# MATANUSKA-SUSITNA BOROUGH

**Planning and Land Use Department**
**Development Services Division**
350 East Dahlia Avenue • Palmer, AK 99645
Phone (907) 861-7822 • Fax (907) 861-8158
Email: permitcenter@matsugov.us

RECEIVED
AUG 07 2024
Mat-Su Borough
Development Services

## APPLICATION FOR A TALL STRUCTURE – MSB 17.67

*Carefully read instructions and applicable borough code. Fill out forms completely. Attach information as needed. Incomplete applications will not be processed.*

Application fee must be attached:
X **$1,500** for **Conditional Use Permit** - > 125 feet in height
_____ **$ 500** for **Administrative Permit** – 85' to 125' in height
_____ **$ 100** for **Network Improvement Permit** – In accordance with MSB 17.67.110.

*Prior to the public hearing, the applicant must also pay the mailing and advertising fees associated with the application. Applicants will be provided with a statement of advertising and mailing charges. Payment must be made **prior** to the application presentation before the Borough Planning Commission or Planning Director decision.*

**Subject Property** Township: _____, Range: _____, Section: _____, Meridian____
MSB Tax Account # S16N10W13, S16N09W16, S16N09W29, S16N09W33, S16N09W32
SUBDIVISION: STATE OF ALASKA BLOCK(S): _____, LOT(S): S15N09W05
STREET ADDRESS: _____
(US Survey, Aliquot Part, Lat. /Long. etc) _____

**Ownership** A *written authorization by the owner must be attached for an agent or contact person, if the owner is using one for the application.* Is authorization attached? **x Yes o No o N/A**

**Name of Property Owner**
State of Alaska, DNR
Address: 550 7th Ave, 900c
Phne: Hm _____ Fax _____
Wk 907-269-5032 Cell _____
E-mail john.forbes@alaska.gov

**Name of Agent/ Contact for application**
Chad Allen, Little Mount Susitna Wind LLC
Address: 125 High St, 17th Floor High St
Suite 1705. Boston, MA 02110
Phne: Hm _____ Fax _____
Work 207-210-1175 Cell _____
E-mail _____

**Special Land Use District** *(if applicable)*: N/A

| **Pre-Application Requirements for New Tall Structures that Require a Conditional Use Permit** | |
|---|---|
| ***Prior to applying for a conditional use permit for a new tall structure, the applicant shall hold at least one community meeting.*** | |
| 1. The meeting shall be held at the nearest facility where community council meetings are regularly scheduled. If the facility is not available, the nearest available public facility that is capable of seating a minimum of 20 people shall be utilized. | |
| 2. The meeting shall be held at least 15 calendar days after mailing of the notification. | |
| 3. The meeting shall not start prior to 5:00 p.m. and no later than 7:00 p.m. | |
| 4. Notification of the meeting shall, at a minimum, include the following:<br>• Legal description and map of the general parcel, or parcels, within the coverage area under consideration for the telecommunication facility.<br>• Description of the proposed development including height, design, lighting, potential access to the site and proposed service.<br>• Date, time, and location of the informational meeting.<br>• Contact name, telephone number, and address of applicant.<br>• Comment form created by the borough that has a comment submittal deadline and provides options for submitting comments. | |
| 5. At a minimum, the notification area for the meeting shall include the following:<br>• Property owners within one-half mile of the parcels under consideration for the proposed tall structure.<br>• The nearest community council and any community council whose boundary is within 1200 feet of the parcels under consideration for the tall structure. | |
| ***A written report summarizing the results of the community meeting shall be prepared that includes the following information:*** | **Attached** |
| 1. Dates and locations of all meetings where citizens were invited to discuss the potential applicant's proposal. | X |
| 2. Content, dates mailed, and numbers of mailings, including letters, meeting notices, newsletters and other publications. | X |
| 3. Sign-in sheet(s) used at the meeting, that includes places for names, address, phone numbers and other contact information such as e-mail addresses. | X |
| 4. A list of residents, property owners, and interested parties who have requested in writing that they keep informed of the proposed development through notices, newsletters, or other written materials. | X |
| 5. The number of people who attended meetings. | X |
| 6. Copies of written comments received at the meeting. | X |
| 7. A certificate of mailing identifying all who were notified of the meeting. | X |
| 8. A written summary that addresses the following:<br>• The substance of the public's written concerns, issues, and problems.<br>• How the applicant has addressed, or intends to address, concerns, issues and problems expressed during the process.<br>• Concerns issues, and problems the applicant has not addressed or does not intend to address and why. | X |

| General application requirements for <u>Administrative</u> and <u>Conditional Use Permits</u> | Attached |
|---|---|
| 1. Design drawings for the proposed tall structure, drawn to scale, and certified by a registered engineer or architect. | X |
| 2. Citizen participation report *(if applying for a Conditional Use Permit)* | X |
| 3. Certified site plan *(As defined in MSB 17.125.010)* | X |
| 4. Copy of a determination of no hazard to air navigation from the Federal Aviation Administration. | X |
| 5. If breakpoint technology is intended to be utilized, a written statement specifying the height at which the engineered structural weakness will be located. | No breakpoint |

| In order to grant a <u>Conditional Use Permit</u> or <u>Administrative Permit</u> the Planning Commission or Planning Director must find that each of the following criteria has been met. Explain the following in detail: | Attached |
|---|---|
| 1. To the extent that is technically feasible and potentially available, the location of the tall structure is such that its negative effects on the visual and scenic resources of all surrounding properties have been minimized. | X |
| 2. Visibility of the tall structure from public parks, trails recognized within adopted MSB plans, and waterbodies has been minimized to the extent that is technically feasible and potentially available. | X |
| 3. The tall structure will not interfere with the approaches to any existing airport or airfield that are identified in the MSB Regional Aviation System Plan or by the Alaska State Aviation System Plan. | X |
| 4. That granting the permit will not be harmful to the public health, safety, convenience, and welfare. | X |

| Application requirements for a <u>Network Improvement Permit</u> | Attached |
|---|---|
| 1. A description of the proposed modifications to the telecommunication tower, including a description of the height, type, and lighting of the new or modified structure and the existing structure. | N/A |
| 2. A certified site *(as defined in MSB 17.125.010)* for purposes of setback verification. | N/A |
| 3. Design drawings for the proposed modified or new structure, drawn to scale, and certified by a registered engineer or architect. | N/A |

| In order to grant a <u>Network Improvement Permit</u> the Planning Director must find that each of the following criteria has been met. Explain the following in detail. | Attached |
|---|---|
| 1. The proposed development conforms to setback requirements of MSB 17.55. | N/A |
| 2. The telecommunication tower being extended was lawfully constructed at the time of application for a Network Improvement Permit. | N/A |
| 3. The proposed modification does not violate permit conditions of any valid permits that have been issued to the existing facility, provided that the condition being violated does not limit height of the structure. | N/A |

| **Operation Standards for New Tall Structures – Conditional Use Permit, Administrative Permit, and Network Improvement Permit** | **Attached** |
|---|---|
| 1. The equipment compound shall meet minimum setback distances from all property lines in accordance with MSB 17.55 | X |
| 2. Setbacks shall be determined from the dimensions of the entire lot, even though the tower may be located on lease areas within the lot. | X |
| 3. Adequate vehicle parking shall be provided on the subject property, outside of public use easements and rights-of-way to enable emergency vehicle access. No more than two spaces per provider shall be required. | X |
| 4. Information signs for the purpose of identifying the tower such as the antenna structure registration number required by the Federal Communications Commission, as well as the party responsible for the operation and maintenance of the facility shall be visibly posted at the equipment compound. | X |
| 5. If more than 220 volts are necessary for the operation of the facility, warning signs shall be located at the base of the facility and shall display in large, bold, high contrast letters the following: "HIGH VOLTAGE – DANGER". | N/A |
| 6. A 24-hour emergency contact number shall be visibly posted at the equipment compound. | X |
| 7. A fence or wall not less than six (6) feet in height with a secured gate shall be maintained around the base of the tower. | N/A |

| **Additional Standards for <u>Wind Energy Conversion Systems</u> (WECS) – In addition to the operations standards for new tall structures, the following standards shall apply to WECS** | **Attached** |
|---|---|
| 1. WECS shall be equipped with an automatic overspeed control device designed to protect the system form sustaining structural failure such as splintered or thrown blades and the overturning or breaking of towers due to an uncontrolled condition brought on by high winds. | N/A |
| 2. WECS shall have a manually operable method that assures the WECS can be brought to a safe condition in high winds. Acceptable methods include mechanical or hydraulic brakes or tailvane deflection systems which turn the rotor out of the wind. | N/A |

**OWNER'S STATEMENT:** I am owner of the following property:

MSB Tax parcel ID #(s) _____ and,
I hereby apply for approval conditional use permit on that property as described in this application.

I understand all activity must be conducted in compliance with all applicable standards of MSB _____ and with all other applicable borough, state or federal laws.

I understand that other rules such as local, state and federal regulations, covenants, plat notes, and deed restrictions may be applicable and other permits or authorization may be required. I understand that the borough may also impose conditions and safeguards designed to protect the public's health, safety and welfare and ensure the compatibility of the use with other adjacent uses.

I understand that it is my responsibility to identify and comply with all applicable rules and conditions, covenants, plat notes, and deed restrictions, including changes that may occur in such requirements.

I understand that this permit and zoning status may transfer to subsequent owners of this land and that it is my responsibility to disclose the requirements of this status to the buyer when I sell the land.

I understand that changes from the approved conditional use permit may require further authorization by the Borough Planning Commission. I understand that failure to provide applicable documentation of compliance with approved requirements, or violation of such requirements will nullify legal status, and may result in penalties.

I grant permission for borough staff members to enter onto the property as needed to process this application and monitor compliance. Such access will at a minimum, be allowed when the activity is occurring and, with prior notice, at other times necessary to monitor compliance.

The information submitted in this application is accurate and complete to the best of my knowledge.

| Signature: Property Owner | Printed Name | Date |
|---|---|---|
| Michael U. Alvarez | Michael U. Alvarez | 7/24/2024 |
| **Signature: Agent** | Printed Name | Date |

**MSB USE ONLY**

Date application submitted:

Date application determined complete: _____

## PERMIT CENTER – FEE RECEIPT FORM

Property Location: SOA Locations (DNR) Applicant: Little Mount Susitna Wind LLC

61.473061N, 150.988809W - 61.476704N, 150.895905W - 61.444640N, 150.927867W

61.429372N, 150.900878W

61.430890N, 150.916978W

61.421817N, 150.920003W

| | USE PERMITS (100.000.000.341.300) | Fee |
|---|---|---|
| | **8.35** Public Display of Fireworks | **$25.00** |
| | **8.40.010** Liquor License - Alcohol & Marijuana Control Office (AMCO) Referrals for Matanuska Susitna Borough Review of Issuance, renewal or transfer (location, owner) | **$100.00** |
| | **8.40.060** Liquor License Relocation | **$500.00** |
| | **8.41.010** Marijuana License - Alcohol & Marijuana Control Office (AMCO) Referrals for Matanuska Susitna Borough Review of Issuance, renewal or transfer (location, owner) | **$100.00** |
| | **8.52** Temporary Noise Permit | **$1000.00** |
| | **8.55** Special Events Permit<br>500 – 1000 Attendees<br>1000+ Attendees<br>**8.55** Special Events Permit Site Monitor Fee / Per Day | <br>**$500.00**<br>**$1,000.00**<br>**$300.00** |
| | **17.02** Mandatory Land Use Permits<br>Commercial | **$50.00** |
| | **17.04** Nancy Lake Special Land Use District CUP | **$1,500.00** |
| | **17.06** Electrical Generating & Delivery Facility Application | **$500.00** |
| | **17.08** Hay Flats Special Land Use District Exception Application | **$1000.00** |
| | **17.17** Denali State Park Conditional Use Permit | **$1500.00** |
| | **17.18** Chickaloon Special Land Use District CUP | **$1500.00** |
| | **17.19** Glacier View Special Land Use District CUP | **$1500.00** |
| | **17.23** Port MacKenzie Development Permit | **$1000.00** |
| | **17.25** Talkeetna Special Land Use CUP | **$1500.00** |
| | **17.25** Talkeetna Conditional Use Permit – Variance | **$1500.00** |
| | **17.27** Sutton Special Land Use District CUP | **$1500.00** |
| | **17.29** Flood Damage Prevention Development Permit | **$100.00** |
| | **17.29** Flood Damage Prevention Development Permit –Variance | **$500.00** |
| | **17.30.040** Earth Materials Extraction Admin. Permit | **$1000.00** |
| | **17.30.050** Earth Materials Extraction CUP | **$1500.00** |
| | **17.36** Residential Planned Unit Development<br>Application – Concept Plan – up to 50 Lots<br>Additional Lots or tracts being created – Per Lot | <br>**$500.00**<br>**$100.00** |
| | **17.48** Mobile Home Park Application | **$500.00** |
| | **17.52** Residential Land Use District App (Rezone) | **$1,000.00** |
| | **17.52** Residential Land Use District CUP | **$1,500.00** |
| | **17.55** Shoreline Setback Exception Application | **$300.00** |
| | **17.60** Conditional Use Permit Application | **$1500.00** |
| | **17.60** Transfer of Junkyard CUP | **$500.00** |

| | | |
|---|---|---|
| | **17.61** Commercial/Industrial Core Area Conditional Use Permit | **$1500.00** |
| | **17.62** Coal Bed Methane Conditional Use Permits | **$1500.00** |
| | **17.63** Racetracks Conditional Use Permit | **$1500.00** |
| | **17.64** Waste Incinerator Conditional Use Permit | |
| | **17.65** Variance | **$1500.00** |
| X | **17.67** Tall Structures - Network Improvement Permit<br>Nonconforming Use<br>Administrative Permit<br>Conditional Use Permit | **$100.00**<br>**$200.00**<br>**$500.00**<br>**$1500.00** |
| | **17.70** Regulation of Alcoholic Beverage Conditional Use Permit | **$1500.00** |
| | **17.73** Multi-Family Land Use Permit – add $25.00 for each additional unit beyond 5 units. | **$500.00** |
| | **17.75** Single-Family Residential Land Use District CUP | **$1500.00** |
| | **17.76** Large Lot Single-Family Residential Land Use District | **$1500.00** |
| | **17.80** Nonconforming Structures (Amnesty)<br>Pre-Existing Legal Nonconforming (Grandfather) | **$300.00**<br>**$300.00** |
| | **17.90** Regulation of Adult Businesses – Conditional Use Permit | **$1500.00** |
| | | |

| | | |
|---|---|---|
| | **RIGHT-OF-WAY FEES:** | |
| | Driveway | **$50.00** |
| ☐ | Driveway Deposit {100.226.100} | **$150.00** |
| | Construction | **$200.00** |
| | Utility (Application Fee = $100 ~ Distance Fee $0.25/per lineal foot) | |
| | Encroachment | **$150.00** |
| | Construction Bond {100.227.000} | |

| | | |
|---|---|---|
| | **PLATTING PRE-APPLICATION CONFERENCE:** | |
| | Pre-Application Fee | **$50.00** |

| | | |
|---|---|---|
| | **FEES:** | |
| | Flood Plain Development Survey CD | **$10.00** |
| | CD/DVD/DVD-R | **$7.50** |
| | Construction Manual/Title 43 | **$5.00** |
| | Plat Map/Tax Map Copies/Mylar | **$5.00** |
| | Color Maps | **$12.00** |
| | Xerox Copies (B/W = $0.25 ~ Color $1.00/page 11X17 Color $1.75/page) | |
| | Advertising Fees | |
| | Cultural Resources Books or Maps | |
| ☐ | Citation Payment (If sent to collections – use total due from Courtview) | |
| | Thumb Drive 8GB = $10; 16GB = $15; 32GB = $20 | |

$ 1,500.00 **Amount Paid** **Date:** 8/7/2024 **Receipt #** 020225318 **By:** S

check #001501

Revised: 11/28/23

Matanuska Susitna Borough

Payment Date Friday, August 9, 2024
Deposit Number 54394
Operator thom1274

Real 2024 (Total) $0.00
MCR (Planning/Platting) $1,500.00
Misc Rec
Tax Map # 2MISC

Total Paid $1,500.00
Check $1,500.00
Change $0.00

Receipt Number msb92022538
8/9/2024 10:19:09 AM
Paid By LONGROAD DEVELOPMENT CO
Cashier Id. thom1274

| | |
|---|---|
| **From:** | Faith Tyson |
| **To:** | Rick Benedict |
| **Cc:** | Matthew Perkins; Andrew McDonnell; Jeff Armbruster; Chad Allen |
| **Subject:** | Re: LMSW - Tall Tower CUP Application & Materials |
| **Date:** | Tuesday, August 27, 2024 11:17:23 AM |
| **Attachments:** | CUP Nearest Trail.png<br>20240701_NRG 60m Super XHD Std Footprint Met Towers_LMS 105 thru LMS 110_Alaska Drawings_S&S_070124_noparking.pdf<br>20240701_NRG 50m XHD Std Footprint Met Towers_LMS 105 thru LMS 110_Alaska Drawings_S&S_070124_noparking.pdf |

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[**EXTERNAL EMAIL** - CAUTION: Do not open unexpected attachments or links.]
Hi Rick,

Thanks for getting this over! Please find the responses below.

1. MSB 17.67.080(B)(2) requires the commission to consider whether the proposed towers will
be visible from public parks.
a. The application does not identify the nearest public park to the proposed towers, and/or whether any of the proposed towers will be visible from that park. Provide a narrative clarifying this subject.
Given the remote locations, the proposed towers are not expected to be visible from any Matanuska Susitna Borough public park (all more than 30 miles away). The nearest "trail" is on Mount Susitna, at a distance of 4.7 miles from the nearest proposed tower (see attached map). The towers may be marginally visible from these distances in weather and lighting conditions that offer excellent visibility, but given their small diameter and the distances involved, it is unlikely that a casual observer will notice them on the landscape.

2. MSB 17.67.090(B)(1) requires a minimum of two parking spaces for emergency vehicle access.
a. Two parking spaces are reflected on the provided site plans; however, the application narrative indicates that no parking will be provided due to the remoteness of the locations.
b. Remove the proposed parking spaces from the site plans and provide a narrative addressing how emergency vehicles and personnel can access the site.
The parking spaces have been removed, and updated site plans are attached. If emergency personnel are required on the tower sites, the sites can be accessed by helicopter. Landing sites are readily available on the open tundra adjacent to all towers. On-site personnel will be trained to direct emergency helicopters to an appropriate landing spot.

3. Provide a narrative detailing the timeline for the erection of each of the six proposed towers.
a. Explain whether the locations identified in the application are final or approximate.
b. If approximate, describe the maximum distance from each proposed tower location. It may help to provide a map identifying the radius of the area of consideration that will not exceed for the installation of each of the six proposed towers.

Under this permit, we plan to install up to six towers in total, with up to two of those installed in 2024, and any remaining towers in 2025. This schedule is approximate and may be subject to changes based on operational needs.

**Tower Locations:** The tower sites are approximate and will be finalized when taking into account ground conditions during the installation process. The towers may be sited anywhere within

their respective PLSS section boundaries, while respecting a one tower- height setback from the PLSS section boundaries. Visuals of the intended locations and the surrounding section boundaries within which the tower will be located are displayed in the engineer's site plans.

4. MSB 17.67.050(B) requires specific criteria be described in a written report in the application
submittal to summarize the results of the community meeting:
a. Summarize the public notification content, dates mailed, and numbers of mailings, including letters, meeting notices, newsletters, and other publications.
b. A list of residents, property owners, and interested parties who have requested in writing that they be kept informed of the proposed development through notices, newsletters, or other written materials.
c. A written summary that addresses the following:
i. The substance of the public's written concerns, issues, and problems.
ii. How the applicant has addressed, or intends to address, concerns, issues, and problems expressed during the process; and
iii. Concerns, issues, and problems
In the dropbox folder that was originally submitted, there is a subfolder titled Community Meeting Materials—the specific criteria of MSB 17.67.050(B) are addressed in the report.

If more questions arise, please feel free to reach out. Thank you!

/ft

On Thu, Aug 22, 2024 at 6:01 PM Rick Benedict <Rick.Benedict@matsugov.us> wrote:

> Good afternoon all,
>
> I have attached a request for additional information for you. If you have any questions, please contact me.
>
> Respectfully,
>
> Rick Benedict – Current Planner
>
> Development Services Division
>
> Matanuska-Susitna Borough
>
> (907)861-8527 direct

**From:** Faith Tyson <faith@alaskarenewables.com>
**Sent:** Wednesday, August 7, 2024 9:54 AM
**To:** Rick Benedict <Rick.Benedict@matsugov.us>
**Cc:** Peggy Horton <Peggy.Horton@matsugov.us>; Chad Allen <chad.allen@longroadenergy.com>; Andrew McDonnell <andrew@alaskarenewables.com>; Jeff Armbruster <jeff.armbruster@longroadenergy.com>; Matthew Perkins <matt@alaskarenewables.com>
**Subject:** Re: LMSW - Tall Tower CUP Application & Materials

[**EXTERNAL EMAIL** - CAUTION: Do not open unexpected attachments or links.]

Goodmorning Rick, happy Wednesday!

I wanted to reach out to you and let you know that the check was mailed from the PNW last Friday. The check number is 1501, and it is from Longroad Development Company. Could you confirm that you've received it?

Additionally, I wanted to follow up and see if you would be interested in meeting to review the application in depth with us. If so, please send some dates and times that work for you in the next week or so.

Talk soon!

/ft

On Tue, Jul 30, 2024 at 10:52 AM Faith Tyson <faith@alaskarenewables.com> wrote:

> Hi Rick!
>
> Happy Tuesday. The application was paid by check - the purchase order was just approved, so the check will be mailed on Thursday!

Best,

Faith

/ft

On Mon, Jul 29, 2024 at 12:49 PM Rick Benedict <Rick.Benedict@matsugov.us> wrote:

Hello Faith,

How was the application fee paid? I don't see a payment in our transaction history for online payments. If paid through the Borough's online portal, do you know who made the payment, the date, and the amount? I will conduct another search once I have more information.

Respectfully,

Rick Benedict – Current Planner

Development Services Division

Matanuska-Susitna Borough

(907)861-8527 direct

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**From:** Faith Tyson <faith@alaskarenewables.com>
**Sent:** Thursday, July 25, 2024 1:54 PM
**To:** Peggy Horton <Peggy.Horton@matsugov.us>; Rick Benedict <Rick.Benedict@matsugov.us>
**Cc:** Chad Allen <chad.allen@longroadenergy.com>; Andrew McDonnell <andrew@alaskarenewables.com>; Jeff Armbruster <jeff.armbruster@longroadenergy.com>; Matthew Perkins <matt@alaskarenewables.com>
**Subject:** LMSW - Tall Tower CUP Application & Materials

[**EXTERNAL EMAIL** - CAUTION: Do not open unexpected attachments or links.]

Dear Peggy & Rick,

I am writing you to officially submit a Tall Tower CUP application on behalf of Little Mount Susitna Wind LLC. Due to the size of files, I have compiled all documents in a dropbox link for download. The application fee was processed on our end as of yesterday. Please reach out with any questions or concerns. We are looking forward to working with you all!

Best,

**Faith Tyson (she/they)**

Community Engagement and Accountability Manager

Alaska Renewables LLC

[c] +1-907-202-0507 [e] faith@alaskarenewables.com

Alaska Renewables LLC occupies the ancestral, traditional, and contemporary lands of Alaska Native people that have resided, occupied, and called this land home. I recognize the historic Indigenous individuals and communities who live here now and those who were forcibly removed from their homes. In offering this land acknowledgement, I affirm Indigenous sovereignty, history and experiences.

# Conditional Use Permit Request for Remote Meteorological Towers on Little Mount Susitna

Little Mount Susitna Wind LLC

Little Mount Susitna Wind LLC seeks a Conditional Use Permit for up to six temporary meteorological tower installations at sites on a remote plateau (Little Mount Susitna) in the far southwest corner of the Matanuska Susitna Borough. The purpose of these installations is to allow for the quantitative assessment of the wind resources in order to enable the development of a future utility-scale wind energy generation project that would provide reliable, low-cost renewable energy to Southcentral Alaska.

Proposed Locations:

| Site Name | Lat/Lon (WGS84) | Elevation (ft) | MTRS |
|---|---|---|---|
| LMS_Met_5 | 61.473061N, 150.988809W | 2466 | S016N010W13 |
| LMS_Met_6 | 61.476704N, 150.895905W | 2200 | S016N009W16 |
| LMS_Met_7 | 61.444640N, 150.927867W | 2339 | S016N009W29 |
| LMS_Met_8 | 61.429372N, 150.900878W | 1934 | S016N009W33 |
| LMS_Met_9 | 61.430890N, 150.916978W | 2037 | S016N009W32 |
| LMS_Met_10 | 61.421817N, 150.928003W | 1903 | S015N009W05 |

The meteorological towers will each consist of a Super 60m XHD TallTower manufactured by NRG Systems consisting of 8-10 inch diameter tube sections and six levels of supporting guy wires. The tower has FAA-compliant industrial paint, guy guards, and marker balls. Because it is below the 200 ft height requirement for FAA lighting, the tower does not have a light on it. This tower model is designed for the wind resource assessment industry and is engineered specifically for harsh climates like Alaska with wind and ice load limits that meet the ANSI/TIA-222-G Standard.

Little Mount Susitna Wind LLC has engaged a number of experts including NRG Systems (tower manufacturer), RESPEC (engineering feasibility and design), Northern Geotechnical Engineering (anchoring geotechnical assessment), Alaska Line Builders (anchor and tower installation), V3 Energy LLC and Lou Bowers (meteorological consultants), and KB Energy (qualified NRG Super-60 installer), as well as a number of Mat-Su based helicopter operators including Heli Alaska, Soloy, Pollux, and Northern Pioneer in order to ensure a safe, well-designed, and reliable meteorological tower installation at this challenging and remote location.

A stamped engineering analysis and report is attached, along with the required site plans, all stamped by an engineer authorized to do so in Alaska.

The tower sites are located on lands managed by the State of Alaska. The tower installations were permitted by the Department of Natural Resources under LAS 34057.

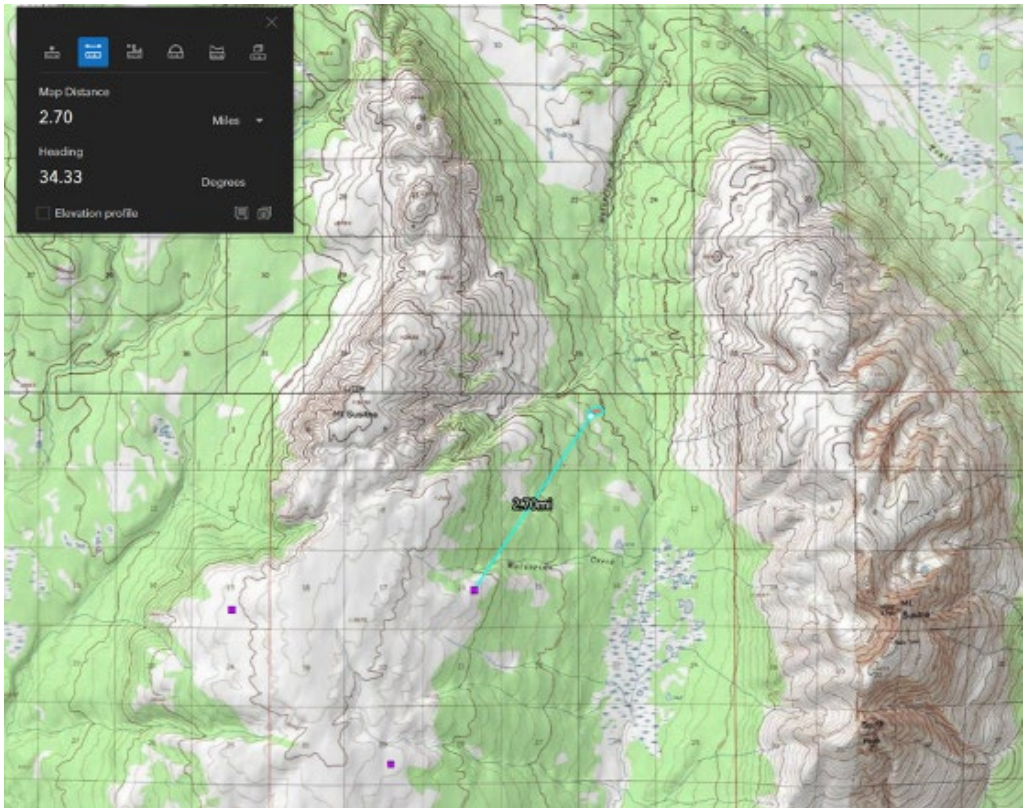
The Conditional Use Permit for Tall Towers requires a pre-application community meeting to be held at the facility where community council meetings are held. Notifications for the meeting are required to be delivered to property owners within one-half mile of the tower site and the nearest community council and any community council whose boundary is within 1200 feet of the tower site. The tower sites are over 2.75 miles from the nearest private parcel, and 19 miles from the nearest active community council (Willow) boundary. Using the contact information provided by MSB, we notified the nearest land owners.

The community meeting was held on June 3rd, 2024 at 5:30 pm. The gathering took place at the Willow Area Community Center, located at 69 Parks Highway, Willow, AK 99688. The written report is attached.

**Responses to Specific Criteria:**

1. To the extent that is technically feasible and potentially available, the location of the tall structures is such that its negative effects on the visual and scenic resources of all surrounding properties have been minimized.

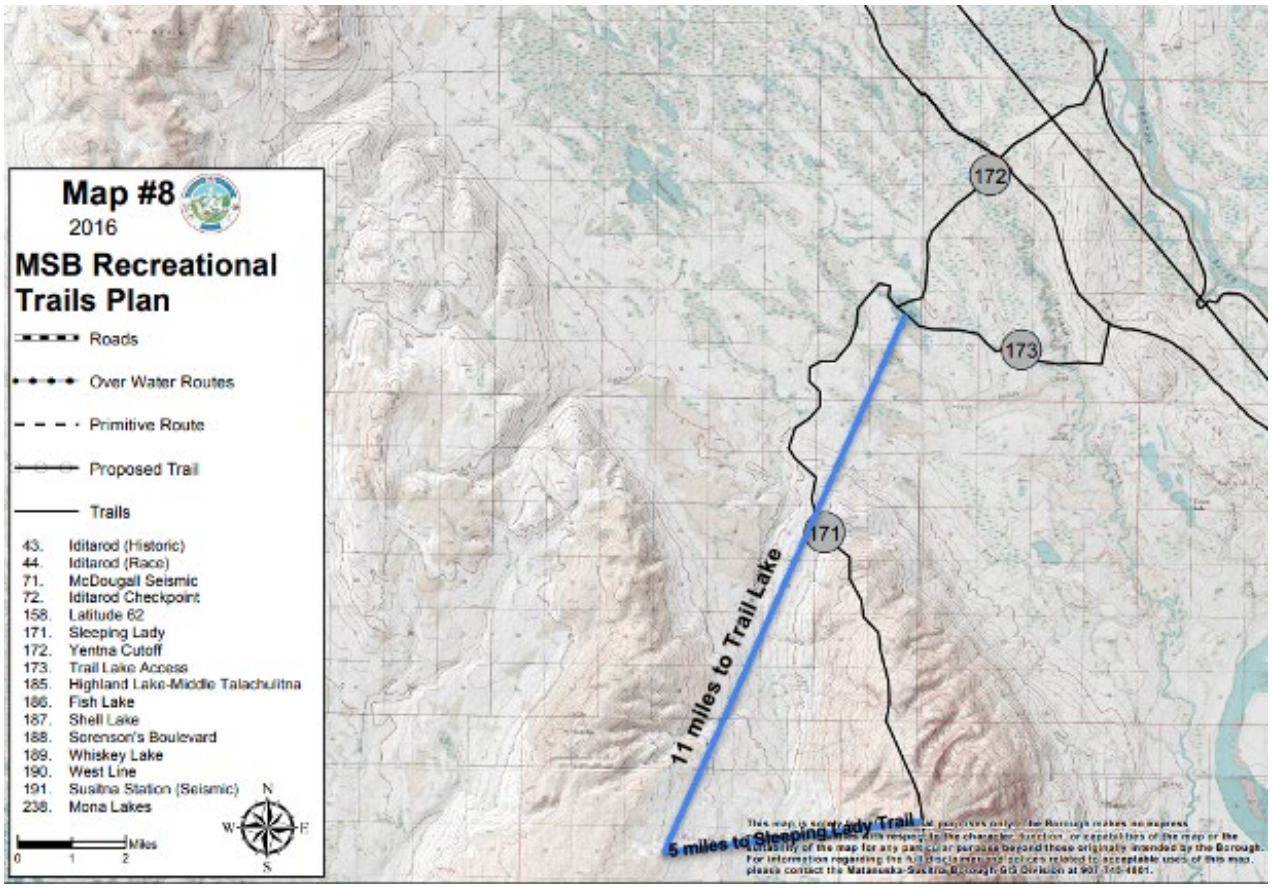
The towers are not expected to have any significant visual impacts for surrounding properties. The nearest property is 2.7 miles away from the northernmost tower site, and is not expected to be visible from this location. One tower may be visible from Trail Lake at a distance of over 11 miles.




2. Visibility of the tall structure from public parks, trails recognized within adopted MSB

plans, and waterbodies has been minimized to the extent that is technically feasible and potentially available.

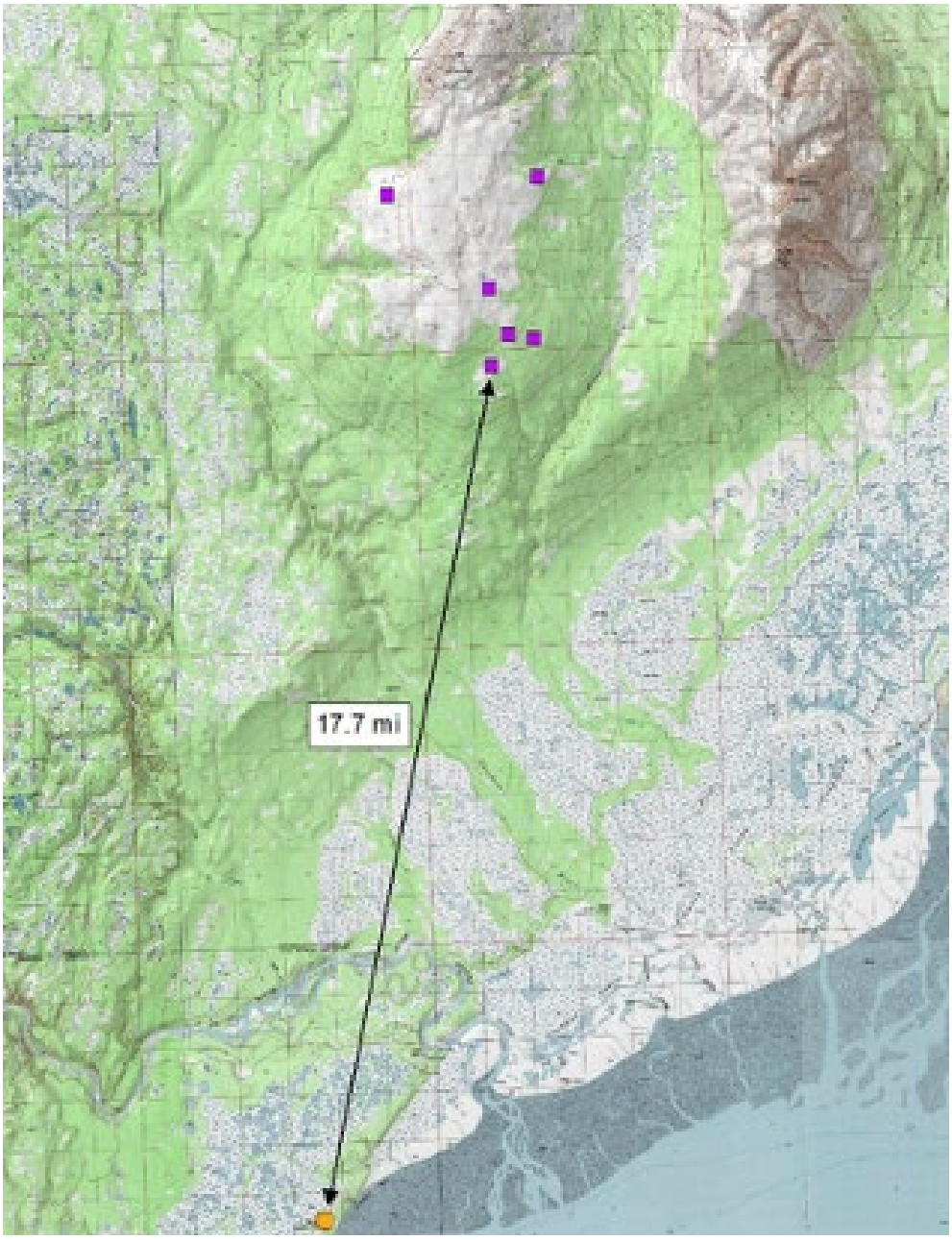
Given that the tower diameter is only 8-10 inches, but does carry high visibility paint and marker balls for aviation safety, the tower is estimated to be visible to casual observers at distances up to approximately 5 miles. Given this, the towers are not expected to have any visual impacts for any public parks, trails, or waterbodies, as there are none within this range of visibility for these remote towers.




Map illustrating the distances of 5 miles and 11 miles from the northernmost tower location to the nearest trail (Sleeping Lady  and named lake (Trail Lake), respectively.

3. The tall structure will not interfere with the approaches to any existing airport or airfield that are identified in the MSB Regional Aviation System Plan or by the Alaska State Aviation System Plan.

There are no nearby airfields and the tower installations are outside of the study area for the MSB Regional Aviation System Plan. The tower sites and specifications were evaluated with the FAA Notice Criteria Tool which found that the structure does not exceed notice criteria.




The nearest airport is the Beluga, 17.77 miles away from the nearest proposed meteorological tower.

4. That granting the permit will not be harmful to the public health, safety, convenience, and welfare.

Given the remote nature of the towers, very few members of the public will even be aware that the towers exist. They will not be harmful to public health, safety, convenience or welfare, especially given their remote nature. The most relevant impact is for remote bush pilots that will have to avoid the tower if navigating in the area of Little Mount Susitna. For these purposes, the

tower and its guy wires have been marked with FAA compliant paint, guy guards, and marker balls.

At the base of the towers there will be a power supply shelter that will hold power supply electronics (PV modules, batteries, methanol or propane fuel cell, and data logger box) that will be fenced and locked with a padlock. Contact information markings will be added to the power supply shelter and tower.

No parking will be provided due to the remote nature of the locations.

Attached are other supporting documents such as the DNR Land Use Permit, Written Community Meeting Report, Site Drawings, Maps, and others.

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Natural Resources

DIVISION OF MINING, LAND & WATER
Southcentral Regional Land Office

550 W. 7th Ave., Suite 900C
Anchorage, Alaska 99501-3577
Main: (907) 269-8503
TTY: 711 or 880.770.8973
Fax: (907) 269-8913

**LAND USE PERMIT**
**AS 38.05.850**

**PERMIT # LAS 34057**

Little Mount Susitna Wind LLC herein known as the Grantee, is issued this permit from the Department of Natural Resources, herein known as the Grantor, authorizing the use of state land within:

**Legal Description:**

- LMS_101: Section 19, Township 16 North, Range 9 West, Seward Meridian 61.4639N, 150.9664W
- LMS_102: Section 8, Township 16 North, Range 9 West, Seward Meridian 61.4863N, 150.9399W
- LMS_103: Section 32, Township 17 North, Range 9 West, Seward Meridian 61.5134N, 150.9352W
- LMS_104: Section 25, Township 16 North, Range 10 West, Seward Meridian 61.4434N, 150.9928W
- LMS_105: Section 13, Township 16 North, Range 10 West, Seward Meridian 61.473061N, 150.988809W
- LMS_106: Section 16, Township 16 North, Range 9 West, Seward Meridian 61.476704N, 150.895905W
- LMS_107: Section 29, Township 16 North, Range 9 West, Seward Meridian 61.444640N, 150.927867W
- LMS_108: Section 33, Township 16 North, Range 9 West, Seward Meridian 61.429372N, 150.900878W
- LMS_109: Section 32, Township 16 North, Range 9 West, Seward Meridian 61.430890N, 150.916978W
- LMS_110: Section 5, Township 15 North, Range 9 West, Seward Meridian 61.421817N, 150.928003W

**This permit is issued for the purpose of authorizing the following:**

The temporary placement of up to ten meteorological towers (met towers) on state lands atop Little Mount Susitna to gather meteorological data and on-site wind conditions. Each tower is between 60 - 80 meters in height and is supported by three sets of guy wires at different intervals. Each tower and co-located LIDAR unit requires a footprint of up to five acres. Brush clearing will be kept to a minimum, but would not exceed five acres at each site.

This permit is for the term beginning **June 15, 2022** and ending **June 14, 2027** unless sooner terminated at the state's discretion, effective the date of signature by the Authorized State Representative. This permit does not convey an interest in state land and as such is revocable, with or without cause. The Grantor will give 30 days' notice before revoking a permit at will. A revocation for cause is effective immediately. No preference right for use or conveyance of the land is granted or implied by this authorization.

This permit is issued subject to the following:

- Remittance of a performance guaranty in the amount of $5,000.00 as required in the stipulations below.
- Proof of insurance as described in stipulations below.
- Payment of the annual use fee in the amount of $1,560.00 per each 5-acre met-tower site, due on or before the annual anniversary date and any additional fees identified in the stipulations below.

The non-receipt of a courtesy billing notice does not relieve the Grantee from the responsibility of paying fees on or before the due date.

All activities shall be conducted in accordance with the following stipulations:

1. **Authorized Officer:** The Authorized Officer (AO) for the State of Alaska (State), Department of Natural Resources (DNR), Division of Mining, Land and Water (DMLW), is the Regional Manager or designee.

2. **Change of Contact Information:** The Grantee shall maintain current contact information with the AO. Any change of contact information must be submitted in writing to the AO.

3. **Valid Existing Rights:** This authorization is subject to all valid existing rights and reservations in and to the authorized area. The State makes no representations or warranties, whatsoever, either expressed or implied, as to the existence, number, or nature of such valid existing rights.

4. **Preference Right:** No preference right for subsequent authorizations is granted or implied by this authorization.

5. **Inspections:** The AO shall have reasonable access to the authorized area for inspection, which may be conducted without prior notice. If the Grantee is found to be in noncompliance the authorized area may be subject to reinspection. The Grantee may be charged for actual expenses of any inspection.

6. **Public Access:** The construction, operation, use, and maintenance of the authorized area shall not interfere with public use of roads, trails, waters, landing areas, and public access easements. The ability to use or access state land or public waters may not be restricted in any manner. However, if a specific activity poses a safety concern, the AO may allow the restriction of public access for a specific period of time. The Grantee is required to contact the AO in advance for approval. No restriction is allowed unless specifically authorized in writing by the AO.

7. **Public Trust Doctrine:** This authorization is subject to the principles of the Public Trust Doctrine regarding navigable or public waters which guarantees public access to, and the public right to use, navigable and public waters and the land beneath them for navigation, commerce, fishing, and other purposes. The AO reserves the right to grant other interests consistent with the Public Trust Doctrine.

8. **Alaska Historic Preservation Act:** The Alaska Historic Preservation Act, AS 41.35.200, prohibits the appropriation, excavation, removal, injury, or destruction of any state owned historic, prehistoric, archaeological or paleontological site without written approval from the DNR Commissioner. Should any sites be discovered, the Grantee shall cease any activities that may cause damage and immediately contact the AO and the Office of History and Archaeology in the Division of Parks and Recreation.

9. **Compliance with Government Requirements:** The Grantee shall, at its expense, comply with all federal, state, and local laws, regulations, and ordinances directly or indirectly related to this authorization. The Grantee shall ensure compliance by its employees, agents, contractors, subcontractors, licensees, or invitees.

10. **Incurred Expenses:** The Grantor shall in no way be held liable for expenses incurred by the Grantee connected with the activities directly or indirectly related to this authorization.

11. **Waiver of Forbearance:** Any failure on the part of the AO to enforce the terms of this authorization, or the waiver of any right under this authorization by the Grantee, unless in writing, shall not discharge or invalidate the authorization of such terms. No forbearance or written waiver affects the right of the AO to enforce any terms in the event of any subsequent violations of terms of this authorization.

12. **Severability Clause:** If any clause or provision of this authorization is, in a final judicial proceeding, determined illegal, invalid, or unenforceable under present or future laws, then the Grantor and the Grantee agree that the remainder of this authorization will not be affected, and in lieu of each clause or provision of this authorization that is illegal, invalid, or unenforceable, there will be added as a part of this authorization a clause or provision as similar in terms to the illegal, invalid, or unenforceable clause or provision as may be possible, legal, valid, and enforceable.

13. **Permit Extensions/Reissuance:** Any request for permit extension or reissuance should be submitted at least 90 days prior to the end of the authorized term. A written statement requesting a one-year extension confirming there will be no changes to the development/operations plan, including photographs clearly depicting the current condition of the site and any improvements, must be submitted to the AO with any required filing fee. A new Land Use Permit application and any required filing fee is required when requesting reissuance of up to five years or for modifications to the approved development/operations plan on file with DMLW.

14. **Assignment:** This permit may not be transferred or assigned.

15. **Reservation of Rights:**
    a. The AO reserves the right to grant additional authorizations to third parties for compatible uses on or adjacent to the land under this authorization.

b. Authorized concurrent users of state land, their agents, employees, contractors, subcontractors, and licensees, shall not interfere with the operation or maintenance activities of each user.
c. The AO may require authorized concurrent users of state land to enter into an equitable operation or maintenance agreement.

16. **Violations:** A violation of this authorization is subject to any action available to the State for enforcement and remedies, including revocation of the permit, civil action for forcible entry and detainer, ejectment, trespass, damages, and associated costs, or arrest and prosecution for criminal trespass in the second degree. The State may seek damages available under a civil action, including restoration damages, compensatory damages, and treble damages under AS 09.45.730 or AS 09.45.735 for violations involving injuring or removing trees or shrubs, gathering geotechnical data, or taking mineral resources.

17. **Directives:** Directives may be issued for corrective actions that are required to correct a deviation from design criteria, project specifications, stipulations, State statutes or regulations. Work at the area subject to the Directive may continue while implementing the corrective action. Corrective action may include halting or avoiding specific conduct, implementing alternative measures, repairing any damage to state resources that may have resulted from the conduct, or other action as determined by DNR.

18. **Stop Work Orders:** Stop Work Orders may be issued if there is a deviation from design criteria, project specifications, stipulations, State statutes or regulations and that deviation is causing or is likely to cause significant damage to state resources. Under a Stop Work Order, work at the area subject to the Stop Work Order may not resume until the deviation is cured and corrective action is taken. Corrective action may include halting or avoiding specific conduct, implementing alternative measures, repairing any damage to state resources that may have resulted from the conduct, or other action as determined by DNR.

19. **Notification of Discharge:** Notification of Discharge: The Grantee shall immediately notify the Department of Environmental Conservation (DEC) and AO of any unauthorized discharge of oil to water, any discharge of hazardous substances (other than oil), and any discharge of oil greater than 55 gallons on land. All fires and explosions must also be reported immediately. If a discharge, including a cumulative discharge, of oil is greater than 10 gallons but less than 55 gallons, or a discharge of oil greater than 55 gallons is made to an impermeable secondary containment area, the Grantee shall report the discharge within 48 hours. Any discharge of oil greater than one gallon up to 10 gallons, including a cumulative discharge, solely to land, must be reported in writing on a monthly basis.
Notification of discharge during normal business hours must be made to the nearest DEC Area Response Team: Anchorage (907) 269-3063, fax (907) 269-7648; Fairbanks (907) 451-2121, fax (907) 451-2362; Juneau (907) 465-5340, fax (907) 465-5245. To report a spill outside of normal business hours, call toll free 1-800-478-9300 or international 1-907-269-0667.
Notification of discharge must be made to the appropriate DNR Office, preferably by e-mail: Anchorage email dnr.scro.spill@alaska.gov, (907) 269-8528; Fairbanks email dnr.nro.spill@alaska.gov, (907) 451-2739; Juneau email sero@alaska.gov, (907) 465-3513. The Grantee shall supply the AO with all incident reports submitted to DEC.

20. **Batteries:** Batteries which contain hazardous liquids should be completely sealed valve regulated, spill-proof, leak-proof and mounted in an appropriate container. Batteries lacking the preceding properties must have an appropriate drip pan designed to hold 110% of the total

liquids held by the battery/batteries. Batteries, new or used, may not be stored or warehoused. Any battery/batteries that are not in use must be removed and disposed of in accordance with existing federal, state and local laws, regulations and ordinances. All hazardous material containers shall be marked with the Grantee's or contractor's name, dated, and transported in accordance with 49 CRF 172 (EPA Hazardous Material Regulations) and 18 AAC 62.

21. **Returned Check Penalty:** A returned check penalty of $50.00 will be charged for any check on which the bank refuses payment. Late payment penalties shall continue to accrue.

22. **Late Payment Penalty Charges:** The Grantee shall pay a fee for any late payment. The amount is the greater of either $50.00 or interest accrued daily at the rate of 10.5% per annum and will be assessed on each past-due payment until paid in full.

23. **Use Fees:** The Grantee shall pay to DMLW an annual use fee of $1,560.00 for each tower deployed. The use fee is due on or before the annual anniversary of the effective date of this permit without the necessity of any billing by DMLW. The annual use fee is subject to adjustments in any relevant fee schedule.

24. **Request for Information:** The AO, at any time, may require the Grantee to provide any information directly or indirectly related to this authorization, in a manner prescribed by the AO.

25. **Completion Report:** A completion report shall be submitted prior to relinquishment, or within 30 days after expiration or termination of the authorization. Failure to submit a satisfactory report subjects the site to a field inspection requirement for which the Grantee may be assessed an inspection fee, as outlined herein. The report shall contain the following information:
    a. a statement of restoration activities and methods of debris disposal;
    b. a statement that the Grantee has removed all improvements and personal property from the authorized area;
    c. a report covering any known incidents of damage to the vegetative mat and underlying substrate, and follow-up corrective actions that may have taken place while operating under this authorization;
    d. and, photographs of the permitted site taken before, during and after the proposed activity to document permit compliance. Photographs must consist of a series of aerial view or ground-level view photographs that clearly depict compliance with site cleanup and restoration guidelines;

26. **Site Disturbance:** Site disturbance shall be kept to a minimum to protect local habitats. All activities at the site shall be conducted in a manner that will minimize the disturbance of soil and vegetation and changes in the character of natural drainage systems.
    a. Brush clearing is allowed but should be kept to the minimum necessary. Removal or destruction of the vegetative mat is not authorized under this permit.
    b. Establishment of, or improvements to, landing areas (i.e. leveling the ground or removing or modifying a substantial amount of vegetation) is prohibited.
    c. Attention must be paid to prevent pollution and siltation of streams, lakes, ponds, wetlands, and disturbances to fish and wildlife habitat.
    d. Any ground disturbances which may have occurred shall be contoured to blend with the natural topography to protect human and wildlife health and safety.

27. **Site Restoration:** On or before permit expiration (if a reissuance application has not been submitted) or termination of this authorization by the Grantee, the Grantee shall remove all improvements, personal property, and other chattels, and return the permitted area to a clean and safe condition. In the event the Grantee fails to comply with this requirement, the Grantee shall be held liable for any and all costs incurred by the State to return the permitted area to a clean and safe condition.

28. **Ground Disturbance Restoration:** The Grantee shall immediately restore areas where soil has been disturbed, or the vegetative mat has been damaged or destroyed. Restoration shall be accomplished in accordance with the directives of the DNR Plant Materials Center, 5310 S. Bodenburg Road, Palmer, AK 99645, (907) 745-4469. All rehabilitation shall be completed to the satisfaction of the AO.

29. **Indemnification:** The Grantee assumes all responsibility, risk and liability for its activities and those of its employees, agents, contractors, subcontractors, licensees, or invitees, directly or indirectly related to this permit, including environmental and hazardous substance risk and liability, whether accruing during or after the term of this permit. The Grantee shall defend, indemnify, and hold harmless the State, its agents and employees, from and against any and all suits, claims, actions, losses, costs, penalties, and damages of whatever kind or nature, including all attorney's fees and litigation costs, arising out of , in connection with, or incident to any act or omission by the Grantee, its employees, agents, contractors, subcontractors, licensees, or invitees, unless the proximate cause of the injury or damage is the sole negligence or willful misconduct of the State or a person acting on the State's behalf. Within 15 days, the Grantee shall accept any such cause, action or proceeding upon tender by the State. This indemnification shall survive the termination of the permit.

30. **Insurance:** Pursuant to 11 AAC 96.065 the Grantee shall secure or purchase at its own expense, and maintain in force at all times during the term of this permit, liability coverage and limits consistent with what is professionally recommended as adequate to protect the Grantee (the insured) and Grantor (the State, its officers, agents and employees) from the liability exposures of ALL the insured's operations on state land. Certificates of Insurance must be furnished to the AO prior to the issuance of this permit and must provide for a notice of cancellation, non-renewal, or material change of conditions in accordance with policy provisions. The Grantee must provide for a 60-day prior notice to the State before they cancel, not renew or make material changes to conditions to the policy. Failure to furnish satisfactory evidence of insurance, or lapse of the policy, are material breaches of this permit and shall be grounds, at the option of the State, for termination of the permit. All insurance policies shall comply with, and be issued by, insurers licensed to transact the business of insurance under Alaska Statute, Title 21. The policy shall be written on an "occurrence" form and shall not be written as a "claims-made" form unless specifically reviewed and agreed to by the Division of Risk Management, Department of Administration. The State must be named as an additional named insured on the policy with respect to the operations of the Grantee on or in conjunction with the permitted premises, referred to as LAS 34057.

31. **Performance Guaranty:** Pursuant to 11 AAC 96.060, the Grantee shall provide a surety bond or other form of security acceptable to the DMLW in the amount of $5,000.00 payable to the State of Alaska. Such performance guaranty shall remain in effect for the term of this authorization and shall secure performance of the Grantee's obligations hereunder. The amount of the performance guaranty may be adjusted by the AO in the event of approved amendments to this authorization, changes in the development plan, or any change in the

activities or operations conducted on the premises. The guaranty may be utilized by the State to cover actual costs incurred by the State to pay for any necessary corrective actions in the event the Grantee does not comply with the site utilization, restoration requirements and other stipulations contained in this permit agreement. If the Grantee fails to perform the obligations under this permit within a reasonable timeframe, the State may perform the Grantee's obligations at the Grantee's expense. The Grantee agrees to pay within 20 days following demand, all costs and expenses incurred by the State as a result of the failure of the Grantee to comply with the terms and conditions of this permit. Failure to do so may result in the termination of an authorization and/or forfeiture of the performance guaranty. The provisions of this permit shall not prejudice the State's right to obtain a remedy under any law or regulation. If the AO determines that the Grantee has satisfied the terms and conditions of this authorization, the performance guaranty will be subject to release. The performance guaranty may only be released in writing by the AO.

32. **Fuel and Hazardous Substances:** No fuel or hazardous substances may be stored on state land.

33. **Fuel and Hazardous Substances:**
    a. The use and/or storage of hazardous substances by the Grantee must be done in accordance with existing federal, state and local laws, regulations and ordinances. Debris (such as soil) contaminated with used motor oil, solvents, or other chemicals may be classified as a hazardous substance and must be removed and disposed of in accordance with existing federal, state and local laws, regulations and ordinances.
    b. Drip pans and materials, such as sorbent pads, must be on hand to contain and clean up spills from any transfer or handling of fuel.
    c. Vehicle refueling shall not occur within the annual floodplain or tidelands. This restriction does not apply to water-borne vessels provided no more than 30 gallons of fuel are transferred at any given time.
    d. During equipment maintenance operations, the site shall be protected from leaking or dripping hazardous substances or fuel. The Grantee shall place drip pans or other surface liners designed to catch and hold fluids under the equipment or develop a maintenance area by using an impermeable liner or other suitable containment mechanism. Secondary containment shall be provided for fuel or hazardous substances. All fuel and hazardous substance containers shall be inspected for defects and marked with the contents and the Grantee's name using paint or a permanent label. Secondary containment shall be provided for fuel or hazardous substances. All fuel and hazardous substance containers shall be marked with the contents and the Grantee's name using paint or a permanent label.

34. **Fuel and Hazardous Substance Storage:**
    a. The storage of petroleum products below Ordinary High Water (OHW) or Mean High Water Mark (MHWM) is prohibited.
    b. Fuel containers which exceed a total combined capacity of 110 gallons must be stored within an impermeable diked area or portable impermeable containment structure capable of containing 110 percent (115 Percent in the Aleutians West CRSA) capacity of the largest independent container (plus 12 inches of freeboard in the Kenai Peninsula Coastal District and Aleutians West CRSA).
    c. Fuel storage containers, including flow test holding tanks and hazardous substances, with a total combined capacity larger than 55 gallons shall not be placed within 100

feet (500 feet in the Bering Straits CRSA) from the ordinary high water mark of waterbodies.

d. All fuel storage containers and associated materials must be removed by the permit expiration date.
e. Secondary containment shall be provided for fuel or hazardous substances.
f. All fuel and hazardous substance containers shall be marked with the contents and the permittee's name using paint or a permanent label.
g. The AO may under unique or special circumstances grant exceptions to this stipulation on a case-by-case basis. Requests for exceptions should be made to the AO.
h. Definitions.
    i. Containers means any item which is used to hold fuel or hazardous substances. This includes tanks, drums, double-walled tanks, portable testing facilities, fuel tanks on small equipment such as light plants and generators, flow test holding tanks, slop oil tanks, bladders, and bags. Manifolded tanks or any tanks in a series must be considered as single independent containers. Vehicles, including mobile seismic tanks, are not intended to be included under this definition.
    ii. Hazardous substances are defined under AS 46.03.826(5) as (a) an element or compound which, when it enters the atmosphere, water, or land, presents an imminent and substantial danger to the public health or welfare, including fish, animals, or vegetation; (b) oil; or (c) a substance defined as a hazardous substance under 42 U.S.C. 9601(14).
    iii. Secondary containment means an impermeable diked area or portable impermeable containment structure capable of containing 110 percent of the volume of the largest independent container. Double-walled tanks do not qualify as secondary containment unless an exception is granted for a particular tank. All piping and manifolds shall be within secondary containment.
    iv. Surface liner means any safe, non-permeable container (e.g., drips pans, fold-a-tanks, etc.) designed to catch and hold fluids for the purpose of preventing spills. Surface liners should be of adequate size and volume based on worst-case spill risk.

**35. Waste Disposal:** On-site refuse disposal is prohibited, unless specifically authorized. All waste generated during operation, maintenance, and termination activities under this authorization shall be removed and disposed of at an off-site DEC approved disposal facility. Waste, in this paragraph, means all discarded matter, including but not limited to human waste, trash, garbage, refuse, oil drums, petroleum products, ashes and discarded equipment.

**36. Wastewater Disposal:** No pit privies are authorized.

**37. Solid Waste:**

a. All solid waste and debris, including dog waste, generated from the activities conducted under this authorization shall be removed to a facility approved by DEC on a regular basis such that the premise be maintained to ensure a healthy and safe environment.
b. Putrescible waste (waste that can decompose and cause obnoxious odor) shall be stored in a manner that prevents the attraction of or access to wildlife or disease vectors; and

c. Paper products may be burned on site if measures (e.g. burn barrels, clearing of burn area to mineral soil) are taken to prevent wildfires.

38. **Destruction of Markers:** The Grantee shall protect all survey monuments, witness corners, reference monuments, mining claim posts, bearing trees, and unsurveyed corner posts against damage, destruction, or obliteration. The Grantee shall notify the AO of any damaged, destroyed, or obliterated markers and shall reestablish the markers at the Grantee's expense in accordance with accepted survey practices of the DMLW.

39. **Site Maintenance:** The authorized area shall be maintained in a neat, clean, and safe condition, free of any solid waste, debris, or litter, except as specifically authorized herein. Nothing may be stored that would be an attractive nuisance to wildlife or create a potentially hazardous situation.

40. **Maintenance of Improvements:** The Grantor is not responsible for maintenance of authorized improvements or liable for injuries or damages related to those improvements. No action or inaction of the Grantor is to be construed as assumption of responsibility.

41. **Amendment or Modification:** The Grantee may request an amendment or modification of this authorization; the Grantee's request must be in writing. Any amendment or modification must be approved by the AO in advance and may require additional fees and changes to the terms of this authorization.

42. **Development Plan:** Development shall be limited to the authorized area and improvements specified in the approved development plan or subsequent modifications approved by the AO. The Grantee is responsible for accurately siting development and operations within the authorized area. Any proposed revisions to the development plan must be approved in writing by the AO before the change in use or development occurs.

43. **Proper Location:** This authorization is for activities on state lands or interests managed by DMLW. It does not authorize any activities on private, federal, native, and municipal lands, or lands which are owned or solely managed by other offices and agencies of the State. The Grantee is responsible for proper location within the authorized area.

44. **Improvements:** Any improvements/structures that may be authorized under this permit must be constructed in a manner that will allow for removal from the permitted site within 48 hours of receiving a notice to vacate. The establishment of permanent foundations and structures is prohibited under this permit. Authorized temporary improvements must be sited in a manner which impacts the least amount of ground consistent with the purpose of the facility. Any use of these improvements for purposes other than those explicitly authorized by this permit are prohibited.

45. **Visual Screening:** The Grantee shall limit the visual impact of their activity. Examples include, but are not limited to, using non-reflective roof cover material, applying dark paint to all metal or light-colored plywood or other surfaces and storing all equipment in an acceptable, well-kept manner. Improvements should be screened from sight whenever possible using vegetation or other natural features.

46. **Fire Prevention, Protection and Liability:** The Grantee shall take all reasonable precautions to prevent and suppress forest, structure, brush and grass fires, and shall assume full liability

for any damage to state land and structures resulting from the negligent use of fire. The State is not liable for damage to the Grantee's personal property and is not responsible for forest fire protection of the Grantee's activity. To report a wildfire, call 911 or 1-800-237-3633.

47. **Tower Hazard:** All improvements on site must be clearly marked in a manner which will reduce the likelihood of conflict with other users. Guy wires and tower structure must be clearly visible. Commercially available full round guy wire markers will be used on all guy wires and will be installed at the time of installation of the tower. Full round guy wire markers will be a minimum of 10 feet (above ground level) in length and of a color that dramatically contrast with the local environment. Anchors or other project features that could be struck by other users in the area will be clearly marked. The guy wire markers and other markings shall be routinely inspected, and any defective or missing markers shall be replaced immediately. In substitution of guy wire markers, plastic fencing of a color that dramatically contrasts with the local environment can be used to mark the improvements on site.

**Permit Advisories:**

1. For any MET towers remaining on the project site throughout the project's lifespan (per ADL 233892 Development Plan), it is strongly recommended to utilize monopole over lattice construction, discouraging guywires when feasible. This measure aims to deter nesting and perching birds, ultimately reducing the risk of bird strikes in wind turbines.

The Authorized Officer reserves the right to modify these stipulations or use additional stipulations as deemed necessary. The Grantee will be advised before any such modifications or additions are finalized. DNR has the authority to implement and enforce these conditions under AS 38.05.850. Any correspondence on this authorization may be directed to the Department of Natural Resources, Division of Mining, Land and Water, Southcentral Regional Land Office, 550 W. 7th Ave., Suite 900C, Anchorage, AK 99501-3577, (907) 269-8503.

I have read and understand all of the foregoing and attached stipulations. By signing this authorization, I agree to conduct the authorized activity in accordance with the terms and conditions of this authorization.

