

6 – SIGNALS, LIGHTING, AND ELECTRICAL SYSTEMS

6.01 GENERAL

6.01.01 DESCRIPTION

The work described in this section shall be done in accordance with Section 86 of the 2010 edition of the State Standard Specifications, the 2010 edition of the State Standard Plans, the City Standard Plans and these City Standard Specifications, unless otherwise specified.

In case of conflict between any of the contract documents, the document which takes precedence over and shall be used in lieu of such conflicting portions, shall be as specified in Section 5-1.02 of the State of California Standard Specifications.

If a discrepancy exists, the governing ranking of Contract parts in descending is:

- 1.1 – Project Special Provisions
- 1.2 – Project Plans
- 1.3 – Revised standard specifications
- 1.4 – Standard Specifications
- 1.5 – Revised Standard Plans
- 1.6 – Standard Plans
- 1.7 – Supplemental project information

The Design Engineer preparing plans and specifications for traffic signals shall:

1. Comply with the requirements of the latest revision of the State of California Standard Plans and Specifications, except as modified herein, for the installation and/or modification of traffic signals, highway safety lighting, and internally illuminated street name signs (IISNS). Sign(s) installation shall comply with State of California Standard Specifications, Section 56. Traffic stripes and pavement markings shall comply with State of California Standard Specifications, Section 84. All pavement marking stencils shall comply with State of California Standard Specifications, Section 85.
2. Use the latest edition of the California Manual on Uniform Traffic Control Devices (MUTCD) available on the Caltrans web site at:
<http://www.dot.ca.gov/hq/traffops/engineering/mutcd>
3. Include the following:

Title sheet with general notes. Title sheet shall also include a note identifying the approval date of the City of Napa Standard Plans and Specifications, and all other relevant standards documents, used in designing of the project.

Reference sheet(s) with applicable detail plans from the attachments herein. Reference sheets shall include up to eight detail plan sheets tiled two vertically and 4 horizontally on each 24-inch x 36-inch sheet.

Civil Engineering plans for any right of way (ROW) and/or traffic signal maintenance easement.

Traffic signal plans shall include new and existing curb and gutter, right of way, maintenance easements showing all existing utilities, all traffic signal interconnect cable, and City boundary lines on both civil and traffic signal plans. All widths shall be clearly labeled and dimensioned to the centerline.

Signing and striping plans, if applicable.

Traffic control plan for vehicles, bicycles and pedestrians, if applicable.

During the design phase of the project, the Design Engineer shall be responsible for potholing proposed traffic signal pole locations (pedestrian poles excluded) to foundation depth and width, prior to completion of the plans in order to identify potential conflicts with existing substructures. A log of the work performed showing depth, width, location, and unusual obstructions in the potholes shall be provided with the plans.

6.01.02 PLANS PREPARATION

A. General

The first plan-check submittal shall be at least 80% complete. Plans not conforming to the standards herein will be returned to the design engineer for correction without further review.

The City of Napa requires the title sheet of "stand-alone" traffic signal plans to be prepared on 24-inch x 36-inch Mylar sheets with a ½ inch margin on all sides except the left side, which shall be 1½ inches. Deviations from these Specifications shall be requested from the Engineer prior to commencement of work.

All traffic signal plans shall be prepared using the latest version of AutoCAD. Prior versions of AutoCAD, released within four years of the plan submittal date, will be allowed. Provide files of completed plans in both AutoCAD and Adobe PDF format on CD-ROM disks to the City Engineer upon completion of design.

B. Plan Preparation

Plan preparation shall conform to the following requirements:

1. Signal plans shall be drawn at a 1" = 20' scale.
2. All lettering shall be 1/10-inch minimum in height when plotted or printed at full scale. The lettering size shall conform to the highest standards in order to issue legible reduced size prints
3. Streets shall always be oriented horizontally and vertically and the north arrow positioned near the upper left-hand corner of the plan.
4. When assigning Signal Phasing, Phase 2 shall be in the northbound direction on the north-south roadway. If the streets are apparently 45 degrees to North, the designer shall request a determination from the City Engineer.
5. Squares shall be used to designate construction notes.
6. Triangles and clouding shall be used to indicate plan revisions.
7. All existing conditions shall be screened to appear lighter than the rest of the drawing.
8. Include standard traffic signal notes.
9. Signal pole schedule.

10. Detector/sensor schedule.
11. Conductor schedule.
12. A minimum of 36 inches of concrete pad shall be provided at the front of the signal cabinet and electrical service/BBS. Clearances shall be unobstructed by any above ground facilities. A retaining wall may be installed where required. The City Engineer must approve the signal cabinet location.
13. Front side of traffic signal controller cabinet should open away from the intersection and be oriented so that the operator is facing the intersection on their left. Electrical meter shall be facing the street.
14. Nearest practical Pacific Gas and Electric service vault and service handhole shall be shown on plan.
15. Utilize N.E.M.A. phasing conforming to the California MUTCD.
16. Symbols shown shall conform to State of California Standard Plans ES-1A and ES-1B.
17. Pole identification lettering shall increase clockwise around the intersection, with the Pole A being the first pole away from the controller corner.
18. All traffic signal plans shall indicate required traffic signal pole locations as referenced from BCR, ECR, and curb face.
19. Conduit run identification numbering shall start at the PG&E service point and increase sequentially clockwise around the intersection and return to the controller cabinet.
20. Signing and striping, where applicable, shall be provided on separate plan sheets, drawn at a scale of 1"=40'. Traffic striping shall be in accordance to the latest editions of the State of California Standard Plans and California MUTCD.
21. Unless otherwise physically required, an exclusive/split phase shall not be used in the phase sequence.
22. Traffic signal modifications requiring the installation of video detection cabling shall require all conductors to be removed from the conduit before pulling new cable. "Slipping" is not allowed.
23. Traffic signal modifications requiring the installation of ADA compliant Push Button Assembly cabling will require all conductors to be removed from the conduit before pulling new cable. "Slipping" is not allowed.
24. Traffic signal modifications shall match installed equipment by make and model. If the system cannot be matched, the entire system shall be replaced.
25. Maximum allowable conduit fill is 26% for new installation and 40% for existing/modified installations.
26. Intersections with any approach with a minimum of four lanes will require two video detection cameras unless one camera is sufficient as determined by the City Engineer.
27. Advance detection shall be provided on streets where the approach speeds are 30 mph or greater. Separate loops or zones shall be placed in each through lane. Advance loop setback requirements from intersections, based on posted approach speeds, are shown below.

APPROACH SPEED (MPH)	SETBACK (FEET FROM LIMIT LINE)
25	105
30	140
35	185
40	230
45	285
50	345

6.01.03 SUBMITTALS

All product submittals shall be provided to the City, 15 calendar days prior to equipment and material orders.

The Contractor shall submit to the City, for approval, all applicable submittals including, but not limited to, name of manufacturer, manufacturer's catalog cut sheets, schematic wiring diagrams, material descriptions, and any other material relevant. These submittals shall be approved by the City Engineer, prior to any equipment deliveries to the City. Any equipment that is delivered to the City and rejected by the City shall be removed and replaced at the Contractor's expense.

The Contractor shall supply signed mylar 24" x 36" copies of the as built signal plans to City Engineer after completion of the project.

6.02 MAINTAINING EXISTING ELECTRICAL SYSTEMS

Maintaining existing electrical systems shall conform to the provisions of Section 86-1.06, "Maintaining Existing and Temporary Electrical Systems," of the State Specifications. Existing traffic signal systems shall be kept in effective operation for the benefit of the traveling public during the progress of the work, except when shut down is permitted. The traffic signal shutdowns shall be limited to the hours of 9:00 a.m. to 3:30 p.m., and shall be permitted only during the switch over from existing to new controller operation, unless prior approval is obtained from the City Staff.

Temporary standards with signal equipment may be required during modification of existing signal systems. The Contractor shall provide temporary equipment if the City Engineer deems it necessary. The cost of the temporary system shall be included in the lump sum price paid for signal modifications and no additional compensation shall be allowed.

The Contractor shall notify the City Engineer 72 hours prior to any operational shutdown of existing signal system.

Any existing equipment or devices damaged during an ongoing construction projects (examples: installation of a new traffic signal, modification of an existing traffic signal, ADA accessibility projects, street repaving projects, etc.), shall be replaced in-kind at no cost to the City. Applicable equipment includes, but not limited to signal cabinet, controller, pedestrian push buttons (PPB), accessible pedestrian signals (APS), loops, video detection systems, wiring, signal interconnect (SIC), fiber optic cabling, battery backup system (BBS), signs, signal heads, etc.

If an ongoing project requires temporary changes in striping to facilitate the work, the contractor

shall be responsible for installing temporary striping. This includes temporarily covering old striping and restoring striping to the original state at no cost to the City.

The contractor shall be responsible for cleaning up and restoring the rock sump on any pull boxes (existing or new) that has been adjusted or replaced as part of the project. The contractor shall take extra care to ensure that no debris enter any conduit during construction. Full compensation for performing the work in these specifications shall be included in the prices paid for the various contract items of work and no additional compensation will be allowed.

6.03 SCHEDULING OF WORK

The initial installation and turn-on of new equipment shall be made on a Tuesday, Wednesday, or Thursday, and not a holiday. The turn-on shall be the first order of work for that day and all components of the traffic signal installation shall be functional and operating prior to turn-on.

