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Seattle-Tacoma International Airport

STANDARDS AND GUIDELINES
FOR
RF COMMUNICATIONS

By
SeaTac Telecommunications Architecture Review Team
(START)

Revision History

Date	Name	Comments
06/27/2001	Julie Chen	Established draft document for Comments and Review.
07/30/2001	Julie Chen Lew Barnum Doug Paasch Linda Dyson	Updates and modifications for 15 August 2001 baseline document.
08/24/2001	Julie Chen	Simplify document per Howard Kourik's input.
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04/08/2004	Gary Mullin	Various updates and corrections. Deleted chapters (Site Acquisition, Site Design and Development, RF Communications Site Building Design and Installation). Modified chapters (Minimizing Site Interference and Port Approval).
7/21/05	Gary Mullin	Modified chapter (Minimizing Site Interference). Added discussion on fluorescent lighting interference.

TABLE OF CONTENTS

TABLE OF APPENDICES

1. INTRODUCTION

This document, “Seattle-Tacoma International Airport Standards and Guidelines for Radio Frequency (RF) Communication Sites”, is the official standards and guidelines document for the Port of Seattle ("Port" or “POS”) Seattle-Tacoma International Airport (“Airport”) for any RF Communications Sites at the Airport premises. The document includes standards and guidelines for the installation of RF equipments, infrastructure, and facilities.

This document is intended for the following personnel on the Airport premises:

- Port of Seattle employees
- Airlines
- Airport Tenants
- Airport Concessionaires
- Program Managers
- Consultants
- Designers
- Contractors responsible for installing RF communications infrastructure at the Airport premises.
- Technicians responsible for installation or maintenance of RF communications sites and equipments.

The document covers the following topics

- Safety summary
- External grounding
- Internal grounding
- Power sources
- Transient voltage surge suppression
- Site interference – addressing minimizing site interference
- Equipment installation

For topics not included in this documentation, please contact Port of Seattle, Facilities and Infrastructure.

1.1 STANDARDS

This section lists all the published standards referenced and used by this document. The standards are categorized into government, industry, and other Port of Seattle standards.

1.1.1 Government Standards

Part 17, Title 47, Code of Federal Regulations, Construction, Marking and Lighting of Antenna Structures.

7460-1K, Part 70, FAA Advisory Circular, Obstruction Marking and Lighting.

1.1.2 Industry Standards

ANSI C62.1, Surge Arresters For AC Power Circuits.

ANSI TI-313, Electrical Protection for Telecommunications Central Offices and Similar Type Facilities.

ANSI / IEEE 80, IEEE Guide for Safety in AC Substation Grounding.

ANSI / IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1).

ANSI / IEEE C95.1, Safety Levels with Respect to Human Exposure to Radio Frequency Energy

EIA / TIA – 222, Tower Foundation and Anchor Design.

ANSI / TIA / EIA – 222 (f), Structure Standards for Steel Antenna Towers and Antenna Supporting Structures.

ANSI / TIA / EIA-568-A, Commercial Building Telecommunications Cabling Standard.

ANSI / TIA / EIA-569-A, Commercial Standard for Telecommunications Pathways and Spaces

ANSI / TIA / EIA-606, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

ANSI / TIA / EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

IEEE C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

IEEE C62.45, IEEE C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

IEEE Green Book; *IEEE STANDARD 142,* Recommended Practice for Grounding of Industrial and Commercial Power Systems

IEEE 802.11 (Current Edition) Wireless Local Area Networks

IEEE Std. 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

MIL-HDBK-419A, Communications Facilities Design and Construction

NFPA 1,Fire Prevention Code.

NFPA 10, Standard for Portable Fire Extinguishers.

NFPA 12, Standard for C 2 Extinguishing Systems.

NFPA 13, Standard for Installation of Sprinkler Systems.

NFPA 17, Standard for Dry Chemical Extinguishing System.

NFPA 33, Standard for Spray Application Using Flammable or Combustible Materials.

NFPA 70, National Electrical Code ®.

NFPA 101, ® Life Safety Code ®.

NFPA 111, Standard on Stored Electrical Energy, Emergency and Standby Power Systems.

NFPA 780, Standard for the Installation of Lightning Protection Systems.

NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems.

OSHA 1926.104, Safety Equipment.

UL 268, Smoke Detectors For Fire Protective Signaling Systems.

UL 467, Grounding and Bonding Equipment.

UL 497A, Secondary Protectors For Communication Circuits.

UL 497B, Protectors For Data Communication And Fire Alarm Circuits.

UL 1449, Transient Voltage Surge Suppressors.

ULC-S504-77, Standard for dry chemical fire extinguishers.

1.1.3 PORT OF SEATTLE STANDARDS

Port of Seattle Seattle-Tacoma International Airport Electrical Utility Standards.

Port of Seattle Seattle-Tacoma International Airport Geotechnical Exploration Storm Water Pollution Prevention Plan.

Port of Seattle Seattle-Tacoma International Airport Communications Standards, including Nomenclatures Standards.

