DIVISION 8

Traffic Signalization

Department of Public Works and Utilities
Engineering Division

DIVISION 8. TRAFFIC SIGNALIZATION

8-10 GENERAL:

All work to be in conformance with Sections 8-20 and 9-29 of the Standard Specifications for Road, Bridge and Municipal Construction (Current Edition), and to all revision and supplements thereto except as modified herein.

References here within this division to Engineer shall be to the City Engineer or their appointed representative.

8-20 OPERATION OF EXISTING SIGNAL SYSTEMS:

It shall be the responsibility of the Contractor to assure the continuous operation of any existing signal systems until activation of the new signal system or as required by the Engineer. This shall include but not be limited to any relocation of poles or equipment required by construction.

In the event that construction requirements necessitate a period of time when the signal system will be non-operational the "down time" must have prior approval of the Engineer. Contractor shall provide traffic control as required by the Bremerton Police Department at any time the signal system is not functioning.

8-30 APPROVAL OF SHOP DRAWINGS AND MANUFACTURER'S DATA:

Within fifteen (15) days following the date of Notice to Proceed, the Contractor shall submit to the Engineer for approval the complete list of material sources for all signal items to be employed on this contract.

Manufacturer's technical information shall be submitted to the Engineer for approval of all items to be included in the project. All approvals by the Engineer must be received by the Contractor before materials will be allowed at the job site. Material not approved by the Engineer will not be permitted at the job site.

Approval of shop drawings for signal work will require up to thirty (30) calendar days from the date the Engineer receives the drawing until they are returned to the Contractor. The actual time required for approval is dependent upon the completeness and appropriateness of the drawings as submitted.

Any deficiencies will require additional time for approval based on the degree of the deficiency and the additional review time required. If the shop drawings are returned to the Contractor to correct deficiencies, an additional 30 calendar days may be required for the approval process.

If more than 30 calendar days are required for routine approval of shop drawings that are completed and accurate, the Contractor will be granted an extension of time equal to the additional review time.

8-40 INSPECTION OF MATERIALS:

The City reserves the right to inspect the manufacturing process of all materials. Final inspection and acceptance of the installed materials will not be given until final installation and testing has been completed on the system.

Approval to install materials and equipment must be obtained from the Engineer at the job site before installation.

Appropriate insulation resistance tests shall be performed in accompaniment with the Engineer.

8-50 REGULATIONS AND CODE:

All electrical equipment shall conform to the Standards of the National Electrical Manufacturers Association (NEMA). In addition to the requirements of these specifications, all material and work shall conform to the requirements of the National Electric Code: Laws & Regulations for installing electric wires & equipment, of the Department of Labor and Industries, State of Washington; the American Standards Association Materials (ASTM); the American Standards Association (ASA); American National Standards Institute (ANSI); Standard Specifications for Road, Bridge and Municipal Construction (Standard Specifications); Standard Plans for Road, Bridge and Municipal Construction (Standard Plans); and any other City Ordinances or requirements of Puget Power and Light Company which may apply.

Prior to start of work, all necessary licenses, permits and approvals shall be obtained. The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work, the protection of adjacent property and the maintenance of all other facilities. The Contractor will be required to comply with all the provisions of these instruments and shall save and hold the City harmless from any damage which may be incurred as a result of the Contractor's failure to comply with all the terms of these permits.

8-60 EXISTING UTILITIES:

See Section 1-1.01 (8) and Section 1-2.10 (2) of these General Provisions.

No new fixture shall be constructed as part of this Contract which is in conflict with any existing Utilities Facility, or the code required thereby, until approved by the Engineer.

8-70 FIELD TESTING

8-70.1 System Activation: Before the signal system is activated for Traffic Control purposes, the Contractor shall perform all field tests specified in Section 8-20.3 (11) of the Standard Specifications.

When all tests have been completed to the satisfaction of the Engineer, the Engineer shall direct the authorized representative of the Contractor to activate the traffic signal system. Authorized City personnel shall be present to assure proper functioning.

The Contractor shall give the Engineer five (5) days advance notice of the capability of signal system activation.

8-80 TRAFFIC SIGNAL CONTROLLER ASSEMBLY

8-80.1 8-Phase Signal Controller/Nema: The controller shall be an Econolite Cobalt controller with advanced display, FSK Module , Data Key and TSP Data key. The units shall be constructed and shall operate in accordance with NEMA Publication No. TS1-1976 and Section 9.29 of the Standard Specifications. The supplier shall submit documentation with his bid detailing the brand and model number of the signal controllers proposed to be furnished for this project. The documentation shall include catalog cuts and operation details. The City reserves the right to reject any and all equipment that does not meet these specifications. All controllers shall be compatible with the Econolite Aries software.

Controllers and cabinets shall be equipped to operate to the full capacity of eight vehicle phases, four pedestrian phases and four overlaps with no additional equipment or major modifications and shall be capable of operating as a fully actuated, semi-actuated, or pre-timed unit. Each unit shall be delivered pre-set to operate in conformance with the phase diagram, sequence charts, and Table I for each location which are a part of these Specifications.

Two sets of controller/board schematics shall be included with the operations and programming documentation.

All cabinet and control equipment shall be designed to operate under the following conditions.

1. An ambient temperature range of -30F to +165F.
2. A relative humidity range of 5%-95% (without condensation).
3. A voltage range of 95 to 135 VAC RMS with a corresponding frequency ranges of 57-67 Hz.

The design life of all components shall not be less than five years of continuous 24-hour a day operation.

All external connections to the signal controller unit shall be made to terminals provided on the back panel. High pressure terminals shall be provided for field signal and primary power connections. Screw terminals shall be provided for all other connections.

8-90 CABINET AND AUXILIARY EQUIPMENT

8-90.1 General: All necessary equipment for the full capacity of the Controller and all auxiliary control equipment as specified in Section 9-29.13 (7) B of the Standard Specifications shall be furnished and installed in each traffic signal controller, except as modified or amended herein. Also required to provide interconnect capabilities, twisted pair, fiber, radio.

All equipment shall employ solid state circuitry including the flash transfer relay assembly and shall be commensurate with the quality of the controller specified herein.

