or Type C. No more than four 6 foot by 6 foot loops shall be connected to each sensor unit. No splices are permitted in detector lead-in cables.

D. The CONTRACTOR shall identify loop wires by lane number, loop number, and start/finish using tie raps and permanent marker.

E. Where detector lead-in cables are connected to the terminal strips in the controller cabinet, the pressure terminal connectors shall be soldered to the detector lead in cables.

F. Hot-melt rubberized asphalt sealant shall be used to fill slots in pavement when installing loops.

G. When inductive loop detectors are used in conjunction with video detection cameras, the traffic signal controller cabinet shall be wired so that when fog or other weather conditions cause the video detection equipment to enter into “fog” or “recall” mode, video detection calls will be isolated and the intersection will run solely on inductive loops.

2.17 VIDEO DETECTORS

This section describes the requirements for providing a complete Video Detection System. The video detection system shall be the **Autoscope Rack Vision Terra** or **Iteris Vantage Edge 2 with RZ4A camera** or approved equal unless otherwise specified on the plans. The system shall be capable of providing presence vehicle detection at the intersection. The video system shall be capable of monitoring all vehicles on the roadway. It shall be a color video detection system and streams MPEG-4 or H.264 and Motion JPEG video over a common Ethernet connection to a laptop at the cabinet or at the Traffic Operation Center. If a video detection system exists at an intersection requiring modifications, and that video detection system is not designated for removal, the CONTRACTOR shall provide a compatible system at that intersection unless otherwise directed by the project plans and these specifications. Any new video detection device shall be capable of seamless integration with other existing video detection system in the cabinet and with existing Traffic

Operations Center software and hardware. Under no circumstance shall the CONTRACTOR install a video detection system that is not compatible with existing hardware and software.

Overview

Acceptable systems include that of any manufacturer, provided such equipment meets the qualifying specifications identified herein. Using standard image sensor optics, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The detection algorithms shall have a proven record of field use at other installations for at least three (3) years of service i.e., not including prototype field trials prior to installation.

General

These video detection specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all vehicles on the roadway. The entire video detection system shall consist of the following:

- Video Image Processing unit.
- Environmentally sealed Video camera(s) with IR filter, enclosure and sunshield.
- Surge suppressor.
- A switching device and cabling shall be installed to allow viewing of up to 4 cameras in the cabinet monitor without changing cables in the cabinet, and allow remote configuration from the Traffic Operations Center.
- All cabling and mounting hardware.
- Ethernet port to allow IP video and data transmission and remote configuration of all cameras from the Traffic Operations Center.
- All other necessary equipment for operation.

The system shall be fully compatible for installation in a NEMA type TS1 or TS2 traffic controller cabinet or in a Caltrans 332 traffic controller cabinet if applicable.

The controller cabinet shall be wired for a Video Detection System with appropriate number of cameras and cables as required in each specific project, mounted according to the manufacturer's specifications for each direction of vehicular travel. The supplied equipment must meet the following requirements:

1. The Video Detection System shall be an above ground vehicle detection system that utilizes machine vision when interfaced with standard monochrome or color CCD cameras to provide complete intersection and roadway detection.

2. The Video Detection System shall provide a minimum of four camera inputs for vehicle detection and an Ethernet interface card to transmit video and data to the Traffic Operations Center. All cables shall be provided and wired in the controller cabinet. All connectors and hardware must also be supplied for the required number of camera operation.

3. Each Video Detection System will include, as a minimum, color cameras for each approach requiring video detection. Camera resolution, image size, and lens angle will be determined by the manufacturer based on optimum system performance. Each camera shall include heater, sun shield and mounting brackets, and have at least twelve user programmable detection zones.

4. The Video Detection System shall provide quick and easy configuration and setup of detection zones at the intersection shall be done by using a standard computer mouse as pointing device, and a graphical interface built into the video processor and displayed on a video monitor, or using

a “Wizard” during initial configuration but can be modified using standard mouse with the video monitor.

5. All delay and extension functions for an approach must be performed within the processing element of the video unit.

6. The units must have the capability of detecting vehicles at a minimum distance of 300 feet from the stop bars of each approach.

7. The video detection system shall be wired and programmed such that during fog conditions, an alternate Max Green Timing can be used.

8. The Video Detection System shall have remote access capability ENABLED to transmit video and detector information to the Traffic Operation Center (TOC) unless the intersection is not connected to the TOC. The Video Detection System shall have the capability to remotely reconfigure detection zones, access, logging and statistics, and transmit video via twisted pair, coaxial cable, and fiber optic interconnect via an external communication port. The communications port shall be Ethernet (IP) enabled and accessible with proprietary software and/or a standard internet browser.

9. All software and hardware, for installation, operation, and maintenance shall be supplied along with necessary technical support upon setup. A minimum of 12-month technical/field support period, and updated software revisions shall be provided to the CITY's staff at no cost. Also, training by the manufacturer shall be provide at the convenience of CITY staff.

10. The Video Detection System shall utilize standard 24 volt logic signal outputs to interface with NEMA TS1/TS2, 170/179, 2070, or 2070N controllers.

11. All equipment schematics and technical material used to completely service the equipment must accompany any equipment supplied to the CITY.

12. A factory representative shall be present during (a) initial setup, to install cabinet equipment, provide initial setup of detection zones; and (b) during the initial traffic signal turn-on to provide assistance as needed, and to ensure proper operation.

13. Luminaire arm installations shall be installed on the luminaire arm, with the camera/video manufacturers recommended brackets. Camera luminaire brackets shall provide adjustments for both vertical and horizontal positioning of the camera. Camera attachments shall be designed to securely fasten the camera to the luminaire arm. If Signal mast arm installation is required on the plans, 6-foot risers shall be used with the installation. Miscellaneous hardware shall be stainless steel or galvanized steel.

14. The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

15. Cabling shall be rated for outdoor use and shall comply with manufacturer’s specification accommodating video, power, zoom, and focus control from the controller cabinet.

16. Each controller cabinet shall be equipped with a color monitor rated for traffic signal cabinet use, compatible with the video detection system for viewing the video and setting up the detection zones. A switching device and cabling shall be installed to allow viewing of up to 4 cameras on the monitor without changing cables in the field and from the Traffic Operation Center.

17. Each controller cabinet shall be equipped with terminals to allow focus and zooming from the cabinet. A device to provide focus and zooming shall be provided to the City.

18. The system shall be fully compatible for installation in NEMA TS1 or TS2 traffic controller cabinet or in a Caltrans 332 cabinet if applicable.

19. The system shall meet testing requirements in ambient operating temperatures from –35 to +55 degrees Centigrade at 0 to 95% relative humidity non-condensing.

20. Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications of the standard specifications.

21. Serial communications shall be through an RS232 serial port. This port can be used for communications to a modem or laptop to upload/download detector configurations, count data and software upgrades.

