ITEM 680.84700010 - HIGHWAY ADVISORY RADIO SYSTEM TRAFFIC
MANAGEMENT CENTER EQUIPMENT
ITEM 680.84710010 - HIGHWAY ADVISORY RADIO SYSTEM TRANSMITTER
SITE EQUIPMENT
ITEM 680.84720010 - HIGHWAY ADVISORY RADIO SYSTEM BEACON
EQUIPMENT

DESCRIPTION:
Under these items, the Contractor shall furnish and install a HAR system consisting of
transmitter site equipment, Traffic Management Center (TMC) equipment and Beacon
equipment at various locations shown in the plans.
The general functions of the HAR system equipment shall be as follows.

Transmitter Site Equipment
The transmitter site equipment shall consist of the following components: AM transmitter,
Antenna tuning unit (ATU), antenna ground plane, standby power supply, microprocessor and
digital/analog player unit.

Traffic Management Center (TMC) Equipment
The corridor HAR system shall include TMC Equipment which shall be connected to each
transmitter site over a fiber optic communications link to be provided under another contract
item. The purpose of the TMC Equipment is to allow complete remote control of each
transmitter from the TMC and the downloading of messages in digital form. In addition, it will
provide the option of transmitting the same analog audio feed to one or more of the field
transmitters, for simultaneous, synchronized transmission.

Beacon Equipment
Beacon equipment shall be provided at locations shown in the plans. The equipment shall
consist of flashers to be mounted on fixed warning signs, control equipment to turn the flashers
on and off, and a power source. The fixed warning signs shall be provided under another
contract item.

MATERIALS:
All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion
resistant and in strict accordance with the details shown in the plans and in the General
Provisions.
All equipment furnished under this item shall be current production equipment, identical models
of which are field operational.
TRANSMITTER SITE EQUIPMENT

AM Transmitter

FCC Part 90 Certification

The AM transmitter shall be FCC certified as accepted and eligible for licensing under Part 90.242 of the Federal Communications Commission Rules and Regulations.

Transmitter Circuitry

The AM transmitter shall utilize solid state circuitry. All components shall be identified by the industry standard nomenclature except manufacturer’s LSI Devices.

Transmitter Frequency

The AM transmitter shall be capable of transmitting at frequencies from 530 kHz to 1720 kHz. The frequency to be used shall be the same for all transmitters and shall be determined by the FCC licensing procedure.

As part of this work item, the Contractor shall conduct the necessary frequency search, provide signal strength contours and all related tasks required for FCC license application preparation.

Transmitter Power

The AM transmitter shall provide a nominal 10 watts of RF power to the antenna. The power shall be field adjustable from 0 to the maximum output. As part of the adjustment process, the power shall be adjusted to the highest legal level. A facility shall be provided which shall allow the transmitter power to be cut in half from a command issued by means of the fiber optic interface.

Transmitter Efficiency

The AM transmitter shall have a power efficiency of 80% or greater. The transmitter shall include an audio limiter and a visual peak limiter.

Transmitter Monitoring
The AM transmitter shall be provided with a headphone jack and headphones for on site monitoring of the output signal. This monitor shall be implemented via an independent AM receiver permanently tuned to the frequency of the transmitter. In addition to on site headphone capability, the monitor signal shall be returned to the TMC via the fiber optic audio interface.

Transmitter Synchronization Circuit

Each transmitter carrier frequency shall have the capability of being synchronized with that of an adjacent transmitter. The adjacent transmitter will be located approximately seven to eight miles away, as indicated in the plans.

Synchronization of the carrier frequency shall be accomplished by using an AM radio station as a common reference. Alternative methods may be used subject to approval by the Engineer.

Synchronization of the audio transmitted shall be accomplished via the TMC which shall distribute the same audio signal to each transmitter via the fiber optic link. Reception of the audio signal shall be within 1 millisecond at any location in the Corridor.