Michael U. Alvarez | Chief Operating Officer | 8/16/2024

Signature of Grantee or Authorized Representative | Title | Date

125 High St, 17th Floor High St Tower, Suite 1705 | Boston | MA | 02110

Grantee's Address | City | State | Zip

Chad Allen | 207-210-1175

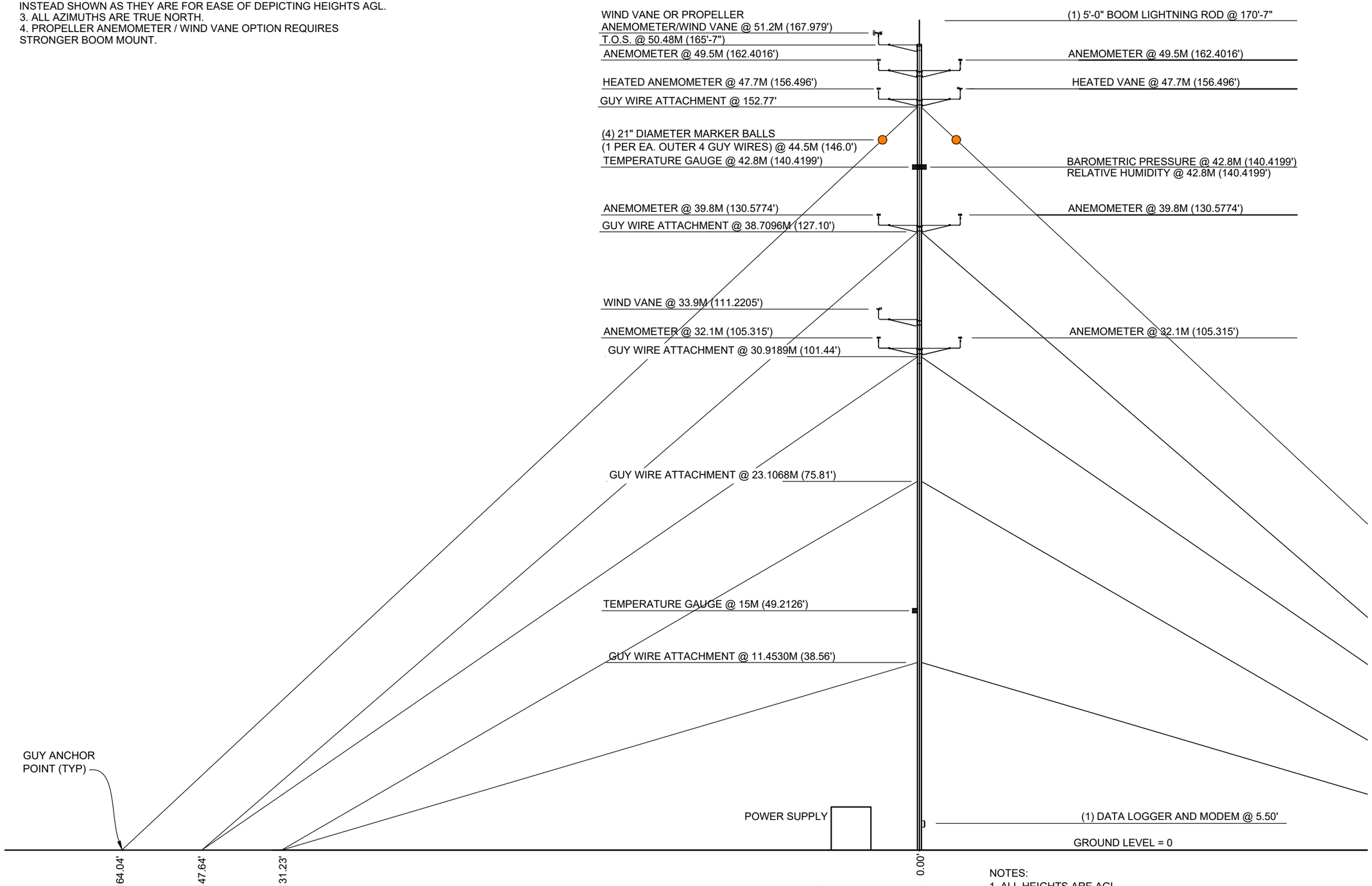
Contact Person | Home Phone | Work Phone

Rachel Longacre | 8/20/2024

Signature of Authorized State Representative | Title | Date

## NOTES:

1. ALL HEIGHTS ARE AGL.
2. DEPICTED BOOM ORIENTATIONS ARE NOT ACCURATE BUT ARE INSTEAD SHOWN AS THEY ARE FOR EASE OF DEPICTING HEIGHTS AGL.
3. ALL AZIMUTHS ARE TRUE NORTH.
4. PROPELLER ANEMOMETER / WIND VANE OPTION REQUIRES STRONGER BOOM MOUNT.




## TOWER ELEVATION

SCALE : 1" = 20'-0"

10' 0 10' 20'

SCALE : 1" = 20'

NOTES:
1. ALL HEIGHTS ARE AGL.
2. DEPICTED BOOM ORIENTATIONS ARE NOT ACCURATE BUT ARE INSTEAD SHOWN AS THEY ARE FOR EASE OF DEPICTING HEIGHTS AGL.
3. ALL AZIMUTHS ARE TRUE NORTH.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| 1 | | |
| 2 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER STANDARD FOOTPRINT

SHEET TITLE:
TOWER ELEVATION

SHEET NO.
1 OF 9

NOTES:
1. MET TOWERS WINCHED UPRIGHT FROM APPROXIMATELY THE NORTH SIDE.

## GUYED TOWER NOTES

1) GUY WIRE INSTALLATION:
ALL GUY WIRES ARE TO BE INSTALLED PER MANUFACTURER'S GUIDELINES AND TENSIONED TO MANUFACTURER'S SPECIFIED LIMITS AND CONFIRMED BY THE USE OF A CALIBRATED TENSIONOMETER. THE TOWER MUST BE PLUMBED TO MANUFACTURER'S SPECIFICATIONS UTILIZING AN ENGINEER TRANSIT AND MUST NOT VARY MORE THAN ONE INCH PER 100 FT OF TOWER HEIGHT. FINAL TENSIONS ARE TO BE RECORDED IN TOWER ERECTION MANUAL AND SUBMITTED TO CONSTRUCTION MANAGER UPON COMPLETION.

2) GUY WIRES:
ALL CUT GUY WIRES WILL BE LASHED WITH A NON-FERROUS MATERIAL AND PAINTED WITH ZINC RICH COMPOUND UPON COMPLETION.

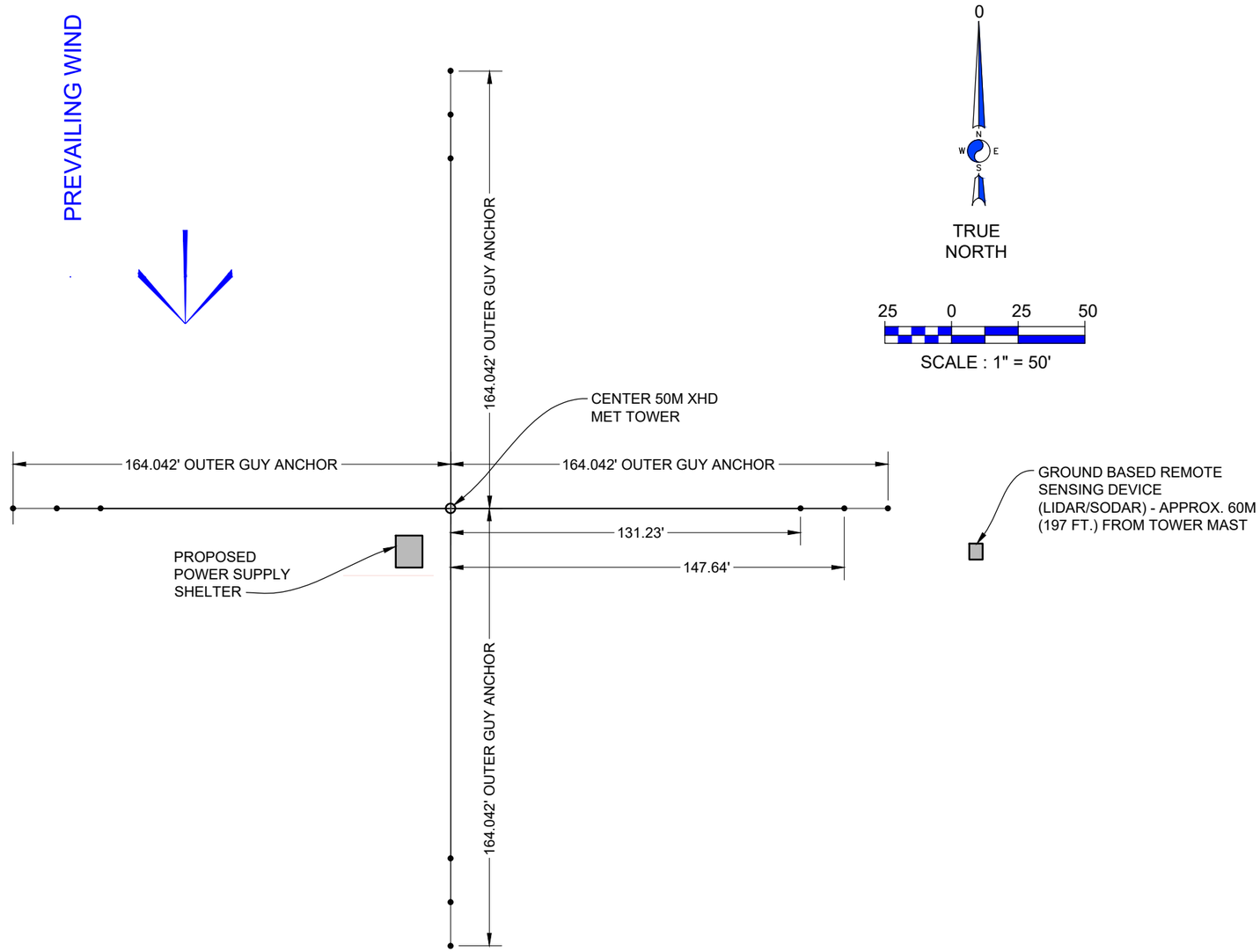
3) TURNBUCKLES:
ALL TURNBUCKLES ARE TO BE INSTALLED IN THE SAME ORIENTATION (WHEN BEHIND ANCHOR AND FACING TOWER, A CLOCKWISE TURN OF THE ADJUSTER WILL TIGHTEN THE TENSION AND A COUNTER-CLOCKWISE TURN OF THE ADJUSTER WILL LOOSEN TENSION). ALL ATTACHMENTS (BOLTS, PINS, CLEVISES) ARE TO BE INSTALLED IN THE SAME DIRECTION. DURING ERECTION, EACH GUY WIRE ADJUSTMENT WILL HAVE A TEMPORARY SAFETY INSTALLED. UPON COMPLETION, FOLLOWING FINAL PLUMB AND TENSION OF TOWER, ALL TURNBUCKLE ADJUSTERS WILL HAVE A SAFETY CABLE ROUTED THROUGHOUT THEM AND SECURED TOGETHER WITH A WIRE ROPE CLIP, TO ENSURE NO MOVEMENT OF ADJUSTER.

4) PREFORM GRIPS:
UPON COMPLETION ALL GUY WIRES WILL HAVE AN ICE CLIP DEVICE INSTALLED AS DIRECTED AND SUPPLIED BY TOWER MANUFACTURER. ANY ABRASIONS ARE TO BE PAINTED WITH ZINC RICH PAINT.

5) GUY WIRE GROUNDS:
ALL GUY WIRES ARE TO BE GROUNDED IN UNISON UTILIZING #2 STRANDED WIRE AND MANUFACTURER SUPPLIED CONNECTORS AND COPPER SHIELD ON CABLE TO WIRE CONNECTIONS TO THE ANCHOR'S EARTHEN GROUND RING.

6) CONTRACTOR SHALL PROVIDE THE MINIMUM NUMBER OF GROUND RODS INDICATED, SEE GROUNDING PLAN FOR APPROXIMATE LOCATIONS.

7) GUY TOWER INSTALLATIONS MUST MEET OR EXCEED THE LATEST TIA/EIA-222-H STANDARDS.




## 50M XHD TOWER PLAN

SCALE : 1" = 50'-0"

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA BOROUGH, AK

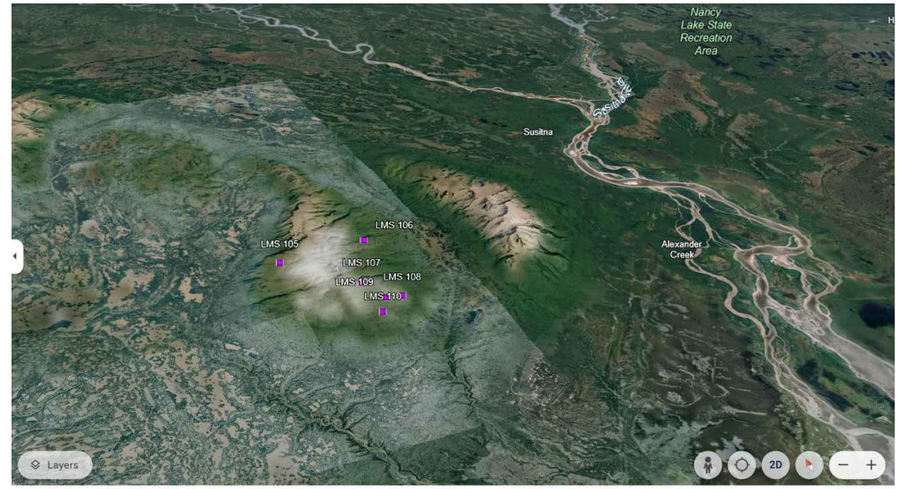
DESIGN TYPE:
50M XHD MET TOWER STANDARD FOOTPRINT

SHEET TITLE:
SITE PLAN

SHEET NO.
2 OF 9

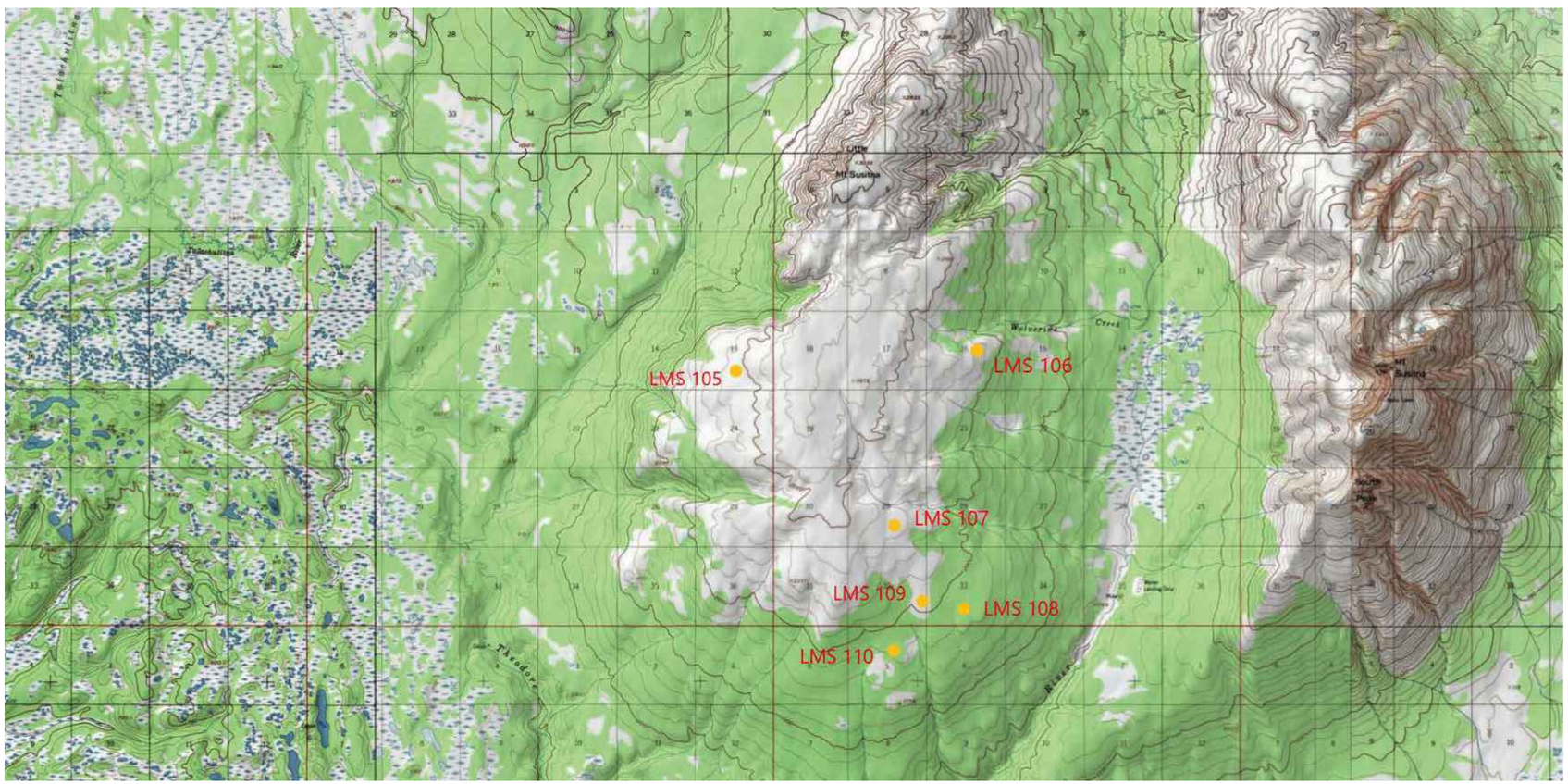
| | | | | |
|---|---|---|---|---|
| 20240430 | | | | |
| LMS met twrs to be permitted | | | | |
| | | | | |
| dataset | littleMountSusitna_toBePermittedMetTwrs_20240430_ja.shp | | | |
| | | | | |
| | UTM WGS84 z5 meters | | WGS84 | |
| id | X | Y | LATITUDE | LONGITUDE |
| LMS 105 | 607144 | 6817133 | 61.47306128° N | 150.98880926° W |
| LMS 106 | 612079 | 6817695 | 61.47670353° N | 150.89590508° W |
| LMS 107 | 610490 | 6814070 | 61.44464000° N | 150.92786700° W |
| LMS 108 | 611983 | 6812416 | 61.42937215° N | 150.90087803° W |
| LMS 109 | 611119 | 6812558 | 61.43089025° N | 150.91697790° W |
| LMS 110 | 610563 | 6811529 | 61.42181675° N | 150.92800343° W |

AK MET TOWER LATITUDE & LONGITUDE COORDINATE TABLE




LMS 105 THRU 110 GOOGLE MAPS LOCATIONS

SCALE : N.T.S.




LMS 105 THRU 110 LOCATIONS

SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| 1 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
SITE LOCATIONS

SHEET NO.
3 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N010W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 438610.156, 837190.354 | **NE:** | 448157.576, 837035.014 |
| **SW:** | 438439.045, 827536.254 | **SE:** | 448013.17, 827380.568 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720902342723964 | 61 25 34.48445 N |
| **E Longitude:** | -2.6349935005514356 | 150 58 26.42385 W |
| **N Latitude:** | 1.0736025151373458 | 61 30 46.41477 N |
| **W Longitude:** | -2.6381243219055466 | 151 09 12.20211 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

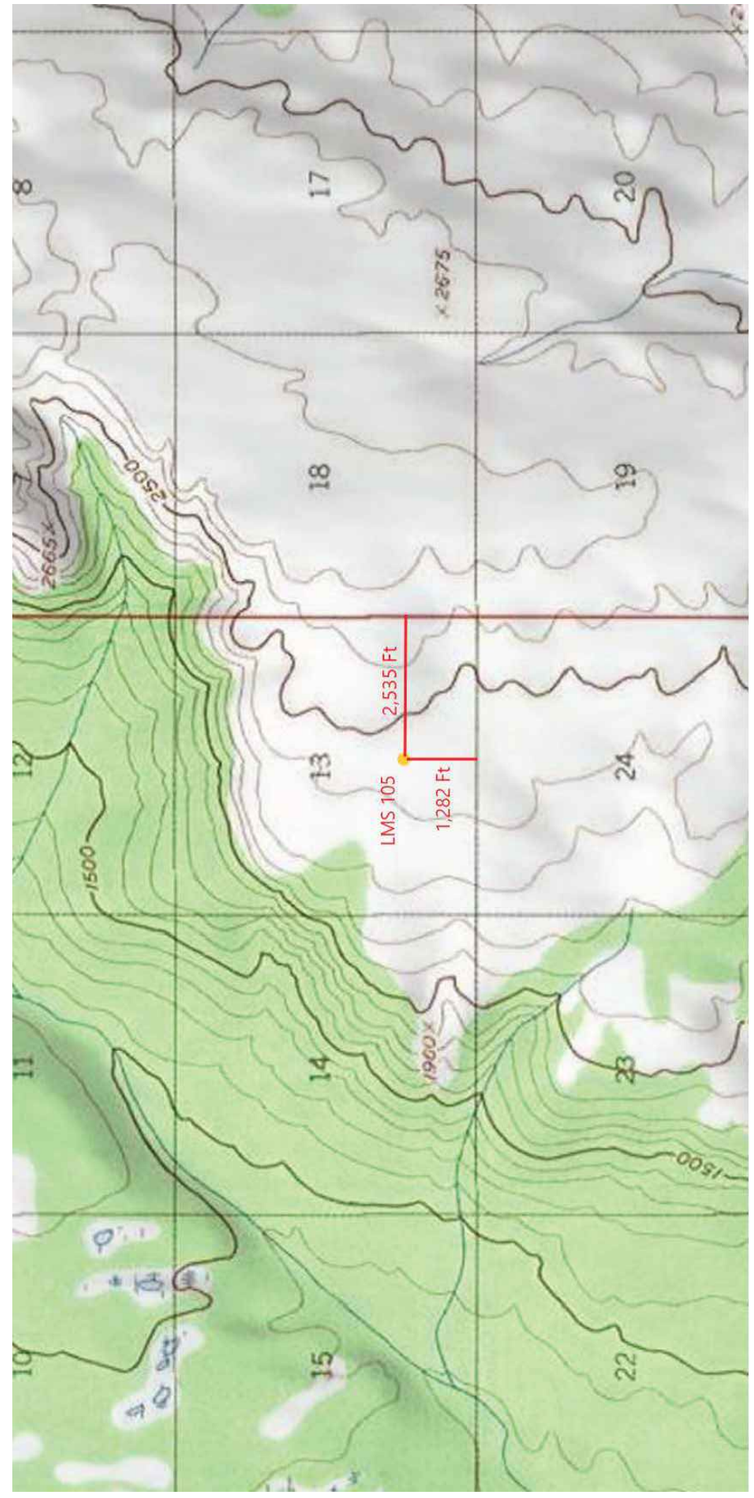
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-4 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-4 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:10 PM)

LMS 105 TOWNSHIP DATA




LMS 105 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 105

SHEET NO.
4 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
| **E Longitude:** | -2.631862563063116 | 150 47 40.62164 W |
| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
| **W Longitude:** | -2.6349934345081767 | 150 58 26.41023 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

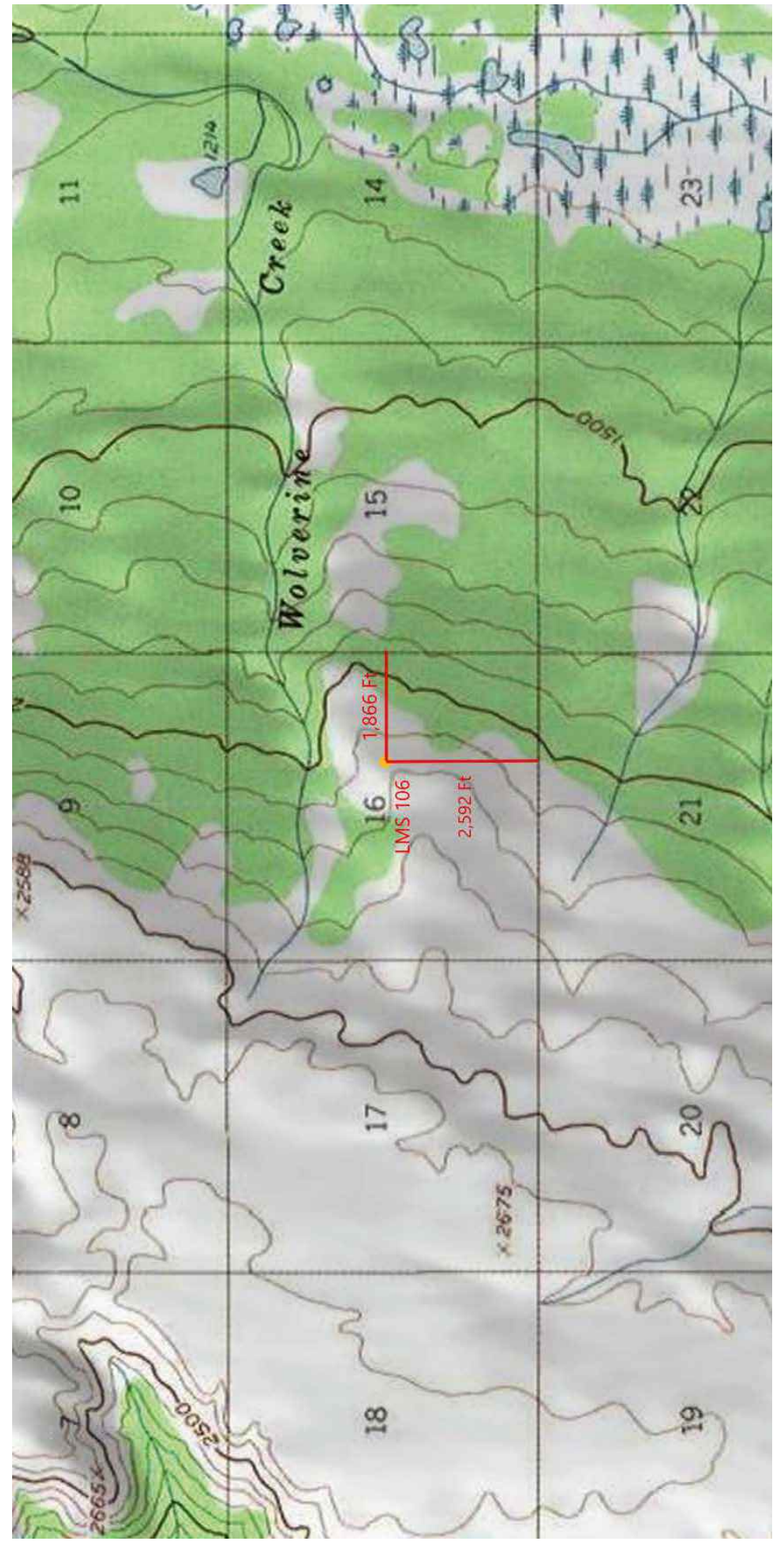
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-3 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:13 PM)

LMS 106 TOWNSHIP DATA




LMS 106 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 106

SHEET NO.
5 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
| **E Longitude:** | -2.631862563063116 | 150 47 40.62164 W |
| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
| **W Longitude:** | -2.6349934345081767 | 150 58 26.41023 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

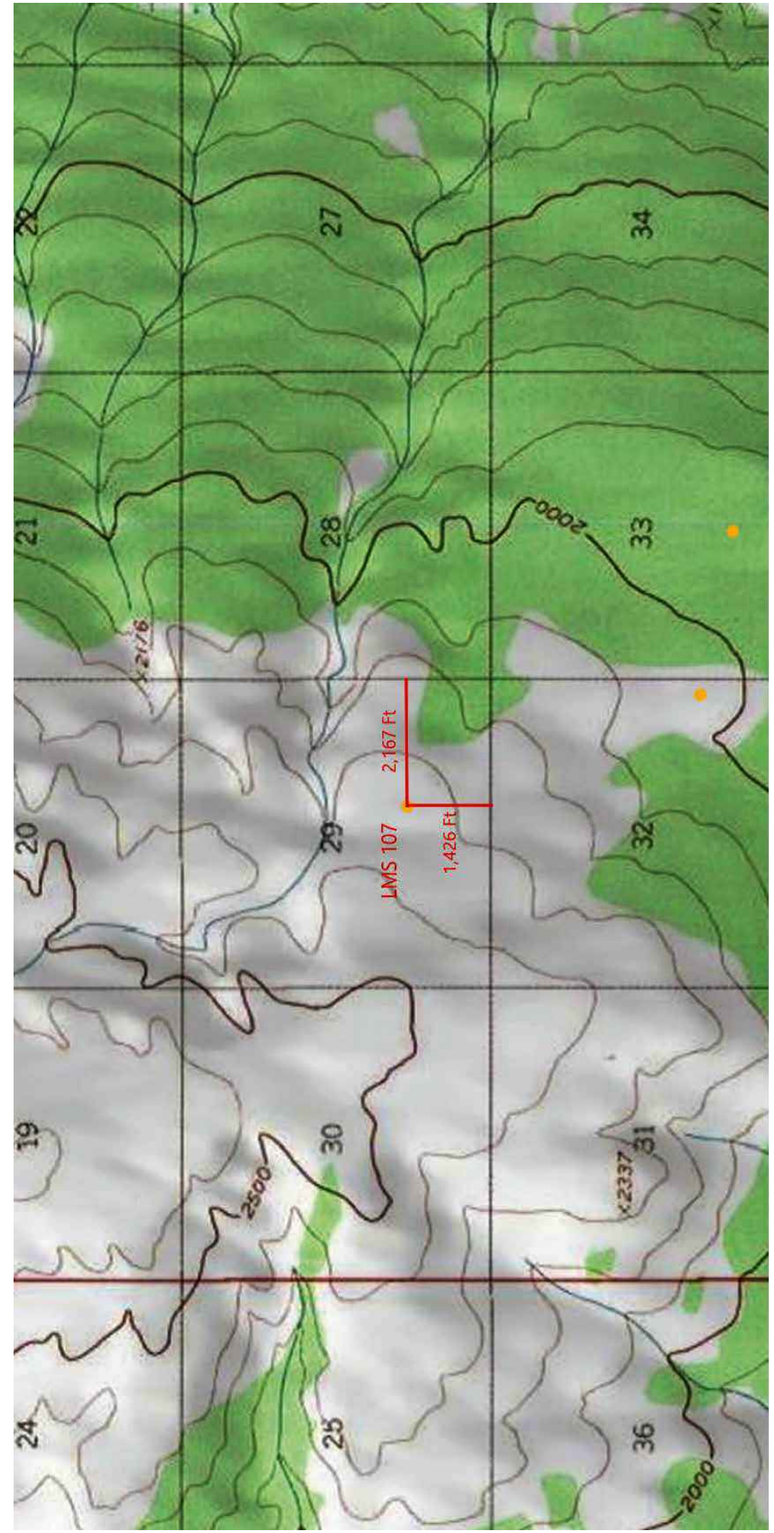
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-3 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 1:58 PM)

LMS 107 TOWNSHIP DATA




LMS 107 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 107

SHEET NO.
6 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S015N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448013.17, 827380.568 | **NE:** | 457587.577, 827251.266 |
| **SW:** | 447868.883, 817726.177 | **SE:** | 457469.991, 817596.635 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0705779481540059 | 61 20 22.55305 N |
| **E Longitude:** | -2.631862575612033 | 150 47 40.62423 W |
| **N Latitude:** | 1.0720902342723964 | 61 25 34.48445 N |
| **W Longitude:** | -2.6349935005514356 | 150 58 26.42385 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

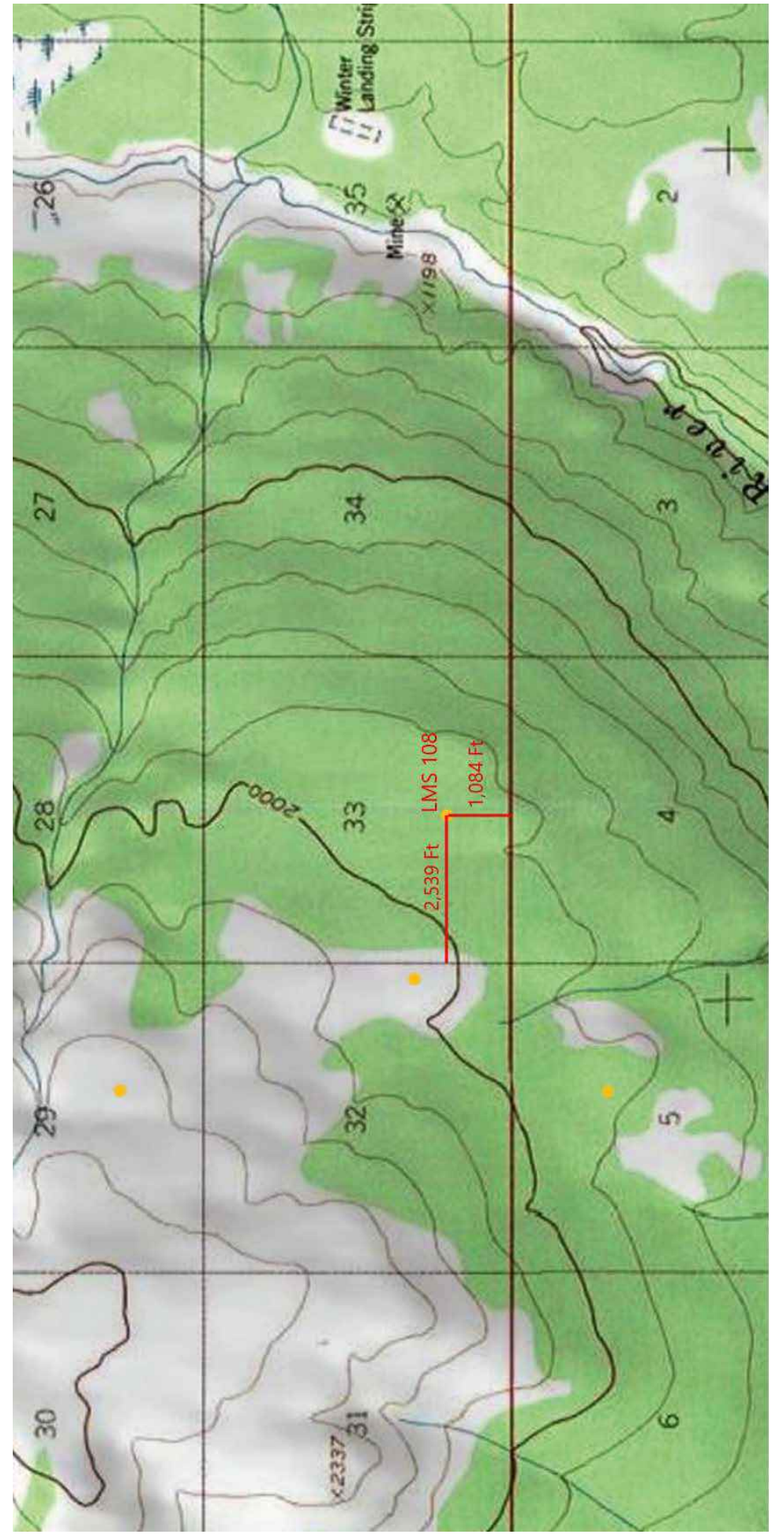
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK B-3 | **NE ITM Name:** | TYONEK B-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:16 PM)

LMS 108 TOWNSHIP DATA




LMS 108 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 108

SHEET NO.
7 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
| **E Longitude:** | -2.631862563063116 | 150 47 40.62164 W |
| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
| **W Longitude:** | -2.6349934345081767 | 150 58 26.41023 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

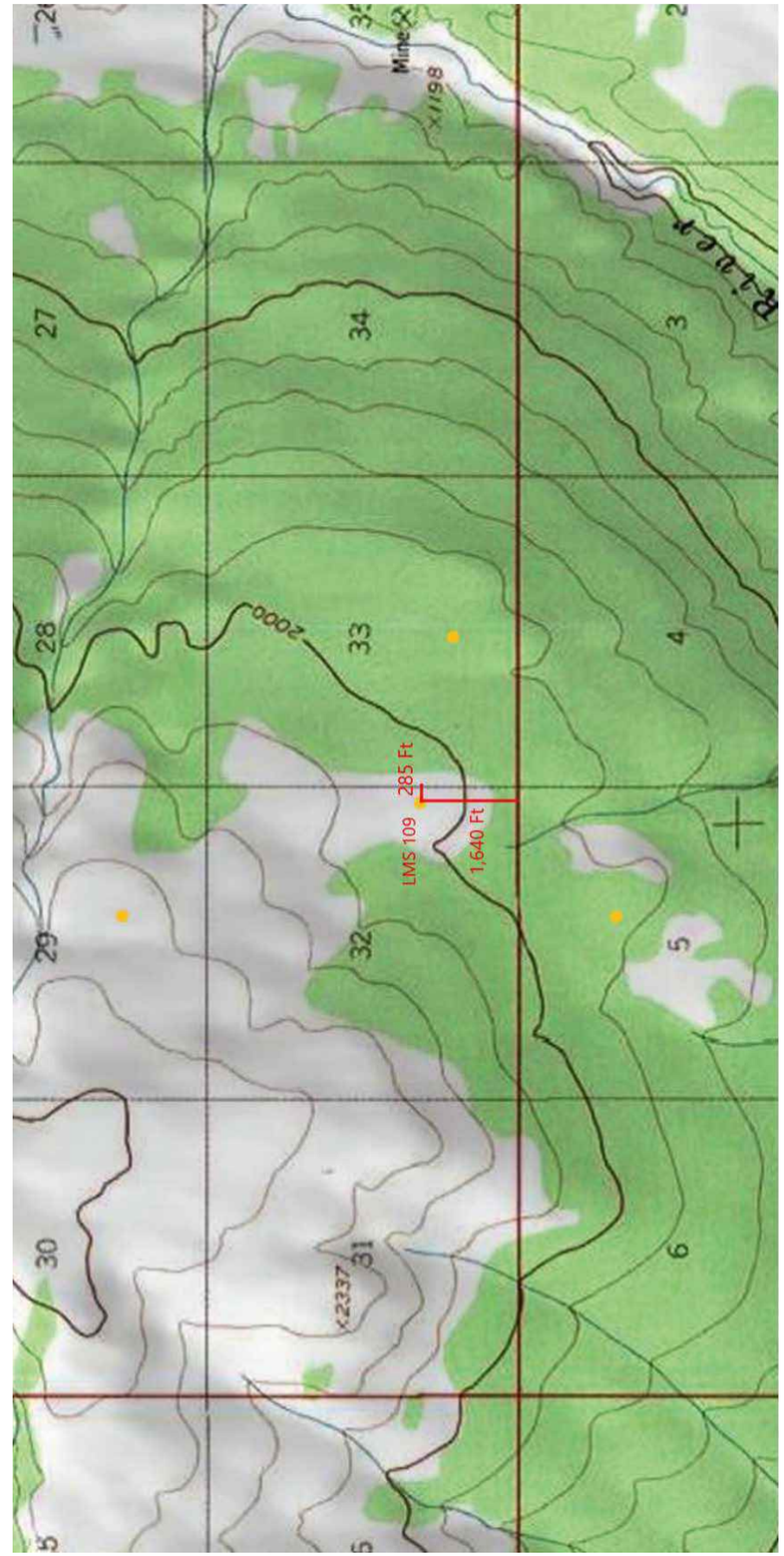
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-3 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:17 PM)

LMS 109 TOWNSHIP DATA




LMS 109 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 109

SHEET NO.
8 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S015N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448013.17, 827380.568 | **NE:** | 457587.577, 827251.266 |
| **SW:** | 447868.883, 817726.177 | **SE:** | 457469.991, 817596.635 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0705779481540059 | 61 20 22.55305 N |
| **E Longitude:** | -2.631862575612033 | 150 47 40.62423 W |
| **N Latitude:** | 1.0720902342723964 | 61 25 34.48445 N |
| **W Longitude:** | -2.6349935005514356 | 150 58 26.42385 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

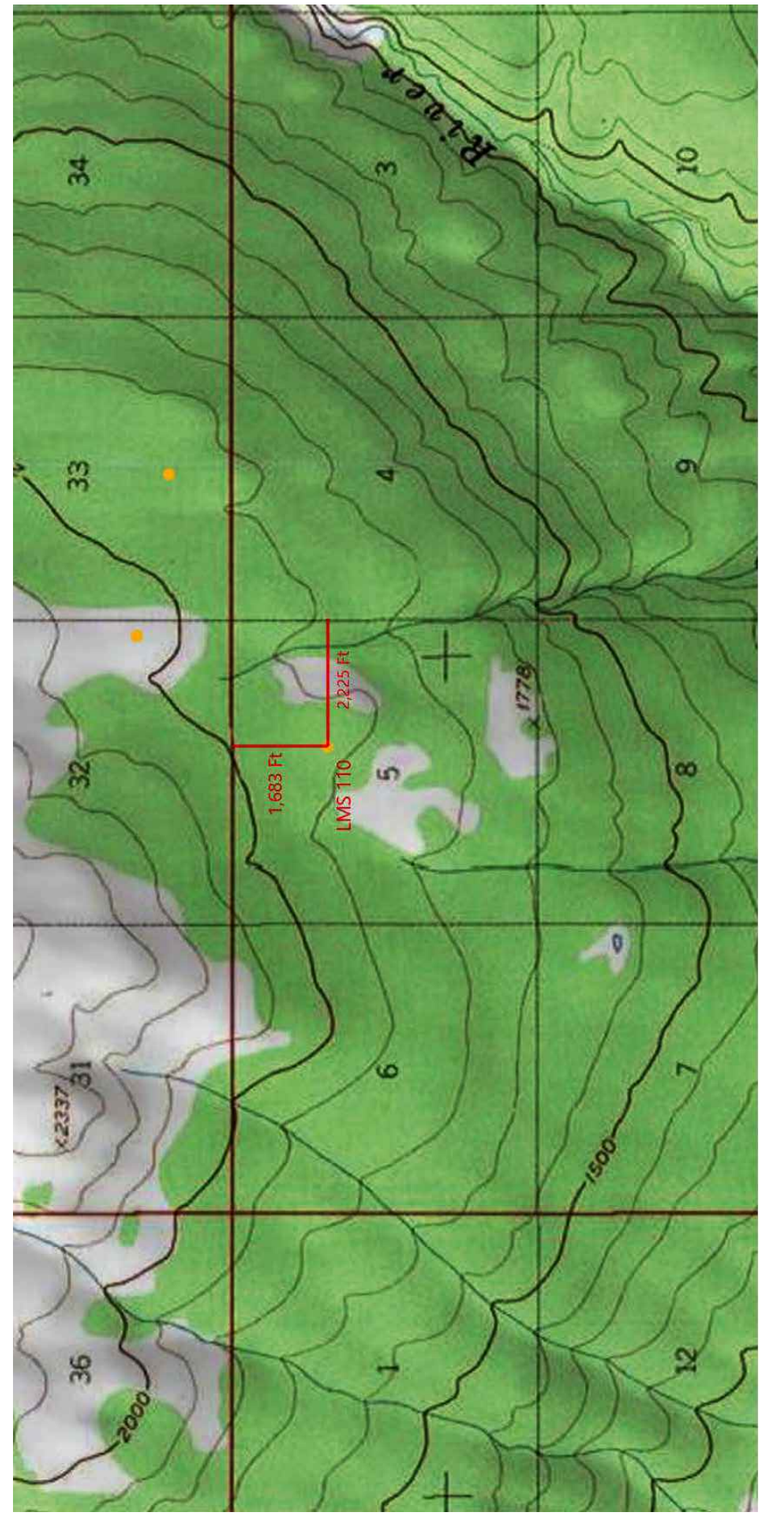
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK B-3 | **NE ITM Name:** | TYONEK B-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:07 PM)

LMS 110 TOWNSHIP DATA




LMS 110 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 50M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
50M XHD MET TOWER
MATANUSKA-SUSITNA
BOROUGH, AK

DESIGN TYPE:
50M XHD MET TOWER
STANDARD FOOTPRINT

SHEET TITLE:
LMS 110

SHEET NO.
9 OF 9

# NewTower Engineering LLC

Date: **July 01, 2024**

Jeff Armbruster
Longroad Energy
125 High Street, Boston, MA 02210
Phone: (857) 202-7475

**Subject:** **Matanuska Susitna Borough Met Tower Conditional Use Permit**

***Applicant:*** ***Longroad Energy / Alaska Renewables***

***Land Owner:*** ***State of Alaska***

***Engineering Project No.:*** **Project Number:** 101-24-002

***Tower Data:*** **(6) NRG Systems 50m XHD Tall Meteorological Towers**
**Matanuska-Susitna Borough, AK**

| | UTM WGS84 z5 meters | | WGS84 | |
|---|---|---|---|---|
| id | X | Y | LATITUDE | LONGITUDE |
| LMS 105 | 607144 | 6817133 | 61.47306128° N | 150.98880926° W |
| LMS 106 | 612079 | 6817695 | 61.47670353° N | 150.89590508° W |
| LMS 107 | 610490 | 6814070 | 61.44464000° N | 150.92786700° W |
| LMS 108 | 611983 | 6812416 | 61.42937215° N | 150.90087803° W |
| LMS 109 | 611119 | 6812558 | 61.43089025° N | 150.91697790° W |
| LMS 110 | 610563 | 6811529 | 61.42181675° N | 150.92800343° W |

Dear Mr. Armbruster,

Please find enclosed the following for the subject six (6) NRG 50m XHD Met Towers with Standard Footprint permit application:

1. A full tower structural analysis is provided (refer attached report and Appendix A output results) in accordance with the 2021 Alaska Building Code, 2021 International Building Code, ASCE 7-16 Code, and ANSI TIA 222-Rev H, based upon an ultimate 3-second gust wind speed of 115 mph ($V_{ult}$), Risk Category I, and Exposure Category C. Seismic analysis not required for Risk Category I structures.
2. Refer Appendix C and the Conclusions/Recommendations for recommended Manta Ray (MR-2) guy anchor, 8" double helix (or approved equal) along with details and minimum pull forces required (Table 4). No soils report is available for the site. As such, anchor pull tests will be required to meet the minimum resultant anchor loads as listed in Table 4 of this report.
3. Refer Appendix D for typical tower grounding and tower installation details.

Structural analysis prepared by: Mikko P. Ahola, PE

Respectfully submitted by:

STATE OF ALASKA
49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

Aaron Boonstra, PE
Professional Engineer

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## 1) INTRODUCTION

The purpose of this report is to investigate the structural adequacy of proposed (6) NRG Systems 50m XHD guyed pole temporary meteorological towers to be located in the Matanuska-Susitna Borough, Alaska (refer Appendix D map locations). The met towers will support wind monitoring devices. The computer plots & output based on a 3D structural analysis using tnxTOWER (Version 8.2.2) is provided in Appendix A.

The 50m XHD tall guyed pole MET towers are designed and manufactured by NRG Systems.

The finite element program “tnxTower” used in this analysis is developed by Tower Numerics in Lexington, MA. It is a specialized 3D structural analysis program widely used and accepted in the tower industry.

## 2) ANALYSIS CRITERIA

The analysis has been performed in accordance with the 2021 Alaska Building Code, 2021 International Building Code, and ANSI TIA-222-Rev H for the tower site locations in Alaska based upon an ultimate 3-second gust wind speed of 115 mph ($V_{ult}$). Exposure Category C, Risk Category I along with topographic category 2 and crest height of 1,500 feet were used in this analysis (typical for all 6 tower sites). Met towers are temporary structures (1 to 3-year installation duration typical) and analyzed as Risk Category I structures with 115 mph ultimate gust wind speed at the met tower site locations per the 2021 IBC/ASCE 7-16 (refer Appendix A ASCE7-16 Hazard Map). Table 1 below shows the proposed MET tower loading.

**Table 1 - Proposed 50m XHD Tall Super XHD Met Tower Equipment Loading**

| Center Line Elevation (ft) | Number of Antennas | Antenna/Mount Manufacturer | Antenna/Mount Model | Number of Feed Lines | Feed Line Size (in) | Note |
|---|---|---|---|---|---|---|
| 167.98 (51.2 m) | 1 | Young | Propellor Anemometer/ Wind Vane | 1 | 0.14”ϕ cable | 1 |
| 167.98 (51.2 m) | 1 | NRG Systems | NRG No. 4214 (95” Long Side Boom) | - | - | 1 |
| 162.40 (49.5 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14”ϕ cables | 1 |
| 162.40 (49.5 m) | 2 | NRG Systems | NRG No. 4214 (95” Long Side Booms) | - | - | 1 |
| 156.496 (47.7 m) | 2 | NRG Systems | Heated Anemometer | 2 | 0.14”ϕ cables | 1 |
| 156.496 (47.7 m) | 2 | NRG Systems | NRG No. 4214 (95” Long Side Booms) | - | - | 1 |
| 145.997 (44.5 m) | 4 | NRG Systems | 21” ϕ Orange Marker Balls (3.1m From Top Guy Ring) | - | - | 1 |
| 140.42 (42.8 m) | 1<br>1<br>1 | Campbell Scientific | Barometric Pressure Gauge<br>Relative Humidity Sensor<br>Temperature Sensor | 3 | 0.14”ϕ cables | 1 |
| 130.58 (39.8 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14”ϕ cables | 1 |
| 130.58 (39.8 m) | 2 | NRG Systems | NRG No. 4214 (95” Long Side Booms) | - | - | 1 |
| 111.22 (33.9 m) | 1 | NRG Systems | NRG 200P Wind Vane | 1 | 0.14”ϕ cable | 1 |
| 111.22 (33.9 m) | 1 | NRG Systems | NRG No. 4214 (95” Long Side Boom) | - | - | 1 |
| 105.32 (32.1 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14”ϕ cables | 1 |
| 105.32 | 2 | NRG Systems | NRG No. 4214 | - | - | 1 |

| Center Line Elevation (ft) | Number of Antennas | Antenna/Mount Manufacturer | Antenna/Mount Model | Number of Feed Lines | Feed Line Size (in) | Note |
|---|---|---|---|---|---|---|
| (32.1 m) | | | (95” Long Side Booms) | | | |
| 49.21 (15.0 m) | 1 | Unknown | Temperature Sensor | 1 | 0.14”ϕ cable | 1 |
| 4.92 (1.5 m) | 1 | NRG Systems | Data Logger & Modem | - | - | 1 |

**Notes:** 1. Proposed Equipment

## 3) ANALYSIS PROCEDURE

**Table 2 - Documents Provided**

| Document | Remarks | Reference | Source |
|---|---|---|---|
| Met Tower Equipment Loading | Anemometers, Wind Vanes, Marker Balls | 06/20/2024 | Longroad Energy |
| 50M XHD & 60M XHD Tall Tower Installation | User’s Manual (Rev 10) | 11/02/2018 | NRG Systems |

### 3.1) Analysis Method

tnxTower (version 8.2.2), a commercially available analysis software package, was used to analyze the 50m XHD MET tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

### 3.2) Assumptions

1. The pole steel is 45 ksi yield.
2. The 50m XHD MET tower is supported by 1/4" diameter Aircraft guy wiring with breaking strength of 7.0 kips with 0.182 kips (2.6%) initial tension (refer 50M & 60M XHD Installation Manual for instructions on proper guy wire tensioning and recommended methods to utilize).
3. The proposed MET tower is temporary (typically 1 to 3-year installation duration)
4. The met tower and guy anchors are to be installed by a professional contractor with prior experience in met tower erection and will be installed following the instructions in the NRG 50m & 60m XHD Installation Manual & Specifications & other manufacturer specifications.

## 4) ANALYSIS RESULTS

**Table 3 - Section Capacity (Summary)**

**Section Capacity Table**

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 | Pole | Guyed Pole 8" OD | 2 | -152.147 | 91413.297 | 35.5 | Pass |
| L2 | 152.771 - 127.104 | Pole | Guyed Pole 8" OD | 3 | -5902.010 | 91413.297 | 36.6 | Pass |
| L3 | 127.104 - 101.437 | Pole | Guyed Pole 8" OD | 4 | -11052.500 | 91413.297 | 44.7 | Pass |
| L4 | 101.437 - 75.812 | Pole | Guyed Pole 10" OD | 5 | -14517.000 | 113300.000 | 35.7 | Pass |
| L5 | 75.812 - 38.562 | Pole | Guyed Pole 10" OD | 6 | -17002.199 | 113300.000 | 36.5 | Pass |
| L6 | 38.562 - 0 | Pole | Guyed Pole 10" OD | 7 | -19226.801 | 113300.000 | 49.9 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L2 | 152.771 - 127.104 | Guy A@152.771 | NRG 0.030125 | 11 | 4029.750 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy A@127.104 | NRG 0.030125 | 15 | 2847.590 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy A@101.437 | NRG 0.030125 | 19 | 2124.400 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy A@75.812 | NRG 0.030125 | 23 | 2050.680 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy A@38.562 | NRG 0.030125 | 27 | 1976.560 | 4200.000 | 47.1 | Pass |
| L2 | 152.771 - 127.104 | Guy B@152.771 | NRG 0.030125 | 10 | 4027.520 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy B@127.104 | NRG 0.030125 | 14 | 2848.480 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy B@101.437 | NRG 0.030125 | 18 | 2125.370 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy B@75.812 | NRG 0.030125 | 22 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy B@38.562 | NRG 0.030125 | 26 | 1975.270 | 4200.000 | 47.0 | Pass |
| L2 | 152.771 - 127.104 | Guy C@152.771 | NRG 0.030125 | 9 | 4027.030 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy C@127.104 | NRG 0.030125 | 13 | 2849.140 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy C@101.437 | NRG 0.030125 | 17 | 2125.700 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy C@75.812 | NRG 0.030125 | 21 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy C@38.562 | NRG 0.030125 | 25 | 1974.240 | 4200.000 | 47.0 | Pass |
| L2 | 152.771 - 127.104 | Guy D@152.771 | NRG 0.030125 | 8 | 4027.610 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy D@127.104 | NRG 0.030125 | 12 | 2848.430 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy D@101.437 | NRG 0.030125 | 16 | 2125.330 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy D@75.812 | NRG 0.030125 | 20 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy D@38.562 | NRG 0.030125 | 24 | 1975.280 | 4200.000 | 47.0 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L6) | 49.9 | Pass |
| | | | | | | Guy A (L2) | 95.9 | Pass |
| | | | | | | Guy B (L2) | 95.9 | Pass |
| | | | | | | Guy C (L2) | 95.9 | Pass |
| | | | | | | Guy D (L2) | 95.9 | Pass |
| | | | | | | **RATING =** | **95.9** | **Pass** |

**Table 4 – Guy Anchor Reactions**

| Anchor Radius | Factored Uplift Force (Vertical) | Factored Shear Force (Horizontal) | Factored Resultant Force |
|---|---|---|---|
| Inner Anchor (Radius = 131.234 ft) | 1,501 lbs | 3,689 lbs | 3,983 lbs |
| Middle Anchor (Radius = 147.638 ft) | 2,863 lbs | 4,017 lbs | 4,933 lbs |
| Outer Anchor (Radius = 164.042 ft) | 2,610 lbs | 3,046 lbs | 4,011 lbs |

1. Anchor reactions are factored.

### 4.1) Conclusions & Recommendations

The proposed NRG 50m XHD MET towers with standard footprint were analyzed with the proposed new wind monitoring devices and marker balls (Refer Table 1) per the 2021 International Building Code/ASCE 7-16 and ANSI TIA 222 Rev H codes for the typical site conditions at the 6 tower site locations in Matanuska-Susitna Borough, AK based upon an ultimate 3-second gust wind speed of 115 mph ($V_{ult}$). Exposure Category C, Risk Category I along with topographic category 2 and crest height of 1,500 feet were used in this analysis. Seismic loading is not required for Risk Category I Structures.

The analysis results show that:

1. The overall tower pole structure and guy wires are structurally adequate to support the proposed equipment. A maximum tower steel usage of 95.9% was computed (Refer Table 3).

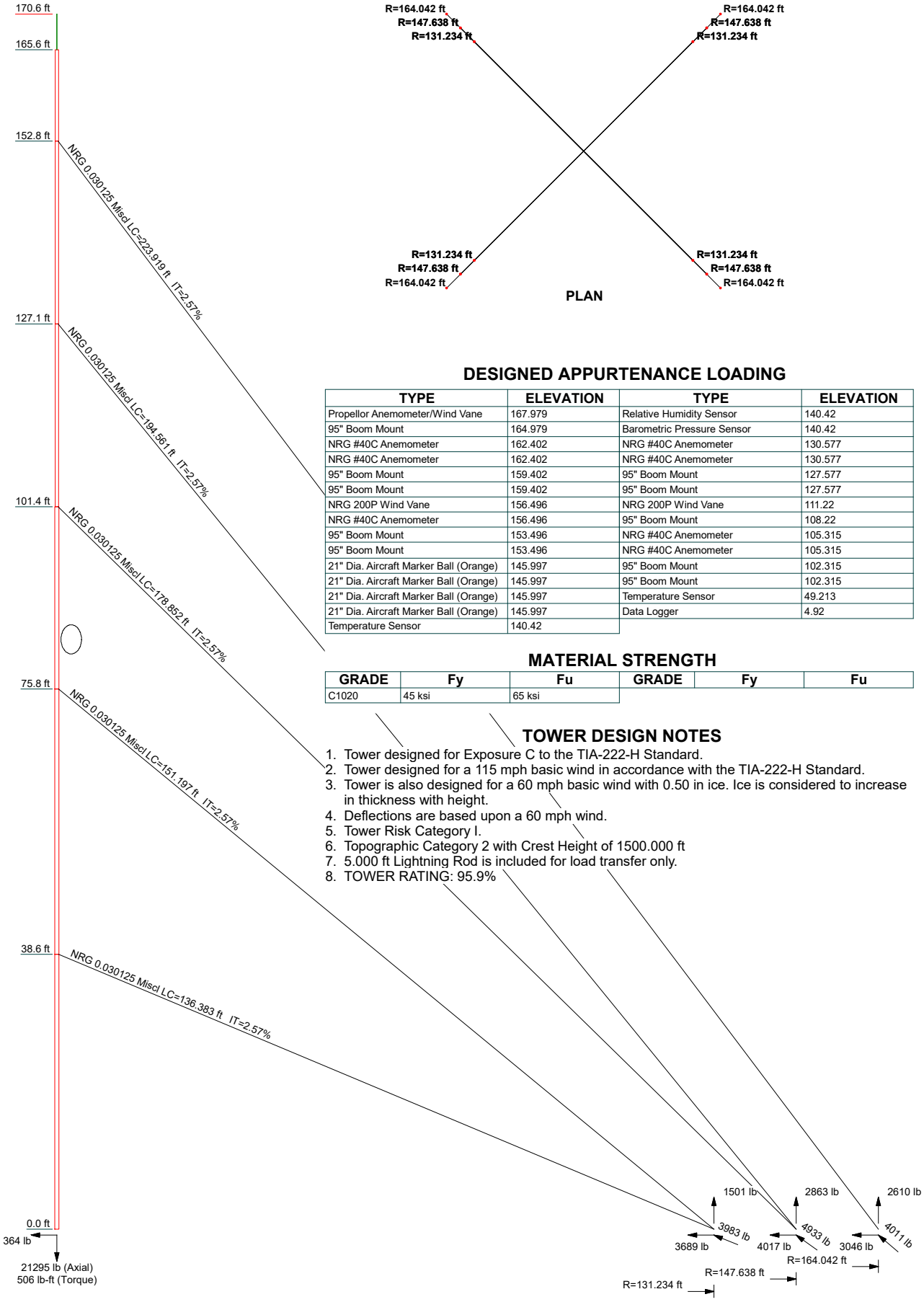
2. The maximum factored guy anchor resultant force computed was 4,933 lbs (Refer Table 4). The Manta Ray Earth Anchor (Model MR-2) has holding capacities up to 36,000 lbs or 8” double helix anchors (depending on soil type – Refer Appendix C earth anchor details & ultimate capacites) and would be adequate to secure the guy anchors in place under the wind loads shown in this analysis. However, no soils report was available to confirm the soil type at the proposed location of the towers. As such, a standard pull test will be required to ensure they meet the minimum factored resultant anchor loads in Table 4 above.

3. The maximum factored axial compression force at the base of the met tower is computed to be 21,295 lbs. Per the NRG tower specs, the 50m XHD standard footprint steel base plate has a surface area of 7.7 $ft^2$. Assuming a typical 1,500 psf allowable soil bearing stress per the IBC code with a Safety of Factor of 2.0 in soil bearing, the ultimate soil bearing stress would be 3,000 psf. Thus, based on factored loads the computed maximum soil bearing stress is 2,766 psf < 3,000 psf and acceptable.

