REVISION OF SECTION 614

**TRAFFIC SIGNAL CONTROLLER (TYPE 170E-HC11)**

**Section 614 of the Standard Specifications is hereby revised for this project as follows:**

**In subsection 614.08, delete (b) and (c) and replace with the following:**

*(b) Traffic Signal Controllers – General.* Each controller shall be a Type 170E-HC11 with 4 ACIA connectors and 2 modem slots per FHWA-IP-78-16 specifications except as noted below.

Each controller shall be fully warranted for materials and workmanship for a period of one year from date of receipt.

In addition to the manual (as specified in the FHWA-IP-78-16 specifications), two “D” size (24” x 34.5”) drawings of all schematics and assembly prints contained in the manual shall be supplied for each twenty controllers or revisions change.

The 170E-HC11 Controller shall come with a blank panel covering the Prom Module opening.

The front panel of the 170E-HC11 shall have a DB-9 connector. This connector shall be in parallel with the C40 connector to allow the operator to attach a laptop to interface with the controller instead of connecting to the C2

All Integrated circuits having more than 14 pins shall be socket mounted on all boards including the front panel, CPU board, Input board, and Output board. Sockets shall have machined beryllium copper contacts with gold plating.

Each controller shall be supplied with diagnostic software on a 32K EPROM. No additional program chip shall be required to set any bit or flag when changing from the Traffic program used by CDOT to the diagnostic program.

The internal EEPROM feature of the 68HC11F1 shall be disabled.

The FHWA-IP-78-16 specification’s Vendor’s Testing Certification shall be modified to read “The Vendor shall supply with each shipment a full test report of the quality control and final test conducted on each item.” In addition, the Contractor shall supply a statement with each 170E-HC11 controller that the unit was tested in accordance with Section 1.8.5.3.3 as modified below.

Section 1.8.5.3.3 shall be modified to read “A minimum 100-hour burn-in of all modules is required. This burn-in shall include 48 hours of monitored testing at the high and low temperatures as described in 1.8.3.7.1 and 1.8.3.7.2.”

1. *HC11 CPU Board.* The HC11 based CPU Module shall operate a 68HC11F1 MPU with a crystal operating frequency of 8 MHz. The MPU chip shall be socket mounted in an AMP PLCC socket #82147-1 series HPT or equal.

The 6850 communication ICs shall be used and shall operate with a crystal frequency of 6.144 MHz. There shall be four 6850 chips with the programmable jumpers to select 5 different communication baud rates per chip (1200, 2400,4800, 9600, and 19,200) for a total of 20 jumpers. There shall be no IRQ inhibits provided and all ACIA’s shall be active. Programs should be written to initialize the four communications chips upon startup. An IRQ status register shall be provided as defined in the 170E CALTRANS specification.

The EPROM and RAM shall be resident on the CPU board, and shall be socket mounted. The EPROM socket shall be a 32-pin ZIF force Device. The Ram socket shall be a 28 pin Augat 828 series or equal.

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RAM will be continuous from locations $0000 to $6FFF. RAM shall be a ZERO power device exclusively, and be a Dallas 1230 or equal.

When an optional RTC clock is required, the RAM shall be a Dallas 1644 or equal. (Clock address shall be in the I/O map at location $7FF8 to $7FFF).

A jumper select shall be provided to switch locations $6000 to $6FFF from Internal to External for access to the remote Dual Port location. The status of the jumper position shall be read on the IRQ register-bit five.

When an enhanced Program Module is used with this system, it shall only have access to addresses 600/6FF for dual port.

The Prom chip shall be either a 32K x 8 or a 128K x 8 device, and be jumper selectable.

When using a 128K EPROM, a bank switch shall be enabled within the EPROM memory system. This bank switch shall function by moving to the upper 64K segment of the EPROM. The bank switch jumper controls address line A16. The bank shall be activated by a write to location $7002 (directly connected to Port G on HC-ll MPU), which will cause memory to go to the upper 64K of the 128K EPROM. This will enable an extra 32K of EPROM memory via bank switching. The status of A16 shall read on the IRQ status register-bit six.

Feature and location switches shall be provided on the front portion of the CPU board. Each switch shall be an eight-position front reading dipswitch. These switches shall be decoded as follows:

Features switch shall be addressed at $700A – Port E

Location Switches shall be addressed at $7000 – Port A

A header shall be provided near the front of the module for the SPI and serial interface pins.