All existing stop signs on minor and major streets (if applicable) shall be removed only on the day of successful turn on of the new signal. Temporary stop signs, changeable message boards and flashing red signal operation is required one (1) week prior to scheduled signal turn on or as directed by the Public Works Department.

Present at the time of testing shall be a representative from: the Electrical Contractor, Controller Manufacturer (when applicable), Communication System Manufacturer (when applicable), Detection System Manufacturer (when applicable), Public Works – Electrical Maintenance, and City Traffic Engineering. The contractor shall assume the responsibility of contacting and coordinating all the stakeholders as mentioned above.

If the Contractor is unable to respond to a problem that develops during the functional test, or for any reason is unable to correct the problem in a timely fashion, as determined by City staff, City crews may work on the problem. Any such work performed by the City shall not invalidate the guarantee provided for in these Specifications and shall be at the Contractor's expense.

All vehicular and pedestrian signal indications including APS systems shall remain covered with burlap or an approved equivalent during installation of new traffic signals. Those covers shall only be taken off on the day of turn on. If the turn on is not successful, all indications described above shall be covered again with burlap or an approved equivalent and remain covered until successful turn on.

Temporary stop signs shall be provided by the contractor.

The Contractor will be given one "punch list" for the contract to be completed within 30 calendar days. This will include a "compliance recheck" of the punch list. If the compliance recheck is performed, and it is found that the Contractor has not completed the punch list, the contractor shall receive an additional 15 calendar days to complete the list. The cost of subsequent compliance rechecks will be deducted from any monies due, or which may become due the Contractor.

All facilities shall be installed in a professional and workmanlike manner. Any portion of the signal system, which is not installed in a professional manner, shall be removed and reinstalled correctly to the satisfaction of the City Engineer.

6.04 CONDUITS

Conduit shall be per Section 86.2.05, "Conduit," of the State Specifications except as modified herein. Conduit should be installed by directional drilling or jacking and boring methods unless otherwise noted. The work shall include backfill and restoration per details on the plans.

Furthermore, regardless of which method is chosen, the Contractor shall pothole as needed to locate existing utilities. The Contractor shall assume all risk associated with chosen method of installation and shall fully locate and verify utilities prior to conduit installation. No additional compensation shall be allowed due to delays or changes in installation method. Conduit runs shall have no more than 360° of bends, unless authorized by the City Engineer, and shall enter the pull box vertically at 90°.

When trenching is allowed for conduit installation, the top of the horizontally installed conduit shall be a minimum of 24 inches below finished grade in the street section. Where the asphalt concrete (AC) portion of the roadway cross section is greater than 24 inches in depth, the finished height of the conduit shall be two (2) inches below the AC section. The trench shall be back filled with two inches of commercial grade sand with the remainder being 2% red oxide concrete, 2 sack sand slurry concrete.

Conduit installed in non-paved areas shall be covered with conductive plastic underground warning tape six inches above the conduit.

Schedule 40 Polyvinyl Chloride (PVC) and Schedule 80 High Density Polyethylene (HDPE) shall be used throughout the project as shown on the plans.

All conduits shall be three inches (3") minimum or otherwise as shown on the plans or specified in these standard specifications. Larger size conduit may be use subject to approval by the City Engineer. Where larger conduit is used, it shall be for the entire length of the run. No reducing couplings shall be permitted underground.

The ends of conduits in pull boxes shall have Bell Bushings and be a minimum of two inches above the surface of the rock, and between eight and ten inches below the top of the pull box.

Loop stub outs shall be two-inch (2") PVC with bell bushings on each end.

For all new signal and modified traffic signal (where new cabinet and controller will be installed) project, three (3) – 3-inch conduit shall be installed between the controller cabinet base to the adjacent home run pull boxes. Out of three conduits, one conduit shall be exclusively dedicated to run signal interconnect cable and fiber cable through a separate interconnect pull box. Splicing shall not be allowed in any of the home run pull boxes. The contractor shall install additional 2" conduits to run service conductors from controller cabinet to the service cabinet, and from home run pull box to the service cabinet.

Conduits terminating in pull boxes or in panels shall be sealed with an authorized sealing compound. Pull ropes shall be provided full length for all conduits

Certificates of Compliance shall be furnished for all supplied materials.

6.05 PULL BOXES

6.05.01 MATERIALS

All pull boxes shall be of the Concrete style construction, or approved equal, and shall be gray in color except otherwise specified. Pull box lids shall have a non-skid surface. At locations other than adjacent to the controller cabinet, and at advance loop locations, number 6 (17" x 30") pull boxes shall be used throughout the project unless otherwise specified on the plans. All home run pull boxes adjacent to the cabinet shall be concrete flared wall style (17" x 30") or approved equal with no hold down bolts. No splicing shall be allowed in these pull boxes. Pull boxes near advance loops shall be number 5 (13" x 24") concrete style or approved equal. No bolt down lids shall be used.

Pull boxes shall be set square to face of the curb and shall be leveled with the existing grade.

6.05.02 COVER MARKING

Marking shall be clearly defined, uniform in depth, and parallel to either the long or short sides of the cover. All pull boxes containing street lighting, interconnect, or service exclusively, shall be supplied with pull box lids that accurately reflect their contents. All pull box lids shall be tier 8 and shall have the words "Traffic Signal," "Street Lighting," "Interconnect," or "Service" on the lid, and shall not be of the bolt-down type. Lids shall be protected or reversed during the course of construction. All lids damaged or scuffed from construction shall be immediately rejected and shall be replaced by the Contractor at no expense cost to the City.

6.05.03 INSTALLATION AND USE

Pull boxes in non-paved or asphalt areas shall be constructed with a minimum 4-inch deep by 12-inch-wide concrete apron. The concrete apron shall be wrapped around with a one (1) #4 rebar.

On all runs, the spacing of pull boxes shall not exceed 200 feet measured along the conduit or as shown on the plans. If required, the contractor shall install additional pull boxes to facilitate the work. On those runs exclusively for "interconnect," the spacing of pulling points or pull boxes shall not exceed 300 feet, unless otherwise directed by the City Engineer. No drain hole or grout shall be placed in the sump area.

A minimum of six inches of $\frac{3}{4}$ inch drain rock shall be placed under each pull box. All pull boxes shall be inspected and approved prior to pulling any conductors

6.06 WIRES, CONDUCTORS AND CABLES

6.06.01 INSTALLATION

Conductors shall be per section 86.2.08 Conductors and Cables of the 2010 State Specifications except as modified herein.

Conductors shall be permanently identified as to function. Identification shall be placed on each conductor, or each group of conductors comprising a signal phase in each pull box and near the end of terminated conductors.

Identification labels shall be embossed and shall be direct labeling method. Labels shall be fastened to the conductors in such manner that they will not move along the conductors. Labeling shall be performed by mechanical methods. Labeling are required for loops, signal conductors, SIC and any other conductors within cabinet and pull box. Only poly-based lubricants shall be used. Conductors shall not be pulled into conduits until the pull boxes have been set to grade and $\frac{3}{4}$ inch aggregate installed.

Conductors shall not be pulled into conduits unless a representative from City's Traffic Signal Section is present to observe the operation. The end of all unused conductors and cables shall be sealed.

All conductors and cables shall be pulled through the conduits with the same wire pull. Slipping of conductors shall not be allowed. Only mule tape shall be used to pull conductors. Each conduit shall be left with a mule tape.

Separate pull boxes shall be installed to accommodate splicing of loop wires including termination or as shown on the plans.

AWG #10, AWG #12 and AWG #14 conductors shall be solid with 45 mils thickness. AWG #8 conductor shall have seven (7) strands with 45 mils thickness and AWG #2 conductor shall be stranded with 60 mils thickness.

The signal conductors shall be organized in a bundle to allow for easy identification for wires and cables.

All conductors require bundling inside the cabinet shall be bundled and terminated neatly. Nylon wire tie wraps spacing shall be at 18" O/C.

Slack for each conductor shall be as shown in the following table:

6.06.02 CONDUCTOR SLACK REQUIREMENTS

LOCATION	SLACK (FEET)
Signal Standard	2
Lighting Standard	2
Signal and Lighting Standard	2
Pull Box	6
Splice	3

6.06.03 SPLICING

Conductors shall not be spliced in the home run pull box/boxes adjacent to the controller, but shall be continued to terminals in the cabinet.

All conductors, including neutrals, shall be spliced by methods shown on State Standard Plan ES-13A. Splices shall be soldered using 60-40 rosin core solder only. Splices shall be insulated by Method "B" as described on State Standard Plan ES-13A.

Separate neutrals shall be used from terminal block to pull boxes for all vehicle, pedestrian and push button assemblies. Separate neutrals shall be used for all mast arm signal heads. No jumpers shall be allowed. All splices and terminals shall be soldered.

6.06.04 BONDING OR GROUNDING

The grounding jumper at each pole shall run continuous to the adjacent pull box attached to the bond wire using Copper C-Tap, or equivalent, compression connector and shall be soldered with 60-40 rosin core solder. All grounding wire shall be No. 8 bare stranded copper wire.

6.06.05 FIBER OPTIC CABLE

A. Description

Fiber Optic Trunk Cable shall be of loose-tube construction, twelve fiber unless otherwise specified. The optical fibers shall be single mode, or as specified by the City Engineer.

The fiber optic cable shall conform to ICEA S-87-640.

B. Performance

The optical performance of each single-mode fiber measured at wave lengths of both 1310 nanometers and 1550 nanometers shall have maximum attenuation of 0.4 decibels per kilometer at 1310 nanometers and 0.3 decibels per kilometer at 1550 nanometers and shall conform to TIA/EIA 49Z C4AA.