# APPENDIX A

# TNXTOWER OUTPUT

| Section | Size | Length (ft) | Grade | Weight (lb) |
|---|---|---|---|---|
| 1 | Guyed Pole 8" OD | 12.833 | C1020 | 103.0 |
| 2 | Guyed Pole 8" OD | 25.667 | | 206.1 |
| 3 | Guyed Pole 8" OD | 25.667 | | 206.1 |
| 4 | Guyed Pole 10" OD | 25.625 | | 268.5 |
| 5 | Guyed Pole 10" OD | 37.250 | | 390.3 |
| 6 | Guyed Pole 10" OD | 38.562 | | 404.1 |
| | | | | 1578.0 |




ALL REACTIONS ARE FACTORED

## DESIGNED APPURTENANCE LOADING

| TYPE | ELEVATION | TYPE | ELEVATION |
|---|---|---|---|
| Propellor Anemometer/Wind Vane | 167.979 | Relative Humidity Sensor | 140.42 |
| 95" Boom Mount | 164.979 | Barometric Pressure Sensor | 140.42 |
| NRG #40C Anemometer | 162.402 | NRG #40C Anemometer | 130.577 |
| NRG #40C Anemometer | 162.402 | NRG #40C Anemometer | 130.577 |
| 95" Boom Mount | 159.402 | 95" Boom Mount | 127.577 |
| 95" Boom Mount | 159.402 | 95" Boom Mount | 127.577 |
| NRG 200P Wind Vane | 156.496 | NRG 200P Wind Vane | 111.22 |
| NRG #40C Anemometer | 156.496 | 95" Boom Mount | 108.22 |
| 95" Boom Mount | 153.496 | NRG #40C Anemometer | 105.315 |
| 95" Boom Mount | 153.496 | NRG #40C Anemometer | 105.315 |
| 21" Dia. Aircraft Marker Ball (Orange) | 145.997 | 95" Boom Mount | 102.315 |
| 21" Dia. Aircraft Marker Ball (Orange) | 145.997 | 95" Boom Mount | 102.315 |
| 21" Dia. Aircraft Marker Ball (Orange) | 145.997 | Temperature Sensor | 49.213 |
| 21" Dia. Aircraft Marker Ball (Orange) | 145.997 | Data Logger | 4.92 |
| Temperature Sensor | 140.42 | | |

## MATERIAL STRENGTH

| GRADE | Fy | Fu | GRADE | Fy | Fu |
|---|---|---|---|---|---|
| C1020 | 45 ksi | 65 ksi | | | |

## TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-H Standard.
2. Tower designed for a 115 mph basic wind in accordance with the TIA-222-H Standard.
3. Tower is also designed for a 60 mph basic wind with 0.50 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Risk Category I.
6. Topographic Category 2 with Crest Height of 1500.000 ft
7. 5.000 ft Lightning Rod is included for load transfer only.
8. TOWER RATING: 95.9%


*Ahola Engineering LLC*
P.O. Box 989
Winter Park, CO 80482-0989
Phone: (719) 640-2408
FAX:


| | | | |
|---|---|---|---|
| Job: ***165.6' (50 meters) XHD MET Tower with Standard Footpri*** | | | |
| Project: ***Matanuska-Susitna Borough, AK*** | | | |
| Client: NRG | Drawn by: Mikko Ahola, PE | App'd: | |
| Code: TIA-222-H | Date: 07/01/24 | Scale: NTS | |
| Path: | | Dwg No. E-1 | |

# Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

Tower base elevation above sea level: 2461.000 ft.
Basic wind speed of 115 mph.
Risk Category I.
Exposure Category C.
Simplified Topographic Factor Procedure for wind speed-up calculations is used.
Topographic Category: 2.
Crest Height: 1500.000 ft.
Nominal ice thickness of 0.500 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 60 mph is used in combination with ice.
Deflections calculated using a wind speed of 60 mph.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Safety factor used in guy design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

# Pole Section Geometry

| *Section* | *Elevation* *ft* | *Section Length* *ft* | *Pole Size* | *Pole Grade* | *Socket Length* *ft* |
|---|---|---|---|---|---|
| L1 | 165.604-152.771 | 12.833 | Guyed Pole 8" OD | C1020 (45 ksi) | |
| L2 | 152.771-127.104 | 25.667 | Guyed Pole 8" OD | C1020 (45 ksi) | |
| L3 | 127.104-101.437 | 25.667 | Guyed Pole 8" OD | C1020 (45 ksi) | |
| L4 | 101.437-75.812 | 25.625 | Guyed Pole 10" OD | C1020 (45 ksi) | |
| L5 | 75.812-38.562 | 37.250 | Guyed Pole 10" OD | C1020 (45 ksi) | |
| L6 | 38.562-0.000 | 38.562 | Guyed Pole 10" OD | C1020 (45 ksi) | |

| *Tower Elevation* *ft* | *Gusset Area (per face)* *ft²* | *Gusset Thickness* *in* | *Gusset Grade* | *Adjust. Factor* $A_f$ | *Adjust. Factor* $A_r$ | *Weight Mult.* | *Double Angle Stitch Bolt Spacing Diagonals* *in* | *Double Angle Stitch Bolt Spacing Horizontals* *in* | *Double Angle Stitch Bolt Spacing Redundants* *in* |
|---|---|---|---|---|---|---|---|---|---|
| L1 165.604-152.771 | | | | 1 | 1 | 1 | | | |
| L2 152.771-127.1 | | | | 1 | 1 | 1 | | | |

| Tower Elevation ft | Gusset Area (per face) $ft^2$ | Gusset Thickness in | Gusset Grade | Adjust. Factor $A_f$ | Adjust. Factor $A_r$ | Weight Mult. | Double Angle Stitch Bolt Spacing Diagonals in | Double Angle Stitch Bolt Spacing Horizontals in | Double Angle Stitch Bolt Spacing Redundants in |
|---|---|---|---|---|---|---|---|---|---|
| 04 | | | | | | | | | |
| L3 | | | | 1 | 1 | 1 | | | |
| 127.104-101.437 | | | | | | | | | |
| L4 | | | | 1 | 1 | 1 | | | |
| 101.437-75.812 | | | | | | | | | |
| L5 | | | | 1 | 1 | 1 | | | |
| 75.812-38.562 | | | | | | | | | |
| L6 | | | | 1 | 1 | 1 | | | |
| 38.562-0.000 | | | | | | | | | |

# Guy Data

| Guy Elevation ft | Guy Grade | | Guy Size | Initial Tension lb | % | Guy Modulus ksi | Guy Weight plf | $L_u$ ft | Anchor Radius ft | Anchor Azimuth Adj. ° | Anchor Elevation ft | End Fitting Efficiency % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 152.771 | Miscl | A | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 223.957 | 164.042 | 0.000 | 0.000 | 100% |
| | | B | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 223.957 | 164.042 | 0.000 | 0.000 | 100% |
| | | C | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 223.957 | 164.042 | 0.000 | 0.000 | 100% |
| | | D | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 223.957 | 164.042 | 0.000 | 0.000 | 100% |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| 127.104 | Miscl | A | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 194.647 | 147.638 | 0.000 | 0.000 | 100% |
| | | B | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 194.647 | 147.638 | 0.000 | 0.000 | 100% |
| | | C | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 194.647 | 147.638 | 0.000 | 0.000 | 100% |
| | | D | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 194.647 | 147.638 | 0.000 | 0.000 | 100% |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| 101.437 | Miscl | A | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 178.872 | 147.638 | 0.000 | 0.000 | 100% |
| | | B | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 178.872 | 147.638 | 0.000 | 0.000 | 100% |
| | | C | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 178.872 | 147.638 | 0.000 | 0.000 | 100% |
| | | D | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 178.872 | 147.638 | 0.000 | 0.000 | 100% |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| 75.812 | Miscl | A | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 151.199 | 131.234 | 0.000 | 0.000 | 100% |
| | | B | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 151.199 | 131.234 | 0.000 | 0.000 | 100% |
| | | C | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 151.199 | 131.234 | 0.000 | 0.000 | 100% |
| | | D | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 151.199 | 131.234 | 0.000 | 0.000 | 100% |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38.562 | Miscl | A | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 136.466 | 131.234 | 0.000 | 0.000 | 100% |
| | | B | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 136.466 | 131.234 | 0.000 | 0.000 | 100% |
| | | C | NRG | 179.900 | 2.57% | 15000.000 | 0.111 | 136.466 | 131.234 | 0.000 | 0.000 | 100% |
| | | D | 0.030125 | 179.900 | 2.57% | 15000.000 | 0.111 | 136.466 | 131.234 | 0.000 | 0.000 | 100% |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |
| | | | NRG | | | | | | | | | |
| | | | 0.030125 | | | | | | | | | |

## Guy Data *(cont'd)*

| *Guy Elevation* *ft* | *Mount Type* | *Torque-Arm Spread* *ft* | *Torque-Arm Leg Angle* ° | *Torque-Arm Style* | *Torque-Arm Grade* | *Torque-Arm Type* | *Torque-Arm Size* |
|---|---|---|---|---|---|---|---|
| 152.771 | Corner | | | | | | |
| 127.104 | Corner | | | | | | |
| 101.437 | Corner | | | | | | |
| 75.812 | Corner | | | | | | |
| 38.562 | Corner | | | | | | |

## Guy Data *(cont'd)*

| *Guy Elevation* *ft* | *Diagonal Grade* | *Diagonal Type* | *Upper Diagonal Size* | *Lower Diagonal Size* | *Is Strap.* | *Pull-Off Grade* | *Pull-Off Type* | *Pull-Off Size* |
|---|---|---|---|---|---|---|---|---|
| 152.771 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 127.104 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 101.437 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 75.812 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 38.562 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |

## Guy Data *(cont'd)*

| *Guy Elevation* *ft* | *Cable Weight A* *lb* | *Cable Weight B* *lb* | *Cable Weight C* *lb* | *Cable Weight D* *lb* | *Tower Intercept A* *ft* | *Tower Intercept B* *ft* | *Tower Intercept C* *ft* | *Tower Intercept D* *ft* |
|---|---|---|---|---|---|---|---|---|
| 152.771 | 30.939 | 30.939 | 30.939 | 30.939 | 18.222<br>7.4 sec/pulse | 18.222<br>7.4 sec/pulse | 18.222<br>7.4 sec/pulse | 18.222<br>7.4 sec/pulse |
| 127.104 | 36.418 | 36.418 | 36.418 | 36.418 | 18.523<br>7.4 sec/pulse | 18.523<br>7.4 sec/pulse | 18.523<br>7.4 sec/pulse | 18.523<br>7.4 sec/pulse |
| 101.437 | 25.467 | 25.467 | 25.467 | 25.467 | 12.191<br>6.0 sec/pulse | 12.191<br>6.0 sec/pulse | 12.191<br>6.0 sec/pulse | 12.191<br>6.0 sec/pulse |
| 75.812 | 21.459 | 21.459 | 21.459 | 21.459 | 8.767 | 8.767 | 8.767 | 8.767 |

| Guy Elevation ft | Cable Weight A lb | Cable Weight B lb | Cable Weight C lb | Cable Weight D lb | Tower Intercept A ft | Tower Intercept B ft | Tower Intercept C ft | Tower Intercept D ft |
|---|---|---|---|---|---|---|---|---|
| 38.562 | 29.963 | 29.963 | 29.963 | 29.963 | 5.1 sec/pulse<br>11.131<br>5.8 sec/pulse | 5.1 sec/pulse<br>11.131<br>5.8 sec/pulse | 5.1 sec/pulse<br>11.131<br>5.8 sec/pulse | 5.1 sec/pulse<br>11.131<br>5.8 sec/pulse |

## Guy Data *(cont'd)*

| Guy Elevation ft | Calc K Single Angles | Calc K Solid Rounds | Torque Arm $K_x$ | Torque Arm $K_y$ | Pull Off $K_x$ | Pull Off $K_y$ | Diagonal $K_x$ | Diagonal $K_y$ |
|---|---|---|---|---|---|---|---|---|
| 152.771 | No | No | | | 1 | 1 | 1 | 1 |
| 127.104 | No | No | | | 1 | 1 | 1 | 1 |
| 101.437 | No | No | | | 1 | 1 | 1 | 1 |
| 75.812 | No | No | | | 1 | 1 | 1 | 1 |
| 38.562 | No | No | | | 1 | 1 | 1 | 1 |

## Guy Data *(cont'd)*

| Guy Elevation ft | Torque-Arm Bolt Size in | Torque-Arm Number | Torque-Arm Net Width Deduct in | Torque-Arm U | Pull Off Bolt Size in | Pull Off Number | Pull Off Net Width Deduct in | Pull Off U | Diagonal Bolt Size in | Diagonal Number | Diagonal Net Width Deduct in | Diagonal U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 152.771 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 |
| 127.104 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 |
| 101.437 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 |
| 75.812 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 |
| 38.562 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 | 0.625<br>A325N | 0 | 0.000 | 0.75 |

## Guy Insulator Data

| Guy Elevation ft | # | Length in | Diameter in | Weight lb | | Equivalent Unit Weight plf | Equivalent Diameter in | Equivalent Diameter w/Ice in |
|---|---|---|---|---|---|---|---|---|
| 152.771 | 13 | 3.500 | 6.000 | 0.500 | A | 0.138 | 0.313 | 1.487 |
| | | | | | B | 0.138 | 0.313 | 1.487 |
| | | | | | C | 0.138 | 0.313 | 1.487 |
| | | | | | D | 0.138 | 0.313 | 1.487 |
| 127.104 | 1 | 21.000 | 21.000 | 15.000 | A | 0.187 | 0.374 | 1.599 |
| | | | | | B | 0.187 | 0.374 | 1.599 |
| | | | | | C | 0.187 | 0.374 | 1.599 |
| | | | | | D | 0.187 | 0.374 | 1.599 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 101.437 | 12 | 3.500 | 6.000 | 0.500 | A | 0.142 | 0.323 | 1.467 |
| | | | | | B | 0.142 | 0.323 | 1.467 |
| | | | | | C | 0.142 | 0.323 | 1.467 |
| | | | | | D | 0.142 | 0.323 | 1.467 |
| 75.812 | 10 | 3.500 | 6.000 | 0.500 | A | 0.142 | 0.322 | 1.437 |
| | | | | | B | 0.142 | 0.322 | 1.437 |
| | | | | | C | 0.142 | 0.322 | 1.437 |
| | | | | | D | 0.142 | 0.322 | 1.437 |
| 38.562 | 1 | 21.000 | 21.000 | 15.000 | A | 0.220 | 0.426 | 1.588 |
| | | | | | B | 0.220 | 0.426 | 1.588 |
| | | | | | C | 0.220 | 0.426 | 1.588 |
| | | | | | D | 0.220 | 0.426 | 1.588 |

## Guy Pressures

| *Guy Elevation* *ft* | *Guy Location* | *z* *ft* | $q_z$ *ksf* | $q_z$ *Ice* *ksf* | *Ice Thickness* *in* |
|---|---|---|---|---|---|
| 152.771 | A | 76.386 | 0.069 | 0.019 | 0.590 |
| | B | 76.386 | 0.069 | 0.019 | 0.590 |
| | C | 76.386 | 0.069 | 0.019 | 0.590 |
| | D | 76.386 | 0.069 | 0.019 | 0.590 |
| 127.104 | A | 63.552 | 0.067 | 0.018 | 0.615 |
| | B | 63.552 | 0.067 | 0.018 | 0.615 |
| | C | 63.552 | 0.067 | 0.018 | 0.615 |
| | D | 63.552 | 0.067 | 0.018 | 0.615 |
| 101.437 | A | 50.719 | 0.064 | 0.018 | 0.576 |
| | B | 50.719 | 0.064 | 0.018 | 0.576 |
| | C | 50.719 | 0.064 | 0.018 | 0.576 |
| | D | 50.719 | 0.064 | 0.018 | 0.576 |
| 75.812 | A | 37.906 | 0.061 | 0.017 | 0.561 |
| | B | 37.906 | 0.061 | 0.017 | 0.561 |
| | C | 37.906 | 0.061 | 0.017 | 0.561 |
| | D | 37.906 | 0.061 | 0.017 | 0.561 |
| 38.562 | A | 19.281 | 0.053 | 0.015 | 0.583 |
| | B | 19.281 | 0.053 | 0.015 | 0.583 |
| | C | 19.281 | 0.053 | 0.015 | 0.583 |
| | D | 19.281 | 0.053 | 0.015 | 0.583 |

## Guy-Mast Forces (Excluding Wind) - No Ice

| *Guy Elevation* *ft* | *Guy Location* | *Chord Angle* ° | *Guy Tension* *Top* *Bottom* *lb* | $F_x$ *lb* | $F_y$ *lb* | $F_z$ *lb* | $M_x$ *lb-ft* | $M_y$ *lb-ft* | $M_z$ *lb-ft* |
|---|---|---|---|---|---|---|---|---|---|
| 152.771 | A | 43.021 | 200.996<br>179.900 | -98.181 | 145.328 | -98.181 | -34.254 | 0.000 | 34.254 |
| | B | 43.021 | 200.996<br>179.900 | 98.181 | 145.328 | -98.181 | -34.254 | 0.000 | -34.254 |
| | C | 43.021 | 200.996<br>179.900 | 98.181 | 145.328 | 98.181 | 34.254 | 0.000 | -34.254 |
| | D | 43.021 | 200.996<br>179.900 | -98.181 | 145.328 | 98.181 | 34.254 | 0.000 | 34.254 |
| | | | Sum: | 0.000 | 581.313 | 0.000 | 0.000 | 0.000 | 0.000 |
| 127.104 | A | 40.790 | 203.671<br>179.900 | -102.276 | 143.390 | -102.276 | -33.797 | 0.000 | 33.797 |

| Guy Elevation<br>ft | Guy Location | Chord Angle<br>° | Guy Tension Top<br>Bottom<br>lb | $F_x$<br>lb | $F_y$<br>lb | $F_z$<br>lb | $M_x$<br>lb-ft | $M_y$<br>lb-ft | $M_z$<br>lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | B | 40.790 | 203.671<br>179.900 | 102.276 | 143.390 | -102.276 | -33.797 | 0.000 | -33.797 |
| | C | 40.790 | 203.671<br>179.900 | 102.276 | 143.390 | 102.276 | 33.797 | 0.000 | -33.797 |
| | D | 40.790 | 203.671<br>179.900 | -102.276 | 143.390 | 102.276 | 33.797 | 0.000 | 33.797 |
| | | | Sum: | 0.000 | 573.561 | 0.000 | 0.000 | 0.000 | 0.000 |
| 101.437 | A | 34.552 | 194.333<br>179.897 | -108.747 | 118.800 | -108.747 | -28.002 | 0.000 | 28.002 |
| | B | 34.552 | 194.333<br>179.897 | 108.747 | 118.800 | -108.747 | -28.002 | 0.000 | -28.002 |
| | C | 34.552 | 194.333<br>179.897 | 108.747 | 118.800 | 108.747 | 28.002 | 0.000 | -28.002 |
| | D | 34.552 | 194.333<br>179.897 | -108.747 | 118.800 | 108.747 | 28.002 | 0.000 | 28.002 |
| | | | Sum: | 0.000 | 475.201 | 0.000 | 0.000 | 0.000 | 0.000 |
| 75.812 | A | 30.093 | 190.257<br>179.501 | -112.933 | 103.391 | -112.933 | -30.462 | 0.000 | 30.462 |
| | B | 30.093 | 190.257<br>179.501 | 112.933 | 103.391 | -112.933 | -30.462 | 0.000 | -30.462 |
| | C | 30.093 | 190.257<br>179.501 | 112.933 | 103.391 | 112.933 | 30.462 | 0.000 | -30.462 |
| | D | 30.093 | 190.257<br>179.501 | -112.933 | 103.391 | 112.933 | 30.462 | 0.000 | 30.462 |
| | | | Sum: | 0.000 | 413.563 | 0.000 | 0.000 | 0.000 | 0.000 |
| 38.562 | A | 16.424 | 188.363<br>179.900 | -124.485 | 66.991 | -124.485 | -19.737 | 0.000 | 19.737 |
| | B | 16.424 | 188.363<br>179.900 | 124.485 | 66.991 | -124.485 | -19.737 | 0.000 | -19.737 |
| | C | 16.424 | 188.363<br>179.900 | 124.485 | 66.991 | 124.485 | 19.737 | 0.000 | -19.737 |
| | D | 16.424 | 188.363<br>179.900 | -124.485 | 66.991 | 124.485 | 19.737 | 0.000 | 19.737 |
| | | | Sum: | 0.000 | 267.965 | 0.000 | 0.000 | 0.000 | 0.000 |

## Guy-Mast Forces (Excluding Wind) - Ice

| Guy Elevation<br>ft | Guy Location | Chord Angle<br>° | Guy Tension Top<br>Bottom<br>lb | $F_x$<br>lb | $F_y$<br>lb | $F_z$<br>lb | $M_x$<br>lb-ft | $M_y$<br>lb-ft | $M_z$<br>lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| 152.771 | A | 43.021 | 646.731<br>542.822 | -305.339 | 481.453 | -305.339 | -113.480 | 0.000 | 113.480 |
| | B | 43.021 | 646.731<br>542.822 | 305.339 | 481.453 | -305.339 | -113.480 | 0.000 | -113.480 |
| | C | 43.021 | 646.731<br>542.822 | 305.339 | 481.453 | 305.339 | 113.480 | 0.000 | -113.480 |
| | D | 43.021 | 646.731<br>542.822 | -305.339 | 481.453 | 305.339 | 113.480 | 0.000 | 113.480 |
| | | | Sum: | 0.000 | 1925.813 | 0.000 | 0.000 | 0.000 | 0.000 |
| 127.104 | A | 40.790 | 634.026<br>532.412 | -309.832 | 458.255 | -309.832 | -108.012 | 0.000 | 108.012 |
| | B | 40.790 | 634.026 | 309.832 | 458.255 | -309.832 | -108.012 | 0.000 | -108.012 |

| Guy Elevation | Guy Location | Chord Angle | Guy Tension Top Bottom lb | $F_x$ | $F_y$ | $F_z$ | $M_x$ | $M_y$ | $M_z$ |
|---|---|---|---|---|---|---|---|---|---|
| ft | | ° | | lb | lb | lb | lb-ft | lb-ft | lb-ft |
| | | | 532.412 | | | | | | |
| | C | 40.790 | 634.026 | 309.832 | 458.255 | 309.832 | 108.012 | 0.000 | -108.012 |
| | | | 532.412 | | | | | | |
| | D | 40.790 | 634.026 | -309.832 | 458.255 | 309.832 | 108.012 | 0.000 | 108.012 |
| | | | 532.412 | | | | | | |
| | | | Sum: | 0.000 | 1833.019 | 0.000 | 0.000 | 0.000 | 0.000 |
| 101.437 | A | 34.552 | 577.844 | -315.617 | 366.981 | -315.617 | -86.498 | 0.000 | 86.498 |
| | | | 511.654 | | | | | | |
| | B | 34.552 | 577.844 | 315.617 | 366.981 | -315.617 | -86.498 | 0.000 | -86.498 |
| | | | 511.654 | | | | | | |
| | C | 34.552 | 577.844 | 315.617 | 366.981 | 315.617 | 86.498 | 0.000 | -86.498 |
| | | | 511.654 | | | | | | |
| | D | 34.552 | 577.844 | -315.617 | 366.981 | 315.617 | 86.498 | 0.000 | 86.498 |
| | | | 511.654 | | | | | | |
| | | | Sum: | 0.000 | 1467.924 | 0.000 | 0.000 | 0.000 | 0.000 |
| 75.812 | A | 30.093 | 527.557 | -306.890 | 299.924 | -306.890 | -88.366 | 0.000 | 88.366 |
| | | | 479.825 | | | | | | |
| | B | 30.093 | 527.557 | 306.890 | 299.924 | -306.890 | -88.366 | 0.000 | -88.366 |
| | | | 479.825 | | | | | | |
| | C | 30.093 | 527.557 | 306.890 | 299.924 | 306.890 | 88.366 | 0.000 | -88.366 |
| | | | 479.825 | | | | | | |
| | D | 30.093 | 527.557 | -306.890 | 299.924 | 306.890 | 88.366 | 0.000 | 88.366 |
| | | | 479.825 | | | | | | |
| | | | Sum: | 0.000 | 1199.695 | 0.000 | 0.000 | 0.000 | 0.000 |
| 38.562 | A | 16.424 | 512.372 | -335.665 | 192.829 | -335.665 | -56.813 | 0.000 | 56.813 |
| | | | 482.803 | | | | | | |
| | B | 16.424 | 512.372 | 335.665 | 192.829 | -335.665 | -56.813 | 0.000 | -56.813 |
| | | | 482.803 | | | | | | |
| | C | 16.424 | 512.372 | 335.665 | 192.829 | 335.665 | 56.813 | 0.000 | -56.813 |
| | | | 482.803 | | | | | | |
| | D | 16.424 | 512.372 | -335.665 | 192.829 | 335.665 | 56.813 | 0.000 | 56.813 |
| | | | 482.803 | | | | | | |
| | | | Sum: | 0.000 | 771.317 | 0.000 | 0.000 | 0.000 | 0.000 |

## Guy-Mast Forces (Excluding Wind) - Service

| Guy Elevation | Guy Location | Chord Angle | Guy Tension Top Bottom lb | $F_x$ | $F_y$ | $F_z$ | $M_x$ | $M_y$ | $M_z$ |
|---|---|---|---|---|---|---|---|---|---|
| ft | | ° | | lb | lb | lb | lb-ft | lb-ft | lb-ft |
| 152.771 | A | 43.021 | 200.996 | -98.181 | 145.328 | -98.181 | -34.254 | 0.000 | 34.254 |
| | | | 179.900 | | | | | | |
| | B | 43.021 | 200.996 | 98.181 | 145.328 | -98.181 | -34.254 | 0.000 | -34.254 |
| | | | 179.900 | | | | | | |
| | C | 43.021 | 200.996 | 98.181 | 145.328 | 98.181 | 34.254 | 0.000 | -34.254 |
| | | | 179.900 | | | | | | |
| | D | 43.021 | 200.996 | -98.181 | 145.328 | 98.181 | 34.254 | 0.000 | 34.254 |
| | | | 179.900 | | | | | | |
| | | | Sum: | 0.000 | 581.313 | 0.000 | 0.000 | 0.000 | 0.000 |
| 127.104 | A | 40.790 | 203.671 | -102.276 | 143.390 | -102.276 | -33.797 | 0.000 | 33.797 |
| | | | 179.900 | | | | | | |
| | B | 40.790 | 203.671 | 102.276 | 143.390 | -102.276 | -33.797 | 0.000 | -33.797 |
| | | | 179.900 | | | | | | |

| Guy Elevation | Guy Location | Chord Angle | Guy Tension Top Bottom | $F_x$ | $F_y$ | $F_z$ | $M_x$ | $M_y$ | $M_z$ |
|---|---|---|---|---|---|---|---|---|---|
| ft | | ° | lb | lb | lb | lb | lb-ft | lb-ft | lb-ft |
| | C | 40.790 | 203.671 | 102.276 | 143.390 | 102.276 | 33.797 | 0.000 | -33.797 |
| | | | 179.900 | | | | | | |
| | D | 40.790 | 203.671 | -102.276 | 143.390 | 102.276 | 33.797 | 0.000 | 33.797 |
| | | | 179.900 | | | | | | |
| | | | Sum: | 0.000 | 573.561 | 0.000 | 0.000 | 0.000 | 0.000 |
| 101.437 | A | 34.552 | 194.333 | -108.747 | 118.800 | -108.747 | -28.002 | 0.000 | 28.002 |
| | | | 179.897 | | | | | | |
| | B | 34.552 | 194.333 | 108.747 | 118.800 | -108.747 | -28.002 | 0.000 | -28.002 |
| | | | 179.897 | | | | | | |
| | C | 34.552 | 194.333 | 108.747 | 118.800 | 108.747 | 28.002 | 0.000 | -28.002 |
| | | | 179.897 | | | | | | |
| | D | 34.552 | 194.333 | -108.747 | 118.800 | 108.747 | 28.002 | 0.000 | 28.002 |
| | | | 179.897 | | | | | | |
| | | | Sum: | 0.000 | 475.201 | 0.000 | 0.000 | 0.000 | 0.000 |
| 75.812 | A | 30.093 | 190.257 | -112.933 | 103.391 | -112.933 | -30.462 | 0.000 | 30.462 |
| | | | 179.501 | | | | | | |
| | B | 30.093 | 190.257 | 112.933 | 103.391 | -112.933 | -30.462 | 0.000 | -30.462 |
| | | | 179.501 | | | | | | |
| | C | 30.093 | 190.257 | 112.933 | 103.391 | 112.933 | 30.462 | 0.000 | -30.462 |
| | | | 179.501 | | | | | | |
| | D | 30.093 | 190.257 | -112.933 | 103.391 | 112.933 | 30.462 | 0.000 | 30.462 |
| | | | 179.501 | | | | | | |
| | | | Sum: | 0.000 | 413.563 | 0.000 | 0.000 | 0.000 | 0.000 |
| 38.562 | A | 16.424 | 188.363 | -124.485 | 66.991 | -124.485 | -19.737 | 0.000 | 19.737 |
| | | | 179.900 | | | | | | |
| | B | 16.424 | 188.363 | 124.485 | 66.991 | -124.485 | -19.737 | 0.000 | -19.737 |
| | | | 179.900 | | | | | | |
| | C | 16.424 | 188.363 | 124.485 | 66.991 | 124.485 | 19.737 | 0.000 | -19.737 |
| | | | 179.900 | | | | | | |
| | D | 16.424 | 188.363 | -124.485 | 66.991 | 124.485 | 19.737 | 0.000 | 19.737 |
| | | | 179.900 | | | | | | |
| | | | Sum: | 0.000 | 267.965 | 0.000 | 0.000 | 0.000 | 0.000 |

# Guy-Tensioning Information

| | | | | Temperature At Time Of Tensioning | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 0 F | | 20 F | | 40 F | | 60 F | | 80 F | | 100 F | | 120 F | |
| Guy Elevation | | H | V | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept |
| ft | | ft | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft |
| 152.771 | A | 163.71 | 152.77 | 208.611 | 15.82 | 197.519 | 16.67 | 188.548 | 17.43 | 179.900 | 18.22 | 171.990 | 19.02 | 164.899 | 19.79 | 158.130 | 20.59 |
| | B | 163.71 | 152.77 | 208.611 | 15.82 | 197.519 | 16.67 | 188.548 | 17.43 | 179.900 | 18.22 | 171.990 | 19.02 | 164.899 | 19.79 | 158.130 | 20.59 |
| | C | 163.71 | 152.77 | 208.611 | 15.82 | 197.519 | 16.67 | 188.548 | 17.43 | 179.900 | 18.22 | 171.990 | 19.02 | 164.899 | 19.79 | 158.130 | 20.59 |
| | D | 163.71 | 152.77 | 208.611 | 15.82 | 197.519 | 16.67 | 188.548 | 17.43 | 179.900 | 18.22 | 171.990 | 19.02 | 164.899 | 19.79 | 158.130 | 20.59 |
| 127.104 | A | 147.30 | 127.10 | 202.355 | 16.57 | 194.550 | 17.20 | 187.057 | 17.85 | 179.900 | 18.52 | 173.715 | 19.15 | 167.917 | 19.77 | 162.529 | 20.39 |
| | B | 147.30 | 127.10 | 202.355 | 16.57 | 194.550 | 17.20 | 187.057 | 17.85 | 179.900 | 18.52 | 173.715 | 19.15 | 167.917 | 19.77 | 162.529 | 20.39 |
| | C | 147.30 | 127.10 | 202.355 | 16.57 | 194.550 | 17.20 | 187.057 | 17.85 | 179.900 | 18.52 | 173.715 | 19.15 | 167.917 | 19.77 | 162.529 | 20.39 |
| | D | 147.30 | 127.10 | 202.355 | 16.57 | 194.550 | 17.20 | 187.057 | 17.85 | 179.900 | 18.52 | 173.715 | 19.15 | 167.917 | 19.77 | 162.529 | 20.39 |
| 101.437 | A | 147.30 | 101.44 | 221.503 | 9.96 | 205.901 | 10.70 | 192.152 | 11.44 | 179.900 | 12.19 | 169.430 | 12.92 | 160.286 | 13.63 | 151.863 | 14.35 |
| | B | 147.30 | 101.44 | 221.503 | 9.96 | 205.901 | 10.70 | 192.152 | 11.44 | 179.900 | 12.19 | 169.430 | 12.92 | 160.286 | 13.63 | 151.863 | 14.35 |
| | C | 147.30 | 101.44 | 221.503 | 9.96 | 205.901 | 10.70 | 192.152 | 11.44 | 179.900 | 12.19 | 169.430 | 12.92 | 160.286 | 13.63 | 151.863 | 14.35 |
| | D | 147.30 | 101.44 | 221.503 | 9.96 | 205.901 | 10.70 | 192.152 | 11.44 | 179.900 | 12.19 | 169.430 | 12.92 | 160.286 | 13.63 | 151.863 | 14.35 |
| 75.812 | A | 130.82 | 75.81 | 233.605 | 6.79 | 212.798 | 7.44 | 194.834 | 8.11 | 179.900 | 8.77 | 166.165 | 9.47 | 154.849 | 10.15 | 144.738 | 10.83 |
| | B | 130.82 | 75.81 | 233.605 | 6.79 | 212.798 | 7.44 | 194.834 | 8.11 | 179.900 | 8.77 | 166.165 | 9.47 | 154.849 | 10.15 | 144.738 | 10.83 |
| | C | 130.82 | 75.81 | 233.605 | 6.79 | 212.798 | 7.44 | 194.834 | 8.11 | 179.900 | 8.77 | 166.165 | 9.47 | 154.849 | 10.15 | 144.738 | 10.83 |
| | D | 130.82 | 75.81 | 233.605 | 6.79 | 212.798 | 7.44 | 194.834 | 8.11 | 179.900 | 8.77 | 166.165 | 9.47 | 154.849 | 10.15 | 144.738 | 10.83 |
| 38.562 | A | 130.82 | 38.56 | 212.634 | 9.44 | 199.544 | 10.05 | 189.342 | 10.58 | 179.900 | 11.13 | 171.471 | 11.67 | 163.423 | 12.24 | 156.937 | 12.73 |
| | B | 130.82 | 38.56 | 212.634 | 9.44 | 199.544 | 10.05 | 189.342 | 10.58 | 179.900 | 11.13 | 171.471 | 11.67 | 163.423 | 12.24 | 156.937 | 12.73 |
| | C | 130.82 | 38.56 | 212.634 | 9.44 | 199.544 | 10.05 | 189.342 | 10.58 | 179.900 | 11.13 | 171.471 | 11.67 | 163.423 | 12.24 | 156.937 | 12.73 |

| | | | Temperature At Time Of Tensioning | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 F | | 20 F | | 40 F | | 60 F | | 80 F | | 100 F | | 120 F | |
| Guy Elevation | H | V | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept | Initial Tension | Intercept |
| ft | ft | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft | lb | ft |
| D | 130.82 | 38.56 | 212.634 | 9.44 | 199.544 | 10.05 | 189.342 | 10.58 | 179.900 | 11.13 | 171.471 | 11.67 | 163.423 | 12.24 | 156.937 | 12.73 |

## Feed Line/Linear Appurtenances - Entered As Area

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Total Number | | $C_AA_A$ $ft^2/ft$ | Weight plf |
|---|---|---|---|---|---|---|---|---|---|
| Cat5 (0.473" Dia.) | C | No | Yes | Inside Pole | 165.604 - 0.000 | 14 | No Ice | 0.000 | 0.150 |
| | | | | | | | 1/2" Ice | 0.000 | 0.150 |

## Feed Line/Linear Appurtenances Section Areas

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| L1 | 165.604-152.771 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 26.949 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L2 | 152.771-127.104 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 53.901 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L3 | 127.104-101.437 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 53.901 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L4 | 101.437-75.812 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 53.812 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L5 | 75.812-38.562 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 78.225 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L6 | 38.562-0.000 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 80.980 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

## Feed Line/Linear Appurtenances Section Areas - With Ice

| Tower Section | Tower Elevation ft | Face or Leg | Ice Thickness in | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|

| Tower Section | Tower Elevation ft | Face or Leg | Ice Thickness in | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|
| L1 | 165.604-152.771 | A | 0.586 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 26.949 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L2 | 152.771-127.104 | A | 0.580 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 53.901 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L3 | 127.104-101.437 | A | 0.571 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 53.901 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L4 | 101.437-75.812 | A | 0.559 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 53.812 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L5 | 75.812-38.562 | A | 0.538 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 78.225 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L6 | 38.562-0.000 | A | 0.487 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 80.980 |
| | | D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

## Antenna Pole Forces *Lightning Rod*

| Length of Pole ft | Ix $in^4$ | Iy $in^4$ | Modulus E ksi | | Antenna Pole $C_AA_A$ $ft^2/ft$ | Antenna Pole Weight plf | Length of Beacon ft | Beacon $C_AA_A$ $ft^2$ | Beacon Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| 5.000 | 1000.000 | 1000.000 | 29000.000 | No Ice | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | With Ice | 0.020 | 0.000 | | 0.000 | 0.000 |

## Discrete Tower Loads

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral Vert ft ft ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|---|---|
| ********** | | | | | | | | | |
| Propellor Anemometer/Wind Vane | C | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 167.979 | No Ice<br>1/2" Ice | 0.350<br>0.500 | 0.350<br>0.500 | 2.200<br>5.000 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 164.979 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| ********** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920 | 0.000 | 162.402 | No Ice | 0.200 | 0.250 | 0.200 |

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral Vert<br>ft ft ft | Azimuth Adjustment<br>° | Placement<br>ft | | $C_AA_A$ Front<br>$ft^2$ | $C_AA_A$ Side<br>$ft^2$ | Weight<br>lb |
|---|---|---|---|---|---|---|---|---|---|
| | | | 0.000<br>0.000 | | | 1/2" Ice | 0.350 | 0.350 | 0.500 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 159.402 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 162.402 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 159.402 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| *** | | | | | | | | | |
| 21" Dia. Aircraft Marker Ball (Orange) | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 145.997 | No Ice<br>1/2" Ice | 1.130<br>1.241 | 1.130<br>1.241 | 15.000<br>20.000 |
| 21" Dia. Aircraft Marker Ball (Orange) | B | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 145.997 | No Ice<br>1/2" Ice | 1.130<br>1.241 | 1.130<br>1.241 | 15.000<br>20.000 |
| 21" Dia. Aircraft Marker Ball (Orange) | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 145.997 | No Ice<br>1/2" Ice | 1.130<br>1.241 | 1.130<br>1.241 | 15.000<br>20.000 |
| 21" Dia. Aircraft Marker Ball (Orange) | D | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 145.997 | No Ice<br>1/2" Ice | 1.130<br>1.241 | 1.130<br>1.241 | 15.000<br>20.000 |
| *** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 130.577 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 127.577 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 130.577 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 127.577 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| *** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 105.315 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 102.315 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 105.315 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 102.315 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| *** | | | | | | | | | |
| NRG 200P Wind Vane | C | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 156.496 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.250<br>0.500 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 153.496 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral Vert<br>ft<br>ft<br>ft | Azimuth Adjustment<br>° | Placement<br>ft | | $C_AA_A$ Front<br>$ft^2$ | $C_AA_A$ Side<br>$ft^2$ | Weight<br>lb |
|---|---|---|---|---|---|---|---|---|---|
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 156.496 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.200<br>0.500 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 153.496 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| *** | | | | | | | | | |
| NRG 200P Wind Vane | C | From Leg | 7.920<br>0.000<br>0.000 | 0.000 | 111.220 | No Ice<br>1/2" Ice | 0.200<br>0.350 | 0.250<br>0.350 | 0.250<br>0.500 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 108.220 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 1.000<br>1.250 | 8.000<br>10.000 |
| *** | | | | | | | | | |
| Data Logger | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 4.920 | No Ice<br>1/2" Ice | 4.000<br>4.250 | 4.000<br>4.250 | 50.000<br>55.000 |
| Temperature Sensor | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 49.213 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 0.250<br>0.350 | 10.000<br>15.000 |
| ***** | | | | | | | | | |
| Temperature Sensor | C | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 140.420 | No Ice<br>1/2" Ice | 0.250<br>0.350 | 0.250<br>0.350 | 5.000<br>10.000 |
| Relative Humidity Sensor | A | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 140.420 | No Ice<br>1/2" Ice | 0.350<br>0.500 | 0.350<br>0.500 | 5.000<br>10.000 |
| Barometric Pressure Sensor | B | From Leg | 0.000<br>0.000<br>0.000 | 0.000 | 140.420 | No Ice<br>1/2" Ice | 0.350<br>0.500 | 0.350<br>0.500 | 2.500<br>5.000 |

## 222-H Verification Constants

| Constant | Value |
|---|---|
| $K_d$ | 0.95 |
| Ice Thickness Importance Factor | 0.8 |
| $Z_g$ | 900 |
| $\alpha$ | 9.5 |
| $K_{zmin}$ | 0.85 |
| $K_c$ | 1 |
| $K_t$ | 0.43 |
| f | 1.25 |
| $K_e$ | 0.915 |

## 222-H Section Verification ArRr By Element

| Section Elevation ft | Elem. Num. | Size | C | C w/Ice | Face | e | e w/Ice | $A_r$ $ft^2$ | $A_r$ w/Ice $ft^2$ | $A_rR_r$ $ft^2$ | $A_rR_r$ w/Ice $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 165.604-152.771 | 2 | Guyed Pole 8" OD | 119.253 | 71.327 | | 1 | 1 | 8.555 | 9.808 | 8.555 | 9.808 |
| | | | | | | | Sum: | 8.555 | 9.808 | 8.555 | 9.808 |
| L2 152.771-127.104 | 3 | Guyed Pole 8" OD | 118.166 | 70.589 | | 1 | 1 | 17.111 | 19.592 | 17.111 | 19.592 |
| | | | | | | | Sum: | 17.111 | 19.592 | 17.111 | 19.592 |
| L3 127.104-101.437 | 4 | Guyed Pole 8" OD | 116.364 | 69.372 | | 1 | 1 | 17.111 | 19.552 | 17.111 | 19.552 |
| | | | | | | | Sum: | 17.111 | 19.552 | 17.111 | 19.552 |
| L4 101.437-75.812 | 5 | Guyed Pole 10" OD | 142.475 | 82.64 | | 1 | 1 | 21.354 | 23.740 | 21.354 | 23.740 |
| | | | | | | | Sum: | 21.354 | 23.740 | 21.354 | 23.740 |
| L5 75.812-38.562 | 6 | Guyed Pole 10" OD | 137.146 | 79.25 | | 1 | 1 | 31.042 | 34.380 | 31.042 | 34.380 |
| | | | | | | | Sum: | 31.042 | 34.380 | 31.042 | 34.380 |
| L6 38.562-0.000 | 7 | Guyed Pole 10" OD | 123.791 | 70.874 | | 1 | 1 | 32.135 | 35.263 | 32.135 | 35.263 |
| | | | | | | | Sum: | 32.135 | 35.263 | 32.135 | 35.263 |

## 222-H Section Verification Tables - No Ice

| Section Elevation ft | $z_{wind}$ ft | $z_{ice}$ ft | $K_z$ | $K_h$ | $K_{zt}$ | $t_z$ in | $q_z$ ksf | Face | e | $A_rR_r$ $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 165.604-152.771 | 159.188 | | 1.396 | 1.142 | 1.895 | | 0.078 | | 1 | 8.555 |
| L2 152.771-127.104 | 139.938 | | 1.358 | 1.124 | 1.912 | | 0.076 | | 1 | 17.111 |
| L3 127.104-101.437 | 114.271 | | 1.302 | 1.1 | 1.935 | | 0.074 | | 1 | 17.111 |
| L4 101.437-75.812 | 88.625 | | 1.234 | 1.077 | 1.958 | | 0.071 | | 1 | 21.354 |
| L5 75.812-38.562 | 57.467 | | 1.126 | 1.049 | 1.988 | | 0.066 | | 1 | 31.042 |
| L6 38.562-0.000 | 19.894 | | 0.901 | 1.017 | 2.025 | | 0.054 | | 1 | 32.135 |

## 222-H Section Verification Tables - Ice

| Section Elevation ft | $z_{wind}$ ft | $z_{ice}$ ft | $K_z$ | $K_h$ | $K_{zt}$ | $t_z$ in | $q_z$ ksf | Face | e | $A_rR_r$ $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 165.604-152.771 | 159.188 | 159.188 | 1.396 | 1.142 | 1.895 | 0.586 | 0.021 | | 1 | 9.808 |
| L2 152.771-127.104 | 139.938 | 139.938 | 1.358 | 1.124 | 1.912 | 0.580 | 0.021 | | 1 | 19.592 |
| L3 127.104-101.437 | 114.271 | 114.271 | 1.302 | 1.1 | 1.935 | 0.571 | 0.020 | | 1 | 19.552 |
| L4 101.437-75.812 | 88.625 | 88.625 | 1.234 | 1.077 | 1.958 | 0.559 | 0.019 | | 1 | 23.740 |
| L5 75.812-38.562 | 57.467 | 57.187 | 1.126 | 1.049 | 1.988 | 0.538 | 0.018 | | 1 | 34.380 |
| L6 38.562-0.000 | 19.894 | 19.281 | 0.901 | 1.017 | 2.025 | 0.487 | 0.015 | | 1 | 35.263 |

## 222-H Section Verification Tables - Service

| Section Elevation ft | $z_{wind}$ ft | $z_{ice}$ ft | $K_z$ | $K_h$ | $K_{zt}$ | $t_z$ in | $q_z$ ksf | Face | e | $A_rR_r$ $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 165.604-152.771 | 159.188 | | 1.396 | 1.142 | 1.895 | | 0.019 | | 1 | 8.555 |
| L2 152.771-127.104 | 139.938 | | 1.358 | 1.124 | 1.912 | | 0.019 | | 1 | 17.111 |
| L3 127.104-101.437 | 114.271 | | 1.302 | 1.1 | 1.935 | | 0.018 | | 1 | 17.111 |
| L4 101.437-75.812 | 88.625 | | 1.234 | 1.077 | 1.958 | | 0.017 | | 1 | 21.354 |
| L5 75.812-38.562 | 57.467 | | 1.126 | 1.049 | 1.988 | | 0.016 | | 1 | 31.042 |
| L6 38.562-0.000 | 19.894 | | 0.901 | 1.017 | 2.025 | | 0.013 | | 1 | 32.135 |

## Tower Forces - No Ice - Wind Normal To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 103.024 | A | 1 | 0.6 | 0.078 | 1 | 1 | 8.555 | 439.402 | 34.240 | D |
| 165.604-152.7 | | | B | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| L2 | 53.901 | 206.055 | A | 1 | 0.6 | 0.076 | 1 | 1 | 17.111 | 862.897 | 33.619 | D |
| 152.771-127.1 | | | B | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| L3 | 53.901 | 206.055 | A | 1 | 0.6 | 0.074 | 1 | 1 | 17.111 | 836.786 | 32.602 | D |
| 127.104-101.4 | | | B | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| L4 | 53.812 | 268.511 | A | 1 | 0.6 | 0.071 | 1 | 1 | 21.354 | 1001.919 | 39.099 | D |
| 101.437-75.81 | | | B | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| 2 | | | C | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| L5 | 78.225 | 390.323 | A | 1 | 0.6 | 0.066 | 1 | 1 | 31.042 | 1345.147 | 36.111 | D |
| 75.812-38.562 | | | B | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| L6 | 80.980 | 404.071 | A | 1 | 0.6 | 0.054 | 1 | 1 | 32.135 | 1152.718 | 29.893 | D |
| 38.562-0.000 | | | B | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| Sum Weight: | 347.768 | 1578.039 | | | | | | | | 5638.869 | | |

## Tower Forces - No Ice - Wind 45 To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 103.024 | A | 1 | 0.6 | 0.078 | 1 | 1 | 8.555 | 439.402 | 34.240 | D |
| 165.604-152.7 | | | B | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 8.555 | | | |
| L2 | 53.901 | 206.055 | A | 1 | 0.6 | 0.076 | 1 | 1 | 17.111 | 862.897 | 33.619 | D |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 152.771-127.1 | | | B | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| L3 | 53.901 | 206.055 | A | 1 | 0.6 | 0.074 | 1 | 1 | 17.111 | 836.786 | 32.602 | D |
| 127.104-101.4 | | | B | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 17.111 | | | |
| L4 | 53.812 | 268.511 | A | 1 | 0.6 | 0.071 | 1 | 1 | 21.354 | 1001.919 | 39.099 | D |
| 101.437-75.81 | | | B | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| 2 | | | C | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 21.354 | | | |
| L5 | 78.225 | 390.323 | A | 1 | 0.6 | 0.066 | 1 | 1 | 31.042 | 1345.147 | 36.111 | D |
| 75.812-38.562 | | | B | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 31.042 | | | |
| L6 | 80.980 | 404.071 | A | 1 | 0.6 | 0.054 | 1 | 1 | 32.135 | 1152.718 | 29.893 | D |
| 38.562-0.000 | | | B | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 32.135 | | | |
| Sum Weight: | 347.768 | 1578.039 | | | | | | | | 5638.869 | | |

## Tower Forces - With Ice - Wind Normal To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 181.843 | A | 1 | 1.2 | 0.021 | 1 | 1 | 9.808 | 274.239 | 21.370 | D |
| 165.604-152.7 | | | B | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| 71 | | | C | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| L2 | 53.901 | 362.059 | A | 1 | 1.2 | 0.021 | 1 | 1 | 19.592 | 537.880 | 20.956 | D |
| 152.771-127.1 | | | B | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| 04 | | | C | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| L3 | 53.901 | 359.404 | A | 1 | 1.2 | 0.020 | 1 | 1 | 19.552 | 520.550 | 20.281 | D |
| 127.104-101.4 | | | B | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| 37 | | | C | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| L4 | 53.812 | 453.168 | A | 1 | 1.2 | 0.019 | 1 | 1 | 23.740 | 606.411 | 23.665 | D |
| 101.437-75.81 | | | B | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| 2 | | | C | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| L5 | 78.225 | 648.210 | A | 1 | 1.2 | 0.018 | 1 | 1 | 34.380 | 811.092 | 21.774 | D |
| 75.812-38.562 | | | B | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| L6 | 80.980 | 644.554 | A | 1 | 1.2 | 0.015 | 1 | 1 | 35.263 | 688.661 | 17.859 | D |
| 38.562-0.000 | | | B | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| Sum Weight: | 347.768 | 2649.238 | | | | | | | | 3438.833 | | |

## Tower Forces - With Ice - Wind 45 To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 181.843 | A | 1 | 1.2 | 0.021 | 1 | 1 | 9.808 | 274.239 | 21.370 | D |
| 165.604-152.7 | | | B | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| 71 | | | C | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 9.808 | | | |
| L2 | 53.901 | 362.059 | A | 1 | 1.2 | 0.021 | 1 | 1 | 19.592 | 537.880 | 20.956 | D |
| 152.771-127.1 | | | B | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| 04 | | | C | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 19.592 | | | |
| L3 | 53.901 | 359.404 | A | 1 | 1.2 | 0.020 | 1 | 1 | 19.552 | 520.550 | 20.281 | D |
| 127.104-101.4 | | | B | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| 37 | | | C | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 19.552 | | | |
| L4 | 53.812 | 453.168 | A | 1 | 1.2 | 0.019 | 1 | 1 | 23.740 | 606.411 | 23.665 | D |
| 101.437-75.81 | | | B | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| 2 | | | C | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 23.740 | | | |
| L5 | 78.225 | 648.210 | A | 1 | 1.2 | 0.018 | 1 | 1 | 34.380 | 811.092 | 21.774 | D |
| 75.812-38.562 | | | B | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 34.380 | | | |
| L6 | 80.980 | 644.554 | A | 1 | 1.2 | 0.015 | 1 | 1 | 35.263 | 688.661 | 17.859 | D |
| 38.562-0.000 | | | B | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| | | | D | 1 | 1.2 | | 1 | 1 | 35.263 | | | |
| Sum Weight: | 347.768 | 2649.238 | | | | | | | | 3438.833 | | |

## Tower Forces - Service - Wind Normal To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 103.024 | A | 1 | 0.752 | 0.019 | 1 | 1 | 8.555 | 134.165 | 10.455 | D |
| 165.604-152.7 | | | B | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| 71 | | | C | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| | | | D | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| L2 | 53.901 | 206.055 | A | 1 | 0.759 | 0.019 | 1 | 1 | 17.111 | 265.895 | 10.359 | D |
| 152.771-127.1 | | | B | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| 04 | | | C | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| L3 | 53.901 | 206.055 | A | 1 | 0.771 | 0.018 | 1 | 1 | 17.111 | 261.841 | 10.201 | D |
| 127.104-101.4 | | | B | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| 37 | | | C | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| L4 | 53.812 | 268.511 | A | 1 | 0.63 | 0.017 | 1 | 1 | 21.354 | 256.057 | 9.992 | D |
| 101.437-75.81 | | | B | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| 2 | | | C | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| | | | D | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| L5 | 78.225 | 390.323 | A | 1 | 0.654 | 0.016 | 1 | 1 | 31.042 | 357.132 | 9.587 | D |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75.812-38.562 | | | B | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| | | | C | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| | | | D | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| L6 | 80.980 | 404.071 | A | 1 | 0.725 | 0.013 | 1 | 1 | 32.135 | 339.062 | 8.793 | D |
| 38.562-0.000 | | | B | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| | | | C | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| | | | D | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| Sum Weight: | 347.768 | 1578.039 | | | | | | | | 1614.150 | | |

## Tower Forces - Service - Wind 45 To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 26.949 | 103.024 | A | 1 | 0.752 | 0.019 | 1 | 1 | 8.555 | 134.165 | 10.455 | D |
| 165.604-152.7 | | | B | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| 71 | | | C | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| | | | D | 1 | 0.752 | | 1 | 1 | 8.555 | | | |
| L2 | 53.901 | 206.055 | A | 1 | 0.759 | 0.019 | 1 | 1 | 17.111 | 265.895 | 10.359 | D |
| 152.771-127.1 | | | B | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| 04 | | | C | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.759 | | 1 | 1 | 17.111 | | | |
| L3 | 53.901 | 206.055 | A | 1 | 0.771 | 0.018 | 1 | 1 | 17.111 | 261.841 | 10.201 | D |
| 127.104-101.4 | | | B | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| 37 | | | C | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| | | | D | 1 | 0.771 | | 1 | 1 | 17.111 | | | |
| L4 | 53.812 | 268.511 | A | 1 | 0.63 | 0.017 | 1 | 1 | 21.354 | 256.057 | 9.992 | D |
| 101.437-75.81 | | | B | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| 2 | | | C | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| | | | D | 1 | 0.63 | | 1 | 1 | 21.354 | | | |
| L5 | 78.225 | 390.323 | A | 1 | 0.654 | 0.016 | 1 | 1 | 31.042 | 357.132 | 9.587 | D |
| 75.812-38.562 | | | B | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| | | | C | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| | | | D | 1 | 0.654 | | 1 | 1 | 31.042 | | | |
| L6 | 80.980 | 404.071 | A | 1 | 0.725 | 0.013 | 1 | 1 | 32.135 | 339.062 | 8.793 | D |
| 38.562-0.000 | | | B | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| | | | C | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| | | | D | 1 | 0.725 | | 1 | 1 | 32.135 | | | |
| Sum Weight: | 347.768 | 1578.039 | | | | | | | | 1614.150 | | |

## Force Totals (Does not include forces on guys)

| Load Case | Vertical Forces lb | Sum of Forces X lb | Sum of Forces Z lb | Sum of Torques lb-ft |
|---|---|---|---|---|
| Leg Weight | 1578.039 | | | |
| Bracing Weight | 0.000 | | | |

| Load Case | Vertical Forces lb | Sum of Forces X lb | Sum of Forces Z lb | Sum of Torques lb-ft |
|---|---|---|---|---|
| Total Member Self-Weight | 1578.039 | | | |
| Guy Weight | 576.985 | | | |
| Total Weight | 2719.392 | | | |
| Wind 0 deg - No Ice | | 0.000 | -7324.152 | 410.134 |
| Wind 45 deg - No Ice | | 5178.958 | -5178.958 | 570.206 |
| Wind 90 deg - No Ice | | 7324.152 | 0.000 | 396.260 |
| Wind 135 deg - No Ice | | 5178.958 | 5178.958 | -9.810 |
| Wind 180 deg - No Ice | | 0.000 | 7324.152 | -410.134 |
| Wind 225 deg - No Ice | | -5178.958 | 5178.958 | -570.206 |
| Wind 270 deg - No Ice | | -7324.152 | 0.000 | -396.260 |
| Wind 315 deg - No Ice | | -5178.958 | -5178.958 | 9.810 |
| Member Ice | 1071.200 | | | |
| Guy Ice | 2123.596 | | | |
| Total Weight Ice | 5990.891 | | | |
| Wind 0 deg - Ice | | 0.000 | -4017.747 | 155.778 |
| Wind 45 deg - Ice | | 2840.976 | -2840.976 | 216.306 |
| Wind 90 deg - Ice | | 4017.747 | 0.000 | 150.124 |
| Wind 135 deg - Ice | | 2840.976 | 2840.976 | -3.998 |
| Wind 180 deg - Ice | | 0.000 | 4017.747 | -155.778 |
| Wind 225 deg - Ice | | -2840.976 | 2840.976 | -216.306 |
| Wind 270 deg - Ice | | -4017.747 | 0.000 | -150.124 |
| Wind 315 deg - Ice | | -2840.976 | -2840.976 | 3.998 |
| Total Weight | 2719.392 | | | |
| Wind 0 deg - Service | | 0.000 | -2024.614 | 99.891 |
| Wind 45 deg - Service | | 1431.618 | -1431.618 | 138.878 |
| Wind 90 deg - Service | | 2024.614 | 0.000 | 96.512 |
| Wind 135 deg - Service | | 1431.618 | 1431.618 | -2.389 |
| Wind 180 deg - Service | | 0.000 | 2024.614 | -99.891 |
| Wind 225 deg - Service | | -1431.618 | 1431.618 | -138.878 |
| Wind 270 deg - Service | | -2024.614 | 0.000 | -96.512 |
| Wind 315 deg - Service | | -1431.618 | -1431.618 | 2.389 |

## Load Combinations

| Comb. No. | Description |
|---|---|
| 1 | Dead Only |
| 2 | 1.2 Dead+1.0 Wind 0 deg - No Ice+1.0 Guy |
| 3 | 1.2 Dead+1.0 Wind 45 deg - No Ice+1.0 Guy |
| 4 | 1.2 Dead+1.0 Wind 90 deg - No Ice+1.0 Guy |
| 5 | 1.2 Dead+1.0 Wind 135 deg - No Ice+1.0 Guy |
| 6 | 1.2 Dead+1.0 Wind 180 deg - No Ice+1.0 Guy |
| 7 | 1.2 Dead+1.0 Wind 225 deg - No Ice+1.0 Guy |
| 8 | 1.2 Dead+1.0 Wind 270 deg - No Ice+1.0 Guy |
| 9 | 1.2 Dead+1.0 Wind 315 deg - No Ice+1.0 Guy |
| 10 | 1.2 Dead+1.0 Ice+Guy |
| 11 | 1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Guy |
| 12 | 1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Guy |
| 13 | 1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Guy |
| 14 | 1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Guy |
| 15 | 1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Guy |
| 16 | 1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Guy |
| 17 | 1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Guy |
| 18 | 1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Guy |

| Comb. No. | Description |
|---|---|
| 19 | Dead+Wind 0 deg - Service+Guy |
| 20 | Dead+Wind 45 deg - Service+Guy |
| 21 | Dead+Wind 90 deg - Service+Guy |
| 22 | Dead+Wind 135 deg - Service+Guy |
| 23 | Dead+Wind 180 deg - Service+Guy |
| 24 | Dead+Wind 225 deg - Service+Guy |
| 25 | Dead+Wind 270 deg - Service+Guy |
| 26 | Dead+Wind 315 deg - Service+Guy |