22. Ethernet communications shall be through an RJ-45 port. This port will transmit streaming video and data from the video detection units to the Traffic Operations Center.

23. The environmental housing shall be an aluminum enclosure designed for outdoor CCD camera installations.

24. See Section 2.16 “Inductive Loop Detectors” for information regarding video and loop detection operations during fog and other inclement weather conditions.

Installation and Training

1. The supplier of the video detection system shall supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer shall be on-site during installation or relocation of existing system. The factory representative shall install, make fully operational, and test the system as indicated on the intersection drawings and this specification.

2. The video detection system shall be installed and programmed such that during fog conditions, an alternate Max Green Timing can be used. The Engineer will provide the alternate timing.

3. Necessary training shall be provided by the manufacturer as required by the contracting agency for its personnel to be proficient in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for up to 5 persons and shall be conducted at a location selected by the City. The City is responsible for travel, room and board expenses for its own personnel.

Warranty

The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

2.18 LIGHTING

A. Traffic signal lighting shall conform to the provisions in Section 86-6, "Lighting," of the Caltrans Standard Specifications and this Section.
B. Luminaires shall be LEOTEK Green Cobra, or approved equal.
C. Decorative luminaires shall be Lumec S56C1-90W49LED4K-ACDR-LE3-240-SFX-PH8-FN10-SC1TX/RAL6022 in the Downtown Core, and Lumec S55-65W49LED4K-ES-ACDR-LE3-120-SFX-HGS-PH8-BKTX elsewhere.

Description of Components for Lumec Luminaires:

Finial: Decorative cast 356 aluminum, mechanically assembled.

Hood: (ACDR), One-piece, seamless, pressure-molded impact-resistant (DR) acrylic globe having internal prisms with smooth external self-cleaning surface, permanently assembled to the globe.

Guard: In a round shape, this guard is made of four cast aluminum 356 decorative arms and one decorative ring. The guard is welded to the fitter.

Globe: (ACDR), One-piece, seamless, injected-molded impact-resistant (DR) acrylic globe having an inner prismatic surface with semi-prismatic house side shield and glare softening prisms on the street side. The smooth external finish offers self-cleaning properties. The globe is permanently sealed onto the access-mechanism.

Lamp: *(Included)*, Composed of 49 improved performance white LEDs, 40w or 90w lamp wattage. Color temperature of 4000 Kelvin nominal, 70 CRI. Operating lifespan, 70 000 hours after which the system emits 70% of its original lumen output, all of those parameters are tested for 100% of light engines. Use of a metal core board ensures greater heat transfer and longer lifespan of the light engine.

Optical System: (LE2, LE3), I.E.S type II or III (asymmetrical). Composed of high performance collimators, optimized with varying acrylic beam angles to achieve desired distribution. System is rated IP66. Performance shall be tested per LM63 and LM79 (IESNA) certifying its photometric performance. Street-side indicated.

Heat Sink: Made of cast aluminum optimising the LEDs efficiency and life. Product does not use any cooling device with moving parts (passive cooling device)

Driver: High power factor of 90%. Electronic driver, operating range 50-60 Hz. **Auto-adjusting to a voltage between 120 and 277 volt AC, Class II**, THD of 20% max. Maximum ambient operating temperature from -40F(-40C) to 130F(55C) degrees. Certified in compliance to CUL requirement. Weather tightness rating IP66. Assembled on a unitized removable tray with Tyco quick disconnect plug resisting to 221F(105C) degrees.

The current supplying the LEDs will be reduced by the driver if the internal temperature exceeds 203F(95C), as a protection to the LEDs and the electrical components. Output is protected from short circuits, voltage overload and current overload. Automatic recovery after correction.

Surge Protector: LED Driver 3 poles surge Protectors that protect Line-Ground, Line-Neutral, and Neutral-Ground in accordance with IEEE / ANSI C62.41.2 guidelines.

Access-Mechanism: A cast A360.1 aluminum technical ring with latch and hinge. The mechanism shall offer toolfree access to the inside of the luminaire. **The Photoelectric Cell can be independently oriented from the optical system**. An embedded memory-retentive gasket shall ensure weatherproofness.

Fitter: Cast aluminum A360.1 c/w 4 set screws 3/8-16 UNC. Fits on a 4"(102mm) outside diameter by 4"(102mm) long tenon.

Luminaire Options: (PH8), Photoelectric Cell, Twistlock Type c/w receptacle.

Wiring: Gauge (#14) TEW/AWM 1015 or 1230 wires, 6" (152mm) minimum exceeding from luminaire.

Hardware: All exposed screws shall be stainless steel with Ceramic primer-seal basecoat to reduce seizing of the parts. All seals and sealing devices are made and/or lined with EPDM and/or silicone.

Finish: Color to be **dark green (SC1TX/RAL6022)**. Application of a polyester powder coat paint. (4 mils/100 microns). The chemical composition provides a highly durable UV and salt spray resistant finish in accordance to the ASTM-B117-73 standard and humidity proof in accordance to the ASTM-D2247-68 standard.

Voltage: 240

Cast components: All cast aluminum components **contains 0.2% copper or less.**

Lamp Technical Information									
Lamps #	Rated life hrs. [1]	LED Manufacturer	CRI	Color Temperature [2]	Initial Lumens	Wattage		Max System AC current: 120v	LED mA
						Lamp	System [3]		
40W30LED4K	70,000	Philips Lumileds Rebel or Cree XP	70	4000K	3000	40W	45W	0.48A	400mA
40W49LED4K	70,000		70	4000K	3800	42W	47W	0.48A	285mA
60W30LED4K	70,000		70	4000K	4000	60W	68W	0.72A	600mA
65W49LED4K	70,000		70	4000K	5200	65W	72W	0.72A	428mA
90W49LED4K	70,000		70	4000K	6300	90W	102W	0.95A	571mA
105W79LED4K	70,000	Philips Lumileds Rebel or Cree XP	70	4000K	8200	105W	119W	1.2A	428mA
130W98LED4K	70,000		70	4000K	10400	130W	147W	1.4A	428mA
150W79LED4K	70,000		70	4000K	10300	150W	170W	1.7A	600mA
180W98LED4K	70,000		70	4000K	12600	180W	204W	1.9A	571mA

[1] Rated life represents the time it takes for the LED system to reach 70% of initial lumen output.

[2] On average.

[3] System wattage includes the lamp and the LED driver.

- How to calculate the lamp lumen per watt ratio: In the above table and according to your choice of lamp, please note the initial lamp lumen value and divide this value by the lamp wattage. (Example: 40W30LED4K : 3000/40=75)

- How to calculate the system lumen per watt ratio (LER): First, visit our website at www.lumec.com and download the IES file (photometric file) of your selected Philips Lumec product . Then, use a photometric software to get the absolute system lumens value and divide by the system wattage. (Example: 40W30LED4K : Absolute system lumens / 45W = LER)

D. The luminaires on standard street lights shall have photoelectric control facing north, unless otherwise noted on the project plans.

