

## SECTION 33 83 04

### RADIO NETWORK / DISTRIBUTED AMPLIFIED RADIATING CABLE SYSTEM

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

This Section covers the general approach for the design of extensions and alterations to the Distributed Amplifier Radiating Cable System (DAS).

##### 1.02 RELATED SECTIONS:

- A. 33 83 01 - Radio Network / Trunked Radio System
- B. 33 83 04 - Radio Network / Mutual Aid Radio System
- C. 33 83 05 - Radio Network / Regional High Level Radio System

##### 1.03 MEASUREMENT AND PAYMENT

All work required under this Section will be measured separately and will be paid for as part of the Contract lump-sum price, as part of the related item of work, as indicated on the Bid Schedule of the Bid Form.

##### 1.04 REFERENCES

- A. Federal Communications Commission (FCC) 47 CFR
- B. National Public Safety Planning Administration Committee (NPSPAC)  
Region 6 (Northern California) planning regulations for 800 MHz Public Safety Agencies

##### 1.05 SUBMITTALS

- A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Shop Drawings: Submit Shop Drawings showing the layout of the system identifying the location of equipment and accessories.
- C. Product Data: Submit manufacturers' Product Data for all manufactured items of materials, equipment, and accessories shown on the Shop Drawings.
- D. Test Reports: Submit Test Reports of all tests conducted by the Contractor.
- E. Certificates: Submit Certificates certifying that the equipment tested is ready for use.

## 1.06 DESCRIPTION

The District owns and operates an 800 mhz radio network. Modifications to the radio network are anticipated over time due to expansion of the BART system. The Distributed Amplifier Radiating Cable System (DAS) is one element of the BART radio network. Radio signals generated by other elements of the BART Radio Network are connected to and then distributed by the DAS into the underground trackway, stations, and facilities.

## PART 2 - PRODUCTS

### 2.01 DESIGN

#### A. General

The DAS system shall be comprised of electronic equipment that accepts, processes, and amplifies radio signals, and a RF cabling system for distribution of those signals into the BART underground.

1. Below ground radio coverage shall be provided in all subway stations and tunnel areas. Radio coverage shall be made available along the BART operating alignment and wayside facilities. This includes the trackway, and both public and secured areas of passenger station concourses and platforms. Certain facilities shall also be provided with coverage.
2. The DAS system shall be designed to interface with other elements of the BART radio network in a manner similar to that used by the existing in-service equipment. This generally consists of a transmit and a receive RF signal interface from the trunked radio system, the mutual aid system, and the regional high level system. Each RF input is separately derived and applied to the DAS system.
3. The DAS system shall consist of all necessary equipment for processing, amplification, and distribution of selected radio channels. It shall have capacity for operating upon BART-use radio channels. It shall also have four channels for future inter-agency operations including fire, police, and other emergency agency personnel. All other channels shall be rejected.
4. The DAS system shall be constructed in a redundant manner. Radio feeds into the tunnel sections shall be fed from a "north" radio site, and also from a "south" radio site. At each bidirectional amplifier node, two separate bidirectional amplifiers shall be provided: one connected to the north feed source, one from the south feed source. The two amplifiers shall be coordinated so that only one is in service at a time, but will automatically connect to the other in case of a amplifier failure, feed source failure, or when manually commanded by a Network Management System (NMS).
5. Interconnection between the DAS tunnel portal radio feeds and the DAS radio network signal interface, co-located with specific trunked radio sites, shall be by fiber optic cable. The fiber cable shall be single mode, and furnished by other District designated representative.

6. Interconnection between the DAS tunnel portal radio feeds and the DAS bidirectional amplifier nodes shall be by fiber optic cable. The fiber cable shall be single mode, and furnished by other District designated representative.
7. DAS Radio System design and equipment shall adhere to applicable codes and regulations, including Federal Communications Commission (FCC) Rules, and National Public Safety Planning Administration Committee (NPSPAC) Region 6 (Northern California) planning regulations for 800 MHz Public Safety Agencies. All transmitting equipment shall be FCC type certified.
8. Any equipment deployed outside of an environmentally controlled facility shall be housed in a NEMA 4 box, and suitable for operation at temperatures of 40 degrees C.
9. Any equipment installed in an environmentally controlled facility must be mounted in a seismic zone 4 cabinet.
10. The DAS shall provide radio coverage in a manner that provides radio signal strength of -95dBm or greater, over 98 percent of the coverage area of BART trackway, public areas of BART Passenger facilities, and other maintenance or operational facilities. Also included is inside BART revenue vehicles, while moving at speeds of up to 80 mph. The Bit Error Rate of digital signals shall be better than 1 in 1000. Performance shall be based upon use of handheld radios.
11. The system shall be provided with a Network Management System that permits remote interrogation and control of the equipment for the purposes of adjustment, diagnostics, and alarms.
12. Bidirectional amplifiers shall support the simultaneous flow of radio energy in uplink and downlink directions.
  - a. 806 to 824 mhz for uplink direction (handheld to base).
  - b. 851 to 869 mhz for downlink direction (base to handheld).
13. The Radiating cable antenna system shall provide and support distribution of radio signals at levels sufficient to provide the radio performance described herein. RF Budget calculations showing signal distribution and predicted performance throughout the facilities provided coverage shall be furnished. The design must provide predictions that demonstrate adequate performance. Splices shall be minimized. The designer shall endeavor to go from equipment location to location without the need to splicing.
14. Deployment of Radiating Cable
  - a. In Tunnels:
    - 1) Radiating cable shall be deployed along the length of each track, from tunnel portal to tunnel portal.
      - a) The placement of the radiating cable shall be on the opposite side wall from the tunnel walkway, at a height as low as possible, but no lower