1.1.4 REFERENCES

Motorola R56 Document "Standards and Guidelines for RF Communications Sites"

1.2 ACRONYMS

(Include only those used in here, please check)

ACC	Airport Command Center
ADA	American Disability Act
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
BTU	British Thermal Unit
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
EIA	Electronics Industries Association
EMC	Electromagnetic Compatibility
EME	Electromagnetic Energy
ERP	Effective Radiated Power
ETSI	European Telecommunications Standards Institute
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
GPS	Global Positioning System
HVAC	Heating, Ventilation and Air Conditioning

IEEE	Institute of Electrical and Electronics Engineers
IPGB	Internal Perimeter Ground Bus
LAN	Local Area Network
MDO	Maintenance Duty Officer
MGB	Master Ground Bus Bar
MSO	Mobile Switching Office
NEBS	Network Equipment Building Systems
NEC	National Electric Code
NFPA	National Fire Protection Association
PEST	Proactive Electrical Systems Team
PFS	Pounds per Square Feet
POS	Port of Seattle
RF	Radio Frequency
RFDS	RF Distribution System
RFI	Radio Frequency Interference
RGB	Rack Ground Bus Bar
PSF	Pounds per Square Foot
SPD	Surge Protection Device
SSGB	Sub System Ground Bus Bar
START	SeaTac Telecommunications Architecture Review Team
TIA	Telecommunications Industry Association
TVSS	Transient Voltage Surge Suppression
UPS	Uninterruptible Power Supply
USGS	US Geological Society

2. SAFETY

This chapter provides safety guidelines, equipment precaution concerns and requirements. These safety guidelines are for the support of installation, construction and modification of any RF communication sites at Seattle-Tacoma International Airport

This chapter includes:

- Fire Safety
- Battery Safety Precautions
- Seismic Safety Precautions
- Electromagnetic Energy Safety
- General Safety Precautions
- Safety Summary
- Equipment Precaution Summary

All other RF safety concerns and issues not addressed in this chapter must be coordinated with Port of Seattle Fire Department, Port of Seattle Maintenance Department and Airport Safety Program Manager.

- **Safety, Precaution and Note Statements**

These are to alert potential hazards to personnel or equipment. Safety statements compose of the following types:

- Warning

Warning indicates danger of injury or health to personnel. Warnings are indicated by an exclamation point and the word warning. The label is of Orange color.

- Caution

Caution indicates the possibility of damage to personnel and equipment.

- Note

2.1 FIRE SAFETY

This section addresses the fire safety precaution that is required at every RF communication site. For requirements on fire safety and fire protection system, please refer to the Port of Seattle Fire Department.
Fire extinguishers shall be present at each RF communications site. The following conditions must be satisfied:

- The fire extinguishers must be of the proper type and size for a fire that may occur.
- The fire extinguishers are properly located and labeled.
- The fire extinguishers are in working order and are properly maintained.
- All personnel that have access to the RF communications sites have a clear understanding of the functional operations of the fire extinguishers.

The primary intent of suppressing a fire in any RF communications site is to protect lives. Equipment protection is secondary. In no circumstances shall fire extinguishing be attempted in order to save equipment when personnel safety is at risk.

All personnel who have access to the Airport's RF communications site shall be familiar with the proper usage of the fire protection equipment provided at the RF communications site. Documentation of the equipment shall be made available and accessible to all personnel who have access to the RF communications site.

2.2 BATTERY SAFETY / POWER CONDITIONING

Batteries used for powering RF equipments shall be observed in accordance with all manufacturer documentation and product placard notices.

All personnel who have access to a RF communication site shall not handle hazardous materials unless properly trained and equipped with appropriate safety equipment.

Any Personnel who have access to any RF communications site shall not attempt to clean electrolyte spills resulting from a battery rupture. When a spill is detected, the personnel must contact the Maintenance Duty Officer (MDO) and notify the spill.

Appropriate signage must be present on doors leading to rooms with batteries and within the room itself, notifying personnel who has access the potential of explosion, chemical, and electrical hazards within the area.

Appropriate fire extinguisher(s) must be present in battery room, as dictated by local code. NFPA Article 64 shall be complied with for mechanical ventilation requirements in battery room(s).

2.3 SEISMIC SAFETY

RF communication site shall be designed properly for seismic activity and shall be assessed by a certified architect using USGS maps and other recognized geologic or risk history documents.

Shipping boxes and other temporary packaging, and cabinet stabilizer supports shall not be used as permanent seismic bracing. Only specifically designed seismic support hardware shall be used for seismic bracing.

Seismic battery racks, seismic bracing and support, and seismic facility and antenna structure construction practices shall be employed. All storage cabinets shall be closable and secured to walls.

2.4 ELECTROMAGNETIC ENERGY SAFETY

All personnel working at a RF communications site shall be aware of Electromagnetic Energy (EME) hazards and corresponding precautions.

All Airport employees and contractors, and other personnel who have access to the RF communications sites shall be required to wear personal Electromagnetic Energy (EME) monitoring devices when working in the vicinity of fixed transmission sources of Radio Frequency (RF) energy.

