

# Electric Service Requirements

## Antenna Installations On District Facilities



**December 2006**

## ENGINEERING SPECIFICATION T012




**SMUD**

SACRAMENTO MUNICIPAL UTILITY DISTRICT  
6201 S Street, P.O. Box 15830, Sacramento, CA 95852-1830

The Power To Do More.<sup>SM</sup>



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## 1 PURPOSE

This specification provides minimum requirements of the Sacramento Municipal Utility District (the District) for the design, approval, and installation of second party communication antennas on the District power facilities. Compliance with this specification is necessary to install any antenna on a District's power facility.

## 2 SCOPE

This specification outlines the necessary actions, and design, construction and operational requirements and considerations for a communications service provider to install an antenna on a District's power facility in the transmission system, at a substation, or elsewhere on the distribution facilities as defined below. It applies to antennas to be installed on transmission towers and poles, at substation sites, and on distribution poles and structures. This document is not a design or construction specification, but provides minimum requirements and typical design details.

This specification does not cover installation at the District's campus, i.e. office buildings, warehouses, garages, parking areas, gardens, etc.

Also, proposed antenna installations on the District operated antenna structures will be considered by the District on a case-by-case basis and is not covered in the scope of this specification.

## 3 REFERENCES

- 3.1 General Order 95 (GO95), Latest Revision.
- 3.2 California Electric Code (CEC), Latest Revision.
- 3.3 California Code of Regulations, Title 8 – Industrial Relations, Subchapter 5 – Electrical Safety Orders.
- 3.4 National Electric Safety Code IEEE C2, Latest Revision.
- 3.5 US Department of Labor Occupational Safety and Health Administration, Regulations (Standard – 29 CFR) Electric power Generation, Transmission, and Distribution. – 1910.269, and Telecommunications – 1910.268
- 3.6 Uniform Building Code – UBC, Latest Revision.
- 3.7 ANSI/Telecommunications/Electronic Industry Standards for Steel Antenna Towers and Supporting Structures, ANSI/TIA/EIA-222-G.
- 3.8 District Specification C914 – Chain Link Fence.
- 3.9 FAA Advisory Circular AC 70/7460-1k Obstruction Marking and Lighting.
- 3.10 District Specification T004 – Commercial and Industrial Service Requirements.
- 3.11 NFPA(70) – NEC, Latest Revision.
- 3.12 Northern California Joint Pole Manual Antenna Operation Procedures, Section 19.11

## 4 DEFINITIONS

### 4.1 Applicant

Applicant is an entity, typically a communications service provider, requesting to install an antenna on District facilities, or a contractor acting on behalf of such an entity.

### 4.2 District Facility Identification (DFI)

DFI is the District's assigned identification for a facility. It may consist of:

- An Identification number for a pole or structure.
- Identification of power lines on the structure, each identified by line voltage and both terminals of the line (terminals may be designated by three place alphanumeric abbreviations).
- Access road(s).
- Substation Name.

### 4.3 Distribution Facility

A pole, or other structure, supporting distribution lines typically rated 69 kV or less. These facilities include attached circuits and devices, such as: secondary electrical circuits, electrical apparatus, risers, lights, communications circuits, and associated equipment. The associated District properties, Right-of-Ways, and/or easements combine to form the Distribution Facility.

### 4.4 Program Manager (PM)

A District employee designated to oversee the process of application, authorization, and installation of communication antennas on District facilities.

### 4.5 Master License Agreement (MLA)

An agreement, in principal, to allow a communications company to locate antennas on the District's facilities when all requirements are met. The MLA prescribes the basis for the District to allow an Applicant to install antennas on the District's facilities, but does not provide a specific design nor constitute authorization to install. The District prepares the MLA for a fee when solicited by an Applicant and both the Applicant and the District execute the agreement. The MLA may define and address the: Site Application Form, Site License Agreement,

Modification/Reconfiguration Application, Insurance Requirements, Processing and Inspection Fees, Scope of Work, Project Costs, Bill of Sale, Use Fees and Payments, Termination Agreement, Utility Access, Taxes, Maintenance, Safety, Surrender of Premises, Default, Disclaimers, Indemnification, Third Party Co-Location, Laws, and other general requirements.

#### **4. 6      Modification / Reconfiguration Application (MRA)**

This form describes applicants proposed modification to an existing site. This form is available at the District's office located at 1708 59<sup>th</sup> Street, Sacramento, CA.

#### **4. 7      Qualified Communication Line Worker**

An employee certified annually by the employer to demonstrate the skills required to work safely in the communication space per OSHA Regulations (Standards – 29 CFR) Telecommunications. – 1910.268.

#### **4. 8      Qualified District Inspector**

An employee, representing the District's interests, qualified to assess the safety and quality of procedures and work performed on District facilities. The inspector will permit construction where safe, will ensure the quality of work and work procedures, and will obtain required clearances from the District's Power System Operator (PSO) or Distribution System Operator (DSO) in order to permit Applicant to proceed with work at a District facility. The inspector is authorized on behalf of the District to start, stop, and shutdown work on its facilities.

#### **4. 9      Qualified Electric Line Worker**

An employee certified annually by the employer to demonstrate the skills required to work safely in the supply space per OSHA Regulations (Standards – 29 CFR) Electric Power Generation, Transmission, and Distribution. – 1910.269.

#### **4. 10     Site Application Form (SAF)**

A form completed by an Applicant to provide the necessary information for the District to consider permitting antenna(s) to be installed on a specific facility. This form is available at the District's office located at 1708 59<sup>th</sup> Street, Sacramento, CA.

#### **4. 11     Site License Agreement (SLA)**

The SLA is a separate agreement allowing antennas to be located at a specific

location, in accordance with the terms and conditions of the Master License Agreement. The Site License Agreement identifies terms and conditions unique to a specific installation. This license is prepared for a fee by the District and executed by the Applicant and the District.

#### **4. 12 Substation Facility**

A District property containing electrical substation equipment including, but not limited to: power transformers, switchgear, power lines, metering, ground grids, and all associated improvements.

#### **4. 13 Transmission Facility**

A pole or tower structure supporting transmission lines, typically 115 kV or 230 kV, and all associated District properties including Right-of-Ways and/or easements.

### **5 GENERAL REQUIREMENTS AND INFORMATION**

- 5. 1** These service requirements shall be consistent with General Order 95, "Rules for Overhead Electric Line Construction," of the California Public Utilities Commission, and all applicable State of California and Federal orders, codes, rules, and regulations; which have been established in the interest of safety to the public and utility workers. The District will not allow the construction or modification of power facilities in any way that does not meet these minimum requirements.
- 5. 2** The Applicant shall comply with applicable ordinances and provisions of City, County, State and/or other jurisdictions that are not provided as a part of this document. All materials used and all work performed as part of the Applicant's antenna installation or modification/reconfiguration must conform to the requirements of local inspection authorities, these specifications, and the District's Rates, Rules, and Regulations.
- 5. 3** The Applicant shall carefully review all materials supplied herein: text, drawings and drawing notes.
- 5. 4** It must be the intent of the Applicant to provide communication services at, or within, the proposed District facilities and the Federal Communication Commission (FCC) must have licensed the Applicant to transmit and receive communications signals as a Cellular, Enhanced Specialized Mobile Radio (ESMR), and/or Personal Communication Service (PCS) in the State of California.
- 5. 5** The District may disconnect service to antenna installations or otherwise deactivate the antenna, without notice, when performing operational activities that require

District personnel to work above ground level in the vicinity of the antenna.