C. Construction

The cable shall be constructed using gel-filled, color-coded buffer tubes stranded (reverse oscillation) around a dielectric central member. The color-coded fibers shall be contained in the buffer tubes and the remaining fillers shall be natural or white in color. A layer of aramid yarn (e.g. Kevlar) shall hold the tubes in position around the central member and provide tensile strength. The color code for the fibers shall be standard colors per TIA-598-C. Water blocking shall be of the dry-tape type within the interstitial spaces, and gel within the buffer tubes.

D. Jacket

The filled cable core shall be covered with a black, medium density polyethylene jacket. This outer jacket shall be abrasion and crack resistant, non-nutrient to fungus, electronically non-conductive and compatible with all cable components to which it may come in contact. The jacket shall be free from holes, splits, blisters or other imperfections.

E. End Termination Cable

Shall be of the tight-buffered type and shall contain two single-mode fibers protected by a yellow jacket and aramid yarn (e.g. Kevlar) strength member. The length of a typical end termination cable shall not exceed 100 feet. Connectors for end termination cables shall be ST unless otherwise specified by the City Engineer.

F. Identification

Each length of cable shall be permanently identified by specifying the manufacturer and type of cable at intervals not greater than six feet along the outside of the outer jacket. Each length of cable shall be permanently marked with foot (or meter) markings at intervals not greater than three feet (or one meter).

G. Reels

The cable shall be wound on standard reels in a manner which provides access to both ends of the cable for testing while the cable is still on the reel.

H. Installation

Cable installation and handling procedures shall be in accordance with accepted industry standards and/or manufacturer's recommendations and shall be performed by adequately trained and certified personnel. In all pullboxes, there shall be 10 feet minimum of extra looped cable for each cable entering or leaving the box.

I. Splicing of Fiber Optic Cable

Splicing of the Fiber Optic Cable shall be done by the fusion technique. All cables shall be

carefully prepared and spliced in accordance with the cable manufacturer's recommendations. Either heat shrinkable tubing shall protect the finished splices, metal protective sleeves or by some other method approved by the City Engineer. All splices must be tested and documented after encasement. No splice shall exceed a 0.05 decibel loss.

The completed splices shall be enclosed in re-enterable splice enclosures that seal to form moisture resistant protection. The splice case or enclosure shall contain a removable splice organizer or crib that shall secure the individual fibers and protect the splices. The splice organizer shall be attached to the strength members in the fiber optic cable. There shall be adequate space inside the enclosure to hold at least three feet of buffer tubes from each cable. There shall be no splices except as authorized by the Traffic Signal Inspector. Splice enclosures shall be Corning 6C22-02 (or equivalent) unless otherwise authorized by the Traffic Signal Inspector. Fiber optic interconnect cables may only be spliced at special fiber optics splice boxes as shown on the plans. Video fiber optic cable shall be spliced in double-deep pullboxes.

6.06.06 SIGNAL INTERCONNECT CABLES

A signal interconnect cable must be a 6-pair type with solid, tinned, copper 22AWG conductors. The insulation for each conductor must be color-coded polypropylene with a minimum 13-mils nominal thickness. The conductors must be in color-coded, twisted pairs. The cable jacket must be black HDPE rated for a minimum of 300 V(ac) and 60 degrees C. The jacket must have a minimum nominal wall thickness of 40 mils.

6.07 SERVICE CABINET AND BATTERY BACK UP SYSTEM

The Service cabinet and Battery Back Up System (BBS) cabinet shall be a combined unit and shall be TESCO MODEL 27-222 BBS METERING or City approved equal. The combined unit shall be furnished and installed by the contractor.

The exterior of the combined cabinet shall be anodized aluminum

The interior of the combined cabinet shall be powder coated gloss appliance white.

There shall be 30amp generator plug on the outside of the BBS panel.

The Contractor shall coordinate with Pacific Gas and Electric Company for any necessary service Installation. Any fees and costs required by the utility company shall be borne by the Contractor.

The service enclosure shall also comply with the following specifications:

1. Removable back pan shall be mounted on 4 welded ¼" studs.
2. All circuit breakers shall be mounted in a vertical position, handle up for "On" handle down for "Off".
3. Intersection safety lighting conductors shall be in a separate conduit from the home run pull box to the service cabinet.
4. The foundation of the service cabinet shall comply with the requirements of Standard Plan ES-2D.

6.08 SIGNAL CONTROLLER CABINET

6.08.01 GENERAL

The signal controller cabinet shall be a Western Systems Type "P" TS-2 Type 1 NEMA traffic signal cabinet as shown on the plans.

6.08.02 CABINET MINIMUM REQUIREMENTS

The cabinet shall be completely wired and tested to the 2003 NEMA Traffic Controller Assemblies specification with NTCIP Requirements Version 02.06 (as amended here in). In addition, and at a minimum, the following requirements shall be met:

City of Napa traffic signal cabinet specification shall supersede any applicable parts of the State of California, Department of Transportation Standard Specifications and Standard Plans. This specification shall apply to all controller cabinet types with noted exceptions.

All items not covered by these specifications shall conform to State of California, Department of Transportation Standard Specifications and Standard Plans. Traffic signal cabinets shall also comply with NEMA specifications where applicable.

The State Specifications referred to in these specifications shall mean the latest State of California, Department of Transportation, Standard Specifications, unless otherwise is indicated.

The cabinet manufacturer shall have pre-approval by the City of Napa on any cabinet that they propose to provide to the city. Said pre-approval shall have been obtained no less than 60 days prior to the closing date of the bid.

All cabinets shall be pre-approved by the City of Napa prior to bid letting.

The controller cabinet shall be furnished by the contractor or the City. The controller cabinet shall be installed by the contractor. The controller cabinet shall be equipped with all auxiliary equipment and plug-ins required to operate 8 vehicle phases, 4 pedestrian phases and 4 overlap phases (NEMA TS-2, Type 1). Solid state switching devices shall conform to the provisions in Section Solid- -State Switching Devices," of these Special Provisions and the following:

The cabinet shall be designed for 16 channel operation. Load switches 1-8 shall be vehicle phases 1-8; load switches 9-12 shall be pedestrian phases 2, 4, 6, 8; Load switches 13-16 shall be overlaps A, B, C & D. These load switch sockets shall be configured in this manor without rewiring the back side of the load-bay. BIU load switch drivers 1-16 shall be wired to appropriate load switch sockets via a terminal block located on the front side of the load bay to allow checking voltage inputs to the load switch sockets without dropping the load bay.

The cabinet shall be wired for up to a minimum of (16) channels of detection, (4) channels of Opticom™ preemption.

The use of PC boards shall not be allowed except in detector racks, SDLC interface panels or BIU cages.

The use of plug and play modules shall not be allowed, with the exception of detector rack(s).

The cabinet shall be wired to provide both a 55-pin "A" connector and a 10-pin "A" connector.

All cabinet 120VAC wires shall be 18AWG or greater, including controller “A” and MMU “A & B” cables.

Controller shall be a separate and revocable bid item. Controller is either city Supplied or purchased as a separate line item and delivered separately to Test Lab to be tested and installed into City of Napa pre-approved Cabinet and Terminal Facility.

The complete cabinet assembly with electronics shall undergo complete input/output function testing by the manufacturer before being released to the City of Napa.

The wired cabinet facility shall use the latest technology applicable and shall be 100% compliant with Section 1605 of the American Recovery and Reinvestment Act of 2009, requiring the use of American iron, steel and manufactured goods.

The cabinet assembly shall be completely manufactured in the United States of America.

6.08.03 TESTING

Prior to field installation of the traffic signal cabinet and controller, the Contractor shall deliver the controller, fully wired Type “P” TS2-Type 1 cabinet including all auxiliary control equipment required for the controller and cabinet assembly to be operational to the City of Napa Corporation Yard Electrical Division, 770 Jackson St., Napa, California for the designated 21-day operational testing period.

The Contractor shall be responsible for transport of the equipment to City’s Corporation Yard and from Corporation Yard to the project site. Deliveries shall be made on Monday through Thursday between 8:00 a.m. and 3:00 p.m. and staff can be reached at (707) 257-9588 to arrange delivery of controller and cabinet.

All shipping cartons and cabinets shall be externally labeled with the name of the final installation location.

The manufacturers of the controller and cabinet system shall certify to the City Engineer that the controller hardware and software has been thoroughly bench and operationally tested and that as a controller system, all components are operating properly.

City staff will test the controller and cabinet equipment for continuous satisfactory operation (without failure) for 21 consecutive calendar days. Delivery of controller equipment for testing shall occur a minimum of 30 calendar days prior to being picked up by the contractor for installation. If equipment is rejected, the contractor shall allow additional 30 days for retesting.

When the controller cabinet has been satisfactorily shop tested, a representative from Public Works Maintenance Department will notify the Contractor that the cabinet is available for pick up. The Contractor shall provide equipment and personnel, as necessary, to safely load and deliver the controller cabinet.

City staff will develop signal timing data sheets and will program the controller. The contractor shall install the controller at project location.

The contractor shall bear the full cost all shipping, handling, and related transportation costs associated with testing and retesting (if applicable).