8-90.2 Multifunction Management Unit (MMU): The MMU shall be a self-contained solid state device, external to the control, capable of detecting conflicting signal displays, displaying all field voltages at the same time on an OLED display, improper power supply

voltages from the controller, and lack of any red yellow or green indications. The unit shall meet the current NEMA TS2-2003 and TS1-1989 requirements for a Type 16L conflict monitor and these special provisions. The MMU will have an organic LED display and an SLDC and an Ethernet port on the front panel for connectivity. The unit shall monitor the green, amber, walks, short yellow intervals and the absence of red indications, as well as being programmable to monitor all conflicting phases' overlaps, and disable short yellow with a universal program board. All monitoring shall be on the field wiring terminals of the cabinet. When the monitor is triggered as a result of sensing conflicting displays, it shall place the intersection in emergency flash, stop time the controller, store and display on the front panel. The front panel display shall have separate indicators for red, yellow, green, and walk for each channel. The monitor shall retain this operation until reset by a front panel push-button, at which time the controller shall immediately take command of the signal displays.

The MMU shall also record the time and date of any incidents at the intersection. This information shall be viewable by a front panel display.

To prevent actuation of MMU due to the removal of electrical loads from monitored circuits, paralleling loads to lamp loads will be required. Those load switches serving single signal heads shall have five watt loads between signal circuit and neutral for the yellow, green, and walk circuit segments only. These loads shall serve to parallel the lamp load and shall prevent the conflict monitor from functioning in the event of a signal lamp burnout.

If additional protection is required, either in the form of increased loads (not to exceed 10 watts) per monitored circuit, or through other means, to assure proper function without malfunction of the conflict monitors, such shall be provided. In addition to all other requirements stated herein for conflict monitors, the use of fluorescent signal cabinet lights is prohibited. Signal cabinet lights shall be an approved LED type.

8-90.3 Load Switches: Load switches shall be specified per NEMA TS2 part 5 and these Special Provisions. The load switches shall operate in a temperature range of -20 F to 165 F and have an individual switch capability of 1,000 watts tungsten lamp load. Only optically isolated load switches will be allowed. Each load switch shall be provided with LED indicators on the input and output of each circuit.

8-90.4 Cabinet Fan Assembly: The cabinets shall be equipped with an electric fan assembly with a minimum capacity of 100 cubic feet per minute. The fan shall be mounted on the top of the cabinet in a manner to prevent rain from entering the cabinet. Each cabinet shall be provided with louvered filtered vents in the front door. The fan shall be thermostatically controlled and shall be manually adjustable to turn on between 90 degrees and 150 degrees Fahrenheit. The cabinet fan circuit shall be fused at 125 percent of capacity of the fan motor.

8-90.5 Load Bay: A load bay and controller interface panel shall be provided with 16 load switch positions. Each load switch output shall be wired to fused field terminals providing for 8 vehicles, 4 pedestrian and 4 overlap movements. Fused terminals shall be provided with 5 amp fuses. Both the front and back of the load bay shall be labeled with all terminal/pin numbers. Four additional fuses shall be provided. The emergency vehicle light circuits shall also be fused independently for 5 amps.

A jumper plug system utilizing Molex connectors shall be installed on the load bay that will facilitate the simple programming of the flashing indications. This shall apply to all vehicle signal indications. Changing the flash from red to yellow shall not require major disassembly or rewiring of the cabinet. Cabinet will be programed for all red flash and 4 spare Molex connectors for yellow flash.

The terminal blocks provided shall be two-position, twelve-pole barrier type or single-position, feed-through type. Terminal blocks shall be so arranged that they shall not upset the entrance, routing, and connection of incoming field conductors. All terminals shall be suitably identified and shall be permanently associated with the terminal block. No more than three (3) conductors shall be brought to any one (1) terminal screw. No electrically live parts shall extend beyond the protection afforded by the barrier. Terminal blocks used for field wiring connections (field terminals) shall be capable of securing conductors with 6-32 or larger, nickel, or cadmium-plated brass binder head screws.

Terminal blocks used for the applied AC power shall be capable of securing conductors with a 10-32, or larger, nickel or cadmium-plated brass binder head screws. There shall be twelve-position field terminal blocks for the connection of loop detectors. A minimum of 12 spare terminals shall be provided.

Two equipment grounding buss shall be provided in each cabinet. The ground buss shall be grounded in the cabinet, and shall provide at least fourteen (14) terminals each. Ground buss will be located one on each side of the cabinet.

All number identifications for the terminal blocks shall be silk screened or engraved on the terminal block board.

8-90.6 **Power Panel:** The cabinets shall have a power distribution panel containing the following elements:

a. 50 amp radio interference suppressor
b. 40 amp main circuit breaker
c. 20 amp auxiliary circuit breaker
d. Solid state flash transfer relay
e. Neutral buss bar isolated from the cabinet
f. Transient voltage protector
g. Cover
h. 20 amp Video circuit breaker
I 15 amp Equip. circuit breaker

The solid state flash transfer relay shall normally be closed and capable of switching 75 amps, 120 volts AC. The two neutral buss terminals shall be easily accessible and provided with at least 14 terminals, and shall not be grounded to the cabinet 1 neutral bus on each side of the cabinet. An additional AC neutral buss with twenty (20) positions shall also be provided.

8-90.7 **Transient Protection:** The transient voltage protectors shall be installed to protect all electrical components within the cabinet from voltage abnormalities of less than one-half cycle duration. The protectors shall be solid state, high-energy circuit, containing no spark gap, gas tube or bar component. Normal service capacity shall be not less than 15 amperes.

The protection provided shall be a transient suppression of 200 volts peak, a transient response of less than five (5) nanoseconds, a power dissipation of 10,000 watts. The protector shall function with 10 x 1000 microsecond wave from clamping no greater than 200 volt peak.

8-90.8 Police and Auxiliary Panel: The cabinets shall have an auxiliary maintenance panel located inside the door and a panel located outside the door containing the following elements:

1. Police Panel (outside)
    a. Auto / Flash switch
2. Auxiliary Panel (inside)
    a. Convenience outlet with ground fault interrupted protection rated at 25 amps
    b. Auto/Flash switch
    c. Rest green/red switch
    d. Stop time switch
    e. Controller On/Off
    f. Vehicle detector input switches
    g. EPV input switches
    h. Ped detector input switches

8-90.9 Police Flash: Two Flash-Automatic switches shall be supplied. One switch shall be located behind the Police panel door.