## Maximum Member Forces

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 | Pole | Max Tension | 5 | 0.398 | -10.313 | -10.057 |
| | | | Max. Compression | 10 | -302.793 | -37.217 | -37.240 |
| | | | Max. Mx | 4 | -152.142 | -6329.101 | -54.897 |
| | | | Max. My | 6 | -152.147 | -57.033 | -6329.083 |
| | | | Max. Vy | 4 | 998.750 | -6329.101 | -54.897 |
| | | | Max. Vx | 6 | 998.764 | -57.033 | -6329.083 |
| | | | Max. Torque | 3 | | | -278.513 |
| | | Pole Antenna | Max Tension | 5 | 4.040 | -0.064 | -2.969 |
| | | | Max. Compression | 12 | -0.240 | 13.102 | 9.471 |
| | | | Max. Mx | 2 | 0.167 | -51.694 | -1.574 |
| | | | Max. My | 8 | 0.215 | -1.448 | -49.678 |
| | | | Max. Vy | 2 | -20.676 | -51.694 | -1.574 |
| | | | Max. Vx | 8 | -19.869 | -1.448 | -49.678 |
| | | | Max. Torque | 6 | | | 0.000 |
| L2 | 152.771 - 127.104 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 13 | -6543.403 | -2953.497 | -22.791 |
| | | | Max. Mx | 4 | -5895.394 | -5402.847 | -61.533 |
| | | | Max. My | 6 | -5895.337 | -63.949 | -5402.832 |
| | | | Max. Vy | 8 | -697.702 | 4992.490 | -43.864 |
| | | | Max. Vx | 2 | -697.664 | -46.011 | 4993.047 |
| | | | Max. Torque | 3 | | | -256.307 |
| | | Guy A | Bottom Tension | 5 | 4010.946 | | |
| | | | Top Tension | 5 | 4029.750 | | |
| | | | Top Cable Vert | 5 | 2823.018 | | |
| | | | Top Cable Norm | 5 | 2875.667 | | |
| | | | Top Cable Tan | 5 | 0.003 | | |
| | | | Bot Cable Vert | 5 | -2609.936 | | |
| | | | Bot Cable Norm | 5 | 3045.640 | | |
| | | | Bot Cable Tan | 5 | 0.003 | | |
| | | Guy B | Bottom Tension | 7 | 4008.714 | | |
| | | | Top Tension | 7 | 4027.519 | | |
| | | | Top Cable Vert | 7 | 2821.523 | | |
| | | | Top Cable Norm | 7 | 2874.007 | | |
| | | | Top Cable Tan | 7 | 0.037 | | |
| | | | Bot Cable Vert | 7 | -2608.442 | | |
| | | | Bot Cable Norm | 7 | 3043.980 | | |
| | | | Bot Cable Tan | 7 | 0.037 | | |
| | | Guy C | Bottom Tension | 9 | 4008.227 | | |
| | | | Top Tension | 9 | 4027.032 | | |
| | | | Top Cable Vert | 9 | 2821.197 | | |
| | | | Top Cable Norm | 9 | 2873.645 | | |
| | | | Top Cable Tan | 9 | 0.005 | | |
| | | | Bot Cable Vert | 9 | -2608.116 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Bot Cable Norm | 9 | 3043.618 | | |
| | | | Bot Cable Tan | 9 | 0.005 | | |
| | | Guy D | Bottom Tension | 3 | 4008.804 | | |
| | | | Top Tension | 3 | 4027.610 | | |
| | | | Top Cable Vert | 3 | 2821.584 | | |
| | | | Top Cable Norm | 3 | 2874.075 | | |
| | | | Top Cable Tan | 3 | 0.029 | | |
| | | | Bot Cable Vert | 3 | -2608.502 | | |
| | | | Bot Cable Norm | 3 | 3044.048 | | |
| | | | Bot Cable Tan | 3 | 0.029 | | |
| L3 | 127.104 - 101.437 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 13 | -11679.589 | -4309.427 | -11.796 |
| | | | Max. Mx | 4 | -11052.515 | -5849.436 | -41.726 |
| | | | Max. My | 6 | -11052.490 | -43.476 | -5849.502 |
| | | | Max. Vy | 8 | -615.403 | 5848.720 | -41.673 |
| | | | Max. Vx | 2 | -615.368 | -43.423 | 5848.645 |
| | | | Max. Torque | 3 | | | -430.829 |
| | | Guy A | Bottom Tension | 5 | 2825.258 | | |
| | | | Top Tension | 5 | 2847.594 | | |
| | | | Top Cable Vert | 5 | 1944.007 | | |
| | | | Top Cable Norm | 5 | 2080.776 | | |
| | | | Top Cable Tan | 5 | 0.000 | | |
| | | | Bot Cable Vert | 5 | -1734.188 | | |
| | | | Bot Cable Norm | 5 | 2230.398 | | |
| | | | Bot Cable Tan | 5 | 0.000 | | |
| | | Guy B | Bottom Tension | 7 | 2826.145 | | |
| | | | Top Tension | 7 | 2848.481 | | |
| | | | Top Cable Vert | 7 | 1944.579 | | |
| | | | Top Cable Norm | 7 | 2081.455 | | |
| | | | Top Cable Tan | 7 | 0.054 | | |
| | | | Bot Cable Vert | 7 | -1734.760 | | |
| | | | Bot Cable Norm | 7 | 2231.077 | | |
| | | | Bot Cable Tan | 7 | 0.054 | | |
| | | Guy C | Bottom Tension | 9 | 2826.800 | | |
| | | | Top Tension | 9 | 2849.135 | | |
| | | | Top Cable Vert | 9 | 1945.001 | | |
| | | | Top Cable Norm | 9 | 2081.956 | | |
| | | | Top Cable Tan | 9 | 0.002 | | |
| | | | Bot Cable Vert | 9 | -1735.183 | | |
| | | | Bot Cable Norm | 9 | 2231.578 | | |
| | | | Bot Cable Tan | 9 | 0.002 | | |
| | | Guy D | Bottom Tension | 3 | 2826.094 | | |
| | | | Top Tension | 3 | 2848.430 | | |
| | | | Top Cable Vert | 3 | 1944.546 | | |
| | | | Top Cable Norm | 3 | 2081.416 | | |
| | | | Top Cable Tan | 3 | 0.052 | | |
| | | | Bot Cable Vert | 3 | -1734.727 | | |
| | | | Bot Cable Norm | 3 | 2231.038 | | |
| | | | Bot Cable Tan | 3 | 0.052 | | |
| L4 | 101.437 - 75.812 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 13 | -15622.832 | -4265.920 | -6.497 |
| | | | Max. Mx | 8 | -14516.965 | 6567.278 | -35.952 |
| | | | Max. My | 2 | -14516.974 | -37.349 | 6567.092 |
| | | | Max. Vy | 8 | -444.794 | 6567.278 | -35.952 |
| | | | Max. Vx | 2 | -444.790 | -37.349 | 6567.092 |
| | | | Max. Torque | 3 | | | -420.346 |
| | | Guy A | Bottom Tension | 5 | 2110.464 | | |
| | | | Top Tension | 5 | 2124.403 | | |
| | | | Top Cable Vert | 5 | 1261.452 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Top Cable Norm | 5 | 1709.335 | | |
| | | | Top Cable Tan | 5 | 0.001 | | |
| | | | Bot Cable Vert | 5 | -1127.477 | | |
| | | | Bot Cable Norm | 5 | 1784.056 | | |
| | | | Bot Cable Tan | 5 | 0.001 | | |
| | | Guy B | Bottom Tension | 7 | 2111.434 | | |
| | | | Top Tension | 7 | 2125.373 | | |
| | | | Top Cable Vert | 7 | 1261.997 | | |
| | | | Top Cable Norm | 7 | 1710.138 | | |
| | | | Top Cable Tan | 7 | 0.041 | | |
| | | | Bot Cable Vert | 7 | -1128.023 | | |
| | | | Bot Cable Norm | 7 | 1784.859 | | |
| | | | Bot Cable Tan | 7 | 0.041 | | |
| | | Guy C | Bottom Tension | 9 | 2111.766 | | |
| | | | Top Tension | 9 | 2125.704 | | |
| | | | Top Cable Vert | 9 | 1262.183 | | |
| | | | Top Cable Norm | 9 | 1710.412 | | |
| | | | Top Cable Tan | 9 | 0.001 | | |
| | | | Bot Cable Vert | 9 | -1128.209 | | |
| | | | Bot Cable Norm | 9 | 1785.133 | | |
| | | | Bot Cable Tan | 9 | 0.001 | | |
| | | Guy D | Bottom Tension | 3 | 2111.392 | | |
| | | | Top Tension | 3 | 2125.330 | | |
| | | | Top Cable Vert | 3 | 1261.973 | | |
| | | | Top Cable Norm | 3 | 1710.103 | | |
| | | | Top Cable Tan | 3 | 0.041 | | |
| | | | Bot Cable Vert | 3 | -1127.999 | | |
| | | | Bot Cable Norm | 3 | 1784.823 | | |
| | | | Bot Cable Tan | 3 | 0.041 | | |
| L5 | 75.812 - 38.562 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 13 | -19039.266 | -215.522 | -1.099 |
| | | | Max. Mx | 8 | -16988.165 | 6139.853 | -35.505 |
| | | | Max. My | 2 | -16988.173 | -36.884 | 6139.670 |
| | | | Max. Vy | 4 | -852.585 | -6138.081 | -35.517 |
| | | | Max. Vx | 6 | -852.584 | -36.897 | -6138.265 |
| | | | Max. Torque | 3 | | | -418.095 |
| | | Guy A | Bottom Tension | 5 | 2040.195 | | |
| | | | Top Tension | 5 | 2050.680 | | |
| | | | Top Cable Vert | 5 | 1066.760 | | |
| | | | Top Cable Norm | 5 | 1751.374 | | |
| | | | Top Cable Tan | 5 | 0.001 | | |
| | | | Bot Cable Vert | 5 | -974.254 | | |
| | | | Bot Cable Norm | 5 | 1792.548 | | |
| | | | Bot Cable Tan | 5 | 0.001 | | |
| | | Guy B | Bottom Tension | 7 | 2040.308 | | |
| | | | Top Tension | 7 | 2050.792 | | |
| | | | Top Cable Vert | 7 | 1066.816 | | |
| | | | Top Cable Norm | 7 | 1751.471 | | |
| | | | Top Cable Tan | 7 | 0.032 | | |
| | | | Bot Cable Vert | 7 | -974.310 | | |
| | | | Bot Cable Norm | 7 | 1792.645 | | |
| | | | Bot Cable Tan | 7 | 0.032 | | |
| | | Guy C | Bottom Tension | 9 | 2040.302 | | |
| | | | Top Tension | 9 | 2050.786 | | |
| | | | Top Cable Vert | 9 | 1066.813 | | |
| | | | Top Cable Norm | 9 | 1751.466 | | |
| | | | Top Cable Tan | 9 | 0.000 | | |
| | | | Bot Cable Vert | 9 | -974.307 | | |
| | | | Bot Cable Norm | 9 | 1792.640 | | |
| | | | Bot Cable Tan | 9 | 0.000 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | Guy D | Bottom Tension | 3 | 2040.307 | | |
| | | | Top Tension | 3 | 2050.791 | | |
| | | | Top Cable Vert | 3 | 1066.816 | | |
| | | | Top Cable Norm | 3 | 1751.471 | | |
| | | | Top Cable Tan | 3 | 0.033 | | |
| | | | Bot Cable Vert | 3 | -974.309 | | |
| | | | Bot Cable Norm | 3 | 1792.644 | | |
| | | | Bot Cable Tan | 3 | 0.033 | | |
| L6 | 38.562 - 0 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 13 | -21286.093 | -0.013 | 3.299 |
| | | | Max. Mx | 4 | -19212.861 | 9492.713 | 30.777 |
| | | | Max. My | 6 | -19212.853 | 31.509 | 9492.722 |
| | | | Max. Vy | 8 | -1057.041 | 0.010 | 13.331 |
| | | | Max. Vx | 2 | -1057.041 | 13.782 | 0.010 |
| | | | Max. Torque | 3 | | | -506.206 |
| | | Guy A | Bottom Tension | 5 | 1968.176 | | |
| | | | Top Tension | 5 | 1976.561 | | |
| | | | Top Cable Vert | 5 | 582.770 | | |
| | | | Top Cable Norm | 5 | 1888.696 | | |
| | | | Top Cable Tan | 5 | 0.000 | | |
| | | | Bot Cable Vert | 5 | -526.635 | | |
| | | | Bot Cable Norm | 5 | 1896.411 | | |
| | | | Bot Cable Tan | 5 | 0.000 | | |
| | | Guy B | Bottom Tension | 7 | 1966.889 | | |
| | | | Top Tension | 7 | 1975.273 | | |
| | | | Top Cable Vert | 7 | 582.409 | | |
| | | | Top Cable Norm | 7 | 1887.459 | | |
| | | | Top Cable Tan | 7 | 0.014 | | |
| | | | Bot Cable Vert | 7 | -526.275 | | |
| | | | Bot Cable Norm | 7 | 1895.174 | | |
| | | | Bot Cable Tan | 7 | 0.014 | | |
| | | Guy C | Bottom Tension | 9 | 1965.852 | | |
| | | | Top Tension | 9 | 1974.237 | | |
| | | | Top Cable Vert | 9 | 582.119 | | |
| | | | Top Cable Norm | 9 | 1886.464 | | |
| | | | Top Cable Tan | 9 | 0.000 | | |
| | | | Bot Cable Vert | 9 | -525.985 | | |
| | | | Bot Cable Norm | 9 | 1894.179 | | |
| | | | Bot Cable Tan | 9 | 0.000 | | |
| | | Guy D | Bottom Tension | 3 | 1966.899 | | |
| | | | Top Tension | 3 | 1975.283 | | |
| | | | Top Cable Vert | 3 | 582.412 | | |
| | | | Top Cable Norm | 3 | 1887.469 | | |
| | | | Top Cable Tan | 3 | 0.013 | | |
| | | | Bot Cable Vert | 3 | -526.278 | | |
| | | | Bot Cable Norm | 3 | 1895.184 | | |
| | | | Bot Cable Tan | 3 | 0.013 | | |

## Maximum Reactions

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| Mast | Max. Vert | 13 | 21294.697 | -85.071 | 0.662 |
| | Max. $H_x$ | 8 | 19557.715 | 311.891 | 0.219 |
| | Max. $H_z$ | 2 | 19557.726 | 0.202 | 311.889 |
| | Max. $M_x$ | 1 | 0.000 | 0.372 | 0.372 |

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| | Max. $M_z$ | 1 | 0.000 | 0.372 | 0.372 |
| | Max. Torsion | 7 | 503.424 | 256.820 | -256.209 |
| | Min. Vert | 1 | 4454.768 | 0.372 | 0.372 |
| | Min. $H_x$ | 4 | 19558.334 | -310.519 | 0.218 |
| | Min. $H_z$ | 6 | 19558.326 | 0.201 | -310.522 |
| | Min. $M_x$ | 1 | 0.000 | 0.372 | 0.372 |
| | Min. $M_z$ | 1 | 0.000 | 0.372 | 0.372 |
| | Min. Torsion | 3 | -506.481 | -256.213 | 256.814 |
| Guy D @ 164.042 ft<br>Elev 0 ft<br>Azimuth 225 deg | Max. Vert | 24 | -106.636 | -61.234 | 61.234 |
| | Max. $H_x$ | 24 | -106.636 | -61.234 | 61.234 |
| | Max. $H_z$ | 3 | -2608.502 | -2152.487 | 2152.446 |
| | Min. Vert | 3 | -2608.502 | -2152.487 | 2152.446 |
| | Min. $H_x$ | 3 | -2608.502 | -2152.487 | 2152.446 |
| | Min. $H_z$ | 24 | -106.636 | -61.234 | 61.234 |
| Guy C @ 164.042 ft<br>Elev 0 ft<br>Azimuth 135 deg | Max. Vert | 22 | -106.592 | 61.200 | 61.200 |
| | Max. $H_x$ | 9 | -2608.116 | 2152.159 | 2152.167 |
| | Max. $H_z$ | 9 | -2608.116 | 2152.159 | 2152.167 |
| | Min. Vert | 9 | -2608.116 | 2152.159 | 2152.167 |
| | Min. $H_x$ | 22 | -106.592 | 61.200 | 61.200 |
| | Min. $H_z$ | 22 | -106.592 | 61.200 | 61.200 |
| Guy B @ 164.042 ft<br>Elev 0 ft<br>Azimuth 45 deg | Max. Vert | 20 | -106.633 | 61.232 | -61.231 |
| | Max. $H_x$ | 7 | -2608.442 | 2152.393 | -2152.446 |
| | Max. $H_z$ | 20 | -106.633 | 61.232 | -61.231 |
| | Min. Vert | 7 | -2608.442 | 2152.393 | -2152.446 |
| | Min. $H_x$ | 20 | -106.633 | 61.232 | -61.231 |
| | Min. $H_z$ | 7 | -2608.442 | 2152.393 | -2152.446 |
| Guy A @ 164.042 ft<br>Elev 0 ft<br>Azimuth -45 deg | Max. Vert | 26 | -106.677 | -61.265 | -61.265 |
| | Max. $H_x$ | 26 | -106.677 | -61.265 | -61.265 |
| | Max. $H_z$ | 26 | -106.677 | -61.265 | -61.265 |
| | Min. Vert | 5 | -2609.936 | -2153.590 | -2153.595 |
| | Min. $H_x$ | 5 | -2609.936 | -2153.590 | -2153.595 |
| | Min. $H_z$ | 5 | -2609.936 | -2153.590 | -2153.595 |
| Guy D @ 147.638 ft<br>Elev 0 ft<br>Azimuth 225 deg | Max. Vert | 24 | -116.318 | -81.090 | 81.092 |
| | Max. $H_x$ | 24 | -116.318 | -81.090 | 81.092 |
| | Max. $H_z$ | 3 | -2862.726 | -2839.708 | 2839.577 |
| | Min. Vert | 3 | -2862.726 | -2839.708 | 2839.577 |
| | Min. $H_x$ | 3 | -2862.726 | -2839.708 | 2839.577 |
| | Min. $H_z$ | 24 | -116.318 | -81.090 | 81.092 |
| Guy C @ 147.638 ft<br>Elev 0 ft<br>Azimuth 135 deg | Max. Vert | 22 | -116.359 | 81.128 | 81.128 |
| | Max. $H_x$ | 9 | -2863.391 | 2840.241 | 2840.245 |
| | Max. $H_z$ | 9 | -2863.391 | 2840.241 | 2840.245 |
| | Min. Vert | 9 | -2863.391 | 2840.241 | 2840.245 |
| | Min. $H_x$ | 22 | -116.359 | 81.128 | 81.128 |

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| | Min. $H_z$ | 22 | -116.359 | 81.128 | 81.128 |
| Guy B @ 147.638 ft<br>Elev 0 ft<br>Azimuth 45 deg | Max. Vert | 20 | -116.321 | 81.094 | -81.093 |
| | Max. $H_x$ | 7 | -2862.783 | 2839.629 | -2839.762 |
| | Max. $H_z$ | 20 | -116.321 | 81.094 | -81.093 |
| | Min. Vert | 7 | -2862.783 | 2839.629 | -2839.762 |
| | Min. $H_x$ | 20 | -116.321 | 81.094 | -81.093 |
| | Min. $H_z$ | 7 | -2862.783 | 2839.629 | -2839.762 |
| Guy A @ 147.638 ft<br>Elev 0 ft<br>Azimuth -45 deg | Max. Vert | 26 | -116.280 | -81.056 | -81.056 |
| | Max. $H_x$ | 26 | -116.280 | -81.056 | -81.056 |
| | Max. $H_z$ | 26 | -116.280 | -81.056 | -81.056 |
| | Min. Vert | 5 | -2861.665 | -2838.648 | -2838.647 |
| | Min. $H_x$ | 5 | -2861.665 | -2838.648 | -2838.647 |
| | Min. $H_z$ | 5 | -2861.665 | -2838.648 | -2838.647 |
| Guy D @ 131.234 ft<br>Elev 0 ft<br>Azimuth 225 deg | Max. Vert | 24 | -17.284 | -64.382 | 64.382 |
| | Max. $H_x$ | 24 | -17.284 | -64.382 | 64.382 |
| | Max. $H_z$ | 3 | -1500.587 | -2607.721 | 2607.656 |
| | Min. Vert | 3 | -1500.587 | -2607.721 | 2607.656 |
| | Min. $H_x$ | 3 | -1500.587 | -2607.721 | 2607.656 |
| | Min. $H_z$ | 24 | -17.284 | -64.382 | 64.382 |
| Guy C @ 131.234 ft<br>Elev 0 ft<br>Azimuth 135 deg | Max. Vert | 22 | -17.274 | 64.357 | 64.357 |
| | Max. $H_x$ | 9 | -1500.292 | 2606.974 | 2606.975 |
| | Max. $H_z$ | 9 | -1500.292 | 2606.974 | 2606.975 |
| | Min. Vert | 9 | -1500.292 | 2606.974 | 2606.975 |
| | Min. $H_x$ | 22 | -17.274 | 64.357 | 64.357 |
| | Min. $H_z$ | 22 | -17.274 | 64.357 | 64.357 |
| Guy B @ 131.234 ft<br>Elev 0 ft<br>Azimuth 45 deg | Max. Vert | 20 | -17.284 | 64.382 | -64.382 |
| | Max. $H_x$ | 7 | -1500.585 | 2607.650 | -2607.715 |
| | Max. $H_z$ | 20 | -17.284 | 64.382 | -64.382 |
| | Min. Vert | 7 | -1500.585 | 2607.650 | -2607.715 |
| | Min. $H_x$ | 20 | -17.284 | 64.382 | -64.382 |
| | Min. $H_z$ | 7 | -1500.585 | 2607.650 | -2607.715 |
| Guy A @ 131.234 ft<br>Elev 0 ft<br>Azimuth -45 deg | Max. Vert | 26 | -17.294 | -64.406 | -64.406 |
| | Max. $H_x$ | 26 | -17.294 | -64.406 | -64.406 |
| | Max. $H_z$ | 26 | -17.294 | -64.406 | -64.406 |
| | Min. Vert | 5 | -1500.889 | -2608.488 | -2608.487 |
| | Min. $H_x$ | 5 | -1500.889 | -2608.488 | -2608.487 |
| | Min. $H_z$ | 5 | -1500.889 | -2608.488 | -2608.487 |

## Tower Mast Reaction Summary

| Load Combination | Vertical lb | $Shear_x$ lb | $Shear_z$ lb | Overturning Moment, $M_x$ lb-ft | Overturning Moment, $M_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|
| Dead Only | 4454.768 | -0.372 | -0.372 | 0.000 | 0.000 | -0.000 |
| 1.2 Dead+1.0 Wind 0 deg - No Ice+1.0 Guy | 19557.726 | -0.202 | -311.889 | 0.000 | 0.000 | 361.599 |
| 1.2 Dead+1.0 Wind 45 deg - No Ice+1.0 Guy | 19142.824 | 256.213 | -256.814 | 0.000 | 0.000 | 506.481 |
| 1.2 Dead+1.0 Wind 90 deg - No Ice+1.0 Guy | 19558.334 | 310.519 | -0.218 | 0.000 | 0.000 | 349.748 |
| 1.2 Dead+1.0 Wind 135 deg - No Ice+1.0 Guy | 19143.393 | 255.835 | 255.816 | 0.000 | 0.000 | -9.919 |
| 1.2 Dead+1.0 Wind 180 deg - No Ice+1.0 Guy | 19558.326 | -0.201 | 310.522 | 0.000 | 0.000 | -361.589 |
| 1.2 Dead+1.0 Wind 225 deg - No Ice+1.0 Guy | 19142.823 | -256.820 | 256.209 | 0.000 | 0.000 | -503.424 |
| 1.2 Dead+1.0 Wind 270 deg - No Ice+1.0 Guy | 19557.715 | -311.891 | -0.219 | 0.000 | 0.000 | -349.758 |
| 1.2 Dead+1.0 Wind 315 deg - No Ice+1.0 Guy | 19142.818 | -257.158 | -257.167 | 0.000 | 0.000 | 6.857 |
| 1.2 Dead+1.0 Ice+Guy | 11321.660 | -0.510 | -0.511 | 0.000 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Guy | 21293.777 | -0.662 | -86.724 | 0.000 | 0.000 | 138.380 |
| 1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Guy | 20772.530 | 86.706 | -88.004 | 0.000 | 0.000 | 193.620 |
| 1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Guy | 21294.697 | 85.071 | -0.662 | 0.000 | 0.000 | 133.522 |
| 1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Guy | 20772.884 | 86.576 | 86.571 | 0.000 | 0.000 | -4.221 |
| 1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Guy | 21294.677 | -0.661 | 85.076 | 0.000 | 0.000 | -138.376 |
| 1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Guy | 20772.521 | -88.011 | 86.708 | 0.000 | 0.000 | -192.059 |
| 1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Guy | 21293.756 | -86.729 | -0.663 | 0.000 | 0.000 | -133.526 |
| 1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Guy | 20772.150 | -88.141 | -88.140 | 0.000 | 0.000 | 2.661 |
| Dead+Wind 0 deg - Service+Guy | 7948.089 | -0.437 | -173.782 | 0.000 | 0.000 | 95.897 |
| Dead+Wind 45 deg - Service+Guy | 7764.790 | 129.352 | -130.205 | 0.000 | 0.000 | 133.553 |
| Dead+Wind 90 deg - Service+Guy | 7948.599 | 172.872 | -0.438 | 0.000 | 0.000 | 92.694 |
| Dead+Wind 135 deg - Service+Guy | 7765.034 | 129.324 | 129.323 | 0.000 | 0.000 | -2.306 |
| Dead+Wind 180 deg - Service+Guy | 7948.591 | -0.437 | 172.872 | 0.000 | 0.000 | -95.896 |
| Dead+Wind 225 deg - Service+Guy | 7764.784 | -130.205 | 129.352 | 0.000 | 0.000 | -133.477 |
| Dead+Wind 270 deg - Service+Guy | 7948.080 | -173.782 | -0.438 | 0.000 | 0.000 | -92.695 |
| Dead+Wind 315 deg - Service+Guy | 7764.519 | -130.246 | -130.247 | 0.000 | 0.000 | 2.230 |

## Solution Summary

| | Sum of Applied Forces | | | Sum of Reactions | | | |
|---|---|---|---|---|---|---|---|
| Load Comb. | PX lb | PY lb | PZ lb | PX lb | PY lb | PZ lb | % Error |
| 1 | 0.000 | -2719.386 | 0.000 | 0.008 | 2719.386 | 0.008 | 0.000% |

| Load Comb. | Sum of Applied Forces PX lb | PY lb | PZ lb | Sum of Reactions PX lb | PY lb | PZ lb | % Error |
|---|---|---|---|---|---|---|---|
| 2 | 0.000 | -3147.867 | -12028.785 | -0.012 | 3147.910 | 12029.446 | 0.005% |
| 3 | 8845.378 | -3147.867 | -8845.378 | -8845.454 | 3147.875 | 8845.453 | 0.001% |
| 4 | 12028.785 | -3147.867 | 0.000 | -12029.444 | 3147.910 | -0.011 | 0.005% |
| 5 | 8845.378 | -3147.867 | 8845.378 | -8845.707 | 3147.901 | -8845.707 | 0.004% |
| 6 | 0.000 | -3147.867 | 12028.785 | -0.012 | 3147.910 | -12029.444 | 0.005% |
| 7 | -8845.378 | -3147.867 | 8845.378 | 8845.453 | 3147.875 | -8845.454 | 0.001% |
| 8 | -12028.785 | -3147.867 | 0.000 | 12029.446 | 3147.910 | -0.011 | 0.005% |
| 9 | -8845.378 | -3147.867 | -8845.378 | 8845.707 | 3147.901 | 8845.707 | 0.004% |
| 10 | 0.000 | -6419.342 | 0.000 | 0.027 | 6419.341 | 0.026 | 0.001% |
| 11 | 0.000 | -6419.342 | -9679.287 | -0.002 | 6419.328 | 9679.087 | 0.002% |
| 12 | 7236.837 | -6419.342 | -7236.837 | -7236.726 | 6419.329 | 7236.720 | 0.001% |
| 13 | 9679.287 | -6419.342 | 0.000 | -9679.086 | 6419.328 | -0.002 | 0.002% |
| 14 | 7236.837 | -6419.342 | 7236.837 | -7236.722 | 6419.329 | -7236.722 | 0.001% |
| 15 | 0.000 | -6419.342 | 9679.287 | -0.002 | 6419.328 | -9679.086 | 0.002% |
| 16 | -7236.837 | -6419.342 | 7236.837 | 7236.720 | 6419.329 | -7236.726 | 0.001% |
| 17 | -9679.287 | -6419.342 | 0.000 | 9679.087 | 6419.328 | -0.002 | 0.002% |
| 18 | -7236.837 | -6419.342 | -7236.837 | 7236.723 | 6419.329 | 7236.723 | 0.001% |
| 19 | 0.000 | -2719.386 | -3170.465 | -0.001 | 2719.390 | 3170.726 | 0.006% |
| 20 | 2324.604 | -2719.386 | -2324.604 | -2324.749 | 2719.389 | 2324.749 | 0.005% |
| 21 | 3170.465 | -2719.386 | 0.000 | -3170.726 | 2719.390 | -0.001 | 0.006% |
| 22 | 2324.604 | -2719.386 | 2324.604 | -2324.749 | 2719.390 | -2324.749 | 0.005% |
| 23 | 0.000 | -2719.386 | 3170.465 | -0.001 | 2719.390 | -3170.726 | 0.006% |
| 24 | -2324.604 | -2719.386 | 2324.604 | 2324.749 | 2719.389 | -2324.749 | 0.005% |
| 25 | -3170.465 | -2719.386 | 0.000 | 3170.726 | 2719.390 | -0.001 | 0.006% |
| 26 | -2324.604 | -2719.386 | -2324.604 | 2324.749 | 2719.389 | 2324.749 | 0.005% |

## Non-Linear Convergence Results

| Load Combination | Converged? | Number of Cycles | Displacement Tolerance | Force Tolerance |
|---|---|---|---|---|
| 1 | Yes | 13 | 0.00000001 | 0.00000001 |
| 2 | Yes | 29 | 0.00009197 | 0.00009029 |
| 3 | Yes | 35 | 0.00000001 | 0.00006963 |
| 4 | Yes | 29 | 0.00009164 | 0.00008671 |
| 5 | Yes | 32 | 0.00009724 | 0.00003794 |
| 6 | Yes | 29 | 0.00009166 | 0.00008991 |
| 7 | Yes | 35 | 0.00000001 | 0.00006909 |
| 8 | Yes | 29 | 0.00009197 | 0.00008709 |
| 9 | Yes | 32 | 0.00009724 | 0.00003741 |
| 10 | Yes | 13 | 0.00000001 | 0.00000001 |
| 11 | Yes | 35 | 0.00007026 | 0.00002507 |
| 12 | Yes | 33 | 0.00007112 | 0.00003302 |
| 13 | Yes | 35 | 0.00007073 | 0.00002433 |
| 14 | Yes | 33 | 0.00007144 | 0.00000780 |
| 15 | Yes | 35 | 0.00007072 | 0.00002526 |
| 16 | Yes | 33 | 0.00007110 | 0.00003270 |
| 17 | Yes | 35 | 0.00007025 | 0.00002413 |
| 18 | Yes | 33 | 0.00007076 | 0.00000761 |
| 19 | Yes | 28 | 0.00000001 | 0.00002851 |
| 20 | Yes | 30 | 0.00000001 | 0.00004387 |
| 21 | Yes | 28 | 0.00000001 | 0.00002817 |
| 22 | Yes | 30 | 0.00000001 | 0.00002120 |
| 23 | Yes | 28 | 0.00000001 | 0.00002856 |
| 24 | Yes | 30 | 0.00000001 | 0.00004384 |
| 25 | Yes | 28 | 0.00000001 | 0.00002811 |
| 26 | Yes | 30 | 0.00000001 | 0.00002114 |

## Maximum Tower Deflections - Service Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| Pole | 170.604 - 165.604 | 12.572 | 21 | 0.894 | 0.196 |
| Antenna | | | | | |
| L1 | 165.604 - 152.771 | 11.636 | 21 | 0.894 | 0.196 |
| L2 | 152.771 - 127.104 | 9.323 | 21 | 0.771 | 0.179 |
| L3 | 127.104 - 101.437 | 5.773 | 25 | 0.559 | 0.147 |
| L4 | 101.437 - 75.812 | 3.499 | 25 | 0.253 | 0.107 |
| L5 | 75.812 - 38.562 | 2.776 | 23 | 0.051 | 0.080 |
| L6 | 38.562 - 0 | 2.749 | 21 | 0.105 | 0.041 |

## Critical Deflections and Radius of Curvature - Service Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 167.979 | Propellor Anemometer/Wind Vane | 21 | 12.080 | 0.897 | 0.196 | 33469 |
| 164.979 | 95" Boom Mount | 21 | 11.519 | 0.892 | 0.196 | 27357 |
| 162.402 | NRG #40C Anemometer | 21 | 11.040 | 0.876 | 0.194 | 13998 |
| 159.402 | 95" Boom Mount | 21 | 10.489 | 0.848 | 0.190 | 8416 |
| 156.496 | NRG 200P Wind Vane | 21 | 9.967 | 0.815 | 0.185 | 6065 |
| 153.496 | 95" Boom Mount | 21 | 9.446 | 0.779 | 0.180 | 4937 |
| 152.771 | Guy | 21 | 9.323 | 0.771 | 0.179 | 4812 |
| 145.997 | 21" Dia. Aircraft Marker Ball (Orange) | 21 | 8.243 | 0.706 | 0.170 | 5023 |
| 140.420 | Temperature Sensor | 19 | 7.438 | 0.662 | 0.163 | 5588 |
| 130.577 | NRG #40C Anemometer | 25 | 6.177 | 0.589 | 0.151 | 6963 |
| 127.577 | 95" Boom Mount | 25 | 5.827 | 0.564 | 0.147 | 7290 |
| 127.104 | Guy | 25 | 5.773 | 0.559 | 0.147 | 7297 |
| 111.220 | NRG 200P Wind Vane | 25 | 4.196 | 0.381 | 0.122 | 5141 |
| 108.220 | 95" Boom Mount | 25 | 3.957 | 0.343 | 0.117 | 4784 |
| 105.315 | NRG #40C Anemometer | 25 | 3.746 | 0.304 | 0.112 | 4485 |
| 102.315 | 95" Boom Mount | 25 | 3.551 | 0.265 | 0.108 | 4273 |
| 101.437 | Guy | 25 | 3.499 | 0.253 | 0.107 | 4246 |
| 75.812 | Guy | 23 | 2.776 | 0.051 | 0.080 | 6121 |
| 49.213 | Temperature Sensor | 21 | 2.913 | 0.064 | 0.053 | 5799 |
| 38.562 | Guy | 21 | 2.749 | 0.105 | 0.041 | 3415 |
| 4.920 | Data Logger | 22 | 0.458 | 0.026 | 0.005 | 24855 |

## Maximum Tower Deflections - Design Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| Pole | 170.604 - 165.604 | 49.335 | 4 | 3.598 | 0.746 |
| Antenna | | | | | |
| L1 | 165.604 - 152.771 | 45.569 | 4 | 3.598 | 0.746 |

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L2 | 152.771 - 127.104 | 36.233 | 4 | 3.149 | 0.678 |
| L3 | 127.104 - 101.437 | 21.799 | 8 | 2.214 | 0.553 |
| L4 | 101.437 - 75.812 | 13.343 | 8 | 0.864 | 0.401 |
| L5 | 75.812 - 38.562 | 10.822 | 8 | 0.143 | 0.300 |
| L6 | 38.562 - 0 | 10.136 | 4 | 0.391 | 0.155 |

## Critical Deflections and Radius of Curvature - Design Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 167.979 | Propellor Anemometer/Wind Vane | 4 | 47.356 | 3.609 | 0.748 | 9806 |
| 164.979 | 95" Boom Mount | 4 | 45.099 | 3.590 | 0.745 | 7940 |
| 162.402 | NRG #40C Anemometer | 4 | 43.170 | 3.535 | 0.737 | 3936 |
| 159.402 | 95" Boom Mount | 4 | 40.949 | 3.433 | 0.721 | 2328 |
| 156.496 | NRG 200P Wind Vane | 4 | 38.843 | 3.312 | 0.703 | 1665 |
| 153.496 | 95" Boom Mount | 4 | 36.732 | 3.180 | 0.683 | 1344 |
| 152.771 | Guy | 4 | 36.233 | 3.149 | 0.678 | 1305 |
| 145.997 | 21" Dia. Aircraft Marker Ball (Orange) | 4 | 31.824 | 2.890 | 0.640 | 1266 |
| 140.420 | Temperature Sensor | 2 | 28.524 | 2.702 | 0.614 | 1300 |
| 130.577 | NRG #40C Anemometer | 8 | 23.402 | 2.357 | 0.570 | 1365 |
| 127.577 | 95" Boom Mount | 8 | 22.011 | 2.235 | 0.555 | 1377 |
| 127.104 | Guy | 8 | 21.799 | 2.214 | 0.553 | 1376 |
| 111.220 | NRG 200P Wind Vane | 8 | 15.834 | 1.391 | 0.458 | 1256 |
| 108.220 | 95" Boom Mount | 8 | 14.970 | 1.225 | 0.440 | 1234 |
| 105.315 | NRG #40C Anemometer | 8 | 14.217 | 1.066 | 0.422 | 1213 |
| 102.315 | 95" Boom Mount | 8 | 13.528 | 0.909 | 0.406 | 1207 |
| 101.437 | Guy | 8 | 13.343 | 0.864 | 0.401 | 1212 |
| 75.812 | Guy | 8 | 10.822 | 0.143 | 0.300 | 2510 |
| 49.213 | Temperature Sensor | 4 | 10.912 | 0.265 | 0.198 | 1887 |
| 38.562 | Guy | 4 | 10.136 | 0.391 | 0.155 | 1165 |
| 4.920 | Data Logger | 4 | 1.632 | 0.091 | 0.020 | 8505 |

## Guy Design Data

| Section No. | Elevation ft | Size | Initial Tension lb | Breaking Load lb | Actual $T_u$ lb | Allowable $\phi T_n$ lb | Required S.F. | Actual S.F. |
|---|---|---|---|---|---|---|---|---|
| L2 | 152.771 (A) (11) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 4029.750 | 4200.000 | 1.000 | 1.042 ✔ |
| | 152.771 (B) (10) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 4027.520 | 4200.000 | 1.000 | 1.043 ✔ |
| | 152.771 (C) (9) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 4027.030 | 4200.000 | 1.000 | 1.043 ✔ |
| | 152.771 (D) (8) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 4027.610 | 4200.000 | 1.000 | 1.043 ✔ |
| L3 | 127.104 (A) | NRG | 179.900 | 6999.996 | 2847.590 | 4200.000 | 1.000 | 1.475 ✔ |

| Section No. | Elevation ft | Size | Initial Tension lb | Breaking Load lb | Actual $T_u$ lb | Allowable $\phi T_n$ lb | Required S.F. | Actual S.F. |
|---|---|---|---|---|---|---|---|---|
| | (15) | 0.030125 Miscl | | | | | | |
| | 127.104 (B) (14) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2848.480 | 4200.000 | 1.000 | 1.474 ✔ |
| | 127.104 (C) (13) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2849.140 | 4200.000 | 1.000 | 1.474 ✔ |
| | 127.104 (D) (12) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2848.430 | 4200.000 | 1.000 | 1.474 ✔ |
| L4 | 101.437 (A) (19) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2124.400 | 4200.000 | 1.000 | 1.977 ✔ |
| | 101.437 (B) (18) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2125.370 | 4200.000 | 1.000 | 1.976 ✔ |
| | 101.437 (C) (17) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2125.700 | 4200.000 | 1.000 | 1.976 ✔ |
| | 101.437 (D) (16) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2125.330 | 4200.000 | 1.000 | 1.976 ✔ |
| L5 | 75.812 (A) (23) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2050.680 | 4200.000 | 1.000 | 2.048 ✔ |
| | 75.812 (B) (22) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2050.790 | 4200.000 | 1.000 | 2.048 ✔ |
| | 75.812 (C) (21) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2050.790 | 4200.000 | 1.000 | 2.048 ✔ |
| | 75.812 (D) (20) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 2050.790 | 4200.000 | 1.000 | 2.048 ✔ |
| L6 | 38.562 (A) (27) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 1976.560 | 4200.000 | 1.000 | 2.125 ✔ |
| | 38.562 (B) (26) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 1975.270 | 4200.000 | 1.000 | 2.126 ✔ |
| | 38.562 (C) (25) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 1974.240 | 4200.000 | 1.000 | 2.127 ✔ |
| | 38.562 (D) (24) | NRG 0.030125 Miscl | 179.900 | 6999.996 | 1975.280 | 4200.000 | 1.000 | 2.126 ✔ |

## *Compression Checks*

## Pole Design Data

| Section No. | Elevation ft | Size | $L$ ft | $L_u$ ft | $Kl/r$ | $A$ $in^2$ | $P_u$ lb | $\phi P_n$ lb | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 (2) | Guyed Pole 8" OD | 12.833 | 0.000 | 0.0 | 2.359 | -152.147 | 91413.297 | 0.002 |
| L2 | 152.771 - 127.104 (3) | Guyed Pole 8" OD | 25.667 | 0.000 | 0.0 | 2.359 | -5902.010 | 91413.297 | 0.065 |
| L3 | 127.104 - 101.437 (4) | Guyed Pole 8" OD | 25.667 | 0.000 | 0.0 | 2.359 | -11052.500 | 91413.297 | 0.121 |
| L4 | 101.437 - 75.812 (5) | Guyed Pole 10" OD | 25.625 | 0.000 | 0.0 | 3.079 | -14517.000 | 113300.000 | 0.128 |
| L5 | 75.812 - 38.562 (6) | Guyed Pole 10" OD | 37.250 | 0.000 | 0.0 | 3.079 | -17002.199 | 113300.000 | 0.150 |
| L6 | 38.562 - 0 (7) | Guyed Pole 10" OD | 38.562 | 0.000 | 0.0 | 3.079 | -19226.801 | 113300.000 | 0.170 |

## Pole Bending Design Data

| Section No. | Elevation ft | Size | $M_{ux}$ lb-ft | $\phi M_{nx}$ lb-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ lb-ft | $\phi M_{ny}$ lb-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 (2) | Guyed Pole 8" OD | 6329.342 | 18014.750 | 0.351 | 0.000 | 18014.750 | 0.000 |
| L2 | 152.771 - 127.104 (3) | Guyed Pole 8" OD | 5403.200 | 18014.750 | 0.300 | 0.000 | 18014.750 | 0.000 |
| L3 | 127.104 - 101.437 (4) | Guyed Pole 8" OD | 5849.667 | 18014.750 | 0.325 | 0.000 | 18014.750 | 0.000 |
| L4 | 101.437 - 75.812 (5) | Guyed Pole 10" OD | 6567.200 | 28837.083 | 0.228 | 0.000 | 28837.083 | 0.000 |
| L5 | 75.812 - 38.562 (6) | Guyed Pole 10" OD | 6139.783 | 28837.083 | 0.213 | 0.000 | 28837.083 | 0.000 |
| L6 | 38.562 - 0 (7) | Guyed Pole 10" OD | 9492.750 | 28837.083 | 0.329 | 0.000 | 28837.083 | 0.000 |

## Pole Shear Design Data

| Section No. | Elevation ft | Size | Actual $V_u$ lb | $\phi V_n$ lb | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ lb-ft | $\phi T_n$ lb-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 (2) | Guyed Pole 8" OD | 998.766 | 28665.000 | 0.035 | 196.593 | 16627.667 | 0.012 |
| L2 | 152.771 - 127.104 (3) | Guyed Pole 8" OD | 689.166 | 28665.000 | 0.024 | 180.234 | 16627.667 | 0.011 |
| L3 | 127.104 - 101.437 (4) | Guyed Pole 8" OD | 614.524 | 28665.000 | 0.021 | 308.700 | 16641.250 | 0.019 |
| L4 | 101.437 - 75.812 (5) | Guyed Pole 10" OD | 444.795 | 30876.100 | 0.014 | 300.906 | 20674.583 | 0.015 |
| L5 | 75.812 - 38.562 (6) | Guyed Pole 10" OD | 852.537 | 30876.100 | 0.028 | 294.307 | 20674.583 | 0.014 |
| L6 | 38.562 - 0 (7) | Guyed Pole 10" OD | 31.899 | 30876.100 | 0.001 | 295.579 | 20674.583 | 0.014 |

## Pole Interaction Design Data

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 (2) | 0.002 | 0.351 | 0.000 | 0.035 | 0.012 | 0.355 ✔ | 1.000 | ✔ |
| L2 | 152.771 - 127.104 (3) | 0.065 | 0.300 | 0.000 | 0.024 | 0.011 | 0.366 ✔ | 1.000 | ✔ |
| L3 | 127.104 - 101.437 (4) | 0.121 | 0.325 | 0.000 | 0.021 | 0.019 | 0.447 ✔ | 1.000 | ✔ |
| L4 | 101.437 - 75.812 (5) | 0.128 | 0.228 | 0.000 | 0.014 | 0.015 | 0.357 ✔ | 1.000 | ✔ |
| L5 | 75.812 - 38.562 (6) | 0.150 | 0.213 | 0.000 | 0.028 | 0.014 | 0.365 ✔ | 1.000 | ✔ |
| L6 | 38.562 - 0 (7) | 0.170 | 0.329 | 0.000 | 0.001 | 0.014 | 0.499 ✔ | 1.000 | ✔ |

## Section Capacity Table

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $\phi P_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 165.604 - 152.771 | Pole | Guyed Pole 8" OD | 2 | -152.147 | 91413.297 | 35.5 | Pass |
| L2 | 152.771 - 127.104 | Pole | Guyed Pole 8" OD | 3 | -5902.010 | 91413.297 | 36.6 | Pass |
| L3 | 127.104 - 101.437 | Pole | Guyed Pole 8" OD | 4 | -11052.500 | 91413.297 | 44.7 | Pass |
| L4 | 101.437 - 75.812 | Pole | Guyed Pole 10" OD | 5 | -14517.000 | 113300.000 | 35.7 | Pass |
| L5 | 75.812 - 38.562 | Pole | Guyed Pole 10" OD | 6 | -17002.199 | 113300.000 | 36.5 | Pass |
| L6 | 38.562 - 0 | Pole | Guyed Pole 10" OD | 7 | -19226.801 | 113300.000 | 49.9 | Pass |
| L2 | 152.771 - 127.104 | Guy A@152.771 | NRG 0.030125 | 11 | 4029.750 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy A@127.104 | NRG 0.030125 | 15 | 2847.590 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy A@101.437 | NRG 0.030125 | 19 | 2124.400 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy A@75.812 | NRG 0.030125 | 23 | 2050.680 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy A@38.562 | NRG 0.030125 | 27 | 1976.560 | 4200.000 | 47.1 | Pass |
| L2 | 152.771 - 127.104 | Guy B@152.771 | NRG 0.030125 | 10 | 4027.520 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy B@127.104 | NRG 0.030125 | 14 | 2848.480 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy B@101.437 | NRG 0.030125 | 18 | 2125.370 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy B@75.812 | NRG 0.030125 | 22 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy B@38.562 | NRG 0.030125 | 26 | 1975.270 | 4200.000 | 47.0 | Pass |
| L2 | 152.771 - 127.104 | Guy C@152.771 | NRG 0.030125 | 9 | 4027.030 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - 101.437 | Guy C@127.104 | NRG 0.030125 | 13 | 2849.140 | 4200.000 | 67.8 | Pass |
| L4 | 101.437 - 75.812 | Guy C@101.437 | NRG 0.030125 | 17 | 2125.700 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy C@75.812 | NRG 0.030125 | 21 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy C@38.562 | NRG 0.030125 | 25 | 1974.240 | 4200.000 | 47.0 | Pass |
| L2 | 152.771 - 127.104 | Guy D@152.771 | NRG 0.030125 | 8 | 4027.610 | 4200.000 | 95.9 | Pass |
| L3 | 127.104 - | Guy D@127.104 | NRG 0.030125 | 12 | 2848.430 | 4200.000 | 67.8 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| | 101.437 | | | | | | | |
| L4 | 101.437 - 75.812 | Guy D@101.437 | NRG 0.030125 | 16 | 2125.330 | 4200.000 | 50.6 | Pass |
| L5 | 75.812 - 38.562 | Guy D@75.812 | NRG 0.030125 | 20 | 2050.790 | 4200.000 | 48.8 | Pass |
| L6 | 38.562 - 0 | Guy D@38.562 | NRG 0.030125 | 24 | 1975.280 | 4200.000 | 47.0 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L6) | 49.9 | Pass |
| | | | | | | Guy A (L2) | 95.9 | Pass |
| | | | | | | Guy B (L2) | 95.9 | Pass |
| | | | | | | Guy C (L2) | 95.9 | Pass |
| | | | | | | Guy D (L2) | 95.9 | Pass |
| | | | | | | **RATING =** | **95.9** | **Pass** |

# ASCE 7 Hazards Report

**Address:**
No Address at This Location

**Standard:** ASCE/SEI 7-16
**Risk Category:** I
**Soil Class:** D - Default (see Section 11.4.3)

**Elevation:** 0 ft (NAVD 88)
**Latitude:** 61.473061
**Longitude:** -150.988809

## Wind

**Results:**

| | |
|---|---|
| Wind Speed | 115 Vmph |
| 10-year MRI | 86 Vmph |
| 25-year MRI | 94 Vmph |
| 50-year MRI | 99 Vmph |
| 100-year MRI | 105 Vmph |

| | |
|---|---|
| Data Source: | ASCE/SEI 7-16, Fig. 26.5-1A and Figs. CC.2-1–CC.2-4, and Section 26.5.2 |
| Date Accessed: | Wed May 29 2024 |

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 15% probability of exceedance in 50 years (annual exceedance probability = 0.00333, MRI = 300 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

# Seismic

**Site Soil Class:** D - Default (see Section 11.4.3)

**Results:**

| | | | |
|---|---|---|---|
| $S_S$ : | 1.618 | $S_{D1}$ : | N/A |
| $S_1$ : | 0.757 | $T_L$ : | 16 |
| $F_a$ : | 1.2 | PGA : | 0.661 |
| $F_v$ : | N/A | $PGA_M$ : | 0.794 |
| $S_{MS}$ : | 1.941 | $F_{PGA}$ : | 1.2 |
| $S_{M1}$ : | N/A | $I_e$ : | 1 |
| $S_{DS}$ : | 1.294 | $C_v$ : | 1.424 |

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

**Data Accessed:** Wed May 29 2024

**Date Source:** USGS Seismic Design Maps

# Ice

**Results:**

| | |
|---|---|
| Ice Thickness: | 0.50 in. |
| Concurrent Temperature: | -15 F |
| Gust Speed | 60 mph |
| **Data Source:** | Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8 |
| **Date Accessed:** | Wed May 29 2024 |

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

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# APPENDIX B

# EQUIPMENT DETAILS

# Heavy Duty Wind Monitor-HD-Alpine

05108-45

The Heavy Duty Wind Monitor HD-Alpine combines the features of the HD unit along with the ice resistant coating of our popular Alpine Wind Monitor. Robust, reliable, durable . . . . all words to describe the latest addition of the YOUNG family of wind monitors developed to endure the most extreme environments.

| | | | |
|---|---|---|---|
| 0 | WIND MONITOR-HD ALPINE<br>3M Cable | 05108-45 | $1,710.00 |

| | | | |
|---|---|---|---|
| 0 | WIND MONITOR-HD ALPINE<br>8M Cable | 05108-45-8M | $1,730.00 |
| 0 | WIND MONITOR-HD ALPINE<br>12M Cable | 05108-45-12M | $1,756.00 |
| 0 | SURGE PROTECTION ASSEMBLY<br>6 Channel | 19120 | $220.00 |
| 0 | WIND SENSOR INTERFACE (for use with Model 05108)<br>0-5 VDC Outputs (recommended cable: 18446) | 05608C | $526.00 |
| 0 | WIND LINE DRIVER (for use with Model 05108)<br>4-20 mA Outputs (recommended cable: 18723) | 05638C | $572.00 |
| 0 | SENSOR CABLE, 5 CONDUCTOR SHIELDED<br>22 AWG, Per Ft. | 18446 | $1.24 |
| 0 | SENSOR CABLE, 2 PAIR SHIELDED<br>22 AWG, Per Ft. | 18723 | $1.02 |
| 0 | SENSOR CABLE, 6 CONDUCTOR SHIELDED<br>22 AWG, Per Ft. | 18721 | $1.50 |

Add to cart

*Quantity discounts applied during checkout. Excludes sensor cables.*

Categories: **All Wind Products**, **Mechanical Wind Sensors**

Description

Specifications

Brochures & Manuals

Replacement Parts

| | |
|---|---|
| **Range:** | *Wind speed: 0-100 m/s (224 mph)*<br>*Azimuth: 360° mechanical, 355° electrical (5° open)* |
| **Accuracy:** | *Wind speed: ± 0.3 m/s (0.6 mph) or 1% of reading*<br>*Wind direction: ± 3 degrees* |
| **Threshold: *** | *Propeller: 1.0 m/s (2.2 mph)*<br>*Vane: 1.0 m/s (2.2 mph)* |
| **Dynamic Response: *** | *Propeller distance constant (63% recovery) 2.7 m (8.9 ft)*<br>*Vane delay distance (50% recovery) 1.3 m (4.3 ft)*<br>*Damping ratio: 0.3*<br>*Damped natural wavelength: 7.4 m (24.3 ft)*<br>*Undamped natural wavelength: 7.2 m (23.6 ft)* |
| **Signal Output:** | *Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 15.0 m/s (33.6 mph)*<br>*Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω , linearity 0.25%, life expectancy – 50 million revolutions* |
| **Power Requirement:** | *Potentiometer excitation: 15 VDC maximum* |
| **Operating Temperature:** | *-50 to 60°C* |
| **Sensor Cable:** | *A water tight pigtail cable is supplied for electrical connections. Available in standard lengths of 3, 8 and 12 meters.*<br>*For longer cable lengths a user supplied junction box or connector may be used.* |
| **Dimensions:** | *Overall height: 37 cm (14.6 in)*<br>*Overall length: 55 cm (21.7 in)*<br>*Propeller: 18 cm (7 in) diameter*<br>*Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)* |
| **Weight:** | *1.0 kg (2.2 lbs)* |
| **Shipping Weight:** | *2.3 kg (5 lbs)* |
| **Model 05608C** | *Wind Sensor Interface*<br>*Signal outputs: 0-5.00 VDC full scale*<br>*Power requirement: 8-24 VDC (5 mA @ 12 VDC)*<br>*Operating temperature: -50 to 60°C* |
| **Model 05638C:** | *Wind Line Driver*<br>*Signal outputs: 4-20 mA full scale*<br>*Power Requirement: 12-30 VDC (40 mA max.)*<br>*Operating Temperature: -50 to 60°C* |
| * | *Nominal values, determined in accordance with ASTM standard procedures.* |

# NRG #40C Anemometer

## FEATURES

- The standard anemometer used in the wind energy industry
- Short distance constant
- Simple, durable design

The NRG #40C anemometer is the industry standard anemometer used worldwide. NRG #40 anemometers have recorded wind speeds of 96 m/s (214 mph). Their low moment of inertia and unique bearings permit very rapid response to gusts and lulls. Because of their output linearity, these sensors are ideal for use with various data retrieval systems. A four pole magnet induces a sine wave voltage into a coil producing an output signal with a frequency proportional to wind speed. The #40C is constructed of rugged Lexan cups molded in one piece for repeatable performance. A protective rubber terminal boot is included.

## SPECIFICATIONS

| | | |
|---|---|---|
| Description | Sensor type | 3-cup anemometer |
| | Applications | • wind resource assessment<br>• meteorological studies<br>• environmental monitoring |
| | Sensor range | 1 m/s to 96 m/s (2.2 mph to 214 mph) (highest recorded) |
| | Instrument compatibility | all NRG loggers |
| Output signal | Signal type | low level AC sine wave, frequency linearly proportional to windspeed |
| | Transfer function | m/s = (Hz x 0.765) + 0.35<br>[miles per hour = (Hz x 1.711) + 0.78] |
| | Accuracy | within 0.1 m/s (0.2 mph) for the range 5 m/s to 25 m/s (11 mph to 55 mph) |
| | Calibration | each anemometer individually calibrated, calibration reports provided via electronic download |
| | Output signal range | 0 Hz to 125 Hz (highest recorded) |

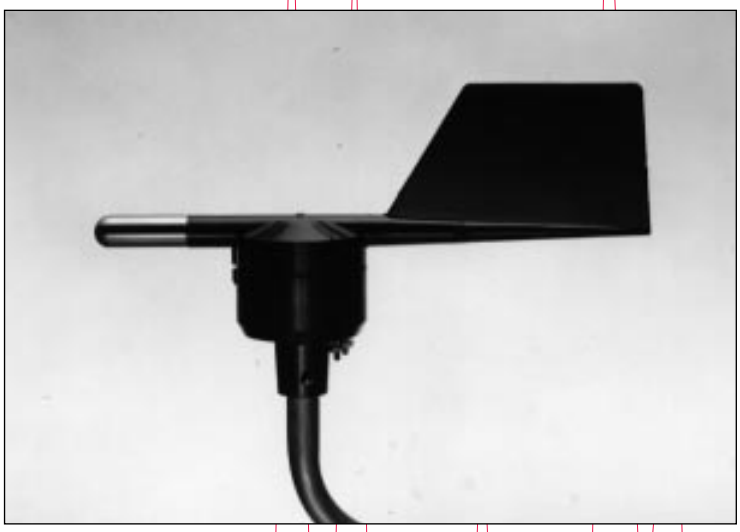
| | | |
|---|---|---|
| Response characteristics | Threshold | 0.78 m/s (1.75 miles per hour) |
| | Distance constant (63% recovery) | 3.0 m (10 feet) |
| | Moment of inertia | 68 x $10^{-6}$ S-$ft^2$ |
| | Swept diameter of rotor | 190 mm (7.5 inches) |
| Installation | Mounting | onto a 13 mm (0.5 inch) diameter mast with cotter pin and set screw |
| | Tools required | 0.25 inch nut driver, petroleum jelly, electrical tape |
| Environmental | Operating temperature range | -55 °C to 60 °C (-67 °F to 140 °F) |
| | Operating humidity range | 0 to 100% RH |
| Physical | Connections | 4-40 brass hex nut/post terminals |
| | Weight | 0.14 kg (0.3 pounds) |
| | Dimensions | • 3 cups of conical cross-section, 51 mm (2 inches) dia.<br>• 81 mm (3.2 inches) overall assembly height |
| Materials | Cups | one piece injection-molded black polycarbonate |
| | Body | housing is black ABS plastic |
| | Shaft | beryllium copper, fully hardened |
| | Bearing | modified Teflon, self-lubricating |
| | Magnet | Indox 1, 25 mm (1 inch) diameter, 13 mm (0.5 inch) long, 4 poles |
| | Coil | single coil, bobbin wound, 4100 turns of #40 wire, shielded for ESD protection |
| | Boot | protective PVC sensor terminal boot included |
| | Terminals | brass |

# 200 SERIES WIND VANE

Wind Direction Sensor

NRG Systems

*MEASURING THE WIND'S ENERGY*



■ The 200 Series Wind Direction Vane is a professional quality sensor, originally designed for use in some of the world's largest wind power plants. Its unique qualities make it ideal for use in many other applications in environmental testing and meteorology. ■ Although moderately priced, these sensors offer a level of quality and reliability often found only at a very high premium. The thermoplastic and stainless steel components resist corrosion, and contribute to a high strength-to-weight ratio. ■ As with all NRG Systems products, the 200 Series Vane is elegantly engineered, employing a minimum number of parts while maximizing functional performance. ■ The vane is directly connected to a precision conductive plastic potentiometer located in the main body. An analog voltage output directly proportional to the wind direction is produced when a constant DC excitation voltage is applied to the potentiometer. Several different yaw vane configurations are available for wind turbine control. ■ Field proven, the #200 is the wind industry de facto standard.

**NRG SYSTEMS**

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# 200 SERIES WIND VANE
## Wind Direction Sensor

## APPLICATIONS
- Wind direction sensor for wind data loggers
- Yaw control on wind turbines
- Environmental monitoring instrumentation
- Meteorological studies

## FEATURES
- Simple mechanical construction
- Long life, professional quality potentiometer
- No slip rings or brushes result in high reliability, low cost
- Corrosion-resistant materials
- Multiple mechanical and contact seals
- No setscrews to vibrate loose
- Very stable and smooth response to wind changes
- Fully balanced sensor vane

## SPECIFICATIONS
**MECHANICAL:**

*Range:* Direction–360° mechanical, continuous rotation
*Sensitivity:* Approx. 1 m/s (2.2 mph)
*Materials:*
Direction vane and housing–black UV stabilized injection molded plastic
Balance weight–stainless steel
Terminals–three #4-40 solid brass studs with nuts
Potentiometer–stainless steel shaft in two shielded precision grade, stainless steel ball bearings, conductive plastic potentiometer element mounted in a machined aluminum housing
Hardware–all stainless steel construction
*Dimensions:*
Overall length–21cm (8.3")
Swept diameter–27cm (10.5")
Overall height–12cm (4.3")
Vane size–6cm high x 10cm long (2.3" x 3.8")
Main housing diameter–5cm (2")
Mounting–13mm (0.5") diameter mast with cotter pin and mast set screw
*Weight:* 0.1kg (0.25 lb)
*Shipping Weight:* 0.5kg (1 lb)

**ELECTRICAL:**

*Range:*
Direction– #200: 340° elecrical (20° open); #200P: 352° electrical (8° open)
*Signal:*
Analog DC voltage from conductive plastic potentiometer 1K(#200), 10K(#200P); linearity 1.0%, life expectancy of 50 million revolutions (2-6 years normal operation)
*Power Requirements:*
Regulated potentiometer excitation of 1 to 15 VDC

**#200YZ YAW CONTROL WIND VANE**

The #200YZ Vane is built with standard #200 Series vane and body with an opto-interrupter type switching system. This yaw control sensor has an open collector, sinking output. Switch points are +/- 10° right or left. Also will control wind turbine yaw at 90° out of the wind.

*SPECIFICATIONS MAY CHANGE WITHOUT NOTICE.*

**ORDERING INFORMATION:**

| | |
|---|---|
| Wind Direction Vane–1K | Cat. No. 200 |
| Precision Wind Direction Vane–10K | Cat. No. 200P |

NRG Systems

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# Barometric Pressure Sensors

**090D**
**091**

Barometric Pressure Sensors convert absolute atmospheric pressure into a linear, proportional voltage, which may be used in any meteorological program.

## Features

- Compact size
- Weatherproof enclosure
- Remote output
- Permanent calibration
- Robust construction

These sensors are inherently stable devices that do not require periodic service or routine recalibration.

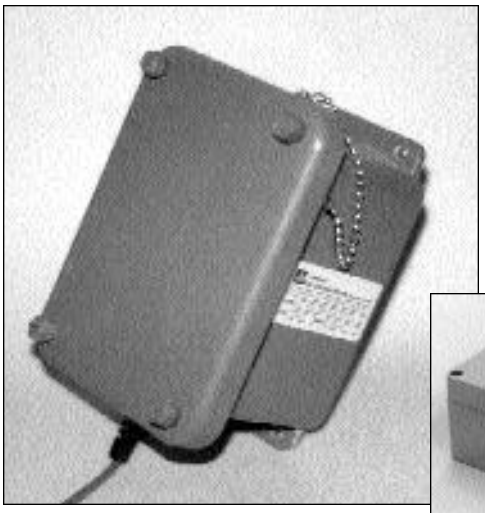
## Operation

The enclosure houses a solid-state pressure transducer, with linearization and amplification electronics.

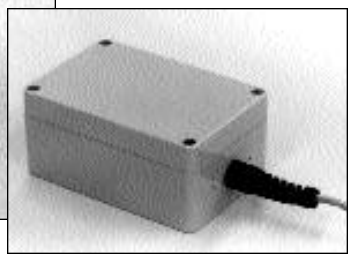
The Model 090D is housed in a heavy duty fiberglass enclosure, suitable for harsh and severe environments. A hose barb is provided to enable the connection of a 1/4" sampling tube to the outside environment.

The Model 091 is contained within a small polycarbonate enclosure, and may be mounted outside or inside a building or other enclosure. Small inlet holes allow the atmospheric pressure access to the sensing element.

The standard range of the 090D/ 091 is 26-32 in. Hg,* suitable for elevations sea level to 1500 ft. Other ranges are available.



090D



091

## Specifications

### Performance

| | |
|---|---|
| Resolution: | Infinite |
| Temp. Operating Range: | -40°C to 65°C |
| Temp. Compensated Range: | -18°C to 65°C |
| Accuracy: | ±0.04 in Hg (±1.35 mbar) or ±0.125% FS |

### Electrical Characteristics

| | |
|---|---|
| Power Requirement: | 11 mA @ 12 VDC, Typical |
| Sensor Output: | 0-1 VDC, Standard<br>0-5 VDC, Optional |

### Physical Characteristics

| | | |
|---|---|---|
| 090D | Weight: | 2 lbs, 5 oz (1.05 Kg) |
| | Dimensions: | 5.5 x 5 x 7.5 in (14 x 12 x 19 cm) |
| 091 | Weight: | 8.8 oz. (250 g) |
| | Dimensions: | 2.1 x 3.2 x 5 in (5.4 x 8.3 x 13 cm) |

### Ordering Information

| | |
|---|---|
| | Specify elevation |
| | Specify output voltage |
| Cable: | #1169-xx (xx = length in feet) |
| | Specify length in feet |

Specifications subject to change without notice.
*Conversions: 1 in. Hg = 3.3864 kPa, 1 in. Hg = 33.864 mbar, 1 in. Hg = 25.4 mm/Hg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http://www.metone.com

# 107 and 108

## Temperature Probes

The 107 and 108 are rugged, accurate probes that measure air, soil, and water temperature in a variety of applications. These probes consist of a thermistor encapsulated in an epoxy-filled aluminum housing. The housing protects the thermistor allowing the probes to be buried or submerged. The 107 measures from -35° to +50°C, the 108 from -5° to +95°C.

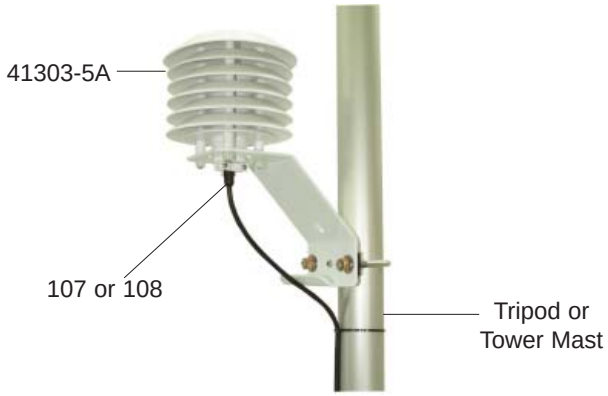
Please note that the 107 and 108 are not compatible with the CR200(X)-series dataloggers. However, a similar thermistor, the 109, has been developed specifically for our CR200(X)-series dataloggers.

Each 107 or 108 probe requires one single-ended channel for measurement.

## Installation

*Air Temperature*

When exposed to sunlight, the 107 and 108 probes should be housed in a 41303-5A 6-plate Gill Radiation Shield. The 41303-5A's louvered construction allows air to pass freely through the shield thereby keeping the probe at or near ambient temperature. The shield's white color reflects solar radiation. The 41303-5A attaches to a crossarm, mast, or user-supplied pipe with a 1.0-in. to 2.1-in. outer diameter.




Above is a probe housed in the 41303-5A radiation shield. The U-bolt is placed in the holes on the side of the bracket to allow the 41303-5A to be attached to a mast or vertical pole.

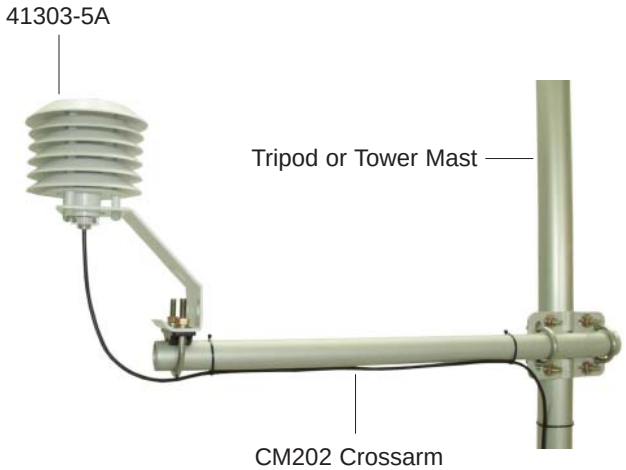
*Water Temperature*

The probes can be submerged to 50 feet (21 psi). Please note that neither the 107 nor 108 is weighted. Therefore, the installer should either add a weighting system or secure the probe to a fixed, submerged object, such as a piling.

*Soil Temperature*

The 107 and 108 are suitable for shallow burial only. Placement of the probe's cable inside a rugged conduit may be advisable for long cable runs—especially in locations subject to digging, mowing, traffic, use of power tools, or lightning strikes.

To attach the 41303-5A to a CM202, CM204, or CM206 crossarm, place the 41303-5A's U-bolt in the bottom holes.



## Recommended Cable Lengths for Air Temperature Measurements

| 2-m Height | | Atop a tripod or tower via a 2-ft crossarm such as the CM202 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mast/Leg** | **CM202** | **CM6** | **CM106** | **CM10** | **CM110** | **CM115** | **CM120** | **UT10** | **UT20** | **UT30** |
| 9 ft | 11 ft | 11 ft | 14 ft | 14 ft | 14 ft | 19 ft | 24 ft | 14 ft | 24 ft | 37 ft |

***Note:*** *Add two feet to the cable length if mounting the enclosure to the leg base of a CM106, CM110, CM115, or CM120 tripod.*

## Ordering Information

### Temperature Probes

**107-L** Temperature Probe (-35° to +50°C) with a user-specified cable length; enter the cable length (in feet) after the -L. Recommended cable length is shown above. Must choose a cable termination option (see below).

**108-L** Temperature Probe (-5° to +95°C) with a user-specified cable length; enter the cable length (in feet) after the -L. Recommended cable length is shown above. Must choose a cable termination option (see below).

