

Macrocell Antennas on Transmission Lattice Towers



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1. Scope

This standard covers the requirements for the installation of macrocell antennas on transmission lattice towers.

For installation of macrocell antennas on wood poles, see SCL 0095.20.

For working in the vicinity of wireless communications antennas, see SCL 0095.04.

2. Application

This standard provides direction to SCL crews, engineers, customers, and approved contractors for the installation of macrocell antennas on SCL-owned lattice towers.

3. Requirements

3.1 General

Prior to construction, a Non-Ionizing Electromagnetic Radiation (NIER) report shall be submitted to SCL Joint Use Engineering and retained on file for each equipment type/model. See SCL 0095.06.

All installations shall include a fall arrest system per SCL 4025.05 if none exist on the tower.

All work on lattice towers shall be performed by SCL crews under the wireless antenna customer's direction.

There shall be no antenna equipment attachment of any kind to the climbing legs of towers.

Non-destructive connections shall be required for new attachments. No drilling or welding will be allowed. Any exceptions shall require written SCL authorization.

All necessary permits shall be obtained by the antenna customer. This includes Federal Aviation Agency (FAA) permits and any easement on private property for pad-mounted communications equipment.

Permits and applications for all proposed work, which includes installations, modifications, or relocations, shall be reviewed and approved by SCL Joint Use Engineering.

All installations shall meet or exceed all applicable structural and clearance requirements of the latest revision to the National Electrical Safety Code (NESC), as well as SCL construction standards. In case of conflict, the most stringent requirement will prevail.

Any variance from this standard shall require approval in writing from SCL Joint Use Engineering.

3.2 Ground Resistance Test Plan

Prior to the start of site design, but after SCL's preliminary acceptance of the site, a Ground Potential Rise (GPR) study will be required, and the system must be built to meet the touch and step potential requirements. To do the GPR study, the customer will notify SCL and submit the GPR study request form including the GPR data request, and SCL will provide the system data for calculations required for the study. The design shall be in accordance with the latest revision of IEEE Std 80.

The study report shall include:

1. Earth Resistivity Test Report
2. Earth Resistivity Analysis
3. Overall Data used for the Calculation
4. Grounding Calculation
5. Safety Calculation
6. Recommended Remedy

All survey data shall be provided to SCL including distances between electrodes, system configuration, notes of any existing grounding, and the ground resistance measurements.

Due to the complexity of the system and serious worker safety issues regarding the grounding, the test and report must be certified by the signature and stamp of a Washington State-licensed Professional Electrical Engineer.

3.3 Structural Analysis

When required by SCL, a structural analysis shall include the following:

- The structural model assumed in the structural analysis shall consider the "as-is" condition subjected to the structural loading conditions specified in the "Seattle City Light Transmission Line Design Criteria" and provided by SCL. This includes tower type, loading conditions, conductors, materials, and design standards. Towers have different types and specification. SCL will also provide the tower information, drawings, and specifications.
- A non-linear analysis shall be performed using "Tower" and "PLS-Pole" from Powerline Systems Inc. Complete analysis output files for the proposed installation are required. Analysis of the bolted connections is required. Electronic input files for computer analysis shall be submitted; files to include "*.BAK" files.
- A detailed combined stress analysis shall be submitted for the tower member that supports the new wireless equipment mounts. Bending, axial, shear, torsional and any secondary stresses shall be considered, as appropriate.
- A foundation analysis is required. The foundation analysis shall reflect local soil conditions, when known and available.
- The structural analysis report shall be stamped by a Washington State-licensed professional structural engineer. This report shall be provided to SCL in electronic PDF files.

3.4 Drawing Submittals

The antenna customer's drawings and all other submittals for each site shall include a reference to the SCL Tower Asset Number (e.g., B01/25N), SCL project number, and the local contact/project manager with a phone number.

The drawings shall contain a note that states that SCL or its approved contractor will install and maintain the antennas, coaxial cables, and all other wireless equipment on all towers.

The drawings and analysis are to be signed and stamped by a Washington State-licensed professional structural engineer or architect, depending on the type of drawing.

Drawings and shop drawings shall reflect assumptions and findings of analysis and shall incorporate SCL comments. Drawings shall be sufficiently detailed for construction on towers by SCL crews or its approved contractor, and to enable a Parts List to be created. Drawings shall be reviewed and accepted by SCL before construction is scheduled.