When this switch is turned to FLASH position, the signals shall immediately revert to flash; and stop-timing will be applied to the Controller. When the switch is placed on AUTOMATIC, the signals shall continue to flash for an additional eight-second flash period. At the completion of the continued eight-second flash period, unless otherwise specified, the Controller shall immediately resume normal cycle operations at the beginning of artery green.

8-90.10 Auxiliary Panels: The second Flash-Automatic switch shall be placed on the Maintenance Panel. When this switch is placed on the FLASH position the signals shall immediately revert to flash; however, the Controller shall continue to function. When the flash automatic switch is placed in the Automatic position, the Controller shall immediately resume normal cyclic operation.

The controller on/off switch shall be a two (2) position toggle switch labeled "Controller On/Off." In the ON position, the controller shall run normally. When placed in the OFF position, AC+ power shall be removed from the controller and flash power AC+ shall be applied to the flash transfer relays, causing the signals to go on flash. When placed from the OFF to the ON position, the controller shall sequence through power up. The Controller power switch shall be electrical interconnected with the inside AUTO-FLASH switch such that the Controller power switch will only remove power from the Controller when the inside AUTO-FLASH switch is in the FLASH position.

The rest green/red switch shall be labeled "Rest Green/Red." In the rest green position, the controller with a lack of calls shall rest in the last phase green. Within the rest red position and with a lack of call, "Call-A-Way" shall be applied and the signals shall display all red.

The stop time switch shall be a three position switch labeled OFF-AUTOMATIC-ON. When the switch is in the AUTOMATIC position, the controller will sequence automatically; when the switch is in the ON position stop time will be applied; and when in the OFF position stop time shall be removed from the controller. Labels for all switches shall be applied via a silk screen or engraving process.

8-90.11 Detectors: The cabinet mounted equipment shall consist of 2-8 position card racks, 2 channel detector modules, and wired for 2 channel operation. Switches with separate operate, test, and OFF positions shall be provided for each field detector input circuit as a plug in card module in the vehicle detector racks. A display LED indicator lamp will be provided for each switch and will illuminate upon vehicle, pedestrian or test-switch actuation. The test-switch shall provide a spring-loaded momentary contact that will place a call into the controller. When in the OFF position, respective detector circuits will be disconnected. In the operate position, each respective detector circuit shall operate normally.

Each detector unit will be model C-1200 series and shall include two complete detector channels, detector switch panels will be model SP301 manufactured by Reno A&E or most current models and 24-volt power supplies.

The detector module shall incorporate LED display, minimum eight sensitivity settings. The system shall be capable of operating in four modes: Presence, Extended Presence, Pulse, and Inhibited Pulse.

All such units shall be rack mounted in the controller cabinet. Rack shall be wired to accommodate two (2) channel Detector Units.

Each channel shall sequentially energize its loop inputs to eliminate crosstalk (mutual coupling) between large, very closely spaced adjacent loops connected to the same unit. The sequential time sharing and digital processing of loop inductance data shall be accomplished on a single LSI micro-circuit per unit for maximum reliability. The method of measurement shall be crystal reference digital period counting, multi-channel scanning. Only one channel input per unit shall be active at any point in time.

8-90.12 Emergency Vehicle Pre-Emptions: Controller cabinet will be wired for discriminator modules. If the units are not compatible with the optical emitters presently mounted in the Fire Station vehicles and Transit agency vehicles, either the units shall be adequately modified or auxiliary equipment supplied and interconnected such that they are compatible.

All such units shall be rack mounted in the controller cabinet. Rack shall be wired to accommodate two (2) two (2) channel units or one (1) channel unit of the newest version manufactured by 3M Opticom. No daughter board units will be allowed.

Discriminator modules shall supply power to and received input from the detectors. Each module shall incorporate connections for four optical detectors, one for each channel. Have an auxiliary board to facilitate advance detectors. When valid detector signals are recognized by the module, they shall provide an output to the controller through an optically isolated NPN transistor.

The discriminator module shall incorporate the following features:

1. Four channels

2. Two priority levels. Priority I vehicles shall produce a 6.25 Hz output, while higher Priority II vehicles shall produce a steady ON condition. Priority demand shall be provided on a first come, first served basis. At all times, Priority II vehicles shall have precedence over Priority I vehicles when both are active.

3. Capability for assigning one of the two priority levels to traffic movement on any of the four channels.

All pre-emption equipment shall be completely wired together and interfaced with the controller to provide a properly functioning system.

8-90.13 Display Panel: A display panel showing signal indications shall be included. The intersection panel shall depict the general intersection layout, street name, phase and overlap identification, and north arrow.

Appropriately colored, LED indicator lamps for each red, amber, flashing amber arrow, green, walk and don't walk, for every phase and overlap, shall be provided. The locations of the display lamps on the panel shall simulate the field locations of associated signal displays. The intersection display LEDs shall be wired to appropriate field wire terminals. The panel shall be located on the inner side of the door. Switches shall be provided on the panel with labels and functions as follows:

a. Display On-Signal indicator LEDs will display the exact operation of the intersection.
b. Test-All signal indicator LEDs shall be energized.
c. Display Off - All signal indicator LEDs shall be de-energized.

The display panel shall include an approved means of disconnecting all wiring entering the panel.

All display LEDs shall turn off when the cabinet door is closed by a door switch or automatically extinguish after a 15-20 minute period of non-use.

8-90.14 Installation: All wiring harnesses, brackets and other devices necessary to mount the equipment in the controller cabinet and to make all electrical and mechanical connections shall also be supplied, installed and connected.

All rack equipment to be installed in the controller cabinet shall be securely mounted and readily accessible. All wiring shall be neatly cabled together and securely fastened to the cabinet or other support structures.

8-90.15 Documentation: Included with the cabinet wiring diagrams shall be schematic diagrams for load switch bay circuit back panel, all detector amplifiers, MMU, flashers, load switches, auxiliary control panels and pre-emption circuits.

All diagrams shall contain a parts listing unless the part number is shown on the parts. Parts that are not common items available in stores shall have the vendor's name and address listed within the parts listing for said part. One reproducible mylar and three sets of blueprints shall be provided.

