

# STATE OF VERMONT

Agency of Administration  
Department of Information & Innovation



**Vermont Telecommunications Authority**

## **TECHNICAL SPECIFICATIONS TO USE AND INSTALL ELECTRONIC COMMUNICATIONS DEVICES ON STATE PROPERTY**

### **CONTACT:**

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## **Technical Specifications for Using Vermont Telecommunications Facilities**

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### **1. Introduction and Objectives**

This document provides specifications regarding the technical aspects of the communication systems design. It is intended to minimize radio frequency interference (RFI), protect state-owned assets, and ensure safety for both equipment and personnel in state-owned facilities. In addition, it will ensure that all communications applicants adhere to the same technical specifications and applications process.

These specifications will provide a high-quality RF environment at each site across the state. RFI, also called electromagnetic interference (EMI), is a disturbance that impacts an electrical circuit due to either electromagnetic induction or electromagnetic radiation emitted from an external source. Installed equipment must be designed and installed so it does not interfere with other co-located equipment.

The technical specifications will apply also to any major modifications performed at a site.

Hazardous material, site maintenance, and operational guidelines are covered in the body of the lease agreement.

Overall installation standards should meet or exceed the Motorola R56 Standards. These standards will in no way dictate the equipment to be used by the licensee.

This document provides technical requirements for the following three scenarios for use of state owned properties:

1. *Property Only* - Lease of state-owned land to install a new communication tower owned by the service provider. (See Sections 2 & 3)
2. *Existing State Tower or Building* - Construction of new communications facilities on state-owned property on the site of an existing tower or building and the service provider places his own cabinets or shelter. (See Sections 2 & 4)
3. *Use of an Existing State Shelter* - Those using existing State shelters, in addition to 1. or 2. above, also see section 5.

In addition to the above scenarios, mobile radio operators must conform to the conditions set in Section 6.

The following section details requirements that are common to all site types, followed by the sections detailing requirements unique to each scenario.

### **2. Common Requirements**

The following technical requirements are common to all applications and must be followed by all applicants in all three of the above scenarios.

## 2.1. Building Site Plan

Applicants are required to submit a building site plan showing the locations of all new or modified equipment at the site.

## 2.2. Tower Structural Design and Integrity

A telecommunication tower designed and constructed in Vermont must at a minimum comply with the version 2006 IBC Code, which is the TIA standard 222.

If it is a co-location on an existing telecommunications tower, then the attaching service provider will assess whether additional structural support will need to be added to the tower to continue compliance with the TIA 222 standard.

If the tower also supports emergency services and/or is owned by the Public Safety Department, then the attaching service provider must comply with the Public Safety Department's policy on tower design criteria. Public Safety requires that the design criteria covered in TIA 222, Revision G be met. In addition, Public Safety requires the following criteria to be used:

- Towers located at facilities *higher* than 3000 feet in elevation:
  - Must be able to withstand 120 mph winds and 2" solid radial ice, no de-rating.
  - For towers equipped with microwave dishes, the twist and sway must be equal to or less than ½ degree at the antenna attaching point.
- Towers located at facilities *lower* than 3000 feet in elevation:
  - Must be able to withstand 90 mph winds and 1" solid radial ice, no de-rating.
  - For towers equipped with microwave dishes, the twist and sway must be equal to or less than ½ degree at the antenna attaching point.

## 2.3. Equipment Installation (Base Stations)

### 2.3.1. Rack and Cabinets

All RF devices, including duplexers, isolators, cavities and switches, etc. shall be located inside grounded cabinets or relay racks. Properly shielded devices may be mounted on grounded relay racks with permission of the State of Vermont.

### 2.3.2. Equipment Identification

All equipment cabinets and/or relay racks shall have visible identification labels attached, which show the Service provider's corporate identity and list the licensee's name, address, call sign, frequency, and telephone number of the person and organization responsible for maintenance work. All transmission lines, including internal jumpers, but not short lengths of interconnect cabling, shall be uniquely identified by numbered tags. A log of the tags shall be maintained at each site associating transmission lines with licensee name, address, and contact number; maintenance personnel name and number;

frequency, antenna manufacturer, and model number; antenna mounting height and orientation; and equipment type and port to which the line is attached.

## **2.4. Grounding Requirements**

### **2.4.1. Existing Site Grounding Conditions**

Proper grounding of the tower and equipment is the most important factor in protecting equipment and personnel from Ground Potential Rise (GPR) induced by lightning.

In the case of existing towers owned by the State of Vermont, the state will provide the service provider with a layout of the existing tower ground rings. The existing ground rings of the tower and other site buildings should be kept intact at all times and should not be disrupted in any way, other than connecting new outside cabinets or shelters to the tower ground ring.