All Airport employees, contractors, and other personnel who have access to an RF communications site and working at the RF communication sites shall be familiar with Electromagnetic Energy and shall follow the appropriate guidelines.

2.5 GENERAL SAFETY PRECAUTIONS

The following are general safety precautions that should always be observed when working at an Airport RF communications site.

- Care should be exercised to ensure surfaces being disturbed do not contain asbestos.
- Only certified asbestos abatement professionals approved by the Airport shall perform asbestos removal.
- In environments where explosion hazards may exist, non-incentive Intrinsically Safe electrical components shall be used where appropriate. Note that certain Airport locations may be entirely unacceptable for housing electronic equipment.
- RF Communications equipment shall not be installed in elevator equipment rooms.
- All applicable health and safety codes shall be adhered to when performing tasks discussed in this manual.
- All applicable OSHA standards shall be adhered to.

2.6 SAFETY SUMMARY

- Any area involving construction shall be tied-off from non-authorized personnel entering.
- Fall protection measures shall be observed and implemented at any and all structures, regardless of ownership, where climbing is required.
- Any and all regulations regarding climbing shall be observed and implemented. In any case, more stringent regulations shall supersede other regulations.
- Contractors/subcontractors shall be required to submit their written comprehensive Safety Program to Airport's Safety Program Manager prior to commencing any work.

- Follow Ground Resistance Tester manufacturer's warning and caution information when using tester. Follow furnished instructions when inserting and removing test rods into soil.
- Utility locator services shall be used to locate buried utilities before conducting any subsurface explorations. All subsurface explorations shall be coordinated with the Airport Engineering Department.
- Before excavating or digging at a site, locate the underground utilities. All excavations shall be conducted in accordance with OSHA safety and excavation regulations, state, local and Port of Seattle safety regulations.

- Fixed or portable fire suppression systems using water shall not be used in communication sites without input from Port of Seattle Fire Department.
- If the building has a sprinkler system, make sure the cable runways do not block the sprinklers. Also, the equipment installation must not alter or block the sprinkler spray pattern or effectiveness.

For external grounding:

- Follow manufacturer's warnings and safety requirements!
- Do not attempt to install a separate grounding electrode system without bonding it to the existing grounding electrode systems. Installation of a separate ground electrode system shall be coordinated with Airport Facilities Department.
- No welding, heating, or drilling of tower structural members shall be performed without written approvals from the Airport.
- All personnel attempting to measure the resistance of a grounding electrode system shall receive prior formal training on the subject and on its associated safety hazards. All applicable laws, rules and codes regulating the work on electrical systems shall be complied with at all times.
- Check for current on the grounding electrode conductor before disconnecting. Never disconnect the ground of a live circuit.
- Follow Ground Resistance Tester manufacturer's warning and caution information when using tester. Follow furnished instructions when inserting and removing test rods into soil. Make certain this procedure is fully understood before proceeding with test.
- Follow Clamp-on Ohmmeter manufacturer's warning and caution information when using tester.

For transient voltage surge suppression:

- Common Mode AC power surge suppression devices shall not be utilized.
- All AC power surge protection devices (SPD) used shall be UL listed or recognized.
- Maintenance of SPDs installed within a panelboard requires panelboard cover removal, which constitutes an electrocution hazard. As such, only an Airport approved qualified and licensed electrician shall perform cover removal and maintenance.

For equipment installation:

- Use caution if there is Isolated Ground Zone and non-Isolated Ground Zone equipment in the same structure. Isolated Ground Zone and non-Isolated Ground Zone equipment shall be mounted apart to avoid touch potential.
- Openings around penetrations through fire resistance-rated walls, partitions, floors, or ceilings shall be fire stopped using Port of Seattle Fire Department approved methods to maintain the fire resistance rating.
- Facility AC wiring within junction boxes, receptacles, and switches shall be performed by an Airport electrician or an Airport approved licensed and bonded electrical contractor.
- Under no circumstances shall consumer-grade power outlet strips be used in any installation. Extension cords of any type shall not be used for connecting line power to communications equipment.
- Never look into an optical fiber cable. Optical fiber cables use invisible laser light that is dangerous and can cause damage to the eye.

2.7 EQUIPMENT PRECAUTION SUMMARY

For RF communication site building design and installation:

- It is critical that the program/project determine if post-tensioning is employed in floor, roof, or wall construction in any of the RF communications site. The project shall be required to avoid structural damage caused by accidental penetration of a tensioning cable.
- Appropriate rack design shall be used to meet the Airport's seismic rating.
- It is recommended to follow manufacturer's installation requirements.

For external grounding:

- Braided ground conductors are not recommended for use at RF sites. Braided conductors corrode easily and become a point for RF intermodulation.

For transient voltage surge suppression:

- SPDs using SAD technology may develop an artificial diode bias when subjected to strong RF fields that may be experienced at AM, FM or TV broadcast sties. This bias may cause data circuit errors.
- Tower lighting cables shall not be bundled along with transmission lines or other conductors anywhere within cable ladders, or the building interior.