6.08.04 CABINET ENCLOSURE

Cabinet shall be Western Systems “P” Cabinet, or an approved equivalent. At a minimum, the cabinets shall meet the following criteria:

1. The "P" shall have nominal dimensions of 56" high x 44" width x 25.5" depth and meet the footprint dimensions as specified in Section 7.3, table 7-1 of NEMA TS2 standards for a Type P cabinet. The cabinet base shall have continuously welded interior mounting reinforcement plates with the same anchor bolt hole pattern as the footprint dimensions.
2. Shall be fabricated from 5052-H32 0.125-inch thick aluminum.
3. The cabinet shall be double-flanged where it meets the cabinet door.
4. The top of the cabinet shall be sloped 1" towards the rear to facilitate water runoff. And shall bend at a 90° angle at the front of the cabinet. Lesser slope angles are not allowed.
5. The inside of the cabinet shall utilize "C" channel rails. (2) Welded on the back wall on 34" center and (4) welded on each side wall on 8" center with 2 5/8" between sets. The "C" channel rails on the back wall shall be 35" in length and start 5" from the bottom of the cabinet interior. The "C" channel rails on the side walls shall be 48" in length and start 5" from the bottom of the cabinet interior. Adjustable rails are not allowed.
6. Unless otherwise specified the cabinet shall be supplied with the following finishes: the interior anodized. The exterior anodized.
7. All external fasteners shall be stainless steel. Pop rivets shall not be allowed on any external surface.
8. The front handle shall be 3/4" round stock stainless steel bar. All door handle mechanisms shall be interchangeable and field replaceable.
9. The main door shall contain a police door with a conventional police lock. A key shall be provided for both the cabinet lock and the police door lock. The police door shall be recessed into the main door so that the police door is flush with the main door. A closed-cell, neoprene gasket shall be bonded to the enclosure doors. The gaskets shall cover all areas where the doors contact the double flanged cabinet housing exterior and be thick enough to provide a watertight seal. A stiffener plate shall be welded across the width of the inside of the main door to prevent flexing. A main door bar stop shall be a two-position, three-point stop that accommodates open-angles at 90, 125, and 150 degrees. A louvered air entrance located at the bottom of the main door shall satisfy NEMA rod entry test requirements for 3R ventilated enclosures. Bearing rollers shall be applied to ends of door latches to discourage metal-on-metal surfaces from rubbing. The lock assembly shall be positioned so handle does not cause interference with key when opening the door.
10. A complete set of keys shall be supplied providing access to the cabinet front door and the police door.
11. The cabinet shall be equipped with a universal lock brackets capable of accepting a Best™ style lock and a Corbin #2 tumbler series lock. The cabinet shall come equipped with a Corbin #2 lock.
12. The cabinet shall be supplied with one (1) door switches that controls the cabinet interior lighting circuits.
13. All exterior seams shall be manufactured with a neatly formed continuously weld construction. The weld for the police box door shall be done on the inside of the cabinet door. All welds shall be free from burrs, cracks, blowholes or other irregularities.

14. The fan baffle panel seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
15. The cabinet shall be UL listed.
16. The cabinet shall come with lifting ears affixed to the upper exterior of the cabinet. These ears shall utilize only one bolt for easy reorientation.
17. The cabinet shall come with two (2) dual-ply Dustlock™ Media polyester, disposable air filter; and the filter performance shall conform to listed UL 900 Class 2 and conform to MERV-8 & ASHRAE Standard 52.2-1999. The filter element shall be secured to louvered entrance on the main door with Velcro type mounting on all four edges and a metal filter cover. The filter and metal cover shall be secured to entrance on main door by two (2) horizontally-mounted restraints.
18. All cabinet doors shall be mounted with a single continuous stainless-steel piano hinge that runs the length of the door. The hinge shall be attaching via stainless steel tamper resistant bolts.
19. All steel incorporated in the cabinet shell shall be manufactured in the United States of America and shall meet the requirements of Section 1605 of the American Recovery and Reinvestment Act of 2009.

6.08.05 LABELS

A permanent printed thermo vinyl, engraved or silk-screened label shall be provided for all terminals and sockets. Labels shall be legible and shall not be obstructed by cabinet wiring, panels or cables. All labels shall conform to the designations on the cabinet wiring prints.

6.08.06 SHELVES

The P shall come with (2) 42.5" double beveled shelves 10" deep that are reinforced welded with V channel, fabricated from 5052-H32 0.125-inch thick aluminum with double flanged edges rolled front to back. Slotted hole shall be inserted every 7" for the purpose of tying off wire bundles.

6.08.07 CABINET LAYOUT

The shelves shall be populated as follows:

1. The controller monitor and power supply shall be placed on the first or bottom shelf. The one (1) detector racks shall be placed on the top shelf.
2. The roll out drawer and LED light shall be mounted under the bottom shelf just left of center.
3. Load bay shall be mounted on the back wall with 7" of clearance to the bottom of the cabinet.
4. The detector panel for all field inputs shall be mounted on the lower left wall.
5. The load resistor panel shall be mounted on the lower left wall under the bottom shelf.
6. The SDLC and power supply interface panels shall be mounted on the left wall between the middle and bottom shelves.

7. The power panel shall be mounted on the lower right wall.
8. The Actelis switch shall be mounted on the right wall above the power panel.
9. The 120VAC six position power strip shall be mounted on the right wall, at the top of the "C" channel.

6.08.08 VENTILATING FANS

The cabinet shall be provided with one (1) finger safe fan mounted on the right and left sides of the cabinet plenum and shall be thermostatically controlled (adjustable between 32°-140° Fahrenheit). The safe touch thermostat, fuse holder and power terminal block(s) shall be din rail mounted on right side of cabinet plenum.

6.08.09 COMPUTER SHELF

A slide-out computer shelf 16" length by 12" width by 2" depth shall be installed below the middle shelf underneath the controller. The shelf shall be mounted just right of center so that controller cables will not interfere with the operation of the shelf when equipment is installed. The shelf shall have a hinged cover that opens from the front and shall be powder-coated black. It shall be a General Devices Part # VC4080-99-1168. The door when fully extended shall hold up to 50-lbs.

6.08.10 CABINET LIGHT ASSEMBLY

The cabinet shall have two (2) LED lighting fixture with 15 high power LEDs using a cool white color emitting 300lm min @ 12VDC/750mA. The LED shall be a Rodeo Electronics TS-LED-05M02. The LED fixture shall be powered by a Mean Well class 2 power supply LPV-20-12 that shall be mounted on the inside top of the cabinet near the front edge. The cabinet light circuit shall be designed so a second LED fixture will be installed in the cabinet without the need a of a second power supply. It shall be attached under the cabinet drawer so that it remains stationary when drawer is extended. An on/off switch that is turned on when the cabinet door is opened and off when it is closed shall activate the lighting fixture(s) power supply.

6.08.11 CONVENIENCE OUTLET

The cabinet shall be wired with one (1) convenience outlet with a ground fault interrupter (GFI) and one (1) six position power strip outlet without ground fault interrupters. The ground fault outlet (GFI) shall be mounted on the right side of the cabinet on or near the power panel. The power strip outlet shall be mounted on the right side at the top of the "C" channel. No outlets shall be mounted on the door. The GFI power shall be fed through the auxiliary breaker (CB2). The power strip shall be fed through an EDCO SHP300-10 transient voltage suppressor located on the cabinet power panel. There shall be a 2-position terminal block on the power panel, between the power strip and the EDCO SHP300-10 for easy replacement.

6.08.12 AUXILIARY PANEL

The cabinet shall include an auxiliary switch panel mounted to the interior side of the police panel compartment on the cabinet door. The panel shall be secured to the police panel

compartment by (2) screws and shall be hinged at the bottom to allow access to the soldered side of the switches with the use of only a Phillips screwdriver. Both sides of the panel shall be silkscreened. Silk-screening on the backside of the switch panel shall be upside down so that when the panel is opened for maintenance the silk-screening will be right side up. All the switches shall be protected by a hinged see-through Plexiglas cover.

At a minimum, the following switches shall be included:

A. Controller ON/OFF Switch

There shall be a switch that renders the controller and load-switching devices electrically dead while maintaining flashing operations for purpose of changing the controller or load-switching devices. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

B. Signals ON/OFF Switch

There shall be a switch that renders the field signal displays electrically dead while maintaining controller operation for purpose of monitoring controller operations. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

C. Stop Time Switch

There shall be a 3-position switch labeled "Normal" (up), "Off" (center), and "On" (down). With the switch in the "Normal" position, a stop timing command shall be applied to the controller by the police flash switch or the MMU (Malfunction Management Unit). When the switch is in its "Off" position, stop timing commands shall be removed from the controller. The "On" position shall cause the controller to stop time. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

D. Technician Flash Switch

There shall be a switch that places the field signal displays in all red flashing operation while the controller continues to operate. This flash shall have no effect on the operation of the controller or MMU. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

E. Pedestrian Test Switches

Four (4) pedestrian phase inputs shall have momentary pushbutton test switches with black caps. With the switch pushed a true input shall be applied to the controller. When released the true input shall be dropped. These switches shall be labeled 2, 4, 6 and 8.

F. Preempt Test Switches

Six (6) preempt inputs shall have momentary pushbutton test switches with red caps. With the switch pushed a true input shall be applied to the controller. When released the true input shall be dropped. These switches shall be labeled 1, 2, 3, 4, 5 and 6.