There shall be one LED indicator located on the front of the CPU board that shall be controlled via a software output of Port G bit 3.

The +12VDC, +5VDC and +/-12VDC voltages input in the CPU board shall have transorb protection.

The system address organization of the HC-11 Module shall consist of two addressing configurations. The decoder shall be furnished in address 1.

The two addressing configurations shall be selectable by use of a three-post jumper. The following input line state conditions shall cause the Decoder to provide the associated address configuration. The jumper shall be labeled “INT” and “EXT”.

Each CPU board shall be furnished with an EPROM Chip with the controller diagnostic program installed. No additional program chip shall be required to set any bit or flag when changing from the Traffic program used by CDOT and the diagnostic program.

All integrated circuits having more than 14 pins shall be socket mounted. Sockets shall have machined beryllium copper contacts with gold plating.

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 *(c) Controller Cabinets.* The controller cabinet shall be a double wide Model 332 herein referred to as a Model 332D as specified in the Contract. Each cabinet shall include anchor bolts in accordance with the FHWA-IP-78-16 specification. The input files shall meet the requirements of the split input file below. Unless otherwise specified in the Contract, the cabinet shall include the following:

# Quantity Item

1 ea. 170E-HC11

4 ea. Internal (at each door) fluorescent lamps

4 ea. Model 430 Transfer Relays

2 ea. Model 204 2-Circuit Flasher (cube type, 25 AMP output)

12 ea. Model 200 Load Switch (cube type, 25 AMP output)

3 ea. Model 242 DC Isolators

6 ea Model 222 Loop Amplifiers

1 ea. Signal Monitor Unit with absence of red monitoring.

2 ea. New York 330 Pull-out Drawer Assembly

1 ea. Auxiliary Detector Termination Panel Assembly

1 ea. Transient Voltage Surge Suppression System

2 ea. Split Input File

1 ea. Output file

1 ea. Traffic UPS

Cabinet dimensions: 66” X 49” X 30”

Each cabinet shall have four doors and Corbin #2 Locks.

The left side of the 332D cabinet assembly shall have shelves attached to the EIA rack assembly to house additional equipment such as, but not limited to, Video Detection, Standby Uninterrupted Power supply and communication equipment.

The left side of the 332D cabinet assembly shall have pull out shelves to accommodate maintenance of the Traffic UPS batteries. The shelves for the UPS batteries shall be capable of handling the weight of the batteries plus 50%. The shelf slides shall utilize ball bearing construction. The shelf shall include a rail of a minimum of 2.5 inches to contain the batteries while operating the shelf. These shelves shall have a double locking mechanism to prevent the shelves from moving unexpectedly in either the fully open or fully closed position. This locking mechanism shall not require any tools to operate. The cabling system between the UPS and the batteries shall be of sufficient length to accommodate the full movement of the shelf and be protected as to avoid damage while the shelf is in motion.

The cabinet shall have a powder coating base TCI WHEEL SILVER #9811-0110 Polyester TGIC Powder Coating and top coating shall be TCI ANTI GRAFFITI Power paint applied at a thickness of 2.4 mils.

The cabinet shall be supplied with a 206L Power Supply Unit as detailed in Caltrans Transportation Electrical Equipment Specification (TEES) 2009 specification.

The cabinet shall be supplied with a Contactor Relay to replace the Mercury Contactor Relay. The Contactor Relay shall be the same or equivalent as the Flash Transfer Relay. The Contactor Relay shall have an operating voltage of 120VAC and contacts rated for thirty (30) Amps minimum. The Contactor Relay shall be in the de-energized position under normal operating conditions and energized when the cabinet is in the FLASH mode. The

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Contactor Relay shall have an internal lamp that will be ON when the Relay is energized. The Contactor Relay shall be installed on the back of the Power Distribution Assembly. The Contactor Relay shall be easily replaced by hand and not interfere with the existing cabinet wiring harness distribution.

The cabinet shall be supplied with a 30 Amp, 120VAC single pole main breaker mounted on the service panel assembly. The breaker shall be supplied with a handle guard to prevent incidental contact with handle. The handle guard shall not interfere with handle or breaker operation.

The cabinet shall have a hinged protective shield over the Circuit Breakers to prevent them from being accidentally turned off. The hinged shield shall be mounted in such a way that the switches are still readily visible to the technician and can be easily turned on or off.