3. EXTERNAL GROUNDING

The following should aid programs/projects in the external grounding requirements considerations for a project:

- At an RF communications site, there shall be only one grounding electrode system.

- All grounding media in or on a structure shall be interconnected to provide a common ground potential.

- Ground rods shall comply with *NFPA 70, Article 250-56,* and *NFPA 780, Section 3-13*.

- The method of bonding grounding conductors to ground rods shall be compatible with the types of metals being bonded.

- When the grounding system design requires a deeper grounding electrode, two or three ground rods shall be exothermically welded end-to-end. Other methods of connecting the rods together shall not be used.

- All metal objects, as allowed by their manufacturer, that are associated with the communications site equipment, shall be bonded to the external grounding system per ANSI T1.313-1997.

- All roof-mounted antenna masts and metal antenna support structures shall be bonded to the building grounding electrode system. If a separate antenna or grounding electrode system is installed, it shall be bonded to the building electrical grounding electrode system.

- Grounding shall comply with NFPA 70, NFPA 780, and ANSI T1.313-1997.

- Antenna masts and metal support structures shall comply with *NFPA 70, Articles 810-15* and *810-21, ANSI T1.313-1997,* and *ANSI/EIA/TIA 222-f.*

- Antenna towers shall be bonded to the tower ground ring.

- The tower grounding conductors shall be exothermically bonded to the tower unless specifically directed otherwise by the tower manufacturer.

- Rooftop mounted towers may increase the lightning risk index for the buildings they are installed upon. Due to their increased height and lightning risk probability, all exposed buildings with rooftop towers shall be equipped with a lightning protection system as outlined in NFPA 780 (See *ANSI T1.313-1997* for more information).

- Rooftop mounted tower structures shall be grounded in accordance with ANSI T1.313-1997.

- The lightning protection system shall meet the requirements of NFPA 780.

- Other metallic objects on the roof shall be bonded to the roof perimeter lightning protection system ring as required by NFPA 780 and ANSI T1.313-1997.

- All grounding electrodes at the building shall be bonded together for a grounding electrode system. See *NFPA 70, Articles 250-90, 800-40, 810-21*, and *820-40*; and *NFPA 780, Section 3-14*.

- All transmission lines shall be grounded using ground kits as specified in *ANSI T1.313-1997.*

- All dedicated communications site buildings shall have an external grounding electrode system installed. The grounding electrode system resistance shall meet the requirements specified in *ANSI T1.313-1997.*

- Bonding to the generator chassis shall be done in accordance with the manufacturer's requirements.

- Grounding conductor shall meet requirements specified in NFPA 70, NFPA 780, and ANSI T1.313-1997.

- All exothermic and irreversible compression connections for use on external grounding applications shall be UL 467 listed, IEEE 837 approved.

- Grounding electrode system testing shall be performed anytime the site is suspected to have taken a direct lightning strike.

4. INTERNAL GROUNDING

The following should aid programs/projects in the internal grounding requirements considerations for the project.

- A single master ground bus bar (MGB) shall be installed at all communications system equipment locations in a shelter, building, room or area. A master ground bus bar may also be installed in an assembly of communications equipment cabinets to ensure an effective bonding point for all equipment grounding conductors.

- A single rack, cabinet or chassis that is not part of an onsite communications system and does not constitute a communications system within itself does not require the installation of a MGB, though one may be installed if desired.

- When equipment is in a stand-alone building or shelter, a grounding conductor shall extend from the MGB to the external ground electrode system.

- When the equipment area is within a larger structure or multi-story building, a grounding conductor shall extend to the building ground electrode system conductor. The ground bus conductors, equipment grounding conductors, and internal perimeter ground bus conductors are terminated to the MGB.

- A ground bus bar installed within a rack or cabinet shall be considered a rack ground bus bar (RGB) and shall be bonded to the MGB.

- A sub system ground bar (SSGB) shall not be used when the associated equipment is located in a separate shelter or building, even if the shelter or buildings are adjacent to one another. A shelter added as a permanent attachment to an original building or shelter, which receives AC power from the same electrical service as the original building or shelter, is not considered a separate shelter or building for the purpose of this paragraph.

- A ground bus conductor shall extend from the SSGB, or RGB to the MGB. When a SSGB, or RGB is not used, a ground bus conductor shall be installed from the single rack, cabinet or chassis to the MGB.

- The SSGB shall carry the UL listing.

- All equipment and ancillary support apparatus shall be effectively bonded to the SSGB as specified in NFPA-70; Article 250.

- At stand-alone cabinet or cabinet assembly installations where no MGB or SSGB is installed, the RGB shall be bonded to the electrical service grounding electrode system or conductor.

- All equipment that is installed within the rack, cabinet or cabinets shall be effectively bonded to the RGB as specified per NFPA 70, Article 250.8).

- Conductors installed within a plenum shall be compliant with NFPA 70, Article 300.22.

