

## **SECTION 687**

### **HIGHWAY ADVISORY RADIO**

#### **687-1 Description.**

Furnish and install a highway advisory radio (HAR) system in accordance with the details specified in the Contract Documents. HAR systems incorporate Travelers' information stations that must be authorized and operated in accordance with FCC rules. Use only equipment and components that meet the requirements of these minimum specifications and are listed on the Department's Approved Product List (APL).

#### **687-2 Materials.**

**687-2.1 General:** Provide a HAR system that includes static signage with flashing beacons to notify motorists of active HAR broadcasts. Ensure that the HAR system includes all equipment necessary to record verbal messages from onsite or remote locations, and to continually broadcast live, prerecorded, and synthesized messages. Ensure that all HAR transmitter components are modular and fit in a rack-mounted chassis.

Ensure that the HAR system includes software, hardware and any other component required to fully configure, operate and monitor the HAR field equipment locally and remotely.

Ensure that all materials furnished, assembled, fabricated, or installed are new products and approved by the Engineer.

**687-2.2 Transmitter:** Ensure that the transmitter complies with the requirements of the Code of Federal Regulations (CFR) Title 47, Section 90.242, "Travelers' information stations", and 47 CFR Section 2.901 et seq. (Part 2, Subpart J), of the Federal Communications Commission (FCC) Rules and Regulations.

Use a transmitter with a power efficiency of 80% or greater. Ensure that the transmitter is adjustable from 0 to 10 watts. Ensure that the transmitter frequency is set at the factory. Ensure that the transmitter parameters can be monitored locally and remotely.

Ensure that the radio frequency (RF) output impedance is 50 ohms and unbalanced.

Ensure that the audio input impedance is 600 ohms and balanced. Ensure that the transmitter module has audio distortion of less than 1.5% for an audio frequency response of 200 Hz to 3.5 kHz.

Provide a transmitter module with indicators or displays for power status, RF power output, and audio modulation level.

**687-2.3 Digital Recorder and Playback Unit:** Ensure that the digital recorder and playback unit can locally and remotely record, store, transmit, and receive digital messages or audio files. Ensure that the digital recorder and playback unit allows operator control by dual tone multi-frequency (DTMF) tones over standard public switched telephone networks (PSTNs) and digital cellular telephone, and digital commands via serial modem. Ensure that the digital recorder and playback unit is FCC certified under Part 68 for dial-up operations.

Ensure that the digital recorder and playback unit can schedule broadcasts, which shall be programmable by the day of the week, month, date, and time. Use a digital recorder and playback unit with the ability to record and store a minimum of 250 distinct, variable-length messages, and provide a minimum of 14 minutes of recorded message time.

Ensure that the digital recorder and playback unit is password protected and has an input source indicator. Ensure that the digital recorder and playback unit can simultaneously record and playback messages. Ensure that the digital recorder and playback unit can retain messages indefinitely, in the event of a power loss, and not require a battery. Ensure that the digital recorder and playback unit has built-in voice prompts.

**687-2.4 Transmitter Synchronizer:** Ensure that multiple HAR transmitters broadcasting the same message can be synchronized.

Provide a global positioning system (GPS) receiver for audio synchronization and frequency synchronization. Provide a minimum of eight channels in the transmitter synchronizer module. Ensure that the accuracy of the module is within 45 nanoseconds at 10 MHz reference.

**687-2.5 Antenna Assembly:** Provide an antenna assembly with hardware and cables to mount the antenna as shown in the Plans. Use either a vertical monopole or a directional array.

Use an antenna that can be tuned to the transmission frequency either mechanically or electronically.

**687-2.6 Surge Protective Devices:** Install surge protective devices between the transmitter and the antenna.

**687-2.7 HAR Sign and Flashing Beacons:** Ensure HAR system is able to activate flashing beacons that are activated when an associated HAR is transmitting.

Provide 12 inch beacons, electronics, communications, power and material needed to provide a fully functioning flashing beacon system. Ensure that the flashing beacons use a NEMA-rated flasher circuit. Ensure that the flashing beacons can be operated locally and remotely. Flashing beacons must support activation via an IP network.

**687-2.8 Power System:** Provide a solar or AC power system as shown in the Plans. Provide a power distribution system, for both solar and AC powered sites, that includes automatic battery charging circuitry. Ensure that battery chargers prevent overcharging and provide a means of battery disconnection and isolation.

Provide external AC power supply module with backup batteries as shown in the Plans. Ensure that AC powered systems utilize 120 volts of alternating current ( $V_{AC}$ ) nominal input voltage. Ensure that the HAR operates from 89-135VAC with a frequency of 60 plus or minus 3 Hz. Provide batteries that can continuously operate the HAR system at full power for a minimum period of three days without an external power source. Ensure that loss of AC power to the system does not interrupt HAR transmissions.

Provide a solar power supply module, as shown in the Plans, with photovoltaic array and battery storage system to operate the HAR system continuously at full power for a minimum period of three days without sunlight. Verify that the system's solar panels are compliant with the International Electrotechnical Commission (IEC) requirements detailed in the IEC 61215 standard. Verify that the DC output power specifications are a nominal 13.6 volts of direct current ( $V_{DC}$ ) at 5 amps, with a maximum of 15  $V_{DC}$  and a maximum of 10 amps.