One reproducible on mylar and a compact disk with an AutoCAD compatible drawing file and in a PDF format and DWG(if available) of the as-built cabinet wiring diagram and component wiring diagram shall be furnished with each cabinet. Each cabinet shall be equipped with a plastic envelope to house one or more cabinet wiring diagrams. The cabinet wiring diagram shall indicate and identify all wire terminations; all plug connectors and the locations of all equipment in the cabinet. Included in the diagram shall be an intersection sketch identifying all heads, detectors, and push buttons; and a signal sequence chart.

8-90.16 Communications: The communications ports on the controller will be the controller manufactures FSK telemetry unit, data key, Ethernet port with the most current version of software.

The unit shall be configured for four wire, multi drop, operation and lightning arresters shall be provided at the field connection point for the four wire interconnect.

8-90.17 Extra Components: The Supplier shall submit with his bid proposal a list of spare parts he recommends the City stock for maintenance of these intersections. The list shall include a current price list with any discount that may apply. Prices included on this list shall not be used in determining award of the bid. The list shall include, but not be limited to, the following:

1. Module circuit boards
2. Indicator lamps where applicable
3. Solid state flasher
4. Malfunction Management Unit
5. Solid state load switches
6. Four / Two channel loop detector amplifiers

No spare parts are to be supplied with this bid proposal.

8-100 TESTING OF TRAFFIC CONTROLLER:

The Contractor shall deliver the traffic signal controller mechanism and signal controller cabinets involved in this contract for bench testing to the Electronics Department, City of Bremerton. The Contractor shall totally assemble all control mechanisms and connect signal load terminals to lamps simulating the traffic signal displays to be constructed over the roadways. The Contractor shall then demonstrate the total functions of all equipment required by the contract. The demonstration shall evidence all signal displays, overlapped displays, pre-emption sequences, etc., as required within this contract, flashing displays, other special sequence displays as may be defined within this contract, vehicle detector function and minimum and maximum timing performance of every timing element required by this contract. The test demonstration shall first be conducted at normal design voltage of the equipment and thereafter repeated at +15% and -15% of that design voltage.

Every module or device, i.e., synchronization units, special sequence units, flash relay assembly, special timers, etc., shall have affixed thereto name tags or name plates stating the component's function within the composite signal device.

The Contractor shall notify the Engineer five (5) working days in advance of the functional demonstration, and shall make available to the Engineer before the start of functional demonstration four (4) complete sets of the following diagrams, manuals and any other technical data necessary for use by City personnel who will witness the functional demonstration:

1. Wiring diagram for composite system.
2. Service manuals for all composite parts.
3. If electronic logic external to controller mechanisms is used to obtain signal functions, logic diagrams identifying all gating and Switching performed by the logic components shall be provided.

Satisfactory performance of all functions required by the foregoing demonstration shall be considered at the start of a ten-day evaluation test period. If malfunction of any component occurs within the ten-day evaluation test period the test shall stop at the time of component malfunction and shall not resume until the Contractor has caused the defective component to be repaired or replaced, as directed by the Engineer. If any component malfunctions or breaks down within the last 72 hours of the test period, the test shall stop until the defective component has been repaired or replaced, and the test shall be resumed for a minimum of 72 hours continuous satisfactory operation.

Even though this may extend the ten-day evaluation test period under no condition shall any part of the signal control mechanism be disassembled and/or removed from the demonstration site until the foregoing test has been satisfactorily concluded, and shall include the final 72 hours trouble-free operation of the entire, integrated signal control mechanism.

The demonstration by the Contractor of all components functioning properly shall not relieve the Contractor of any responsibilities relative to the proper functioning of signal control equipment when field installed. Upon satisfactory completion of the test, it shall be the Contractor's responsibility to transport all signal control enclosures from the City of Bremerton's Electronics Department to the project. All costs of the functional demonstration and evaluation test shall be included in the lump sum bid.

8-110 TRAINING SESSION:

The Contractor shall arrange for the signal manufacturer's local authorized representative to conduct a minimum of 8 hours of training session in the theory of operation and the maintenance of the traffic signal controller equipment. The Contractor shall provide the Engineer no less than five (5) working days advance notice prior to the presentation of the training session. Those personnel in attendance at the training session shall be provided complete manuals and other material necessary for operation and maintenance of this equipment. The training session shall occur during the ten day shakedown period of the control mechanism as discussed elsewhere herein. The training session shall be held at the Electronics Department, City of Bremerton.

The above described minimum eight (8) hour training session shall be considered incidental to other bid items on the proposal.

8-110.1 Additional Training: In the event that additional training time is required by the City in the use and operation of intersection controllers including programming, general equipment maintenance and/or diagnostic equipment, the Contractor shall arrange for the signal manufacturer's local authorized representative to provide a minimum of four (4) hours additional training at a location agreeable to the City.

Bid price shall be per hour of additional training time.

8-120 CONTROLLER CABINETS

8-120.1 Pad Mounted Cabinets: The 8-phase traffic signal controllers and accessories shall be housed in Type P pad mounted, single door, weather-proof, outdoor cabinets manufactured by Cascade Signal Corp. of WA. To the city of Bremerton layout standard with adequate shelf space to accommodate all controllers and auxiliary equipment called for in these provisions and contract plans including a retractable drawer to hold drawing and a laptop computer. Nominal external dimensions shall be: width-44", depth-26", height-65".

The concrete pad shall have 36” of pad on door side of cabinet and a minimum of 12” on all remaining sides. The side walk can be included in the pad size. The door shall not face the street side

The outside of the housings shall not be painted. The inside shall be painted white with two coats of factory applied aluminum paint. The cabinets shall be constructed of sheet aluminum at least 0.125 of an inch thick and adequately reinforced.

The main cabinet door shall be provided with a BEST blue construction lock. Cast cabinets shall have an approved one point positive latch. Formed cabinets shall have a three point latch. The auxiliary door shall be equipped with a lock for a standard police key. Two (2) keys shall be furnished for each police door lock. When the door is closed and latched, with the key removed, the door shall lock. The Contractor shall furnish two (2) keys for the main cabinet door.

Four (4) Best Cores will be ordered with City of Bremerton Specifications for Installation after construction.