- All communications wires and cables installed within buildings, including ground and grounding electrode conductors, shall be compliant with NFPA 70, Article 800.

- The internal perimeter ground bus conductor shall not be used for bonding communications equipment such as cabinets, racks, chassis or equipment grounding conductors to the MGB.

- The internal perimeter ground bus conductors shall be exothermically welded or be spliced using an IEEE 837-approved irreversible connection.

- The internal perimeter ground bus conductor shall not be used for bonding communications equipment such as cabinets, racks, chassis or equipment grounding conductors to the MGB.

- Equipment grounding conductors shall be used to bond communications equipment and ancillary support apparatus to the ground bus conductor, internal perimeter ground bus conductor, or to the MGB, SSGB, or RGB.

- Equipment grounding conductors shall be connected so that the removal of a connection will not break the ground path to any other piece of equipment or ancillary support device that may have electrical power applied.

- The series or daisy chain method, which refers to any method of connection whereby the conductors are connected from one chassis, equipment frame or rack connection point to a second chassis, equipment frame or rack connection point and on to a third connection point, creating a series arrangement whereby the removal of the second connection point interrupts the ground path from the first chassis, equipment frame or rack, shall not be used.

- All equipment and ancillary support apparatus shall be bonded to the MGB, SSGB, RGB, ground bus conductor or internal perimeter ground bus (IPGB) conductor with an equipment-grounding conductor.

- A bonding jumper shall be used to ensure an electrically conductive path between components to be bonded. A bonding jumper shall not be used in lieu of an equipment-grounding conductor.

- Bonding jumpers shall be compliant with NFPA 70, Article 250.119 or jurisdictional codes.

- The equipment-grounding conductor shall be attached to the equipment grounding terminal, chassis or frame utilizing methods.

- Racks or cabinets equipped with a RGB shall have an independent bonding jumper installed between the rack or cabinet equipment mounting rail and the RGB. All equipment within the rack or cabinet shall be bonded to the RGB with an equipment-grounding conductor.

- All conductors shall be installed and routed so that personal safety is not compromised and that all equipment is serviceable

5. POWER SOURCES

The following should aid programs/projects in determining power sources for a project:

- AC power is categorized by boundaries:
  - Within the Airport premises, power shall be provided by Port of Seattle.
  - Outside of the Airport premises, from public utilities.

- For services within the Airport premises, please contact Port of Seattle Seattle-Tacoma International Airport Proactive Electrical Utility Team.

- All design and implementation of any type of electrical service shall be conform to NFPA 70, and State of Washington Codes. For AC power requirements and standards, please refer to Seattle-Tacoma International Airport Electrical Standards.

- For electrical service outside the Airport boundaries the design and construction shall follow the applicable local codes.

- The use of uninterruptible power supplies to support system electronics is encouraged but is entirely the decision and responsibility of the system owner and/or designer. UPS requirements shall be factored into the electrical design. The UPS unit selected shall be submitted to the Airport for review. The Airport will not automatically provide UPS support for radio systems nor will the Airport automatically provide generator backup power to a radio site.

- For Uninterruptible Power Supply and Battery Systems requirements and standards, please refer to Section 16261, “Static Uninterruptible Power Supplies” in the Seattle-Tacoma International Airport Electrical Standards.

- It is recommended that Uninterruptible Power Supplies be on-line type with a minimum 4 hours of backup time.

- Equipment rooms containing UPS systems shall be environmentally conditioned as per ANSI/TIA/EIA-569-B.

- When power-conditioning equipment is specified, the effect of electronics on the input line should be considered and means taken to prevent power line distortion.

- Power conditioning equipment shall perform in accordance with “IT (CBEMA) Curve Application Note” in the POS Communications Standards.

6. TRANSIENT VOLTAGE SURGE SUPPRESSION

The installation of Transient Voltage Surge Suppression (TVSS) devices is a requirement for all communication sites and is essential for all facilities where communication-related electronics and electrical equipment is in use. It is recommended that each point-of-entry into the equipment area be protected against anomalies such as surges, spikes and lightning.

In this document, the term 'SPD' is used interchangeably with TVSS. IEEE C62.41 and UL define TVSS as an SPD.

The following should aid programs/projects in the transient voltage surge suppression requirement considerations for the project.

- All considerations for TVSS shall comply with NFPA 70.
  NFPA 70 requires that telephone, communications or data type circuit conductors be properly surge protected with a primary SPD as close as practicable to the point of entry into the structure or building.

- The primary SPD installation shall comply with all applicable codes. The primary SPD shall be grounded in accordance with NFPA 70 or other codes, and industry standards.

- Secondary SPDs shall be installed. Secondary SPDs shall be UL 497A listed or recognized.

- RF transmission lines from the antenna structure to the shelter or building shall be grounded. Upon entering the shelter or building, all RF transmission lines (including sample port and unused spares) shall route through coaxial RF-type SPDs.