Drawings of the proposed installation, including shop and assembly drawings, shall be submitted as follows:

- 11 in x 17 in PDF drawings file
- 22 in x 34 in (D-Size)

As built drawings shall include:

- 11 in x 17 in PDF drawing file
- 22 in x 34 in (D-Size)

3.5 Wireless Antenna Panel Attachments and Clearances

No installation of any wireless antenna or its equipment shall be permitted above or between the transmission power lines.

Installations shall only be allowed on tower legs as approved by SCL Joint Use.

The wireless antenna and its equipment shall be installed no closer than 12 ft (minimum) below the lowest transmission conductor to the top of the wireless antenna panels. See Figure 3.5a.

The wireless antennas attachment points to the tower legs shall be no closer than 12 in (minimum) above or below a tower joint. See Figure 3.5b.

Figure 3.5a. Macrocell Antennas on Lattice Towers

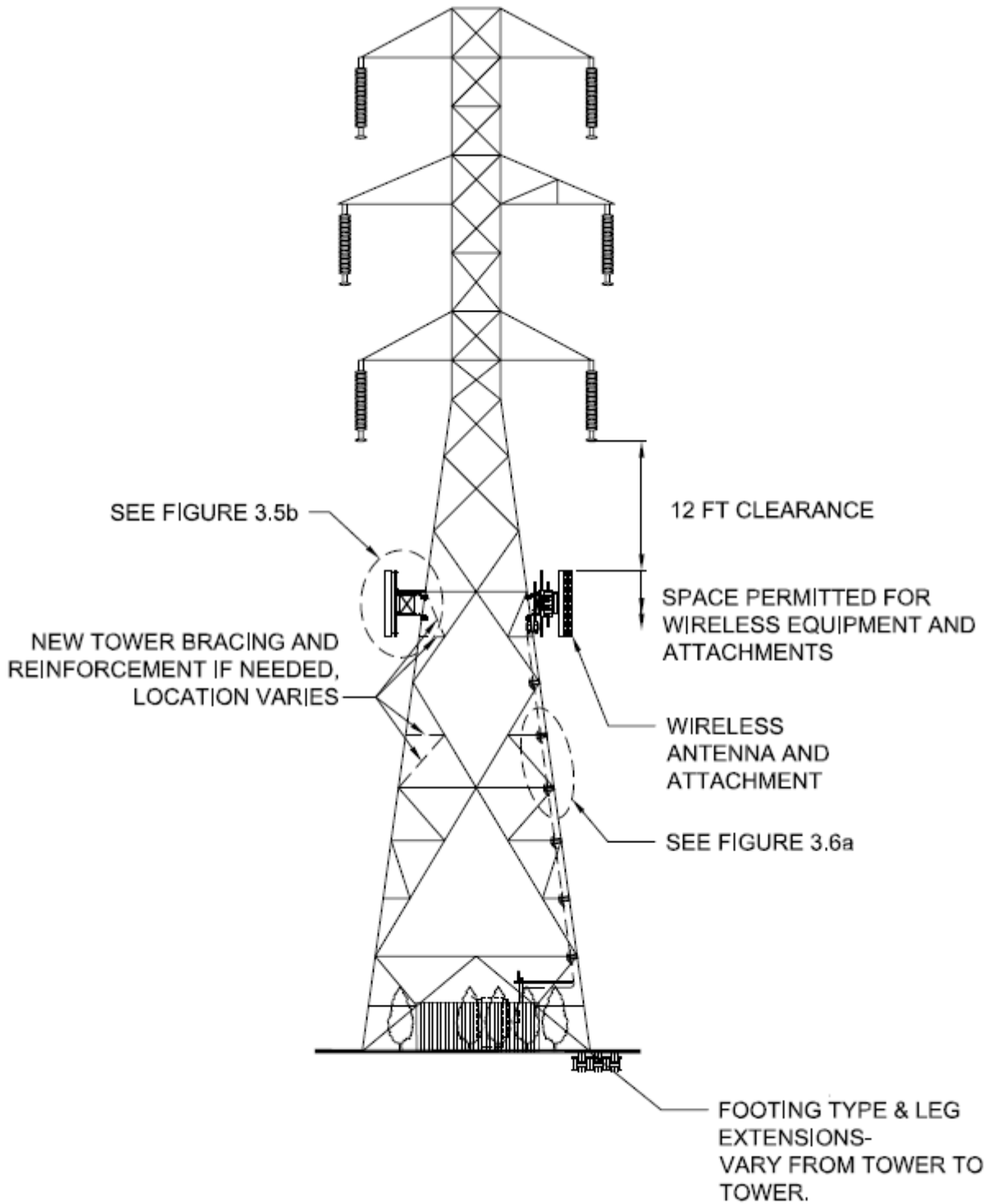
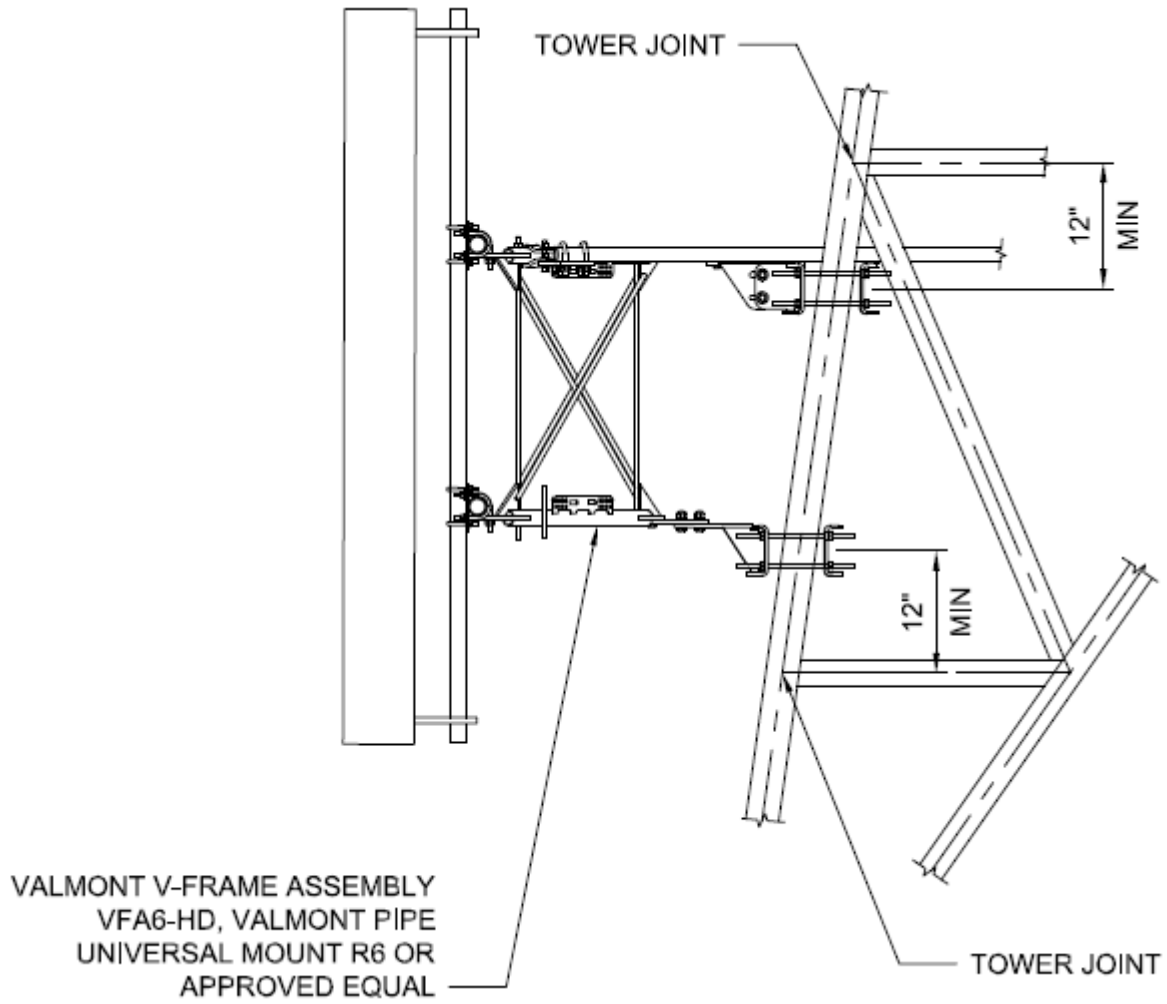