- 5.6** Where an antenna will be installed on a jointly owned pole, the Applicant shall comply with all requirements of the Northern California Joint Pole Association Manual Section 19.11, and all subsections.

Failure to comply with the above requirements could cause unnecessary delays for the Applicant and/or cancellation of agreements allowing the installation, or requiring the removal of antenna facilities.

## **6 MASTER LICENSE AGREEMENT**

A TELECOMMUNICATIONS MASTER LICENSE AGREEMENT (MLA) must be drafted, signed by both the District and Applicant, and formally executed, before the District will address any specific request. Applicant will complete a Master License Request form supplying all necessary information to the District's Real Estate Services Department. The Master License Request forms may be obtained at the District's offices located at 1708 59<sup>th</sup> Street, Sacramento, CA.

## **7 REQUEST TO INSTALL OR MODIFY ANTENNA(S)**

All proposals and submittals pertaining to antenna installations on District facilities, or residing within District's rights-of way or property, shall be submitted to the District's Program Manager at 6201 S Street, Sacramento, CA, where they shall be reviewed for completeness.

The District will not consider any proposal or submittal for installation or modification of antennas unless the District and the Applicant have formally executed a Master License Agreement (See Section 6, above).

Maintenance of antennas installed on District facilities within the electric utility space may only proceed after receiving approval from the District of the planned work and schedule. All maintenance of antennas installed within the District's supply space shall only take place in the presence of a District inspector.

### **7.1 SITE AGREEMENT**

- 7.1.1** The Applicant shall request the District to consider a potential facility, or site, for antenna installation by submitting a Site Application Form (SAF) to the District's Program Manager. The SAF must be complete in its entirety including digital photos of the location and existing District facility before the District will consider the request. The District's Program



Manager will ensure that all necessary information has been provided and verify that a MLA is in affect.

- 7.1.2** Once the initial screening process has been completed, a District notification (job) number will be assigned and all information will be forwarded to the appropriate staff to process the request. The District may reject a proposed site because of conflicts with District projects or plans; conflicts with facility operating agreements; conflicts with stipulations of the Right-of-Way, easement or property; community agreements or concerns; facility availability; operating or reliability concerns; exceptions to District construction, maintenance or operating practices; engineering, construction or operational constraints; electric service supply problems; and other considerations specific to a site.
- 7.1.3** District Staff will notify the Applicant if the SAF is initially accepted or rejected. If the SAF is rejected the District will identify the reason(s) for the rejection. In some cases, the Applicant may negotiate acceptable mitigation to the District's concerns, and the application may then receive approval. NOTE: Approval of the SAF and all associated materials allows the applicant to proceed with the facility design, but does not constitute District authorization to install the antenna or any associated communication facilities.
- 7.1.4** After SAF approval, the District may forward certain District information to the Applicant, such as: the District's existing facility design and construction drawings; available fault current at the exiting site for the purpose of telecommunications design; Right-of-Way information; requirements for electric service; etc.
- 7.1.5** The Applicant shall develop and submit a proposed design for District approval in accordance with Section 8 of this specification. During construction, deviation from the approved design will be cause to halt construction. The Applicant should inform the District's inspector immediately of design/construction deviations from that which was approved. When applicable, District staff will work with the Applicant to review and approve changes.
- 7.1.6** Following design approval, the District will develop a Site License Agreement (SLA) to be executed with the applicant.

## **7.2 WORK PLANNING, SCHEDULING AND CONSTRUCTION**

Work scheduling and construction of antenna installations/modifications will be performed under the review of a Qualified District Inspector. Before scheduling any work, the Applicant and/or its contractor must request a pre-construction meeting with the District Inspector. The Applicant will review the agreements

and approved design, and supply a work plan to the inspector with additional information as follows:

- The identification of the facility at which the work is to be performed
- The reason for the work and type of work to be performed
- The applicant's primary contact including: name, company, phone number, and e-mail address.
- A proposed schedule showing the requested start dates, breaks, and end dates for:
  - Installation of the site's base station infrastructure, i.e. grounding, foundations, fencing, poles, etc., that does not require access to District structures or substations.
  - Installation requiring access to the District structures, or substations, for construction.
- Names of the qualified line workers and/or qualified communication workers proposed to perform the work (with qualifications noted).
- Name of Applicant's field foreman directing work
- A complete set of District approved design drawings and documents showing the proposed work with statement and seal per paragraph 8.1.2.
- Agreed upon conditions of service, construction, or maintenance that are specific to the site.

After reviewing the complete work plan submittal, the District Inspector will notify the Applicant if the proposed work plan is approved or not approved. The work plan will be approved if the submitted information is sufficient, the work can be safely performed, and the work has no unacceptable adverse effects on the District's electric system operations, and clearances can be obtained. If not approved, discussions between the District and the Applicant may take place to resolve any issues, including schedule changes.

The District Inspector will oversee the Applicant's installation work and coordinate schedules and clearances with District Operating organizations. Regardless of work schedules and plans, the District may cancel work due to factors such as severe weather conditions or power system emergencies.

**\*\*\* Please Note** – system conditions may prohibit the granting of electrical clearances required to perform the installation, or maintenance, of antennas. Summer load conditions may prohibit the granting of electrical clearances on key facilities for upwards of three months. \*\*\*

The District Inspector is authorized to order the Applicant to stop work and/or correct any work practices or construction which: endanger the safety of the work

force, the public, or District crews; that impact the reliability of the facility and/or power supply system; or is inconsistent with the approved design.

**7.2.1** Only qualified communication line workers or qualified electrical workers are permitted to install, connect, maintain, and work on antennas installed on power supply poles, towers, and structures, located below the electric supply lines and in the telecommunication space, as defined per GO95.

**7.2.2** Only qualified electric line workers are permitted to install, connect, maintain, and work on antennas and associated equipment and apparatus installed on the power supply poles, towers, and structures located in the District's supply space, as defined per GO95.

### **7.3 BILLING AND PAYMENTS**

#### **7.3.1 License Fee**

This is a monthly fee for the right to operate a particular site. The MLA and SLA further define this fee. The District will periodically bill the Applicant this fee with instruction on payment.

#### **7.3.2 Other Fees**

These fees are defined in the MLA to cover the cost of processing an Applicant's request. Typically these fees are for: Site License Agreement, Site License Extension, Process & Installation, Modification/Reconfiguration Application, Modification Structural Analysis, etc. The Applicant shall submit a check upon invoice, payable to the Sacramento Municipal Utility District. Note the process (MLA, SAF, MRA, etc.) and specify the DFI on the check.

#### **7.3.3 Cost Reimbursements**

The District will invoice the Applicant for Cost Reimbursements, as provided in the MLA, with instructions on payment.

### **7.4 FACILITY TITLE TRANSFER TO DISTRICT OWNERSHIP**

When the installation of an antenna on a District facility requires replacement of the District facility with a facility more appropriate for the installation of the communication antenna, the Applicant shall register title of the new facility through a bill of sale in the name of the Sacramento Municipal Utility District before the antenna is put into service.

## 8 DESIGN REQUIREMENTS

### 8.1 GENERAL REQUIREMENTS

#### 8.1.1 Professional Engineers Responsibility

The Applicant's design documents, drawings and pertinent calculations shall be approved, signed, dated, and sealed by registered professional engineer(s) in their respective field of expertise for the electrical, civil, or structural designs. The engineer(s) shall incorporate applicable Codes, Standards, and accepted sound engineering practices in the design.

