Amend **Section 623 - Traffic Signal System** to read as follows:

## "SECTION 623 - TRAFFIC SIGNAL SYSTEM

**623.01 Description.** This work includes furnishing labor, materials, tools, machinery, and equipment necessary to install loop detector sensing units and temporary microwave vehicle detectors with cables complete in place according to the contract.

The traffic signal system includes:

**(1)** providing and installing loop detector sensing units and temporary microwave vehicle detectors with cables;

**(2)** saw cutting and restoring work;

**(3)** coordinating work and arranging for inspection of work with the Engineer and other agencies as required.

Furnish and install the incidental parts that the contract does not show and that are necessary to complete the traffic signal system as though such parts were in the contract.

Electrical equipment shall conform to the NEMA Standards and this contract. Material and workmanship shall conform to the "National Electric Code", (the Code); General Order Nos. 6 and 10 of the Hawaii Public Utilities Commission; the standards of the ASTM; the ANSI; Local Joint Pole Agreement; local power company rules; and local ordinances that may apply.

The following definitions apply:

**(1) Actuation** - The operation of types of detector.

**(2) Clearance Interval** - The length of time of display of the signal indication following the right-of-way interval.

**(3) Detector for Traffic Actuation** - A device that pedestrians or vehicles can register their presence with a traffic-actuated controller.

**(4) Extendible Portion** - That part of the green interval that follows the initial portion.

**(5) Extension Limit** - The maximum time that a traffic phase may retain the right-of-way after actuation on another traffic phase, after timimg out the initial portion.

**(6) Flashing Feature** - That feature incorporated to stop normal signal operation and cause the flashing of any predetermined combination of signal lights.

**(7) Initial Portion** - That part of the green interval that is timed-out or separately controlled by a traffic-actuated controller before the extendible portion of the interval takes effect.

**(8) Interval** - Several divisions of the time cycle during which signal indications do not change.

**(9) Interval Sequence** - The order of appearance of the signal indications during successive intervals of a time cycle.

**(10) Magnetic Vehicle Detector** - A detector actuated by the movement of a vehicle passing through its magnetic field.

**(11) Major Street** - The roadway approach or approaches at an intersection normally carrying the greater volume of vehicular traffic.

**(12) Manual Operation** - The operation of a signal controller by a hand-operated switch.

**(13) Minimum Period** - In semi-traffic-actuated controllers, the shortest time for which the right-of-way will be given to the approaches not having detectors.

**(14) Minor Movement Interval** - An auxiliary phase added to a controller phase (parent phase) and modified by an auxiliary movement controller.

**(15) Minor Street** - The roadway approach or approaches at an intersection normally carrying the smaller volume of vehicular traffic.

**(16) Non-Parent Phase** - A controller phase not modified by an auxiliary control unit.

**(17) Parent Phase** - A controller phase modified by an auxiliary control unit.

**(18) Passage Period** - The time allowed for a vehicle to travel at a selected speed from the detector to the nearest point of conflicting traffic.

**(19) Pedestrian Detector** - A detector, usually of the push-button type, installed near the roadway and operated by hand.

**(20) Pressure-Sensitive Vehicle Detector** - A detector installed in the roadway, actuated by the pressure of a vehicle passing over its surface.

**(21) Pre-Timed Controller** - An automatic control device for supervising the operation of traffic control signals according to a pre-timed cycle and divisions.

**(22) Recall Switch** - A manually operated switch in an actuated controller to provide for the automatic return of the right-of-way to a street.

**(23) Right-of-Way** - The privilege of the immediate use of the highway.

**(24) Signal Indication** - The illumination of a traffic signal lens or equivalent device, or of a combination of several lenses or equivalent devices.

**(25) Time Cycle** - The number of seconds required for one complete revolution of the timing dial or complete sequence of signal indications.

**(26) Traffic-Actuated Controller** - A digital control device for supervising the operation of traffic control signals according to the varying demands of traffic as registered with the controller by loop detectors or pedestrian push buttons.