Antenna Assembly

Antenna Components

The antenna assembly shall consist of an antenna, antenna mounting hardware and antenna tuning unit.

Antenna Type

The antenna shall be a whip-type antenna. The antenna shall be vertically polarized, center loaded monopole tuned for operation at the transmitter frequency. The antenna shall be constructed of anodized aluminum with an adjustable stainless steel tuning tip. The antenna shall withstand sustained winds of 80 mph with ½ inch radial ice.

Antenna Mounting Hardware

Hardware shall be provided for mounting the antenna on sign trusses as shown in the plans.

All hardware used shall be stainless steel.
**Antenna Tuning Unit (ATU)**

The antenna tuning unit shall be compatible with transmitter power of up to 10 watts continuous at 50 ohms unbalanced. The output impedance shall be variable from 0.5 to 65 ohms at 1:1 VSWR, as indicated on a self-contained VSWR bridge and meter. The meter shall read VSWR directly, and also directly read RF power delivered to the unit.

The ATU shall be located in the HAR equipment cabinet.

**Ground Plane**

The ground plane shall consist of three (3) copper pipes, 20 ft long buried vertically near the antenna location as shown in the plans. The pipes shall have weep holes in the bottom 10 ft. If the installed pipes do not reach into the water table, the pipes shall be filled with a slurry of salt, copper sulfate and sand to increase conductivity with the surrounding soil.

**Standby Power Supply**

The standby power supply shall be capable of providing normal full power operation of the transmitter site equipment for a minimum of 72 hours without normal 115 volt power. The current draw of each component of the system, including the transmitter, and any other electrical loads present during operation will be measured and provided to the Engineer for verification of proper sizing of the battery system.

**Batteries**

The batteries for the standby power system shall be maintenance free, deep cycle, gel-cell industrial batteries capable of total discharge and recharge without damage to the batteries. The proposed number and type of batteries shall be approved by the Engineer.

**Charging System**

A battery charging system shall trickle charge the batteries from the normal 115 volt power. The system shall not over charge the batteries and will include a load controller and a charge regulator in addition to automatic battery temperature compensation. Voltmeters and ammeters shall be provided to indicate the current state and rate of charge of the batteries.

**Digital/Analog Player Unit**
The Digital/Analog Player Unit shall be a microprocessor controlled device that shall provide the following functions:

**Message Memory**

The digital/analog player unit shall be completely solid state with no moving parts. The device shall be able to retain a minimum of twenty-four minutes of voice messages. The message time shall be segmentable into up to 250 distinct messages which may be recorded or deleted independently. Sequences of up to 100 messages shall be possible.

**Message Retention**

The digital/analog player unit shall be capable of playing the current message sequence while new messages are being programmed into the system for subsequent replay. The messages shall be retained during a power failure of at least seven days by a rechargeable battery, in addition to that capacity provided by the standby power system.

**Internal Clock**

The digital/analog player unit shall have an internal clock which can be utilized to schedule the message sequences on a 24 hour and 7 day week basis. The clock shall be capable of being updated remotely via the fiber optic interface.

**Transmitter Site Communications Interface**

The digital/analog player unit shall maintain communications with the TMC equipment via the fiber optic link to be provided under another contract item. The fiber optic link shall consist of two bi-directional 64 kbits/sec (DS-0) channels. One DS-0 channel shall be used for digital download of messages and overall transmitter site control. The second channel shall be used for the transmission of an analog audio signal from the central site for simultaneous synchronized transmission by all HAR transmitters. The second channel shall also be used to transmit the transmitter monitoring signal to the central site.