6.08.13 POLICE PANEL

Behind the police panel door there shall be switches for use by emergency personnel. The wiring for these switches shall be accessible when the auxiliary panel is open. The following switches shall be included;

A. Flash Switch

There shall be a switch for the police that puts the cabinet into flashing operations. The switch shall have two positions, "Auto" (up) and "Flash" (down). The "Auto" position shall allow normal signal operation. The "Flash" position shall immediately cause all signal displays to flash as programmed for emergency flash and apply stop time to the controller. When the police flash switch is returned to "Auto", the controller shall restart except when the MMU has commanded flash operation. The effect shall be to disable the police panel switch when the MMU has detected a malfunction and all controller and MMU indications shall be available to the technician regardless of the position of the police flash switch. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

B. Signals ON/OFF Switch

There shall be a switch that renders the field signal displays electrically dead while maintaining controller operation for purpose of monitoring controller operations. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

6.08.14 MAIN PANEL CONFIGURATION (LOAD-BAY)

The design of the panel shall conform to NEMA TS2 Section 5, Terminals and Facilities, unless modified herein. This panel shall be the termination point for the controller unit (CU) MSA, (MMU) MSA & B cables, bus interface units 1 & 2 (BIU) and field terminal facilities. The terminal and facilities layout shall be arranged in a manner that allows all equipment in the cabinet and all screw terminals to be readily accessible by maintenance personnel.

The load-bay shall be fully wired and meet the following requirements:

1. The load-bay shall have the following dimensions; constructed from aluminum with a nominal thickness of 0.125", a maximum height of 19" and maximum width of 38" including attached wiring bundles.
2. The entire assembly shall roll down and provide access to all of the back of panel wiring. All solder terminals shall be accessible when the load-bay is rolled down. The assembly shall be able to roll down without requiring other components, cables or switches to be removed.
3. The load-bay shall be designed so that all other cabinet screw terminals are accessible without removing cabinet electronics.
4. All the controller (CU) and malfunction management (MMU) cables shall be routed through the back of the load-bay so that they will not be subject to damage during load-bay roll down.
5. The top of the load-bay panel shall attach directly to "C" channel and detach without the use of tools or loose hardware for roll down purpose.
6. The load-bay shall be balanced such that it will not roll down when the top of the load bay is detached from the "C" channel, even when fully loaded with BIUs load switches, flasher and flash transfer relays.
7. The load-bay facility shall be wired for 16 channels. Load switch(s) 1-8 shall be vehicle phases 1-8; load switch(s) 9-12 shall be pedestrian phases 2, 4, 6 & 8; load switches 13-16 shall be overlaps A, B, C & D. Load switches 1-8 & 13-16 shall be routed through a flash transfer relay.

8. (16) Load switch sockets in one row, spaced on 2" center per NEMA TS2 section 5.3.1.2, figure 5-2.
9. (6) Flash transfer relay sockets.
10. (1) Flasher socket.
11. All load switches and flasher shall be supported by a bracket extending at least ½ the length of the load switch.
12. (2) Bus interface unit rack slots for BIU's 1 and 2. The load-bay must have space available for a 3rd BIU. All of the cabinet BIU's shall fit into one rack in the top left corner of the load-bay. Multiple racks are not allowed.
13. BIU wires connection to the PCB shall be two (2) 34 pin connectors. These connectors shall have locking latches.
14. All BIU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to all functions of BIUs.
15. Wiring for one Type-16 MMU. All MMU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to all functions of the MMU.
16. All 24 VDC relays shall have the same base socket, but it shall be different from the 115VAC relays.
17. All 115VAC relays shall have the same base socket, but it shall be different from the 24VDC relays. (not applicable to flash transfer relays)
18. Shall have a relay that drops +24VDC to load switches when the cabinet is in flash.
19. The load bay shall have terminals to access the flash circuits 1 and 2.
20. There shall be a wire between the pedestrian yellow field terminals and another terminal on the load bay. The MMU channel 9-12 yellows shall terminate next to said pedestrian yellows terminal.
21. The load-bay shall be silkscreened on both sides. Silkscreen shall be numbers and functions on the front side, and numbers only on the back side. The back side shall have labels upside down, so when load bay is rolled down labels will be right side up.
22. Field wiring terminations shall be per channel across the bottom of the load-bay. Each channel shall have 3 terminations corresponding to the appropriate vehicle phase Red, Yellow and Green. Default wiring shall be starting with green, left to right vehicle phases 1-8, pedestrian phases 2, 4, 6 & 8 and overlap channels A, B, C & D following the order of the load switches. Field terminals shall be #10 screw terminal and be rated for 600V.
23. All cable wires shall be terminated. No tie-off of unused terminals will be allowed.
24. Shall be 100% manufactured in the United States of America

All wiring shall conform to NEMA TS2 Section 5.2.5 and table 5-1. Conductors shall conform to military specification MIL-W-16878D, Electrical insulated high heat wire, type B. Conductors #14 or larger shall be permitted to be UL type THHN. Main panel wiring shall conform to the following colors and minimum wire sizes:

Vehicle green load switch output	14 gauge brown
Vehicle yellow load switch output	14 gauge yellow
Vehicle red load switch output	14 gauge red

Pedestrian Don't Walk switch	14 gauge orange
Pedestrian Walk switch	14 gauge blue
Pedestrian Clearance load switch	14 gauge yellow
Vehicle green load switch input	22 gauge brown
Vehicle yellow load switch input	22 gauge yellow
Vehicle red load switch input	22 gauge red
Pedestrian Don't Walk input	22 gauge orange
Pedestrian Walk input	22 gauge blue
Pedestrian Clearance input	22 gauge yellow
Logic Ground	18 gauge white with red tracer
+24V DC	18 gauge red with white tracer
+12V DC	18 gauge pink
AC+ Line	14 gauge black
AC- Line	14 gauge white
Earth Ground	16 gauge green
AC line (load bay)	12/14 gauge black
AC neutral (load bay)	12/14 gauge white
Controller A cables	22 gauge blue <i>with the exception of power wires (AC+ Black, AC- White & Earth Ground Green) These wires shall be 18AWG</i>
MMU A & B cables	22 gauge orange <i>with the exception of power wires (AC+ Black, AC- White & Earth Ground Green Start Delay Relay Common Black, Normally open Black & Normally Closed Black) These wires shall be 18AWG</i>

Four conductors will supply alternating current (AC) power to the load switch sockets. The load switch sockets shall be supplied 1-4, 5-8, 9-12 & 13-16 by each conductor.

The field terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. Four (4) 12-position terminal blocks shall be provided in a single row across the bottom of the main panel. Spade lugs from internal cabinet wiring are not allowed on field terminal screws. There shall be a second row of three (3) 12-position terminal blocks with screw type #10 above the field terminal blocks. These blocks shall operate the flash program. It shall be changeable from the front of the load bay.

The power terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. One (1) 12-position terminal block shall be provided vertically on the right side of the load bay. The placement of the power terminal block on any other panel shall not be allowed.

All load switches, flasher, and flash transfer relay sockets shall be marked and mounted with screws. Rivets and clip-mounting is unacceptable.

Wire size 16 AWG or smaller at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. All wires shall have lugs or terminal fittings when not soldered. Lap joint/tack on soldering is not acceptable. All soldered connections shall be made with 60/40 solder and non-corrosive, non-conductive flux. All wiring shall be run neatly and shall use mechanical clamps and conductors shall not be spliced

between terminations. Cables shall be sleeved in braided nylon mesh and wires shall not be exposed.

6.08.15 LOAD-BAY AND PANEL WIRE TERMINATION

All wires terminated behind the main panel or on the back side of other panels shall be **SOLDERED**. No pressure or solder-less connectors shall be used. Printed circuit boards shall only be used on the load bay where connecting to the bus interface units (BIU).

6.08.16 CABLES

All wire cable bundles shall be encased in flex or expandable braided sleeving along their entire free length.

All SDLC cables shall be terminated on both ends, securely terminated to the SDLC interface panel with screw type connection and professionally routed in the cabinet interior to easily reach the load bay, controller, malfunction management unit and detector racks. All SDLC connectors shall be fully populated with 15 pins each.

6.08.17 FLASHING OPERATION

All cabinets shall be wired to flash for all vehicle channels. Flashing operation shall alternate between the used vehicle phases 1, 3, 5, 7, OLA & OLC and 2, 4, 6, 8, OLB & OLD. Flash programming shall be either red, yellow or no flash simply by changing wires on the front of the load-bay.

6.08.18 DETECTOR RACKS

At a minimum, the cabinet shall be wired to accommodate (16) channels of detection. The detector rack shall support (16) channels of loop detection, (1) Buss Interface Unit (BIU) and (4) channel of Opticom™. The rack shall be capable of using both two channel or four channel detection devices or Opticom™ cards. The loop cabling shall be connected via a 37 pin DB connector using spring clips. The Opticom cable shall be connected via a 24 pin connector using locking latches. The power cable shall be a 6 pin connector. All power wires shall be 18AWG. The addressing of detector racks shall be accomplished via dipswitches mounted to the PCB. There shall be the capability to turn off the TS2 status to the BIU for the uses of TS1 detector equipment via dipswitches mounted to the PCB. There shall be a 34 pin connector using locking latches that breaks the output from the detector to the input of the BIU, there shall also be +24VDC and logic ground on this connector. All racks shall have space at the bottom front for labeling. All racks shall be designed for horizontal stacking. Separate racks for detection and preemption are not allowed.