**(27) Traffic Phase** - A part of the cycle allocated to traffic movements receiving the right-of-way or to combinations of traffic movements receiving the right-of-way simultaneously during one or more intervals.

**(28) Unit Extension** - The minimum time, during the extendible portion, for which the right-of-way must remain on traffic phases following an actuation on that phase, subject to the extension limit.

**623.02 Materials.** Concrete shall conform to Section 601 - Structural Concrete.

Reinforcing steel shall conform to Section 602 - Reinforcing Steel.

Steel plate covers and anchor bolts shall conform to ASTM A 36 and A 307 respectively. The Contractor shall zinc-coat the anchor bolts if exposed.

Other materials shall conform to the following:

| | |
|---|---|
| Dark Green Enamel Paint | 708.03 |

| | |
|---|---|
| Paint Thinner | 708.04 |
| Pullboxes | 712.06(B) |
| Conduits | 712.27 |
| Conductors and Cables for Traffic Signal System | 712.34(B) |
| Controller Equipment | 712.37 |
| Traffic Signal Standards | 712.38 |
| Traffic Signals and Appurtenances | 712.39 |
| Epoxy Sealer | 712.54 |
| Hot Applied Rubberized Sealant | 712.57 |

Materials will be subject to inspection after delivery to the work site and during installation. Failure of the Engineer to note faulty material or workmanship during construction will not relieve the Contractor of the responsibility for removing or replacing materials at no cost to the State.

The Engineer may make inspection or sampling of certain materials at the factory or warehouse before delivery to the work site, when required.

Approach-Only Microwave Vehicle Detector is a vehicle detection unit for computerized signals. The detector shall detect motion of every vehicle type, including mopeds moving in only one direction utilizing a very low power microwave beam.

The detector's range shall be from 3 feet to 100 feet or greater. Base the cone of the detector on a 16 degrees field of view with a maximum width of 18-1/2 feet at 60 feet. The detector shall have two field adjustment controls, those being range control and time delay extension.

The extension timer shall be capable of extending the detector output from at least 0.5 to 7.5 seconds. Begin the extension with the termination of the detected vehicle output and continue for the duration of the selected extension time interval.

The microwave unit shall have a Federal Communication Commission (FCC) certification. The detector shall work at the frequency of 10.525 Ghz as allowed under the FCC Rules, Part 15. The detector shall be self-contained except for the power source that shall operate at both 10VAC to 24VAC and 12VDC.

The unit shall have an electro-mechanical two AMP SPDT Relay to send a signal to the controller. The unit shall employ a circuit for power failure to put relay to a close position (recall) during a power failure.

The detector shall have a monitoring circuit for the transceiver (Gunn diodes) that will failsafe the relay to a closed position (recall). Except for the range adjustment, tuning will be automatic. The Engineer will allow a five minute warm up period for diodes. There shall be no tuning controls of any kind which require an operator.

The detector shall work while installed on the side of a pole, on top of a pole, or overhead at the height of between 12 and 18 feet above the pavement. Encase each detector in a finished fabricated aluminum case with no larger than a 4-inch square, high impact plastic opening in front of the antenna.

Each detector case will be water resistant without the use of slicone gels or any other materials that will deteriorate with ultra-violet rays. Size of the detector shall be no greater than:

| | |
|---|---|
| Height: | 4.5 inches |
| Width: | 4.5 inches |
| Depth: | 7.5 inches |

Mounting bracket supplied shall be for side, top, or overhead mounting. The detector shall be capable of continuous operation over a temperature range of -35 degrees F. to 165 degrees F.

The manufacturer shall test all microwave units to meet FCC specifications. The manufacturer shall supply a medical statement as to the safety of the unit to the general public, specifically to persons with pace-makers.

**623.03 Construction Requirements.**

**(A) Equipment List and Drawings.** The bidder shall submit the equipment list according to Subsection 106.13 - Ordering of Certain Materials.

Upon completion of the work, submit an 'As Built' or corrected plan showing in detail the construction changes.