### Cable Termination Options (choose one)

**-PT** Cable terminates in stripped and tinned leads for direct connection to a datalogger's terminals.

**-PW** Cable terminates in connector for attachment to a prewired enclosure.

### Solar Radiation Shield for Air Temperature Measurements

**41303-5A** 6-Plate Gill Radiation Shield that houses a 107 or 108 for air temperature measurements.

## Specifications

**Sensor:** BetaTherm 100K6A1B Thermistor

**Tolerance**
- **107:** ±0.2°C over 0° to 50°C range
- **108:** ±0.2°C over 0° to 70°C range

**Temperature Measurement Range**
- **107:** -35° to +50°C
- **108:** -5° to +95°C

**Steinhart-Hart Equation Error (CRBasic loggers only):** ≤±0.01°C over measurement range

**Polynomial Linearization Error (Edlog loggers only)**
- **107:** Typically <±0.5°C over measurement range
- **108:** Typically <±0.5°C over -5° to +90°C range

**Time Constant in Air:** 30 to 60 seconds in a wind speed of 5 m $sec^{-1}$

**Maximum Cable Length:** 1000 ft (305 m)

**Probe Length:** 4.1 in. (10.4 cm)

**Probe Diameter:** 0.3 in. (0.762 cm)

**Weight with 10-ft cable:** 5 oz (136 g)



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# NRG Side Mount Boom, 2.4 m (95")

Made of galvanized steel, the 2.4 m (95") side mount boom resists corrosion and is designed to securely mount NRG sensors away from NRG TallTowers to minimize tower shadowing effects.

## FEATURES

- For use with NRG #40C or NRG #200P sensors
- Easy to assemble
- Robust, dual-beam support structure
- Mounting bracket tabs assure proper boom installation
- Self-aligning mounting bracket assures secure, 90-degree vertical orientation
- Meets or exceeds industry IEC 61400-12-1 recommendations for tower and boom offset distances
  - » *Horizontal mast offset:* 12.38D on 8" tube; 10D on 10" tube [1]
  - » *Vertical boom offset:* 20D above boom for an NRG #40C anemometer, exceeding IEC 61400-12-1 minimum recommendation of 15D [2]

*Self-orienting mounting bracket* *Mounting bracket tab*

## SPECIFICATIONS

| | | |
|---|---|---|
| **Description** | Boom type | Sensor mounting boom for standard NRG sensors on NRG TallTowers 8" or 10" diameter |
| | Applications | Wind resource assessment; for mounting NRG #40C anemometer or NRG #200P wind direction vane on NRG TallTowers |
| | Sensor compatibility | • NRG #40C anemometer<br>• NRG #200P wind direction vane |
| | Tower compatibility | NRG TallTowers with 8" or 10" diameter tubing sections |
| **Installation** | Mounting | • Mounting bracket attaches to tower with three heavy-duty, stainless steel hose clamps<br>• Sensor mounts to boom with set screw and cotter pin |
| | Tools required | • 5/16 inch hex driver or flat blade (-) screwdriver for hose clamps<br>• Phillips head (+) screwdriver to mount sensor |
| | Recommended for installation | • Electric drill with 5/16 nut driver bit for tightening hose clamps<br>• Sheet metal shears or similar for trimming hose clamps |
| **Environmental** | Lifespan | 2 years + |
| **Physical** | Weight | 3.6 kg (8 lbs) |
| | Boom diameter | 15.875 mm (0.625 inch) dual beam support at mounting bracket location<br>19.05 mm (0.75 inch) at boom extension sleeve<br>12.7 mm (0.50 inch) at sensor mount location |
| | Offset distance | 2.4 m (95 inches) |
| | Offset height | 381 mm (15.0 inches) |
| **Materials** | Boom | 15.8 mm (0.625 inch) galvanized steel tube |
| | Mounting bracket | Galvanized steel |
| **Shipping** | Shipping weight | 3.8 kg (8.4 lbs) for one boom in one box |

*Note:*

[1] *Horizontal offset value, D refers to diameter of the tube tower. Per IEC 61400-12-1 horizontal mast offset is defined as the boom distance from the center of a tubular mast divided by the mast diameter (R/d).*

[2] *Vertical offset value, D refers to the diameter of the mounting boom tube directly below the sensor. Per IEC 61400-12-1 vertical boom offset is defined as the distance from top of the mounting boom tube to the centerline of anemometer cup rotor.*

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# High Visibility Cable Balls

## Introduction

These instructions will assist you in installing high visibility cable balls on TallTower guy wires. The items included are:

- 8 orange plastic cable ball ½ (part number 3814)
- 24 bolts, truss-head #10-32x5/8, stainless steel (part number 3842)
- 48 washers, stainless steel (part number 3843)
- 24 nuts, #10-32 stainless steel Nylock (part number 3844)
- 1/4" cable kit
    - 4 short wire rope cables ¼", 26 inches long (part number 1513) [*compatible with 3/16" or ¼" guy wires*]
    - 8 wire rope clips for ¼" cable (part number 1596)

The tools required are:
(1) #2 Phillips head (+) screwdriver
(1) 3/8 inch nut driver or socket
(1) 1/2 inch nut driver or socket

## Installing the Cable Balls

Balls should be installed on each guy wire 3 m (10 feet) below the guy ring on the top set of guy wires. An additional set of balls can be installed lower on the same guy wires at least 3 m (10 feet) above highest point vegetation is likely to reach.

Place one half of a cable ball (part number 3814) in position with the TallTower guy wire cable running through the two grooves molded into the plastic to accept the cable.

Position the short wire rope cable next to the tower guy wire cable (marked with white tape in the photo below) in the grooves. Electrical tape may be used to hold this cable in place (as shown in photo 1).

**PHOTO 1**

**PHOTO 2**

Position the top half of the ball over the two cables (photo 2).

Install the bolts, washers and locknuts to secure the plastic pieces together (photo 3). Use a washer under the head of each bolt and another under each locknut. Tighten only enough to secure the plastic pieces together. Avoid over-tightening because this will crack the plastic.

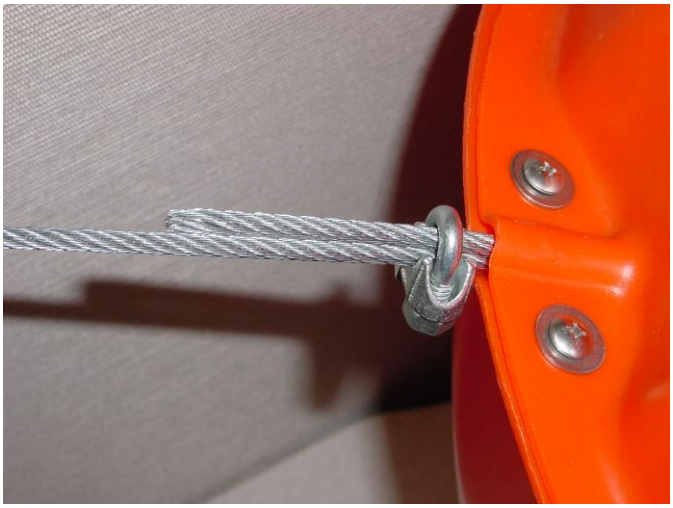


**PHOTO 3**

Place the u-bolt part of the wire rope clip over the 'dead' cable (the short wire rope cable). Place the saddle part of the wire rope clip over the 'live' cable (the TallTower guy wire cable) and tighten nuts. If you installed the wire rope clip correctly, the nuts will be on the same side as the TallTower guy wire cable (Photo 3). Pull the short cable tight and install another wire rope clip on the other side of the ball as described above.

*CAUTION:* Incorrect installation of the wire rope clip can severely weaken the cable and cause premature cable failure.

# APPENDIX C

# TYPICAL GUY ANCHORS AND TOWER BASE PLATE DETAIL

# Appendix B: Anchoring Guidelines

### B.1 DETERMINE SITE SOIL AND ANCHOR TYPE BEFORE YOU ORDER YOUR TOWER

Per ANSI/TIA-222-G, for design purposes, one can assume Class 6 soils. However, the Standard requires that soil parameters and assumptions be validated prior to installing the tower.

Before your tower is ordered, determine the soil type, preferably through soil sampling. Order the correct anchors based on the results of the soil sample.

The purpose of this section is to give you the information needed to provide suitable anchoring for your Super 60 m XHD TallTower. **Because anchor requirements are site specific, it is the responsibility of the customer to determine suitable anchors. If you are not sure what is required, seek professional guidance.**

Local utility companies can often provide useful information regarding anchoring used in the site area. Do not use rebar anchors, especially when the surface soils are loose or wet.

**Table B-1: Soil Classes**

| Class | Common Soil Types | Geological Soil Classification |
|---|---|---|
| 3 | Dense clays, sands and gravel; hard silts and clays | Glacial till; weathered shales, schist, gneiss and siltstone |
| 4 | Medium dense sandy gravel; very stiff to hard silts and clays | Glacial till; hardpan; marls |
| 5 | Medium dense coarse sand and sandy gravels; stiff to very stiff silts and clays | Saprolites, residual soils |
| 6 | Loose to medium dense fine to coarse sand; firm to stiff clays and silts | Dense hydraulic fill; compacted fill; residual soils |
| 7** | Loose fine sand; Alluvium; loess; soil-firm clays; varied clays; fill | Flood plain soils; lake clays; adobe; gumbo; fill |

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.
Charts reproduced by permission, The A.B. Chance Company.

## B.2 ANCHOR CHOICES AND OTHER CONSIDERATIONS

The choice of anchors must take into consideration soil type, maximum winds expected, icing or other weather that may affect the tower, and a safety factor suitable for the location and to meet any legal requirements. Considerations include but are not limited to: tornadoes, hurricanes or typhoons, locations where very high winds are expected, potential for flooding or periodic soaking of the soil, soil erosion, and icing events.

## B.3 Screw-In Anchor Description

Screw-in anchors are the most commonly used anchors for normal clay soils without rocks. The 8 inch single helix anchors are installed by hand, using a cross bar to screw them into the earth like a corkscrew. The 8 inch twin helix anchors require machinery.

The Super 60 m XHD tower employs two (2), 8 inch diameter screw-in anchors and sixteen (12), 8 inch twin helix anchors.

**Table B-2: Specifications for 203 mm (8 inches) diameter Screw-In Anchors**

| Length Overall: | **203 mm (8 inches) Anchor** |
|---|---|
| Helix diameter: | 203 mm (8.0 inches) |
| Length Overall: | 1.65 m (66 inches) |
| Rod diameter: | 25 mm (1 inch) |
| Material: | Galvanized steel |
| **Holding Power:** (These anchors are not suitable for soils denser than class 5.) | |
| Class 5 soils * | 44.5 kN (10000 pounds) |
| Class 6 soils * | 31.1 kN (7000 pounds) |
| Class 7 soils ** | 17.8 kN (4000 pounds) |

* See Table  for soil class descriptions

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.

**Table B-3: Specifications for Mid-Strength 203 mm (8 inches) diameter Twin Helix**

| Length Overall: | 2.7 m ( 9 feet) (including 7 foot rod) |
|---|---|
| Helix Diameter: | 203 mm (8.0 inches) |
| Materials: | TBD |
| **Holding Power:** | |
| Class 3 soils * | 12700 kg (28000 pounds) |
| Class 4 soils * | 10900 kg (24000 pounds) |
| Class 5 soils * | 9090 kg (20000 pounds) |
| Class 6 soils * | 6800 kg (15000 pounds) |
| Class 7 soils * | 5450 kg (12000 pounds) |

* See Table 13 for soil class descriptions

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.

Products > Anchors - Utility > Manta Ray® Earth Anchor

# MANTA RAY® EARTH ANCHOR

The Manta Ray Utility Anchor System is used by utilities worldwide. Manta Rays are driven into the ground using a jackhammer, not augured or torqued. No excavation is necessary. The anchors are driven with conventional hydraulic equipment that is readily available.

## Description

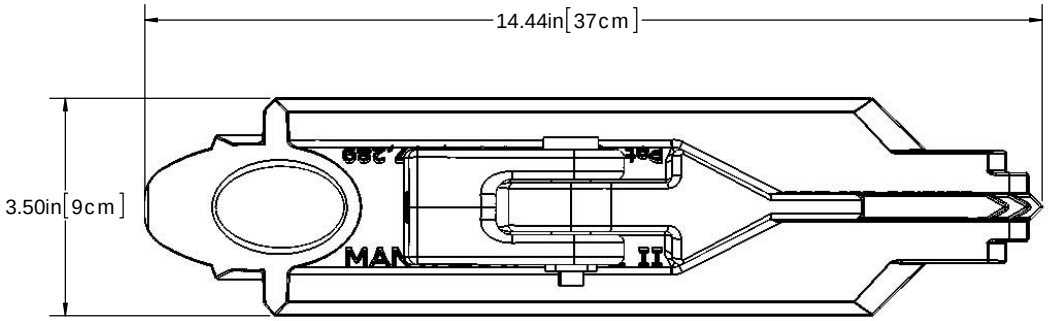
Manta Ray Anchors are RUS approved, rugged and versatile driven plate anchors for all types of soil conditions. They can be installed in extremely tough soils such as caliche, decomposed rock, glacial till, and permafrost. Larger models are also available for swamp application. Fully portable installation equipment which can fit in the back of a standard pickup truck can be used to access difficult to reach anchor locations. They can also be installed using the line truck's hydraulic system. Every anchor is proof tested during standard installation procedures for a verified tension load measurement. Manta Ray anchors are compatible with standard power hub anchor rods and eyenuts for distribution guy anchors.

## Links & PDFs

## Manta Ray Anchors

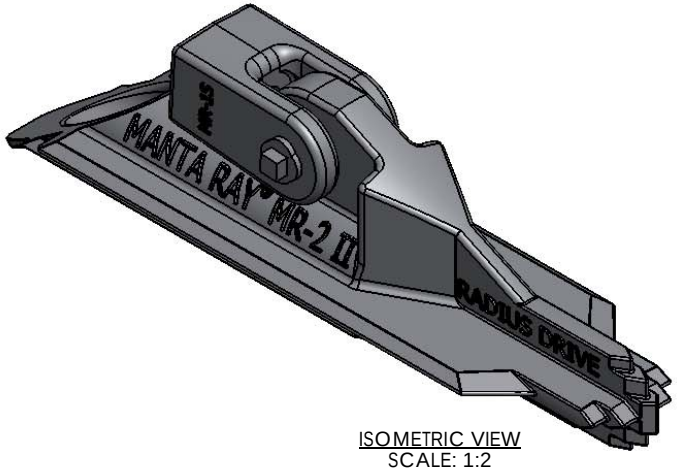
| Catalog Number | Model | For PH Rod Size | Ultimate Load Rating (lbs) | Weight (lbs) |
|---|---|---|---|---|
| 20036-UT-II | MR-1 | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 13 |
| 20199-UT-II | MR-2 | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 11 |
| 20210-UT-II | MR-3 | D62 (5/8") | 16,000 | 7 |
| 20229-UT-II | MR-SR | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 21 |

| PAPER SIZE | CATALOG NUMBER |
|---|---|
| B | 20199-UT-II |

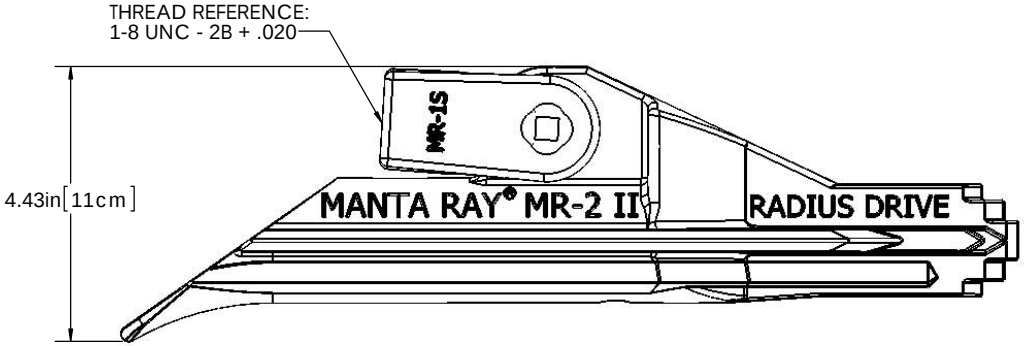



NOTES: UNLESS OTHERWISE SPECIFIED:

1) MECHANICAL ULTIMATE CAPACITY: 40,000 LBS [177.9kN]
2) MAXIMUM WORKING LOAD: UP TO 27,000 LBS [120.1 kN]
   (THIS VALUE IS SOIL AND ANCHOR ROD DEPENDANT)
3) AVERAGE WEIGHT: 10.2 LBS [4.6 kg]
4) FINISH: HOT DIP GALVANIZED




ISOMETRIC VIEW
SCALE: 1:2

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# ODA

**OUTSIDE DISTRIBUTION APPROVED: NON-PRODUCTION DRAWING**

MACLEAN POWER SYSTEMS
www.macleanpower.com

| | |
|---|---|
| DRAWING NUMBER: | 20199-UT-II |
| SHEET NAME: SHEET1 | 1 OF 1 |
| PRODUCT DESCRIPTION | MR-2-1"-UTILITY-II ANCHOR/SHACKLE ASSEMBLY |
| DRAWN BY: JFD | DATE: 03/06/13 |

MANTA RAY®
EARTH ANCHOR SYSTEMS

Manta Ray® anchor load ultimate tension capacity with 5/8” (16,000 lb-force), ¾” (23,000 lb-force) and 1” (36,000 lb-force) power hub anchor rods.

**Manta Ray anchor ultimate load capacity with power hub anchor rods (lbs-force)**

| Soil Description | Standard Penetrometer Blow Count (N) | MR-1 (3/4” or 1” rod) | MR-2 (3/4” or 1” rod) | MR-3 (5/8” rod) | MR-SR (3/4” or 1” rod) |
|---|---|---|---|---|---|
| Very dense/cemented sands; coarse gravel and cobbles | 60-100+ | 36,000 (1) | 36,000 (1) | 16,000 (1) | NA |
| Dense fine compacted sands, very hard silts or clays | 45-60 | 36,000 (1) | 28,000 (2) | 16,000 (1) | 36,000 (1) |
| Dense clays, sands and gravels, hard silts and clays | 35-40 | 36,000 (1) | 22,000 (2) | 16,000 (1) | 36,000 (1) |
| Medium dense sandy gravel, stiff to hard silts and clays | 24-40 | 20,000 (2) | 18,000 (2) | 14,000 (2) | 34,000 (2) |
| Medium dense coarse sandy gravel, stiff to very still silts and clays | 14-25 | 20,000 (2) | 12,000 (2) | 9,000 (2) | 24,000 (2) |
| Loose to medium dense fine to coarse sand: firm to stiff clays and silts | 7-14 | 15,000 (2) | 10,000 (2) | 8,000 (2) | 18,000 (2) |
| Loose fine sand, alluvium, soft clays, fine saturated silty sand | 4-8 | 12,000 (2) | 8,000 (2) | 5,000 (2) | 14,000 (2) |
| Peat, organic silts: inundates silts fly ash | 0-5 | 8,000 (2) | 5,000 (2) | 2,000 (2) | 12,000 (2) |

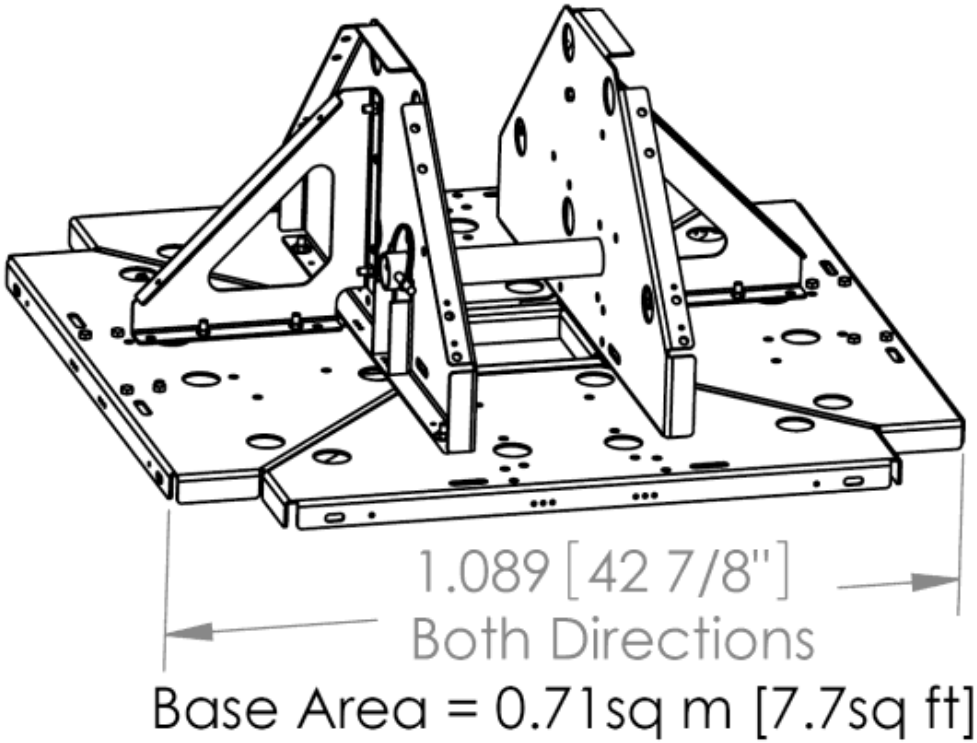
Notes: (1) Manta Ray anchor holding capacity limited by rod tension strength rating
(2) Manta Ray anchor holding capacity limited by soil capacity

Manta Ray® anchor load ultimate tension capacity with 5/8” (71.2 kn), ¾” (102.3 kn) and 1” (160.1 kn) power hub anchor rods.

| **Manta Ray anchor ultimate load capacity with power hub anchor rods (kn)** | | | | | |
|---|---|---|---|---|---|
| Soil Description | Standard Penetrometer Blow Count (N) | MR-1 kn | MR-2 kn | MR-3 kn | MR-SR kn |
| Very dense/cemented sands; coarse gravel and cobbles | 60-100+ | 160.1 (1) | 160.1 (1) | 71.2 (1) | NA |
| Dense fine compacted sands, very hard silts or clays | 45-60 | 160.1 (1) | 124.6 (2) | 71.2 (1) | 160.1 (1) |
| Dense clays, sands and gravels, hard silts and clays | 35-40 | 160.1 (1)) | 97.9 (2) | 71.2 (1) | 160.1 (1) |
| Medium dense sandy gravel, stiff to hard silts and clays | 24-40 | 89 (2) | 80.1 (2) | 62.3 (2) | 151.2 (2) |
| Medium dense coarse sandy gravel, stiff to very still silts and clays | 14-25 | 89 (2) | 53.4 (2) | 40.0 (2) | 106.8 (2) |
| Loose to medium dense fine to coarse sand: firm to stiff clays and silts | 7-14 | 66.7 (2) | 44.5 (2) | 35.6 (2) | 80.1 (2) |
| Loose fine sand, alluvium, soft clays, fine saturated silty sand | 4-8 | 53.4 (2) | 35.6 (2) | 22.2 (2) | 62.3 (2) |
| Peat, organic silts: inundates silts fly ash | 0-5 | 35.6 (2) | 22.2 (2) | 8.9 (2) | 53.4 (2) |

Notes: (1) Manta Ray anchor holding capacity limited by rod tension strength rating
(2) Manta Ray anchor holding capacity limited by soil capacity

**Baseplate Geometry**



# APPENDIX D

# TOWER GROUNDING AND TOWER DETAILS

# 50m XHD with Standard Footprint

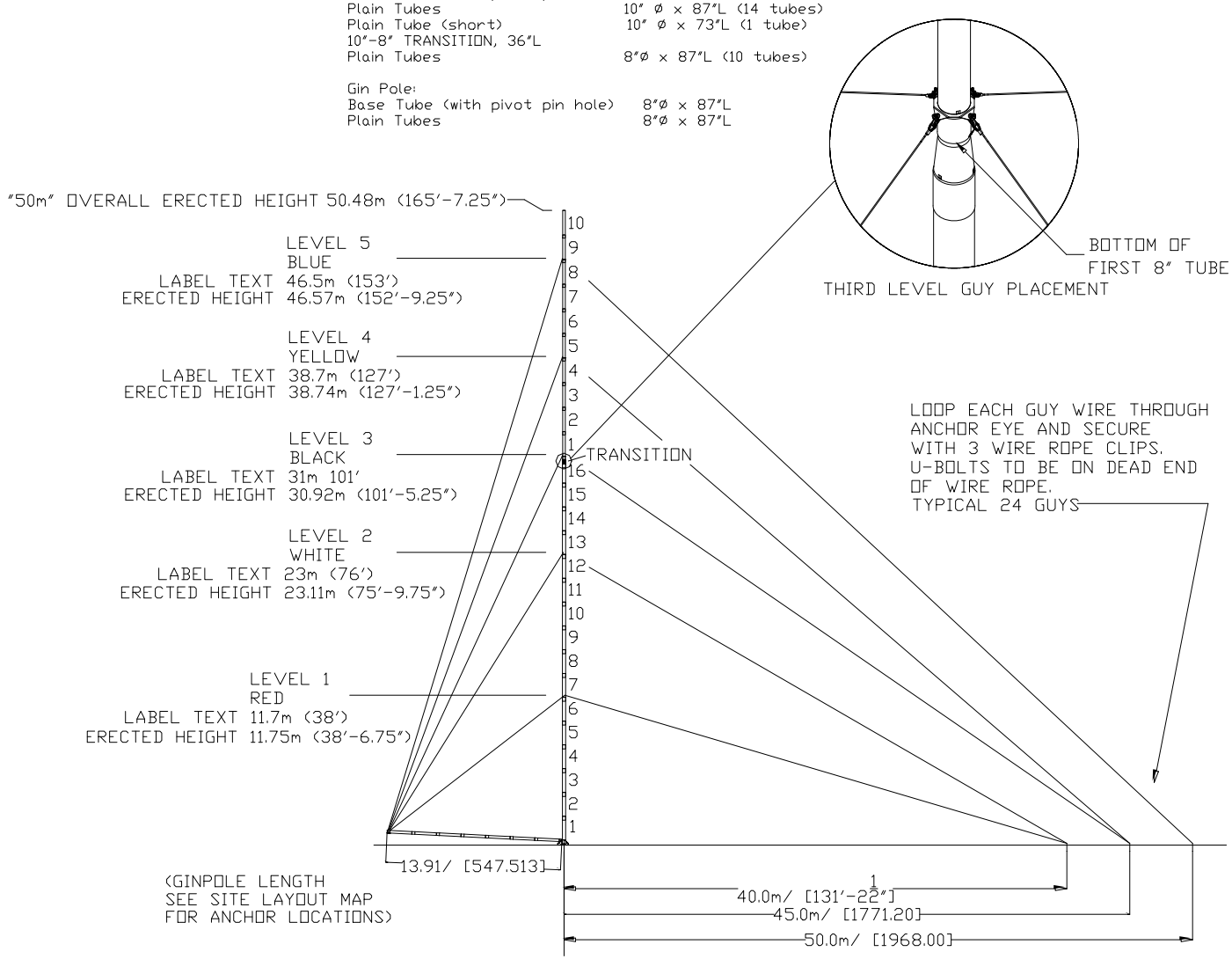
TUBE SPECS (in order of assembly):

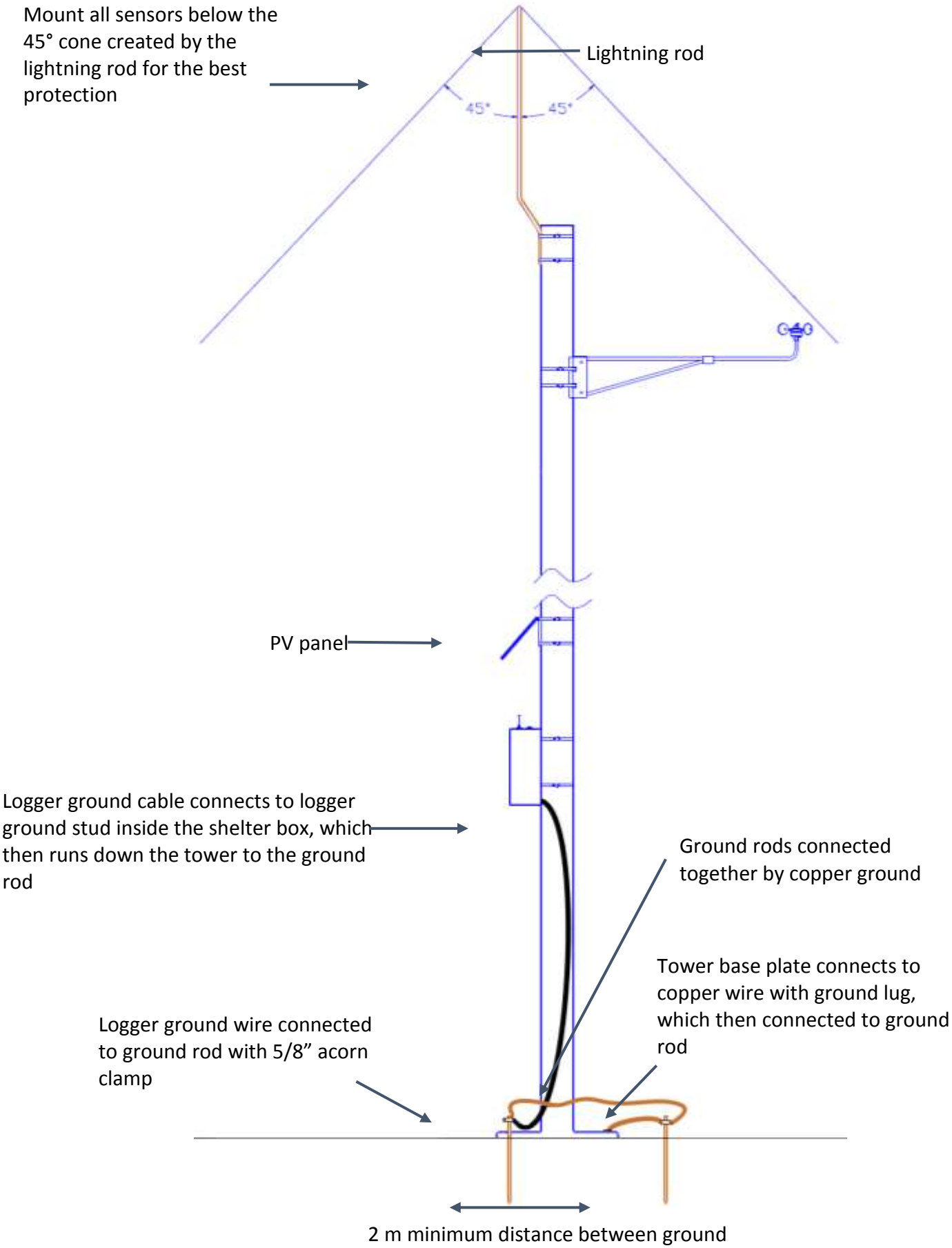
Tower:

| | |
|---|---|
| Base Tube (with pivot pin hole) | 10" ø x 87"L (1 tube) |
| Plain Tubes | 10" ø x 87"L (14 tubes) |
| Plain Tube (short) | 10" ø x 73"L (1 tube) |
| 10"-8" TRANSITION, 36"L | |
| Plain Tubes | 8"ø x 87"L (10 tubes) |

Gin Pole:

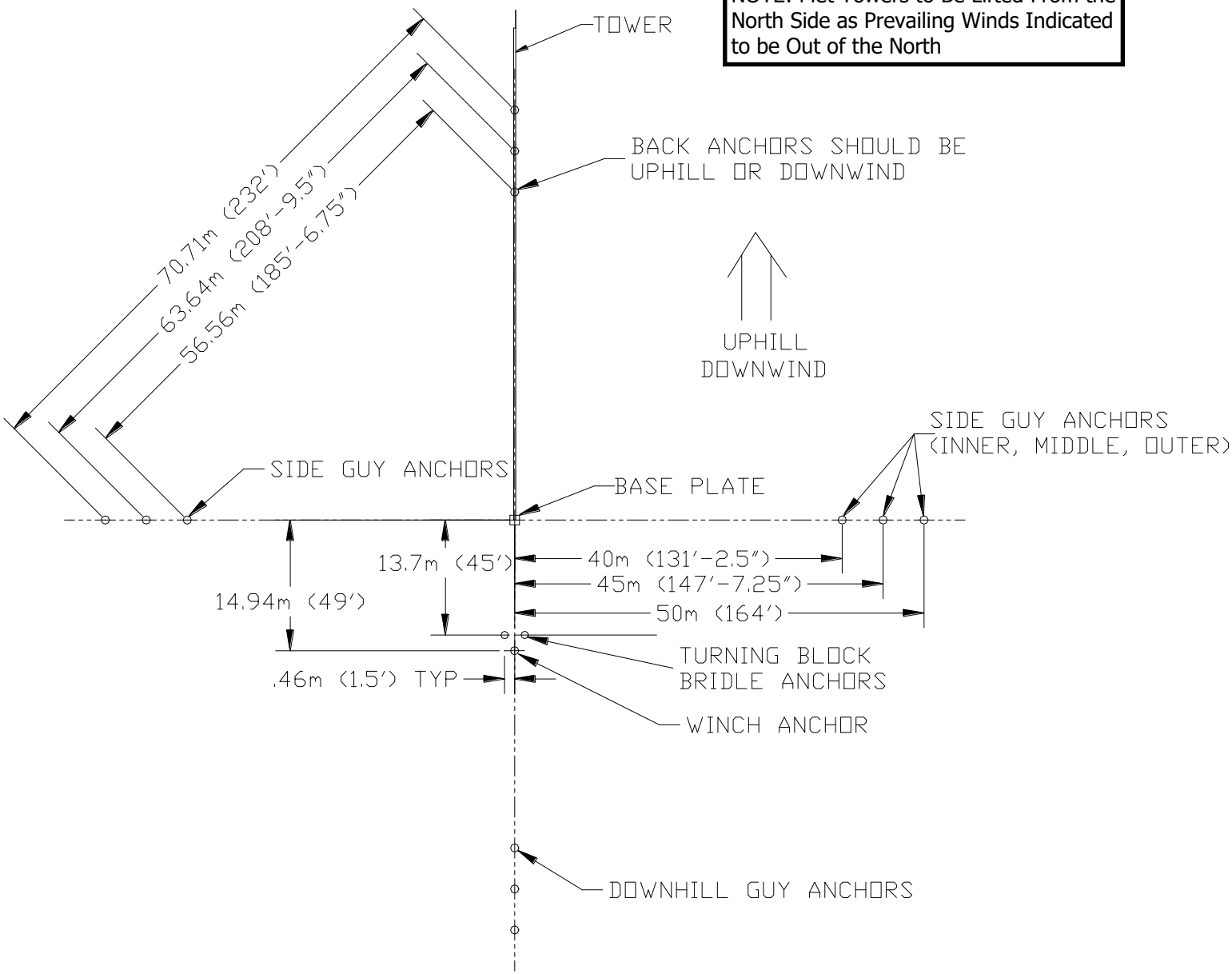
| | |
|---|---|
| Base Tube (with pivot pin hole) | 8"ø x 87"L |
| Plain Tubes | 8"ø x 87"L |




Mount all sensors below the 45° cone created by the lightning rod for the best protection
Lightning rod
45°
45°
PV panel
Logger ground cable connects to logger ground stud inside the shelter box, which then runs down the tower to the ground rod
Ground rods connected together by copper ground
Tower base plate connects to copper wire with ground lug, which then connected to ground rod
Logger ground wire connected to ground rod with 5/8" acorn clamp
2 m minimum distance between ground

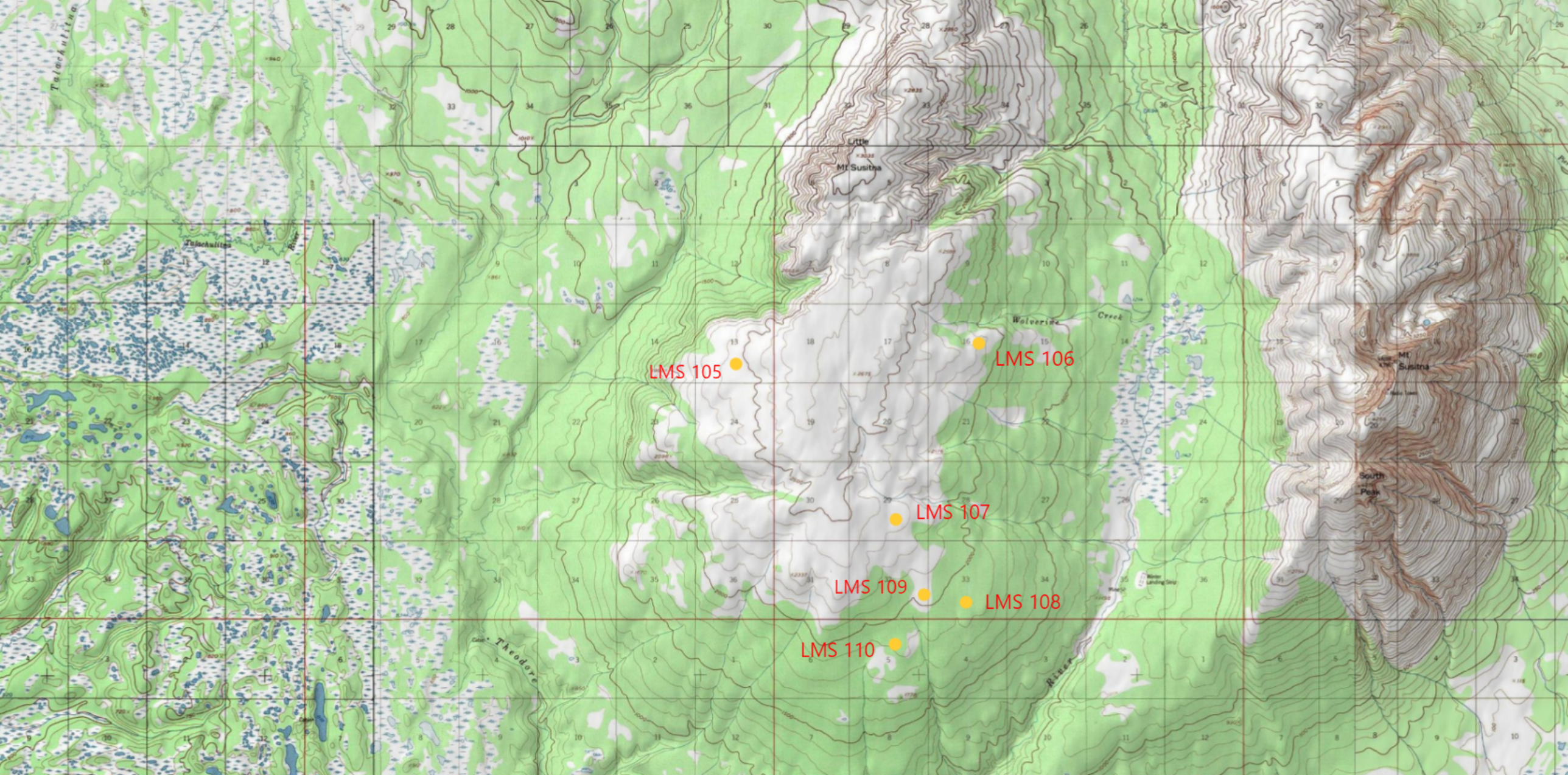
## Site Layout

NOTE: Met Towers to Be Lifted From the North Side as Prevailing Winds Indicated to be Out of the North



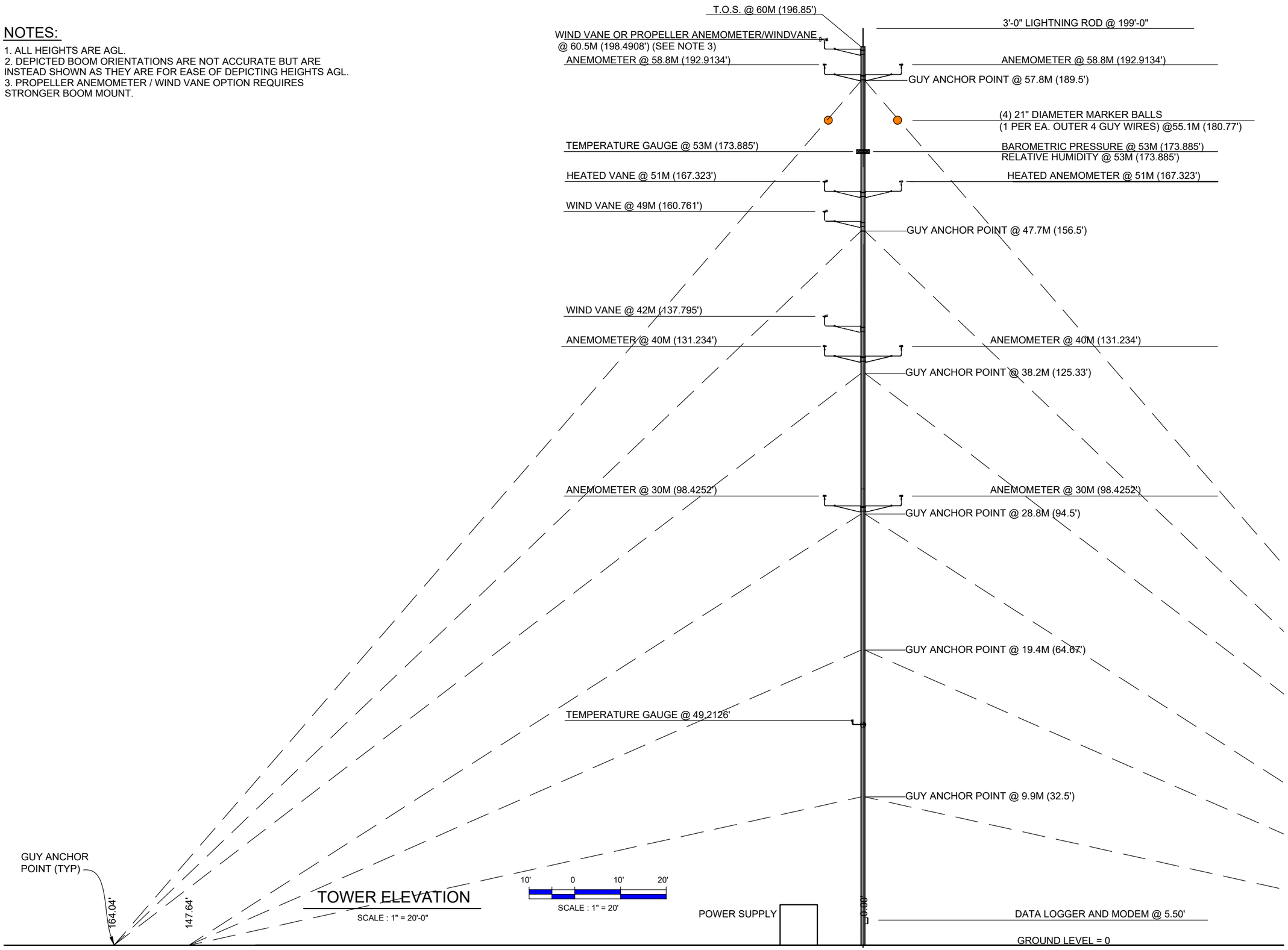
# APPENDIX E

# PROPOSED MET TOWER SITE LOCATION MAP


LMS 105
LMS 106
LMS 107
LMS 108
LMS 109
LMS 110
Little
Mt Susitna
Wolverine
Creek
Mt
Susitna
South
Peak
Talachulitna
River
Theodore
River

## NOTES:

1. ALL HEIGHTS ARE AGL.
2. DEPICTED BOOM ORIENTATIONS ARE NOT ACCURATE BUT ARE INSTEAD SHOWN AS THEY ARE FOR EASE OF DEPICTING HEIGHTS AGL.
3. PROPELLER ANEMOMETER / WIND VANE OPTION REQUIRES STRONGER BOOM MOUNT.




TOWER ELEVATION

SCALE : 1" = 20'-0"

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
TOWER ELEVATION

SHEET NO.
1 OF 9

NOTES:

1. MET TOWERS WINCHED UPRIGHT APPROXIMATELY FROM THE NORTH SIDE.

## GUYED TOWER NOTES

1) GUY WIRE INSTALLATION:
ALL GUY WIRES ARE TO BE INSTALLED PER MANUFACTURER'S GUIDELINES AND TENSIONED TO MANUFACTURER'S SPECIFIED LIMITS AND CONFIRMED BY THE USE OF A CALIBRATED TENSIONOMETER. THE TOWER MUST BE PLUMBED TO MANUFACTURER'S SPECIFICATIONS UTILIZING AN ENGINEER TRANSIT AND MUST NOT VARY MORE THAN ONE INCH PER 100 FT OF TOWER HEIGHT. FINAL TENSIONS ARE TO BE RECORDED IN TOWER ERECTION MANUAL AND SUBMITTED TO CONSTRUCTION MANAGER UPON COMPLETION.

2) GUY WIRES:
ALL CUT GUY WIRES WILL BE LASHED WITH A NON-FERROUS MATERIAL AND PAINTED WITH ZINC RICH COMPOUND UPON COMPLETION.

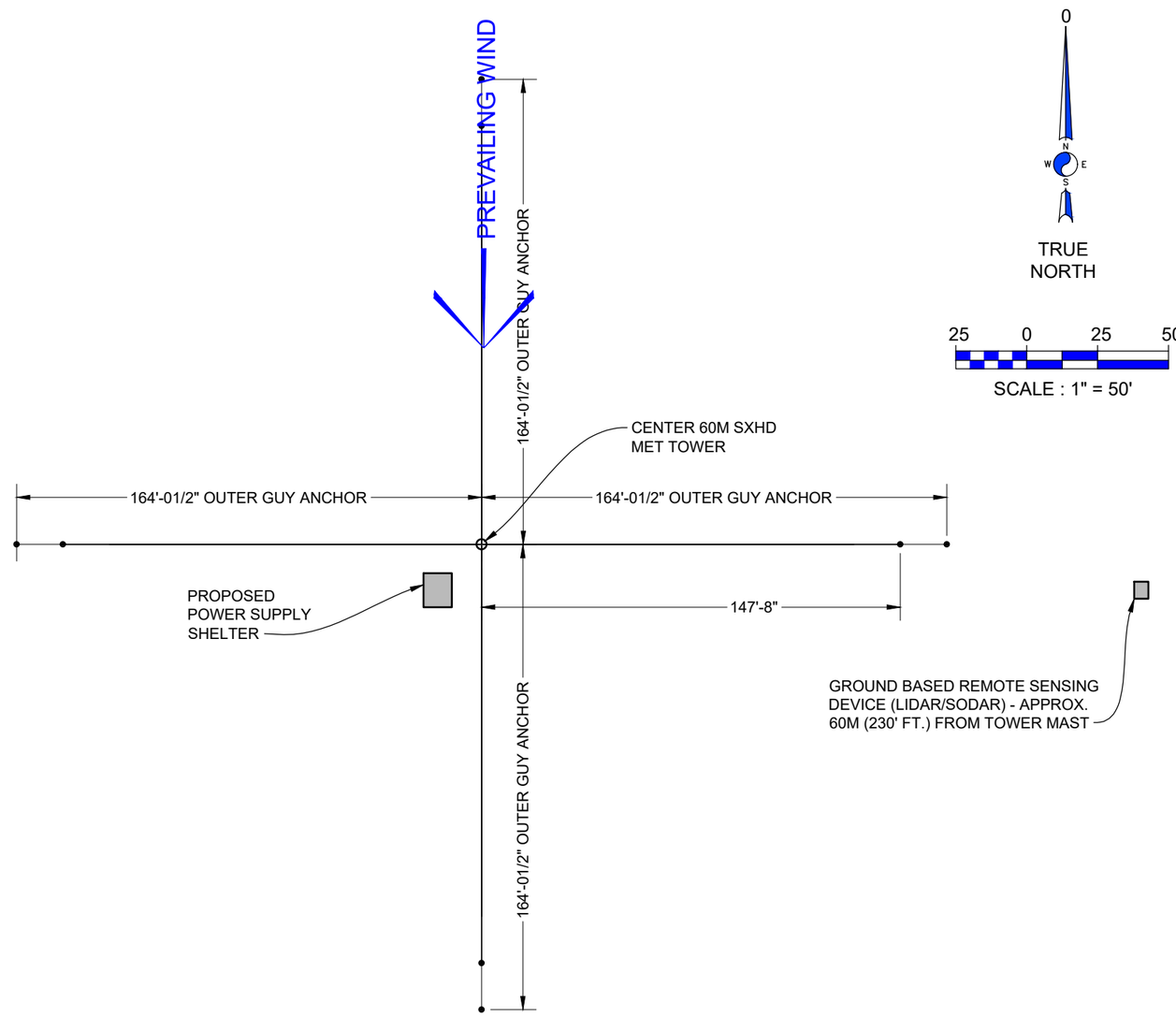
3) TURNBUCKLES:
ALL TURNBUCKLES ARE TO BE INSTALLED IN THE SAME ORIENTATION (WHEN BEHIND ANCHOR AND FACING TOWER, A CLOCKWISE TURN OF THE ADJUSTER WILL TIGHTEN THE TENSION AND A COUNTER-CLOCKWISE TURN OF THE ADJUSTER WILL LOOSEN TENSION). ALL ATTACHMENTS (BOLTS, PINS, CLEVISES) ARE TO BE INSTALLED IN THE SAME DIRECTION. DURING ERECTION, EACH GUY WIRE ADJUSTMENT WILL HAVE A TEMPORARY SAFETY INSTALLED. UPON COMPLETION, FOLLOWING FINAL PLUMB AND TENSION OF TOWER, ALL TURNBUCKLE ADJUSTERS WILL HAVE A SAFETY CABLE
ROUTED THROUGHOUT THEM AND SECURED TOGETHER WITH A WIRE ROPE CLIP, TO ENSURE NO MOVEMENT OF ADJUSTER.

4) PREFORM GRIPS:
UPON COMPLETION ALL GUY WIRES WILL HAVE AN ICE CLIP DEVICE INSTALLED AS DIRECTED AND SUPPLIED BY TOWER MANUFACTURER. ANY ABRASIONS ARE TO BE PAINTED WITH ZINC RICH PAINT.

5) GUY WIRE GROUNDS:
ALL GUY WIRES ARE TO BE GROUNDED IN UNISON UTILIZING #2 STRANDED WIRE AND MANUFACTURER SUPPLIED CONNECTORS AND COPPER SHEILD ON CABLE TO WIRE CONNECTIONS TO THE ANCHOR'S EARTHEN GROUND RING.

6) CONTRACTOR SHALL PROVIDE THE MINIMUM NUMBER OF GROUND RODS INDICATED, SEE GROUNDING PLAN FOR APPROXIMATE LOCATIONS.

7) GUY TOWER INSTALLATIONS MUST MEET OR EXCEED THE LATEST TIA/EIA-222-H STANDARDS.




60M SUPER XHD NRG TALL TOWER PLAN

SCALE : 1" = 50'-0"

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ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

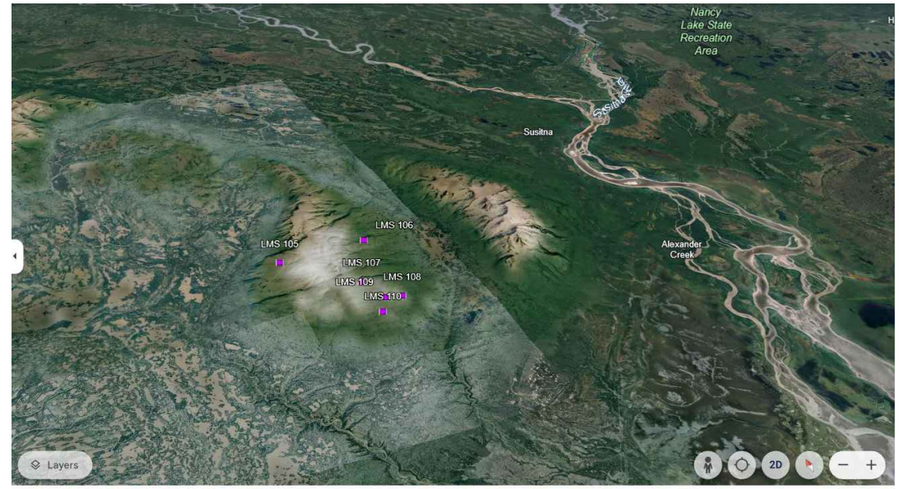
TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
TOWER PLAN

SHEET NO.
2 OF 9

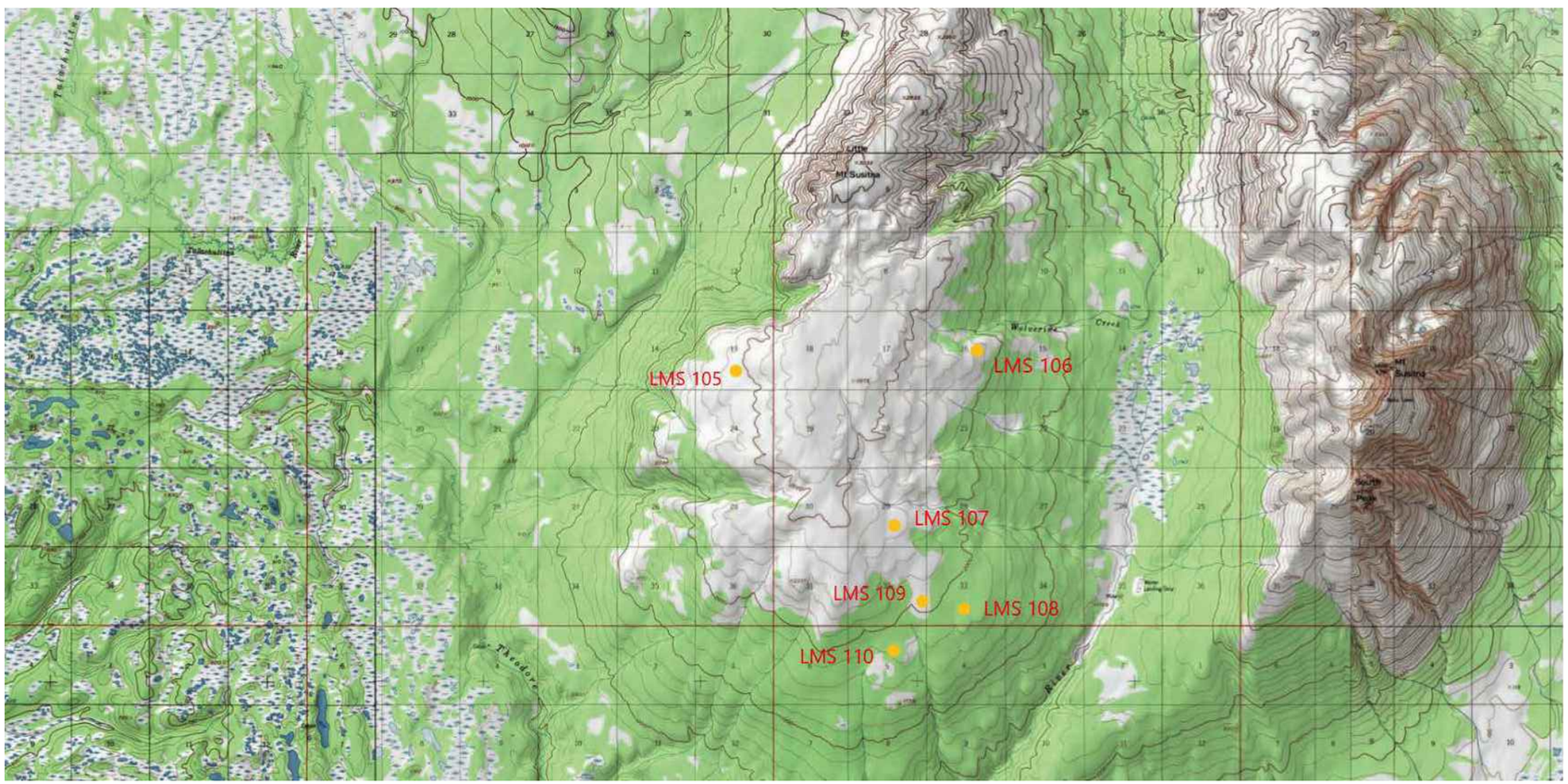
| | | | | |
|---|---|---|---|---|
| 20240430 | | | | |
| LMS met twrs to be permitted | | | | |
| | | | | |
| dataset | littleMountSusitna_toBePermittedMetTwrs_20240430_ja.shp | | | |
| | | | | |
| | UTM WGS84 z5 meters | | WGS84 | |
| id | X | Y | LATITUDE | LONGITUDE |
| LMS 105 | 607144 | 6817133 | 61.47306128° N | 150.98880926° W |
| LMS 106 | 612079 | 6817695 | 61.47670353° N | 150.89590508° W |
| LMS 107 | 610490 | 6814070 | 61.44464000° N | 150.92786700° W |
| LMS 108 | 611983 | 6812416 | 61.42937215° N | 150.90087803° W |
| LMS 109 | 611119 | 6812558 | 61.43089025° N | 150.91697790° W |
| LMS 110 | 610563 | 6811529 | 61.42181675° N | 150.92800343° W |

AK MET TOWER LATITUDE & LONGITUDE COORDINATE TABLE




LMS 105 THRU 110 GOOGLE MAPS LOCATIONS

SCALE : N.T.S.




LMS 105 THRU 110 LOCATIONS

SCALE : N.T.S.