6.08.19 DETECTION PANEL

The detection panel shall support (16) channels of vehicle detection, (4) channels of emergency vehicle preemption detection, (4) channels or pedestrian detection and (4) pedestrian returns on a single panel. The loop wires shall be a 22AWG twisted pair, color coded as follows. Channel one brown, channel two red, channel three orange and channel four yellow. One of the twisted pair wires of all colors shall have a white tracer and land on

the second position terminal of each loop. The emergency preempt wires shall be color coded as follows. +24VDC orange, preempt inputs yellow and ground blue. This panel will be mounted on the left side of the cabinet below the bottom shelf. The panel shall also include a (19) position solid aluminum, tin plated neutral and ground buss bars with raised slotted & torque style screws heads. They shall be mounted vertically at the bottom of the panel.

6.08.20 POWER SUPPLY INTERFACE PANEL

The power supply interface panel shall include terminations for all the cabinet power supply inputs and outputs. It shall have a protective plastic cover. This panel shall be mounted on the left wall of the cabinet.

6.08.21 SDLC INTERCONNECTION PANEL

The SDLC hub shall have at a minimum 9 connections. The cable shall be secured by screws. One connector shall have blocks for securing the cable with spring clips. This is for the purpose of connecting/disconnecting a cable quickly and easily.

6.08.22 SUPPLEMENTAL LOADS

There shall be a supplemental load panel with (4) 2.5K-ohm, 10-watt panel mount resistor. One side terminated to a (4) position terminal block tied to neutral. The other side terminated to another (4) position terminal block. This block shall be left open for future loading in the cabinet.

6.08.23 SERVICE SURGE SUPPRESSION

The cabinet shall be equipped with an EDCO model SHP300-10 or approved equivalent surge arrester mounted on the power panel. Power to all cabinet electronics equipment and power strip shall come through this surge suppression circuit.

6.08.24 POWER PANEL

The power panel shall handle all the power distribution and protection for the cabinet and shall be mounted in the bottom right side of the facility. All equipment shall be mounted on a 12" x 17" silkscreened aluminum panel and include at a minimum the following equipment:

1. A 50-amp main breaker shall be supplied. This breaker shall supply power to the load bay, load switches and auxiliary panel. It shall also power via the EDCO SHP300-10 the controller, MMU, power supply, detector racks, convenience outlet & power strip.
2. A 20-amp auxiliary breaker shall supply power to the fan, light and GFI.
3. A 50-amp, 125 VAC radio interference line filter.
4. A normally open, 50-amp, solid-state relay. The relay shall have a green LED light that is on when energized. (No Mercury Contactors shall be allowed)
5. One see-through Plexiglas cover on stand-offs to protect maintenance personnel from AC line voltages. The cover shall also cover the top of the panel to prevent items from

falling into electronics. This shall be removable by loosening screws but without removing screws.

6. Two (19) position solid aluminum, tin plated neutral buss bar with raised slotted & torque style screw heads.
7. One (19) position solid aluminum, tin plated ground buss bar with raised slotted & torque style screw heads.
8. Two MOVs shall be terminated on the 120AC in field terminal. One tied between line and ground, the other between neutral and ground.

6.08.25 UNUSED RED JUMPERS

The cabinet shall be equipped with eight (8) unused red jumpers.

6.08.26 LOAD SWITCH

The cabinet shall come with (16) load switches. All load switches shall be cube type and have LED indications for both the input and output side of the load. The load switches shall be PDC model SSS-87I/O.

6.08.27 FLASHER

The cabinet shall come with (1) flasher. The flasher shall be cube type and have LED indications. The flasher shall be PDC model SSF-87.

6.08.28 FLASHER TRANSFER RELAY

The cabinet shall come with (6) heavy duty flash transfer relays. The relays shall be Detrol Controls model 295.

6.08.29 BUS INTERFACE UNIT (BIU)

The cabinet shall come with (3) bus interface units (BIU), (2) T&F, (1) detector racks. These shall meet all the requirements of Section 8 of the NEMA TS-2 2003 standards. In addition, all BIUs shall provide separate front panel indicator LED's for DC power status and SDLC Port 1 transmit and receive status. The (BIU)'s shall be Eberle Design, Inc. model BIU700.

6.08.30 POWER SUPPLY (PS)

The cabinet shall come with a shelf mounted cabinet power supply meeting at minimum TS 2-2003 standards. It shall be a heavy-duty device that provides +12VDC at 5 Amps / +24VDC at 2 Amps / 12VAC at .25 Amp, and line frequency reference at 50 mA. The power supply shall provide a separate front panel indicator LED for each of the four outputs. Front panel banana jack test points for 24VDC and logic ground shall also be provided. The power supply shall provide 5A of power and be able to cover the load of four (4) complete detector racks. The (PS) shall be Eberle Design, Inc. model PS250.

6.08.31 PRE-EMPTION - OPTICOM

The cabinet shall come with (1) 4-channel rack mounted Opticom™ phase selector. This device shall be capable of receiving encoded signals from Opticom series 700 emitters and detectors. The Opticom™ phase selectors shall be Global Traffic Technologies model 764.

The Contractor shall furnish and install required optical detectors, rack(s), four (4) multimode phase selectors and cables, etc., (complete and operable) as shown on the plans and according to the manufacturer's recommendations.

All optical detectors shall be mounted on the MAS signal heads. Mounting shall comply with the requirements as specified in 2015 Standard Plan ES-4E. The City Engineer will mark the optical detector location for the Contractor. The Contractor shall notify the City Engineer at least 48 hours prior to installing the optical detector.

Mounting of the optical detector on a ¾ inch diameter conduit stub shall conform to the following:

1. Type 1 Standards, if necessary, retrofit signal framework and hardware.
2. Optical detectors shall be 3M, Type 721 or approved equal, and shall be compatible with the City's requirements.
3. Cable shall be Opticom Model 138 detector cable including Opticom span wire clamp or approved equal, and shall be installed with six feet of slack in controller cabinet and pull boxes. The cable shall not be spliced.
4. Optical cables shall be labeled in the controller cabinet and in the pull boxes adjacent to the signal standards with appropriate phase designations.
5. Multimode phase selector shall be "Opticom "Model 764" or approved equal.

The City will test the optical system. Tests will be performed at a distance between 300 feet to 1,800 feet between the emitter and the detector being tested.

6.08.32 MANUALS & DOCUMENTATION

The cabinet shall be furnished with (3) complete sets of cabinet prints. All cabinet wiring, and layout shall come on (1) E1 size sheet, multiple pages shall not be allowed. Upon request (1) CDROM with AutoCAD v2008 cabinet drawing for the cabinet wiring.

6.09 CONTROLLER CABINET EQUIPMENT

6.09.01 GENERAL

This section shall include the installation of:

1. Intelight YTC-XN_2 TS-2 type 1 traffic signal controller,
2. EDI MMU2-16LEip Malfunction Management Unit,
3. Actelis ML688 network element,
4. Miovision Video Detection System,
5. or as otherwise indicated on the project plans.

6.09.02 CONTROLLER REQUIREMENTS

Intelight YTC-XN_2 Controller shall be used and must include:

1. Intelight's newest Local Intersection software (Maxtime) and Intelights newest central system licensing (MaxView)

The entire controller assembly shall be warranted to be free from defects from workmanship and material for one (1) from the date of turn-on by the manufacturer. Any parts found to be defective within the warranty period shall be replaced free of charge by the contractor.

6.09.03 TRAFFIC SIGNAL CONTROLLER SOFTWARE

The Contractor shall install the latest version of Intelight's local intersection software in the Intelight controllers to be compatible and completely functional with City's MaxView central traffic signal controller communication software prior to delivering controller to the City for testing.

The Contractor shall provide licenses, which include the basic support and integration for use of this software.

6.09.04 MALFUNCTION MANAGEMENT UNIT (MMU)

The MMU shall be an Eberle Design, Inc. model MMU2-16LEip. The cabinet shall come with this MMU that meets all the requirements of NEMA TS2-2003 while remaining downward compatible with NEMA TS1. It shall have (2) high contrast LCD displays and an internal diagnostic wizard. It shall come with a 10/100 ethernet port. It shall come with software to run flashing yellow arrow operation.

6.09.05 FIBER / COPPER / ETHERNET NETWORK ELEMENT AND SWITCH

The cabinet shall come with a Actelis ML688 or ComNet CNGE3FE8MSPOE (and applicable power supply, cables and modules for specific location) switch that meets all the requirements below.

Each network element will have the option to support an additional optical interface operating up to a 100Mbps or 100/1000 Mbps line rate. The optical port upgrade option will be available via a SFP optical plug in module and be capable of working in conjunction with both high speed links (East and West). In addition, should the network be upgraded to fiber backhaul, the system must be able to support the fiber connection while continuing to provide existing Ethernet services over existing hardware, thus allowing for a fiber upgrade without replacing the existing hardware.

The traffic interconnect network elements shall be contractor furnished and shall be installed at locations as shown on as shown on the project plans.

6.09.06 VIDEO DETECTION SYSTEM (VDS)

Video Detection System shall be a Miovision Multimodal or GridSmart GS2 or Iteris Vantage Vector Hybrid.

The system shall have a modular electrical design and use Ethernet to connect and network with the different system components. Streaming video images, alerts, and data shall be transmitted from the field back to a Traffic Operations Center (TOC) via the systems client software and to the cloud by using any or combination of the following:

- Fiber optic
- Microwave
- WAN
- TCP/IP
- Internal modem/ cell modem
- Any other means of commonly used communication practices and standards for digital content and information.

