Design Guideline 273523
Emergency Responder Radio Coverage

Scope

This guideline defines the requirements and standards for design of a two-way distributed antenna system to provide code compliant emergency responder radio coverage (ERRC).

Related Sections

U-M Design Guideline Sections:

SBA 5.4 – Telecommunications Rooms
6.3 DG 260513 – Medium, Low and Control Voltage Cables
6.3 DG 260526 – Grounding and Bonding for Electrical
6.3 DG 260533 – Electrical Materials and Methods
6.3 DG 272000 – Voice and Data Communications

U-M Master Specification Sections:

7.1 MS 017823 – Operations and Maintenance Manuals
7.3 MS 260513 – Medium, Low and Control Voltage Cables
7.3 MS 260526 – Grounding and Bonding for Electrical
7.3 MS 260533 – Electrical Materials and Methods
7.3 MS 272000 – Voice and Data Communications

Reference Documents:

Federal Communications Commission Regulations
IFC, “International Fire Code”
MBC, “Michigan Building Code”
Michigan Public Safety Communications System
NFPA-72, “National Fire Alarm and Signaling Code Handbook”

Design Requirements

Provide Emergency Responder Radio Coverage (ERRC) two-way radio communication enhancement systems in new buildings and in large renovations (Level 2 or greater renovations as defined by Michigan Rehabilitation Code) to enable communication between emergency responders (see list below) at the exterior perimeter of the building and emergency responders within the building. All areas of the building shall have code compliant radio coverage. Buildings which achieve radio coverage without amplification are exempt. U-M emergency responders include but are not limited to the following:

- U-M Division of Public Safety and Security (DPSS).
- U-M, F&O encompassing a) Environmental Health & Safety (EHS); b) Maintenance - Auxiliaries & Central Shops (MACs) which includes the U of M Radio Shop, and c) Maintenance - Regions.
- City of Ann Arbor Fire and Police Departments.

- Washtenaw County Sheriff and Michigan State Police Departments.
- Huron Valley Ambulance.

Provide drawings showing the general system architecture, equipment locations and routings. Provide a performance-based specification. The detailed technical design of the ERRC shall be by the selected and qualified firm's professional (Contractor).

ERRC shall be designed and constructed to comply with NFPA 72. Head end equipment, riser cables, directional couplers between riser cables and individual antenna cables, and donor antenna cables shall be located within two hour rated enclosures. Installation of this equipment and cabling in Building Entrance (BE) and Telecommunication Rooms (TR) that are two hour rated is an acceptable method of compliance.

System design shall include signal amplification on every floor of the building. Infrastructure (equipment space, electrical power and cable pathways) shall be installed throughout the building. However, install amplification only on floors that fail to pass the Contractor's pre-installation and acceptance tests.

The system shall have spare capacity to install amplification later on floors that pass pre-installation testing but may drop below the required percent coverage or signal strength when construction and furniture move-in are completed.

Prior to construction of the ERRC system, the Contractor shall survey the building to determine if signal amplification is required. Any prior survey performed by U-M is only a snap shot in time and shall not be used to define scope requirements.

ERRC shall be registered under the most current applicable rulings of the Federal Communications Commission (FCC). The system shall comply with the requirements of and obtain licensee consent from the Michigan Public Safety Communications System (MPSCS). A copy of the consent letter shall be submitted to the U-M Project Manager.

All equipment shall be Underwriters' Laboratories (UL) listed and labeled in accordance with applicable NEMA and ANSI standards. The system shall be listed and comply with UL 2524.

Do not combine the ERRC with other radio systems such as:

- Wi-Fi systems.
- Pager systems.
- Medical telemetry systems.
- Cellular Phone Signal Reinforcement (CPSR)

Consider a design based on a regional ERRC antenna location. Verify with U-M Radio Shop.

System Requirements

ERRC shall utilize a bidirectional amplifier (BDA) with a distributed antenna system to achieve the required radio coverage.