#### 8.1.2 Code Requirements

Designs shown in drawings and calculations shall conform to the requirements of the latest editions of the California General Order 95 (GO95), the California Electric Code, and the National Electric Safety Code IEEE C2 (NESC). All design documents shall be annotated with the following affirmation of the Professional Engineer responsible for the design "I Name of PE affirm that the design presented in this document meets the requirements of the latest editions of GO95, the California Electric Code, the NESC and NEC".

The G.O. 95 latest edition does not directly address antenna installations on electric utility facilities. No part of the antenna installation shall cause a G.O. 95 violation on the existing facility.

The NESC 2002 edition addresses the installation of antennas on electric utility facilities. All pertinent areas of the NESC shall apply with special attention directed to paragraphs 224, 235C, 235F, 238, 239G, 239H, sections 22, 41, and 44. Conflicting requirements may exist between GO95 and the NESC. The Applicant's design shall resolve all conflicts by meeting the more stringent code requirements, with recognition that the District facilities are built following the California requirements of G.O. 95. All conflicts shall be brought to the attention of the District's Program Manager with the Applicant's proposed resolution in writing.

#### 8.1.3 District Facility Identification

The District's Facility Identification shall be clearly shown on every drawing and document.

#### 8.1.4 Guidelines for Selecting a Distribution Pole for Antenna Installation

Items to consider during the selection of a distribution pole location for installing an antenna:

- 8.1.4.1** Maintain minimum pole height to accomplish antenna function while minimizing visual impact. If a wood pole is selected for antenna location, it shall be replaced by a steel pole designed to accommodate all existing conductors and attachments as well as all proposed antennas and appurtenances.
- 8.1.4.2** When possible, select a pole supporting only secondary voltage and communications conductors.
- 8.1.4.3** When a pole that supports primary voltage (12 kV or 21 kV) will be selected, consider poles carrying small diameter wires built in tangent configuration (i.e. no dead-ends, guy wires, or corner poles), and a single cross-arm. The pole should not support other power distribution equipment, such as fused cutouts, switches, capacitors, transformers, risers, etc.
- 8.1.4.4** Installation on poles where the District primary voltage exceeds 21 kV should be avoided for several reasons: 1. The risk exposure to communication equipment and workers increases with voltage. 2. Design clearance requirements are more stringent, making installation more costly. 3. District operational clearance availability may be limited, or seasonally dependant.
- 8.1.4.5** Ease of access to the proposed antenna location is highly desirable to allow for the maintenance and repair of equipment. Locations along streets or alleys are best. Back yards should be avoided if at all possible, as well as locations adjacent to fences, landscaping, or other obstructions.

## **8.2 DESIGN REVIEW BY THE DISTRICT**

### **8.2.1 Submittals**

Transmittal letters shall accompany all design document and drawing submittals, and shall include the following information:

- Company name, date mailed, and responsible contact person together with contact's phone, e-mail, and postal mailing address.
- The District's Facility Identification
- Purpose of document transmittal, i.e. for approval, to record as built documents, etc.
- Listing of Documents transmitted containing the following information for each document:

- ID number for Drawing or Document
- Title for Drawing or Document
- Revision for Drawing or Document

### **8.2.2 Design Criteria**

The approvals of the design drawings, calculations and specifications shall include at least the following information, where applicable:

- Structural calculations of the structure on which the antenna is to be installed.
- Structure layout showing antenna, antenna cable installation, and all related equipment on the structure. Show these structural additions and modifications as an integral part of the existing structural layout and detail drawings.
- Base station plan and elevation equipment layout.
- Description of vertical cable and cableway passing through the supply space, including the maximum possible operating voltage to ground.
- Site plan and topography.
- Fencing and gate layout and details.
- Meter and accessory panel layout and installation details.
- Lighting details (where applicable).
- Power service one line and schematic drawings.
- Grounding plan and details.
- Service design details.
- Lists of all RF transmit frequencies.
- In case of increase in pole/tower height, FAA compliance must be provided, including a copy of FAA Form 7460-1.
- A fully dimensioned plan and elevation views of the RF radiation patterns at the proposed site showing the FCC MPE guideline limits for Specific Absorption Rate (SAR). A single three-dimensional view, with dimensions, would be acceptable.

**For a guideline on some of these details, refer to Appendix A of this document.**

### **8.2.3 Electronic Submittals**

Drawings and other submittals should be provided in electronic format. This will facilitate a timely review by the District. Transmittal by e-mail will expedite the processing between the Applicant and the District as well as within the District. All drawings shall be in Adobe® (.pdf) formats. Documents shall be in Word® (.doc), Excel® (.xls), or Adobe® (.pdf) formats. Digital photographs should be (.jpg) format. The drawings, documents and photographs may be zip compressed for e-mail transmittal.

**8.2.4 Approval Process**

- 8.2.4.1** The District's technical staff will review submittals. The applicant will be notified by e-mail of required changes for submittals that are not approved.
- 8.2.4.2** Submittals meeting the District's requirements will be signed as approved. District approvals shall be considered valid for a period of one year.
- 8.2.4.3** The Applicant may revise design submittals that are not approved. The Applicant shall incorporate all District requirements in all documents of the revised submittal package. The Applicant shall resubmit the whole revised package as described above.

**8.3 STRUCTURAL DESIGN****8.3.1 Design and Analysis of Steel Poles**

A Civil Engineer, licensed in the State of California and acting on behalf of the Applicant, shall perform Structural design and analysis on each District tower, pole, or structure designated for the attachment or addition of antennas and/or antenna mounts. All drawings and calculations shall be "sealed" by the engineer performing the design and analysis. The design and analysis shall conform to the rules and provisions of California General Order 95 (GO95) pertaining to strength; working and electrical clearances; and safety factors for poles and towers. Loads applied to poles, towers, antennas, and antenna supports shall be in accordance with ANSI/TIA/EIA-222, latest revision, with a minimum wind speed of 75 miles per hour, without ice, where applicable. Loads applied to the poles and towers from the power line conductors shall be in accordance with GO95. The applicant may design to more stringent criteria to ensure the reliability, operability and/or protection of the antenna and associated equipment.

All sizes and dimensions shall be United States standards units. The details of the poles, arms and attachments shall be compatible with standard electrical line hardware. All poles shall have end caps for poles and arms. Any hole greater than ½ inch diameter that is exposed where birds may enter after assembly, shall be covered with either a solid cap or with a 3/8" by 3/8" wire mesh or expanded metal fabric. All poles shall include a ½ x 13 heavy hex grounding nut one foot above the ground line or base plate and where shown on the configuration drawings.



The minimum thickness of the pole shaft shall be 3/16 inch, and for arms or appurtenances shall be 3/16 inch. Pole shaft dimensions and width to thickness ratios shall conform to the requirements of ASCE manual No. 72 "Design of Steel Transmission Pole Structures", to limit localized buckling. All welding shall be done during fabrication and prior to galvanizing. Welding will not be permitted for field assembly of poles. Pole top deflection shall be limited to a maximum of L/20 for loads applied at worst case loading conditions including wind load on the pole, less the 1.50 overload factor.

A climbing system consisting of removable ladders and mounting brackets compatible with McGregor Ladders capable of supporting a load of 900 pounds shall be included on all poles.

For direct embedded poles, the pole shall be coated with a 14 Mil thickness of "Corrocote II" by Madison Chemicals Industries, Inc., from 12 inches above the ground line to the bottom, including the bearing plate.

The pole and components shall be stamped or marked with a weld bead with the UD identification number assigned by the District.

### **8.3.2 Material Specification**

Structural members and their connections shall be designed and constructed to ensure that the structures and their parts will not fail or be seriously distorted at any load less than the sum of the maximum applied loads (per Section 7.3.1 above) multiplied by a safety factor of not less than 1.50, as specified in GO95 Rule 44 for Grade "A" construction.