E. Pole numbers for decorative lights shall be attached to a 2.5" x 15" x 0.020 aluminum plate and mounted on the pole by use of 1/16" rivets.

F. Fuse holders for streetlights shall be located in the pole handhole at the bottom of the pole with 5 feet of conductor coiled in the handhole.

2.19 PHOTOELECTRIC CONTROL

A. Photoelectric control shall be Type V for traffic signals and Type IV for standard street lights. Photoelectric units shall be installed inside the service cabinet.

2.20 INTERCONNECT

A. The controller cabinet shall include appropriately sized terminal facilities for connection of the interconnect cable to the local controller. All required equipment and facilities for reliable communication with the master controller shall be provided. It shall be the CONTRACTOR's responsibility to establish communication between the local controllers and the central master controller unless otherwise indicated in this specification or on the plans.

B. Each controller cabinet shall contain a sufficient number of terminals of appropriate size and type to terminate and/or splice the interconnect cable.

C. Interconnect cable shall be 6 pair minimum for underground use, No. 20 twisted pairs each pair with shielding and solid core copper wire, unless otherwise shown on the plans.

D. See fiber optics specifications under Section 2.6 - Conductors and Wiring.

E. The CONTRACTOR shall be responsible for maintaining existing interconnect during construction. Any interruption of interconnectivity during the construction process due to CONTRACTOR activity shall be resolved by the CONTRACTOR within **72 hours** at the CONTRACTOR's expense. Failure to resolve may result to liquidated damages.

F. Temporary twisted-pair (copper) interconnect splicing shall be allowed during construction for a maximum period of 60 days. Temporary splices of interconnect shall be insulated with heat-shrink tubing of the appropriate size and shall overlap the conductor insulation at least 0.6 inches. The overall cable splice shall be covered with heat-shrink tubing, with at least 1 1/2 inch of overlap of the cable jacket. Any alternate temporary splice method shall be approved by the Project Engineer.

2.21 ETHERNET SWITCHES AND COMMUNICATIONS

The Ethernet switch to be used for a specific project depends on the signal interconnect cable media (i.e., fiber optic or copper twisted pair) used in the project. See plans to determine if fiber optic or copper twisted pair is identified.

FIBER OPTIC CABLE

Where fiber optic installation is part of the project, the Ethernet Switch shall meet the following specifications:

- Provides a minimum of four 10/100 switched RJ-45 ports and three 100 Mb fiber ports
- Designed for un-heated / un-cooled "outdoor" applications. Conduction cooled, sealed case with no fans and no air vent openings
- Ambient operating temperature: -40° to 170° F (-40° to 75° C). Plenum rated
- Link-Loss-Learn feature for redundant LANs with industry standards
- Two 100 Mb fiber ports built in. Connectors shall be 20km single mode SC (female).
- Over 10 years MTBF
- AC-powered
- Meets IEC 61850 and IEEE 1613 Environmental Standard for Electric Power Substations
- DIN-Rail mounting
- A power supply unit shall be included with the Ethernet Switch

The CONTRACTOR shall provide the City with all applicable product documentation for configuration. If a switch is installed at existing drop of an intersection already utilizing a particular Ethernet Switch, the CONTRACTOR shall be responsible for providing the same make and model switch. The Ethernet Managed Switch for fiber optic use shall be the **RuggedCom RS 900-HI-P-C2-C2-C2-XX** or approved equal.

COPPER CABLE

Where copper signal interconnect installation is part of the project, the CONTRACTOR shall provide an Ethernet over Copper Bridge in the controller cabinet supporting Ethernet data and video communications between the Traffic Operation Center (TOC) communications servers and field devices located at the intersection, including (but not limited to) the traffic signal controller, Battery Backup System, Video Detection System, and Closed-Circuit Television Camera (CCTV). When multiple devices are present, the controller shall provide a field hardened switch to allow connectivity to the Bridge. The CONTRACTOR shall provide all necessary wiring and cabling to establish communications with these devices. All proposed communications cable shall be outdoor rated to operate between -40 degrees Fahrenheit and 158 degrees Fahrenheit. Communications cable shall be **CommScope Ultra II Enhanced Category 5e Outdoor Cable** or approved equal.

The Bridge shall meet the following specifications:

- Support a minimum of 9.2 Mbps on two twisted pair
- 10/100 BaseT LAN enabled
- Remote Management Capabilities, including remote unit diagnostics, VLAN tagging, bandwidth resource allocation, and alarm/email paging.
- Communicate up to 27,000 feet
- Two (2) RJ45 LAN Switch Ports
- One RS232 Serial Port (DB9 Female) or Console Port for unit diagnostics
- Tested to NEMA TS2-2003 Specifications
- 802.1d and 802.1q compliant
- IEEE 802.3 10BaseT
- 15,000 fps forwarding rate
- 10,000 MAC Address Table
- 1-year manufacturers warranty
- AC Powered
- LED Status indication lights

If the CONTRACTOR proposes a managed bridge, the CONTRACTOR shall provide the City with all applicable product documentation for configuration. If a bridge is installed at existing drop of an intersection already utilizing a particular Ethernet over Copper bridge, the CONTRACTOR shall be responsible for providing the same make and model bridge. The Ethernet over Copper bridge shall be the **Actelis MetaLight ML688** or approved equal.

2.22 CLOSED CIRCUIT TELEVISION (CCTV) CAMERA

The CONTRACTOR if required shall install a power over Ethernet (PoE) CCTV Network Dome Camera including all associated equipment such as mounting hardware and weatherproof housing per the project plans. The CONTRACTOR shall install necessary conductors, and communication wiring between the CCTV camera mounted on the signal pole or street light pole shaft and the traffic signal controller cabinet. The City will provide IP address for the CCTV camera. The CONTRACTOR shall work with the Engineer to determine exact mounting location of the CCTV camera on the pole. It shall be the CONTRACTOR's responsibility to make certain that the appropriate mounting screws/hardware are used such that the camera's viewing angle is unobstructed to the satisfaction of the Engineer.