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ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| 1 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATIONS

SHEET NO.
3 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N010W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 438610.156, 837190.354 | **NE:** | 448157.576, 837035.014 |
| **SW:** | 438439.045, 827536.254 | **SE:** | 448013.17, 827380.568 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720902342723964 | 61 25 34.48445 N |
| **E Longitude:** | -2.6349935005514356 | 150 58 26.42385 W |
| **N Latitude:** | 1.0736025151373458 | 61 30 46.41477 N |
| **W Longitude:** | -2.6381243219055466 | 151 09 12.20211 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

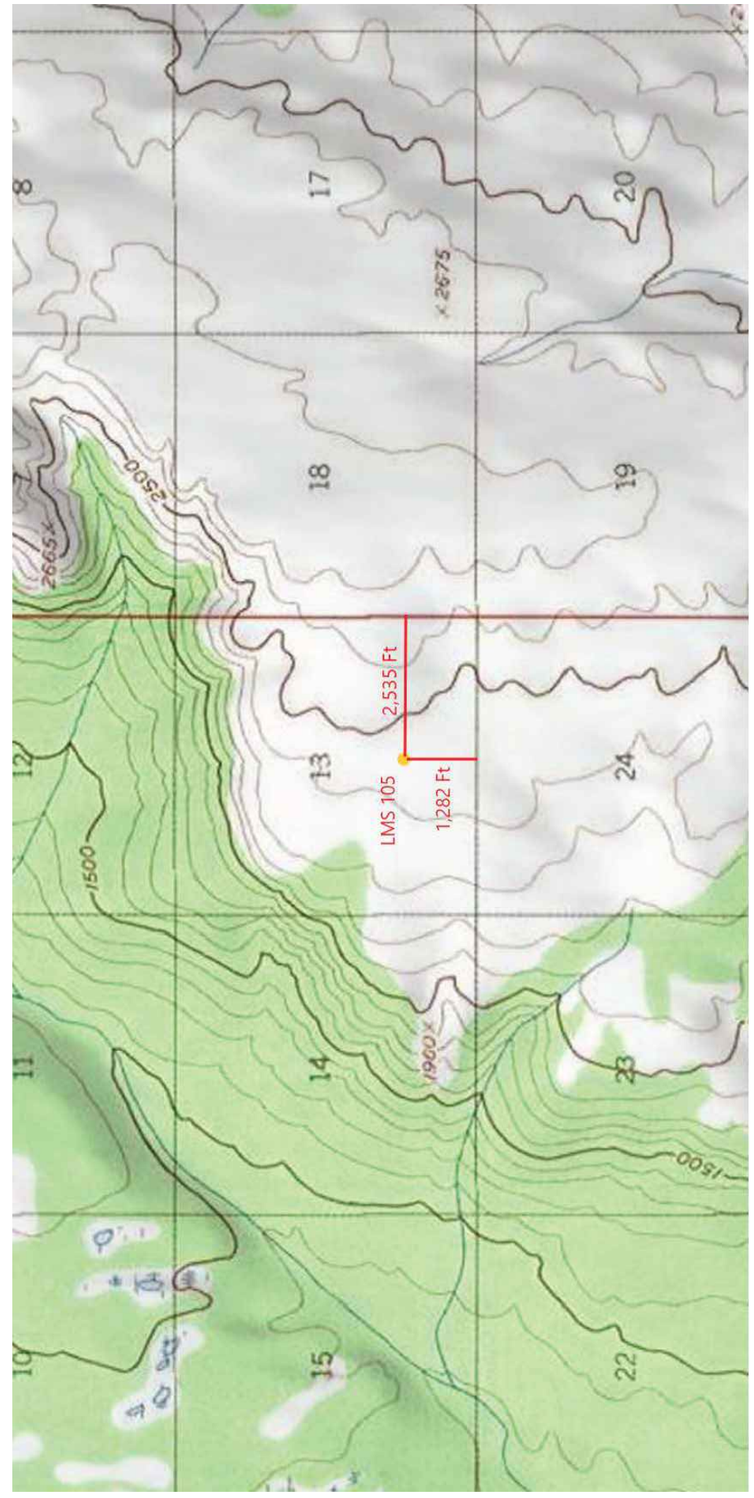
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-4 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-4 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:10 PM)

LMS 105 TOWNSHIP DATA




LMS 105 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 105

SHEET NO.
4 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
| **E Longitude:** | -2.631862563063116 | 150 47 40.62164 W |
| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
| **W Longitude:** | -2.6349934345081767 | 150 58 26.41023 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

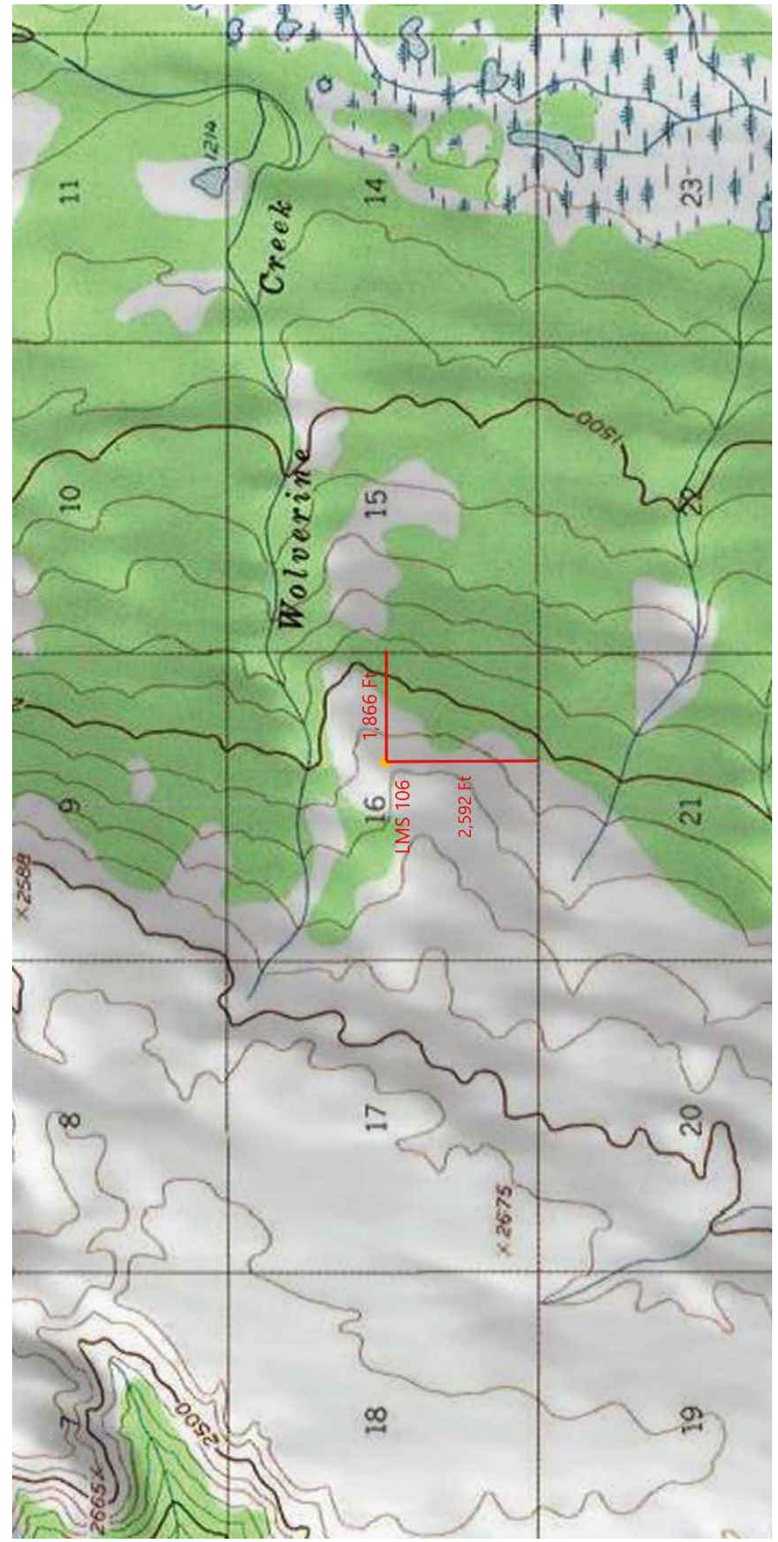
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-3 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:13 PM)

LMS 106 TOWNSHIP DATA




LMS 106 SETBACK DISTANCES TO SECTION LINES

SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 106

SHEET NO.
5 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
| **E Longitude:** | -2.631862563063116 | 150 47 40.62164 W |
| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
| **W Longitude:** | -2.6349934345081767 | 150 58 26.41023 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

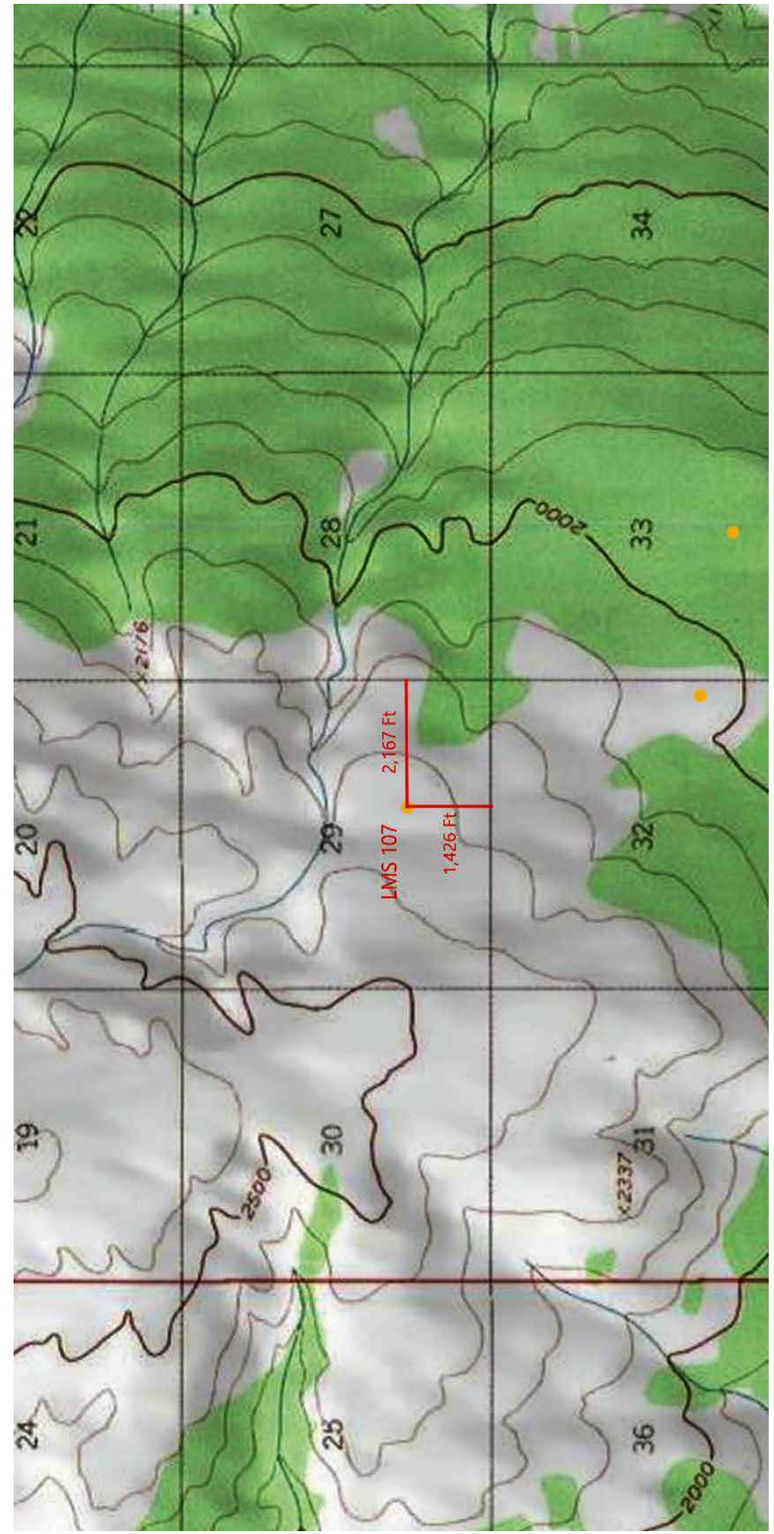
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK C-3 | **NE ITM Name:** | TYONEK C-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 1:58 PM)

LMS 107 TOWNSHIP DATA




LMS 107 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 107

SHEET NO.
6 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S015N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448013.17, 827380.568 | **NE:** | 457587.577, 827251.266 |
| **SW:** | 447868.883, 817726.177 | **SE:** | 457469.991, 817596.635 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0705779481540059 | 61 20 22.55305 N |
| **E Longitude:** | -2.631862575612033 | 150 47 40.62423 W |
| **N Latitude:** | 1.0720902342723964 | 61 25 34.48445 N |
| **W Longitude:** | -2.6349935005514356 | 150 58 26.42385 W |

**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

**ADL Protraction Diagram:** S-13-03
**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

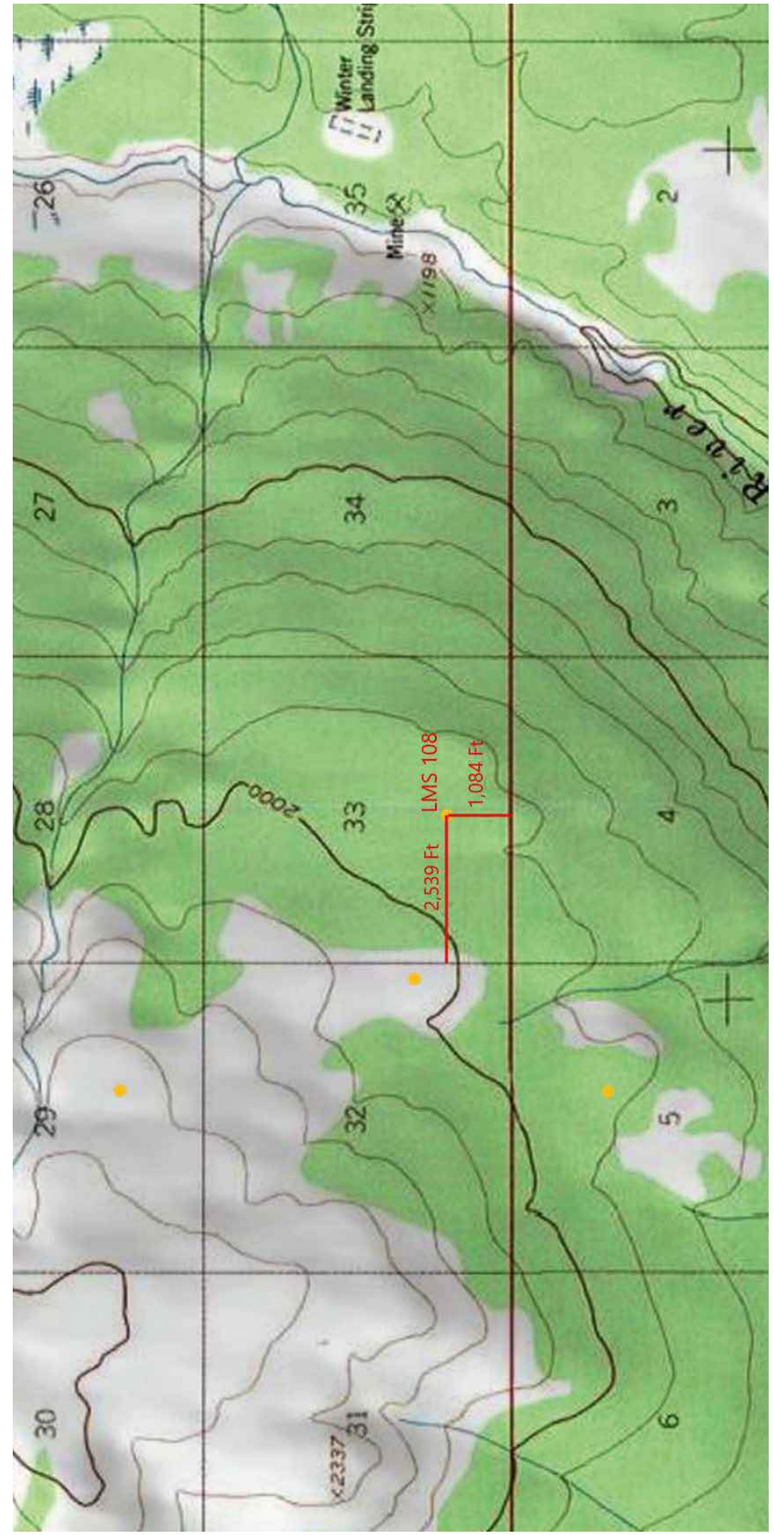
| | | | |
|---|---|---|---|
| **NW ITM Name:** | TYONEK B-3 | **NE ITM Name:** | TYONEK B-3 |
| **SW ITM Name:** | TYONEK B-3 | **SE ITM Name:** | TYONEK B-3 |

**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:16 PM)

LMS 108 TOWNSHIP DATA




LMS 108 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 108

SHEET NO.
7 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S016N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448157.576, 837035.014 | **NE:** | 457705.264, 836905.964 |
| **SW:** | 448013.17, 827380.568 | **SE:** | 457587.577, 827251.266 |

**Township Gracticule:**

| | Radians | DMS |
|---|---|---|
| **S Latitude:** | 1.0720903097927932 | 61 25 34.50003 N |
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| **N Latitude:** | 1.0736025881444686 | 61 30 46.42983 N |
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**BLM Protraction Diagram:** S-13-03
**Approved Date:** 01/25/1963
**Amended Date:**

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**Approved Date:** 12/29/1960
**Amended Date:**

**USGS Quadrangles:**

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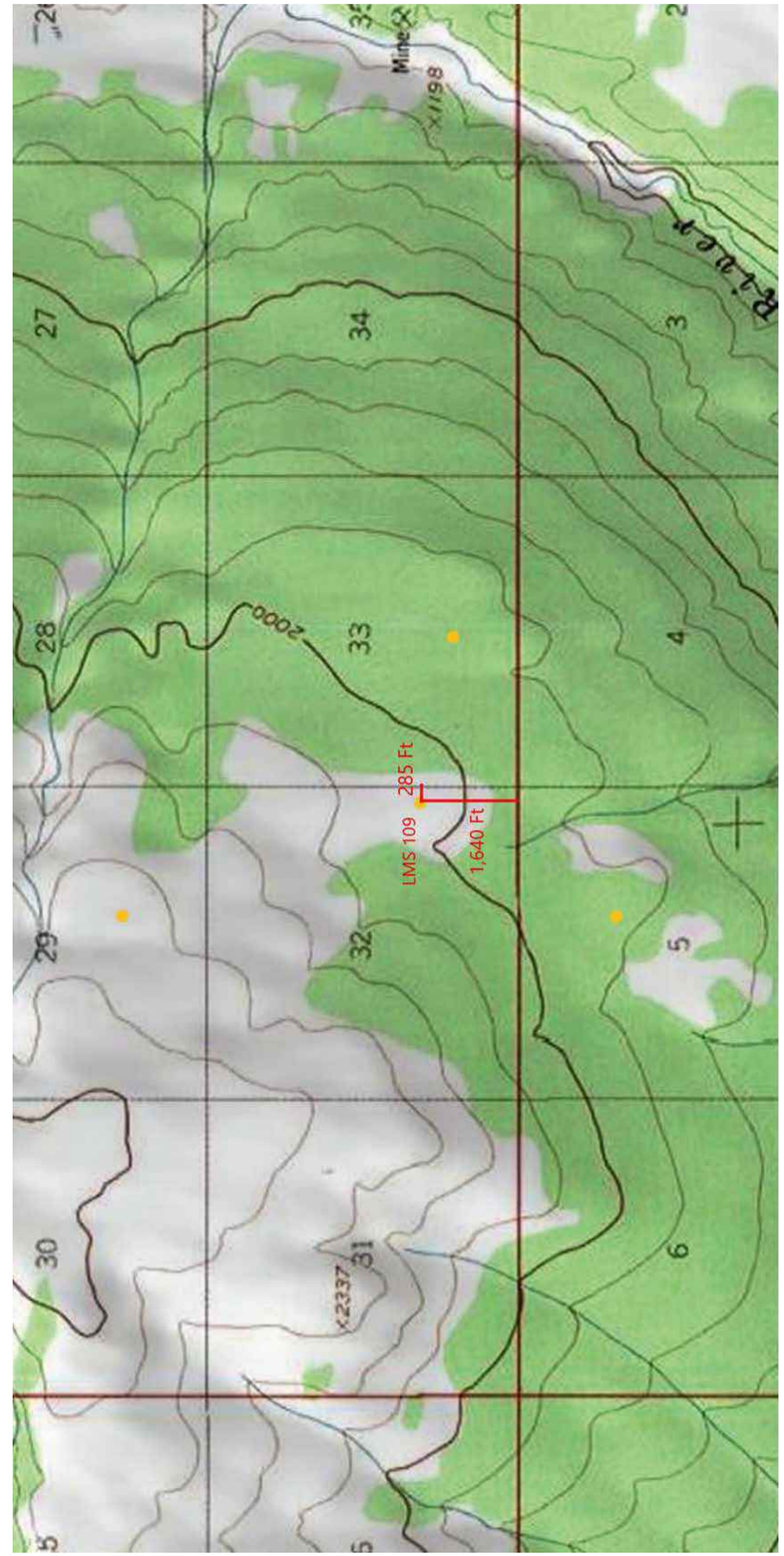
**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:17 PM)

LMS 109 TOWNSHIP DATA




LMS 109 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 109

SHEET NO.
8 OF 9

## Township Information

**Note: All generated information is based on the NAD83 datum.**

**Township:** S015N009W

**State Plane Zone:** 4

**Township Corners (State Plane Coordinates in Meters):**

| | | | |
|---|---|---|---|
| **NW:** | 448013.17, 827380.568 | **NE:** | 457587.577, 827251.266 |
| **SW:** | 447868.883, 817726.177 | **SE:** | 457469.991, 817596.635 |

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| | Radians | DMS |
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**Approved Date:** 12/29/1960
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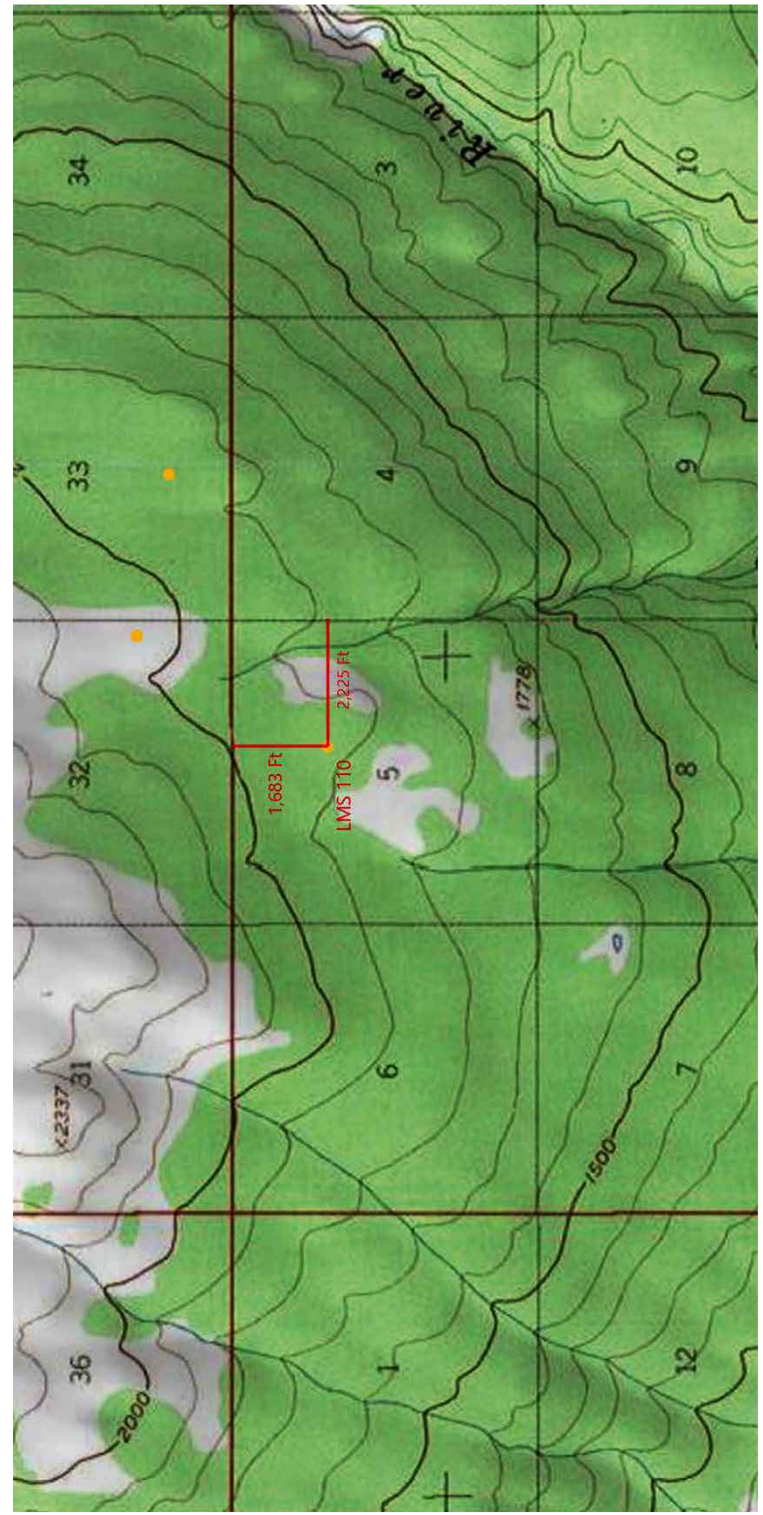
**Recording Districts:** ANCHORAGE RECORDING DISTRICT

**Boroughs:** Matanuska-Susitna Borough

Source: Alaska Department of Natural Resources, Support Services Division, Information Resource Management, GIS Programming Unit, Township Information Generator (Date Generated: June 26, 2024, 2:07 PM)

LMS 110 TOWNSHIP DATA




LMS 110 SETBACK DISTANCES TO SECTION LINES
SCALE : N.T.S.

longroad ENERGY

ALASKARENEWABLES

NewTower Engineering LLC

AHOLA ENGINEERING

| | |
|---|---|
| A&E PROJECT #: | 60M XHD ALASKA |
| DRAWN BY: | CB |
| CHECKED BY: | MA |

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | 06.26.2024 | I.F.C. |

STATE OF ALASKA 49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

SITE ADDRESS:
MATANUSKA-SUSITNA BOROUGH, AK

TOWER TYPE:
60M SUPER XHD NRG TALL TOWER

SHEET TITLE:
SITE LOCATION LMS 110

SHEET NO.
9 OF 9

# NewTower Engineering LLC

Date: **July 01, 2024**

Jeff Armbruster
Longroad Energy
125 High Street
Boston, MA 02210
Phone: (857) 202-7475

**Subject:** **Matanuska Susitna Borough Met Tower Conditional Use Permit**

***Applicant:*** ***Longroad Energy / Alaska Renewables***

***Land Owner:*** ***State of Alaska***

***Engineering Project No.:*** **Project Number:** 101-24-001

***Tower Data:*** **(6) NRG Systems 60m Super XHD Tall Meteorological Towers**
**Matanuska-Susitna Borough, AK**

| | UTM WGS84 z5 meters | | WGS84 | |
|---|---|---|---|---|
| id | X | Y | LATITUDE | LONGITUDE |
| LMS 105 | 607144 | 6817133 | 61.47306128° N | 150.98880926° W |
| LMS 106 | 612079 | 6817695 | 61.47670353° N | 150.89590508° W |
| LMS 107 | 610490 | 6814070 | 61.44464000° N | 150.92786700° W |
| LMS 108 | 611983 | 6812416 | 61.42937215° N | 150.90087803° W |
| LMS 109 | 611119 | 6812558 | 61.43089025° N | 150.91697790° W |
| LMS 110 | 610563 | 6811529 | 61.42181675° N | 150.92800343° W |

Dear Mr. Armbruster,

Please find enclosed the following for the subject six (6) NRG 60m Super XHD Met Tower with Standard Footprint permit application:

1. A full tower structural analysis is provided (refer attached report and Appendix A output results) in accordance with the 2021 Alaska Building Code, 2021 International Building Code, ASCE 7-16 Code, and ANSI TIA 222-Rev H, based upon an ultimate 3-second gust wind speed of 121 mph ($V_{ult}$), Risk Category II, and Exposure Category C including seismic analysis.
2. Refer Appendix C and the Conclusions/Recommendations for recommended Manta Ray (MR-2) guy anchor, 8" double helix (or approved equal) details and minimum pull forces required (Table 4). No soils report is available for the site. As such, anchor pull tests will be required to meet the minimum resultant anchor loads as listed in Table 4 of this report.
3. Refer Appendix D for typical tower grounding and related tower installation details.

Structural analysis prepared by: Mikko P. Ahola, PE

Respectfully submitted by:

Aaron Boonstra, PE
Professional Engineer

STATE OF ALASKA
49TH
Aaron R. Boonstra
Date 7/1/24
No. CE 198374
REGISTERED PROFESSIONAL ENGINEER

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3.2) Assumptions

**4) ANALYSIS RESULTS**
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**6) APPENDIX B**
Equipment Details

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Proposed Met Tower Site Location Map

## 1) INTRODUCTION

The purpose of this report is to investigate the structural adequacy of proposed (6) 60m NRG Super XHD Tall guyed pole temporary meteorological towers to be located in the Matanuska-Susitna Borough, Alaska (refer Appendix D map locations). The met towers will support wind monitoring devices. The computer plots & output based on a 3D structural analysis using tnxTOWER (Version 8.2.2) is provided in Appendix A.

The 60m tall Super NRG guyed pole MET towers are designed and manufactured by NRG Systems and are a stronger version of the standard 60m XHD NRG met towers.

The finite element program “tnxTower” used in this analysis is developed by Tower Numerics in Lexington, MA. It is a specialized 3D structural analysis program widely used and accepted in the tower industry.

## 2) ANALYSIS CRITERIA

The analysis has been performed in accordance with the 2021 Alaska Building Code, 2021 International Building Code, and ANSI TIA-222-Rev H for the tower site locations in Alaska based upon an ultimate 3-second gust wind speed of 121 mph ($V_{ult}$). Exposure Category C, Risk Category II along with topographic category 2 and crest height of 1,500 feet were used in this analysis (typical for all 6 tower sites), including seismic analysis. Met towers are temporary structures (typically 1 to 3-year installation duration) and could be analyzed as Risk Category I structures and a lower 115 mph ultimate gust wind speed at the met tower site locations. Table 1 below shows the proposed MET tower loading.

**Table 1 - Proposed 60m Tall Super XHD Met Tower Equipment Loading**

| Center Line Elevation (ft) | Number of Antennas | Antenna/Mount Manufacturer | Antenna/Mount Model | Number of Feed Lines | Feed Line Size (in) | Note |
|---|---|---|---|---|---|---|
| 198.49 (60.5 m) | 1 | Young | Propellor Anemometer/ Wind Vane | 1 | 0.14”ϕ cable | 1 |
| 198.49 (60.5 m) | 1 | NRG Systems | NRG No. 4214 (95” Long Side Boom) | - | - | 1 |
| 192.91 (58.8 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14”ϕ cables | 1 |
| 192.91 (58.8 m) | 2 | NRG Systems | NRG No. 4214 (95” Long Side Booms) | - | - | 1 |
| 180.77 (55.1 m) | 4 | NRG Systems | 21” ϕ Orange Marker Balls (3.6m From Top Guy Ring) | - | - | 1 |
| 173.89 (53.0 m) | 1<br>1<br>1 | Campbell Scientific | Barometric Pressure Gauge<br>Relative Humidity Sensor<br>Temperature Sensor | 3 | 0.14”ϕ cables | 1 |
| 167.323 (51.0 m) | 2 | NRG Systems | Heated Anemometer | 2 | 0.14”ϕ cables | 1 |
| 167.323 (51.0 m) | 2 | NRG Systems | NRG No. 4214 (95” Long Side Booms) | - | - | 1 |
| 160.76 (49.0 m) | 1 | NRG Systems | NRG 200P Wind Vane | 1 | 0.14”ϕ cable | 1 |
| 160.76 (49.0 m) | 1 | NRG Systems | NRG No. 4214 (95” Long Side Boom) | - | - | 1 |
| 137.80 (42.0 m) | 1 | NRG Systems | NRG 200P Wind Vane | 1 | 0.14”ϕ cable | 1 |
| 137.80 (42.0 m) | 1 | NRG Systems | NRG No. 4214 (95” Long Side Boom) | - | - | 1 |
| 131.23 (40.0 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14”ϕ cables | 1 |

| Center Line Elevation (ft) | Number of Antennas | Antenna/Mount Manufacturer | Antenna/Mount Model | Number of Feed Lines | Feed Line Size (in) | Note |
|---|---|---|---|---|---|---|
| 131.23 (40.0 m) | 2 | NRG Systems | NRG No. 4214 (95" Long Side Booms) | - | - | 1 |
| 98.43 (30.0 m) | 2 | NRG Systems | NRG #40C Anemometers | 2 | 0.14"ϕ cables | 1 |
| 98.43 (30.0 m) | 2 | NRG Systems | NRG No. 4214 (95" Long Side Booms) | - | - | 1 |
| 49.21 (15.0 m) | 1 | Unknown | Temperature Sensor | 1 | 0.14"ϕ cable | 1 |
| 4.92 (1.5 m) | 1 | NRG Systems | Data Logger & Modem | - | - | 1 |

**Notes:** 1. Proposed Equipment

## 3) ANALYSIS PROCEDURE

**Table 2 - Documents Provided**

| Document | Remarks | Reference | Source |
|---|---|---|---|
| Met Tower Equipment Loading | Anemometers, Wind Vanes, Marker Balls | 06/20/2024 | Longroad Energy |
| Super 60m XHD Tall Tower Manual | Installation & Specifications Guide | 12/14/2022 | NRG Systems |

### 3.1) Analysis Method

tnxTower (version 8.2.2), a commercially available analysis software package, was used to analyze the 60m Super XHD tall MET tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

### 3.2) Assumptions

1. The pole steel is 45 ksi yield.
2. The MET tower is supported by 5/16" diameter Aircraft guy wiring with breaking strength of 9.8 kips with 0.255 kips (2.6%) initial tension.
3. The proposed MET tower is temporary (typically 1 to 3-year installation duration).
4. The met tower and anchors are to be installed by a professional contractor knowledge in met tower installation and will be installed following the instructions in the NRG 60m Super XHD Tower Installation Manual & Specifications & other manufacturer specifications.

## 4) ANALYSIS RESULTS

**Table 3 - Section Capacity (Summary)**

**Section Capacity Table**

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 | Pole | TP8.05x8x0.134 | 1 | -99.47 | 134865.00 | 6.2 | Pass |
| L2 | 190.438 - 184.021 | Pole | TP8.05x7.7763x0.134 | 2 | -7819.06 | 134427.00 | 18.5 | Pass |
| | | Guy A@189.321 | NRG Guy 5/16 13MM | 36 | 4661.95 | 5880.00 | 79.3 | Pass |
| | | Guy B@189.321 | NRG Guy 5/16 13MM | 35 | 5064.07 | 5880.00 | 86.1 | Pass |
| | | Guy C@189.321 | NRG Guy 5/16 13MM | 34 | 4663.94 | 5880.00 | 79.3 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| | | Guy D@189.321 | NRG Guy 5/16 13MM | 33 | 5064.44 | 5880.00 | 86.1 | Pass |
| L3 | 184.021 - 177.604 | Pole | TP8.05x7.7505x0.134 | 3 | -8368.19 | 134376.00 | 33.2 | Pass |
| L4 | 177.604 - 171.187 | Pole | TP8.05x7.7476x0.134 | 4 | -8414.02 | 131194.00 | 35.7 | Pass |
| L5 | 171.187 - 164.771 | Pole | TP8.05x7.7472x0.134 | 5 | -8522.15 | 130395.00 | 33.9 | Pass |
| L6 | 164.771 - 158.354 | Pole | TP8.05x7.7472x0.134 | 6 | -8628.17 | 130394.00 | 21.8 | Pass |
| L7 | 158.354 - 151.937 | Pole | TP8.05x7.7472x0.134 | 7 | -15025.40 | 131984.00 | 27.9 | Pass |
| | | Guy A@156.121 | NRG Guy 5/16 13MM | 40 | 4057.42 | 5880.00 | 69.0 | Pass |
| | | Guy B@156.121 | NRG Guy 5/16 13MM | 39 | 4361.66 | 5880.00 | 74.2 | Pass |
| | | Guy C@156.121 | NRG Guy 5/16 13MM | 38 | 4055.13 | 5880.00 | 69.0 | Pass |
| | | Guy D@156.121 | NRG Guy 5/16 13MM | 37 | 4361.41 | 5880.00 | 74.2 | Pass |
| L8 | 151.937 - 145.521 | Pole | TP8.05x7.7472x0.134 | 8 | -15091.00 | 130394.00 | 21.1 | Pass |
| L9 | 145.521 - 139.104 | Pole | TP8.05x7.7472x0.134 | 9 | -15187.00 | 130394.00 | 14.2 | Pass |
| L10 | 139.104 - 132.687 | Pole | TP8.05x7.7472x0.134 | 10 | -15523.80 | 134370.00 | 19.0 | Pass |
| L11 | 132.687 - 126.271 | Pole | TP8.05x7.7472x0.134 | 11 | -15637.60 | 134370.00 | 32.3 | Pass |
| L12 | 126.271 - 119.854 | Pole | TP8.05x7.7472x0.134 | 12 | -20106.70 | 131189.00 | 40.4 | Pass |
| | | Guy A@125.154 | NRG Guy 5/16 13MM | 44 | 2744.11 | 5880.00 | 46.7 | Pass |
| | | Guy B@125.154 | NRG Guy 5/16 13MM | 43 | 2937.87 | 5880.00 | 50.0 | Pass |
| | | Guy C@125.154 | NRG Guy 5/16 13MM | 42 | 2744.05 | 5880.00 | 46.7 | Pass |
| | | Guy D@125.154 | NRG Guy 5/16 13MM | 41 | 2937.74 | 5880.00 | 50.0 | Pass |
| L13 | 119.854 - 113.437 | Pole | TP8.05x7.7472x0.134 | 13 | -20188.90 | 130394.00 | 33.6 | Pass |
| L14 | 113.437 - 107.021 | Pole | TP8.05x7.7472x0.134 | 14 | -20288.10 | 130394.00 | 27.9 | Pass |
| L15 | 107.021 - 100.604 | Pole | TP8.05x7.7472x0.134 | 15 | -20459.90 | 134370.00 | 26.6 | Pass |
| L16 | 100.604 - 98.4375 | Pole | TP10.04x7.7472x0.109 | 16 | -20488.80 | 113431.00 | 31.8 | Pass |
| L17 | 98.4375 - 93.3959 | Pole | TP10.04x9.0259x0.134 | 17 | -20614.50 | 165931.00 | 25.7 | Pass |
| | | Guy A@94.4376 | NRG Guy 5/16 13MM | 48 | 2205.98 | 5880.00 | 37.5 | Pass |
| | | Guy B@94.4376 | NRG Guy 5/16 13MM | 47 | 2302.03 | 5880.00 | 39.2 | Pass |
| | | Guy C@94.4376 | NRG Guy 5/16 13MM | 46 | 2206.74 | 5880.00 | 37.5 | Pass |
| | | Guy D@94.4376 | NRG Guy 5/16 13MM | 45 | 2302.06 | 5880.00 | 39.2 | Pass |
| L18 | 93.3959 - 87.1876 | Pole | TP10.04x9.5983x0.134 | 18 | -23925.90 | 162443.00 | 25.6 | Pass |
| L19 | 87.1876 - 80.9793 | Pole | TP10.04x9.7085x0.134 | 19 | -24052.80 | 164052.00 | 18.0 | Pass |
| L20 | 80.9793 - 74.771 | Pole | TP10.04x9.7244x0.134 | 20 | -24103.50 | 167880.00 | 15.5 | Pass |
| L21 | 74.771 - 68.5627 | Pole | TP10.04x9.7267x0.134 | 21 | -24231.90 | 167883.00 | 20.1 | Pass |
| L22 | 68.5627 - 62.3544 | Pole | TP10.04x9.727x0.134 | 22 | -26459.20 | 167364.00 | 27.2 | Pass |
| | | Guy A@64.4294 | NRG Guy 5/16 13MM | 52 | 2022.88 | 5880.00 | 34.4 | Pass |
| | | Guy B@64.4294 | NRG Guy 5/16 13MM | 51 | 2024.51 | 5880.00 | 34.4 | Pass |
| | | Guy C@64.4294 | NRG Guy 5/16 13MM | 50 | 2022.78 | 5880.00 | 34.4 | Pass |
| | | Guy D@64.4294 | NRG Guy 5/16 13MM | 49 | 2024.53 | 5880.00 | 34.4 | Pass |
| L23 | 62.3544 - 56.1461 | Pole | TP10.04x9.727x0.134 | 23 | -26513.80 | 164322.00 | 23.9 | Pass |
| L24 | 56.1461 - 49.9378 | Pole | TP10.04x9.727x0.134 | 24 | -26950.00 | 167884.00 | 25.2 | Pass |
| L25 | 49.9378 - 43.7295 | Pole | TP10.04x9.727x0.134 | 25 | -27057.30 | 166604.00 | 27.2 | Pass |
| L26 | 43.7295 - 37.5212 | Pole | TP10.04x9.727x0.134 | 26 | -27130.60 | 164322.00 | 27.5 | Pass |
| L27 | 37.5212 - 31.3129 | Pole | TP10.04x9.727x0.134 | 27 | -27257.70 | 164322.00 | 23.6 | Pass |
| | | Guy A@32.3546 | NRG Guy 5/16 13MM | 56 | 1735.48 | 5880.00 | 29.5 | Pass |
| | | Guy B@32.3546 | NRG Guy 5/16 13MM | 55 | 1719.95 | 5880.00 | 29.3 | Pass |
| | | Guy C@32.3546 | NRG Guy 5/16 13MM | 54 | 1733.35 | 5880.00 | 29.5 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| | | Guy D@32.3546 | NRG Guy 5/16 13MM | 53 | 1719.94 | 5880.00 | 29.3 | Pass |
| L28 | 31.3129 - 25.1046 | Pole | TP10.04x9.727x0.134 | 28 | -28489.50 | 167884.00 | 27.7 | Pass |
| L29 | 25.1046 - 18.8963 | Pole | TP10.04x9.727x0.134 | 29 | -28617.80 | 167884.00 | 33.5 | Pass |
| L30 | 18.8963 - 12.688 | Pole | TP10.04x9.727x0.134 | 30 | -28690.30 | 165843.00 | 35.3 | Pass |
| L31 | 12.688 - 6.47966 | Pole | TP10.04x9.727x0.134 | 31 | -28789.60 | 164322.00 | 35.3 | Pass |
| L32 | 6.47966 - 0 | Pole | TP10.04x9.727x0.134 | 32 | -28914.60 | 164295.00 | 30.6 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L12) | 40.4 | Pass |
| | | | | | | Guy A (L2) | 79.3 | Pass |
| | | | | | | Guy B (L2) | 86.1 | Pass |
| | | | | | | Guy C (L2) | 79.3 | Pass |
| | | | | | | Guy D (L2) | 86.1 | Pass |
| | | | | | | **RATING =** | **86.1** | **Pass** |

**Table 4 – Guy Anchor Reactions**

| Anchor Radius | Factored Uplift Force (Vertical) | Factored Shear Force (Horizontal) | Factored Resultant Force |
|---|---|---|---|
| Inner Anchor (Radius = 147.67 ft) | 2,280 lbs | 5,507 lbs | 5,960 lbs |
| Outer Anchor (Radius = 164.04 ft) | 8,165 lbs | 9,137 lbs | 12,253 lbs |

1. Anchor reactions are factored.

### 4.1) Conclusions & Recommendations

The proposed 60m Super XHD MET towers with standard footprint were analyzed with the proposed new wind monitoring devices and marker balls (Refer Table 1) per the 2021 International Building Code/ASCE 7-16 Code for the typical site conditions at the 6 tower site locations in Matanuska-Susitna Borough, AK based upon an ultimate 3-second gust wind speed of 121 mph ($V_{ult}$). Exposure Category C, Risk Category II along with topographic category 2 and crest height of 1,312 feet were used in this analysis. Seismic loading was also included in the analysis.

The analysis results show that:

1. The overall tower pole structure and guy wires are structurally adequate to support the proposed equipment. A maximum tower steel usage of 86.1% was computed (Refer Table 3).

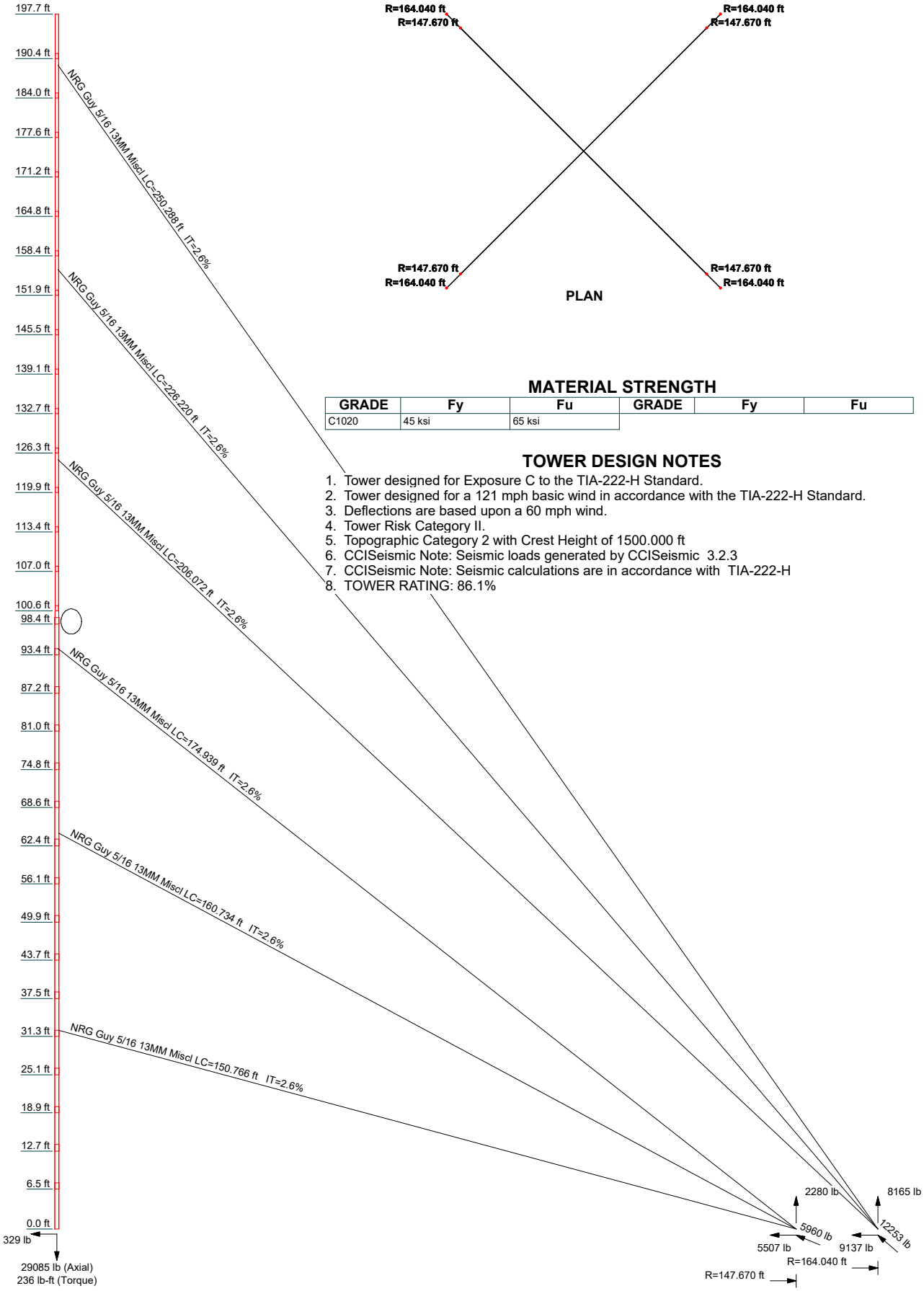
2. The maximum factored guy anchor resultant force computed was 12,253 lbs (Refer Table 4). The Manta Ray Earth Anchor (Model MR-2) has holding capacities up to 36,000 lbs (depending on soil type – Refer Appendix C earth anchor details & ultimate capacites) and would be adequate to secure the guy anchors in place under the wind loads shown in this analysis. However, no soils report was available to confirm the soil type at the proposed location of the towers. As such, a standard pull test will be required to ensure they meet the minimum factored resultant anchor loads in Table 4 above.

3. The maximum factored axial compression force at the base of the met tower is computed to be 29,085 lbs. Per the NRG tower specs, the 60m Super XHD steel base plate has a surface area of 19.5 $ft^2$. Thus, the maximum soil bearing stress is computed to be 1,492 psf and within the generally accepted 1,500 psf allowable soil bearing stress per the IBC code, even though the tower reactions are factored loads.

# APPENDIX A

# TNXTOWER OUTPUT

| Section | Length (ft) | Number of Sides | Thickness (in) | Socket Length (ft) | Top Dia (in) | Bot Dia (in) | Grade | Weight (lb) |
|---|---|---|---|---|---|---|---|---|
| 1 | 7.250 | 1 | 0.1340 | 0.833 | 8.0000 | 8.0500 | C1020 | 84.4 |
| 2 | 7.250 | 1 | 0.1340 | 0.833 | 7.7763 | 8.0500 | | 83.2 |
| 3 | 7.250 | 1 | 0.1340 | 0.833 | 7.7505 | 8.0500 | | 83.1 |
| 4 | 7.250 | 1 | 0.1340 | 0.833 | 7.7476 | 8.0500 | | 83.1 |
| 5 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 6 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 7 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 8 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 9 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 10 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 11 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 12 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 13 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 14 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 15 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 16 | 7.000 | 1 | 0.1090 | 0.420 | 7.7472 | 8.0500 | | 31.6 |
| 17 | 6.083 | 1 | 0.1340 | 1.042 | 9.0259 | 10.0400 | | 84.4 |
| 18 | 7.250 | 1 | 0.1340 | 1.042 | 9.5983 | 10.0400 | | 103.6 |
| 19 | 7.250 | 1 | 0.1340 | 1.042 | 9.7085 | 10.0400 | | 104.2 |
| 20 | 7.250 | 1 | 0.1340 | 1.042 | 9.7244 | 10.0400 | | 104.3 |
| 21 | 7.250 | 1 | 0.1340 | 1.042 | 9.7266 | 10.0400 | | 104.3 |
| 22 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 23 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 24 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 25 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 26 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 27 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 28 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 29 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 30 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 31 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 32 | 7.521 | 1 | 0.1340 | | 9.7270 | 10.0400 | | 108.2 |
| | | | | | | | | 2930.9 |







PLAN

## MATERIAL STRENGTH

| GRADE | Fy | Fu | GRADE | Fy | Fu |
|---|---|---|---|---|---|
| C1020 | 45 ksi | 65 ksi | | | |

## TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-H Standard.
2. Tower designed for a 121 mph basic wind in accordance with the TIA-222-H Standard.
3. Deflections are based upon a 60 mph wind.
4. Tower Risk Category II.
5. Topographic Category 2 with Crest Height of 1500.000 ft
6. CCISeismic Note: Seismic loads generated by CCISeismic 3.2.3
7. CCISeismic Note: Seismic calculations are in accordance with TIA-222-H
8. TOWER RATING: 86.1%

ALL REACTIONS ARE FACTORED


**Ahola Engineering LLC**
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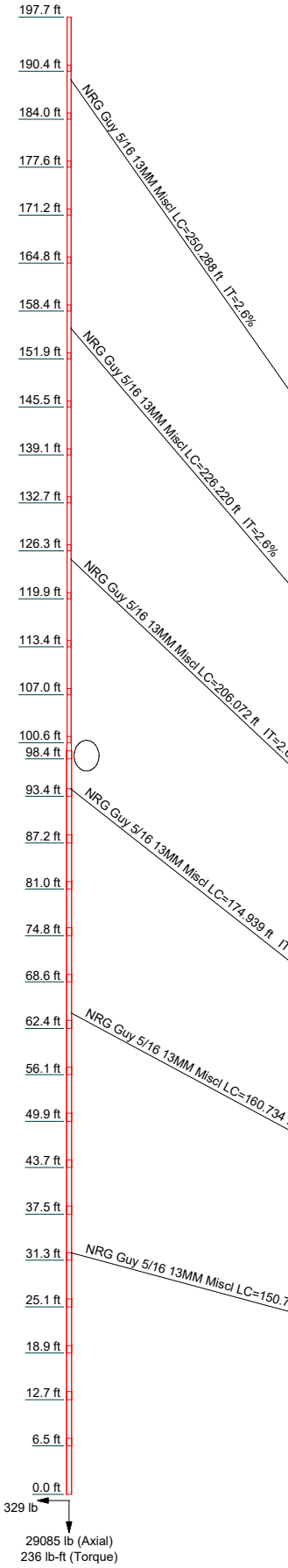
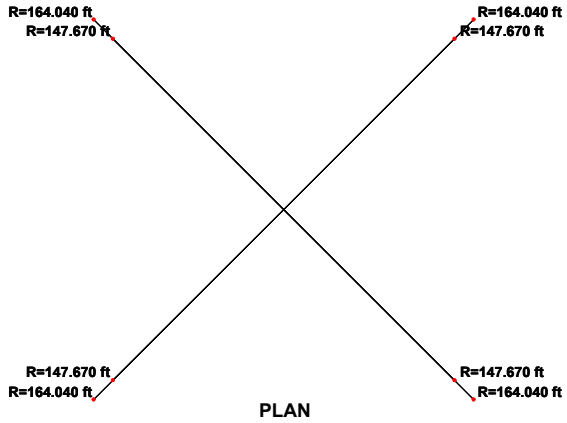
Winter Park, CO 80482-0989
Phone: (719) 640-2408
FAX:


| | | | |
|---|---|---|---|
| Job: | ***NRG 60m Super NRG Tall Tower*** | | |
| Project: | ***Matanuska-Susitna Borough, AK*** | | |
| Client: Longroad Energy | Drawn by: Mikko Ahola, PE | App'd: | |
| Code: TIA-222-H | Date: 07/01/24 | Scale: NTS | |
| Path: | | Dwg No. E-1 | |

| Section | Length (ft) | Number of Sides | Thickness (in) | Socket Length (ft) | Top Dia (in) | Bot Dia (in) | Grade | Weight (lb) |
|---|---|---|---|---|---|---|---|---|
| 1 | 7.250 | 1 | 0.1340 | 0.833 | 8.0000 | 8.0500 | C1020 | 84.4 |
| 2 | 7.250 | 1 | 0.1340 | 0.833 | 7.7763 | 8.0500 | | 83.2 |
| 3 | 7.250 | 1 | 0.1340 | 0.833 | 7.7505 | 8.0500 | | 83.1 |
| 4 | 7.250 | 1 | 0.1340 | 0.833 | 7.7476 | 8.0500 | | 83.1 |
| 5 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 6 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 7 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 8 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 9 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 10 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 11 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 12 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 13 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 14 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 15 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 16 | 7.250 | 1 | 0.1340 | 0.833 | 7.7472 | 8.0500 | | 83.1 |
| 17 | 6.083 | 1 | 0.1340 | 1.042 | 9.0259 | 9.7472 | | 84.4 |
| 18 | 7.250 | 1 | 0.1340 | 1.042 | 9.5983 | 10.0400 | | 103.6 |
| 19 | 7.250 | 1 | 0.1340 | 1.042 | 9.7085 | 10.0400 | | 104.2 |
| 20 | 7.250 | 1 | 0.1340 | 1.042 | 9.7244 | 10.0400 | | 104.3 |
| 21 | 7.250 | 1 | 0.1340 | 1.042 | 9.7266 | 10.0400 | | 104.3 |
| 22 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 23 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 24 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 25 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 26 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 27 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 28 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 29 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 30 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 31 | 7.250 | 1 | 0.1340 | 1.042 | 9.7270 | 10.0400 | | 104.3 |
| 32 | 7.521 | 1 | 0.1340 | | 9.7270 | 10.0400 | | 108.2 |
| | | | | | | | | 2930.9 |




## DESIGNED APPURTENANCE LOADING

| TYPE | ELEVATION |
|---|---|
| ProperIlor Anemometer/Wind Vane | 198.491 |
| CCISeismic ProperIlor Anemometer/Wind Vane | 198.491 |
| 95" Boom Mount | 196.194 |
| CCISeismic 95" Boom Mount | 196.194 |
| CCISeismic Tower Section 1 - 1 | 194.062 |
| NRG #40C Anemometer | 192.913 |
| NRG #40C Anemometer | 192.913 |
| CCISeismic NRG #40C Anemometer | 192.913 |
| CCISeismic NRG #40C Anemometer | 192.913 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (188ft to196ft) | 192 |
| 95" Boom Mount | 190.913 |
| 95" Boom Mount | 190.913 |
| CCISeismic 95" Boom Mount | 190.913 |
| CCISeismic 95" Boom Mount | 190.913 |
| CCISeismic Tower Section 2 - 1 | 187.646 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (178ft to188ft) | 183 |
| CCISeismic Tower Section 3 - 1 | 181.229 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 |
| CCISeismic Tower Section 4 - 1 | 174.812 |
| Temperature Probe w/ Shield | 173.885 |
| Barometric Pressure | 173.885 |
| CCISeismic Temperature Probe w/ Shield | 173.885 |
| CCISeismic Relative Humidty Sensor | 173.885 |
| CCISeismic Barometric Pressure | 173.885 |
| Relative Humidty Sensor | 173.885 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (168ft to178ft) | 173 |
| CCISeismic Tower Section 5 - 1 | 168.396 |
| NRG #40C Anemometer | 167.323 |
| CCISeismic NRG 200P Wind Vane | 167.323 |
| CCISeismic NRG #40C Anemometer | 167.323 |
| NRG 200P Wind Vane | 167.323 |
| 95" Boom Mount | 165.323 |
| 95" Boom Mount | 165.323 |
| CCISeismic 95" Boom Mount | 165.323 |
| CCISeismic 95" Boom Mount | 165.323 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (158ft to168ft) | 163 |
| CCISeismic Tower Section 6 - 1 | 161.979 |
| NRG 200P Wind Vane | 160.761 |
| CCISeismic NRG 200P Wind Vane | 160.761 |
| 95" Boom Mount | 158.761 |
| CCISeismic 95" Boom Mount | 158.761 |
| CCISeismic Tower Section 7 - 1 | 155.562 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (148ft to158ft) | 153 |
| CCISeismic Tower Section 8 - 1 | 149.146 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (138ft to148ft) | 143 |

| TYPE | ELEVATION |
|---|---|
| CCISeismic Tower Section 9 - 1 | 142.729 |
| NRG 200P Wind Vane | 137.795 |
| CCISeismic NRG 200P Wind Vane | 137.795 |
| CCISeismic Tower Section 10 - 1 | 136.312 |
| 95" Boom Mount | 135.795 |
| CCISeismic 95" Boom Mount | 135.795 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (128ft to138ft) | 133 |
| NRG #40C Anemometer | 131.234 |
| NRG #40C Anemometer | 131.234 |
| CCISeismic NRG #40C Anemometer | 131.234 |
| CCISeismic NRG #40C Anemometer | 131.234 |
| CCISeismic Tower Section 11 - 1 | 129.896 |
| 95" Boom Mount | 129.234 |
| CCISeismic 95" Boom Mount | 129.234 |
| CCISeismic 95" Boom Mount | 129.234 |
| 95" Boom Mount | 129.234 |
| CCISeismic Tower Section 12 - 1 | 123.479 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (118ft to128ft) | 123 |
| CCISeismic Tower Section 13 - 1 | 117.062 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (108ft to118ft) | 113 |
| CCISeismic Tower Section 14 - 1 | 110.646 |
| CCISeismic Tower Section 15 - 1 | 104.229 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (98ft to108ft) | 103 |
| CCISeismic Tower Section 16 - 1 | 99.9375 |
| NRG #40C Anemometer | 98.425 |
| NRG #40C Anemometer | 98.425 |
| CCISeismic NRG #40C Anemometer | 98.425 |
| CCISeismic NRG #40C Anemometer | 98.425 |
| CCISeismic Tower Section 17 - 1 | 96.4375 |
| 95" Boom Mount | 96.425 |
| CCISeismic 95" Boom Mount | 96.425 |
| CCISeismic 95" Boom Mount | 96.425 |
| 95" Boom Mount | 96.425 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (88ft to98ft) | 93 |
| CCISeismic Tower Section 18 - 1 | 90.8126 |
| CCISeismic Tower Section 19 - 1 | 84.6043 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (78ft to88ft) | 83 |
| CCISeismic Tower Section 20 - 1 | 78.396 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (68ft to78ft) | 73 |
| CCISeismic Tower Section 21 - 1 | 72.1877 |
| CCISeismic Tower Section 22 - 1 | 65.9794 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (58ft to68ft) | 63 |
| CCISeismic Tower Section 23 - 1 | 59.7711 |
| CCISeismic Tower Section 24 - 1 | 53.5628 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (48ft to58ft) | 53 |
| CCISeismic Temperature Probe w/ Shield | 49.2 |
| Temperature Probe w/ Shield | 49.2 |
| CCISeismic Tower Section 25 - 1 | 47.3545 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (38ft to48ft) | 43 |
| CCISeismic Tower Section 26 - 1 | 41.1462 |
| CCISeismic Tower Section 27 - 1 | 34.9379 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (28ft to38ft) | 33 |
| CCISeismic Tower Section 28 - 1 | 28.7296 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (18ft to28ft) | 23 |


Ahola Engineering LLC
P.O. Box 989
Winter Park, CO 80482-0989
Phone: (719) 640-2408
FAX:


| | | | |
|---|---|---|---|
| Job: NRG 60m Super NRG Tall Tower | | | |
| Project: Matanuska-Susitna Borough, AK | | | |
| Client: Longroad Energy | Drawn by: Mikko Ahola, PE | App'd: | |
| Code: TIA-222-H | Date: 07/01/24 | Scale: NTS | |
| Path: | | Dwg No. E-1 | |

# Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

Tower base elevation above sea level: 2461.000 ft.
Basic wind speed of 121 mph.
Risk Category II.
Exposure Category C.
Simplified Topographic Factor Procedure for wind speed-up calculations is used.
Topographic Category: 2.
Crest Height: 1500.000 ft.
Deflections calculated using a wind speed of 60 mph.
CCISeismic Note: Seismic loads generated by CCISeismic 3.2.3.
CCISeismic Note: Seismic calculations are in accordance with TIA-222-H.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Safety factor used in guy design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

# Options

| | | |
|---|---|---|
| Consider Moments - Legs | Distribute Leg Loads As Uniform | Use ASCE 10 X-Brace Ly Rules |
| Consider Moments - Horizontals | Assume Legs Pinned | Calculate Redundant Bracing Forces |
| Consider Moments - Diagonals | Assume Rigid Index Plate | Ignore Redundant Members in FEA |
| Use Moment Magnification | Use Clear Spans For Wind Area | SR Leg Bolts Resist Compression |
| √ Use Code Stress Ratios | √ Use Clear Spans For KL/r | All Leg Panels Have Same Allowable |
| √ Use Code Safety Factors - Guys | √ Retension Guys To Initial Tension | Offset Girt At Foundation |
| Escalate Ice | Bypass Mast Stability Checks | Consider Feed Line Torque |
| Always Use Max Kz | √ Use Azimuth Dish Coefficients | Include Angle Block Shear Check |
| Use Special Wind Profile | Project Wind Area of Appurt. | Use TIA-222-H Bracing Resist. Exemption |
| Include Bolts In Member Capacity | Autocalc Torque Arm Areas | 4_ Use TIA-222-H Tension Splice Exemption |
| | | __ |
| | | _ |
| | | Poles |
| Leg Bolts Are At Top Of Section | Add IBC .6D+W Combination | Include Shear-Torsion Interaction |
| Secondary Horizontal Braces Leg | Sort Capacity Reports By Component | Always Use Sub-Critical Flow |
| Use Diamond Inner Bracing (4 Sided) | Triangulate Diamond Inner Bracing | Use Top Mounted Sockets |
| SR Members Have Cut Ends | Treat Feed Line Bundles As Cylinder | Pole Without Linear Attachments |
| SR Members Are Concentric | Ignore KL/ry For 60 Deg. Angle Legs | Pole With Shroud Or No Appurtenances |

# Tapered Pole Section Geometry

| *Section* | *Elevation* *ft* | *Section Length* *ft* | *Splice Length* *ft* | *Number of Sides* | *Top Diameter* *in* | *Bottom Diameter* *in* | *Wall Thickness* *in* | *Bend Radius* *in* | *Pole Grade* |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 197.688-190.438 | 7.250 | 0.833 | Round | 8.0000 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L2 | 190.438-184.021 | 7.250 | 0.833 | Round | 7.7763 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L3 | 184.021-177.604 | 7.250 | 0.833 | Round | 7.7505 | 8.0500 | 0.1340 | | C1020 (45 ksi) |

| Section | Elevation<br>ft | Section Length<br>ft | Splice Length<br>ft | Number of Sides | Top Diameter<br>in | Bottom Diameter<br>in | Wall Thickness<br>in | Bend Radius<br>in | Pole Grade |
|---|---|---|---|---|---|---|---|---|---|
| L4 | 177.604-171.187 | 7.250 | 0.833 | Round | 7.7476 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L5 | 171.187-164.771 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L6 | 164.771-158.354 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L7 | 158.354-151.937 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L8 | 151.937-145.521 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L9 | 145.521-139.104 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L10 | 139.104-132.687 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L11 | 132.687-126.271 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L12 | 126.271-119.854 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L13 | 119.854-113.437 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L14 | 113.437-107.021 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L15 | 107.021-100.604 | 7.250 | 0.833 | Round | 7.7472 | 8.0500 | 0.1340 | | C1020 (45 ksi) |
| L16 | 100.604-98.437 | 3.000 | 1.042 | Round | 7.7472 | 10.0400 | 0.1090 | | C1020 (45 ksi) |
| L17 | 98.437-93.396 | 6.083 | 1.042 | Round | 9.0259 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L18 | 93.396-87.188 | 7.250 | 1.042 | Round | 9.5983 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L19 | 87.188-80.979 | 7.250 | 1.042 | Round | 9.7085 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L20 | 80.979-74.771 | 7.250 | 1.042 | Round | 9.7244 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L21 | 74.771-68.563 | 7.250 | 1.042 | Round | 9.7266 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L22 | 68.563-62.354 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L23 | 62.354-56.146 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L24 | 56.146-49.938 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L25 | 49.938-43.729 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L26 | 43.729-37.521 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L27 | 37.521-31.313 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L28 | 31.313-25.105 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L29 | 25.105-18.896 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L30 | 18.896-12.688 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L31 | 12.688-6.480 | 7.250 | 1.042 | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |
| L32 | 6.480-0.000 | 7.521 | | Round | 9.7270 | 10.0400 | 0.1340 | | C1020 (45 ksi) |