ERRC shall use a Class A channelized amplifier set up to only use MPSCS and U-M radio channels.

ERRC shall provide coverage on the 700 MHz and 800 MHz bands.

ERRC shall permit the simultaneous use and interoperability of analog and digital modulation radios.

ERRC shall be neutral host and nonproprietary.

ERRC shall not infringe on or overrun building (or adjacent building) communication systems or CPSR systems.

The system shall have expandability to permit future additions and changes to the emergency responder radio frequencies.

ERRC headend and node equipment shall be securely attached to racks or backboards.

Identify all required outside plant fiber optic cables required to connect ERRC to remote antennas and/or other systems in other buildings.

Passive Infrastructure Network

A passive infrastructure network shall be a combination of coax cables and directional couplers designed in such a manner to distribute signals with equalized losses to each antenna node.

Individual antenna feeds shall be coaxial cable installed in conduit or air dielectric coaxial cable with corrugated copper sheathing and PVDF jacket.

Install conduit for routing cabling through inaccessible ceilings, finished spaces with open ceilings and unfinished spaces below 10’-0.

Riser and feeder cables shall be plenum rated.

Cables shall be installed hidden from view except in open ceiling areas.

Antennas shall be Low PIM rated to reduce signal mixing and creation of harmonics.

Review antenna styles and mounting locations with Project Manager for aesthetic concerns and approval.

Use above ceiling antennas in dorm rooms, corridors and common areas. In other areas use low profile, flush-mount types installed on the underside of ceilings.

Antennas shall be securely attached independently from the work of other trades.

Antennas shall have an identifying label or address number visible from the traffic path location.

Obtain approval for donor antenna locations from U-M Radio Shop. Provide access for maintenance and code-required fall protection.

Support Systems and Spaces

The system shall include supervision of the ERRC antennas, signal boosters, power supplies and UPS as noted below.

- Supervisory and trouble alarm output contacts indicating an impairment. Connect the supervisory and trouble alarm contacts to the building fire alarm system.

- A fire alarm system shall transmit ERRC supervisory and trouble alarm signals to the appropriate supervising station (DPSS Dispatch Services).

ERRC shall be designed to maintain full system operation during a normal power outage. It shall transfer to and from an Uninterruptible Power Supply (UPS) without interruption. Size UPS to provide emergency power to ERRC headend and node equipment for a minimum of 12 hours. Connect the UPS to a generator-backed emergency power circuit if available.

- Active components shall be enclosed in a NEMA Type 4X enclosure.
- UPS batteries shall be of the sealed maintenance-free type.
- Provide battery ventilation in accordance with code as required.

Locate the headend equipment in the telecommunications Building Entrance (BE) room whenever possible. Locate the node equipment in Telecommunications Rooms (TRs). See Design Guideline DG 5.4. Coordinate with U-M ITComm for space within telecommunication rooms.

ERRC headend rooms and the TRs containing ERRC equipment shall have continuous air conditioning to alleviate heat build-up within the rooms. Air conditioning systems shall be connected to normal power building circuits. The ERRC equipment can operate at an elevated temperature during a power outage.

ERRC headend room doors shall be labeled to identify the presence of headend equipment.

Specification Requirements

Provide performance-based specifications. Require final and complete design, specifications and drawings be provided by the Contractor and submitted as part of the shop drawing process.

Include the following in the ERRC performance specification.