The CONTRACTOR shall provide all necessary cables, and shall be responsible establishing communications from the CCTV to the Traffic Operations Center at City Hall. Included with the CCTV camera shall be any license required with the camera, and any software required at no charge to the City and shall directly interface with the City's traffic signal network of CCTV cameras. The CCTV camera shall deliver superior quality H.264 and Motion JPEG video in all lighting conditions and shall meet the following requirements:

Shutter	1 to 1/10,000 seconds
Min. Illum.	0.7 Lux (Color); 0.01 Lux (B/W)
Exposure	Auto
White Balance	Auto
Iris	Auto
Focus	Auto and manual
View Angle	1.7° - 57.8°
Focal Length	3.4 – 122.4 mm
F-number	1.4
Zoom ratio	36x Optical; 4x Digital; 144x Total
Pan Angle	360°
Pan Speed	360° per second
Tilt Angle	-90° to 0° (113° view range)
Tilt Speed	360° per second
Ethernet	10/100 Mbps Ethernet, (RJ-45)
I/O Terminals	4 Input/Output
Resolution	704 x 480 max
Compression	M-JPEG, H.264
Frame Rate	30 FPS
Protocols	TCP/IP, HTTP, FTP, SMTP
Weight	16 lbs. or less
Voltage Req.	Ultra High Power PoE
Power Cons.	50 W
Oper. Temp	-29° to 50° C
Dimensions	14" H x 11" W x 16" D
Rating	IP-66

The power over Ethernet CCTV shall be the **IVC PTZ-3330-NC66** outdoor dome camera or approved equal. All mounting hardware and outdoor housing for the CCTV camera shall be as per the CCTV manufacturer specification.

2.23 WIRELESS ETHERNET DEVICE

CONTRACTOR shall furnish and install power over Ethernet wireless Ethernet Mesh Networks that have dynamic, scalable, and cost effective solution equipment enabled with "network redundancy / expansion" that will ensure a robust network for future expansion, able to send/receive concurrent video, voice, and data linking various Intelligent Transportation Systems (ITS) infrastructure with the City's traffic signal network and ultimately with the Traffic Operations Center (TOC).

The objective is to establish solid Ethernet communication link from the traffic signals back to the TOC at City Hall using wireless technology, potentially in combination with the City's fiber optic network. It shall be the CONTRACTOR's responsibility to establish solid communication between installed Ethernet field devices as part of the project and the TOC. A manufacturer's representative shall be responsible in installing and programming the wireless system, and shall be present during signal turn-on to make sure the wireless system is fully operational.

The City will provide required IP addresses to establish VLAN and communicate with the City's TOC. Included with the wireless system shall be any license required with system, and any software required at no charge to the City and shall directly interface with the City's traffic signal network. The wireless Ethernet Mesh network shall be **Ruckus ZoneFlex™ 7731, Intuicom Nitro58** or approved equal.

At a minimum, the wireless provider or CONTRACTOR, shall complete the following tasks:

- Must perform Spectrum Analysis using a spectrum analyzer.
- Perform own site survey.
- Provide Path Calculations & link budget calculations.
- Must provide own bucket truck.
- Must identity a preferred installation location within the established area. Wireless antenna locations shown on the plans are schematic.
- Identify potential cost savings by utilizing existing infrastructure (i.e. adjacent fiber optic cable, adjacent wireless bridges, etc).
- Properly ground all radios and antennas.
- Install lightning suppression systems according to manufacturer specifications.
- Install proper weather proofing on complete system.
- All radios must be back-to-back tested according to manufacture specifications.
- Perform a minimum of four (4) hours of end user training for interested City Staff.
- Must have all proper Bonds and Insurance.
- Responsible for all necessary City Permits and Licenses.
- Provide two year support and Maintenance (phone support within 2 hours of call from City and provide on site support within 4 hours).

At a minimum, the equipment shall meet the following specifications:

- Shall operate using a single Power-over-Ethernet (POE) Cat-5e cable.
- Links must provide 99.999% reliability.
- Shall have external LED indicators to simplify antenna alignment
- Cables must be VSWR tested.
- Support 100 to 300 Mbps throughput
- Range of up to 10 miles.
- Support asymmetric user defined data transmission rates.
- Shall be able to operate in the 4.9 GHz (US Public Safety band)
- Security and Encryption
  • 128 bit, 256 bit AES keys
  (WPA2, end-to-end data)
  • MAC access control list
  • Radius Authentication
  • Digital certificates on nodes
- Traffic Prioritization
  • Quality of Service (QoS 802.1p)
- Wireless Interface
  • IEEE 802.11a/n
- Ability to configure 5, 10, 20 and 40 MHz
- Channel bandwidth
  • Dynamic Frequency Selection (DFS)
  • Transmit Power Control (TPC)
- Environmental Specifications
  • Operating temperature: -40°C to +60°C
  • Storage temperature: -40°C to +85°C
  • Humidity (non-condensing): 10% to 90%
  • Storage humidity (non-condensing): 5% to 95%
- Lightning Suppression: PolyPhaser and Transtector (or as recommended by wireless system manufacturer).
- CAT-5e Outdoor rated “Shielded” cable for radios.
- Network Ports
  • GigE 10/100/1000 Mbps Ethernet ports with weatherproof connectors, LED activity indicator
  • IEEE 802.3, 802.3u compliant

  - CSMA/CD 10/100 autosense
  - Ports 2, 3 PSE Power over Ethernet per 802.3af
- Enclosure
  - Cast aluminum NEMA-4X/IP66 enclosure
  - One weatherproof power connector
  - Weatherproof Ethernet connectors
  - System LEDs (power, status, mesh)
- Power
  - AC Input: 100–240 VAC, 50–60 Hz, 0.9 A
  - DC Input: 12 VDC +/-15%, 5 A
  - Ports 2 and 3: IEEE 802.3af compliant PoE (PSE), consumption
- Warranty
  - Hardware: one year limited warranty
  - Software: 90 days limited warranty
- The system shall be fully compatible for installation in NEMA TS1 or TS2 traffic controller cabinet, or in a Caltrans 332 cabinet if applicable.
- The System shall provide quick and easy configuration and setup using a standard computer or laptop and a graphical user interface.

2.24 INTELLIGENT TRANSPORTATION SYSTEMS (ITS) INTEGRATION

This section is meant to provide direction for future ITS device installation, which includes (but is not limited to) Closed Circuit Television Cameras, Wireless Ethernet devices, Changeable Message Signs, Interagency Communications devices, future IP enabled traffic signal control equipment, streaming video encoders/decoders, etc. When providing products that are not details in Sections 2.1- 2.23, the following general conditions shall apply:

- If a proposed ITS device already exists at other locations in the City, the contractor shall provide an identical device “or equal” unless otherwise directed by the project plans and these specifications. Any “or equal” device shall be able to seamless integrate with other existing ITS devices and with existing Traffic Operations Center software and hardware. Under no circumstance shall the contractor install a device that is not compatible with existing hardware and software.
- All equipment shall be installed by a technician certified by the manufacturer. The contractor shall provide necessary training on any devices installed as part of the project.
- If applicable, all ITS equipment IP Addresses shall be provided to the contractor by the City.
- When possible, all devices using IP technology shall utilize Power over Ethernet technology.
- All field devices shall be environmentally hardened to meet minimum cabinet temperatures ranging from 32-140 degrees Fahrenheit.
- All ITS devices shall be approved by the Project Engineer prior to installation.