The cabinets shall be equipped with a door stop assembly to hold the door open at 90 degrees and at 135 degrees.

All cabinet wiring harnesses shall be neat, firm and routed to minimize "crosstalk" and electrical interference. Printed circuit mother boards may be used to eliminate or reduce cabinet wiring. All conductors and live terminals, or parts which could be hazardous to maintenance personnel, shall be covered with suitable insulation material.

8-130 VEHICLE DETECTION SYSTEM:

The vehicle detection system and equipment shall conform to all criteria contained in Section 9-29.18 of the Standard Specifications and including the City of Bremerton Design Standard details 8001, 8002, 8003, 8004, 8005 as included herein.

Vehicle detection equipment compatible with field installed induction loops and lead-in cables shall be furnished and installed in the controller cabinet.

The equipment, when used in conjunction with the field installed loops, shall be capable of detecting the presence or passage of automobiles, trucks, motorcycles, and bicycles.
The electronic circuitry shall be self-tuning to compensate for changes in environmental conditions, including temperature, humidity, and stalled vehicles.

The system components shall be capable of operating on 120 volt AC+10%, -15% and shall function normally without manual adjustment in a temperature range of -20F to 165F.

Detector units shall have optically-isolated transistor outputs.

Relays shall be used for interface with electro-mechanical controllers, traffic counters, parking gates, etc.

Optically isolated outputs may be specified for interface with existing or new solid state controllers and computer systems.

Controls for selection of sensitivity, mode of operation, and reset/circuit breakers shall be front panel accessible. The front panel shall include an erasable, write-on channel identification area and clearly indicated switch operating positions via the LCD display on each unit.

Sequential scanning shall fully prevent crosstalk between channels of a detector connected to closely spaced or overlapped loops for directional detection.

Sequential scanning shall allow two detection channels to operate with full performance using a common four conductor home-run cable.

Sequential scanning shall allow two or more detection channels to be connected to a single detection loop with full operating performance, including separate mode and sensitivity selection capability on each channel.

Each channel of the sensor unit shall automatically self tune to any loop and lead-in inductance from 20 to 2000 micro henries within 10 seconds after application or interruption of supply voltage. Units shall also track changes in loop/lead-in electrical characteristics, as might reasonably be expected to occur in undamaged loops, properly installed in sound pavement, without producing false indications or changes in sensitivity.

Each channel shall retune and detect properly, immediately following reconnection of the broken (open) circuit. Previous "open" loop/lead-in connections shall be held in memory for recall and verification via a front panel "open loop test" switch.

Each detector unit shall be provided with a loop test switch position to verify loop system integrity and reduce maintenance costs. The "open loop test" position shall indicate a previous fault via the front panel indicator. The memory shall remain intact and can be queried repeatedly. Existing detections shall not be reset and the memory shall only be reset by power interruption as by pressing the circuit breaker/reset button on AC powered units, or removing and re-inserting the plug-in detector units.

Each channel shall have the capability to allow selection of 8 Pulse sensitivities, 7 Presence levels and an "Off" position. The sensitivity setting shall offer 2:1 steps over a range of 128:1 to enable selection of the proper sensitivity (threshold) to insure detection of all licensed motor vehicles (including 70cc motorcycles) without detecting automobiles in the adjacent lane, moving or stopped, within 36" of the loop(s) described in the following configurations, each with 50', 500', and 1000' of lead-in cable.

Three-turn Square loops:

- Single 6'x6' loop
- Four 6'x6' loops
- Four 6'x6' loops
- Three 6'x6' loops for left turn applications

Three-turn Round Loops:

- Single 5'x5' loop
- Four 5'x5' loops - Series/Parallel connected
- Four 5'x5' loops - Series connected
- Three 5'x5' loops - in series with special bicycle loop

Two-turn loops: (note) Long loops require special configuration to insure adjacent lane rejection (i.e., left turn lanes).

- Single 6'x30' loop
- Single 6'x30' loop (2-4-2 wire count)

8-140 EMERGENCY VEHICLE PRE-EMPTION EQUIPMENT

8-140.1 General Operation: The emergency pre-emption equipment shall provide signal operation and display as indicated in these Specifications.

Activation of the pre-emption equipment shall cause the signal to sequence as follows:

The phase or phases which are in the green interval and are not to be in the green interval during the pre-emption mode shall immediately begin a yellow clearance interval before displaying red. Such pre-emption shall not take place during the timing of initial or yellow clearance.

The phase or phases which are in the green interval and are to be in the green interval during the pre-emption mode shall remain in the green interval.

The phase or phases which are in the red interval and are to be in the green interval during pre-emption mode shall advance to the green mode immediately following display of the red indication on any conflicting movements.

When the signal display conditions specified for a particular detector actuation have been completed, the indicator light (specified later) associated with that detector shall be activated by a solid state output and indicate a steady light throughout the pre-emption mode.

Termination of the pre-emption mode shall cause the controller to immediately provide the normal clearance interval for the pre-emption phase displayed. The controller shall then advance to the next phase to which it would normally proceed following this phase. Manual switches shall be provided in the controller cabinet to simulate remote emergency pre-emption input.

The indicator light shall not be activated until immediately after the intersection signals are displaying pre-emption conditions associated with the phase activated by the pre-empt detector.

8-140.2 **Detectors**: The unit shall be capable of receiving optical pulses from an OPTICOM emitter and converting these signals to electrical impulses compatible with the other control equipment. The unit shall employ solid state circuitry and shall have a detection range adjustable between 1800 feet and a few feet. The detector shall be capable of receiving an impulse from an emitter located within an area approximately 120 feet on each side of the detector centerline at 1800 feet distance from the detector. Detector units will be of the newest version manufactured by Opticom.

8-140.3 **Indicators Light**: A light shall be provided which will indicate to approaching emergency vehicles that the signal has advanced to the pre-emption mode associated with the corresponding detector. The housing shall be constructed of cast iron or aluminum. All cast iron parts shall be galvanized while all fasteners shall be galvanized or stainless steel.

Indicator lamps Use Sylvania LED PAR20 36 120v 8W”

A neoprene gasket shall be installed between the lens and housing which will provide a watertight seal when the lens is secured in position.

The entire unit shall be weather tight and vibration proof.