Pole shaft material shall have minimum yield strength of 65 ksi. Higher strength materials may be used. All materials shall comply with the requirements of the appropriate ASTM specifications. Steel shall be in accordance with ASTM Specification A6 and shall be mill certified for physical properties and chemistry. The steel used for galvanized pole shaft and arm material (base plate material not included) shall have a maximum silicon content of 0.06 percent and be suitable for galvanizing. The materials used for the pole and appurtenances shall be in accordance with ASTM Specifications A36, A572, A588, A871 or A633.

The filler metal for all weld material shall be compatible with the parent metal and shall have physical properties equal to or greater than the material is being joined. Filler metal shall conform to the requirements of AWS "FILLER METAL SPECIFICATION." The weld filler metal shall have a



toughness of fifteen foot-pounds at minus twenty degrees Fahrenheit (-20 degrees F) as determined by the Charpy V-notch test.

All bolts shall be heavy hex head and shall comply with ASTM A307, A325, or A354 grade BC. All nuts shall be heavy hex and shall have a proof load capacity equal or greater than the bolt on which it is to be used. Bolts, nuts and other hardware for use on galvanized poles shall be galvanized in accordance with ASTM A153. Unless otherwise specified, anchor bolts shall be fabricated from number 18 (2¼") reinforcing steel bars conforming to ASTM A615 Grade 75. Anchor bolts and nuts shall be galvanized heavy hex.

The substitution of any materials for those listed in these specifications will not be permitted unless approved in writing by the District prior to incorporation into the poles and appurtenances.

## **8.4 CLEARANCES**

### **8.4.1 Physical Clearances**

Antenna, antenna cables, cableways, and all associated hardware shall be installed to maintain clear and safe clearances, climbing space, and working space. The installation shall enable District crews to easily remove, install, and maintain the aerial wires, cables, and insulators and other apparatus installed on power delivery poles, towers, and/or structures. The requirements for all joint pole partners or leased attachment must also be accommodated.

#### **8.4.1.1 Working Space**

District crews may be required to perform work to change, maintain, and modify supply wires and cables, insulators and other equipment located on facilities. District crews may climb a tower, pole, or structure to access this equipment. Lift buckets may also be used to access equipment located on the towers or metal poles. The Applicant shall not place any antenna, or associated equipment such as antenna cable ladder(s), cableway(s), or any other antenna associated hardware so as to encumber this access. Drawings shall show sufficient detail so that the District is able to confirm that this requirement is met. GO95 climbing and working space shall be maintained.

#### **8.4.1.2 WHIP Antenna Danger**

Whip antenna wire tips shall be made easily visible and the tips covered.

**8.4.1.3 Antenna RF Radiation Danger and Service Disconnect**

Radiation from the antenna must be within the limits defined in US OSHA regulations 1910.97 paragraph (a) (2) (ii). If not, the antenna shall be moved a distance from the supply line and shield wire area so that acceptable limits are obtained on the tower at a distance of ten feet above these lines and wires. The Applicant shall install an appropriate RF caution sign (refer to US OSHA regulations 1910.97 paragraph (a) (3) (iii)) at the base of the pole where these limits can be exceeded. See paragraph 8.7.4 for RF Caution sign specification.

The District may disconnect service to antenna installations, without notice, when performing operational or maintenance activities that require District personnel to work above ground level in the vicinity of the antenna. If the service cannot be easily disconnected at the antenna site, e.g. the service is at a remote location, or will not immediately de-activate the antenna, the applicant shall provide an appropriate visible disconnect means (switch) that shall be clearly identified and accessible to District personnel. Provisions shall be made to install a District padlock on the switch to prevent public access but ensure District accessibility. In no case shall the applicant apply a lock to prevent District access.

**8.4.1.4 Antenna Electric Touch Potential Danger**

If any exposed antenna part is operated at a potential that might cause a muscular reaction when touched, the Applicant shall install a warning sign reading “DANGEROUS ANTENNA VOLTAGE.” This sign shall be installed at the base of the pole where the danger exists. See paragraph 8.7.3 for Hazardous Antenna Voltage specification.

**8.4.1.5 Clearances from Power Conductors****i Antennas Placed Below Supply Conductors**

Any equipment installed below the supply conductors shall follow the typical clearance requirements per G.O. 95 section 92.1 F(2), which must be 6 feet (72 inches) from the supply conductors. For 230 kV supply conductors typical clearance requirements shall follow NESC Table 238-1, which specifies 9'-8" (115 inches).

- ii     **Antennas Placed Above Supply Conductors**  
 Minimum distance from the line conductor to the antenna, or its connecting cables, shall meet the requirements of GO95 Table 2, case 10 and the appropriate column.
- iii    **0 - 69 kV Clearance**  
 See Drawing C011.7
- iv     **115 kV Clearance to line conductor**  
 120 inches
- v      **230 kV Clearance to line conductors**  
 120 inches

### 8.5       **GROUNDING**

Grounding design for antenna installations shall be consistent with this specification, including the attached drawings as appropriate. These requirements provide for safety at the location of antenna equipment in the case that power supply conductors discharge to ground (ground fault) through the transmission, substation, or distribution facilities, antenna structures or associated equipment. Without such grounding provisions, a ground fault could result in dangerously elevated ground potential voltage gradients.

Grounding requirements for transmission and substation facilities are based on Substation Grounding Standard IEEE 80, and case studies of ground grid performance. The Applicant shall apply grounding requirements from IEEE 80 standard and GO95 code. For a Sample Calculation, see Section 9.9.

Industrial and communication grounding practices (refer to CEC and IEEE Green Book Std. 142), as well as the requirements of inspection authorities, compliment these specific grounding requirements.

Grounding designs for transmission and substation facilities have been successfully analyzed while varying the parameters of earth resistivity and available fault current in the following cases:

<b>PARAMETER</b>	<b>UNITS</b>	<b>CASE 1</b>	<b>CASE 2</b>	<b>CASE 3</b>
Earth Resistivity	Ohms/M	>=100	>=40	>=25
Max available S.C. Symmetrical Current	Kilo amps	<=5	<=15	<=25

In all cases asphalt resistivity is assumed greater than 100,000 ohms / Meter.

At antenna sites where these parameters vary significantly from those in the case studies, the grounding design will require further analysis by the District to establish requirements.

### 8.6       **FENCING AND GATES**

Where installation of an antenna and base station contributes to making a tower or pole climbable by non-utility workers, refer to NESC article 217A2, the Applicant

shall install a fence and gate around the tower or pole and the associated base station.

Where the antenna will be installed in a District substation, the Applicant shall install chain link fence to isolate its leased area from all District operated equipment. The Applicant shall install exterior access gates to permit its personnel to enter its leased area without entering the area for District operated equipment.

Chain link fence and gate installations shall meet the requirements of the, District's Engineering Specification C914 – CHAIN LINK FENCE. Walls may be installed to accomplish the functions provided by exterior chain link fence. The applicant may request the District to provide typical wall designs acceptable to the District. All wall and fence designs are subject to District approval.

A chain used together with District and Applicants pad-locks shall lock the gates accessing the Applicant leased area. District and Applicants pad-locks shall be connected in tandem so that unlocking either lock will allow the gate to be opened.

## **8.7 SIGNAGE**

The Applicant shall provide all signs in accordance to the requirements of ANSI standards Z535-1, 2, 3, 4, and 5. Signs shall be installed in locations that do not obstruct climbing. Sign locations shall be shown in drawing submittals.