- ERRC equipment shall be FCC certified.
- The contractor shall be FCC licensed as required by code.
- The contractor shall submit detailed shop drawings for review to U-M Design Manager and U-M Radio Shop.
- Components shall be industry standard and readily available to U-M.
- Performance specifications for major components.
- Requirements for spare parts.
- Required separation distances between ERRC equipment and other mechanical, electrical and telecommunications equipment.
- Required separation distances between ERRC antennas and antennas of other radio systems.
- Components shall be labeled with unique part or address numbers which correspond to numbers shown on the Contractor drawings.
- Riser cables and cables for individual antenna feeders shall be installed in a neat and workman like manner. Each cable shall be individually supported.
- Furnishing factory-authorized service representatives to supervise the field assembly, connection of components, commissioning and testing of their respective systems.
- Contractor to submit a detailed work plan including narrative setting forth in sufficient detail how the Contractor will provide the scope of services.
- Contractor to attend progress meetings as required by the Construction Manager to maintain a

thorough understanding of the project schedule and associated coordination issues.
- Utilizing iBwave Model Generation software, the Contractor shall perform a predictive RF propagation survey in native and AutoCAD formats and submit results to U-M Design Manager.

Shop drawing submittals shall include the following:

- Proof of Contractor's qualifications.
- FCC registration number.
- Detail technical design package
- Submittal of design to AHJ for approval in accordance with NFPA-72.
- Testing and commissioning procedures

Specify the following to support operation and maintenance activities:

- Four paper copies of operation and maintenance manuals.
- An electronic file storage device (USB drive) containing the final system software including the master program generic to the system, the software associated with each programmable piece of equipment, and the software licenses and passwords required by the U-M Radio Shop to perform programming changes.
- A minimum of 8 hours of Owner training on operation and maintenance.
- One year of customer service from the date of acceptance by U-M.
- A parts and labor warranty for 1 year from the date of acceptance by U-M.
- The first code-required annual operational test at the end of 1 year.

Code requires one set of ERRC technical information and documentation to be filed in the Fire Command Center (if one exists) or in the ERRC headend room. Specify submittal of one set of the following:

- ERRC bid specifications and drawings.
- ERRC as-built drawings.
- Summary of ERRC frequencies utilized.
- Summary drawing showing locations of ERRC headend and node equipment, and antenna sites.
- Table of effective radiated power at antenna sites.

Bidding Requirements

Before bidding, forecast which floors will likely require amplification.

To bid the work, request a base bid price for the ERRC headend and for amplification on just the floors forecast to require amplification. Request an add price for adding amplification on each additional floor.

Testing Requirements

Arrange preliminary ERRC signal testing for renovations with U-M Radio Shop to assist in forecasting building floors requiring signal amplification. Any survey performed by U-M is only a snap shot in time and shall not be used to define scope requirements.

The Contractor shall perform pre-installation testing for percent coverage and signal strength in accordance with code. Testing shall not be performed until after the building is fully enclosed (roof, exterior skin, doors

and windows are installed), and interior ceilings and walls are in place. Measure the percent coverage and signal strength in both the critical and general areas on each floor. Measure the signal strength receivable within the building and the signal strength received when transmitting from within the building.

The Contractor shall test for system interferences with building communication systems and CPSR systems prior to and after installation of ERRC systems.

The Contractor shall perform acceptance testing for percent coverage and signal strength in accordance with code. Testing shall be performed after furniture move-in.

Final testing shall be scheduled and performed in conjunction with EHS Fire Safety and U-M Radio Shop personnel. The Project's Commissioning Authority will witness the testing.

- Demonstrate full compliance with IFC and NFPA 72 requirements.
- Demonstrate full compliance with specification requirements.
- Modify or add equipment, cables and antennas as required to achieve the code-required performance. Resolve specification deviations.

Testing for systems in buildings without an emergency generator system shall be performed on unit battery power. The normal power circuit serving the unit shall be shut off 6 hours prior to testing.

Signal strength test shall be conducted using a calibrated spectrum analyzer utilizing antennas similar in use by the emergency responders.

Final test results shall be spreadsheet form, along with building floor plans overlaid with test grid used in testing procedure. Each drawing grid shall show the test results for uplink signal, downlink signal and delivered audio quality (DAQ) measured. A DAQ level of 3 or better throughout the building is deemed acceptable. Testing and testing results shall comply with NFPA 72, Appendix A 14.

Test results shall indicate date, time and weather conditions at the time of the testing.