7. MINIMIZING SITE INTERFERENCE

All transmitters and privately owned structures located on Port of Seattle proprieties must adhere to the following rules:

All installations of fixed repeaters, control stations, base stations and paging transmitters shall employ isolators or alternative techniques meeting the same criteria, in order to minimize spurious radiation, as follows:

• *Transmitter Frequency*

1. Transmitters in the **25 to 66 MHz** range shall have isolation of at least 20 dB followed by a low pass filter or cavity providing a minimum of 30 dB attenuation at 1.0 MHz from the operating frequency .

2. Transmitters in the **66 to 88 MHz** range shall have at least 25 dB of isolation followed by a band pass cavity providing at least 20 dB of attenuation at 1.0 MHz from the operating frequency.

3. Transmitters in the **88 to 108 MHz** range operating at a power level of 350 watts or less shall have at least 25 dB of isolation followed by a band pass cavity providing at least 25 dB of attenuation at 1.0 MHz from the operating frequency.

4. Transmitters in the **88 to 108 MHz** range operating at a power level greater than 350 watts shall have a band pass cavity providing at least 25 dB of attenuation at1.0 MHz from the operating frequency.

5. Transmitters in the **108 to 400 MHz** range shall have at least 50 dB of isolation followed by a low pass filter and band pass cavity with a minimum of 25 dB attenuation at 1.0 MHz from the operating frequency.

6. Transmitters in the **400 to 470 MHz** range shall have at least 50 dB of isolation followed by a low pass filter and band pass cavity with a minimum of 15 dB of attenuation at 1.0 MHz from the operating frequency.

7. Transmitters in the **470 to 806 MHz** range shall have at least 50 dB of isolation followed by a low pass filter and band pass cavity with a minimum of 15 dB of attenuation at 1.0 MHz from the operating frequency.

8. Transmitters in the **806 MHz to 18 GHz** range shall have at least 50 dB of isolation followed by a low pass filter and band pass cavity with a minimum of 15 dB of attenuation at 1.0 MHz from the operating frequency.

9. A band pass cavity or crystal filter is recommended at the input of all receivers. Its purpose is to protect against RF energy "off frequency" from mixing in a non-linear device such as the first RF amplifier in a receiver, which can re-radiate causing interference.

10. The band reject duplexer (cross notch duplexer) shall not be used without a cavity/isolator outlined above.

• *Transmitter Cables and Connectors*

1. Single braid coax cable is prohibited. Double shielded cable must have over 97 % shield coverage. RG213 type and under is unacceptable. RG214 type or better is acceptable.

2. Jacketed coaxial cable is required. Unjacketed transmission line of any type is prohibited.

3. All cables must be run in grounded conduit or grounded cable trays and labeled at a maximum of every 25' with the owner's name and number.

4 All cable installed in cable tray shall be plenum rated.

5. Use of "N" or "TNC' connectors are preferred over other non-constant impedance types. Every effort should be made not to use coaxial adapters.

• *Fixed Transmitter and Receiver Standards*

All fixed transmitter and receiver installations shall employ the following:

1. All Radio equipment with an outside antenna that plugs into the Port of Seattle electric outlets must be protected from lightning damage. Feed-through lightning protectors must be used on all coaxial cable connections to equipment enclosures. Gas or Gap and MOV protectors should be used on AC Power, Control and Audio connections. The "green wire" of the AC power plug or the Conduit is NOT an acceptable grounding point. Use the station ground grid and building ground. Contact the Port Construction Inspector before hooking to building ground.

2. Outside antenna structure must be grounded. Grounding shall be done with heavy braid wire with a green cover, and shall be connected to the station ground grid and building ground. Bare metallic ties are prohibited for securing transmission lines to towers and building. Hardware capable of rusting, and dissimilar metals, are prohibited. Transmission lines shall be insulated from metallic structures/objects that are not grounded. All loose wire or metal objects shall be removed from the site.

3. All equipment shall be licensed and operated in full accordance with all applicable rules and regulations of the regulating agency, (FCC, NT1A). There shall be no modifications which violate "FCC Type Acceptance". All unlicensed or expired licensed transmitters must be disabled.

4. **A copy of the valid FCC license must be posted at the transmitter.** All equipment (transmitter coax, conduit, control cables, and antenna **must be labeled with the owner's name and a current 24-hour telephone contact number** (service agency is acceptable).

5. The owner of the equipment is responsible for any damage to other proprieties caused by the owner's equipment.

• *Interference Policy Statement*

In the event Radio Interference (RI) occurs, all users of the site are required to participate in solving the problem by providing technical personnel and test equipment to locate the source of the specific problem. If the above standards are complied with, additional isolators, filters, cavities, etc. may be required. All equipment must be maintained in good working order and must meet original manufacturer and FCC specifications for reduction of transmitter spurious radiation. Involved systems, not in full compliance with these standards, will be asked to comply immediately. Any equipment emitting electrical, electronic or radio emissions which interferes with, obstructs, or adversely affects the operation of air navigation aids or Airport radio communications shall be turned off immediately.