than the top corner of the BART revenue vehicle.

- b) The placement of the cable and hanger assemblies shall be in a straight line, consistently at the same tunnel position throughout the track environment. Alternative placement shall be permitted within the BART passenger station environment.
  - c) The cable system shall not encroach within the train car safety envelope.
  - d) The cable shall not be placed in a manner that prevents its maintenance, or maintenance of adjacent equipment, or within 12 inches of tunnel lighting.
  - e) It shall be up to the Designer to ascertain the proper radiating cable placement using these parameters.
- 2) Each track shall be provisioned with its own radiating cable. In underground areas that have more than two tracks and a common opening between all tracks, two radiating cables, one cable on each outside side wall shall be deemed sufficient if radio calculations show adequate radio signal margin will be provided by this arrangement for all tracks.
  - 3) All underground RF cable segments that interconnect adjacent amplifier equipment locations which are spaced more than 100 feet apart shall be provided with DC isolation.
  - 4) The cable size shall be as large as required to minimize the attenuation loss in the cable for the spans as designed. The cable shall be optimized for radio signals from 800 mhz to 2400 mhz.
  - 5) The cable jacket shall be of a low smoke, non-halogen design.
  - 6) All connectors shall have weatherproof boots, suitable for the installation environment, applied to them prior to placing the radiating cable system into service operation.
- b. In Stations:
- 1) Radiating cable system deployed for the stations must provide coverage for all public and secured areas of the station.
  - 2) Free space antennas may be used if their coverage will provide equivalent coverage as radiating cable.

**B. Design Modifications and Additions Requirements:**

Modifications or additions to the DAS Radio System shall satisfy the following general design principles:

1. It shall be designed and deployed in a manner so that no single point failure will render the radio coverage to the underground BART trackway environment or inoperable. If a failure occurs, the redundant path equipment shall take over operation of the system, and provide annunciation of the failure into the NMS.
2. Modifications or extension to the DAS system design shall be fully compatible with and become an integral part of the existing radio network.
3. Unless otherwise specified, DAS shall be configured to operate up to 17 duplex 800 Mhz NPSPAC radio channels simultaneously without performance degradation below requirements.
4. DAS system additions shall be compatible with and provide the same functions and operability as the existing DAS system. This includes a remote network management capability, and interface ports available to other BART radio systems. If upgrades to the existing BART DAS system equipment are required to establish compatibility to the new equipment, then those upgrades shall become part of the work.

## **2.02. SYSTEM REQUIREMENTS**

### **A. System Interface Requirements**

1. RF signals from Trunked Radio shall be applied to the DAS equipment by use of RF couplers installed in the transmit and receive coaxial cables to the site above ground antenna system. RF signals from mutual aid radio and the regional high level radio shall be coupled directly from local base stations, installed in the above ground radio site, into a DAS RF port. RF signal levels shall be coordinated, and specified by the DAS manufacturer.
2. Data, and control signals to and from DAS equipment site shall interface with the existing EDACS control point radio equipment at Lake Merritt and shall also be configured to be compatible with the requirements of the BARTnet.
3. Fiber optic cables shall be used to transfer the RF signals between tunnel portal section equipment and specific above ground radio site equipment. Fiber cable will be by others.
4. Power to the amplifier nodes shall be -48 vdc. Unless otherwise noted, the power supply, batteries, charging, and telemetry circuits shall be provided by the DAS manufacturer. The batteries shall be capable of providing normal operation for a period of 8 hours after loss of local power.

### **B. Radio System Site Locations:**

1. Newly proposed DAS radio amplifier sites shall be located to obtain the specified system radio coverage and reliability percentages. New transmit site facilities shall be located away from existing source of signal interference to limit or minimize degradation to the trunk radio system.
2. New site locations shall be placed upon District-owned property or projected-District-owned property along the right of way if at all possible. If the location of District

property is not suitable for establishing radio coverage performance, then the designer shall attempt to find space in an existing and developed radio facility. Failing that, other off-site property locations may be proposed and evaluated.

**PART 3 – EXECUTION**

**NOT USED**

**END OF SECTION 33 83 04**