### **8.7.1 Keep Out Gate Sign**

Install a KEEP OUT sign on the gate facing outward. The sign shall read and be constructed per sign C011.2.

### **8.7.2 Antenna Workers Notice Sign**

Fasten an ANTENNA WORKERS NOTICE sign to the inside side of the fence at a point easily visible and near the pole or tower. If no fence is required at the antenna installation, install the sign on the pole or tower. The sign shall read and be constructed per sign C011.3, with the specific location specified.

### **8.7.3 HAZARDOUS ANTENNA VOLTAGE SIGN**

When required by paragraph 8.4.1.3, fasten a HAZARDOUS ANTENNA VOLTAGE sign to the inside of the fence at a point easily visible and near the pole or tower. If no fence is required at the antenna installation, install the sign on the pole or tower. The sign shall read and be constructed per sign T004.4.

### **8.7.4 RF CAUTION SIGN**

When required by paragraph 8.4.1.2, fasten a RF CAUTION sign on the inside of the fence at a point easily visible and near the pole or tower. If no fence is required at the antenna installation, install the sign on the pole or tower. The sign shall read and be constructed per sign T004.5.

**8.7.5 RF GUIDELINE NOTICE**

Fasten an RF GUIDELINE NOTICE sign to the inside of the fence at a point easily visible from the pole or tower. If no fence is required at the antenna installation, install the sign on the pole or tower. The sign shall read and be constructed per drawing T004.6.

**8.8 ELECTRIC SERVICE**

The electric service for the antenna installation shall meet the minimum requirements set forth in the District's Rules and Regulations. In addition to these requirements, the area three feet around power cabinets and telephone cabinets shall be surfaced with a three-inch thick asphalt cover. The District shall not be liable for damage to Applicant's equipment or communications issues that may result from fault current, ground potential rise, or other physical or electrical events that may occur in proximity to its power delivery facilities.

**8.8.1 SERVICE TO ANTENNAS LOCATED ON HIGH VOLTAGE TRANSMISSION LINE STRUCTURES (60kV and Higher Voltage)****General Information**

Special design precautions must be taken when providing 120/240V or 277/480V electric service to cellular antennas that are located on high voltage transmission towers and poles. The antenna base station is typically located on a concrete pad located directly under, or adjacent to, the high voltage structure. There is a direct metallic path from the antenna to the base station equipment ground bus, which is also connected to the utility service neutral and ground. Should a fault occur on the transmission structure, fault current and voltage can transfer to the service panel and the service conductors. Normal construction practices for service installations may not adequately protect personnel that are standing on the ground in contact with the service panel. During fault conditions these personnel could be exposed to "touch voltages" in excess of allowable safe limits. The following design practices shall be employed to improve the safety of the service design for workers and the public.

1. Determine the worst-case ground potential rise (GPR) based upon the available fault current to be quoted by SMUD and the local earth resistivity. The worst-case GPR value shall be submitted to the District, with the site-specific grounding design.
2. If the primary distribution system from which the cell site will be served is not solidly multi-grounded, and the predicted GPR is above 12 kV symmetrical, then one of the following design options shall be implemented. Also, the District may

require one service design or the other, depending upon local conditions or constraints.

A. Dedicated Transformer - To ensure that no other customers share the service neutral connection with these cell sites, a dedicated service transformer shall be installed. The meter must be located on the base station equipment pad with enough clearance around the meter to ensure that personnel who can touch any part of the metering enclosure shall be standing on the equipment pad.

B. Isolation Transformer - If the SMUD service transformer will serve multiple customers or more than one cell site, the applicant must install a ground isolation transformer of adequate rating on the base station pad. The service panel shall be isolated from any/all parts of the base station or transmission structure or ground grid, by a minimum of 50 feet.

**Exception:** Isolation transformers are not available to accommodate GPR greater than 45,000V. In these cases, a dedicated service transformer is required. Where service cannot be provided in an acceptably safe manner, the District will not allow the installation of a cell antenna at the site.

3. If the GPR is less than 12 kV symmetrical, or if the primary distribution system from which the cell site will be served is a solidly grounded, the site is treated as a District Rule 16 service, except that the service pedestal is required to be placed on the equipment pad of the base station or on a separate pad, electrically connected to the ground grid of the base station, and large enough to ensure that personnel will be standing on the equipment pad when they touch the panel.

4. Note: Rule 2 special facility charges shall apply to District expenses required to serve the antenna with a dedicated transformer, including the cost to extend primary service to provide power to the antenna location.

5. If multiple cell antennas occupy a single transmission structure, they can share a common ground grid and service facilities. If cell antennas are installed on two adjacent transmission structures, supporting the same transmission circuits, they can share a common ground grid and service facilities.

6. Cell antennas installed on transmission structures that support different transmission circuits shall not share the same service or base station ground grid.

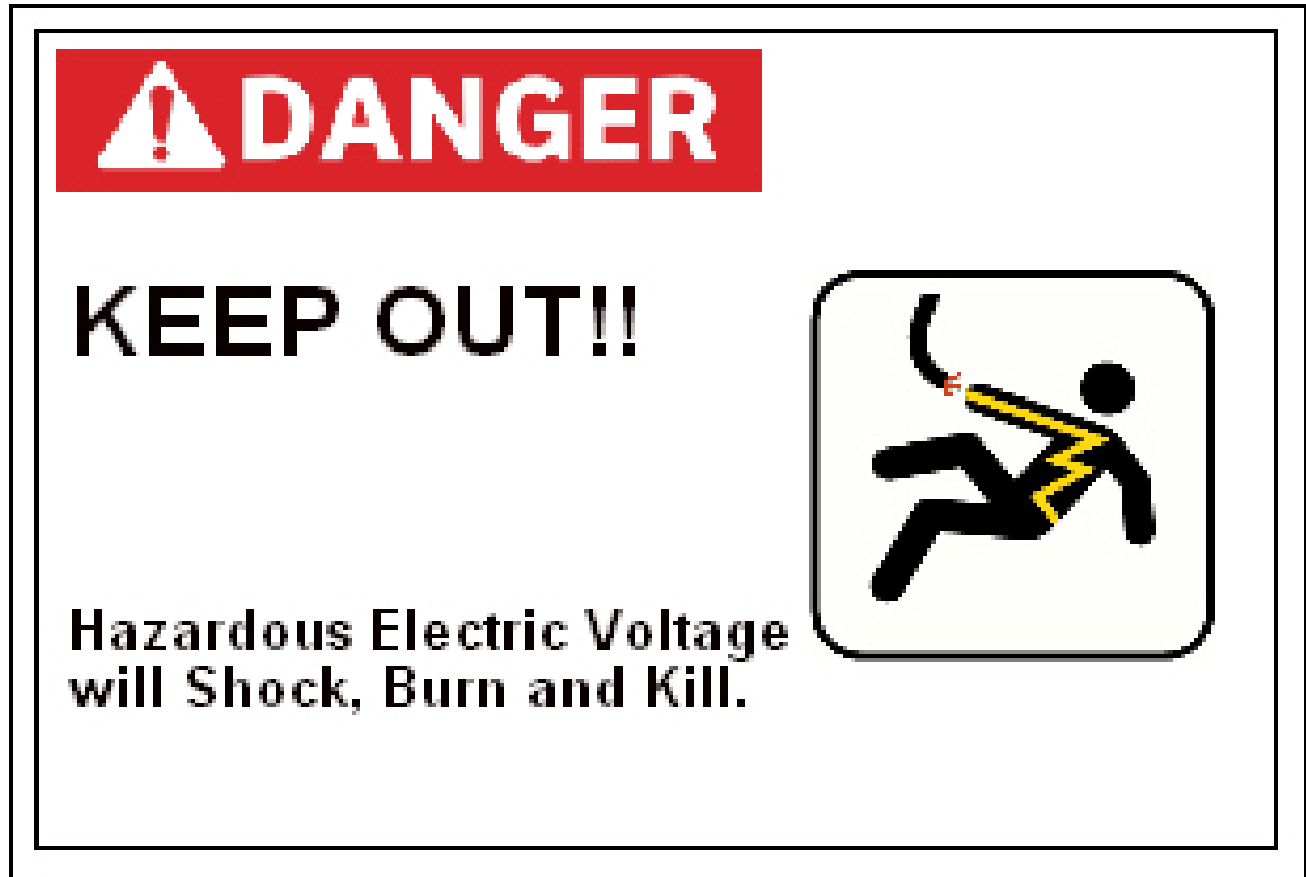
7. Isolation transformers must have BIL ratings in excess of the predicted GPR for the quoted transmission fault. The high side bushings of the transformer shall not be connected to the case or ground in any manner. Secondary cables and neutrals shall be isolated from ground and run in Schedule 40 PVC conduit to the meter