• *Site Environment Requirements*

The following should aid programs/projects in the site environment requirement considerations for the project:

- Rust - All materials must be free of rust.
- Braided wire shall not be used because it can corrode and cause intermodulation signals.
- Rigid metal connections - Metal to metal connections must be rigid.
- All loose metal should be removed from the site.
- Fencing - Chain link type fence material should be vinyl clad.
- Dissimilar metals - Connection of dissimilar metals should be done after review of the galvanic table for each metal. The connections must be rigid and tight.
- Transmission line – Unjacketed transmission line is prohibited.
- Cable ties – Bare metallic cable ties shall not be used.
- Power line insulators (glass type) – Cracked insulators are a very likely source of broadband noise. If broadband noise cannot be eliminated by implementing the above recommendations, contact the Port and ask to perform a noise sweep of the general area.

• *Mitigating potential RF interference with **fluorescent lighting***

In order to prevent potential RF interference with fluorescent lighting fixtures around radiax and whip antennas, the following distance limits are recommended:

- Fluorescent lighting fixtures with electronic ballasts shall not be located within a 10 foot radius from a whip antenna.

- Fluorescent lighting fixtures shall not be located within 30 feet of a radiax antenna.

- Instant re-strike HPS fixtures are acceptable for locations near antennas.

This is to minimize the likelihood of "mixing" with the 800 MHZ police/fire radio system, since the channel spacing of five frequency pairs on this system is 50 KHz.

In addition, the following guidelines should be followed:

- In a problematic location, the ballast frequency shall be 60 Hz and the ballast shall be of the magnetic type.

- If absolutely necessary in a problematic location of lighting RF interference, add attenuation to the BDA which feeds the radiax. However, this should be coordinated with Motorola so as not to adversely affect coverage in critical areas.

8. EQUIPMENT INSTALLATION

This chapter describes requirements and standard methods for communications equipment installation. This chapter assumes that all site and structure preparations have been performed (including battery systems, generators, line transient voltage suppression systems, tower systems, and site/structure grounding systems).

This chapter includes the following topics:

- Facility Readiness
- General Considerations for Layout, Work Areas, and Spacing
- Seismic Considerations
- Equipment Mounting Plumb and Squareness
- Equipment Anchoring
- Equipment Installation Within Racks or Cabinets
- Equipment Cabling
- Electrostatic Discharge Considerations

The requirements described in this chapter shall be met before communications equipment is installed on site.

8.1 FACILITY READINESS

Following all construction work, both exterior and interior, the site and facility (structure or shelter) shall be in a suitable condition for installation of communication equipment.

8.2 LABELING

Communications spaces, pathways, cables, equipment, terminations, and grounding shall be labeled per Port of Seattle standard *17190A - Telecommunications Standard for Labeling and Nomenclature* using products specified in Port of Seattle guide specification *Section 17190 – Identification and Labeling*.

Antennae shall be labeled with weather resistant labeling. Metal tags with stamped labeling information are acceptable.

A valid copy of the FCC license shall be displayed in a weatherproof placard at the transmitter. All equipment (transmitter, conduit, control cables, and antenna must be labelled with the owner's name a current 24-hour contact number (service agency is acceptable).

8.3 GENERAL CONSIDERATIONS FOR LAYOUT, AND SPACING

Consideration should be exercised when laying out a site to allow primarily for all code requirements for spacing, and then the most efficient use of space. Special attention shall be given to future expansion with regard to cable runway heights, electrical outlet placement, and equipment placement.

Proper spacing of equipment is essential for efficient use of the room area, ease of maintenance, and safety of personnel. National Fire Protection Associations (NFPA) Code, and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) standards, and any local regulations shall be adhered to. When a facility is to be normally occupied, American with Disabilities Act (ADA) shall be complied with.

8.4 SEISMIC CONSIDERATIONS

Earthquake-resistant design should be contracted to a firm specializing in such work. All design shall be sealed and signed by an engineer registered in the State of Washington as a Professional Structural Engineer.

8.5 EQUIPMENT MOUNTING

Equipment shall be level and plumb. Equipment level shall be tested on a known flat surface in at least two directions to verify accuracy. Equipment shall be parallel or perpendicular to the surrounding walls and adjacent installed equipment.

8.6 EQUIPMENT ANCHORING

Equipment racks or cabinets should be positioned and anchored to the floor using preferred mounting methods.

Selected anchors shall meet standards set forth in NEBS (Network Equipment Building Systems) TR-64 and ASTM (American Society For Testing and Materials) 488-90 for earthquake compliance. This compliance will also adhere to Bellcore Technical Specifications AU-434 for earthquake concrete expansion anchors.

Anchor selection criteria shall comply with all general requirements for standard concrete anchors plus meet the above seismic requirements. All seismic anchoring shall be enhanced with top cabinet or rack bracing.

It is recommended to mount base stations and other non-racked ancillary equipment on a “C-channel” type of mounting track where possible.

Mounting arrangement shall be in accordance with mounting kit manufacturer’s instructions.