2.25 RECTANGULAR RAPID FLASHING BEACON

DEVELOPER/CONTRACTOR shall furnish and install Rectangular Rapid Flashing Beacon (RRFB), which shall consist of two rapidly and alternately flashed rectangular yellow indications having LED-array based pulsing light sources, and shall be designed, located, and operated in accordance with the detailed requirements specified below. The RRFB shall be the **Carmanah SC315 Gen III, TAPCO RRFB-XL,** or approved equal. The system shall be solar powered unless otherwise noted on the plans.

1. Sign/Beacon Assembly Locations:
   a. For any approach on which RRFBs are used, two W11-2 or S1-1 crossing warning signs (each with RRFB and W16-7p plaque) shall be installed at the crosswalk, one on the right-hand side of the roadway and one on the left-hand side of the roadway. On a divided highway, the left-hand side assembly should be installed on the median, if practical, rather than on the far left side of the highway. The signs shall have diamond grade reflectivity.

b. An RRFB shall not be installed independent of the crossing signs for the approach the RRFB faces. The RRFB shall be installed on the same support as the associated W11-2 (Pedestrian) or S1-1 (School) crossing warning sign and plaque.

2. Beacon Dimensions and Placement in Sign Assembly:
   a. Each RRFB shall consist of two rectangular-shaped yellow indications, each with an LED-array based light source. Each RRFB indication shall be a minimum of approximately 5 inches wide by approximately 2 inches high. Installation on each pole shall be bi-directional. Each direction can be adjusted to desired angle for maximum visibility to approaching traffic.
   b. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of approximately seven inches (7 in), measured from inside edge of one indication to inside edge of the other indication.
   c. The outside edges of the RRFB indications, including any housings, shall not project beyond the outside edges of the W11-2 or S1-1 sign.
   d. As a specific exception to 2003 MUTCD Section 4K.01 guidance, the RRFB shall be located between the bottom of the crossing warning sign and the top of the supplemental downward diagonal arrow plaque (or, in the case of a supplemental advance sign, the AHEAD plaque), rather than 12 inches above or below the sign assembly.

3. Beacon Flashing Requirements:
   a. When activated, the two yellow indications in each RRFB shall flash in a rapidly alternating "wig-wag" flashing sequence (left light on, then right light on). A small light directed at and visible day or night to pedestrians in the crosswalk shall be installed integral to the RRFB to give confirmation that the RRFB is in operation.
   b. As a specific exception to 2003 MUTCD Section 4K.01 requirements for the flash rate of beacons, RRFBs shall use a much faster flash rate. Each of the two yellow indications of an RRFB shall have 70 to 80 periods of flashing per minute and shall have alternating but approximately equal periods of rapid pulsing light emissions and dark operation. During each of its 70 to 80 flashing periods per minute, one of the yellow indications shall emit two rapid pulses of light and the other yellow indication shall emit three rapid pulses of light.
   c. The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second, to avoid frequencies that might cause seizures. It shall be MUTCD IA-11 compliant flash pattern.
   d. The light intensity of the yellow indications shall meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005.

4. Beacon Operation:
   a. The RRFB shall be normally dark, shall initiate operation only upon pedestrian actuation, and shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk.
   b. All RRFBs associated with a given crosswalk (including those with an advance crossing sign, if used) shall, when activated, simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously.
   c. Pedestrian push buttons (PPB) used to actuate the RRFBs, shall have a pedestrian instruction sign with the legend PUSH BUTTON TO TURN ON WARNING LIGHTS should be mounted adjacent to or integral with each (PPB). The PPB shall be audible with voice message **"cross street with caution, vehicles may not stop"**, and visual LED confirmation of device activation.
   d. The duration of a predetermined period of operation of the RRFBs following each actuation should be based on the MUTCD procedures for timing of pedestrian clearance times for pedestrian signals.
   e. A small light directed at and visible to pedestrians in the crosswalk shall be installed integral to the RRFB or push button to give confirmation that the RRFB is in operation.

Except as otherwise provided above, all other provisions of the MUTCD applicable to Warning Beacons shall apply to RRFBs.

5. User-Interface and RRFB System

The RRFB user interface and display for quick configuration and status monitoring shall allow for simple in-the-field set-up and adjustments without the need for additional device such as a laptop. Programming and adjustments shall be such that when programming any unit, the settings are broadcasted wirelessly and automatically to all units in the system. A minimum of four (4) selectable frequencies/channels shall be available such that other adjacent RRFB systems will not be interfering with each other. System operating temperature shall be -30°F to +140°F (-35°C to +60°C). It shall have ambient auto-adjust night dimming configuration.

6. Solar, Enclosure, and Battery Requirements

The enclosure shall be of minimal dimension discrete design housing the processor, all required electronics, and batteries mountable to a pole. The solar panels and power management required to power the system shall have rated usage of at least 300 cycles per day, 20 second activation with charged capacity minimum 25 days at rated usage (without charging). Batteries shall be standard sealed maintenance free and field replaceable. RRFB system requiring special proprietary batteries are not acceptable.

7. Mounting

Mounting of the RRFB system, including the required warning signs, and PPB with voice message & visual LED confirmation shall be per manufacturer's specification. Type 1B pole unless otherwise noted on the plans shall be used for new pole installation or per manufacturer's specification. If RRFB installation is on an existing streetlight pole, side mount pole solar mounting shall be used per manufacturer's specification. The bottom of the sign and RRFB assembly shall have a 7-foot minimum clearance from the sidewalk.

8. Warranty and Support

A manufacturer's representative shall be present during activation of RRFB system to make sure it is installed and programmed properly. RRFB Manufacturer shall provide 24 hour technical support via toll-free telephone service. Field technical support shall be at least 1 year. It is the Contractor's responsibility to arrange training for at least 2 City personnel. A minimum 3 year system warranty including batteries (non-prorated) is required. Manufacturer shall provide a minimum two (2) year factory-repair warranty for parts and labor.

2.26 VEHICLE SPEED FEEDBACK SIGN (Radar Speed Sign)

DEVELOPER/CONTRACTOR when required shall furnish and install solar powered Vehicle Speed Feedback sign (Radar Sign) system, which shall consist of diamond grade reflective signs, "YOUR SPEED" sign with LED display cluster display, R2-1 Speed Limit sign or SR4-1 (CA) sign, solar panel, controller module and enclosure, batteries, and mounting hardware. Signs shall conform to the latest CaMUTCD, Section 56, "Signs" of the Caltrans Standard Specifications and the Caltrans "Approved Sign Specification Sheets". A manufacturer's representative when requested shall be present in the field during initial activation and programming to make sure the system is fully operational. The Vehicle Speed Feedback sign shall be the **15" SpeedCheck by Information Display Company** or approved equal. The vehicle speed feedback sign shall meet or exceed the following requirements:

Vehicle Speed Feedback Sign (example)

General

1. Feedback sign meets FHWA, CAMUTCD requirements.
2. Feedback sign shall be 90 MPH (144 km/h) wind load rated.
3. The sign housing shall be a non-sealed, ventilated NEMA 3R type design.