1. *Signal Monitor Unit.* The signal monitor unit shall be a sixteen (16) channel monitor used in type 170 output files. The unit shall have the capability to monitor absence of red. The unit shall meet as a minimum all of the requirements of the Caltrans, Traffic Signal Control Equipment Specifications with basic fault coverage of Conflict, 24 VDC, Watchdog and AC line monitoring. The unit shall be compatible with LED type signal displays. The signal monitor unit shall be capable of monitoring Flashing Yellow Arrow (FYA) as defined in the 2009 Manual of Uniform Traffic Control Devices (MUTCD). The unit shall be capable of two (2) modes of user selectable FYA operation, standard output file or auxiliary output file. FYA configuration shall be user settable without the need for software interface. Permissive diode card modification beyond standard phase allowance shall not be acceptable. The signal monitor unit shall be provided with serial communication capability (EIA-232 Port (9-pin)) for diagnostic access. The signal monitor unit shall maintain a nonvolatile event log of at least one hundred (100) fault events indicating the complete intersection status as well as AC line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages. Each event shall be stamped with time and date. Data acquisition software shall be included with the monitor and shall be compatible with the latest Windows Operating System. Software updates shall be provided as available at no additional cost.
2. *Output file*. The output file shall have eight “flash programming jumper blocks,” one for each of the eight phases. The output file shall utilize twelve (12) position terminal blocks.
3. Split Input file. The split input file shall be an SF 170, which will operate in the standard 332/336 cabinets. The Split Input File shall use the same form factors as the present (older) input file and shall be completely interchangeable with these older input files except as follows. The input file shall use a split 22-pin connector (2 rows or 22 pins) which provide for 44 unique contacts, rather than the 22 double contacts as provided by the former input file. This design shall interface electrically with the older 2 and 4 channel devices available under the 170 and NEMA TS1 specification as will as the newer 2 and 4 channel devices as specified in the TS2 NEMA specification.

The input file shall be divided into two partitions. The first partition shall include the first eight slots from the left; the second partition shall include the next six slots.

The serial/TTL Transmit and receive pairs shall be wired across the back panel. TXO, DXO, and Ground0 serve the first eight slots; TX1, DX1 and Ground1 serve the next six slots. Back plane addressing is automatically assigned in the rear of the input file, such that Slot 1 – Address 0, Slot 2 – Address 1 . . . Slot 8 = Address 7(all three lines low)

Addressing from the front of any input device shall override the back plane addressing.

Serial connections shall use a standard quick lock connection.

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**TRAFFIC SIGNAL CONTROLLER (TYPE 170E-HC11)**

1. Transient Voltage Surge Suppression System. Transient Voltage Surge Suppression (Surge Protection) shall be a solid-state device with a maximum surge current capacity of 6500 peak current amps x 1 @ 8 X 20 microsecond wave.

The unit shall be listed to ANSI 1449, 3rd Edition. The enclosure is to be rated as a NEMA 1 and resistant to oil, moisture, dust and other airborne contaminants.

The units shall be fused (no thermo fusing allowed). Components shall be suitably spaced and have a sub-nanosecond response time (potting compound is not allowed). The Surge Protection is to be suitable for continuous line voltage of a maximum of 130 volts. Nominal clamping voltage shall be no more than 200 volts.

Unit shall have a failure indicator and alarm suitable for RTU connection.

The Operating temperature shall be -40oC to +70oC. EMI-RFI noise attenuation to 40 dB. Capacitance shall be 1 to 1.5 microfarad per line.

Neutral to ground/phase to ground connection is not allowed. The Unit shall be modularly designed for quick replacement with no tools needed. The unit shall have a retaining clip to secure the device in place.

The Unit shall be mounted no more than 8 inches from the incoming power termination point and terminated in parallel with the incoming power.

The Manufacturer must have a satisfactory performance record with this specific device for a minimum of five years.

1. Traffic UPS. The 332D shall have a UPS as specified below rack mounted in the left cabinet. The Traffic UPS shall consist of three major components, the Electronics Module, the Power Interface Module, and the Battery System.

The Traffic UPS shall provide two modes of operation. Standby; will introduce battery power upon loss of utility power and On – Line; shall flow 100% of the load through the inverter 100% of the time. The mode of operation shall be user selectable.