location. There shall be no ground connection between the cell equipment and the electric meter service pedestal.

8. Any deviation from these guidelines shall require District approval. A specific design and associated engineering analysis shall be submitted to confirm touch and step protection to personnel working in the vicinity of the meter panel or cell site equipment.

## **9 WARNING SIGNS & DRAWINGS**

- 9.1 KEEP OUT!! GATE SIGN
- 9.2 ANTENNA WORKERS NOTICE SIGN
- 9.3 HAZARDOUS ANTENNA VOLTAGE SIGN
- 9.4 RF CAUTION SIGN
- 9.5 RF GUIDELINE NOTICE
- 9.6 DISTRIBUTION POLE TYPICAL ANTENNA REQUIREMENTS
- 9.7 TYPICAL TOWER GROUNDING DETAIL
- 9.8 TYPICAL SUBSTATION ANTENNA REQUIREMENTS
- 9.9 TYPICAL GROUNDING CALCULATIONS



**9.1 KEEP OUT!! GATE SIGN**

Make sign from 18 gauge steel with Porcelain Enamel finish, Red "Danger" header with all other copy and symbols black on white background, size 8.5" x 14", 4 holes with 1/2" i.d. brass grommets, located 1/2" in from each corner, (Standard Sign Blank). Electromark part No. SMD051-W-ZD-AN2 or approved equal.



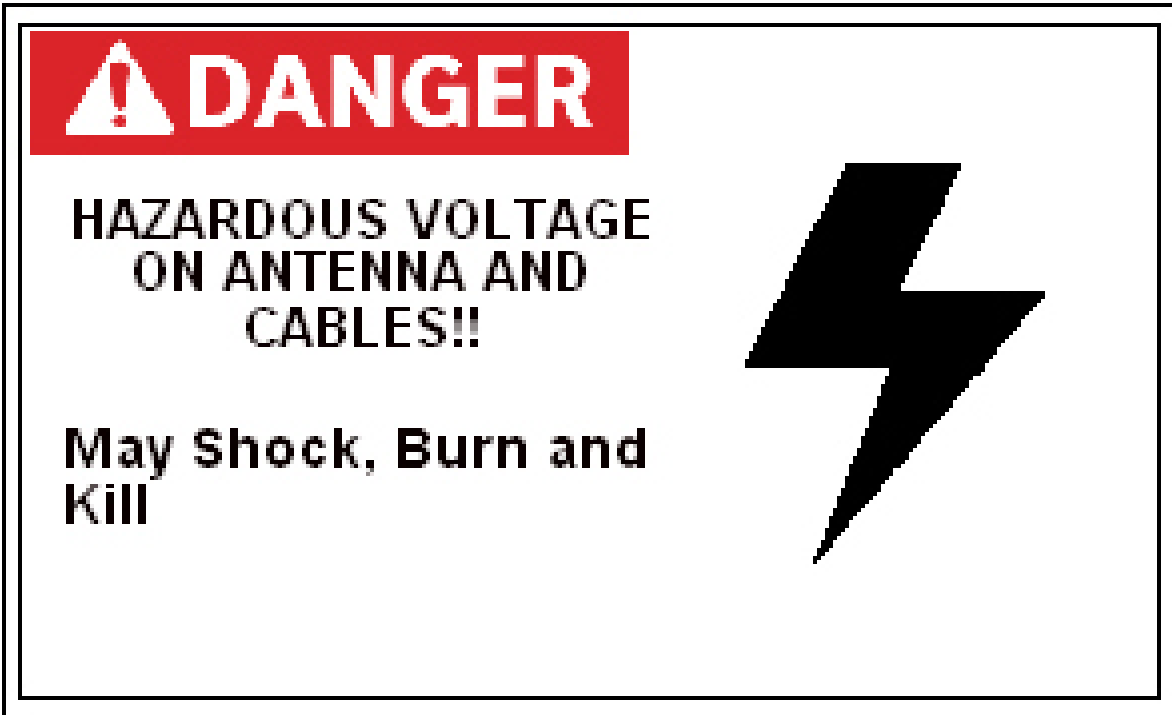


## 9.2 ANTENNA WORKERS NOTICE SIGN

The Applicant shall complete LOCATION letter placeholder with numbers provided by the District. Make sign from 18 gauge steel with Porcelain Enamel finish, Blue "Notice" header with all other copy and symbols black on white background, size 8.5" x 14", 4 holes with 1/2" i.d. brass grommets, located 1/2" in from each corner, (Standard Sign Blank). Electromark part or approved equal.

### VARIATIONS:

Substitute the word pole for tower as appropriate.  
At distribution poles do not include information after WWWW