Please see Chapter 4 of the Motorola R56 Guidelines for proper External and Internal Grounding requirements.

### **2.4.2. Ground Testing and Documentation Required**

#### ***Measurements***

Premeasurements should be performed by the service provider on the existing tower grounding system before any attachments are made. In the event the pretesting of the existing ground ring indicate that the ring does not meet the 5 Ohm standard, the service provider will notify the VTA immediately. The service provider should cease all construction/modifications at the site until they are notified in writing by the VTA that they may proceed.

Premeasurements should also be performed on the service provider's "new ground ring" before connections are made to the existing tower ground ring.

Post measurements should also be performed by the service provider after the "new ground ring" has been connected to the existing tower ground ring.

#### ***Documentation***

Detailed photos should be taken of the newly installed ground ring and any connection points made to the existing ring before the trenches are back filled. These photos along with written documentation on the grounding design and final resistance measurements shall be submitted to the VTA. The final measurements must meet the 5 Ohm standard.

If the post measurements do not meet the 5 Ohm standard, then a full report describing all attempts made to meet this standard, including site specific photos of those attempts, must be submitted to the VTA and Public Safety for consideration of a waiver or plan of correction.

### **2.4.3. Ground Connections**

See Motorola R56 Guidelines Chapter 4 for more details regarding external grounding connections that must be followed. The following topics are covered in that section:

- Building ground ring
- Tower ground ring
- Ground rods properly installed and spaced around the building and tower ground rings
- Radial grounding conductors for high lightning prone geographical areas, sites that are normally occupied (such as 911 dispatch centers), sites with high soil resistivity, or when bedrock prohibits the driving of ground rods
- Proper bonding of all grounding electrode system components
- Grounding (Earthing) Electrode System
- Proper bonding of all ancillary equipment
- Grounding electrode system resistance requirements

### **2.4.4. Inside Site Grounding**

See Motorola R56 Guidelines Chapter 5 for more details regarding internal grounding. The following topics are included:

- Common grounding
- Grounding system components and installation requirements
- Connection methods for internal grounding system
- Bonding equipment to internal grounding system
- Grounding for stand-alone equipment shelters
- Grounding for small, large, and multi-story buildings
- Grounding for integrated communication sites

## **2.5. Antennas and Lines**

### **2.5.1. Permissible Antennas**

Antennas should be fiberglass enclosed when possible. Exposed metal antennas should be treated by chromate conversion to prevent corrosion.

### **2.5.2. Antenna Mountings**

Service providers may not weld antenna mounts to tower.

All antenna mounts or supporting structures will be stainless steel, hot-dipped galvanized steel, or cast aluminum. Any hot-dipped galvanized pipes or brackets that have been field cut must be sprayed with a minimum of two coats of cold galvanizing paint.

### **2.5.3. Transmission Line Routings**

External Routing:

- Cabling must be attached to the tower leg or waveguide support assigned by each party so tower loading is properly distributed.

- All attachments will be made using the appropriately-sized stainless steel clamps, UV stabilized nylon ties, or other manufacturer-approved method.
- Attachments should be at one (1) foot intervals for the top three (3) feet of line, and at three (3) foot intervals thereafter.
- Cables must incorporate a drip loop or other method of shedding water immediately prior to the shelter entrance.
- Cable bends must not be less than the minimum-bending radius specified by the manufacturer.

Internal Routing:

- Cabling should enter the shelter through a weatherproof boot on a grounded entry bulkhead.
- Cable between the shelter entrance and equipment cabinet must be a continuous length without splices.
- Cable bends must not be less than the minimum-bending radius specified by the manufacturer.
- It may be desirable to use a more flexible cable for interior routing between the cable entry surge suppressor and equipment.

## **2.6. Power Sources**

### **2.6.1. Commercial AC Power**

The service provider will be required to have its own metered AC power feed and associated billing for all equipment, cabinets, and shelters.

In the event that the power feed to the tower location lacks sufficient capacity for the newly proposed equipment, the service provider should plan on installing a new power feed to the site and will be responsible for all costs incurred.

### **2.6.2. Emergency Generators and Fuel Storage**

The State of Vermont does not allow connection to their existing site emergency generators.

## ***3. Property Only Sites***

In addition to the requirements set forth in Section 2, *Common Requirements*, Service providers must comply with all local codes and building requirements, as well as meet the TIA standard 222 for structural design.

It is recommended that the Motorola R56 standard be used as a minimum quality standard, supplemented by the service provider's requirements and standards.