 Input Voltage: 75VAC to 155VAC

 Input Frequency: 60Hz (+/- 5%)

 Output Voltage: 120VAC +/- 3%

 Output Frequency: 60Hz (+/- 5%)

The user shall have the capability to program the intersection run time based on time and/or percentage of battery power before going into a flash mode of operation.

Up to the maximum rating, the Traffic UPS shall be capable of running any combination of signal heads, whether Incandescent, LED or Neon, by any manufacturer, regardless of power factor, without overdriving the poorer power factor LED heads which may cause early degradation, low luminosity or early signal failure.

Upon loss of utility power, the Traffic UPS shall insert battery power into the system via a supplied Power Interface Module (PIM). In case of UPS failure and/or battery depletion, the PIM shall ensure that the UPS will drop out and, upon return of utility power, the traffic control system will default to normal operating mode.

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**TRAFFIC SIGNAL CONTROLLER (TYPE 170E-HC11)**

The Power Interface Module (PIM) shall enable removal and replacement of the Traffic UPS without shutting down the traffic control system (i.e. “hot swap” capability). Connectors shall be equipped with a “safety interlock” feature.

The Traffic UPS shall provide manual on site programming of all parameter without the use of a computer. The unit shall have a minimum of three individual contact closures for On Battery, a user selectable Timer and a Low Battery indicator. Each contact closure shall have a Common, Normally Open, and Normally Closed contacts.

For 170 or “California” style cabinets, upon loss of power the Traffic UPS shall actuate the existing Flash Transfer Relays (FTRs) and Contactor Relay to force the traffic control system into Flash Mode operation. Existing Flasher Modules and Flash Transfer Relays shall be utilized.

To facilitate emergency crews and police activities, the Traffic UPS shall be compatible with police panel functions (i.e. “Signals OFF” switch must kill power to the field wiring even when on UPS/Battery power).

The Traffic UPS shall be temperature rated to operate from -40ºC to +74ºC

The Traffic UPS shall not duplicate or take over flash operation or flash transfer relay functions.

The Traffic UPS shall be capable of providing continuous, fully conditioned, regulated, sinusoidal (AC) power to selected devices such as signal controllers, modems, communications hubs, NTCIP adapters and video equipment.

1. *Electronics Module***.** The Electronics Module shall consist of the following:
	1. True sine wave, high frequency inverter utilizing IGBT technology.
	2. 3-stage, temperature compensated, battery charger.
	3. For connection from the Electronics Module to the Power Interface Module and Battery System, dedicated harnesses shall be provided with quick-release, keyed and braided nylon sleeving over all conductors.
	4. Local and remote control of UPS functions.
	5. Local and remote communications capabilities.

The mounting method shall be 19” rack-mount.

1. Battery System.The battery system shall be comprised of extreme temperature, deep cycle, Absorbed Glass Mat/ Valve Regulated Lead Acid (AGM/VRLA) batteries.

Batteries shall be certified to operate at extreme temperatures from –40°C to +74°C.

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

The interconnect cable shall be protected with abrasion-resistant nylon sheathing. The interconnect cable shall connect to the base module via a quick-release circular connector.

For purposes of safety and proper operation, the circular battery connector shall have interlocking pins to prevent turn-on if batteries are not connected, and to shut off the UPS should the batteries be disconnected.

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**TRAFFIC SIGNAL CONTROLLER (TYPE 170E-HC11)**

The battery system shall be certified and field proven to meet or exceed NEMA temperature standards from –40°C to +74°C.

The traffic UPS shall include a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

1. Loss of Utility Power
2. Inverter Failure
3. Low Battery

An RS232 Interface shall be provided via a DB-9F connector allowing full, interactive, remote computer monitoring and control of the UPS functions.

The UPS shall be equipped with the following functions on the front panel: Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker, and DC/Battery Breaker.

Calculated MTBF shall be 100,000 hours based on component ratings, except when Bypass and Power Interface Modules are included. When these two additional modules are included, the MBTF shall be 150,000 hours.

The system shall have a mean time to replace or repair the electronics or battery system of 15 minutes or less.

All of the above components provided, excluding the signal monitor unit, shall be on the CDOT Approved Products list.

**Subsection 614.14 shall include the following:**

Pay Item Unit

Traffic Signal Controller (Type 170E-HC11) Each