The video client software shall provide graphical user interfaces between the administrator(s) and permissioned users of the system and the sensor(s) itself. The software shall allow the user to conduct maintenance, monitor information relayed from the sensor(s), and provide access to real-time data, system and user defined alerts, and access to historical data collected by the sensor(s). The client software shall be installed across a network of computers. One or more users will be able to access VDS simultaneously.

Each system will include client software for detecting, counting and reporting the vehicle's entrance and exit of the intersection. The system will also include software for communicating with the traffic controllers and other electronic devices.

The client software shall be included with each system and should be downloaded and run on any personal computer with a Windows 7 or newer operating system. The client software at minimum should include management tools to perform the following:

- View, diagnose, configure, and reset individual sensor outputs
- View the status of inputs to enable setup and troubleshooting in the field
- Configure and view calls and phases
- The ability to create and define, as well as edit, vehicle zones, road masks, object masks, and pedestrian zones by drawing arbitrary shaped polygons using a computer
- View the site's configuration history
- Publish and revert back to previous configuration
- View video and images from the sensor within the software's interface
- Optionally access and use an API that is documented online and that uses HTTP
- Provide System Alerts for diagnostic and administrative events

The system shall provide data packages that provide count data, access to real time data, and system and user defined alerts. The count data shall be accessible from the processor or from the cloud. The count data will include; turning movement counts, length based vehicle classifications, volume, occupancy on green, occupancy on red, percent of arrivals on green, percentage of arrivals on red.

All reports should be exportable and downloadable in; PDF, Excel, RTF, TIFF, Web Archive

The alerts/notifications package provided shall include at least; wrong way vehicle detection, loss of visibility event and volume exceeded.

6.09.07 DOCUMENTATION

Two (2) manuals shall be supplied for all equipment and components of the system. Documentation shall be supplied explaining the operation of all system features. Additionally, the contractor shall provide two (2) laminated copies (8.5" x 11") of the signal phasing plan to City Engineer.

6.09.08 TECHNICAL ASSISTANCE & BACK-UP SERVICES

The manufacturer's representative shall provide the City with a California telephone number for the ordering of replacement parts that are required and for providing technical advice to City personnel. The manufacturer shall have on hand at this number a complete file of the City's equipment, including all serial numbers pertinent to this project. The manufacturer shall have available at the telephone number a person with competence in parts, nomenclature and functional characteristics of the City's signal controller equipment. This person shall be able to provide descriptions, part numbers, prices and availability of the City's requirements. A fully qualified electronics technician with the capacity to expertly advise on all matters relating to the City's equipment shall be available immediately, or by return telephone call within 24 hours (normal work days only, holidays and weekends accepted). There shall be no charge to the City for any advice or information provided in this matter.

6.10 POLE STANDARDS

6.10.01 STANDARDS, STEEL PEDESTALS AND POSTS

All traffic signal standards shall be per Caltrans 2010 Revised Standard Plans Electrical Systems unless otherwise specified.

The identification number shall be stamped on the top of the base plate with minimum ½ inch characters in lieu of the riveted stamped identification number on the shaft above the handhole as described on the State Standard Plan ES-7M.

Traffic signal poles shall be set back from face of curb no less than 36 inches to face of standard or pole, and the base plate installed parallel to the flow (direction) of traffic unless otherwise specified by the City Engineer. All poles shall be leveled using a level. All signal poles and signal standards shall be galvanized except downtown area.

Within the downtown area (as defined in the Downtown Napa Specific Plan) all signal poles and signal standards shall be painted Black (minimum two coats). Outside of downtown area, all signal poles and signal standards shall be galvanized.

All holes drilled for wire entry (i.e. pedestrian and vehicle terminal compartments, and APS/pedestrian push button) shall be filed to remove all sharp edges. Any incorrectly drilled or otherwise damaged poles must be repaired by a certified welder to the manufacture's specifications at the expense of the contractor.

Signal mast arms shall not have a negative angle. If so, the contractor shall contact the manufacturer and correct the negative angle issue.

Signal standard Type 1-B shall not be used.

6.10.02 FOUNDATIONS

Schedule 40 PVC or Schedule 80 PVC with bell bushings shall be used in all cabinet and pole foundations. A 5/8 inch, 10-foot ground rod shall be installed in the controller cabinet foundation and service cabinet foundation.

Type "P" TS-2 Type 1 NEMA cabinet foundation shall have a 32"x48"x24" recessed area for all conductors. Edges/corners of the foundation shall use chamfer strip.

Exposed portions of the foundation to present a neat appearance and shall be true to line and grade. The top of the foundation posts and standards shall be finished to curb or sidewalk grade except special foundations or as directed by the City Engineer. Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be placed in proper position and to proper height. Anchor bolts shall be installed a maximum of 1:40 from vertical and shall be held in place by rigid top and bottom templates. The bottom template shall be made of steel and shall be at least ½ inch thick. The bottom template shall provide proper spacing and alignment of anchor bolts near the embedded bottom end and shall be installed before placing footing concrete.

The mortar shall be no thicker than thickness of the highest leveling nut/nuts leveling plus or minus ½". The highest leveling nut shall be set to grade.

The controller cabinet pad and service enclosure shall have a concrete walk access to it from the existing sidewalk.

6.11 HEADS

6.11.01 PURPOSE

Until ready for use, signal faces shall be securely covered so that no signal indications are visible. A flash hole no larger than one inch in diameter may be placed in front of each lens. Traffic signal heads shall be of aluminum construction with dark green. Pedestrian signal housing shall be of aluminum construction with dark green. Mounting hardware shall be as per State Standard Plan (ES-4A), unless otherwise indicated on the Project Plans.

Terminal compartments, Mast Arm Side (MAS) mount, curved washers, and slip fitters shall be bronze. Traffic signal frameworks, heads, framework, pedestrian housings, clamshell, and pedestrian button housing shall be factory powder coated dark green and all shall be furnished and installed by the Contractor.

"Knock Out" type seals are not acceptable for sealing unused pipe thread connections to terminal compartments, or top/bottom of signal heads. Connections shall be sealed with threaded fittings with a rubber gasket, or by the use of an "ornamental cap" designed for such purpose.

The Contractor shall exercise care at the time the signal heads are installed to ensure that the gaskets provided for the mounting of the heads are installed on the outside of the housing to provide a watertight seal. Gaskets shall not be placed on the inside of the housing.

All back plates shall be louvered with 5-inch border and shall be aluminum, unless otherwise indicated on the Project Plans. All back plates shall be powder coated fat black or matte black.

Signal visors shall be aluminum (12" diameter X 12" depth), shall be tunnel type and shall be powder coated fat black or matte black.

Signal heads and framework, as a unit, shall be installed by the Contractor at the job site. Extreme care shall be taken by the Contractor's workers during the installation of the signals, frame works, and heads. Any scarred marks or cosmetic damage to the equipment caused from tools or installation processes shall be cause for rejection and shall be replaced at the expense of the Contractor.

6.11.02 LIGHT EMITTING DIODE (LED) SIGNAL MODULES

The purpose of this specification is to provide the minimum performance requirements for 12 inch circular (ball and arrow), "walking person", "upraised hand" icons and 16X18 inch countdown pedestrian signal modules. This specification refers to definitions and practices described in "Vehicle Traffic Control Signal Heads (VTCSH): Light Emitting Diode (LED) Circular Signal Supplement", "Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement" and "Pedestrian Traffic Control Signal Indicators" (PTCSI): Light Emitting Diode (LED) Signal Modules, as published by The Institute of Transportation Engineers. They may be purchased online from www.ite.org. The contractor shall furnish and install all LED modules as shown on the plans.

A. General

Referenced vehicle type LED modules shall fit in all standard, incandescent vehicle traffic signal housings.

The modules may be used for the replacement of the reflector, socket, gasket, and lens assembly of existing warranty expired LED vehicle signal indication or may be used for new installations.

Each module shall consist of smooth lens with the same appearance and color as incandescent lenses.

Each module shall have a rigid housing for protection in shipping, handling and installation.

Each module shall have a one-piece neoprene gasket.

The power supply shall be integral to the LED module and shall be one piece.

Lens type for green, yellow and red vehicular indications (ball and arrow) shall be tinted. LED modules covered by this specification include the following types and all modules shall be "GE LED" type or approved equal.

12 inch Circular Red

12 inch Circular Yellow

12 inch Circular Green

12 inch Circular Red Arrow

12 inch Circular Yellow Arrow

12 inch Circular Green Arrow

16"X18" Countdown Pedestrian Modules

Contractor shall provide exact catalog number for each module provided.

B. Identification and Labeling

Each individual LED signal module shall be identified for Warranty purposes and clearly marked with:

- Manufacturer's name
- Date of manufacture
- Nominal operating voltage
- Unit serial number
- Operating voltage
- Power consumption in Watts. No indication may exceed 20 watts
- Manufactured in Conformance with the ITE LED Circular Signal Supplement, June 27, 2005
- Manufactured in Conformance with the ITE LED Vehicle Arrow Traffic Signal Supplement, July 1, 2007
- Manufactured in Conformance with the ITE LED Pedestrian Traffic Signal Modules, August 4, 2010

C. Certification and Testing Standards

All 12-inch circular LED Signal Indications shall fully and completely comply with all sections of ITE VTCSH LED Circular Supplement specifications dated June 27, 2005.

All 12-inch Arrow LED Signal Indications shall fully and completely comply with all sections of ITE VTCSH LED Vehicle NTOW Traffic Signal Supplement dated July 1, 2007.