4. Sign shall be FCC approved with no operating license requirements.
5. The sign shall operate normally in an environment of -40° F to 167° F, and humidity exceeding 90%.
6. The sign and its components include the battery cabinet and solar panel shall be water resistant to NEMA 3R. Internal components shall be easily accessible with removal of four or fewer external vandal-resistant fasteners.
7. Display shall be comprised of modular components that can be exchanged easily in the field without removal of the sign from the mounting post.
8. Static sign shall be retro-reflective white, dimension shall be 30" x 42"
9. The radar shall have a reporting accuracy of ±1MPH and shall be set to detect **approaching vehicles only**.
10. Display brightness control - Each sign shall include an Automatic Dim control setting that allows each sign to automatically adjust to light conditions. LED display shall have a minimum of 1.4 Candela.
11. Sign must not have direct sunlight issues and must be bright in all weather conditions.
12. SLOW DOWN Message: Warning message shall be embedded within the main display window as the speed display. The SLOW DOWN message shall be activated by the sign using the High Speed Flashing program or other program settings; separate SLOW DOWN display window and/or external sign shall not be accepted.
13. Speed Range and Display: Each sign shall be capable of detecting vehicle speeds ranging from 5 miles per hour to 99 miles per hour (equivalent or better).
14. Sign material and enclosure shall be .09” (2.29mm) aluminum. Outer surfaces of enclosure shall be coated with white UV resistant coating to minimize solar heat absorption.
15. Sign mounting hardware shall be of brass and/or stainless steel.
16. For field support, programmability, data downloads and diagnostics must be accessible via Bluetooth™ wireless link to a Windows-compatible notebook computer.

17. The gel cell battery shall include a 55AH or greater, 12 VDC, deep cycle; solar rated, sealed valve regulated, gelled electrolyte lead acid battery, and rated as non-spillable. Gel cells battery shall be located inside the NEMA 3R (or better) enclosure.
18. A single solar panel with appropriate wattage for the application shall be supplied, as industry-standard 12 V dc design with tempered glass cover. The power output shall be designed for at least 15 years of usable output and shall be free from defects in materials and workmanship for three years

Software and Programming

1. Software shall allow scheduling and schedule component operation to be created even while disconnected from the display sign.
2. Sign shall be programmable and data retrievable in the field using a PC Notebook with a wireless Bluetooth™ connection, up to 50 feet in front of the sign. The programming interface must be easy to use, with minimal training required. Bluetooth™ connectivity shall be included.
3. The violation alert display shall optionally flash the driver's speed once the radar detects the pre-set speed threshold and increase flashing rate proportional to higher speed. The display shall blank out or display slow down message once the radar detects the pre-set high speed threshold. Pre-sets can be set for different time periods of the day and calendar.

4. On/Off Timer Options - Each sign shall allow for a minimum of 8 unique On/Off settings per day to turn the sign display On/Off independently of data collection capabilities.
5. Calendar Programming: Programming shall have the (demonstrated) capability for creating unlimited weekly schedules and timetables with 2-years schedule exceptions defined by date and time.
6. Stealth Mode: The software shall have the ability (demonstrated) to program the sign display to be off while the radar and data collection capabilities continue to detect vehicles, collect data, and provide traffic data remotely and/or via Bluetooth communication download.
7. Each sign shall include programmable settings for a minimum speed violation alert (flashing the speed at the driver) and a maximum speed violation (Blanking the display screen).
8. All control software and/or firmware updates will be available to the end user at no charge.

Electronic Performance

1. Display control electronics shall maintain programmed settings and schedules indefinitely and shall incorporate a separate real-time clock backup power supply to maintain on-board clock settings through a power outage for up to two weeks and recharge itself when power is restored.
2. Power to the LEDs shall use DC display drive to provide continuous, non-pulsating current to LEDs when speeds are displayed, to maximize LED life.
3. Display shall operate on 12VDC nominal (10V – 18V) and display control electronics must automatically turn the display off when the voltage is below a lower threshold to prevent over-discharge damage to the solar power system.

4. Charging control system shall be a solar industry standard item with temperature compensated charging voltage and battery temperature monitoring for long battery life of 5 to 10 years.
5. The individual LEDs shall be wired such that a short failure of one LED will not result in the loss of more than 5 percent of that segment. – ensuring the digits will remain visible.
6. RADAR device shall meet specifications for an FCC part 15 Low Power Device - 24.150 GHz (K-band) and shall not require an operating license. It shall have a reporting accuracy of ±1MPH.

Vandalism Protection

1. Display cabinet shall be constructed to absorb impacts from thrown objects or vandalism attempts, by allowing the display boards to deflect inwards up to 2" (50mm) without damaging internal components.
2. Display window shall be made of ¼" (6.35mm) minimum thickness shatter-resistant polycarbonate. The LEDs shall be protected so that LEDS are not impacted by the polycarbonate window upon deflection.

Traffic Data Collection and Reporting

1. System data retrieval from the field shall be via a PC Notebook with a wireless Bluetooth™ connection, up to 50 feet in front of the sign. Bluetooth™ connectivity shall be included.
2. It shall capture and store separate data points for each target, which shall include final speed and the date and time for each detected target. The data shall not be averaged, consolidated or binned as the individual data points are then lost. It shall have the capacity for storing over 200,000 individual target data points. It shall be capable of capturing vehicle speed data with the display off to support "before and after" studies.
3. Reporting software shall be easy to use and charts easy to modify. Automatic reports will be provided with graphical analysis of the following data using a personal computer running Microsoft Excel™. Reporting and graphing must run locally on a desktop PC without requiring the internet. The reports shall contain reference posted speed limit, average vehicle speeds, 85th percentile vehicle speeds, total number of vehicles and percent of conforming vehicles.
4. Must have the ability to select a range of dates and times that is less than the total time period for which data is collected. A software utility shall be provided to further window the raw data to include/exclude certain hours of the day (school hours), weekdays or weekends only to remove statistical outliers, and to create a new .csv file for this data that can be used with the reporting software.

Warranty

The manufacturer's warranty for the display and accessories shall be at least three years from the time of purchase. The manufacturer's warranty on the LEDs comprising the display segments shall be at least 10 years from the time of purchase. Outbound shipping costs for warranty replacement parts shall be paid by the manufacturer. Manufacturer will supply technical telephone support at no extra charge during the warranty period. All control software and/or firmware updates will be available to the end user at no charge.

PART 3 -- EXECUTION

3.1 GENERAL

A. Traffic signal and street light installation shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and as specified herein.

3.2 FOUNDATIONS

A. Controller cabinet foundation shall extend 18 inches above grade.

B. Foundations for decorative street lights shall be as shown on the approved Drawings based on the soil engineer's recommendations or in accordance with the Caltrans Standard Plans for a Type 15 lighting standard foundation.