8.7 EQUIPMENT INSTALLATION WITHIN RACKS AND CABINETS

Most communication equipment is mounted into standard 19-in EIA racks or enclosed cabinets. Follow the rack and/or equipment manufacturer's instructions when installing equipment into racks or cabinets. Racks which are existing at a site may only be utilized with the permission of the START committee.

8.8 EQUIPMENT CABLING

Cabling within racks and cabinets shall conform to the requirements of NFPA 70, National Electric Code, State and local codes, and Port of Seattle requirements. Particularly applicable are NEC Article 300, Article 800, Article 810, and Article 820. (See *ANSI/TIA/EIA-568B* and *569A* for additional information.)

All cables shall be installed and routed so that personal safety and equipment functionality is not compromised and that all equipment is accessible for servicing

Insulated standoffs are recommended for use in racks or cabinets. The standoffs should be of sufficient length to maintain the proper cable separation.

Nonmetallic cable ties shall be used to secure cables and conductors. Attachment shall be tight enough to secure cables without crushing them.

Excess cable shall not be coiled on top of cabinets or racks, nor in cable runways.

AC power cords longer than necessary may be looped down and back up a rack or cabinet. Excess lengths of AC power cord shall not be coiled on top of racks or cabinets.

Grounding conductor tap joints shall be installed in order to prevent the conductor or connection device from coming in contact with metallic surfaces.

Where cables or conductors are routed through holes in metallic surfaces or near sharp edges, the sharp surfaces shall be suitably protected with a grommet or similar material to help protect the cable or conductor from damage caused by sharp edges.

All other cables shall not have sharp bends that will damage or degrade the performance of the cable. The cable manufacturer's specifications shall be followed. See ANSI/TIA/EIA-568B, 569A, 758, 758-1 and CSA-T529 for additional information.

Refer to *NFPA 70, Article 45* for details on Information Technology equipment room wiring.

8.9 ELECTROSTATIC DISCHARGE CONSIDERATIONS

When an equipment must be opened, electrostatic discharge (ESD) precautions shall be adhered to. In general, the following requirements shall be met:

- An ESD-protected work area shall be present.
- An ESD wrist strap shall be worn when handling ESD-sensitive modules.
- ESD-protected packaging shall be available for containing modules removed from equipment.

All precautions specifically stated for the equipment being worked on shall be adhered to in accordance with the respective documentation for the equipment.

9. ADDITIONAL REQUIREMENTS

Satellite Dish Guidelines

Tenant satellite dish installations to receive cable/pay television transmissions for signal distribution at Seattle/Tacoma International Airport are **not allowed**. Tenants have the option of connecting to the existing Airport cable network.

Tenant satellite dish installations for the sole purpose of receiving and distributing aviation operations data are allowed. Installation of dish sizes over 1.2 meters are allowed only if no other comparable data source exists to eliminate the need for the larger sized dish. Solid dishes are not allowed (must be wire mesh) unless reception requires a solid dish installation, or a solid dish installation would result in a smaller diameter dish. All satellite dishes must be grounded to the building structure.

10. PORT APPROVAL

• RF Application for Connection

Both an RF Application For Connection and a drawing of the antennae and equipment installation method desired by the tenant shall be submitted to the Port via the US mail, email or Fax. The drawing submitted shall include dimensions to building parapet, existing antennae and existing infrastructure equipment such as rooftop HVAC units, etc. Preapproval may be made by telephone followed with a written approval by US mail, email or Fax.

Any modification to the tenants system will require the tenant to submit a new RF Application and drawing for Port approval.

The cost of meeting these standards is the sole responsibility of the equipment owner.

RF Applications and instructions may be downloaded from the Web at

https://www.portseattle.org/downloads/seatac/pppt/Standards/

A hardcopy of the RF application may be found in Appendix A.

• START Committee

All RF applications for connection are reviewed for approval by the Sea-Tac Telecommunications Architecture Review Team (START).

Most RF installations will require attendance to START meetings prior to construction. Contact Aviation, Facilities and Infrastructure (F&I), Marisa Valencia (phone 206-433-5298) to schedule a time to attend.

• As-Built Drawings

After construction, the RF installation contractor is responsible for providing as-built drawings of the RF Site installation to F&I. At a minimum, these drawings should include the following:

- RF signal block diagram;
- Plan and elevation views of antennae mounting and cable routing (include dimensions to building parapet, existing antennae and existing infrastructure equipment such as rooftop HVAC units, etc);
- RF and data cable schedule;

- Antennae mounting details;
- Schedule of antennae types;
- Documentation of power circuits used, and;
- Equipment footprint.

- **Port of Seattle Contacts**

Aviation, Facilities & Infrastructure (F&I):

Babu Parayil, PE	(206) 835-5894;	parayil.b@portseattle.org
Gary Mullin, PE	(206) 444-4389;	mullin.g@portseattle.org

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Port of Seattle
Sea-Tac Airport
Facilities and Infrastructure
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APPENDIX

A. RF APPLICATION

B. INSTRUCTIONS FOR RF APPLICATION