8-150 FOUNDATION FOR CONTROLER CABINETS:

The base foundation shall conform to State of Washington Standard Plans and Sections 8-20 and Section 6-02 of the Standard Specifications. Except foundation will include a pad for maintenance of the cabinet, minimum size is cabinet depth plus 12” on each side and 36” on door side. All foundations will include a 3/8” diameter plastic drain.

8-160 EQUIPMENT:

The equipment comprising a Traffic Controller Assembly shall be identical to that specified in these Specifications and shall include, but not be limited to:

8-phase controller and all auxiliary equipment described in Section 8-80 of these Specifications.

Controller cabinet as described in these Specifications.

Electrical Service as described in Drawing 8007 and in the City of Bremerton Division 7 Street Lighting Specifications.

Vehicle detection equipment as described in Section 8-90 & 8-130 of these Specifications.

Emergency vehicle pre-emption and transit pre-emption equipment as described in Section 8-90 & 8-140 of these Specifications.

All equipment shall be assembled, tested and delivered to the City of Bremerton Electronics Shop in Bremerton ready for operation. All equipment shall be capable of providing full 8-phase operation as described herein.

8-180 WIRING & UNDERGROUND SYSTEMS

8-180.1 Vehicle Detector Loops:

8-180.1(A) Materials: All wiring for loop detectors shall comply with the requirements of Section 9-29.3 (7) and (8) of the Standard Specifications.

8-180.1(B) Installation: All vehicle detection loops shall be completely installed by the Contractor including saw-cutting, laying-wire, testing and sealing. Splices will be allowed only where unshielded loop wire is joined to shielded lead-in wire in the closest junction box. All splices will be made is a ridged 2 piece plastic resin filled tank

Proper installation of vehicle detection loops is vital to the performance of the controller and special care shall be used at all times. Special instructions given by the Engineer and these Special Provisions shall be adhered to.

Loop installation shall conform to Manufacturer's recommendations.

Conductors of lead-in pairs from all loop detectors shall be identified by the following labeling practice. Where the detector loop wires from the clockwise laid loop, by convention, enter the curb side of the junction box and connect to shielded lead-in cable, each twisted pair of loop wires shall be coded with PVC sleeve bearing as its identification the loop number indicated on the wiring schematic drawings. Vehicle loop detector wire shall be placed in the roadway in accordance with the Plans and City of Bremerton Standard Plan 8005. The loop location shall not be altered by the Contractor without the express permission of the Engineer.

After the lead-in and loop saw-cuts are completed, the slot shall be thoroughly blown out with 100 PSI air pressure. Any rocks or sharp protrusions shall be removed. If traffic is allowed to travel over the saw cuts, they shall be blown out again before placement of the wire and sealing.

The wiring shall be installed with a blunt nosed wooden wedge. Care shall be taken not to pull the wire. There shall be slack at each corner.

All loops shall have the insulation resistance tested at 500 volts D.C., and installation approved by the Engineer before filling the saw-cuts with crack pouring compound. Acceptable tests will measure between 100 megohms and infinity. The Contractor shall furnish the Engineer with three copies of the test results. Proper performance of the loops shall be the responsibility of the Contractor but no additional payment shall be made to the Contractor for additional work required to make the loops operable.

Saw cuts shall be filled with crack pouring compound before being exposed to traffic, where possible. The Contractor shall take care to ensure that no air bubbles or foam are entrapped in the saw cut. Crack pouring compound shall be approved by the Engineer. Acceptable crack pouring compounds are:

1. CRAFCO #34271 Loop Sealant or approved equivalent.

8-180.1(C) Testing: All amplifiers shall be tested at the Electronics Department, City of Bremerton, Washington.

A test shall be made of the inductance of the loop and recorded in the Electrical Inspector's Handbook upon completion of each amplifier circuit. Testing shall conform to Section 8-20.3 (14) D Standard Specifications.

All tests shall be performed by the Contractor in the presence of the Engineer for each loop. The tests shall be performed at the amplifier location after complete installation of the loop. All costs associated with testing shall be incidental to the unit contract prices of the respective bid items.

Test A - The DC resistance between the two lead-in cable wires will be measured by a volt ohmmeter. The resistance shall not exceed 10 OHMS.

Test B - An insulation resistance test at 500 Volts DC shall be made between the lead-in cable shield and grounding prior to connection to grounding. The resistance shall equal or exceed 100 megohms.

Test C - A megger test shall be made between the loop circuit and grounding. The resistance shall equal or exceed 100 megohms.

Test D - An inductance test to determine the inductance level of each inductance loop. The Contractor shall record the inductance level of each inductance loop installed on the project and shall furnish the findings to the Engineer. An inductance level below 150 microhenries is considered a failure for a Type 1 loop, any one round loop and an inductance level below 75 microhenries is considered a failure for a Type 2 loop.

If any of the installations fails to pass all tests, the loop installation and/or lead-in cable shall be repaired and replaced and then retested.

Detection shall be positive for all vehicles passing through the loop from 0 to 80 miles per hour. Detection shall be positive for all classes of vehicles from motor bikes to tractor-trailer combinations.

8-180.2 Conduits: Installation and material shall conform to Sections 8-20 and 9.29 of the Standard Specifications, except as modified herein and to appropriate articles of the latest edition of the National Electrical Code.

Conduit to be installed underground across roadways or across driveway shall Schedule 80 PVC conforming to the National Electrical Code. All conduit installed underground shall have Polyethylene Underground Hazard Marking Tape, 6 inches wide, legend "Caution-Electric Line Buried below", placed approximately 12" above the conduit.

Conduit to be installed above ground shall be rigid metal type conforming to Article 346 of the National Electrical Code and must contain an equipment ground conductor with a minimum size of 8 awg insulated copper.

Conduit installed underground along the edge of the roadway shall be PVC non-metallic conduit Schedule 80 unless otherwise noted in the wiring schedule and must contain a equipment ground conductor with a minimum size 8 awg insulated copper.

Conduit installed underground outside the driving area of the roadway shall be PVC rigid non-metallic conduit Schedule No. 40 unless otherwise noted in the wiring schedule and must contain a equipment ground conductor with a minimum size 8 awg insulated copper.

P.V.C. conduit shall conform to the National Electric Code.