# Tapered Pole Properties

| Section | Tip Dia. in | Area $in^2$ | I $in^4$ | r in | C in | I/C $in^3$ | J $in^4$ | It/Q $in^2$ | w in | w/t |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 8.0000 | 3.3114 | 25.6184 | 2.7815 | 4.0000 | 6.4046 | 51.2369 | 1.6547 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L2 | 7.8077 | 3.2172 | 23.4943 | 2.7024 | 3.8881 | 6.0426 | 46.9886 | 1.6076 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L3 | 7.7850 | 3.2064 | 23.2579 | 2.6933 | 3.8753 | 6.0016 | 46.5159 | 1.6022 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L4 | 7.7823 | 3.2051 | 23.2309 | 2.6922 | 3.8738 | 5.9969 | 46.4618 | 1.6016 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L5 | 7.7820 | 3.2050 | 23.2278 | 2.6921 | 3.8736 | 5.9964 | 46.4555 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L6 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4548 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L7 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L8 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L9 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L10 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L11 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L12 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L13 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L14 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L15 | 7.7820 | 3.2050 | 23.2274 | 2.6921 | 3.8736 | 5.9963 | 46.4547 | 1.6015 | 0.0000 | 0 |
| | 8.0500 | 3.3324 | 26.1100 | 2.7991 | 4.0250 | 6.4870 | 52.2200 | 1.6652 | 0.0000 | 0 |
| L16 | 8.3841 | 2.6156 | 19.0786 | 2.7008 | 3.8736 | 4.9253 | 38.1572 | 1.3070 | 0.0000 | 0 |
| | 10.0400 | 3.4007 | 41.9293 | 3.5114 | 5.0200 | 8.3525 | 83.8586 | 1.6993 | 0.0000 | 0 |
| L17 | 9.1995 | 3.7432 | 37.0034 | 3.1441 | 4.5129 | 8.1994 | 74.0068 | 1.8705 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L18 | 9.6618 | 3.9842 | 44.6193 | 3.3465 | 4.7992 | 9.2973 | 89.2386 | 1.9909 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L19 | 9.7562 | 4.0306 | 46.1959 | 3.3854 | 4.8543 | 9.5166 | 92.3918 | 2.0141 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L20 | 9.7697 | 4.0373 | 46.4255 | 3.3910 | 4.8622 | 9.5483 | 92.8509 | 2.0174 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L21 | 9.7717 | 4.0383 | 46.4585 | 3.3918 | 4.8633 | 9.5528 | 92.9170 | 2.0179 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L22 | 9.7720 | 4.0384 | 46.4633 | 3.3920 | 4.8635 | 9.5535 | 92.9265 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L23 | 9.7720 | 4.0384 | 46.4639 | 3.3920 | 4.8635 | 9.5536 | 92.9279 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L24 | 9.7720 | 4.0384 | 46.4640 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L25 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L26 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L27 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L28 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L29 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |

| Section | Tip Dia. in | Area $in^2$ | I $in^4$ | r in | C in | I/C $in^3$ | J $in^4$ | It/Q $in^2$ | w in | w/t |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L30 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L31 | 9.7720 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |
| L32 | 9.7704 | 4.0384 | 46.4641 | 3.3920 | 4.8635 | 9.5536 | 92.9281 | 2.0180 | 0.0000 | 0 |
| | 10.0400 | 4.1702 | 51.1610 | 3.5026 | 5.0200 | 10.1914 | 102.3220 | 2.0838 | 0.0000 | 0 |

| Tower Elevation ft | Gusset Area (per face) $ft^2$ | Gusset Thickness in | Gusset Grade | Adjust. Factor $A_f$ | Adjust. Factor $A_r$ | Weight Mult. | Double Angle Stitch Bolt Spacing Diagonals in | Double Angle Stitch Bolt Spacing Horizontals in | Double Angle Stitch Bolt Spacing Redundants in |
|---|---|---|---|---|---|---|---|---|---|
| L1 197.688-190.438 | | | | 1 | 1 | 1.03 | | | |
| L2 190.438-184.021 | | | | 1 | 1 | 1.03 | | | |
| L3 184.021-177.604 | | | | 1 | 1 | 1.03 | | | |
| L4 177.604-171.187 | | | | 1 | 1 | 1.03 | | | |
| L5 171.187-164.771 | | | | 1 | 1 | 1.03 | | | |
| L6 164.771-158.354 | | | | 1 | 1 | 1.03 | | | |
| L7 158.354-151.937 | | | | 1 | 1 | 1.03 | | | |
| L8 151.937-145.521 | | | | 1 | 1 | 1.03 | | | |
| L9 145.521-139.104 | | | | 1 | 1 | 1.03 | | | |
| L10 139.104-132.687 | | | | 1 | 1 | 1.03 | | | |
| L11 132.687-126.271 | | | | 1 | 1 | 1.03 | | | |
| L12 126.271-119.854 | | | | 1 | 1 | 1.03 | | | |
| L13 119.854-113.437 | | | | 1 | 1 | 1.03 | | | |
| L14 113.437-107.021 | | | | 1 | 1 | 1.03 | | | |
| L15 107.021-100.604 | | | | 1 | 1 | 1.03 | | | |
| L16 100.604-98.437 | | | | 1 | 1 | 1.03 | | | |

| Tower Elevation<br>ft | Gusset Area (per face)<br>$ft^2$ | Gusset Thickness<br>in | Gusset Grade | Adjust. Factor $A_f$ | Adjust. Factor $A_r$ | Weight Mult. | Double Angle Stitch Bolt Spacing Diagonals<br>in | Double Angle Stitch Bolt Spacing Horizontals<br>in | Double Angle Stitch Bolt Spacing Redundants<br>in |
|---|---|---|---|---|---|---|---|---|---|
| L17<br>98.437-93.396 | | | | 1 | 1 | 1.03 | | | |
| L18<br>93.396-87.188 | | | | 1 | 1 | 1.03 | | | |
| L19<br>87.188-80.979 | | | | 1 | 1 | 1.03 | | | |
| L20<br>80.979-74.771 | | | | 1 | 1 | 1.03 | | | |
| L21<br>74.771-68.563 | | | | 1 | 1 | 1.03 | | | |
| L22<br>68.563-62.354 | | | | 1 | 1 | 1.03 | | | |
| L23<br>62.354-56.146 | | | | 1 | 1 | 1.03 | | | |
| L24<br>56.146-49.938 | | | | 1 | 1 | 1.03 | | | |
| L25<br>49.938-43.729 | | | | 1 | 1 | 1.03 | | | |
| L26<br>43.729-37.521 | | | | 1 | 1 | 1.03 | | | |
| L27<br>37.521-31.313 | | | | 1 | 1 | 1.03 | | | |
| L28<br>31.313-25.105 | | | | 1 | 1 | 1.03 | | | |
| L29<br>25.105-18.896 | | | | 1 | 1 | 1.03 | | | |
| L30<br>18.896-12.688 | | | | 1 | 1 | 1.03 | | | |
| L31<br>12.688-6.480 | | | | 1 | 1 | 1.03 | | | |
| L32<br>6.480-0.000 | | | | 1 | 1 | 1.03 | | | |

## Guy Data

| Guy Elevation<br>ft | Guy Grade | Guy Size | Initial Tension<br>lb | % | Guy Modulus<br>ksi | Guy Weight<br>plf | $L_u$<br>ft | Anchor Radius<br>ft | Anchor Azimuth Adj.<br>° | Anchor Elevation<br>ft | End Fitting Efficiency<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 189.321 | Miscl | A NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 250.292 | 164.040 | 0.0000 | 0.000 | 100% |
| | | B 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 250.292 | 164.040 | 0.0000 | 0.000 | 100% |
| | | C NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 250.292 | 164.040 | 0.0000 | 0.000 | 100% |
| | | D 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 250.292 | 164.040 | 0.0000 | 0.000 | 100% |
| | | NRG Guy | | | | | | | | | |
| | | 5/16 13MM | | | | | | | | | |
| | | NRG Guy | | | | | | | | | |
| | | 5/16 13MM | | | | | | | | | |
| 156.121 | Miscl | A NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 226.226 | 164.040 | 0.0000 | 0.000 | 100% |
| | | B 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 226.226 | 164.040 | 0.0000 | 0.000 | 100% |
| | | C NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 226.226 | 164.040 | 0.0000 | 0.000 | 100% |
| | | D 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 226.226 | 164.040 | 0.0000 | 0.000 | 100% |
| | | NRG Guy | | | | | | | | | |
| | | 5/16 13MM | | | | | | | | | |
| | | NRG Guy | | | | | | | | | |
| | | 5/16 13MM | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125.154 | Miscl | A | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 206.081 | 164.040 | 0.0000 | 0.000 | 100% |
| | | B | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 206.081 | 164.040 | 0.0000 | 0.000 | 100% |
| | | C | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 206.081 | 164.040 | 0.0000 | 0.000 | 100% |
| | | D | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 206.081 | 164.040 | 0.0000 | 0.000 | 100% |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| 94.4376 | Miscl | A | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 174.932 | 147.670 | 0.0000 | 0.000 | 100% |
| | | B | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 174.932 | 147.670 | 0.0000 | 0.000 | 100% |
| | | C | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 174.932 | 147.670 | 0.0000 | 0.000 | 100% |
| | | D | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 174.932 | 147.670 | 0.0000 | 0.000 | 100% |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| 64.4294 | Miscl | A | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 160.729 | 147.670 | 0.0000 | 0.000 | 100% |
| | | B | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 160.729 | 147.670 | 0.0000 | 0.000 | 100% |
| | | C | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 160.729 | 147.670 | 0.0000 | 0.000 | 100% |
| | | D | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 160.729 | 147.670 | 0.0000 | 0.000 | 100% |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| 32.3546 | Miscl | A | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 150.764 | 147.670 | 0.0000 | 0.000 | 100% |
| | | B | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 150.764 | 147.670 | 0.0000 | 0.000 | 100% |
| | | C | NRG Guy | 254.80 | 2.6% | 13000 | 0.173 | 150.764 | 147.670 | 0.0000 | 0.000 | 100% |
| | | D | 5/16 13MM | 254.80 | 2.6% | 13000 | 0.173 | 150.764 | 147.670 | 0.0000 | 0.000 | 100% |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |
| | | | NRG Guy | | | | | | | | | |
| | | | 5/16 13MM | | | | | | | | | |

## Guy Data *(cont'd)*

| *Guy Elevation ft* | *Mount Type* | *Torque-Arm Spread ft* | *Torque-Arm Leg Angle °* | *Torque-Arm Style* | *Torque-Arm Grade* | *Torque-Arm Type* | *Torque-Arm Size* |
|---|---|---|---|---|---|---|---|
| 189.321 | Corner | | | | | | |
| 156.121 | Corner | | | | | | |
| 125.154 | Corner | | | | | | |
| 94.4376 | Corner | | | | | | |
| 64.4294 | Corner | | | | | | |
| 32.3546 | Corner | | | | | | |

## Guy Data *(cont'd)*

| *Guy Elevation ft* | *Diagonal Grade* | *Diagonal Type* | *Upper Diagonal Size* | *Lower Diagonal Size* | *Is Strap.* | *Pull-Off Grade* | *Pull-Off Type* | *Pull-Off Size* |
|---|---|---|---|---|---|---|---|---|
| 189.321 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 156.121 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |

| Guy Elevation ft | Diagonal Grade | Diagonal Type | Upper Diagonal Size | Lower Diagonal Size | Is Strap. | Pull-Off Grade | Pull-Off Type | Pull-Off Size |
|---|---|---|---|---|---|---|---|---|
| 125.154 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 94.438 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 64.429 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |
| 32.355 | A572-50 (50 ksi) | Solid Round | | | | A572-50 (50 ksi) | Solid Round | |

## Guy Data *(cont'd)*

| Guy Elevation ft | Cable Weight A lb | Cable Weight B lb | Cable Weight C lb | Cable Weight D lb | Tower Intercept A ft | Tower Intercept B ft | Tower Intercept C ft | Tower Intercept D ft |
|---|---|---|---|---|---|---|---|---|
| 189.321 | 43.30 | 43.30 | 43.30 | 43.30 | 20.012<br>7.7 sec/pulse | 20.012<br>7.7 sec/pulse | 20.012<br>7.7 sec/pulse | 20.012<br>7.7 sec/pulse |
| 156.121 | 39.14 | 39.14 | 39.14 | 39.14 | 16.523<br>7.0 sec/pulse | 16.523<br>7.0 sec/pulse | 16.523<br>7.0 sec/pulse | 16.523<br>7.0 sec/pulse |
| 125.154 | 35.65 | 35.65 | 35.65 | 35.65 | 13.850<br>6.4 sec/pulse | 13.850<br>6.4 sec/pulse | 13.850<br>6.4 sec/pulse | 13.850<br>6.4 sec/pulse |
| 94.4376 | 30.26 | 30.26 | 30.26 | 30.26 | 10.078<br>5.5 sec/pulse | 10.078<br>5.5 sec/pulse | 10.078<br>5.5 sec/pulse | 10.078<br>5.5 sec/pulse |
| 64.4294 | 27.81 | 27.81 | 27.81 | 27.81 | 8.593<br>5.1 sec/pulse | 8.593<br>5.1 sec/pulse | 8.593<br>5.1 sec/pulse | 8.593<br>5.1 sec/pulse |
| 32.3546 | 26.08 | 26.08 | 26.08 | 26.08 | 7.642<br>4.8 sec/pulse | 7.642<br>4.8 sec/pulse | 7.642<br>4.8 sec/pulse | 7.642<br>4.8 sec/pulse |

## Guy Data *(cont'd)*

| Guy Elevation ft | Calc K Single Angles | Calc K Solid Rounds | Torque Arm $K_x$ | Torque Arm $K_y$ | Pull Off $K_x$ | Pull Off $K_y$ | Diagonal $K_x$ | Diagonal $K_y$ |
|---|---|---|---|---|---|---|---|---|
| 189.321 | No | No | | | 1 | 1 | 1 | 1 |
| 156.121 | No | No | | | 1 | 1 | 1 | 1 |
| 125.154 | No | No | | | 1 | 1 | 1 | 1 |
| 94.4376 | No | No | | | 1 | 1 | 1 | 1 |
| 64.4294 | No | No | | | 1 | 1 | 1 | 1 |
| 32.3546 | No | No | | | 1 | 1 | 1 | 1 |

## Guy Data *(cont'd)*

| Guy Elevation ft | Torque-Arm Bolt Size in | Torque-Arm Number | Torque-Arm Net Width Deduct in | Torque-Arm U | Pull Off Bolt Size in | Pull Off Number | Pull Off Net Width Deduct in | Pull Off U | Diagonal Bolt Size in | Diagonal Number | Diagonal Net Width Deduct in | Diagonal U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 189.321 | 0.6250<br>A325N | 0 | 0.0000 | 0.75 | 0.0000<br>A325N | 0 | 0.0000 | 1 | 0.0000<br>A325N | 0 | 0.0000 | 1 |

| Guy Elevation ft | Torque-Arm Bolt Size in | Torque-Arm Number | Torque-Arm Net Width Deduct in | Torque-Arm U | Pull Off Bolt Size in | Pull Off Number | Pull Off Net Width Deduct in | Pull Off U | Diagonal Bolt Size in | Diagonal Number | Diagonal Net Width Deduct in | Diagonal U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 156.121 | 0.6250 A325N | 0 | 0.0000 | 0.75 | 0.0000 A325N | 0 | 0.0000 | 1 | 0.0000 A325N | 0 | 0.0000 | 1 |
| 125.154 | 0.6250 A325N | 0 | 0.0000 | 0.75 | 0.0000 A325N | 0 | 0.0000 | 1 | 0.0000 A325N | 0 | 0.0000 | 1 |
| 94.4376 | 0.6250 A325N | 0 | 0.0000 | 0.75 | 0.0000 A325N | 0 | 0.0000 | 1 | 0.0000 A325N | 0 | 0.0000 | 1 |
| 64.4294 | 0.6250 A325N | 0 | 0.0000 | 0.75 | 0.0000 A325N | 0 | 0.0000 | 1 | 0.0000 A325N | 0 | 0.0000 | 1 |
| 32.3546 | 0.6250 A325N | 0 | 0.0000 | 0.75 | 0.0000 A325N | 0 | 0.0000 | 1 | 0.0000 A325N | 0 | 0.0000 | 1 |

## Guy Pressures

| Guy Elevation ft | Guy Location | z ft | $q_z$ psf | $q_z$ Ice psf | Ice Thickness in |
|---|---|---|---|---|---|
| 189.321 | A | 94.660 | 80 | | |
| | B | 94.660 | 80 | | |
| | C | 94.660 | 80 | | |
| | D | 94.660 | 80 | | |
| 156.121 | A | 78.060 | 77 | | |
| | B | 78.060 | 77 | | |
| | C | 78.060 | 77 | | |
| | D | 78.060 | 77 | | |
| 125.154 | A | 62.577 | 74 | | |
| | B | 62.577 | 74 | | |
| | C | 62.577 | 74 | | |
| | D | 62.577 | 74 | | |
| 94.4376 | A | 47.219 | 70 | | |
| | B | 47.219 | 70 | | |
| | C | 47.219 | 70 | | |
| | D | 47.219 | 70 | | |
| 64.4294 | A | 32.215 | 65 | | |
| | B | 32.215 | 65 | | |
| | C | 32.215 | 65 | | |
| | D | 32.215 | 65 | | |
| 32.3546 | A | 16.177 | 57 | | |
| | B | 16.177 | 57 | | |
| | C | 16.177 | 57 | | |
| | D | 16.177 | 57 | | |

## Guy-Mast Forces (Excluding Wind) - No Ice

| Guy Elevation ft | Guy Location | Chord Angle ° | Guy Tension Top Bottom lb | $F_x$ lb | $F_y$ lb | $F_z$ lb | $M_x$ lb-ft | $M_y$ lb-ft | $M_z$ lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| 189.321 | A | 49.1488 | 287.73<br>255.00 | -125.19 | 226.82 | -125.19 | -52.46 | 0.00 | 52.46 |
| | B | 49.1488 | 287.73<br>255.00 | 125.19 | 226.82 | -125.19 | -52.46 | 0.00 | -52.46 |

| Guy Elevation | Guy Location | Chord Angle | Guy Tension Top Bottom lb | $F_x$ | $F_y$ | $F_z$ | $M_x$ | $M_y$ | $M_z$ |
|---|---|---|---|---|---|---|---|---|---|
| ft | | ° | | lb | lb | lb | lb-ft | lb-ft | lb-ft |
| | C | 49.1488 | 287.73<br>255.00 | 125.19 | 226.82 | 125.19 | 52.46 | 0.00 | -52.46 |
| | D | 49.1488 | 287.73<br>255.00 | -125.19 | 226.82 | 125.19 | 52.46 | 0.00 | 52.46 |
| | | | Sum: | 0.00 | 907.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 156.121 | A | 43.6404 | 281.80<br>254.80 | -136.99 | 204.64 | -136.99 | -47.48 | 0.00 | 47.48 |
| | B | 43.6404 | 281.80<br>254.80 | 136.99 | 204.64 | -136.99 | -47.48 | 0.00 | -47.48 |
| | C | 43.6404 | 281.80<br>254.80 | 136.99 | 204.64 | 136.99 | 47.48 | 0.00 | -47.48 |
| | D | 43.6404 | 281.80<br>254.80 | -136.99 | 204.64 | 136.99 | 47.48 | 0.00 | 47.48 |
| | | | Sum: | 0.00 | 818.57 | 0.00 | 0.00 | 0.00 | 0.00 |
| 125.154 | A | 37.3968 | 275.71<br>254.06 | -148.51 | 178.62 | -148.51 | -41.20 | 0.00 | 41.20 |
| | B | 37.3968 | 275.71<br>254.06 | 148.51 | 178.62 | -148.51 | -41.20 | 0.00 | -41.20 |
| | C | 37.3968 | 275.71<br>254.06 | 148.51 | 178.62 | 148.51 | 41.20 | 0.00 | -41.20 |
| | D | 37.3968 | 275.71<br>254.06 | -148.51 | 178.62 | 148.51 | 41.20 | 0.00 | 41.20 |
| | | | Sum: | 0.00 | 714.48 | 0.00 | 0.00 | 0.00 | 0.00 |
| 94.4376 | A | 32.6722 | 271.13<br>254.80 | -156.29 | 157.03 | -156.29 | -45.65 | 0.00 | 45.65 |
| | B | 32.6722 | 271.13<br>254.80 | 156.29 | 157.03 | -156.29 | -45.65 | 0.00 | -45.65 |
| | C | 32.6722 | 271.13<br>254.80 | 156.29 | 157.03 | 156.29 | 45.65 | 0.00 | -45.65 |
| | D | 32.6722 | 271.13<br>254.80 | -156.29 | 157.03 | 156.29 | 45.65 | 0.00 | 45.65 |
| | | | Sum: | 0.00 | 628.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 64.4294 | A | 23.6311 | 265.94<br>254.80 | -168.44 | 118.23 | -168.44 | -34.66 | 0.00 | 34.66 |
| | B | 23.6311 | 265.94<br>254.80 | 168.44 | 118.23 | -168.44 | -34.66 | 0.00 | -34.66 |
| | C | 23.6311 | 265.94<br>254.80 | 168.44 | 118.23 | 168.44 | 34.66 | 0.00 | -34.66 |
| | D | 23.6311 | 265.94<br>254.80 | -168.44 | 118.23 | 168.44 | 34.66 | 0.00 | 34.66 |
| | | | Sum: | 0.00 | 472.92 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32.3546 | A | 12.3921 | 260.40<br>254.80 | -177.68 | 68.30 | -177.68 | -20.11 | 0.00 | 20.11 |
| | B | 12.3921 | 260.40<br>254.80 | 177.68 | 68.30 | -177.68 | -20.11 | 0.00 | -20.11 |
| | C | 12.3921 | 260.40<br>254.80 | 177.68 | 68.30 | 177.68 | 20.11 | 0.00 | -20.11 |
| | D | 12.3921 | 260.40<br>254.80 | -177.68 | 68.30 | 177.68 | 20.11 | 0.00 | 20.11 |
| | | | Sum: | 0.00 | 273.20 | 0.00 | 0.00 | 0.00 | 0.00 |

## Guy-Mast Forces (Excluding Wind) - Service

| Guy Elevation | Guy Location | Chord Angle | Guy Tension Top Bottom lb | $F_x$ | $F_y$ | $F_z$ | $M_x$ | $M_y$ | $M_z$ |
|---|---|---|---|---|---|---|---|---|---|
| ft | | ° | | lb | lb | lb | lb-ft | lb-ft | lb-ft |
| 189.321 | A | 49.1488 | 287.73<br>255.00 | -125.19 | 226.82 | -125.19 | -52.46 | 0.00 | 52.46 |
| | B | 49.1488 | 287.73<br>255.00 | 125.19 | 226.82 | -125.19 | -52.46 | 0.00 | -52.46 |
| | C | 49.1488 | 287.73<br>255.00 | 125.19 | 226.82 | 125.19 | 52.46 | 0.00 | -52.46 |
| | D | 49.1488 | 287.73<br>255.00 | -125.19 | 226.82 | 125.19 | 52.46 | 0.00 | 52.46 |
| | | | Sum: | 0.00 | 907.28 | 0.00 | 0.00 | 0.00 | 0.00 |
| 156.121 | A | 43.6404 | 281.80<br>254.80 | -136.99 | 204.64 | -136.99 | -47.48 | 0.00 | 47.48 |
| | B | 43.6404 | 281.80<br>254.80 | 136.99 | 204.64 | -136.99 | -47.48 | 0.00 | -47.48 |
| | C | 43.6404 | 281.80<br>254.80 | 136.99 | 204.64 | 136.99 | 47.48 | 0.00 | -47.48 |
| | D | 43.6404 | 281.80<br>254.80 | -136.99 | 204.64 | 136.99 | 47.48 | 0.00 | 47.48 |
| | | | Sum: | 0.00 | 818.57 | 0.00 | 0.00 | 0.00 | 0.00 |
| 125.154 | A | 37.3968 | 275.71<br>254.06 | -148.51 | 178.62 | -148.51 | -41.20 | 0.00 | 41.20 |
| | B | 37.3968 | 275.71<br>254.06 | 148.51 | 178.62 | -148.51 | -41.20 | 0.00 | -41.20 |
| | C | 37.3968 | 275.71<br>254.06 | 148.51 | 178.62 | 148.51 | 41.20 | 0.00 | -41.20 |
| | D | 37.3968 | 275.71<br>254.06 | -148.51 | 178.62 | 148.51 | 41.20 | 0.00 | 41.20 |
| | | | Sum: | 0.00 | 714.48 | 0.00 | 0.00 | 0.00 | 0.00 |
| 94.4376 | A | 32.6722 | 271.13<br>254.80 | -156.29 | 157.03 | -156.29 | -45.65 | 0.00 | 45.65 |
| | B | 32.6722 | 271.13<br>254.80 | 156.29 | 157.03 | -156.29 | -45.65 | 0.00 | -45.65 |
| | C | 32.6722 | 271.13<br>254.80 | 156.29 | 157.03 | 156.29 | 45.65 | 0.00 | -45.65 |
| | D | 32.6722 | 271.13<br>254.80 | -156.29 | 157.03 | 156.29 | 45.65 | 0.00 | 45.65 |
| | | | Sum: | 0.00 | 628.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 64.4294 | A | 23.6311 | 265.94<br>254.80 | -168.44 | 118.23 | -168.44 | -34.66 | 0.00 | 34.66 |
| | B | 23.6311 | 265.94<br>254.80 | 168.44 | 118.23 | -168.44 | -34.66 | 0.00 | -34.66 |
| | C | 23.6311 | 265.94<br>254.80 | 168.44 | 118.23 | 168.44 | 34.66 | 0.00 | -34.66 |
| | D | 23.6311 | 265.94<br>254.80 | -168.44 | 118.23 | 168.44 | 34.66 | 0.00 | 34.66 |
| | | | Sum: | 0.00 | 472.92 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32.3546 | A | 12.3921 | 260.40<br>254.80 | -177.68 | 68.30 | -177.68 | -20.11 | 0.00 | 20.11 |
| | B | 12.3921 | 260.40<br>254.80 | 177.68 | 68.30 | -177.68 | -20.11 | 0.00 | -20.11 |
| | C | 12.3921 | 260.40<br>254.80 | 177.68 | 68.30 | 177.68 | 20.11 | 0.00 | -20.11 |
| | D | 12.3921 | 260.40<br>254.80 | -177.68 | 68.30 | 177.68 | 20.11 | 0.00 | 20.11 |
| | | | Sum: | 0.00 | 273.20 | 0.00 | 0.00 | 0.00 | 0.00 |

# Feed Line/Linear Appurtenances - Entered As Area

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Total Number | | $C_AA_A$ $ft^2/ft$ | Weight plf |
|---|---|---|---|---|---|---|---|---|---|
| Cat5 | C | No | Yes | Inside Pole | 196.000 - 0.000 | 12 | No Ice | 0.000 | 0.05 |

# Feed Line/Linear Appurtenances Section Areas

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| L1 | 197.688-190.438 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.34 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L2 | 190.438-184.021 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L3 | 184.021-177.604 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L4 | 177.604-171.187 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L5 | 171.187-164.771 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L6 | 164.771-158.354 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L7 | 158.354-151.937 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L8 | 151.937-145.521 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L9 | 145.521-139.104 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L10 | 139.104-132.687 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L11 | 132.687-126.271 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| L12 | 126.271-119.854 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L13 | 119.854-113.437 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L14 | 113.437-107.021 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L15 | 107.021-100.604 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.85 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L16 | 100.604-98.437 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 1.30 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L17 | 98.437-93.396 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.02 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L18 | 93.396-87.188 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L19 | 87.188-80.979 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L20 | 80.979-74.771 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L21 | 74.771-68.563 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L22 | 68.563-62.354 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L23 | 62.354-56.146 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L24 | 56.146-49.938 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L25 | 49.938-43.729 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L26 | 43.729-37.521 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L27 | 37.521-31.313 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight lb |
|---|---|---|---|---|---|---|---|
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L28 | 31.313-25.105 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L29 | 25.105-18.896 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L30 | 18.896-12.688 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L31 | 12.688-6.480 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.72 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| L32 | 6.480-0.000 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 3.89 |
| | | D | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 |

# User Defined Loads - Seismic

| Description | Elevation ft | Offset From Centroid ft | Azimuth Angle ° | $E_v$ lb | $E_{hx}$ lb | $E_{hz}$ lb | $E_h$ lb |
|---|---|---|---|---|---|---|---|
| CCISeismic Tower Section 1 - 1 | 194.063 | 0.000 | 0.0000 | 21.78 | 0.00 | 0.00 | 102.45 |
| CCISeismic Tower Section 2 - 1 | 187.646 | 0.000 | 0.0000 | 21.16 | 0.00 | 0.00 | 93.06 |
| CCISeismic Tower Section 3 - 1 | 181.229 | 0.000 | 0.0000 | 21.09 | 0.00 | 0.00 | 86.51 |
| CCISeismic Tower Section 4 - 1 | 174.812 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 80.46 |
| CCISeismic Tower Section 5 - 1 | 168.396 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 74.66 |
| CCISeismic Tower Section 6 - 1 | 161.979 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 69.08 |
| CCISeismic Tower Section 7 - 1 | 155.562 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 63.71 |
| CCISeismic Tower Section 8 - 1 | 149.146 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 58.57 |
| CCISeismic Tower Section 9 - 1 | 142.729 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 53.64 |
| CCISeismic Tower Section 10 - 1 | 136.312 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 48.92 |
| CCISeismic Tower Section 11 - 1 | 129.896 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 44.42 |
| CCISeismic Tower Section 12 - 1 | 123.479 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 40.14 |
| CCISeismic Tower Section 13 - 1 | 117.062 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 36.08 |
| CCISeismic Tower Section 14 - 1 | 110.646 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 32.23 |
| CCISeismic Tower Section 15 - 1 | 104.229 | 0.000 | 0.0000 | 21.08 | 0.00 | 0.00 | 28.60 |
| CCISeismic Tower Section 16 - 1 | 99.937 | 0.000 | 0.0000 | 7.12 | 0.00 | 0.00 | 8.88 |
| CCISeismic Tower Section 17 - 1 | 96.438 | 0.000 | 0.0000 | 20.66 | 0.00 | 0.00 | 24.00 |
| CCISeismic Tower Section 18 - 1 | 90.813 | 0.000 | 0.0000 | 26.21 | 0.00 | 0.00 | 26.99 |
| CCISeismic Tower Section 19 - | 84.604 | 0.000 | 0.0000 | 26.51 | 0.00 | 0.00 | 23.70 |

| Description | Elevation | Offset From Centroid | Azimuth Angle | $E_v$ | $E_{hx}$ | $E_{hz}$ | $E_h$ |
|---|---|---|---|---|---|---|---|
| | ft | ft | ° | lb | lb | lb | lb |
| 1 | | | | | | | |
| CCISeismic Tower Section 20 - 1 | 78.396 | 0.000 | 0.0000 | 26.56 | 0.00 | 0.00 | 20.38 |
| CCISeismic Tower Section 21 - 1 | 72.188 | 0.000 | 0.0000 | 26.56 | 0.00 | 0.00 | 17.29 |
| CCISeismic Tower Section 22 - 1 | 65.979 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 14.44 |
| CCISeismic Tower Section 23 - 1 | 59.771 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 11.85 |
| CCISeismic Tower Section 24 - 1 | 53.563 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 9.52 |
| CCISeismic Tower Section 25 - 1 | 47.354 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 7.44 |
| CCISeismic Tower Section 26 - 1 | 41.146 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 5.62 |
| CCISeismic Tower Section 27 - 1 | 34.938 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 4.05 |
| CCISeismic Tower Section 28 - 1 | 28.730 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 2.74 |
| CCISeismic Tower Section 29 - 1 | 22.521 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 1.68 |
| CCISeismic Tower Section 30 - 1 | 16.313 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 0.88 |
| CCISeismic Tower Section 31 - 1 | 10.105 | 0.000 | 0.0000 | 26.57 | 0.00 | 0.00 | 0.34 |
| CCISeismic Tower Section 32 - 1 | 3.761 | 0.000 | 0.0000 | 27.56 | 0.00 | 0.00 | 0.05 |
| CCISeismic Properllor Anemometer/Wind Vane | 198.491 | 0.000 | 0.0000 | 0.57 | 0.00 | 0.00 | 2.80 |
| CCISeismic 95" Boom Mount | 196.194 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 9.96 |
| CCISeismic NRG #40C Anemometer | 192.913 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.24 |
| CCISeismic 95" Boom Mount | 190.913 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 9.43 |
| CCISeismic NRG #40C Anemometer | 192.913 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.24 |
| CCISeismic 95" Boom Mount | 190.913 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 9.43 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.770 | 0.000 | 0.0000 | 3.88 | 0.00 | 0.00 | 15.85 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.770 | 0.000 | 0.0000 | 3.88 | 0.00 | 0.00 | 15.85 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.770 | 0.000 | 0.0000 | 3.88 | 0.00 | 0.00 | 15.85 |
| CCISeismic Aircraft Marker Balls (21" Dia - Orange) | 180.770 | 0.000 | 0.0000 | 3.88 | 0.00 | 0.00 | 15.85 |
| CCISeismic NRG 200P Wind Vane | 167.323 | 0.000 | 0.0000 | 0.06 | 0.00 | 0.00 | 0.23 |
| CCISeismic 95" Boom Mount | 165.323 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 7.07 |
| CCISeismic NRG #40C Anemometer | 167.323 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.18 |
| CCISeismic 95" Boom Mount | 165.323 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 7.07 |
| CCISeismic Temperature Probe w/ Shield | 173.885 | 0.000 | 0.0000 | 1.29 | 0.00 | 0.00 | 4.89 |
| CCISeismic Relative Humidty Sensor | 173.885 | 0.000 | 0.0000 | 2.59 | 0.00 | 0.00 | 9.78 |
| CCISeismic Barometric Pressure | 173.885 | 0.000 | 0.0000 | 2.59 | 0.00 | 0.00 | 9.78 |
| CCISeismic NRG 200P Wind Vane | 160.761 | 0.000 | 0.0000 | 0.06 | 0.00 | 0.00 | 0.21 |
| CCISeismic 95" Boom Mount | 158.761 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 6.52 |
| CCISeismic NRG 200P Wind | 137.795 | 0.000 | 0.0000 | 0.06 | 0.00 | 0.00 | 0.15 |

| Description | Elevation | Offset From Centroid | Azimuth Angle | $E_v$ | $E_{hx}$ | $E_{hz}$ | $E_h$ |
|---|---|---|---|---|---|---|---|
| | ft | ft | ° | lb | lb | lb | lb |
| Vane | | | | | | | |
| CCISeismic 95" Boom Mount | 135.795 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 4.77 |
| CCISeismic NRG #40C Anemometer | 131.234 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.11 |
| CCISeismic 95" Boom Mount | 129.234 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 4.32 |
| CCISeismic NRG #40C Anemometer | 131.234 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.11 |
| CCISeismic 95" Boom Mount | 129.234 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 4.32 |
| CCISeismic NRG #40C Anemometer | 98.425 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.06 |
| CCISeismic 95" Boom Mount | 96.425 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 2.40 |
| CCISeismic NRG #40C Anemometer | 98.425 | 0.000 | 0.0000 | 0.05 | 0.00 | 0.00 | 0.06 |
| CCISeismic 95" Boom Mount | 96.425 | 0.000 | 0.0000 | 2.07 | 0.00 | 0.00 | 2.40 |
| CCISeismic Temperature Probe w/ Shield | 49.200 | 0.000 | 0.0000 | 1.29 | 0.00 | 0.00 | 0.39 |
| CCISeismic Data Logger | 5.000 | 0.000 | 0.0000 | 12.94 | 0.00 | 0.00 | 0.04 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (188ft to196ft) | 192.000 | 0.000 | 0.0000 | 1.24 | 0.00 | 0.00 | 5.72 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (178ft to188ft) | 183.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 6.50 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (168ft to178ft) | 173.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 5.81 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (158ft to168ft) | 163.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 5.15 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (148ft to158ft) | 153.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 4.54 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (138ft to148ft) | 143.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 3.97 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (128ft to138ft) | 133.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 3.43 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (118ft to128ft) | 123.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 2.93 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (108ft to118ft) | 113.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 2.48 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (98ft to108ft) | 103.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 2.06 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (88ft to98ft) | 93.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 1.68 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (78ft to88ft) | 83.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 1.34 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (68ft to78ft) | 73.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 1.03 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (58ft to68ft) | 63.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.77 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (48ft to58ft) | 53.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.54 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (38ft to48ft) | 43.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.36 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (28ft to38ft) | 33.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.21 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (18ft to28ft) | 23.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.10 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (8ft to18ft) | 13.000 | 0.000 | 0.0000 | 1.55 | 0.00 | 0.00 | 0.03 |
| CCISeismic (12) miscl Cat5 From 0 to 196 (0ft to8ft) | 4.000 | 0.000 | 0.0000 | 1.24 | 0.00 | 0.00 | 0.00 |

# Discrete Tower Loads

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral Vert<br>ft ft ft | Azimuth Adjustment<br>° | Placement<br>ft | | $C_AA_A$ Front<br>$ft^2$ | $C_AA_A$ Side<br>$ft^2$ | Weight<br>lb |
|---|---|---|---|---|---|---|---|---|---|
| *** | | | | | | | | | |
| Properllor Anemometer/Wind Vane | A | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 198.491 | No Ice | 0.350 | 0.350 | 2.20 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 196.194 | No Ice | 0.250 | 1.000 | 8.00 |
| *** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 192.913 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 190.913 | No Ice | 0.250 | 1.000 | 8.00 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 192.913 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 190.913 | No Ice | 0.250 | 1.000 | 8.00 |
| *** | | | | | | | | | |
| Aircraft Marker Balls (21" Dia - Orange) | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 180.770 | No Ice | 1.130 | 1.130 | 15.00 |
| Aircraft Marker Balls (21" Dia - Orange) | B | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 180.770 | No Ice | 1.130 | 1.130 | 15.00 |
| Aircraft Marker Balls (21" Dia - Orange) | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 180.770 | No Ice | 1.130 | 1.130 | 15.00 |
| Aircraft Marker Balls (21" Dia - Orange) | D | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 180.770 | No Ice | 1.130 | 1.130 | 15.00 |
| **** | | | | | | | | | |
| NRG 200P Wind Vane | A | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 167.323 | No Ice | 0.250 | 0.250 | 0.25 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 165.323 | No Ice | 0.250 | 1.000 | 8.00 |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 167.323 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 165.323 | No Ice | 0.250 | 1.000 | 8.00 |
| **** | | | | | | | | | |
| Temperature Probe w/ Shield | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 173.885 | No Ice | 0.250 | 0.250 | 5.00 |
| Relative Humidty Sensor | B | From Leg | 0.000<br>0.000 | 0.0000 | 173.885 | No Ice | 0.450 | 0.450 | 10.00 |

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral Vert<br>ft ft ft | Azimuth Adjustment<br>° | Placement<br>ft | | $C_AA_A$ Front<br>$ft^2$ | $C_AA_A$ Side<br>$ft^2$ | Weight<br>lb |
|---|---|---|---|---|---|---|---|---|---|
| Barometric Pressure | C | From Leg | 0.000<br>0.000<br>0.000<br>0.000 | 0.0000 | 173.885 | No Ice | 0.500 | 0.500 | 10.00 |
| **** | | | | | | | | | |
| NRG 200P Wind Vane | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 160.761 | No Ice | 0.250 | 0.250 | 0.25 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 158.761 | No Ice | 0.250 | 1.000 | 8.00 |
| **** | | | | | | | | | |
| NRG 200P Wind Vane | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 137.795 | No Ice | 0.250 | 0.250 | 0.25 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 135.795 | No Ice | 0.250 | 1.000 | 8.00 |
| **** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 131.234 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 129.234 | No Ice | 0.250 | 1.000 | 8.00 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 131.234 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 129.234 | No Ice | 0.250 | 1.000 | 8.00 |
| *** | | | | | | | | | |
| NRG #40C Anemometer | C | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 98.425 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 96.425 | No Ice | 0.250 | 1.000 | 8.00 |
| NRG #40C Anemometer | A | From Leg | 7.920<br>0.000<br>0.000 | 0.0000 | 98.425 | No Ice | 0.250 | 0.250 | 0.20 |
| 95" Boom Mount | A | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 96.425 | No Ice | 0.250 | 1.000 | 8.00 |
| **** | | | | | | | | | |
| Temperature Probe w/ Shield | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 49.200 | No Ice | 0.250 | 0.250 | 5.00 |
| *** | | | | | | | | | |
| Data Logger | C | From Leg | 0.000<br>0.000<br>0.000 | 0.0000 | 5.000 | No Ice | 4.000 | 4.000 | 50.00 |

# 222-H Verification Constants

| *Constant* | *Value* |
|---|---|
| $K_d$ | 0.95 |
| Ice Thickness Importance Factor | 1 |
| $Z_g$ | 900 |
| $\alpha$ | 9.5 |
| $K_{zmin}$ | 0.85 |
| $K_c$ | 1 |
| $K_t$ | 0.43 |
| f | 1.25 |
| $K_e$ | 0.915 |

# 222-H Section Verification ArRr By Element

| *Section Elevation* *ft* | *Elem. Num.* | *Size* | *C* | *C w/Ice* | *Face* | *e* | *e w/Ice* | *$A_r$* *$ft^2$* | *$A_r$ w/Ice* *$ft^2$* | *$A_rR_r$* *$ft^2$* | *$A_rR_r$ w/Ice* *$ft^2$* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 197.688-190.438 | 1 | TP8.05x8x0.134 | 127.511 | 63.229 | | 1 | 1 | 4.848 | 4.848 | 4.848 | 4.848 |
| | | | | | | | Sum: | 4.848 | 4.848 | 4.848 | 4.848 |
| L2 190.438-184.021 | 2 | TP8.05x7.7763x0.134 | 125.451 | 62.207 | | 1 | 1 | 4.240 | 4.240 | 4.240 | 4.240 |
| | | | | | | | Sum: | 4.240 | 4.240 | 4.240 | 4.240 |
| L3 184.021-177.604 | 3 | TP8.05x7.7505x0.134 | 124.968 | 61.968 | | 1 | 1 | 4.234 | 4.234 | 4.234 | 4.234 |
| | | | | | | | Sum: | 4.234 | 4.234 | 4.234 | 4.234 |
| L4 177.604-171.187 | 4 | TP8.05x7.7476x0.134 | 124.651 | 61.81 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L5 171.187-164.771 | 5 | TP8.05x7.7472x0.134 | 124.338 | 61.655 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L6 164.771-158.354 | 6 | TP8.05x7.7472x0.134 | 124.009 | 61.492 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L7 158.354-151.937 | 7 | TP8.05x7.7472x0.134 | 123.662 | 61.32 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L8 151.937-145.521 | 8 | TP8.05x7.7472x0.134 | 123.294 | 61.138 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L9 145.521-139.104 | 9 | TP8.05x7.7472x0.134 | 122.904 | 60.944 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |
| L10 139.104-132.687 | 10 | TP8.05x7.7472x0.134 | 122.49 | 60.739 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: | 4.233 | 4.233 | 4.233 | 4.233 |

| Section Elevation ft | Elem. Num. | Size | C | C w/Ice | Face | e | e w/Ice | $A_r$ $ft^2$ | $A_r$ w/Ice $ft^2$ | $A_rR_r$ $ft^2$ | $A_rR_r$ w/Ice $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L11 132.687-126.271 | 11 | TP8.05x7.7472x0.134 | 122.049 | 60.52 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| L12 126.271-119.854 | 12 | TP8.05x7.7472x0.134 | 121.579 | 60.287 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| L13 119.854-113.437 | 13 | TP8.05x7.7472x0.134 | 121.077 | 60.038 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| L14 113.437-107.021 | 14 | TP8.05x7.7472x0.134 | 120.539 | 59.771 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| L15 107.021-100.604 | 15 | TP8.05x7.7472x0.134 | 119.961 | 59.485 | | 1 | 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| | | | | | | | Sum: 1 | 4.233 | 4.233 | 4.233 | 4.233 |
| L16 100.604-98.437 | 16 | TP10.04x7.7472x0.109 | 134.609 | 66.748 | | 1 | 1 | 1.663 | 1.663 | 1.663 | 1.663 |
| | | | | | | | Sum: 1 | 1.663 | 1.663 | 1.663 | 1.663 |
| L17 98.437-93.396 | 17 | TP10.04x9.0259x0.134 | 143.848 | 71.33 | | 1 | 1 | 4.042 | 4.042 | 4.042 | 4.042 |
| | | | | | | | Sum: 1 | 4.042 | 4.042 | 4.042 | 4.042 |
| L18 93.396-87.188 | 18 | TP10.04x9.5983x0.134 | 147.426 | 73.104 | | 1 | 1 | 5.096 | 5.096 | 5.096 | 5.096 |
| | | | | | | | Sum: 1 | 5.096 | 5.096 | 5.096 | 5.096 |
| L19 87.188-80.979 | 19 | TP10.04x9.7085x0.134 | 147.364 | 73.073 | | 1 | 1 | 5.121 | 5.121 | 5.121 | 5.121 |
| | | | | | | | Sum: 1 | 5.121 | 5.121 | 5.121 | 5.121 |
| L20 80.979-74.771 | 20 | TP10.04x9.7244x0.134 | 146.513 | 72.651 | | 1 | 1 | 5.124 | 5.124 | 5.124 | 5.124 |
| | | | | | | | Sum: 1 | 5.124 | 5.124 | 5.124 | 5.124 |
| L21 74.771-68.563 | 21 | TP10.04x9.7267x0.134 | 145.47 | 72.134 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L22 68.563-62.354 | 22 | TP10.04x9.727x0.134 | 144.307 | 71.557 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L23 62.354-56.146 | 23 | TP10.04x9.727x0.134 | 143.016 | 70.917 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L24 56.146-49.938 | 24 | TP10.04x9.727x0.134 | 141.572 | 70.201 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L25 49.938-43.729 | 25 | TP10.04x9.727x0.134 | 139.939 | 69.391 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L26 43.729-37.521 | 26 | TP10.04x9.727x0.134 | 138.069 | 68.464 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L27 37.521-31.313 | 27 | TP10.04x9.727x0.134 | 135.885 | 67.381 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L28 31.313-25.105 | 28 | TP10.04x9.727x0.134 | 133.272 | 66.085 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| | | | | | | | Sum: 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| L29 | 29 | TP10.04x9.727x0.13 | 130.027 | 64.476 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |

| Section Elevation ft | Elem. Num. | Size | C | C w/Ice | Face | e | e w/Ice | $A_r$ $ft^2$ | $A_r$ w/Ice $ft^2$ | $A_rR_r$ $ft^2$ | $A_rR_r$ w/Ice $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.105-18.896 | | 4 | | | | | | | | | |
| | | | | | | | Sum: | 5.125 | 5.125 | 5.125 | 5.125 |
| L30 | 30 | TP10.04x9.727x0.134 | 125.757 | 62.359 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| 18.896-12.688 | | 4 | | | | | | | | | |
| | | | | | | | Sum: | 5.125 | 5.125 | 5.125 | 5.125 |
| L31 | 31 | TP10.04x9.727x0.134 | 125.365 | 62.165 | | 1 | 1 | 5.125 | 5.125 | 5.125 | 5.125 |
| 12.688-6.480 | | 4 | | | | | | | | | |
| | | | | | | | Sum: | 5.125 | 5.125 | 5.125 | 5.125 |
| L32 6.480-0.000 | 32 | TP10.04x9.727x0.134 | 125.564 | 62.263 | | 1 | 1 | 5.349 | 5.349 | 5.349 | 5.349 |
| | | | | | | | Sum: | 5.349 | 5.349 | 5.349 | 5.349 |

## 222-H Section Verification Tables - No Ice

| Section Elevation ft | $z_{wind}$ ft | $z_{ice}$ ft | $K_z$ | $K_h$ | $K_{zt}$ | $t_z$ in | $q_z$ psf | Face | e | $A_rR_r$ $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 197.688-190.438 | 194.059 | | 1.455 | 1.176 | 1.865 | | 88 | | 1 | 4.848 |
| L2 190.438-184.021 | 187.213 | | 1.444 | 1.169 | 1.871 | | 88 | | 1 | 4.240 |
| L3 184.021-177.604 | 180.795 | | 1.434 | 1.163 | 1.877 | | 88 | | 1 | 4.234 |
| L4 177.604-171.187 | 174.378 | | 1.423 | 1.156 | 1.882 | | 87 | | 1 | 4.233 |
| L5 171.187-164.771 | 167.961 | | 1.412 | 1.15 | 1.887 | | 87 | | 1 | 4.233 |
| L6 164.771-158.354 | 161.544 | | 1.4 | 1.144 | 1.893 | | 86 | | 1 | 4.233 |
| L7 158.354-151.937 | 155.128 | | 1.388 | 1.138 | 1.898 | | 86 | | 1 | 4.233 |
| L8 151.937-145.521 | 148.711 | | 1.376 | 1.132 | 1.904 | | 85 | | 1 | 4.233 |
| L9 145.521-139.104 | 142.294 | | 1.363 | 1.126 | 1.91 | | 85 | | 1 | 4.233 |
| L10 139.104-132.687 | 135.878 | | 1.35 | 1.12 | 1.915 | | 84 | | 1 | 4.233 |
| L11 132.687-126.271 | 129.461 | | 1.336 | 1.114 | 1.921 | | 84 | | 1 | 4.233 |
| L12 126.271-119.854 | 123.044 | | 1.322 | 1.108 | 1.927 | | 83 | | 1 | 4.233 |
| L13 119.854-113.437 | 116.628 | | 1.307 | 1.102 | 1.933 | | 82 | | 1 | 4.233 |
| L14 113.437-107.021 | 110.211 | | 1.292 | 1.096 | 1.938 | | 82 | | 1 | 4.233 |
| L15 107.021-100.604 | 103.794 | | 1.276 | 1.09 | 1.944 | | 81 | | 1 | 4.233 |
| L16 100.604-98.437 | 99.488 | | 1.264 | 1.086 | 1.948 | | 80 | | 1 | 1.663 |
| L17 98.437-93.396 | 95.880 | | 1.254 | 1.083 | 1.952 | | 80 | | 1 | 4.042 |
| L18 93.396-87.188 | 90.272 | | 1.239 | 1.078 | 1.957 | | 79 | | 1 | 5.096 |
| L19 87.188-80.979 | 84.069 | | 1.22 | 1.073 | 1.963 | | 78 | | 1 | 5.121 |
| L20 80.979-74.771 | 77.861 | | 1.201 | 1.067 | 1.968 | | 77 | | 1 | 5.124 |
| L21 74.771-68.563 | 71.653 | | 1.18 | 1.062 | 1.974 | | 76 | | 1 | 5.125 |
| L22 68.563-62.354 | 65.445 | | 1.158 | 1.056 | 1.98 | | 75 | | 1 | 5.125 |
| L23 62.354-56.146 | 59.236 | | 1.134 | 1.051 | 1.986 | | 73 | | 1 | 5.125 |
| L24 56.146-49.938 | 53.028 | | 1.107 | 1.045 | 1.992 | | 72 | | 1 | 5.125 |
| L25 49.938-43.729 | 46.820 | | 1.079 | 1.04 | 1.998 | | 70 | | 1 | 5.125 |
| L26 43.729-37.521 | 40.611 | | 1.047 | 1.034 | 2.004 | | 68 | | 1 | 5.125 |
| L27 37.521-31.313 | 34.403 | | 1.011 | 1.029 | 2.01 | | 66 | | 1 | 5.125 |
| L28 31.313-25.105 | 28.195 | | 0.97 | 1.024 | 2.016 | | 64 | | 1 | 5.125 |
| L29 25.105-18.896 | 21.986 | | 0.92 | 1.018 | 2.023 | | 61 | | 1 | 5.125 |
| L30 18.896-12.688 | 15.778 | | 0.858 | 1.013 | 2.029 | | 57 | | 1 | 5.125 |
| L31 12.688-6.480 | 9.570 | | 0.85 | 1.008 | 2.035 | | 56 | | 1 | 5.125 |
| L32 6.480-0.000 | 3.225 | | 0.85 | 1.003 | 2.042 | | 57 | | 1 | 5.349 |

# 222-H Section Verification Tables - Service

| Section Elevation ft | $z_{wind}$ ft | $z_{ice}$ ft | $K_z$ | $K_h$ | $K_{zt}$ | $t_z$ in | $q_z$ psf | Face | e | $A_rR_r$ ft² |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 197.688-190.438 | 194.059 | | 1.455 | 1.176 | 1.865 | | 19 | | 1 | 4.848 |
| L2 190.438-184.021 | 187.213 | | 1.444 | 1.169 | 1.871 | | 19 | | 1 | 4.240 |
| L3 184.021-177.604 | 180.795 | | 1.434 | 1.163 | 1.877 | | 19 | | 1 | 4.234 |
| L4 177.604-171.187 | 174.378 | | 1.423 | 1.156 | 1.882 | | 19 | | 1 | 4.233 |
| L5 171.187-164.771 | 167.961 | | 1.412 | 1.15 | 1.887 | | 19 | | 1 | 4.233 |
| L6 164.771-158.354 | 161.544 | | 1.4 | 1.144 | 1.893 | | 19 | | 1 | 4.233 |
| L7 158.354-151.937 | 155.128 | | 1.388 | 1.138 | 1.898 | | 19 | | 1 | 4.233 |
| L8 151.937-145.521 | 148.711 | | 1.376 | 1.132 | 1.904 | | 19 | | 1 | 4.233 |
| L9 145.521-139.104 | 142.294 | | 1.363 | 1.126 | 1.91 | | 19 | | 1 | 4.233 |
| L10 139.104-132.687 | 135.878 | | 1.35 | 1.12 | 1.915 | | 19 | | 1 | 4.233 |
| L11 132.687-126.271 | 129.461 | | 1.336 | 1.114 | 1.921 | | 18 | | 1 | 4.233 |
| L12 126.271-119.854 | 123.044 | | 1.322 | 1.108 | 1.927 | | 18 | | 1 | 4.233 |
| L13 119.854-113.437 | 116.628 | | 1.307 | 1.102 | 1.933 | | 18 | | 1 | 4.233 |
| L14 113.437-107.021 | 110.211 | | 1.292 | 1.096 | 1.938 | | 18 | | 1 | 4.233 |
| L15 107.021-100.604 | 103.794 | | 1.276 | 1.09 | 1.944 | | 18 | | 1 | 4.233 |
| L16 100.604-98.437 | 99.488 | | 1.264 | 1.086 | 1.948 | | 18 | | 1 | 1.663 |
| L17 98.437-93.396 | 95.880 | | 1.254 | 1.083 | 1.952 | | 18 | | 1 | 4.042 |
| L18 93.396-87.188 | 90.272 | | 1.239 | 1.078 | 1.957 | | 17 | | 1 | 5.096 |
| L19 87.188-80.979 | 84.069 | | 1.22 | 1.073 | 1.963 | | 17 | | 1 | 5.121 |
| L20 80.979-74.771 | 77.861 | | 1.201 | 1.067 | 1.968 | | 17 | | 1 | 5.124 |
| L21 74.771-68.563 | 71.653 | | 1.18 | 1.062 | 1.974 | | 17 | | 1 | 5.125 |
| L22 68.563-62.354 | 65.445 | | 1.158 | 1.056 | 1.98 | | 16 | | 1 | 5.125 |
| L23 62.354-56.146 | 59.236 | | 1.134 | 1.051 | 1.986 | | 16 | | 1 | 5.125 |
| L24 56.146-49.938 | 53.028 | | 1.107 | 1.045 | 1.992 | | 16 | | 1 | 5.125 |
| L25 49.938-43.729 | 46.820 | | 1.079 | 1.04 | 1.998 | | 15 | | 1 | 5.125 |
| L26 43.729-37.521 | 40.611 | | 1.047 | 1.034 | 2.004 | | 15 | | 1 | 5.125 |
| L27 37.521-31.313 | 34.403 | | 1.011 | 1.029 | 2.01 | | 15 | | 1 | 5.125 |
| L28 31.313-25.105 | 28.195 | | 0.97 | 1.024 | 2.016 | | 14 | | 1 | 5.125 |
| L29 25.105-18.896 | 21.986 | | 0.92 | 1.018 | 2.023 | | 13 | | 1 | 5.125 |
| L30 18.896-12.688 | 15.778 | | 0.858 | 1.013 | 2.029 | | 12 | | 1 | 5.125 |
| L31 12.688-6.480 | 9.570 | | 0.85 | 1.008 | 2.035 | | 12 | | 1 | 5.125 |
| L32 6.480-0.000 | 3.225 | | 0.85 | 1.003 | 2.042 | | 12 | | 1 | 5.349 |

# Tower Pressures - No Ice

$G_H = 1.100$

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 194.059 | 1.455 | 88 | 4.848 | A | 0.000 | 4.848 | 4.848 | 100.00 | 0.000 | 0.000 |
| 197.688-190.4 | | | | | B | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| 38 | | | | | C | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| L2 | 187.213 | 1.444 | 88 | 4.240 | A | 0.000 | 4.240 | 4.240 | 100.00 | 0.000 | 0.000 |
| 190.438-184.0 | | | | | B | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| 21 | | | | | C | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| L3 | 180.795 | 1.434 | 88 | 4.234 | A | 0.000 | 4.234 | 4.234 | 100.00 | 0.000 | 0.000 |
| 184.021-177.6 | | | | | B | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |
| 04 | | | | | C | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L4 | 174.378 | 1.423 | 87 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 177.604-171.187 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L5 | 167.961 | 1.412 | 87 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 171.187-164.771 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L6 | 161.544 | 1.4 | 86 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 164.771-158.354 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L7 | 155.128 | 1.388 | 86 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 158.354-151.937 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L8 | 148.711 | 1.376 | 85 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 151.937-145.521 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L9 | 142.294 | 1.363 | 85 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 145.521-139.104 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L10 | 135.878 | 1.35 | 84 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 139.104-132.687 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L11 | 129.461 | 1.336 | 84 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 132.687-126.271 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L12 | 123.044 | 1.322 | 83 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 126.271-119.854 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L13 | 116.628 | 1.307 | 82 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 119.854-113.437 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L14 | 110.211 | 1.292 | 82 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 113.437-107.021 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L15 | 103.794 | 1.276 | 81 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 107.021-100.604 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L16 | 99.488 | 1.264 | 80 | 1.663 | A | 0.000 | 1.663 | 1.663 | 100.00 | 0.000 | 0.000 |
| 100.604-98.437 | | | | | B | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| L17 | 95.880 | 1.254 | 80 | 4.042 | A | 0.000 | 4.042 | 4.042 | 100.00 | 0.000 | 0.000 |
| 98.437-93.396 | | | | | B | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| L18 | 90.272 | 1.239 | 79 | 5.096 | A | 0.000 | 5.096 | 5.096 | 100.00 | 0.000 | 0.000 |
| 93.396-87.188 | | | | | B | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L19 | 84.069 | 1.22 | 78 | 5.121 | A | 0.000 | 5.121 | 5.121 | 100.00 | 0.000 | 0.000 |
| 87.188-80.979 | | | | | B | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| L20 | 77.861 | 1.201 | 77 | 5.124 | A | 0.000 | 5.124 | 5.124 | 100.00 | 0.000 | 0.000 |
| 80.979-74.771 | | | | | B | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| L21 | 71.653 | 1.18 | 76 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 74.771-68.563 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L22 | 65.445 | 1.158 | 75 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 68.563-62.354 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L23 | 59.236 | 1.134 | 73 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 62.354-56.146 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L24 | 53.028 | 1.107 | 72 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 56.146-49.938 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L25 | 46.820 | 1.079 | 70 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 49.938-43.729 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L26 | 40.611 | 1.047 | 68 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 43.729-37.521 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L27 | 34.403 | 1.011 | 66 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 37.521-31.313 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L28 | 28.195 | 0.97 | 64 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 31.313-25.105 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L29 | 21.986 | 0.92 | 61 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 25.105-18.896 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L30 | 15.778 | 0.858 | 57 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 18.896-12.688 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L31 | 9.570 | 0.85 | 56 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 12.688-6.480 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L32 | 3.225 | 0.85 | 57 | 5.349 | A | 0.000 | 5.349 | 5.349 | 100.00 | 0.000 | 0.000 |
| 6.480-0.000 | | | | | B | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |

# Tower Pressure - Service

$G_H = 1.100$

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 194.059 | 1.455 | 19 | 4.848 | A | 0.000 | 4.848 | 4.848 | 100.00 | 0.000 | 0.000 |
| 197.688-190.4 | | | | | B | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| 38 | | | | | C | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.848 | | 100.00 | 0.000 | 0.000 |
| L2 | 187.213 | 1.444 | 19 | 4.240 | A | 0.000 | 4.240 | 4.240 | 100.00 | 0.000 | 0.000 |
| 190.438-184.0 | | | | | B | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| 21 | | | | | C | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.240 | | 100.00 | 0.000 | 0.000 |
| L3 | 180.795 | 1.434 | 19 | 4.234 | A | 0.000 | 4.234 | 4.234 | 100.00 | 0.000 | 0.000 |
| 184.021-177.6 | | | | | B | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |
| 04 | | | | | C | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.234 | | 100.00 | 0.000 | 0.000 |
| L4 | 174.378 | 1.423 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 177.604-171.1 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 87 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L5 | 167.961 | 1.412 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 171.187-164.7 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 71 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L6 | 161.544 | 1.4 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 164.771-158.3 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 54 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L7 | 155.128 | 1.388 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 158.354-151.9 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 37 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L8 | 148.711 | 1.376 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 151.937-145.5 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 21 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L9 | 142.294 | 1.363 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 145.521-139.1 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 04 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L10 | 135.878 | 1.35 | 19 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 139.104-132.6 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 87 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L11 | 129.461 | 1.336 | 18 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 132.687-126.2 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 71 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L12 | 123.044 | 1.322 | 18 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 126.271-119.8 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 54 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L13 | 116.628 | 1.307 | 18 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 119.854-113.4 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| 37 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L14 | 110.211 | 1.292 | 18 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 113.437-107.0 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ $ft^2$ | Face | $A_F$ $ft^2$ | $A_R$ $ft^2$ | $A_{leg}$ $ft^2$ | Leg % | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L15 | 103.794 | 1.276 | 18 | 4.233 | A | 0.000 | 4.233 | 4.233 | 100.00 | 0.000 | 0.000 |
| 107.021-100.604 | | | | | B | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.233 | | 100.00 | 0.000 | 0.000 |
| L16 | 99.488 | 1.264 | 18 | 1.663 | A | 0.000 | 1.663 | 1.663 | 100.00 | 0.000 | 0.000 |
| 100.604-98.437 | | | | | B | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 1.663 | | 100.00 | 0.000 | 0.000 |
| L17 | 95.880 | 1.254 | 18 | 4.042 | A | 0.000 | 4.042 | 4.042 | 100.00 | 0.000 | 0.000 |
| 98.437-93.396 | | | | | B | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 4.042 | | 100.00 | 0.000 | 0.000 |
| L18 | 90.272 | 1.239 | 17 | 5.096 | A | 0.000 | 5.096 | 5.096 | 100.00 | 0.000 | 0.000 |
| 93.396-87.188 | | | | | B | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.096 | | 100.00 | 0.000 | 0.000 |
| L19 | 84.069 | 1.22 | 17 | 5.121 | A | 0.000 | 5.121 | 5.121 | 100.00 | 0.000 | 0.000 |
| 87.188-80.979 | | | | | B | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.121 | | 100.00 | 0.000 | 0.000 |
| L20 | 77.861 | 1.201 | 17 | 5.124 | A | 0.000 | 5.124 | 5.124 | 100.00 | 0.000 | 0.000 |
| 80.979-74.771 | | | | | B | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.124 | | 100.00 | 0.000 | 0.000 |
| L21 | 71.653 | 1.18 | 17 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 74.771-68.563 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L22 | 65.445 | 1.158 | 16 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 68.563-62.354 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L23 | 59.236 | 1.134 | 16 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 62.354-56.146 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L24 | 53.028 | 1.107 | 16 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 56.146-49.938 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L25 | 46.820 | 1.079 | 15 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 49.938-43.729 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L26 | 40.611 | 1.047 | 15 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 43.729-37.521 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L27 | 34.403 | 1.011 | 15 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 37.521-31.313 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L28 | 28.195 | 0.97 | 14 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 31.313-25.105 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L29 | 21.986 | 0.92 | 13 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 25.105-18.896 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ psf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L30 | 15.778 | 0.858 | 12 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 18.896-12.688 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L31 | 9.570 | 0.85 | 12 | 5.125 | A | 0.000 | 5.125 | 5.125 | 100.00 | 0.000 | 0.000 |
| 12.688-6.480 | | | | | B | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.125 | | 100.00 | 0.000 | 0.000 |
| L32 | 3.225 | 0.85 | 12 | 5.349 | A | 0.000 | 5.349 | 5.349 | 100.00 | 0.000 | 0.000 |
| 6.480-0.000 | | | | | B | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |
| | | | | | D | 0.000 | 5.349 | | 100.00 | 0.000 | 0.000 |

