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May 30, 2022

City of Portland, Oregon
C/O Gillespie, Prudhon & Associates, Inc.
Attn: Jim Nolan, Sr. Telecom Engineer
16111 SE 106th Ave., Ste. 100
Clackamas, OR 97015

Subject: Proposed 180' 3-Leg SS Tower for Bull Run Filtration Facility
Ice Hazards and Mitigation Measures
Western Utility Telecom, Inc. Project No.: 22-0112

Dear Mr. Nolan,

Per your request Western Utility Telecom, Inc. (hereafter as Western UT) has been contracted to provide an assessment of the potential ice hazards that may be anticipated for the above subject tower, along with recommendations for mitigation measures which may be employed.

In lieu of a site-specific ice study, Western UT has been instructed to consider 1½" of solid radial ice for the purpose of this assessment. It should be noted the latest standards for the design of antenna supporting structures escalates the ice thickness relative to the height of the tower. Therefore, considering a design ice thickness of 1½", the ice would escalate to approximately 2.0" at the 180' level (Ref. ANSI/TIA-222-H, Section 2.6.10). It is our opinion this escalated ice thickness is reasonable for the Bull Run Filtration Facility and represents a 500-year mean recurrence.

For the purpose of this assessment, precipitation icing caused by freezing rain is considered to be the most significant icing event that would occur at this tower site. Ice accretion from freezing rain is known as Glaze Ice and is usually transparent, smooth, and dense. As Glaze Ice melts, either through the increase of air temperature or solar radiation, the ice loses internal cohesion and adhesion to the tower members. Ice shedding is the phenomenon where gravity and wind forces cause sheets or chunks of ice to fall potentially causing a considerable risk to human safety and possibly the integrity of the structure.

Since the Bull Run Filtration Facility is located in a region where freezing rain occurs, the hazard of ice shedding should be anticipated.

The document, "An Analysis of Cell Tower Ice Falls", by Dr. Dennis L. Rogers, dated April 16, 2013, includes a graph figure showing the distance of ice fall from tower vs wind speed. Based on a 1 square meter ice sheet 1 inch thick (2.54cm) & weighing 20 lbs., the ice sheet would travel approximately 50' from the top of a 150' tall tower in a 50-mph wind. For a 2-inch-thick

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ice sheet (~80 lbs.), the distance would be approximately 30', and comparably 100' for a 3/8-inch-thick ice sheet. For the 180' tower proposed for this project, an additional 30' should be accounted for in the above stated distances of ice fall from the proposed structure. Smaller ice sheets weighing 5 lbs. or less may blow further from the tower structure in winds exceeding 50 mph, reaching walkways, roadways, or buildings.

Upon review of the plot plan of the subject facility, the tower is located approximately 100' from the perimeter road and 180' from Road 1. It is expected the perimeter road may not be used frequently, however, may be used during inspections following an icing event. The distance from the proposed tower to the nearest segment of the perimeter road would be most susceptible to falling ice. Adequate measures should be taken to warn individuals traveling the perimeter road of falling ice potentials when approaching the tower site.

Many mitigation measures have been studied and tested in ice prevention, removal, protection, and retention systems. Whether through active measures such as manual, mechanical, and thermal, or passive measures such as surface covers or chemicals and coatings, none of these have prevented or removed ice effectively. Furthermore, these methods are not considered to be cost effective. Currently, there is no feasible proven means of ice prevention available for tall towers. The best way to guard against risk to humans and damage to adjacent property is to restrict human traffic and land use in the icefall shadow of the tower.

Mitigation measures may include fencing or barriers surrounding the base of the tower by approximately 100' to 130'. Additionally, it is recommended providing temporary caution signage warning of falling ice surrounding the tower at distances within 180' from the tower. Mobile, folding caution signs may be deployed when climate forecasts warn of a freezing rain event.

If there are any questions or comments relating to the information above, please call me at (503) 587-0101, ext. 103.

Sincere regards,

REGISTERED PROFESSIONAL ENGINEER
18,573
OREGON
JULY 10, 1996
ADRIAN McJUNKIN
EXPIRES: 12/31/2022

Adrian McJunkin, PE
President