**Transmitter Site Equipment Cabinet**

The transmitter site equipment shall be installed in a Caltrans Model 334 cabinet as shown in the plans. The cabinet shall contain all mounting hardware and other equipment necessary to
Item 680.84700010 - Highway Advisory Radio System Traffic Management Center Equipment

Item 680.84710010 - Highway Advisory Radio System Transmitter Site Equipment

Item 680.84720010 - Highway Advisory Radio System Beacon Equipment

provide for the installation of the transmitter site equipment and fiber optic communications transceivers as shown in the plans. The fiber optic communications transceivers are part of the fiber optic link between the central site and transmitter site that shall be provided under another contract item. The cabinet shall be identical in size and appearance to the Model 334 Field Controller cabinets provided under another contract item. The cabinet shall meet all applicable requirements of the Field Controller cabinet with the exception of the requirements for door contacts.

Central Control Equipment

General

The central control equipment shall consist of a HAR operator's console, a file server for message storage, communications interface equipment and equipment for the recording and playback of messages. The following functions shall be provided.

Operator’s Interface

A graphical user interface (GUI) shall be provided that will allow an operator to monitor and control all characteristics of the transmitter site equipment and the central message library and the scheduling of messages. By means of the GUI the operator shall be able to select messages for downloading to the transmitter sites, select locally stored messages for broadcast by individual transmitters or select messages from the central message library to be sent to multiple transmitters for simultaneous synchronized broadcast.

Message Recording and Storage

TMC equipment shall provide a means of recording and monitoring new messages as well as to re-record and delete old messages. Messages shall be digitized at an audio bandwidth of at least 5 kHz. Storage for a minimum of 128 minutes of audio shall be provided. Message recording shall be performed at the HAR operator's console.

Central Communications Interface

TMC equipment shall provide an interface to the fiber optic link described above.

LAN Interface
ITEM 680.84700010 - HIGHWAY ADVISORY RADIO SYSTEM TRAFFIC MANAGEMENT CENTER EQUIPMENT

ITEM 680.84710010 - HIGHWAY ADVISORY RADIO SYSTEM TRANSMITTER SITE EQUIPMENT

ITEM 680.84720010 - HIGHWAY ADVISORY RADIO SYSTEM BEACON EQUIPMENT

TMC equipment shall be capable of being interfaced to a Local Area Network (LAN) at the central site. The LAN shall be provided under another contract item. Via the LAN it shall be possible to exercise the monitoring and control functions of the HAR Operator's Console from another workstation. Applications software to permit control from the other workstation shall be provided.

In addition, via the LAN interface, it shall be possible to send control signals from a workstation on the LAN to a communication server and telephone modem for transmission to the HAR beacon sites using a paging service. The communications server, telephone modem and paging service shall be provided under another contract item.

Transmitter Monitoring

Provisions shall be made to permit monitoring of the AM signal output of individual transmitters at the Operator's console via the fiber optic link as described above.

HAR BEACON EQUIPMENT

Flashers

Flashers shall consist of two retrofittable 12 VDC, 12 inch amber signal heads to be mounted on each fixed warning sign as shown in the plans. The signal heads shall meet the applicable requirements of the National Manual for Uniform Traffic Control Devices (NMUTCD).

Control Circuitry

The HAR beacons shall be controlled from the TMC. Communications between the TMC and the beacon locations shall be accomplished by means of a commercial paging service to be provided under another contract item. It shall be possible to control (turn on or off) beacons individually and independent of the HAR transmitters. The control circuitry shall consist of a paging receiver, message decoder, control relay and flasher circuit. When the flasher signal heads are turned on they shall operate in a wig-wag format at a rate of one flash per second for each signal. A photoelectric operated dimming circuit shall be provided to conserve battery power during night operation.