Provide 12 volt batteries that are rated at a minimum of 180 Ah, are deep cycle, and maintenance-free.

Provide an accessible attachment point that allows connection of a portable generator for emergency power.

Ensure the system includes a low voltage drop out circuit or device that will remove all power from the transmitter should the available supply voltage drop below the manufactures specifications for minimum power requirements.

**687-2.9 Control Cabinet:** Provide a control cabinet for housing the transmitter, digital recorder and playback unit, transmitter synchronizer, power, surge suppressors, and flashing beacon controller unless otherwise shown in the Plans. Ensure that cabinets meet NEMA 3R requirements for aluminum enclosures and conform to applicable requirements of Section 676.

**687-2.10 Performance Requirements:** Furnish a HAR system that is compatible with the current version of the Department's SunGuide® Software System.

Ensure that the system has a text-to-speech capability for converting typed words to audio files. Ensure that the system logs the status of all devices. Ensure that the operator is able to record, edit, and delete messages, and to select desired messages for broadcast. Ensure that the system maintains event schedules, diagnostic information, and logs of messages that have been downloaded and played, along with the date and time that a message was activated for each HAR. Ensure that the HAR system provides system failure remote alarms and indicates system status in the user interface.

**687-2.11 Environmental Specifications:** Ensure the HAR performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.

### **687-3 Installation Requirements.**

Obtain all required licenses to operate the HAR as per FCC requirements. Coordinate frequency selection and licensing with the HAR manufacturer, the maintaining agency, and the State Traffic Engineering and Operations Office. Ensure that each application for a station or system satisfies 47 CFR, Ch.1, §90.242(a)(2). Submit the application with a map in accordance with 47 CFR, Ch.1, §90.242(a)(2)(iii) showing an estimate of the signal strength of each station at the contour of the desired coverage area, and the 0.5 mV/m contour of co-channel and first adjacent channel AM broadcast stations that might be affected. Perform all necessary on-site testing to select the clearest and most appropriate operating frequency for all HAR transmitters at the proposed locations. Submit the results of the frequency search, testing, and the recommended frequency selection to the Engineer for approval prior to application for FCC licenses.

Provide all utility coordination, power design and power service installations to obtain power for the HAR and flashing beacon sites.

Ensure that any public network connections (PSTN, cellular, or other connections) used for system interconnect are approved by the Engineer.

Ensure that the synchronization eliminates interference and audio distortion within possible overlapping areas. Ensure the antenna is tuned to the frequency of the transmitter.

Provide a field measurement for RF forward and reflected power after the HAR system has been installed.

**687-3.1 Antenna Ground Plane:** Use a minimum of American Wire Gauge (AWG) #20 wire for any radial ground planes. Install these wires extending outward from the base of the antenna, at a minimum of 6 inches below ground, forming a circular pattern with a radius of 30 to 100 feet, unless otherwise shown in the plans or manufacturer's recommendations.

### **687-4 Testing.**

Subject the equipment covered by these specifications to field acceptance tests (FATs). Develop and submit a test plan for FATs to the Engineer for consideration and approval.

The Engineer reserves the right to witness all FATs. Complete the tests within five calendar days.

Ensure that the test plans demonstrate each and every feature available in the device or system under test and includes the tests discussed below.

**687-4.1 Stand-Alone Tests:** Perform the following stand-alone tests on the HAR, after all equipment has been installed and initial adjustment is complete at the field site.

**687-4.1.1 Transmitter:** Perform field measurements to verify compliance with 47 CFR Part 90.242. Document the location and results of field measurements and submit them to the Engineer.

**687-4.1.2 Digital Recorder and Playback Unit:** Demonstrate the correct operation of each function of the digital recorder and playback unit at the field site using the display screen. Verify the test message is received on a vehicle radio set to the approved transmitter frequency and located within the coverage area of the HAR transmission.

**687-4.1.3 Battery System:** Verify that the batteries and charging system are functioning properly.

**687-4.2 System Tests:** Conduct approved HAR system tests on at least one HAR system, including the operations center, one sign and flashing beacon, and one transmitter. Perform, at a minimum, all remote control functions. Complete approved data forms and submit them to the Engineer for review, and as a basis for rejection or acceptance.

If the system test fails because of any subsystem component, correct that component or substitute another in its place, then repeat the test. If a component has been modified as a result of a system test failure, prepare a report and submit it to the Engineer prior to retesting.

**687-4.2.1 Digital Recorder and Playback Unit:** Test the remote loading of the messages on digital recorder and playback unit and verify the quality of voice broadcasted. Demonstrate different sequences of playback. Test the message loading from at least one remote location using cellular telephone, standard analog telephone line or digital commands via serial modem.

**687-4.2.2 Transmitter Synchronization:** If multiple HARs are deployed, test that a clear signal is obtained in the signal influence region that is free of interference caused by synchronization faults.

## **687-5 Warranty.**

Ensure that the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or the maintaining agency within 10 calendar days of notification.

Ensure that the HAR has a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

## **687-6 Method of Measurement.**

The Contract unit price for each HAR system, furnished and installed, will include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software package(s) and firmware(s), supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

**687-7 Basis of Payment.**

Price and payment will be full compensation for furnishing all materials and completing all work as specified in this section or shown in the Plans.

Payment will be made under:

Item No. 687-1          Highway Advisory Radio System - each.