Figure 3.5b. Antenna Panel Attachment Details



3.6 Coaxial Cable Attachments and Clearances

No coaxial cable shall be installed on the climbing leg.

Coaxial cable shall be installed to meet the clearances below and as shown in Figure 3.6a, 3.6b and 3.6c.

- 11 ft-0 in (maximum) between cable standoff brackets.
- 4 ft-0 in (maximum) between cable tie-wrap (2 ft preferred).
- 1 ft-6 in (maximum) between standoff brackets and the nearest cable tie-wrap.

Cables are generally to be supported by strapping or suitable means on the inside of the tower leg between joints to reduce wind loading and torsion.

Maximum number of cables per tower leg shall not exceed 12. Use diagonally opposite tower leg if cables are in excess.

Maximum number of cables per tower shall not exceed 30.

Attach coaxial cable connectors and brackets in a location as close as possible to the joints in the tower leg.

Figure 3.6a. Cable Attachment and Clearance Details

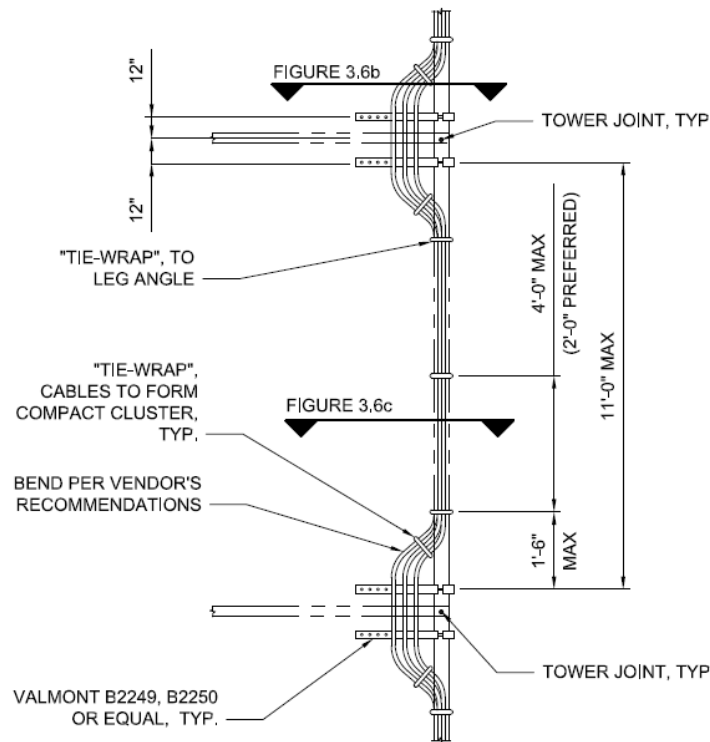


Figure 3.6b. Cable Attachment Cross Section Details per Figure 3.6a

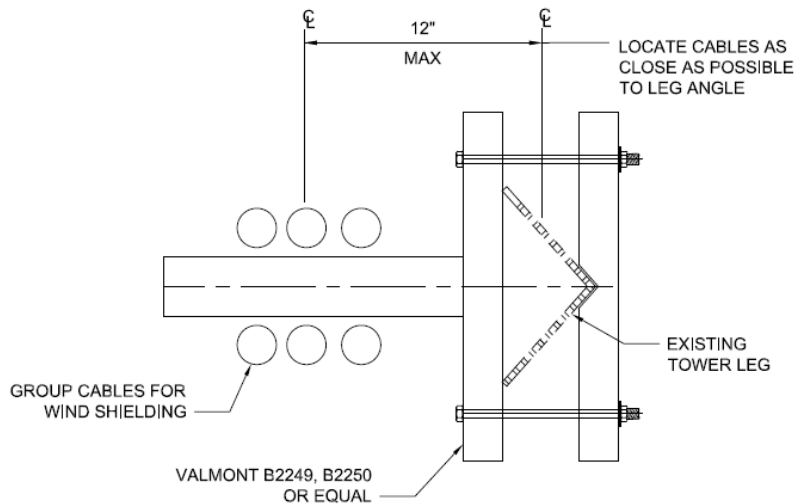
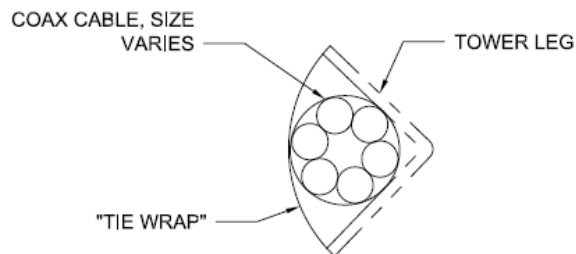


Figure 3.6c. Cable Attachment Cross Section Details per Figure 3.6a



3.7 Ground Station Location and Clearances

The ground station for communication equipment shall be in a fenced or secured location on the ground.

The ground station shall be located directly beneath the tower or 10 ft (minimum) from the lattice tower legs.

The ground station shall not result in pooling of water at the tower's leg. Drainage shall be directed away from the foundation.

3.8 Electric Service

A single-phase, 120/240 V service voltage will be available for power.

Power to serve the wireless antennas shall be metered. An application for electrical service shall be submitted to the Authority Having Jurisdiction (AHJ).