## ***4. Existing State Towers or Buildings***

This section addresses existing state towers or buildings. In addition to the common standards stated above in Section 2, *Common Requirements*, the service provider will be responsible for the items in the following sections.

## **4.1.1. Reports**

### **4.1.1.1. Intermodulation Studies**

These reports might be required by the State of Vermont for new or modified applications. The Intermodulation and Compatibility reports are required when the applicant is applying for use of a shared facility. If the applicant is the first service provider at the location, these reports are not required.

### **4.1.1.2. Structural Analysis**

The need to complete a structural analysis report will be determined by the State of Vermont on a site-by-site basis.

In the case of existing towers used by the Department of Public Safety, additional structural enhancements must be maintained. This design criterion is part of the TIA 222 Rev G standard, which includes limits of deflection or sway in the tower design. The common requirements previously identified in Section 2.2 are also required.

## **4.1.2. Security and Access Requirements**

When applying to use a State communications site that houses public safety equipment, the applicant will be required to identify the staff members requiring access to the facility. The applicant and the identified staff members will be required to complete a background check conducted by the Vermont Department of Public Safety.

## **4.1.3. Inspection and Service Requirements**

### **4.1.3.1. Service Requirements**

Service provider shall keep and maintain the premises in good condition, allowing reasonable wear and tear.

Equipment on the property shall be properly maintained in accordance with the manufacturers' specifications and in such a manner as to prevent it from becoming a source of interference or a safety hazard.

### **4.1.3.2. Inspections**

Service provider will perform annual inspections or as instructed by the State.

## ***5. Use of An Existing Shelter***

This section covers those cases when a service provider utilizes an existing State building or shelter. In addition to the common standards stated above in Section 2, *Common Requirements*, the service provider will be responsible for the items in this section 5.

### **5.1.1. Receivers and Condition**

All speakers will be turned off except during periods of maintenance work.

Receivers must have minimal protection from interference before the State of Vermont will require any changes to another service provider's transmitter, which is operating according to the specifications set forth in this section. Minimal protection for a single-channel receiver system is a bandpass filter with rejection as specified in Section 5.2.2 for the applicable frequency band. In certain cases, a service provider may be required to use a crystal filter.

All transmitters must meet or exceed manufacturer's original specification.

### **5.1.2. Transmitters**

All transmitting equipment must be FCC type-accepted for the use intended and must comply with current FCC rules and regulations.

Service provider should have the ability to remotely disable all transmitting equipment.

If notified by the State of Vermont that the service provider's equipment is causing harmful interference, the service provider shall agree to immediately cease or modify operation until it is corrected. Service provider will supply an interference analysis demonstrating that the issue has been resolved if requested by the State of Vermont.

### **5.1.3. Security**

Equipment installed in an existing building has to be separated from state owned equipment by construction of a demising wall or similar means of separation (cage structure). In addition it has to be secured with its own entrance and exit.

## **6. Minimizing Site Interference (2-Way Radio)**

This section is intended to address potential interference issues between two-way radio and other existing co-located tenants. Special care must be taken in those cases where Public Safety facilities are present.

### **6.1. Shielding**

Shielding refers to the elimination or blocking of EMI/RFI emissions generated by operating equipment. All existing RF shields must remain in place. All low-level, pre-driver, and driver stages in exciter must be shielded, as well as all power amplifiers.



## 6.2. Isolation and Filtering (Intermodulation)

All transmitters must be equipped with isolators to provide the following minimum isolation to reduce the possibility of IM interference within the specific bands listed.

- 30 MHz – 50 MHz      Isolators – None required  
Bandpass cavity with a minimum of 20 db rejection at  $\pm 0.5$  MHz
- 88 MHz – 108 MHz      Isolators – None required  
Bandpass filter to meet FCC emission requirements
- 72 MHz – 76 MHz      Isolators – Minimum of 25 dB  
Bandpass cavity with a minimum of 20 dB rejection at  $\pm 0.5$  MHz
- 138 MHz – 174 MHz      Isolators – Minimum of 60 dB  
Bandpass cavity with a minimum of 20 dB rejection at  $\pm 1.5$  MHz
- 220 MHz – 221 MHz      Isolators – Minimum of 60 dB  
Bandpass cavity with a minimum of 20 dB rejection at  $\pm 5.0$  MHz
- 440 MHz – 512 MHz      Isolators – Minimum of 60 dB  
Bandpass cavity with a minimum of 20 dB rejection at  $\pm 3.5$  MHz

Additional interfaces and/or isolation specifications may be required on a case-by-case basis as determined by the State of Vermont. Frequencies not included in the above list shall be dealt with on a case-by-case basis. The specific frequencies and frequency bands listed are in no way intended to limit the scope or application of this section.