Size of conduit shall be as shown on the Plans, but not less than that required to meet the requirements of the National Electrical Code.

A 200 pound minimum breaking strength Pull string with footage measurements shall be installed in each run of conduit between junction boxes.

Conduits will have foam plugs installed in all unused conduits and duct seal or foam plugs in all conduits with conductors.

8-180.3 Conductors: All electric cables and conductors used through this project shall conform to the requirements of Section 9-29.3 of the Standard Specifications, except as required elsewhere in these Special Provisions. The conductor insulation shall be of the respective (red, yellow, green) colors as specified in the schematic wiring diagram.
Five (5) conductors (IMSA Spec. 19-1 or 20-1) shall be used for signal head circuits.

Wiring schedules have been included on the plan sheets to aid the Contractor. If there should be a discrepancy between the wiring schedules and the wiring diagram, the wiring diagram shall govern.

Every end of every conductor at each wire termination, connector or device shall have a PVC wire marking sleeve bearing as the legend the circuit number indicated in the wiring schematic drawings. If the Contractor elects to put in additional spares, spare conductors shall be numbered consistent with the approved schematic wiring diagram as described herein. In

addition to the foregoing, where terminal strips also bear the circuit number consistent with the wiring schematic the field wiring terminal in the signal cabinet shall be numbered consistent with the Contract plans.

All cabinet wiring harnesses shall be neat, firm and routed to minimize "crosstalk" and electrical interference. All wiring shall be neatly cabled together and securely fastened to the cabinet or other support structures.

The Contractor shall provide red-lined print of the wiring diagram showing as-built information of the field wiring prior to the acceptance of the job by the City.

8-180.4 Splicing: No splicing of any traffic signal conductors or detector conductors shall be permitted, including service wires.

Only terminal boards with pressure type binding shall be used in any conductor for signal heads or detectors. The only exception shall be the splice in detector loops at the nearest junction box to the buried pavement induction loop. See Standard Plan J-50.

8-180.5 Concrete Junction Boxes: Concrete junction boxes shall conform to the requirements shown on the State of Washington Standard Plans. The cover plates shall have the letters "TS" welded to them and will be locking with a SS penta head bolt. All exposed steel will be galvanized by the manufacturer. Boxes shall be of sufficient size to easily accommodate required conduit or as specified on the plans. All Junction Boxes will have a minimum of 6” pea gravel pad underneath.

Conduits terminating in concrete junction boxes shall terminate not less than five inches nor more than nine inches below the lid of the box. Every conduit entering such boxes shall be neatly upswept and contain an equipment ground with a minimum size 8 awg. The only conduit bends permitted shall be either factory bends or those formed by the use of an approved conduit bending tool employing correctly sized dies. Conduit entering any electrical enclosures shall be positioned to avoid bending or cutting cabinet braces and cross members that are formed as a part of the electrical enclosure or its pedestal. Such bending or cutting is expressly prohibited.

8-190 EXISTING PAVEMENT AND PAVED SURFACES:

The installation of conduits and associated junction boxes, signal poles, and conductors may require the removal of certain already paved and/or landscaped surfaces. It shall be the responsibility of the Contractor to make such removals as is required for his work and perform temporary patching and maintenance. Permanent repairs will be made by the Contractor in conformance with Section 3-3.5, after all tests have been satisfactorily completed and before acceptance of the work. Removals and repairs performed in the course of signal installation shall be incidental to the lump sum bid for the signal system complete.

Where asphalt concrete paving is included in the contract, all installation of conduits, induction loops, etc., requiring pavement sawing or trenching shall be completed prior to the final overlay.

Pavement patching shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel.

8-200 SIGNAL DISPLAY

8-200.1 Traffic Signal Heads: All traffic signal heads employed on this project shall be 12 inch heads and shall be consistent with the requirements of Section 9-29. of the Standard Specifications and the State of Washington Standard Plans and as indicated on the Contract Plans with the exception that all vehicles displays be made up entirely of led and all arrow indications to be 3 row design by the same manufacturer. Each signal head shall have 3/16" drain hole.

Polycarbonate traffic signal heads, visors or lenses are not acceptable.

Mounting of traffic signal heads shall conform to 9-29 Standard Specifications for mast arm and span wire mounted signals. The heads shall be adjusted in the field, such that a person standing on the pavement, a distance four times the speed limit in feet from the stop bar, shall see the brightest image of the red section. All heads shall be plumbed as viewed from the direction in which they face. Leveling of all signal heads shall be by reference to the red signal sections.

8-200.2 Back plates: Traffic signal heads shall be furnished with back plates as shown on the Plans. Back plates shall conform to Section 9-29 of the Standard Specifications.

8-200.3 Pedestrian Heads: Pedestrian signals shall be LED countdown, modular type, with international symbols and shall conform to the requirements of 9-29 of the Standard Specifications with the exception that aluminum housings shall not be required and the displays are made entirely of LED's. Housings of equal quality shall be considered for approval. Housings shall be mounted such that normal access to the interior is provided.

8-200.4 Pedestrian Push-Button: Where shown on the Plans, pedestrian push-button conforming to Section 9-29 of the Standard Specifications, Current Edition, and State of Washington Standard Plans, and be Campbell Advisor AGPS57YR10-3E shall be furnished and installed. Verify all mounting heights prior to installation with the City of Bremerton Engineering Division.

8-210 TRAFFIC SIGNAL STANDARDS WITH MAST ARMS:

All Signal standards with mast arms will have junctions as shown on City Standard Drawing 8006. Signal arm traffic signal supports with signal mast arm lengths less than 45 feet and with projected wind load areas, including future back plates, less than the allowable values indicated in Standard Plans section J may be fabricated in accordance with the methods and materials specified in Standard Plans section J, provided all other requirements, of the Special Provisions are also satisfied, in conformance with the following pre-approved plan:

Pre-Approved Plan	Fabricator
Drawing No. TB-10164-R	Union Metal Manufacturing Co.
Drawing No. 5000-1-R	Valmont

Combination single arm traffic signal pole and luminaire standards with single mast arm lengths of less than 45 feet; with laminar mast arm lengths of less than 16 feet; and with projected wind load areas, including future back plates, less than the allowable values indicated on Standard Plan J, may be fabricated in conformance with the methods and materials specified in the following pre-approved plan, at the specified mounting height, provided all other requirements of the Special Provisions are satisfied:

Pre-Approved Plan	Fabricator	Mounting Height
Drawing No. 71026-F2-R2	Union Metal	
Drawing No. 5000-1-R1	Valmont	40 and 50 feet

Signal Standards that exceed the previously mentioned limiting values may be fabricated consistent with shop drawings that meet requirements of the latest ASSHTO Standard Specifications for structural supports for highway signs, luminaires and traffic signals, provided the signal mast arm can is 5 degrees, the handhole conforms to the details on Standard Plan section J: and Drawing 8006. The luminaries arm connection, if required, must have special approval; complete calculations for structural design, including foundation and anchor bolt details have been submitted with the shop drawings and other requirements of the Special Provisions have been satisfied.