All 16 inchX18 inch Countdown Pedestrian Signal Modules shall fully and completely comply with all sections of ITE PTSCI LED Pedestrian Traffic Signal Module Specifications dated August 4, 2010. Modules shall be fully compliant with CAMUTCD 2003 Section 4E.07 and be fully preemption compatible. The modules shall include a 6" visor. The modules shall countdown the flashing "Don't Walk" prior to clearance interval and shall fit into existing 16" traffic signal housing built to PTSCI standards without modification to the housing. They shall require no special wiring or electronic modules to operate.

All indications shall be tested to be in full compliance to all sections of the ITE VTCSH & PTSCI standards without exceptions and reports for each module shall be provided by the third-party tester. Test report must list the LED manufacturer's model number and the model number must match the bid model number.

D. Optical Visibility

All LED Arrow modules shall be OMNI-DIRECTIONAL. That is, an LED traffic signal module that provides the same luminous intensity signal to the driver regardless of the orientation of the arrow icon or placement of the circular indication.

E. Warranty

ALL LED traffic signal modules supplied shall be warranted for five (5) years against manufacturing defects.

Failures due to acts of God, abuse, and accidents are excluded from warranty coverage.

Vendors expressly warrant that all modules furnished shall be new, and shall be free from defects in material or workmanship.

Vendor shall replace or correct defects if any modules not conforming to the foregoing warranty promptly, without expense to the City, when notified of such non-conformity by the City.

In the event of failure of Vendor to correct defects in or replace non-conforming modules promptly, City, after reasonable notice to the Vendor, may take such corrections or replace such modules and charge Vendor for the cost incurred by the City in doing so.

For each defective module returned, one new module shall be returned to the City. Vendor shall pay shipping for both ways for modules found to be defective and under warranty.

Warranty shall commence from date of receipt of the modules by the City.

6.12 PEDESTRIAN PUSH BUTTONS (PPB)

6.12.01 PEDESTRIAN PUSH BUTTON ASSEMBLIES

Pedestrian push button assemblies shall comply with the following requirements:

1. Push button shall be "Polara Bulldog III" or approved equivalent.
2. Shall meet or exceed all ADA and CAMUTCD-2014 accessibility guidelines.
3. Shall have 2" (minimum) activator button.
4. Shall be furnished and installed by the contractor with all required fixtures and accessories to operate in momentary or latching mode.
5. Operating temperature range: -34° C to +74° C (-30° F to +165° F) • Operating force of less than 2.5 lbs. and a minimum release force of 3 lbs.
6. Telescoping, tamper-proof design.
7. Stainless steel plunger and components.
8. Dustproof, water resistant switch tested to 10 million cycles.
9. Shall require no additional wiring to each button (only two wires).
10. Powder coated black finish on switch housing unless otherwise specified by the City Engineer.

6.12.02 PEDESTRIAN PUSH BUTTON 5X7 FRAME ASSEMBLY

The following requirements shall apply:

1. House pedestrian push button cap and switch and most brands of pedestrian push buttons.
2. House a standard 5" x 7" pedestrian push button sign
3. Manufactured of die cast aluminum.
4. Provide with Philips head mounting screws.
5. Powder coated black
6. Fits traffic signal poles and pedestrian push button posts with diameter of 2-1/2" or greater.

6.13 INTERNALLY ILLUMINATED STREET NAME SIGNS

Each Internally Illuminated Street Name Sign shall be NuArt LED Edge Lit IISNS sign that is detailed in City Standard Plan ES-12. IISNS shall be installed per Caltrans ES-7P on the shaft of the mast arm. IISNS shall be furnished and installed by the Contractor.

Internally illuminated street name sign (IISNS) fixtures shall be 22-inch height and 72-inch or 96-inch length.

Fixtures shall have two street name panels with lettering background overlay shall be 3M ElectroCut Film Series 3630-126 (Emerald Green).

Panels shall be covered with 3M 1160 premium protective overlay film. Panels shall have powder coated black aluminum frames compatible with approved fixtures. Design specifications for the IISNS panels are shown on the City Standard Plan E-12. Text font shall be "ClearView; 3W 8" upper case street name and 2W 4" upper case street suffix. Each panel shall have only one street name in a single line of text, unless otherwise approved by the City Engineer. When opposing approaches have different street names, unique street name panels shall be used for each side of the intersection. The unique street name panel shall contain an arrow for the associated street. Street names placed on signs shall be approved through the City Public Works Department before panels are ordered and installed.

Type IV photoelectric control shall be provided on each IISNS fixture. The IISNS shall be illuminated by a solid-state high flux/high output ultra-high brightness white LED light engine panel.

The standard housing width will be a nominal 2.63" wide and 22" high (actual height 21.25"). Standard lengths are 72" and 96".

The complete fixture maximum weight will be as follows:

72" x 22": 53lbs 96" x 22": 65lbs

Lettering to be centered horizontally and vertically. A 1/2" white border will show around the entire perimeter of the sign panel after installed in the sign housing.

6.14 CAMERAS

The system should have at least one downward-facing fisheye sensor capable of seeing the center of the intersection and have an omnidirectional line of site to track vehicles entering and exiting the intersection. Other required features shall include the following:

1. Color images outputted into digital format as MJPEG images
2. Horizontal resolution of at least 2580 lines and vertical resolution of at least 1920 lines.
3. A five (5) megapixel CMOS camera with an active-pixel sensor (APS)
4. Camera lens shall not require adjustment and is always in focus
5. A thermostatically controlled heater residing inside the enclosure to reduce the effects of ice and condensation
6. Any plastics used in the enclosure shall have ultraviolet inhibitors
7. A waterproof and dust tight aluminum enclosure

6.15 SIGNS

Traffic signs on signal masts and arms shall be furnished and installed by the contractor. Installation shall be per Section 56 Signs of the Standard Specifications. Signs shall be 0.125" thick and shall be sized for a conventional road or as shown on the project plans. All sign sizes are subject to approval by the City Engineer. Sheeting shall be 3M Diamond Grade – DG3 with VIP legend and include 3M 1160 premium protective overlay film.

Existing signs on traffic signal poles or mast arms shall be removed or covered when they become obsolete or convey a message that misguides or misdirects traffic as directed by the City Engineer.

6.16 VEHICLE SPEED FEEDBACK SIGNS

Each Vehicle Speed Feedback Sign (VSFS) shall be Carmanah solar SpeedCheck-15 and shall be approved per location by City Engineer. VSFS shall be furnished and installed by the contractor as shown on the plans. VSFS shall be installed 2010 Caltrans ES-7B Type 1A poles and base.

Each 15" radar speed sign shall consist of a display enclosure that houses the LED boards, controller, radar, Bluetooth, and shall be available in DC or AC power options. Each 15" radar speed sign shall include a static sign mounted to the display enclosure. The 15" radar speed sign shall be pre-wired to the maximum extent possible. The 15" radar speed sign shall conform to all MUTCD provisions contained in Chapter 2L Changeable Message Signs for color, dimensions, and layout and Chapter 2B.13 for speed limit regulatory signs.

Detailed solar simulations shall be provided as evidence that the 15" radar speed sign is capable of meeting the performance requirements at a specific location. Solar Simulations shall be composed of three calculations: Energy Balance, Array-to-Load Ratio (ALR), and Autonomy. The manufacturer or bidder shall provide a detailed analysis of these three calculations in an "Energy Balance Report."

The battery cabinet shall house one sealed 12-volt valve-regulated AGM lead-acid maintenance-free battery. The battery shall be equipped with a fast-acting 7-amp cartridge fuse on the positive lead.

The battery, in conjunction with recommended 15" radar speed sign performance, shall be designed for a demonstrable service life of 5 years.

Included with installation shall be manufacture's software for data collection and reporting on the date, speed and time of vehicles, the number of daily vehicles, average daily volume, posted speed, average speed, vehicles within user-specified percentiles (typically 50th and 85th percentiles), and percent compliance. The software shall also filter and windowing of data for analysis.

6.17 RECTANGULAR RAPID FLASHING BEACONS (RRFB)

Each RRFB shall be a Carmanah Model R920-E and shall consist of a self-contained solar engine that houses the charge controller, flash controller, on-board user interface, wireless communications, batteries and solar panel. Each RRFB shall include either one or two light bars. The RRFB shall conform to all provisions of the MUTCD, Interim Approval IA-21 including WW+S flash pattern. The RRFB shall be pre-wired to the maximum extent possible. The RRFB shall also offer sufficient interior space to house third-party equipment and associated cabling and connectors.

The initial duration of an RRFB system shall be set to the following times during installation:

- 20sec – at 40-50ft wide streets with a posted/prima facie speed limit of 25-30mph
- 25sec – at 40-65ft wide streets with a posted speed limit above 30mph
- 30sec – at 65+ft wide streets without a median island

This initial setting does not restrict any engineering judgement of timing adjustments made after installation.

Detailed solar simulations shall be provided as evidence that the RRFB is capable of meeting the performance requirements at a specific location. The manufacturer or contractor shall provide a detailed analysis of these three calculations in an “Energy Balance Report.”

Mounting adapter hardware for the RRFB shall be available for the following configurations:

- Type 1A pole per Caltrans 2010 RSP ES-7B
- 2.5” Perforated Square Pole Mount

RRFB shall be mounted to a 13-15ft Type 1-A pole per 2010 Caltrans RSP ES-7B unless otherwise approved by City Engineer.

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