Power Source
ITEM 680.84700010 - HIGHWAY ADVISORY RADIO SYSTEM TRAFFIC MANAGEMENT CENTER EQUIPMENT
ITEM 680.84710010 - HIGHWAY ADVISORY RADIO SYSTEM TRANSMITTER SITE EQUIPMENT
ITEM 680.84720010 - HIGHWAY ADVISORY RADIO SYSTEM BEACON EQUIPMENT

The power source for the beacon equipment shall consist of a 12 volt photovoltaic panel, storage battery (or batteries) and a voltmeter and ammeter. The panel shall have a power rating of at least 75 watts. The panel area shall not exceed 6 ft². The panel shall be pole mounted as shown in the plans. The mounting pole shall be provided under another contract item. The battery shall be a maintenance free, deep cycle, gel-cell industrial battery capable of total discharge and recharge without damage. The battery shall be capable of providing a load current of 1.75 amperes for each flash of a signal head. Starting with a full charge, the battery shall be capable of providing a minimum of 48 hours of continuous operation of the two flashes at the specified flashing rate.

Beacon Equipment Cabinet

The beacon control circuitry and power source shall be installed in a 24 inch x 24 inch x 16 inch NEMA 4 pole mounted cabinet as shown in the plans. The cabinet shall contain all the mounting hardware and other equipment necessary for the installation of this equipment.

CONSTRUCTION DETAILS:

TESTING

The HAR system shall be subject to four levels of testing as described in the General Provisions. The final system acceptance test for the HAR system shall include FCC compliance testing as follows:

An HAR factory trained technician shall adjust each transmitter and test the system to insure compliance with FCC part 90.242. A test procedure shall be supplied for approval by the Engineer as described in the Central Provisions.

After the transmitter is fine tuned, a minimum of 20 sites within the coverage area will be selected by the Engineer for testing. The test program shall demonstrate to the Engineer that an acceptable signal is being obtained throughout the coverage area for both day and night conditions. If the technician determines that the maximum field strength is not being obtained with the 10-watt input power setting, the Contractor will prepare the necessary FCC applications to request a waiver which will allow the transmitter power to be adjusted upwards to achieve the maximum field strength allowable under FCC Part 90.242.

All test documentation required to complete the FCC licensing procedure shall be prepared as part of this item.

12/29/08E- 8 2/7/8
TRAINING

Training shall be provided for the NYSDOT engineering, maintenance and operations staff, at a facility provided by the Department. The training shall include all material and manuals required for each participant. The training shall be as follows:

Maintenance Training

The training shall be provided for a minimum of 24 hours for up to five (5) maintenance personnel. The training shall include operation instructions, theory of operation, circuit description, preventive maintenance procedures, troubleshooting and repair of all central and transmitter site equipment.

Engineering Training

The training shall be provided for a minimum of 24 hours for up to 5 engineering personnel. The training shall include a complete demonstration of the system operation, troubleshooting procedures and equipment operation. This course shall stress the day-to-day operation of the completed system and its capabilities.

Documentation Requirements

Three (3) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following:

- Equipment operation
- Complete installation procedures
- Complete performance specifications (functional, electrical, mechanical and environmental)
- Complete and accurate troubleshooting, diagnostic and maintenance procedures

METHOD OF MEASUREMENT:

The HAR system items will be measured for payment as each unit furnished, installed, made fully operational and tested.

BASIS OF PAYMENT:
ITEM 680.84700010 - HIGHWAY ADVISORY RADIO SYSTEM TRAFFIC MANAGEMENT CENTER EQUIPMENT
ITEM 680.84710010 - HIGHWAY ADVISORY RADIO SYSTEM TRANSMITTER SITE EQUIPMENT
ITEM 680.84720010 - HIGHWAY ADVISORY RADIO SYSTEM BEACON EQUIPMENT

The unit price bid shall include the cost of furnishing all equipment, materials, labor, tools, training and documentation required to complete the work.

Progress payments will be made as follows:

Fifty percent of the bid price of each item will be paid when it is installed; fifteen percent will be paid upon satisfactory completion of Milestone 4, On-site Stand-alone Test; twenty-five percent of the bid price will be paid upon satisfactory completion of Milestone 6, System Performance Test; and ten percent of the bid price will be paid upon satisfactory completion of Milestone 7, 180 Day Operational Test as described in the General Provisions.