**(B) Installation.**

**(1) Vehicle Detectors.** Vehicle detectors shall be inductive loop detectors installed according to details shown in the contract. The saw cut groove shall be air blown to remove debris before inserting the loop cable. The loop cable shall be continuous

within the roadway. Splice in the pullbox. Fill the saw cut groove with epoxy sealer or hot applied rubberized sealant. As accepted by the Engineer, the Contractor may use a sealant designed for use as a protective seal for traffic inductive loop detectors installed in asphalt concrete or concrete pavements.

**(2) Wiring.** Wiring shall conform to the appropriate articles of the Code. Arrange the wiring within cabinets, signal heads, standards and pullboxes neatly. Encase the wiring installed underground in conduits. Before installing the wires and cables in conduits, pull a wire brush, swab and mandrel through each conduit for the removal of extraneous matter and verification of the absence of obstructions and debris from the conduit system.

Pull the cables directly from their cores or reels into the conduits. Do not pull off and lay the cables on the ground before installation. Make the pulls in one direction only. Lubricants used shall be as recommended by the cable manufacturer or accepted by the Engineer. Leave the wires or cables under tension nor tight against bushings or fittings.

Remove the damaged ends resulting from the use of pulling grips soon after pulling the cable. Maintain the cable end seals. Do not pull the open ended cables through the conduits. Cables shall be continuous from pulling point to pulling point. The Engineer will not permit splices. Make the splices, taps and terminations with pressure-indented connectors or lugs as appropriate or as specified herein. Tape or seal the ends of the spare conductors as accepted.

Run the signal light conductors continuously from the terminal block located in a cabinet or signal head to a similarly located terminal block without splices. The Contractor may splice the branch signal light neutrals at pullboxes. Leave at least 5 feet of slack in each conductor at each standard and at least 2 feet of slack at each pullbox.

Join the conductors by a 'western union' type splice. Use the connectors for splicing conductors No. 8 AWG, or larger. Solder the splices by the pouring or dipping method.

Pencil the conductor insulation well, trim the conductor insulation to conical shape, and roughen the conductor insulation before applying splice insulation.

Splice insulation includes layers of thermoplastic electrical insulating tape not over 0.007-inch thick applied to a thickness equal to and well lapped over the original insulation. The splice insulation shall conform to Federal Specifications MIL–I-7798. On high voltage and multiple lighting conductor splices, apply two layers of synthetic oil resistant rubber tape conforming to ASTM D 119 over each conductor before placing the thermoplastic tape. Then cover the splice well with at least two layers of asphaltic impregnated open mesh fabric tape and a coating of high grade insulating paint or similar material. Leave at least 2 feet of slack for each conductor at each splice.

Furnish the cables on reels and handle the cables with great care to avoid damage to the conductors or the jacket.

Tape the cable ends to exclude moisture and shall remain so until the Contractor attaches the terminal equipment. For cable connections in terminal cabinets, use Bell Telephone System or equivalent connectors accepted for outside use.

Pull the cable in the conduit with a cable grip designed to provide a firm hold on the exterior covering of the cable. Pull the cable with a minimum dragging on the ground or pavement. Use powdered soapstone, talc, or other accepted lubricants to ease the pulling of the cable.

**(3) Bonding and Grounding.** Make the metallic cable sheaths, conduits and standards mechanically and electrically secure to form a continuous system. Ground the system effectively. Bonding and grounding jumpers shall be No. 8 AWG copper wire or equivalent copper strap of the same cross-sectional area.

Bond the standards by a bonding strap attached to an anchor bolt or a 3/16 inch or larger, brass or bronze bolt installed in the lower portion of the shaft.

Ground the conduits and the neutral wires at the service points as required under the Code except that grounding conductors shall be No. 6 AWG or equal.

Install a copper-clad steel or pure copper ground rod 5/8 inch diameter by 8 feet long alongside each traffic signal standard and controller concrete base.

The Contractor shall connect them with No. 6 AWG wire to the No. 8 AWG ground wire loop and power system neutral.