C. Mortar is required between the foundation and the base plate of all traffic signal and lighting standards. Mortar shall consist of one part by volume of Portland Cement and three parts of sand per Caltrans' requirements.

3.3 CONDUIT

A. Conduit runs shown on the Drawings which are to be located behind the curbs may be installed in the street, within 2 feet of and parallel to the gutter line of the curb by the trenching method specified in Section D below.

B. After conductors have been installed, the ends of conduits terminating in pull boxes and controller cabinets shall be sealed with an approved type of sealing compound.

C. All conduit bends greater than 44 degrees shall be factory bends, and shall have a minimum radius of 18 inches. Where factory bends are not used conduit shall be bent without crimping or flattening using the longest radius possible. Bending of non-metallic conduit shall be by methods recommended by the conduit manufacturer and with equipment approved for that purpose. Conduits designated for signal interconnect shall be installed satisfying the requirements of both twisted pair and fiber optic cables use (e.g., sweeps/bends for fiber optic shall be used).

D. At locations where conduit is to be installed by jacking or drilling as provided in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications, and if delay to any vehicle will not exceed 2 minutes, conduit may be installed in accordance with the City Standard Details.

E. To reduce the potential for damaging conduits when pulling conductors, only **Muletape** or approved equal shall be used when pulling conductors through. The muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and pre-lubricated for easy pulling and reduced friction.

3.4 PULL BOXES

A. Pull boxes in areas subject to traffic loads shall be installed on a concrete footing to withstand the traffic load. Tops of pull boxes shall be flush with the surrounding grade.

B. The bottom of pull boxes shall be bedded in Class 2 Permeable Material in conformance with Section 312300 "Utility Earthwork" as shown on the Drawings.

C. Grout in the bottom of pull boxes will not be required.

D. Where the sump of an existing pull box is disturbed by the DEVELOPER/CONTRACTOR'S operations, the sump shall be reconstructed and if the sump was grouted, the old grout shall be removed and new grout shall be placed.

E. Recesses for suspension of ballasts will not be required.

F. Where pull boxes are to be placed in areas subject to traffic loads, a steel or cast iron cover shall be used in lieu of the concrete cover.

B. Maximum pull box spacing shall be 100' for traffic signals, 200' for street lights and hardwire signal interconnect, and 800' for fiber optic communications.

C. Pull boxes shall also be installed at locations where conduits branch, adjacent to the foundation for each signal standard, lighting standard, illuminated sign, controller cabinet, or service cabinet, and at the toe of slope or at the hinge point when placed on a slope.

D. Pull boxes are to be located behind the five (5') foot sidewalks and not within the sidewalk. Where sidewalks are wider than five feet, the pull box shall be located outside of the pedestrian's general walking area such that it will not interfere with pedestrian activity. In under no condition shall pull boxes be located within pedestrian pathways unless otherwise approved by the engineer.

3.5 PEDESTRIAN PUSH BUTTONS

A. Pedestrian push buttons installed on traffic signal poles located in the sidewalk shall be within 5 feet of the adjacent handicap curb ramp. Pedestrian push buttons installed on traffic signal poles located behind the sidewalk shall be within 1 1/2 feet of the back of sidewalk. If a traffic signal pole cannot meet either of the above criteria, the associated pedestrian push button shall be installed on a separate pedestrian push button post.

3.6 CONDUCTORS AND WIRING

A. Identification bands shall be placed near the ends of termination points of all conductors. All wires shall be clearly marked inside the controller cabinet designating the appropriate signal phases.

B. When signal heads for more than one phase are mounted on the same pole, the DEVELOPER/CONTRACTOR shall identify phases by tagging wires in the nearest pull box using nylon tie raps and permanent marker.

C. A 5 amp in-line fuse shall be installed on the hot leg of service in the pull box adjacent to each street light.

3.7 BONDING AND GROUNDING

A. Grounding jumper shall be attached by a 3/16-inch or larger brass bolt in the signal and street light standards or controller pedestal, and shall be run to the conduit, ground rod, or bonding wire in the adjacent pull box.

B. Equipment grounding conductors will not be required in conduit containing loop lead-in cables only

3.8 DECORATIVE STREET LIGHTS

A. Decorative street lights shall be installed in accordance with the manufacturer's recommendations.

3.9. UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

A. The UPS-BBS system shall be **wired and programmed** such that when AC power is interrupted, the UPS-BBS will seamlessly enter UPS mode and provide full signal operation until the battery level is at 40%. If AC power has not been restored at that time, the traffic signal shall switch to flashing red operation until failure for a minimum of two (2) hours or until AC power is restored. When AC power is restored, the system shall seamlessly revert back to AC power without interruption to the full signal operation.

B. The UPS-BBS system shall be wired and programmed to communicate with the existing 2070 controller at the intersection through the use of special function outputs. The 2070 controller shall communicate with the TOC through the use of the special alarm functions to return BBS activation and other information to the TOC. In addition, the system shall be wired and programmed to communicate via Ethernet from the intersection to the TOC allowing remote diagnostic and unit modifications.

C. A representative from the supplier or manufacturer shall be present during the signal turn-on or UPS-BBS activation to program/establish Ethernet communication, and make certain that the UPS-BBS system will operate properly.

3.10 CONTROLLER CABINET ASSEMBLY

A. Interconnect cable shall be run continuously without splices between controller cabinets. Splices shall not be made in the pull boxes. Splices shall only be made in the controller cabinets on the terminal blocks provided for that purpose by the controller manufacturer. It shall be the DEVELOPER/CONTRACTOR's responsibility to establish communication between local controllers and the central master controller unless otherwise indicated.

B. The base of the controller cabinet shall be sealed with a silicon caulking material.

C. A representative from the supplier or manufacturer of all the components in the controller cabinet (e.g., modulated signal detection system, detectors, controller, PPB processors, video detectors) shall be present during the signal turn-on to make certain that the signal system will operate properly

3.11 FUNCTIONAL TESTING

A. In order to properly conduct functional testing of the controller assembly, schematic drawings **specific** for the cabinet to be used in this specific project shall be submitted with the cabinet. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result to the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. The functional test for each signal system shall consist of not less than 14 days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until the 14 days of continuous satisfactory operations is obtained.

B. Controller and cabinets shall be delivered to the City of Livermore Maintenance Service Center at 3500 Robertson Park Road, Livermore, for pretesting no later than 45 days prior to installation. After completion of functional testing by the CITY, the DEVELOPER/CONTRACTOR shall pick up and install the equipment at the work site.