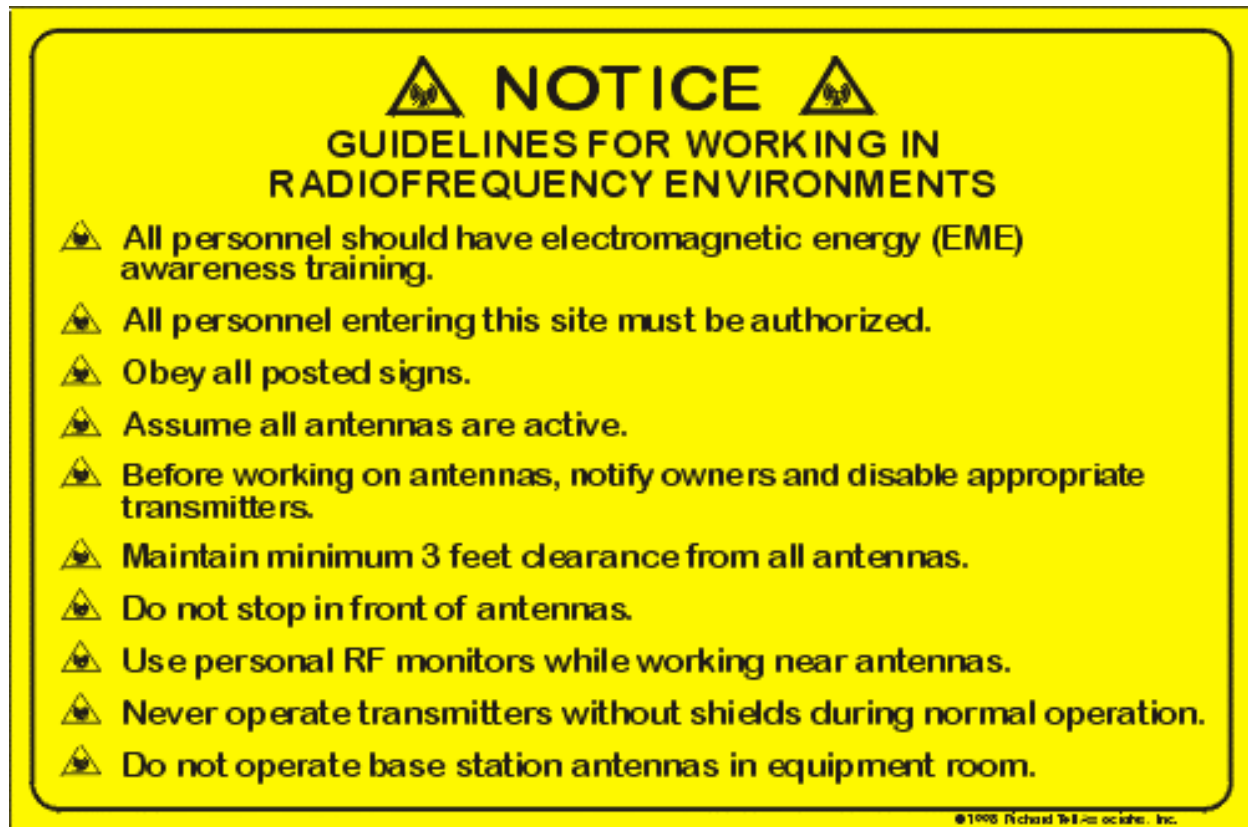
### 9.3 HAZARDOUS ANTENNA VOLTAGE SIGN

Make sign from 18 gauge steel with Porcelain Enamel finish, Red "Danger" header with all other copy and symbols black on white background, size 8.5" x 14", 4 holes with 1/2" i.d. brass grommets, located 1/2" in from each corner, (Standard Sign Blank). Electromark part No. SMD049-W-ZD-AN2 or approved equal.



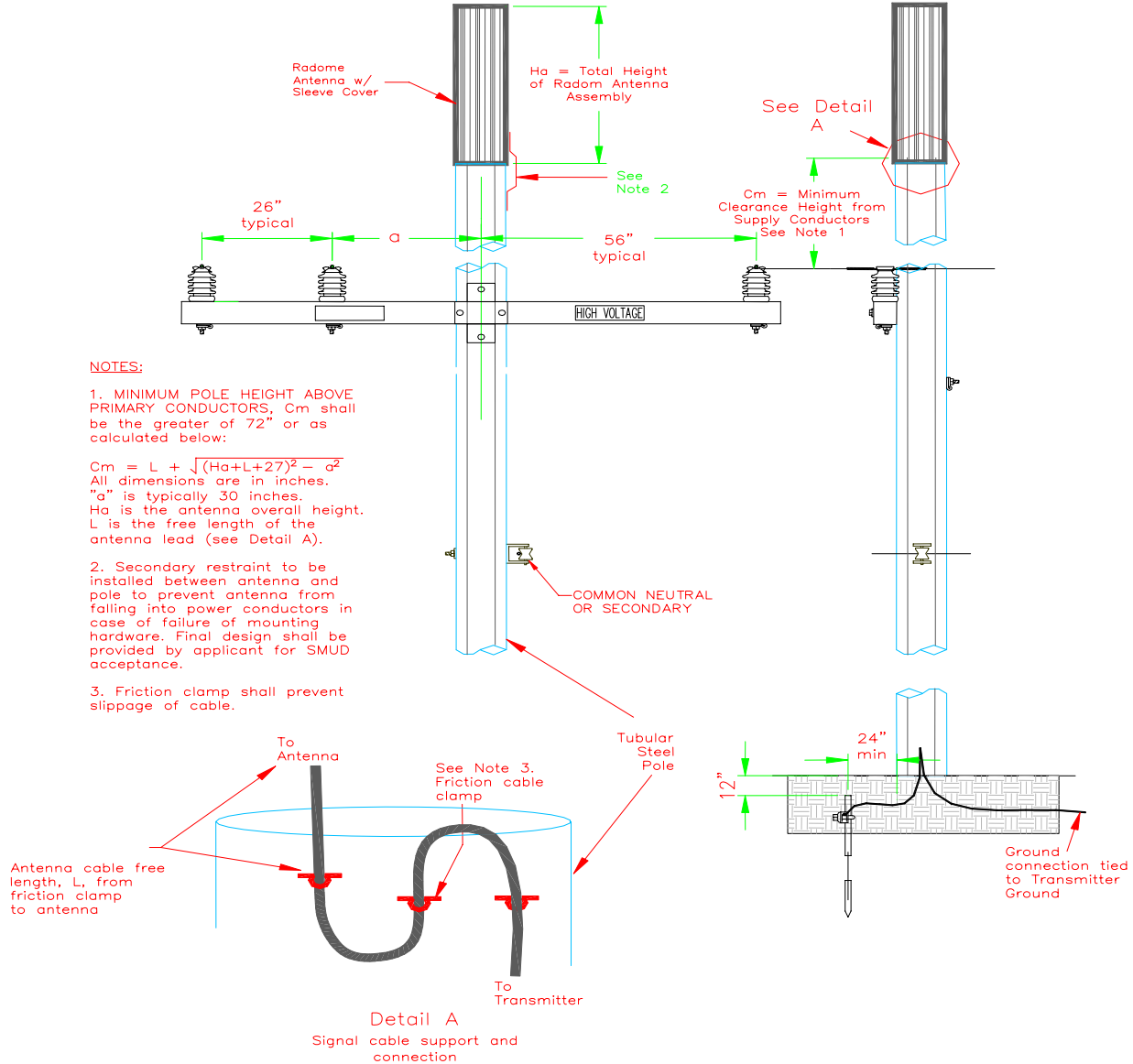
#### 9.4 RF CAUTION SIGN

Sign 12"X18" aluminum panel with rounded corners and holes located near each of the four corners for convenience in mounting. Manufacture the sign with a special UV resisting coat applied to the surface to increase longevity in outdoor environments. TESCO part No. 43875 or approved equal.

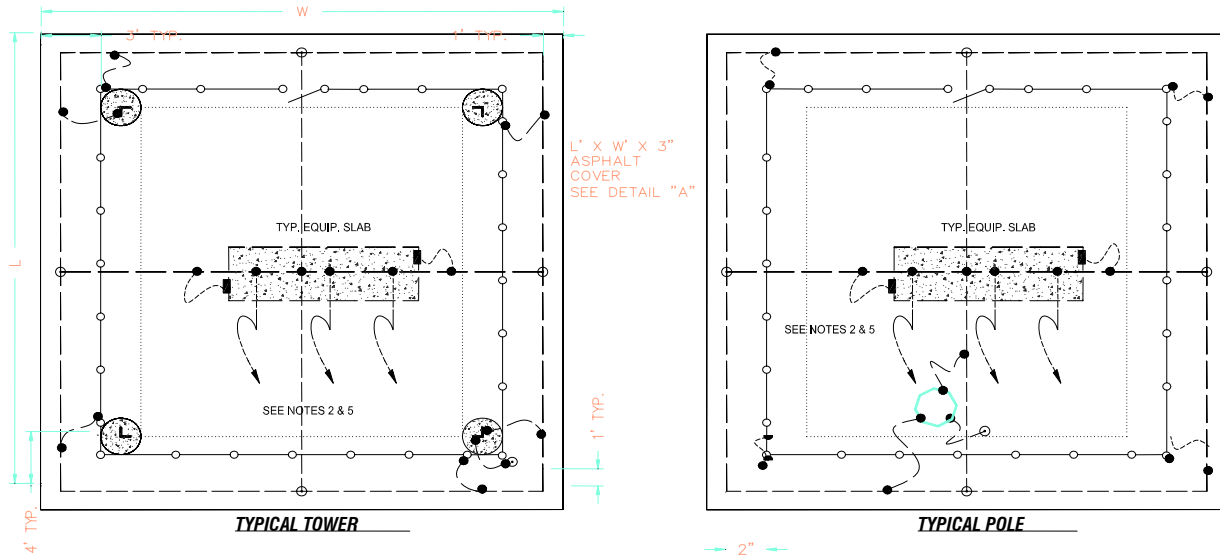


## 9.5 RF GUIDELINE NOTICE

Sign 12"X18" aluminum panel with rounded corners and holes located near each of the four corners for convenience in mounting. Manufactured the sign with a special UV resisting coat applied to the surface to increase longevity in outdoor environments. TESSCO part No. 68796 or approved equal.