The Contractor shall submit for approval 8 sets of shop drawings to the Engineer for each of the following types of standards proposed for use on this project:

(A) Traffic Signal Standards

(B) Combination Traffic Signal and Lighting Standard

(C) Pedestrian Signal Standards

(D) Metal Strain Poles

(E) Pedestrian Push Button Posts

If traffic signal standards or combination traffic signal and lighting standards are proposed, final verified dimensions including pole base to signal mast arm connection point, pole base light source distances (H1), mast arm length, offset distances to mast arm mounted appurtenances and orientations of pole mounted appurtenances will be furnished by the Engineer as part of the final approved shop drawings prior to fabrication.

The area of the face of each mast arm mounted signal head with back plates shall not exceed the amount for each combination head shown on the plan. The design weight of each signal head and plumb riser shall be the exact per manufacturer's specifications for each combination of sections and appurtenances. Complete calculations for structural design shall be submitted with the shop drawings for approval before fabrication or ordering materials.

These calculations shall include stresses in the pole and cantilever arms, attachment of signals to the structure, connection between cantilever arms and vertical pole, pole session at handhole, base plate anchor plates, and foundation. The submittal shall include material and welding specifications, and details of the foundation and anchor bolts.

The traffic signal support structure shall consist of a single vertical pole erected on a concrete foundation, with one cantilever signal arm or one cantilever signal arm and one luminaire arm as shown on the plans. After signals have been installed, the poles shall be plumbed and the cantilever arms shall have an upward slope away from the pole that shall not exceed 0.05 ft/ft except where specified elsewhere in this section. The vertical clearance to any portion of the signal heads nearest the pavement shall be a minimum of 16'6" and a maximum of 18'6".

The poles and arms shall be tapered tubes round or octagonal in cross-section. The size of the arm where it connects to the pole shall not be larger than the pole's size at that height. The largest gauge pole thickness shall be chosen such that the pole diameter shall be a minimum.

A handhole with cover shall be provided in the pole within 18" of the base, and there shall be approved wire way fixtures installed to facilitate pulling wire from the base of an outlet at each signal after the structure is erected. The finished structure shall be rain tight. Conduit terminating in the pole base shall be aimed toward the handhole opening.

The pole base shall accommodate the conduit stubbed up from the foundation. The pole base shall be drained by a 1/2" drain pipe through the grout pad. Leveling nuts on the anchor bolts shall be furnished for use in plumbing the pole. The drain pipe shall be copper. Tamper resistant covers shall be provided for the anchor bolts.

All materials and work shall be in accordance with Section 8-20and Section 9-06 of the Standard Specifications. Structural steel having a minimum yield point of 33,000 PSI or more shall be used for all structural parts, and it shall be galvanized after fabrication per ASTM A-123. The foundation concrete shall be Class B mix and shall have reinforcing steel as required by the design loads.

The following loads shall be used: dead load shall consist of the weight of the signals, signs, appurtenances and supporting structure, wind load shall be taken as 35 PSF for the signal heads, and 25 PSF for the supporting structures (which valves account for the effects of gust and shape factors) on the greatest area of signals, signs, and structure in any elevated view; live load and ice load may be omitted.

8-210.1 Luminaires, Wiring and Photo Electronic Controls:

Luminaires, wiring and photo electric controls shall be LED type and conform to all applicable portions of Section 8-20 and Section 9-29 of the State of Washington Standard Specifications except as modified herein.

8-210.2 Foundation for Traffic Signal Standards With Mast Arms:

The base foundation shall conform to State of Washington Standard Plans section J and Sections
8-20.3(4)and Section 6-02.3 of the Standard Specifications.

8-210.3 Installation of Signal Standards With Mast Arms:

All work shall be in conformance with Section 8-20.1 (1) of the Standard Specifications for the safe installation of signal standards.

The Contractor shall take care to handle the material in such a manner that marring, overstressing or soiling of the fixtures does not occur. If it is necessary to inhibit the flow of traffic around the area, or if there is any danger to adjacent traffic, as determined by the Engineer, then proper traffic control procedures shall be utilized as noted elsewhere in these provisions.

8-210.4 Fabrication For all Components:

Where bolts, nuts, flat washers, screws and rivets are mixed or used with aluminum, they shall be stainless steel or bronze only, except that anchor bolts shall be in accordance with the Standard Specifications. Galvanized components may be used as part of the slip fitter assembly. All aluminum surfaces in contact with steel or concrete shall be given one coat of zinc chromate primer paint conforming to U. S. Federal Specification TTP-645.

8-210.5 Signal Pole Attachments:

All attachments shall be located in the field and allwire entrances into the pole shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed and/or deburred before application of a coat of galvanic paint. The Engineer shall confirm the location and mounting heights of all pole attachments located in the field prior to installation.

8-220 REMOVAL OF EXISTING SIGNAL EQUIPMENT & STRUCTURES:

Existing signal equipment remains the property of the City. No existing signal equipment or structures shall be removed until approved by the Engineer.

When so directed, the Contractor shall carefully remove the existing signal equipment and deliver it to the area designated by the Engineer. Removed span cables and signal cables shall be disposed of by the Contractor.

When so directed, the Contractor shall remove existing signal structures (pole foundations, controller foundations, j-boxes, conduit, poles, etc.) and dispose of them. The poles and j-boxes shall be delivered to a storage site in the City as directed by the Engineer.

All equipment from the existing controller shall be evaluated by Electronics for salvage.