C. Before scheduling the traffic signal "Turn On," the DEVELOPER/CONTRACTOR is required to coordinate a pre-testing to be conducted by the City's Signal Maintenance Department. Seventy-two (72) hours minimum advance notice is required to schedule this pre-test. During the pre-test, the City's traffic signal maintenance staff will determine if all components of the traffic signal system are operational as designed, including the Battery Backup System and video detection system. If deficiencies are found, the DEVELOPER/CONTRACTOR shall make the necessary corrections and schedule a follow up pre-testing. Only after all the deficiencies found are corrected can the

DEVELOPER/CONTRACTOR schedule the signal "Turn On." The DEVELOPER/CONTRACTOR shall provide a minimum of forty-eight (48)-hour advance notice to schedule the "Turn On".

- END OF SECTION -

SECTION 344105 - SIGNAGE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all roadside signs, street name signs, and City/private property off-street signs, and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 033050	Utility Cast-In-Place Concrete.
B.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

United States Department of Transportation, Manual of Uniform Traffic Control Devices

595-A	Federal Standard

B. **City of Livermore:**

1. Sign Ordinance
2. Zoning Ordinance

C. **State of California (Caltrans) Standards:**

1. Standard Specifications:

Section 56	Signs.

2. Standard Plans
3. Traffic Manual

D. **Commercial Standards:**

ASTM C 653	Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed,) by the Hot-Dip Process.
USA	Underground Service Alert.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

1.5 UTILITY LOCATIONS

A. The CONTRACTOR'S attention is called to the fact that utilities are present in the work areas. It is the CONTRACTOR'S responsibility to notify the utility companies having facilities in the project work areas at least 48 hours prior to beginning WORK to accurately locate said utilities before beginning of underground work. Utilities may be notified by contacting USA, Underground Service Alert, at (800) 642-2444.

B. For utilities not marked by USA, such as irrigation mains and laterals or on site services, the CONTRACTOR shall contact the property owner for assistance in locating said facilities.

C. The CONTRACTOR shall be responsible for repairing, at his own cost, any damage to utilities or irrigation facilities encountered during construction.

1.6 PRIVATE PROPERTY SIGNS

A. All private property signs are subject to approval by the City of Livermore Planning Division and shall be in conformance with the Zoning Ordinance, the Sign Ordinance, and all other City of Livermore regulations.

PART 2 -- PRODUCTS

2.1 SIGNS

A. **Roadside Signs:** Roadside signs shall be of the type as shown on the Drawings in accordance with the Caltrans Traffic Manual unless as otherwise noted on the drawings. Signs shall conform to Section 56, "Signs" of the Caltrans Standard Specifications and the Caltrans “Approved Sign Specification Sheets” as modified by this Section.

B. **Sign Plates:** Sign Plates shall be 0.080 gage aluminum alloy. Sign message shall be made using engineering grade sheeting **3M or equal**. Type N markers shall be made using high intensity reflective sheeting **3M or equal**.

C. **Street Name Signs:** Street names and size of signs shall be as shown on the Drawings. Sign background shall be reflective green with white lettering.

D. **City/Private Property Off-Street Signs:** City/private property off-street signs shall have message and size of sign as shown on the Drawings.

E. All signs in street right-of-way shall have “COL” and installation date etched or stamped on back of sign with 1/4" letters at lower right corner.

2.2 POSTS

A. **Roadside Signs, Street Name Signs, and City Off-Street Signs:**

1. All posts for signs installed on City property or within the public right of way shall be square formed steel tube, telescoping metal breakaway type, **Unistrut Telespar Sign Support System or equal**, of the size and dimensions as shown on the Drawings and as specified herein.

2. All posts shall be painted green and electrically powder coated except the sleeve and anchor which shall be galvanized. The color shall be green in conformance with Federal Standard 595-A, color number 14109 (Dark Limit V).

3. Tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A-570 Grade 33.

4. Galvanized tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A 446 Grade A; hot-dipped galvanized with a 1.25-ounce zinc coat, interior and exterior, conforming to ASTM C 653 coating designation G90; and the corner welds shall be zinc coated after scarifying operations.

2.3 HARDWARE

A. **Roadside, Street Name, and City Off-Street Signs:** Hardware for signs installed on City property or within the public right of way, shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**. Drive rivets to be **Unistrut TL 3806 or equal**.

B. **Street Name Sign Installation on Street Lights:**

1. The cantilever bracket supports for street name signs installed on round street light standards shall conform to the requirements of **SIGNFIX Cantilever Sign System or equal**.

2. For sign blanks up to 20 inches in length with a maximum area of 2 square feet use **SIGNFIX Stainless Steel Mini Cantilever Brackets** with 5/8-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.

3. For sign blanks up to 42 inches in length with a maximum area of 6 square feet, use **SIGNFIX V-Back Aluminum Cantilever Brackets** with 3/4-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.

PART 3 -- EXECUTION

3.1 GENERAL

A. All sign locations on City property must be inspected and approved by the ENGINEER prior to installation. The CONTRACTOR shall notify the ENGINEER no later than 48 hours prior to the start of the scheduled sign installation.

B. The locations of all Off-Street signs must be approved by the Planning Division prior to start of installation of the signs.

C. All reference markings made by the CONTRACTOR shall be done with spray chalk and shall be removed by the CONTRACTOR after installation of the signs.

D. Roadside signs shall be installed 6" behind 5' monolithic sidewalk, and 18" behind face of curb where there is a separated sidewalk, 10' sidewalk or no sidewalk unless otherwise noted on plans.

E. All utilities damaged by the CONTRACTOR shall be repaired and replaced by the CONTRACTOR at its expense to the satisfaction of the ENGINEER and the owner of the utility.

3.2 INSTALLATION OF POST

A. **Roadside, Street Name, and City Off-Street Signs:** Installation of roadside, street name, and City off-street signs installed on City property shall be at the locations shown on the Drawings or as specified herein.

1. Installation shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.

2. The square end of the anchor shall not be modified or pointed, but shall be capable of being driven into the ground by the use of an approved driving cap. The driving cap shall be reusable and shall allow the square anchors to be manually driven into the ground with the aid of a sledge hammer or a jack hammer without deforming the anchor or the driving cap.

3.3 INSTALLATION IN EXISTING SIDEWALK

A. For signs installed in existing sidewalks a 6-inch core shall be drilled, the anchor installed, the the core filled with Class B portland cement concrete in conforming to Section 033050, "Utility Cast-In-Place Concrete." Existing surfacing other than portland cement concrete shall be replaced in kind, with the replacement matching the existing product, depth, and pattern, to the satisfaction of the ENGINEER. The sleeve shall be protected such that concrete will not enter the inside of the square post.

3.4 INSTALLATION OF SIGN

A. **Roadside, Street Name, and City Off-Street Signs:** Mounting of the sign to the pole for roadside, street name, and City off-street signs on City property shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.

B. Mounting of Street Name Signs on street light standards using Cantilever support brackets shall be installed in accordance with the manufacturer's recommendations. Cantilever bracket system shall be installed on both the top and bottom of each sign.

C. An R26E, "Tow-Away Zone" shall be installed below each R26F sign in designated fire lanes.

- END OF SECTION -