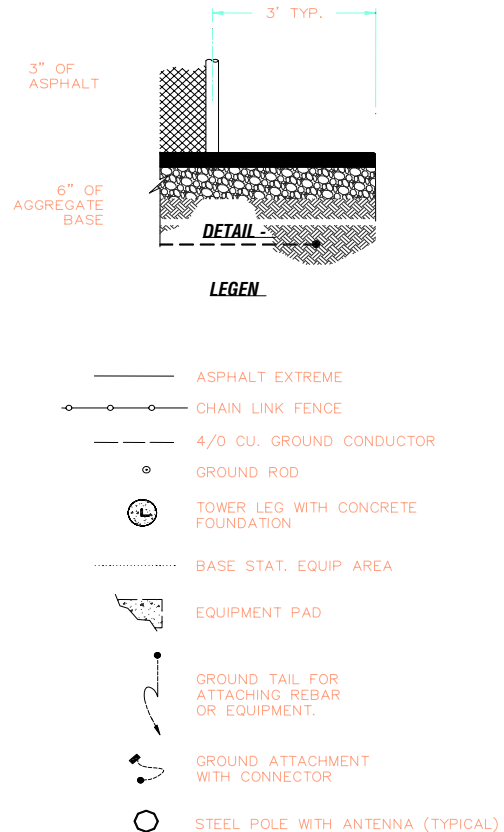


**9.6 DISTRIBUTION POLE TYPICAL ANTENNA REQUIREMENTS**

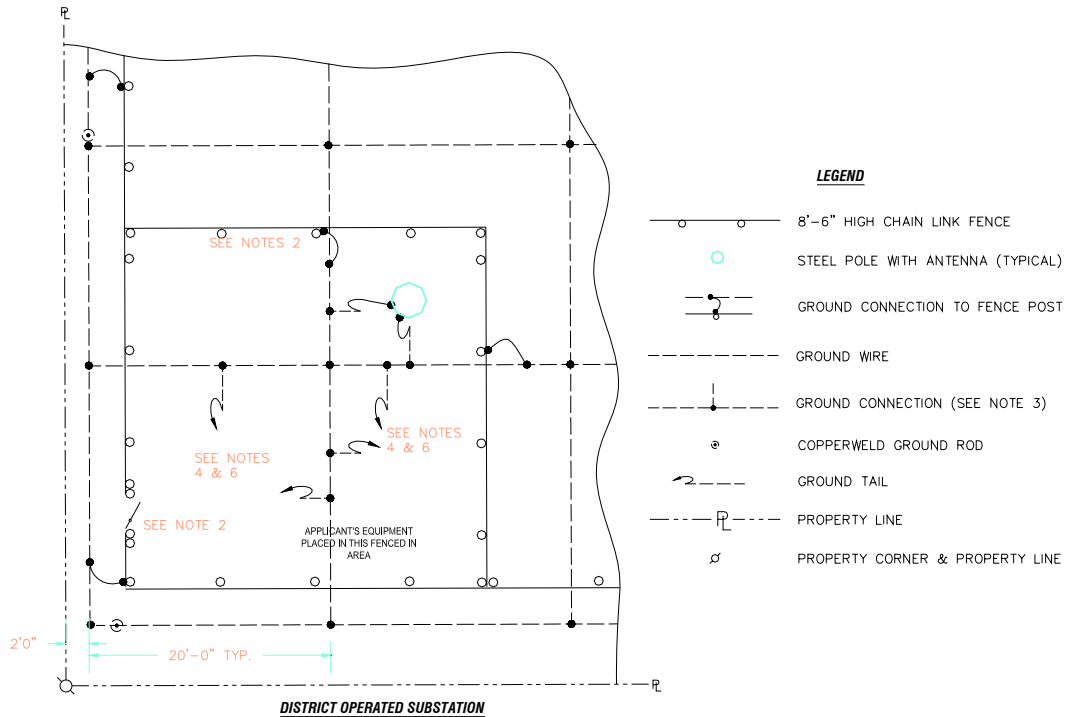


**NOTES:**

- 1) Three inches of to be placed over 6" aggregate base (see Detail A). Asphalt material and placement shall be in accordance with section 39 of the State of California, Department of Transportation CALTRAN Standard Specifications. Aggregate gradation shall be 3/4" maximum. Abut asphalt cover to concrete pad provided for applicants equipment.
- 2) Applicant's concrete pads shall contain #4 minimum rebar with a 1'-0" maximum grid spacing. All rebar intersections must be securely tied together. Connect concrete pads to ground grid at least two points.
- 3) Ground conductors to be buried at least 18 inches in compacted earth..
- 4) Applicant to provide easement rights and / or lease for property to install all required facilities.
- 5) Applicant to connect ground conductors to antenna and base station equipment per Industrial and communication grounding practices (refer to NEC, IEEE Green Book STD.142, EIA and TIA standards).
- 6) Eight foot 5/8" Diameter copper clad ground rods shall be driven from base of ground conductors trench.
- 7) Ground tails to attach to lower legs above ground at two (2) locations.



**9.7 TOWER GROUNDING DETAIL**



**9.8 TYPICAL TOWER GROUNDING DETAIL**

**GROUNDING SPECIFICATION:**

Maximum Grid Voltage Rise: 5000V

Maximum Resistance: 5  $\Omega$

Maximum Step Potential:  $E_S = (165+\rho)/t^{0.5}$

$$E_S = (165+\rho)/t^{0.5} = (165+345)/3^{0.5} = 295V \text{ (allowed for 3 sec.)}$$

$$E_T = (165+\rho/4)/t^{0.5} = (165+345/4)/3^{0.5} = 145V \text{ (allowed for 3 sec.)}$$

$$I_L = 34,800 \text{ d.L}/(\rho t)^{0.5} = [34,800(0.475/12)(1)]/[345(3.28)(3)]^{0.5}$$

$$I_L = 23.64 \text{ A-Ft. (max per linear foot of #4/0 \& } \rho \text{ of } 13 \Omega \text{ -meter)}$$

$I_F \text{ Max} = 20,000A$  (provided by SMUD)

$$I_F \text{ Max} / I_L = 20,000A / 23.64 \text{ A-ft.} = 846 \text{ ft.} = 258 \text{ m}$$

$$R = [\rho/4\pi L] (\ln 4L/a + \ln 4L/s - 2)$$

$$R = [345/4.\pi.258] \{ \ln [(4)(258)/(0.006)] + \ln [(4)(258)/(0.46)] - 2 \}$$

$$R = 1.89 \Omega$$

**9.9 TYPICAL GROUNDING CALCULATIONS**