On wood poles, ground all equipment mounted less than 8 feet above ground surface.

**(4) Continuity of Service.** During relocation, reconstruction or other improvements of existing traffic signal systems, keep the existing system operational until the reconstructed or new traffic signal system can be started and put into service. Arrange the work accordingly and shall provide temporary relocations and wiring as necessary.

**(5) Approach-Only Microwave Vehicle Detector.** Temporarily mount the detector on the side of an existing traffic signal standard, highway light standard, or at the location specified by the Engineer. The dectectors shall be operational before disabling the existing pavement loop detectors. Install the required conductors in the existing conduits and controller or at the location specified by the Engineer. After the permanent pavement loop detectors becomes operational, remove the microwave detectors and conductors and deliver them to a location specified by the Engineer. Also, repair any holes and/or damages which was caused by mounting the detector to the existing traffic signal and/or highway lighting standards.

**(C) Field Test.** Before the acceptance of the work, do the following tests on traffic signals and circuits, in the presence of the Engineer:

**(1)** Test for continuity of each circuit.

**(2)** Test for grounds in each circuit.

**(3)** A megger test on each circuit between the circuit ground. The insulation resistance shall not be less than the values specified in Table 622-I - Insulation Resistance when measured with an instrument having a voltage rating of 500 volts.

**(4)** A functional test to show that the system functions as specified or as intended herein.

Replace or repair the fault in material or the installation revealed by these tests according to the contract. Repeat the same tests until no fault appears.

**(D) Services Provided By The Contractor and/or Traffic Signal Equipment Supplier.**

**(1)** The Contractor and /or Traffic Signal Equipment Supplier will be responsible for the following:

**(a)** making all splices and connections in the pullboxes and cabinet locations pertaining to vehicle detectors.

**(b)** cost for these services shall be incidental to the furnishing and installing of the loop detector sensing units and temporary microwave detectors. The Department will not make additional payments for these services.

**(E) Restoring Pavements and Other Improvements.** Restore the existing pavements and other improvements such as driveways, sidewalks, curbs and gutters disturbed by excavation to their original condition according to the contract. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

**(F) Warranty.** Materials and equipment installed for permanent construction shall be new. The contract contemplates the use of first-class material and equipment throughout the performance of the contract.

Secure from the manufacturer(s), a warranty or warranties guaranteeing equipments from defects in materials, design and workmanship for not less than 12 months from the date of acceptance.

When requiring adjustments or repairs during the warranty period, adjust or repair the existing unit within 24 hours from the time of notification.

When requiring repairs that need factory corrections during the warranty period, replace the existing unit with an accepted temporary operational replacement unit within 24 hours from the time of notification until the Contractor can install the new unit. Install the new, identical non-defective unit within 30 days from the time of notification.

**623.05 Method of Measurement.** The Engineer will measure the loop detector sensing unit and microwave vehicle detector per each complete in place.

The Engineer will not measure traffic signal cable for payment.

**623.06 Basis of Payment.** The Engineer will pay for the accepted loop detector sensing unit at the contract unit price per each complete in place. The price includes full compensation for saw cutting; cleaning and blowing the saw cut area; furnishing and inserting the loop cable; splicing in the pullbox; filling the saw cut groove with epoxy sealer or hot applied rubberized sealant; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will pay for the accepted approach-only microwave vehicle detector at the contract unit price per each complete in place. The price includes full compensation for furnishing and mounting the detector; making it operational; removing the detector after installing the permanent loop detector; delivering them to the designated location; repairing any damages caused by mounting the detector; and furnishing equipments, tools, labor, materials and other incidentals necessary to complete the work.

The Engineer will consider full compensation for additional materials and labor not specifically shown or called for that are necessary to complete the work incidental to the various contract items in the proposal.

The Engineer will make payment under:

| **Pay Item** | **Pay Unit** |
|---|---|
| Loop Detector Sensing Unit (6 Ft. x 6 Ft.) _____ Loops | Each |
| Microwave Vehicle Detector _____ | Each" |

**END OF SECTION**