An external disconnect switch shall be installed at the ground station to allow the wireless antennas to be de-energized before work can be performed on the tower. The service disconnect switch shall isolate all electric services including any battery backups.

Fuel tanks for backup power shall not be allowed.

3.9 Grounding and Bonding for Wireless Equipment

Ground rods and ground grids shall be installed per the Ground Resistance Test and Study.

All conductive parts of the wireless antenna installation on the tower, including any enclosure and mounting brackets, shall be bonded together and grounded.

All connections at the ground rod(s) shall be made with an exothermic weld (Cadweld or equivalent).

3.10 Labeling, Identification (ID), and Radiofrequency (RF) Tags

Antenna customer ID and RF tags shall meet the requirements of SCL 0095.08.

3.11 Aesthetics and Inspection

All installations shall be done in a manner that allows for maintenance and climbing of the towers.

Antenna cables shall be installed in a manner that minimizes cabling.

Secure (with nylon zip ties) all loose wires and cables to minimize flapping and entanglement.

4. Materials

All materials shall be provided by the antenna customer.

New bolts or replacement bolts are to be galvanized ASTM 325 type 1 or alternative as approved by the engineer.

These materials shall meet or exceed SCL specifications where SCL specifications exist.

If needed, specialized tools and training for those tools shall be provided to SCL to assist with the antenna installations.

5. Community Notification and Disputes

All required community notifications shall be the responsibility of the antenna customer.

All questions and inquiries resulting from the installation shall be resolved by the antenna customer.

The antenna customer shall provide SCL Joint Use Engineering with a current contact for referral of citizen inquiries.

6. Vegetation Management within the Transmission Right-of-Way

Landscaping shall meet the requirements below:

- No vegetation shall be planted that screens the ground equipment from view.
- No vegetation shall be planted within 10 ft of the tower legs.
- Vegetation shall not exceed 10 ft in height at maturity. Vegetation that exceeds 10 ft in height shall be brought into compliance by City Light either by trimming or removal at the expense of the licensee of the right of way.
- Pesticide use shall be in accordance with City of Seattle policies.

7. Construction Notes

Any grading at the base of the tower should not bury the tower legs.

Contact SCL Joint Use Engineering for concerns regarding the following:

- Avian and wildlife protection
- Clearances
- Site-specific conflicts

8. References

National Electrical Safety Code (NESC), C-2 2017 Edition, Institute of Electrical and Electronics Engineers (IEEE) Inc., New York, NY, 2016

IEEE Standard 80-2013; "IEEE Guide for Safety in AC Substation Grounding"

SCL Work Practice 0095.04; "Working in the Vicinity of Wireless Communications Antennas"

SCL Construction Standard 0095.06; "Non-Ionizing Electromagnetic Radiation (NIER) Report Requirements"

SCL Construction Standard 0095.08; "Wireless Communications Antenna Tags"

SCL Construction Standard 0095.20; "Wireless Communications Antennas on Wood Pole Tops"

SCL Material Standard 4025.05; "Climbing System Kits, Lattice Tower, MSA"

SCL Site Specific Design Criteria; "Seattle City Light Transmission Line Design Criteria"

9. Sources

City of Seattle Standard Specifications for Road, Bridge and Municipal Construction; 2017

Federal Aviation Administration (FAA) Regulations, Section 77; "Objects Affecting Navigable Airspace," July 2010

Federal Communications Commission (FCC); Order 11-50

Federal Communications Commission (FCC), Office of Engineering & Technology (OET) Bulletin 65; "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 97-01, August 1997

Haberman, Douglas; SCL Joint Use Strategic Advisor and subject matter expert for 0095.23

IEEE 1654-2009; "IEEE Guide for RF Protection of Personnel Working in the Vicinity of Wireless Communications Antennas Attached to Electric Power Line Structures"

IEEE C95.1-2019; "Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz"

IEEE C95.2-2018; "Standard for Radio-Frequency Energy and Current-Flow Symbols"

IEEE C95.7-2014; "Recommended Practice for Radio Frequency Safety Program, 3 kHz to 300 GHz"

Kohashi, Owen; SCL Structural Engineering Supervisor and subject matter expert for 0095.23

NFPA 70, National Electrical Code (NEC); 2014 Edition; National Fire Protection Association, Quincy, MA, 2010

Neuansourinh, Ponet; SCL Standards Engineer and originator for 0095.23

SCL Drawing D-36038; "Wireless Antenna (PCS) and Coaxial Cable Attachment to Tower Guidelines"

SCL Wireless Antenna Installation Requirements; "115/230 kV Steel Transmission Towers and Poles"