## Tower Forces - No Ice - Wind Normal To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ ft² | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 3.34 | 84.41 | A | 1 | 0.6 | 88 | 1 | 1 | 4.848 | 282.93 | 39.02 | D |
| 197.688-190.4 | | | B | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| 38 | | | C | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| L2 | 3.85 | 83.21 | A | 1 | 0.6 | 88 | 1 | 1 | 4.240 | 246.30 | 38.38 | D |
| 190.438-184.0 | | | B | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| L3 | 3.85 | 83.08 | A | 1 | 0.6 | 88 | 1 | 1 | 4.234 | 244.85 | 38.16 | D |
| 184.021-177.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| L4 | 3.85 | 83.06 | A | 1 | 0.6 | 87 | 1 | 1 | 4.233 | 243.66 | 37.97 | D |
| 177.604-171.1 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L5 | 3.85 | 83.06 | A | 1 | 0.6 | 87 | 1 | 1 | 4.233 | 242.44 | 37.78 | D |
| 171.187-164.7 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L6 | 3.85 | 83.06 | A | 1 | 0.6 | 86 | 1 | 1 | 4.233 | 241.16 | 37.58 | D |
| 164.771-158.3 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L7 | 3.85 | 83.06 | A | 1 | 0.6 | 86 | 1 | 1 | 4.233 | 239.82 | 37.37 | D |
| 158.354-151.9 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L8 | 3.85 | 83.06 | A | 1 | 0.6 | 85 | 1 | 1 | 4.233 | 238.39 | 37.15 | D |
| 151.937-145.5 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L9 | 3.85 | 83.06 | A | 1 | 0.6 | 85 | 1 | 1 | 4.233 | 236.89 | 36.92 | D |
| 145.521-139.1 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L10 | 3.85 | 83.06 | A | 1 | 0.6 | 84 | 1 | 1 | 4.233 | 235.29 | 36.67 | D |
| 139.104-132.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L11 | 3.85 | 83.06 | A | 1 | 0.6 | 84 | 1 | 1 | 4.233 | 233.60 | 36.41 | D |
| 132.687-126.2 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L12 | 3.85 | 83.06 | A | 1 | 0.6 | 83 | 1 | 1 | 4.233 | 231.81 | 36.13 | D |
| 126.271-119.8 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L13 | 3.85 | 83.06 | A | 1 | 0.6 | 82 | 1 | 1 | 4.233 | 229.89 | 35.83 | D |
| 119.854-113.4 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L14 | 3.85 | 83.06 | A | 1 | 0.6 | 82 | 1 | 1 | 4.233 | 227.86 | 35.51 | D |
| 113.437-107.0 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L15 | 3.85 | 83.06 | A | 1 | 0.6 | 81 | 1 | 1 | 4.233 | 225.68 | 35.17 | D |
| 107.021-100.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L16 | 1.30 | 31.63 | A | 1 | 0.6 | 80 | 1 | 1 | 1.663 | 88.07 | 40.65 | D |
| 100.604-98.43 | | | B | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| 7 | | | C | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| L17 | 3.02 | 84.36 | A | 1 | 0.6 | 80 | 1 | 1 | 4.042 | 212.71 | 42.19 | D |
| 98.437-93.396 | | | B | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| L18 | 3.72 | 103.60 | A | 1 | 0.6 | 79 | 1 | 1 | 5.096 | 265.54 | 42.77 | D |
| 93.396-87.188 | | | B | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| L19 | 3.72 | 104.19 | A | 1 | 0.6 | 78 | 1 | 1 | 5.121 | 263.62 | 42.46 | D |
| 87.188-80.979 | | | B | 1 | 0.6 | | 1 | 1 | 5.121 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.121 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.121 | | | |
| L20 | 3.72 | 104.28 | A | 1 | 0.6 | 77 | 1 | 1 | 5.124 | 260.35 | 41.94 | D |
| 80.979-74.771 | | | B | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| L21 | 3.72 | 104.29 | A | 1 | 0.6 | 76 | 1 | 1 | 5.125 | 256.62 | 41.34 | D |
| 74.771-68.563 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L22 | 3.72 | 104.29 | A | 1 | 0.6 | 75 | 1 | 1 | 5.125 | 252.53 | 40.68 | D |
| 68.563-62.354 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L23 | 3.72 | 104.29 | A | 1 | 0.6 | 73 | 1 | 1 | 5.125 | 248.03 | 39.95 | D |
| 62.354-56.146 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L24 | 3.72 | 104.29 | A | 1 | 0.6 | 72 | 1 | 1 | 5.125 | 243.05 | 39.15 | D |
| 56.146-49.938 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L25 | 3.72 | 104.29 | A | 1 | 0.6 | 70 | 1 | 1 | 5.125 | 237.47 | 38.25 | D |
| 49.938-43.729 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L26 | 3.72 | 104.29 | A | 1 | 0.6 | 68 | 1 | 1 | 5.125 | 231.17 | 37.24 | D |
| 43.729-37.521 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L27 | 3.72 | 104.29 | A | 1 | 0.6 | 66 | 1 | 1 | 5.125 | 223.91 | 36.07 | D |
| 37.521-31.313 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L28 | 3.72 | 104.29 | A | 1 | 0.6 | 64 | 1 | 1 | 5.125 | 215.38 | 34.69 | D |
| 31.313-25.105 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L29 | 3.72 | 104.29 | A | 1 | 0.6 | 61 | 1 | 1 | 5.125 | 205.02 | 33.02 | D |
| 25.105-18.896 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L30 | 3.72 | 104.29 | A | 1 | 0.6 | 57 | 1 | 1 | 5.125 | 191.78 | 30.89 | D |
| 18.896-12.688 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L31 | 3.72 | 104.29 | A | 1 | 0.6 | 56 | 1 | 1 | 5.125 | 190.59 | 30.70 | D |
| 12.688-6.480 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L32 | 3.89 | 108.19 | A | 1 | 0.6 | 57 | 1 | 1 | 5.349 | 199.53 | 30.79 | D |
| 6.480-0.000 | | | B | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| Sum Weight: | 117.60 | 2930.86 | | | | | | | | 7385.95 | | |

## Tower Forces - No Ice - Wind 45 To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 3.34 | 84.41 | A | 1 | 0.6 | 88 | 1 | 1 | 4.848 | 282.93 | 39.02 | D |
| 197.688-190.4 | | | B | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| 38 | | | C | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.848 | | | |
| L2 | 3.85 | 83.21 | A | 1 | 0.6 | 88 | 1 | 1 | 4.240 | 246.30 | 38.38 | D |
| 190.438-184.0 | | | B | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.240 | | | |
| L3 | 3.85 | 83.08 | A | 1 | 0.6 | 88 | 1 | 1 | 4.234 | 244.85 | 38.16 | D |
| 184.021-177.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.234 | | | |
| L4 | 3.85 | 83.06 | A | 1 | 0.6 | 87 | 1 | 1 | 4.233 | 243.66 | 37.97 | D |
| 177.604-171.1 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L5 | 3.85 | 83.06 | A | 1 | 0.6 | 87 | 1 | 1 | 4.233 | 242.44 | 37.78 | D |
| 171.187-164.7 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L6 | 3.85 | 83.06 | A | 1 | 0.6 | 86 | 1 | 1 | 4.233 | 241.16 | 37.58 | D |
| 164.771-158.3 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L7 | 3.85 | 83.06 | A | 1 | 0.6 | 86 | 1 | 1 | 4.233 | 239.82 | 37.37 | D |
| 158.354-151.9 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L8 | 3.85 | 83.06 | A | 1 | 0.6 | 85 | 1 | 1 | 4.233 | 238.39 | 37.15 | D |
| 151.937-145.5 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L9 | 3.85 | 83.06 | A | 1 | 0.6 | 85 | 1 | 1 | 4.233 | 236.89 | 36.92 | D |
| 145.521-139.1 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L10 | 3.85 | 83.06 | A | 1 | 0.6 | 84 | 1 | 1 | 4.233 | 235.29 | 36.67 | D |
| 139.104-132.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L11 | 3.85 | 83.06 | A | 1 | 0.6 | 84 | 1 | 1 | 4.233 | 233.60 | 36.41 | D |
| 132.687-126.2 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L12 | 3.85 | 83.06 | A | 1 | 0.6 | 83 | 1 | 1 | 4.233 | 231.81 | 36.13 | D |
| 126.271-119.8 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L13 | 3.85 | 83.06 | A | 1 | 0.6 | 82 | 1 | 1 | 4.233 | 229.89 | 35.83 | D |
| 119.854-113.4 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L14 | 3.85 | 83.06 | A | 1 | 0.6 | 82 | 1 | 1 | 4.233 | 227.86 | 35.51 | D |
| 113.437-107.0 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L15 | 3.85 | 83.06 | A | 1 | 0.6 | 81 | 1 | 1 | 4.233 | 225.68 | 35.17 | D |
| 107.021-100.6 | | | B | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.233 | | | |
| L16 | 1.30 | 31.63 | A | 1 | 0.6 | 80 | 1 | 1 | 1.663 | 88.07 | 40.65 | D |
| 100.604-98.43 | | | B | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| 7 | | | C | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 1.663 | | | |
| L17 | 3.02 | 84.36 | A | 1 | 0.6 | 80 | 1 | 1 | 4.042 | 212.71 | 42.19 | D |
| 98.437-93.396 | | | B | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 4.042 | | | |
| L18 | 3.72 | 103.60 | A | 1 | 0.6 | 79 | 1 | 1 | 5.096 | 265.54 | 42.77 | D |
| 93.396-87.188 | | | B | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.096 | | | |
| L19 | 3.72 | 104.19 | A | 1 | 0.6 | 78 | 1 | 1 | 5.121 | 263.62 | 42.46 | D |
| 87.188-80.979 | | | B | 1 | 0.6 | | 1 | 1 | 5.121 | | | |

| Section Elevation<br>ft | Add Weight<br>lb | Self Weight<br>lb | Face | e | $C_F$ | $q_z$<br>psf | $D_F$ | $D_R$ | $A_E$<br>$ft^2$ | F<br>lb | w<br>plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | 1 | 0.6 | | 1 | 1 | 5.121 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.121 | | | |
| L20 | 3.72 | 104.28 | A | 1 | 0.6 | 77 | 1 | 1 | 5.124 | 260.35 | 41.94 | D |
| 80.979-74.771 | | | B | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.124 | | | |
| L21 | 3.72 | 104.29 | A | 1 | 0.6 | 76 | 1 | 1 | 5.125 | 256.62 | 41.34 | D |
| 74.771-68.563 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L22 | 3.72 | 104.29 | A | 1 | 0.6 | 75 | 1 | 1 | 5.125 | 252.53 | 40.68 | D |
| 68.563-62.354 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L23 | 3.72 | 104.29 | A | 1 | 0.6 | 73 | 1 | 1 | 5.125 | 248.03 | 39.95 | D |
| 62.354-56.146 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L24 | 3.72 | 104.29 | A | 1 | 0.6 | 72 | 1 | 1 | 5.125 | 243.05 | 39.15 | D |
| 56.146-49.938 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L25 | 3.72 | 104.29 | A | 1 | 0.6 | 70 | 1 | 1 | 5.125 | 237.47 | 38.25 | D |
| 49.938-43.729 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L26 | 3.72 | 104.29 | A | 1 | 0.6 | 68 | 1 | 1 | 5.125 | 231.17 | 37.24 | D |
| 43.729-37.521 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L27 | 3.72 | 104.29 | A | 1 | 0.6 | 66 | 1 | 1 | 5.125 | 223.91 | 36.07 | D |
| 37.521-31.313 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L28 | 3.72 | 104.29 | A | 1 | 0.6 | 64 | 1 | 1 | 5.125 | 215.38 | 34.69 | D |
| 31.313-25.105 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L29 | 3.72 | 104.29 | A | 1 | 0.6 | 61 | 1 | 1 | 5.125 | 205.02 | 33.02 | D |
| 25.105-18.896 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L30 | 3.72 | 104.29 | A | 1 | 0.6 | 57 | 1 | 1 | 5.125 | 191.78 | 30.89 | D |
| 18.896-12.688 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L31 | 3.72 | 104.29 | A | 1 | 0.6 | 56 | 1 | 1 | 5.125 | 190.59 | 30.70 | D |
| 12.688-6.480 | | | B | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.125 | | | |
| L32 | 3.89 | 108.19 | A | 1 | 0.6 | 57 | 1 | 1 | 5.349 | 199.53 | 30.79 | D |
| 6.480-0.000 | | | B | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| | | | D | 1 | 0.6 | | 1 | 1 | 5.349 | | | |
| Sum Weight: | 117.60 | 2930.86 | | | | | | | | 7385.95 | | |

# Tower Forces - Service - Wind Normal To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 3.34 | 84.41 | A | 1 | 0.74 | 19 | 1 | 1 | 4.848 | 76.79 | 10.59 | D |
| 197.688-190.4 | | | B | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| 38 | | | C | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| | | | D | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| L2 | 3.85 | 83.21 | A | 1 | 0.751 | 19 | 1 | 1 | 4.240 | 67.81 | 10.57 | D |
| 190.438-184.0 | | | B | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| 21 | | | C | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| | | | D | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| L3 | 3.85 | 83.08 | A | 1 | 0.754 | 19 | 1 | 1 | 4.234 | 67.66 | 10.54 | D |
| 184.021-177.6 | | | B | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| 04 | | | C | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| | | | D | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| L4 | 3.85 | 83.06 | A | 1 | 0.755 | 19 | 1 | 1 | 4.233 | 67.50 | 10.52 | D |
| 177.604-171.1 | | | B | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| L5 | 3.85 | 83.06 | A | 1 | 0.757 | 19 | 1 | 1 | 4.233 | 67.33 | 10.49 | D |
| 171.187-164.7 | | | B | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| L6 | 3.85 | 83.06 | A | 1 | 0.759 | 19 | 1 | 1 | 4.233 | 67.15 | 10.47 | D |
| 164.771-158.3 | | | B | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| L7 | 3.85 | 83.06 | A | 1 | 0.762 | 19 | 1 | 1 | 4.233 | 66.96 | 10.44 | D |
| 158.354-151.9 | | | B | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| L8 | 3.85 | 83.06 | A | 1 | 0.764 | 19 | 1 | 1 | 4.233 | 66.76 | 10.40 | D |
| 151.937-145.5 | | | B | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| L9 | 3.85 | 83.06 | A | 1 | 0.766 | 19 | 1 | 1 | 4.233 | 66.55 | 10.37 | D |
| 145.521-139.1 | | | B | 1 | 0.766 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.766 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.766 | | 1 | 1 | 4.233 | | | |
| L10 | 3.85 | 83.06 | A | 1 | 0.769 | 19 | 1 | 1 | 4.233 | 66.33 | 10.34 | D |
| 139.104-132.6 | | | B | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| L11 | 3.85 | 83.06 | A | 1 | 0.772 | 18 | 1 | 1 | 4.233 | 66.09 | 10.30 | D |
| 132.687-126.2 | | | B | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| L12 | 3.85 | 83.06 | A | 1 | 0.775 | 18 | 1 | 1 | 4.233 | 65.84 | 10.26 | D |
| 126.271-119.8 | | | B | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| L13 | 3.85 | 83.06 | A | 1 | 0.778 | 18 | 1 | 1 | 4.233 | 65.56 | 10.22 | D |
| 119.854-113.4 | | | B | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| L14 | 3.85 | 83.06 | A | 1 | 0.781 | 18 | 1 | 1 | 4.233 | 65.27 | 10.17 | D |
| 113.437-107.0 | | | B | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| L15 | 3.85 | 83.06 | A | 1 | 0.785 | 18 | 1 | 1 | 4.233 | 64.96 | 10.12 | D |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107.021-100.604 | | | B | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| | | | C | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| L16 | 1.30 | 31.63 | A | 1 | 0.677 | 18 | 1 | 1 | 1.663 | 21.86 | 10.09 | D |
| 100.604-98.437 | | | B | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| | | | C | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| | | | D | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| L17 | 3.02 | 84.36 | A | 1 | 0.65 | 18 | 1 | 1 | 4.042 | 50.71 | 10.06 | D |
| 98.437-93.396 | | | B | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| | | | C | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| | | | D | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| L18 | 3.72 | 103.60 | A | 1 | 0.638 | 17 | 1 | 1 | 5.096 | 62.13 | 10.01 | D |
| 93.396-87.188 | | | B | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| | | | C | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| | | | D | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| L19 | 3.72 | 104.19 | A | 1 | 0.639 | 17 | 1 | 1 | 5.121 | 61.76 | 9.95 | D |
| 87.188-80.979 | | | B | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| | | | C | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| | | | D | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| L20 | 3.72 | 104.28 | A | 1 | 0.643 | 17 | 1 | 1 | 5.124 | 61.35 | 9.88 | D |
| 80.979-74.771 | | | B | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| | | | C | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| | | | D | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| L21 | 3.72 | 104.29 | A | 1 | 0.647 | 17 | 1 | 1 | 5.125 | 60.91 | 9.81 | D |
| 74.771-68.563 | | | B | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| L22 | 3.72 | 104.29 | A | 1 | 0.653 | 16 | 1 | 1 | 5.125 | 60.42 | 9.73 | D |
| 68.563-62.354 | | | B | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| L23 | 3.72 | 104.29 | A | 1 | 0.658 | 16 | 1 | 1 | 5.125 | 59.88 | 9.65 | D |
| 62.354-56.146 | | | B | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| L24 | 3.72 | 104.29 | A | 1 | 0.665 | 16 | 1 | 1 | 5.125 | 59.28 | 9.55 | D |
| 56.146-49.938 | | | B | 1 | 0.665 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.665 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.665 | | 1 | 1 | 5.125 | | | |
| L25 | 3.72 | 104.29 | A | 1 | 0.673 | 15 | 1 | 1 | 5.125 | 58.59 | 9.44 | D |
| 49.938-43.729 | | | B | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| L26 | 3.72 | 104.29 | A | 1 | 0.682 | 15 | 1 | 1 | 5.125 | 57.81 | 9.31 | D |
| 43.729-37.521 | | | B | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| L27 | 3.72 | 104.29 | A | 1 | 0.693 | 15 | 1 | 1 | 5.125 | 56.90 | 9.16 | D |
| 37.521-31.313 | | | B | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| L28 | 3.72 | 104.29 | A | 1 | 0.707 | 14 | 1 | 1 | 5.125 | 55.80 | 8.99 | D |
| 31.313-25.105 | | | B | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| L29 | 3.72 | 104.29 | A | 1 | 0.724 | 13 | 1 | 1 | 5.125 | 54.44 | 8.77 | D |
| 25.105-18.896 | | | B | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| L30 | 3.72 | 104.29 | A | 1 | 0.749 | 12 | 1 | 1 | 5.125 | 52.65 | 8.48 | D |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18.896-12.688 | | | B | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| L31 | 3.72 | 104.29 | A | 1 | 0.751 | 12 | 1 | 1 | 5.125 | 52.49 | 8.45 | D |
| 12.688-6.480 | | | B | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| L32 | 3.89 | 108.19 | A | 1 | 0.75 | 12 | 1 | 1 | 5.349 | 54.87 | 8.47 | D |
| 6.480-0.000 | | | B | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| | | | C | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| | | | D | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| Sum Weight: | 117.60 | 2930.86 | | | | | | | | 1950.43 | | |

## Tower Forces - Service - Wind 45 To Face

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 3.34 | 84.41 | A | 1 | 0.74 | 19 | 1 | 1 | 4.848 | 76.79 | 10.59 | D |
| 197.688-190.4 | | | B | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| 38 | | | C | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| | | | D | 1 | 0.74 | | 1 | 1 | 4.848 | | | |
| L2 | 3.85 | 83.21 | A | 1 | 0.751 | 19 | 1 | 1 | 4.240 | 67.81 | 10.57 | D |
| 190.438-184.0 | | | B | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| 21 | | | C | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| | | | D | 1 | 0.751 | | 1 | 1 | 4.240 | | | |
| L3 | 3.85 | 83.08 | A | 1 | 0.754 | 19 | 1 | 1 | 4.234 | 67.66 | 10.54 | D |
| 184.021-177.6 | | | B | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| 04 | | | C | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| | | | D | 1 | 0.754 | | 1 | 1 | 4.234 | | | |
| L4 | 3.85 | 83.06 | A | 1 | 0.755 | 19 | 1 | 1 | 4.233 | 67.50 | 10.52 | D |
| 177.604-171.1 | | | B | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.755 | | 1 | 1 | 4.233 | | | |
| L5 | 3.85 | 83.06 | A | 1 | 0.757 | 19 | 1 | 1 | 4.233 | 67.33 | 10.49 | D |
| 171.187-164.7 | | | B | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.757 | | 1 | 1 | 4.233 | | | |
| L6 | 3.85 | 83.06 | A | 1 | 0.759 | 19 | 1 | 1 | 4.233 | 67.15 | 10.47 | D |
| 164.771-158.3 | | | B | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.759 | | 1 | 1 | 4.233 | | | |
| L7 | 3.85 | 83.06 | A | 1 | 0.762 | 19 | 1 | 1 | 4.233 | 66.96 | 10.44 | D |
| 158.354-151.9 | | | B | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.762 | | 1 | 1 | 4.233 | | | |
| L8 | 3.85 | 83.06 | A | 1 | 0.764 | 19 | 1 | 1 | 4.233 | 66.76 | 10.40 | D |
| 151.937-145.5 | | | B | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.764 | | 1 | 1 | 4.233 | | | |
| L9 | 3.85 | 83.06 | A | 1 | 0.766 | 19 | 1 | 1 | 4.233 | 66.55 | 10.37 | D |
| 145.521-139.1 | | | B | 1 | 0.766 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.766 | | 1 | 1 | 4.233 | | | |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | D | 1 | 0.766 | | 1 | 1 | 4.233 | | | |
| L10 | 3.85 | 83.06 | A | 1 | 0.769 | 19 | 1 | 1 | 4.233 | 66.33 | 10.34 | D |
| 139.104-132.6 | | | B | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| 87 | | | C | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.769 | | 1 | 1 | 4.233 | | | |
| L11 | 3.85 | 83.06 | A | 1 | 0.772 | 18 | 1 | 1 | 4.233 | 66.09 | 10.30 | D |
| 132.687-126.2 | | | B | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| 71 | | | C | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.772 | | 1 | 1 | 4.233 | | | |
| L12 | 3.85 | 83.06 | A | 1 | 0.775 | 18 | 1 | 1 | 4.233 | 65.84 | 10.26 | D |
| 126.271-119.8 | | | B | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| 54 | | | C | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.775 | | 1 | 1 | 4.233 | | | |
| L13 | 3.85 | 83.06 | A | 1 | 0.778 | 18 | 1 | 1 | 4.233 | 65.56 | 10.22 | D |
| 119.854-113.4 | | | B | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| 37 | | | C | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.778 | | 1 | 1 | 4.233 | | | |
| L14 | 3.85 | 83.06 | A | 1 | 0.781 | 18 | 1 | 1 | 4.233 | 65.27 | 10.17 | D |
| 113.437-107.0 | | | B | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| 21 | | | C | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.781 | | 1 | 1 | 4.233 | | | |
| L15 | 3.85 | 83.06 | A | 1 | 0.785 | 18 | 1 | 1 | 4.233 | 64.96 | 10.12 | D |
| 107.021-100.6 | | | B | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| 04 | | | C | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| | | | D | 1 | 0.785 | | 1 | 1 | 4.233 | | | |
| L16 | 1.30 | 31.63 | A | 1 | 0.677 | 18 | 1 | 1 | 1.663 | 21.86 | 10.09 | D |
| 100.604-98.43 | | | B | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| 7 | | | C | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| | | | D | 1 | 0.677 | | 1 | 1 | 1.663 | | | |
| L17 | 3.02 | 84.36 | A | 1 | 0.65 | 18 | 1 | 1 | 4.042 | 50.71 | 10.06 | D |
| 98.437-93.396 | | | B | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| | | | C | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| | | | D | 1 | 0.65 | | 1 | 1 | 4.042 | | | |
| L18 | 3.72 | 103.60 | A | 1 | 0.638 | 17 | 1 | 1 | 5.096 | 62.13 | 10.01 | D |
| 93.396-87.188 | | | B | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| | | | C | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| | | | D | 1 | 0.638 | | 1 | 1 | 5.096 | | | |
| L19 | 3.72 | 104.19 | A | 1 | 0.639 | 17 | 1 | 1 | 5.121 | 61.76 | 9.95 | D |
| 87.188-80.979 | | | B | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| | | | C | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| | | | D | 1 | 0.639 | | 1 | 1 | 5.121 | | | |
| L20 | 3.72 | 104.28 | A | 1 | 0.643 | 17 | 1 | 1 | 5.124 | 61.35 | 9.88 | D |
| 80.979-74.771 | | | B | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| | | | C | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| | | | D | 1 | 0.643 | | 1 | 1 | 5.124 | | | |
| L21 | 3.72 | 104.29 | A | 1 | 0.647 | 17 | 1 | 1 | 5.125 | 60.91 | 9.81 | D |
| 74.771-68.563 | | | B | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.647 | | 1 | 1 | 5.125 | | | |
| L22 | 3.72 | 104.29 | A | 1 | 0.653 | 16 | 1 | 1 | 5.125 | 60.42 | 9.73 | D |
| 68.563-62.354 | | | B | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.653 | | 1 | 1 | 5.125 | | | |
| L23 | 3.72 | 104.29 | A | 1 | 0.658 | 16 | 1 | 1 | 5.125 | 59.88 | 9.65 | D |
| 62.354-56.146 | | | B | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.658 | | 1 | 1 | 5.125 | | | |
| L24 | 3.72 | 104.29 | A | 1 | 0.665 | 16 | 1 | 1 | 5.125 | 59.28 | 9.55 | D |
| 56.146-49.938 | | | B | 1 | 0.665 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.665 | | 1 | 1 | 5.125 | | | |

| Section Elevation ft | Add Weight lb | Self Weight lb | Face | e | $C_F$ | $q_z$ psf | $D_F$ | $D_R$ | $A_E$ ft² | F lb | w plf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | D | 1 | 0.665 | | 1 | 1 | 5.125 | | | |
| L25 | 3.72 | 104.29 | A | 1 | 0.673 | 15 | 1 | 1 | 5.125 | 58.59 | 9.44 | D |
| 49.938-43.729 | | | B | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.673 | | 1 | 1 | 5.125 | | | |
| L26 | 3.72 | 104.29 | A | 1 | 0.682 | 15 | 1 | 1 | 5.125 | 57.81 | 9.31 | D |
| 43.729-37.521 | | | B | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.682 | | 1 | 1 | 5.125 | | | |
| L27 | 3.72 | 104.29 | A | 1 | 0.693 | 15 | 1 | 1 | 5.125 | 56.90 | 9.16 | D |
| 37.521-31.313 | | | B | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.693 | | 1 | 1 | 5.125 | | | |
| L28 | 3.72 | 104.29 | A | 1 | 0.707 | 14 | 1 | 1 | 5.125 | 55.80 | 8.99 | D |
| 31.313-25.105 | | | B | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.707 | | 1 | 1 | 5.125 | | | |
| L29 | 3.72 | 104.29 | A | 1 | 0.724 | 13 | 1 | 1 | 5.125 | 54.44 | 8.77 | D |
| 25.105-18.896 | | | B | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.724 | | 1 | 1 | 5.125 | | | |
| L30 | 3.72 | 104.29 | A | 1 | 0.749 | 12 | 1 | 1 | 5.125 | 52.65 | 8.48 | D |
| 18.896-12.688 | | | B | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.749 | | 1 | 1 | 5.125 | | | |
| L31 | 3.72 | 104.29 | A | 1 | 0.751 | 12 | 1 | 1 | 5.125 | 52.49 | 8.45 | D |
| 12.688-6.480 | | | B | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| | | | C | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| | | | D | 1 | 0.751 | | 1 | 1 | 5.125 | | | |
| L32 | 3.89 | 108.19 | A | 1 | 0.75 | 12 | 1 | 1 | 5.349 | 54.87 | 8.47 | D |
| 6.480-0.000 | | | B | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| | | | C | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| | | | D | 1 | 0.75 | | 1 | 1 | 5.349 | | | |
| Sum Weight: | 117.60 | 2930.86 | | | | | | | | 1950.43 | | |

## Mast Vectors - No Ice

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 197.688-190.438 | 0 | Wind Normal | 282.93 | 0.00 | -282.93 | -54905.19 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 282.93 | 200.06 | -200.06 | -38823.83 | -38823.83 | 0.00 |
| | | 90 | Wind Normal | 282.93 | 282.93 | 0.00 | 0.00 | -54905.19 | 0.00 |
| | | 135 | Wind 45 | 282.93 | 200.06 | 200.06 | 38823.83 | -38823.83 | 0.00 |
| | | 180 | Wind Normal | 282.93 | 0.00 | 282.93 | 54905.19 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 282.93 | -200.06 | 200.06 | 38823.83 | 38823.83 | 0.00 |
| | | 270 | Wind Normal | 282.93 | -282.93 | 0.00 | 0.00 | 54905.19 | 0.00 |
| | | 315 | Wind 45 | 282.93 | -200.06 | -200.06 | -38823.83 | 38823.83 | 0.00 |
| L2 | 190.438-184.021 | 0 | Wind Normal | 246.30 | 0.00 | -246.30 | -46110.43 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 246.30 | 174.16 | -174.16 | -32605.00 | -32605.00 | 0.00 |
| | | 90 | Wind Normal | 246.30 | 246.30 | 0.00 | 0.00 | -46110.43 | 0.00 |
| | | 135 | Wind 45 | 246.30 | 174.16 | 174.16 | 32605.00 | -32605.00 | 0.00 |
| | | 180 | Wind Normal | 246.30 | 0.00 | 246.30 | 46110.43 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 246.30 | -174.16 | 174.16 | 32605.00 | 32605.00 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 270 | Wind Normal | 246.30 | -246.30 | 0.00 | 0.00 | 46110.43 | 0.00 |
| | | 315 | Wind 45 | 246.30 | -174.16 | -174.16 | -32605.00 | 32605.00 | 0.00 |
| L3 | 184.021-177.604 | 0 | Wind Normal | 244.85 | 0.00 | -244.85 | -44267.76 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 244.85 | 173.14 | -173.14 | -31302.03 | -31302.03 | 0.00 |
| | | 90 | Wind Normal | 244.85 | 244.85 | 0.00 | 0.00 | -44267.76 | 0.00 |
| | | 135 | Wind 45 | 244.85 | 173.14 | 173.14 | 31302.03 | -31302.03 | 0.00 |
| | | 180 | Wind Normal | 244.85 | 0.00 | 244.85 | 44267.76 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 244.85 | -173.14 | 173.14 | 31302.03 | 31302.03 | 0.00 |
| | | 270 | Wind Normal | 244.85 | -244.85 | 0.00 | 0.00 | 44267.76 | 0.00 |
| | | 315 | Wind 45 | 244.85 | -173.14 | -173.14 | -31302.03 | 31302.03 | 0.00 |
| L4 | 177.604-171.187 | 0 | Wind Normal | 243.66 | 0.00 | -243.66 | -42488.74 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 243.66 | 172.29 | -172.29 | -30044.07 | -30044.07 | 0.00 |
| | | 90 | Wind Normal | 243.66 | 243.66 | 0.00 | 0.00 | -42488.74 | 0.00 |
| | | 135 | Wind 45 | 243.66 | 172.29 | 172.29 | 30044.07 | -30044.07 | 0.00 |
| | | 180 | Wind Normal | 243.66 | 0.00 | 243.66 | 42488.74 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 243.66 | -172.29 | 172.29 | 30044.07 | 30044.07 | 0.00 |
| | | 270 | Wind Normal | 243.66 | -243.66 | 0.00 | 0.00 | 42488.74 | 0.00 |
| | | 315 | Wind 45 | 243.66 | -172.29 | -172.29 | -30044.07 | 30044.07 | 0.00 |
| L5 | 171.187-164.771 | 0 | Wind Normal | 242.44 | 0.00 | -242.44 | -40720.83 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 242.44 | 171.43 | -171.43 | -28793.97 | -28793.97 | 0.00 |
| | | 90 | Wind Normal | 242.44 | 242.44 | 0.00 | 0.00 | -40720.83 | 0.00 |
| | | 135 | Wind 45 | 242.44 | 171.43 | 171.43 | 28793.97 | -28793.97 | 0.00 |
| | | 180 | Wind Normal | 242.44 | 0.00 | 242.44 | 40720.83 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 242.44 | -171.43 | 171.43 | 28793.97 | 28793.97 | 0.00 |
| | | 270 | Wind Normal | 242.44 | -242.44 | 0.00 | 0.00 | 40720.83 | 0.00 |
| | | 315 | Wind 45 | 242.44 | -171.43 | -171.43 | -28793.97 | 28793.97 | 0.00 |
| L6 | 164.771-158.354 | 0 | Wind Normal | 241.16 | 0.00 | -241.16 | -38958.64 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 241.16 | 170.53 | -170.53 | -27547.92 | -27547.92 | 0.00 |
| | | 90 | Wind Normal | 241.16 | 241.16 | 0.00 | 0.00 | -38958.64 | 0.00 |
| | | 135 | Wind 45 | 241.16 | 170.53 | 170.53 | 27547.92 | -27547.92 | 0.00 |
| | | 180 | Wind Normal | 241.16 | 0.00 | 241.16 | 38958.64 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 241.16 | -170.53 | 170.53 | 27547.92 | 27547.92 | 0.00 |
| | | 270 | Wind Normal | 241.16 | -241.16 | 0.00 | 0.00 | 38958.64 | 0.00 |
| | | 315 | Wind 45 | 241.16 | -170.53 | -170.53 | -27547.92 | 27547.92 | 0.00 |
| L7 | 158.354-151.937 | 0 | Wind Normal | 239.82 | 0.00 | -239.82 | -37202.03 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 239.82 | 169.58 | -169.58 | -26305.81 | -26305.81 | 0.00 |
| | | 90 | Wind Normal | 239.82 | 239.82 | 0.00 | 0.00 | -37202.03 | 0.00 |
| | | 135 | Wind 45 | 239.82 | 169.58 | 169.58 | 26305.81 | -26305.81 | 0.00 |
| | | 180 | Wind Normal | 239.82 | 0.00 | 239.82 | 37202.03 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 239.82 | -169.58 | 169.58 | 26305.81 | 26305.81 | 0.00 |
| | | 270 | Wind Normal | 239.82 | -239.82 | 0.00 | 0.00 | 37202.03 | 0.00 |
| | | 315 | Wind 45 | 239.82 | -169.58 | -169.58 | -26305.81 | 26305.81 | 0.00 |
| L8 | 151.937-145.521 | 0 | Wind Normal | 238.39 | 0.00 | -238.39 | -35451.48 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 238.39 | 168.57 | -168.57 | -25067.98 | -25067.98 | 0.00 |
| | | 90 | Wind Normal | 238.39 | 238.39 | 0.00 | 0.00 | -35451.48 | 0.00 |
| | | 135 | Wind 45 | 238.39 | 168.57 | 168.57 | 25067.98 | -25067.98 | 0.00 |
| | | 180 | Wind Normal | 238.39 | 0.00 | 238.39 | 35451.48 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 238.39 | -168.57 | 168.57 | 25067.98 | 25067.98 | 0.00 |
| | | 270 | Wind Normal | 238.39 | -238.39 | 0.00 | 0.00 | 35451.48 | 0.00 |
| | | 315 | Wind 45 | 238.39 | -168.57 | -168.57 | -25067.98 | 25067.98 | 0.00 |
| L9 | 145.521-139.104 | 0 | Wind Normal | 236.89 | 0.00 | -236.89 | -33707.55 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 236.89 | 167.50 | -167.50 | -23834.84 | -23834.84 | 0.00 |
| | | 90 | Wind Normal | 236.89 | 236.89 | 0.00 | 0.00 | -33707.55 | 0.00 |
| | | 135 | Wind 45 | 236.89 | 167.50 | 167.50 | 23834.84 | -23834.84 | 0.00 |
| | | 180 | Wind Normal | 236.89 | 0.00 | 236.89 | 33707.55 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 236.89 | -167.50 | 167.50 | 23834.84 | 23834.84 | 0.00 |
| | | 270 | Wind Normal | 236.89 | -236.89 | 0.00 | 0.00 | 33707.55 | 0.00 |
| | | 315 | Wind 45 | 236.89 | -167.50 | -167.50 | -23834.84 | 23834.84 | 0.00 |
| L10 | 139.104-132.687 | 0 | Wind Normal | 235.29 | 0.00 | -235.29 | -31970.91 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 235.29 | 166.38 | -166.38 | -22606.84 | -22606.84 | 0.00 |
| | | 90 | Wind Normal | 235.29 | 235.29 | 0.00 | 0.00 | -31970.91 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 135 | Wind 45 | 235.29 | 166.38 | 166.38 | 22606.84 | -22606.84 | 0.00 |
| | | 180 | Wind Normal | 235.29 | 0.00 | 235.29 | 31970.91 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 235.29 | -166.38 | 166.38 | 22606.84 | 22606.84 | 0.00 |
| | | 270 | Wind Normal | 235.29 | -235.29 | 0.00 | 0.00 | 31970.91 | 0.00 |
| | | 315 | Wind 45 | 235.29 | -166.38 | -166.38 | -22606.84 | 22606.84 | 0.00 |
| L11 | 132.687-126.271 | 0 | Wind Normal | 233.60 | 0.00 | -233.60 | -30242.24 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 233.60 | 165.18 | -165.18 | -21384.49 | -21384.49 | 0.00 |
| | | 90 | Wind Normal | 233.60 | 233.60 | 0.00 | 0.00 | -30242.24 | 0.00 |
| | | 135 | Wind 45 | 233.60 | 165.18 | 165.18 | 21384.49 | -21384.49 | 0.00 |
| | | 180 | Wind Normal | 233.60 | 0.00 | 233.60 | 30242.24 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 233.60 | -165.18 | 165.18 | 21384.49 | 21384.49 | 0.00 |
| | | 270 | Wind Normal | 233.60 | -233.60 | 0.00 | 0.00 | 30242.24 | 0.00 |
| | | 315 | Wind 45 | 233.60 | -165.18 | -165.18 | -21384.49 | 21384.49 | 0.00 |
| L12 | 126.271-119.854 | 0 | Wind Normal | 231.81 | 0.00 | -231.81 | -28522.32 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 231.81 | 163.91 | -163.91 | -20168.32 | -20168.32 | 0.00 |
| | | 90 | Wind Normal | 231.81 | 231.81 | 0.00 | 0.00 | -28522.32 | 0.00 |
| | | 135 | Wind 45 | 231.81 | 163.91 | 163.91 | 20168.32 | -20168.32 | 0.00 |
| | | 180 | Wind Normal | 231.81 | 0.00 | 231.81 | 28522.32 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 231.81 | -163.91 | 163.91 | 20168.32 | 20168.32 | 0.00 |
| | | 270 | Wind Normal | 231.81 | -231.81 | 0.00 | 0.00 | 28522.32 | 0.00 |
| | | 315 | Wind 45 | 231.81 | -163.91 | -163.91 | -20168.32 | 20168.32 | 0.00 |
| L13 | 119.854-113.437 | 0 | Wind Normal | 229.89 | 0.00 | -229.89 | -26811.99 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 229.89 | 162.56 | -162.56 | -18958.94 | -18958.94 | 0.00 |
| | | 90 | Wind Normal | 229.89 | 229.89 | 0.00 | 0.00 | -26811.99 | 0.00 |
| | | 135 | Wind 45 | 229.89 | 162.56 | 162.56 | 18958.94 | -18958.94 | 0.00 |
| | | 180 | Wind Normal | 229.89 | 0.00 | 229.89 | 26811.99 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 229.89 | -162.56 | 162.56 | 18958.94 | 18958.94 | 0.00 |
| | | 270 | Wind Normal | 229.89 | -229.89 | 0.00 | 0.00 | 26811.99 | 0.00 |
| | | 315 | Wind 45 | 229.89 | -162.56 | -162.56 | -18958.94 | 18958.94 | 0.00 |
| L14 | 113.437-107.021 | 0 | Wind Normal | 227.86 | 0.00 | -227.86 | -25112.18 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 227.86 | 161.12 | -161.12 | -17756.99 | -17756.99 | 0.00 |
| | | 90 | Wind Normal | 227.86 | 227.86 | 0.00 | 0.00 | -25112.18 | 0.00 |
| | | 135 | Wind 45 | 227.86 | 161.12 | 161.12 | 17756.99 | -17756.99 | 0.00 |
| | | 180 | Wind Normal | 227.86 | 0.00 | 227.86 | 25112.18 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 227.86 | -161.12 | 161.12 | 17756.99 | 17756.99 | 0.00 |
| | | 270 | Wind Normal | 227.86 | -227.86 | 0.00 | 0.00 | 25112.18 | 0.00 |
| | | 315 | Wind 45 | 227.86 | -161.12 | -161.12 | -17756.99 | 17756.99 | 0.00 |
| L15 | 107.021-100.604 | 0 | Wind Normal | 225.68 | 0.00 | -225.68 | -23423.93 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 225.68 | 159.58 | -159.58 | -16563.22 | -16563.22 | 0.00 |
| | | 90 | Wind Normal | 225.68 | 225.68 | 0.00 | 0.00 | -23423.93 | 0.00 |
| | | 135 | Wind 45 | 225.68 | 159.58 | 159.58 | 16563.22 | -16563.22 | 0.00 |
| | | 180 | Wind Normal | 225.68 | 0.00 | 225.68 | 23423.93 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 225.68 | -159.58 | 159.58 | 16563.22 | 16563.22 | 0.00 |
| | | 270 | Wind Normal | 225.68 | -225.68 | 0.00 | 0.00 | 23423.93 | 0.00 |
| | | 315 | Wind 45 | 225.68 | -159.58 | -159.58 | -16563.22 | 16563.22 | 0.00 |
| L16 | 100.604-98.437 | 0 | Wind Normal | 88.07 | 0.00 | -88.07 | -8761.93 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 88.07 | 62.27 | -62.27 | -6195.62 | -6195.62 | 0.00 |
| | | 90 | Wind Normal | 88.07 | 88.07 | 0.00 | 0.00 | -8761.93 | 0.00 |
| | | 135 | Wind 45 | 88.07 | 62.27 | 62.27 | 6195.62 | -6195.62 | 0.00 |
| | | 180 | Wind Normal | 88.07 | 0.00 | 88.07 | 8761.93 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 88.07 | -62.27 | 62.27 | 6195.62 | 6195.62 | 0.00 |
| | | 270 | Wind Normal | 88.07 | -88.07 | 0.00 | 0.00 | 8761.93 | 0.00 |
| | | 315 | Wind 45 | 88.07 | -62.27 | -62.27 | -6195.62 | 6195.62 | 0.00 |
| L17 | 98.437-93.396 | 0 | Wind Normal | 212.71 | 0.00 | -212.71 | -20394.18 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 212.71 | 150.41 | -150.41 | -14420.86 | -14420.86 | 0.00 |
| | | 90 | Wind Normal | 212.71 | 212.71 | 0.00 | 0.00 | -20394.18 | 0.00 |
| | | 135 | Wind 45 | 212.71 | 150.41 | 150.41 | 14420.86 | -14420.86 | 0.00 |
| | | 180 | Wind Normal | 212.71 | 0.00 | 212.71 | 20394.18 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 212.71 | -150.41 | 150.41 | 14420.86 | 14420.86 | 0.00 |
| | | 270 | Wind Normal | 212.71 | -212.71 | 0.00 | 0.00 | 20394.18 | 0.00 |
| | | 315 | Wind 45 | 212.71 | -150.41 | -150.41 | -14420.86 | 14420.86 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| L18 | 93.396-87.188 | 0 | Wind Normal | 265.54 | 0.00 | -265.54 | -23971.13 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 265.54 | 187.77 | -187.77 | -16950.15 | -16950.15 | 0.00 |
| | | 90 | Wind Normal | 265.54 | 265.54 | 0.00 | 0.00 | -23971.13 | 0.00 |
| | | 135 | Wind 45 | 265.54 | 187.77 | 187.77 | 16950.15 | -16950.15 | 0.00 |
| | | 180 | Wind Normal | 265.54 | 0.00 | 265.54 | 23971.13 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 265.54 | -187.77 | 187.77 | 16950.15 | 16950.15 | 0.00 |
| | | 270 | Wind Normal | 265.54 | -265.54 | 0.00 | 0.00 | 23971.13 | 0.00 |
| | | 315 | Wind 45 | 265.54 | -187.77 | -187.77 | -16950.15 | 16950.15 | 0.00 |
| L19 | 87.188-80.979 | 0 | Wind Normal | 263.62 | 0.00 | -263.62 | -22162.49 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 263.62 | 186.41 | -186.41 | -15671.25 | -15671.25 | 0.00 |
| | | 90 | Wind Normal | 263.62 | 263.62 | 0.00 | 0.00 | -22162.49 | 0.00 |
| | | 135 | Wind 45 | 263.62 | 186.41 | 186.41 | 15671.25 | -15671.25 | 0.00 |
| | | 180 | Wind Normal | 263.62 | 0.00 | 263.62 | 22162.49 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 263.62 | -186.41 | 186.41 | 15671.25 | 15671.25 | 0.00 |
| | | 270 | Wind Normal | 263.62 | -263.62 | 0.00 | 0.00 | 22162.49 | 0.00 |
| | | 315 | Wind 45 | 263.62 | -186.41 | -186.41 | -15671.25 | 15671.25 | 0.00 |
| L20 | 80.979-74.771 | 0 | Wind Normal | 260.35 | 0.00 | -260.35 | -20271.08 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 260.35 | 184.10 | -184.10 | -14333.82 | -14333.82 | 0.00 |
| | | 90 | Wind Normal | 260.35 | 260.35 | 0.00 | 0.00 | -20271.08 | 0.00 |
| | | 135 | Wind 45 | 260.35 | 184.10 | 184.10 | 14333.82 | -14333.82 | 0.00 |
| | | 180 | Wind Normal | 260.35 | 0.00 | 260.35 | 20271.08 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 260.35 | -184.10 | 184.10 | 14333.82 | 14333.82 | 0.00 |
| | | 270 | Wind Normal | 260.35 | -260.35 | 0.00 | 0.00 | 20271.08 | 0.00 |
| | | 315 | Wind 45 | 260.35 | -184.10 | -184.10 | -14333.82 | 14333.82 | 0.00 |
| L21 | 74.771-68.563 | 0 | Wind Normal | 256.62 | 0.00 | -256.62 | -18387.76 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 256.62 | 181.46 | -181.46 | -13002.11 | -13002.11 | 0.00 |
| | | 90 | Wind Normal | 256.62 | 256.62 | 0.00 | 0.00 | -18387.76 | 0.00 |
| | | 135 | Wind 45 | 256.62 | 181.46 | 181.46 | 13002.11 | -13002.11 | 0.00 |
| | | 180 | Wind Normal | 256.62 | 0.00 | 256.62 | 18387.76 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 256.62 | -181.46 | 181.46 | 13002.11 | 13002.11 | 0.00 |
| | | 270 | Wind Normal | 256.62 | -256.62 | 0.00 | 0.00 | 18387.76 | 0.00 |
| | | 315 | Wind 45 | 256.62 | -181.46 | -181.46 | -13002.11 | 13002.11 | 0.00 |
| L22 | 68.563-62.354 | 0 | Wind Normal | 252.53 | 0.00 | -252.53 | -16526.72 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 252.53 | 178.57 | -178.57 | -11686.15 | -11686.15 | 0.00 |
| | | 90 | Wind Normal | 252.53 | 252.53 | 0.00 | 0.00 | -16526.72 | 0.00 |
| | | 135 | Wind 45 | 252.53 | 178.57 | 178.57 | 11686.15 | -11686.15 | 0.00 |
| | | 180 | Wind Normal | 252.53 | 0.00 | 252.53 | 16526.72 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 252.53 | -178.57 | 178.57 | 11686.15 | 11686.15 | 0.00 |
| | | 270 | Wind Normal | 252.53 | -252.53 | 0.00 | 0.00 | 16526.72 | 0.00 |
| | | 315 | Wind 45 | 252.53 | -178.57 | -178.57 | -11686.15 | 11686.15 | 0.00 |
| L23 | 62.354-56.146 | 0 | Wind Normal | 248.03 | 0.00 | -248.03 | -14692.35 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 248.03 | 175.38 | -175.38 | -10389.06 | -10389.06 | 0.00 |
| | | 90 | Wind Normal | 248.03 | 248.03 | 0.00 | 0.00 | -14692.35 | 0.00 |
| | | 135 | Wind 45 | 248.03 | 175.38 | 175.38 | 10389.06 | -10389.06 | 0.00 |
| | | 180 | Wind Normal | 248.03 | 0.00 | 248.03 | 14692.35 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 248.03 | -175.38 | 175.38 | 10389.06 | 10389.06 | 0.00 |
| | | 270 | Wind Normal | 248.03 | -248.03 | 0.00 | 0.00 | 14692.35 | 0.00 |
| | | 315 | Wind 45 | 248.03 | -175.38 | -175.38 | -10389.06 | 10389.06 | 0.00 |
| L24 | 56.146-49.938 | 0 | Wind Normal | 243.05 | 0.00 | -243.05 | -12888.24 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 243.05 | 171.86 | -171.86 | -9113.36 | -9113.36 | 0.00 |
| | | 90 | Wind Normal | 243.05 | 243.05 | 0.00 | 0.00 | -12888.24 | 0.00 |
| | | 135 | Wind 45 | 243.05 | 171.86 | 171.86 | 9113.36 | -9113.36 | 0.00 |
| | | 180 | Wind Normal | 243.05 | 0.00 | 243.05 | 12888.24 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 243.05 | -171.86 | 171.86 | 9113.36 | 9113.36 | 0.00 |
| | | 270 | Wind Normal | 243.05 | -243.05 | 0.00 | 0.00 | 12888.24 | 0.00 |
| | | 315 | Wind 45 | 243.05 | -171.86 | -171.86 | -9113.36 | 9113.36 | 0.00 |
| L25 | 49.938-43.729 | 0 | Wind Normal | 237.47 | 0.00 | -237.47 | -11118.46 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 237.47 | 167.92 | -167.92 | -7861.94 | -7861.94 | 0.00 |
| | | 90 | Wind Normal | 237.47 | 237.47 | 0.00 | 0.00 | -11118.46 | 0.00 |
| | | 135 | Wind 45 | 237.47 | 167.92 | 167.92 | 7861.94 | -7861.94 | 0.00 |
| | | 180 | Wind Normal | 237.47 | 0.00 | 237.47 | 11118.46 | 0.00 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 225 | Wind 45 | 237.47 | -167.92 | 167.92 | 7861.94 | 7861.94 | 0.00 |
| | | 270 | Wind Normal | 237.47 | -237.47 | 0.00 | 0.00 | 11118.46 | 0.00 |
| | | 315 | Wind 45 | 237.47 | -167.92 | -167.92 | -7861.94 | 7861.94 | 0.00 |
| L26 | 43.729-37.521 | 0 | Wind Normal | 231.17 | 0.00 | -231.17 | -9388.03 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 231.17 | 163.46 | -163.46 | -6638.34 | -6638.34 | 0.00 |
| | | 90 | Wind Normal | 231.17 | 231.17 | 0.00 | 0.00 | -9388.03 | 0.00 |
| | | 135 | Wind 45 | 231.17 | 163.46 | 163.46 | 6638.34 | -6638.34 | 0.00 |
| | | 180 | Wind Normal | 231.17 | 0.00 | 231.17 | 9388.03 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 231.17 | -163.46 | 163.46 | 6638.34 | 6638.34 | 0.00 |
| | | 270 | Wind Normal | 231.17 | -231.17 | 0.00 | 0.00 | 9388.03 | 0.00 |
| | | 315 | Wind 45 | 231.17 | -163.46 | -163.46 | -6638.34 | 6638.34 | 0.00 |
| L27 | 37.521-31.313 | 0 | Wind Normal | 223.91 | 0.00 | -223.91 | -7703.31 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 223.91 | 158.33 | -158.33 | -5447.06 | -5447.06 | 0.00 |
| | | 90 | Wind Normal | 223.91 | 223.91 | 0.00 | 0.00 | -7703.31 | 0.00 |
| | | 135 | Wind 45 | 223.91 | 158.33 | 158.33 | 5447.06 | -5447.06 | 0.00 |
| | | 180 | Wind Normal | 223.91 | 0.00 | 223.91 | 7703.31 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 223.91 | -158.33 | 158.33 | 5447.06 | 5447.06 | 0.00 |
| | | 270 | Wind Normal | 223.91 | -223.91 | 0.00 | 0.00 | 7703.31 | 0.00 |
| | | 315 | Wind 45 | 223.91 | -158.33 | -158.33 | -5447.06 | 5447.06 | 0.00 |
| L28 | 31.313-25.105 | 0 | Wind Normal | 215.38 | 0.00 | -215.38 | -6072.67 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 215.38 | 152.30 | -152.30 | -4294.03 | -4294.03 | 0.00 |
| | | 90 | Wind Normal | 215.38 | 215.38 | 0.00 | 0.00 | -6072.67 | 0.00 |
| | | 135 | Wind 45 | 215.38 | 152.30 | 152.30 | 4294.03 | -4294.03 | 0.00 |
| | | 180 | Wind Normal | 215.38 | 0.00 | 215.38 | 6072.67 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 215.38 | -152.30 | 152.30 | 4294.03 | 4294.03 | 0.00 |
| | | 270 | Wind Normal | 215.38 | -215.38 | 0.00 | 0.00 | 6072.67 | 0.00 |
| | | 315 | Wind 45 | 215.38 | -152.30 | -152.30 | -4294.03 | 4294.03 | 0.00 |
| L29 | 25.105-18.896 | 0 | Wind Normal | 205.02 | 0.00 | -205.02 | -4507.73 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 205.02 | 144.97 | -144.97 | -3187.45 | -3187.45 | 0.00 |
| | | 90 | Wind Normal | 205.02 | 205.02 | 0.00 | 0.00 | -4507.73 | 0.00 |
| | | 135 | Wind 45 | 205.02 | 144.97 | 144.97 | 3187.45 | -3187.45 | 0.00 |
| | | 180 | Wind Normal | 205.02 | 0.00 | 205.02 | 4507.73 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 205.02 | -144.97 | 144.97 | 3187.45 | 3187.45 | 0.00 |
| | | 270 | Wind Normal | 205.02 | -205.02 | 0.00 | 0.00 | 4507.73 | 0.00 |
| | | 315 | Wind 45 | 205.02 | -144.97 | -144.97 | -3187.45 | 3187.45 | 0.00 |
| L30 | 18.896-12.688 | 0 | Wind Normal | 191.78 | 0.00 | -191.78 | -3025.93 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 191.78 | 135.61 | -135.61 | -2139.65 | -2139.65 | 0.00 |
| | | 90 | Wind Normal | 191.78 | 191.78 | 0.00 | 0.00 | -3025.93 | 0.00 |
| | | 135 | Wind 45 | 191.78 | 135.61 | 135.61 | 2139.65 | -2139.65 | 0.00 |
| | | 180 | Wind Normal | 191.78 | 0.00 | 191.78 | 3025.93 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 191.78 | -135.61 | 135.61 | 2139.65 | 2139.65 | 0.00 |
| | | 270 | Wind Normal | 191.78 | -191.78 | 0.00 | 0.00 | 3025.93 | 0.00 |
| | | 315 | Wind 45 | 191.78 | -135.61 | -135.61 | -2139.65 | 2139.65 | 0.00 |
| L31 | 12.688-6.480 | 0 | Wind Normal | 190.59 | 0.00 | -190.59 | -1823.87 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 190.59 | 134.76 | -134.76 | -1289.67 | -1289.67 | 0.00 |
| | | 90 | Wind Normal | 190.59 | 190.59 | 0.00 | 0.00 | -1823.87 | 0.00 |
| | | 135 | Wind 45 | 190.59 | 134.76 | 134.76 | 1289.67 | -1289.67 | 0.00 |
| | | 180 | Wind Normal | 190.59 | 0.00 | 190.59 | 1823.87 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 190.59 | -134.76 | 134.76 | 1289.67 | 1289.67 | 0.00 |
| | | 270 | Wind Normal | 190.59 | -190.59 | 0.00 | 0.00 | 1823.87 | 0.00 |
| | | 315 | Wind 45 | 190.59 | -134.76 | -134.76 | -1289.67 | 1289.67 | 0.00 |
| L32 | 6.480-0.000 | 0 | Wind Normal | 199.53 | 0.00 | -199.53 | -643.52 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 199.53 | 141.09 | -141.09 | -455.03 | -455.03 | 0.00 |
| | | 90 | Wind Normal | 199.53 | 199.53 | 0.00 | 0.00 | -643.52 | 0.00 |
| | | 135 | Wind 45 | 199.53 | 141.09 | 141.09 | 455.03 | -455.03 | 0.00 |
| | | 180 | Wind Normal | 199.53 | 0.00 | 199.53 | 643.52 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 199.53 | -141.09 | 141.09 | 455.03 | 455.03 | 0.00 |
| | | 270 | Wind Normal | 199.53 | -199.53 | 0.00 | 0.00 | 643.52 | 0.00 |
| | | 315 | Wind 45 | 199.53 | -141.09 | -141.09 | -455.03 | 455.03 | 0.00 |

## Mast Totals - No Ice

| Wind Azimuth ° | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|
| 0 | 0.00 | -7385.95 | -742235.59 | 0.00 | 0.00 |
| 45 | 5222.65 | -5222.65 | -524839.82 | -524839.82 | 0.00 |
| 90 | 7385.95 | 0.00 | 0.00 | -742235.59 | 0.00 |
| 135 | 5222.65 | 5222.65 | 524839.82 | -524839.82 | 0.00 |
| 180 | 0.00 | 7385.95 | 742235.59 | 0.00 | 0.00 |
| 225 | -5222.65 | 5222.65 | 524839.82 | 524839.82 | 0.00 |
| 270 | -7385.95 | 0.00 | 0.00 | 742235.59 | 0.00 |
| 315 | -5222.65 | -5222.65 | -524839.82 | 524839.82 | 0.00 |

## Mast Vectors - Service

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 197.688-190.438 | 0 | Wind Normal | 76.79 | 0.00 | -76.79 | -14901.16 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 76.79 | 54.30 | -54.30 | -10536.71 | -10536.71 | 0.00 |
| | | 90 | Wind Normal | 76.79 | 76.79 | 0.00 | 0.00 | -14901.16 | 0.00 |
| | | 135 | Wind 45 | 76.79 | 54.30 | 54.30 | 10536.71 | -10536.71 | 0.00 |
| | | 180 | Wind Normal | 76.79 | 0.00 | 76.79 | 14901.16 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 76.79 | -54.30 | 54.30 | 10536.71 | 10536.71 | 0.00 |
| | | 270 | Wind Normal | 76.79 | -76.79 | 0.00 | 0.00 | 14901.16 | 0.00 |
| | | 315 | Wind 45 | 76.79 | -54.30 | -54.30 | -10536.71 | 10536.71 | 0.00 |
| L2 | 190.438-184.021 | 0 | Wind Normal | 67.81 | 0.00 | -67.81 | -12694.54 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 67.81 | 47.95 | -47.95 | -8976.39 | -8976.39 | 0.00 |
| | | 90 | Wind Normal | 67.81 | 67.81 | 0.00 | 0.00 | -12694.54 | 0.00 |
| | | 135 | Wind 45 | 67.81 | 47.95 | 47.95 | 8976.39 | -8976.39 | 0.00 |
| | | 180 | Wind Normal | 67.81 | 0.00 | 67.81 | 12694.54 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 67.81 | -47.95 | 47.95 | 8976.39 | 8976.39 | 0.00 |
| | | 270 | Wind Normal | 67.81 | -67.81 | 0.00 | 0.00 | 12694.54 | 0.00 |
| | | 315 | Wind 45 | 67.81 | -47.95 | -47.95 | -8976.39 | 8976.39 | 0.00 |
| L3 | 184.021-177.604 | 0 | Wind Normal | 67.66 | 0.00 | -67.66 | -12232.01 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 67.66 | 47.84 | -47.84 | -8649.34 | -8649.34 | 0.00 |
| | | 90 | Wind Normal | 67.66 | 67.66 | 0.00 | 0.00 | -12232.01 | 0.00 |
| | | 135 | Wind 45 | 67.66 | 47.84 | 47.84 | 8649.34 | -8649.34 | 0.00 |
| | | 180 | Wind Normal | 67.66 | 0.00 | 67.66 | 12232.01 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 67.66 | -47.84 | 47.84 | 8649.34 | 8649.34 | 0.00 |
| | | 270 | Wind Normal | 67.66 | -67.66 | 0.00 | 0.00 | 12232.01 | 0.00 |
| | | 315 | Wind 45 | 67.66 | -47.84 | -47.84 | -8649.34 | 8649.34 | 0.00 |
| L4 | 177.604-171.187 | 0 | Wind Normal | 67.50 | 0.00 | -67.50 | -11770.09 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 67.50 | 47.73 | -47.73 | -8322.71 | -8322.71 | 0.00 |
| | | 90 | Wind Normal | 67.50 | 67.50 | 0.00 | 0.00 | -11770.09 | 0.00 |
| | | 135 | Wind 45 | 67.50 | 47.73 | 47.73 | 8322.71 | -8322.71 | 0.00 |
| | | 180 | Wind Normal | 67.50 | 0.00 | 67.50 | 11770.09 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 67.50 | -47.73 | 47.73 | 8322.71 | 8322.71 | 0.00 |
| | | 270 | Wind Normal | 67.50 | -67.50 | 0.00 | 0.00 | 11770.09 | 0.00 |
| | | 315 | Wind 45 | 67.50 | -47.73 | -47.73 | -8322.71 | 8322.71 | 0.00 |
| L5 | 171.187-164.771 | 0 | Wind Normal | 67.33 | 0.00 | -67.33 | -11308.74 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 67.33 | 47.61 | -47.61 | -7996.48 | -7996.48 | 0.00 |
| | | 90 | Wind Normal | 67.33 | 67.33 | 0.00 | 0.00 | -11308.74 | 0.00 |
| | | 135 | Wind 45 | 67.33 | 47.61 | 47.61 | 7996.48 | -7996.48 | 0.00 |
| | | 180 | Wind Normal | 67.33 | 0.00 | 67.33 | 11308.74 | 0.00 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 225 | Wind 45 | 67.33 | -47.61 | 47.61 | 7996.48 | 7996.48 | 0.00 |
| | | 270 | Wind Normal | 67.33 | -67.33 | 0.00 | 0.00 | 11308.74 | 0.00 |
| | | 315 | Wind 45 | 67.33 | -47.61 | -47.61 | -7996.48 | 7996.48 | 0.00 |
| L6 | 164.771-158.354 | 0 | Wind Normal | 67.15 | 0.00 | -67.15 | -10848.00 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 67.15 | 47.48 | -47.48 | -7670.70 | -7670.70 | 0.00 |
| | | 90 | Wind Normal | 67.15 | 67.15 | 0.00 | 0.00 | -10848.00 | 0.00 |
| | | 135 | Wind 45 | 67.15 | 47.48 | 47.48 | 7670.70 | -7670.70 | 0.00 |
| | | 180 | Wind Normal | 67.15 | 0.00 | 67.15 | 10848.00 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 67.15 | -47.48 | 47.48 | 7670.70 | 7670.70 | 0.00 |
| | | 270 | Wind Normal | 67.15 | -67.15 | 0.00 | 0.00 | 10848.00 | 0.00 |
| | | 315 | Wind 45 | 67.15 | -47.48 | -47.48 | -7670.70 | 7670.70 | 0.00 |
| L7 | 158.354-151.937 | 0 | Wind Normal | 66.96 | 0.00 | -66.96 | -10387.96 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 66.96 | 47.35 | -47.35 | -7345.39 | -7345.39 | 0.00 |
| | | 90 | Wind Normal | 66.96 | 66.96 | 0.00 | 0.00 | -10387.96 | 0.00 |
| | | 135 | Wind 45 | 66.96 | 47.35 | 47.35 | 7345.39 | -7345.39 | 0.00 |
| | | 180 | Wind Normal | 66.96 | 0.00 | 66.96 | 10387.96 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 66.96 | -47.35 | 47.35 | 7345.39 | 7345.39 | 0.00 |
| | | 270 | Wind Normal | 66.96 | -66.96 | 0.00 | 0.00 | 10387.96 | 0.00 |
| | | 315 | Wind 45 | 66.96 | -47.35 | -47.35 | -7345.39 | 7345.39 | 0.00 |
| L8 | 151.937-145.521 | 0 | Wind Normal | 66.76 | 0.00 | -66.76 | -9928.66 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 66.76 | 47.21 | -47.21 | -7020.63 | -7020.63 | 0.00 |
| | | 90 | Wind Normal | 66.76 | 66.76 | 0.00 | 0.00 | -9928.66 | 0.00 |
| | | 135 | Wind 45 | 66.76 | 47.21 | 47.21 | 7020.63 | -7020.63 | 0.00 |
| | | 180 | Wind Normal | 66.76 | 0.00 | 66.76 | 9928.66 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 66.76 | -47.21 | 47.21 | 7020.63 | 7020.63 | 0.00 |
| | | 270 | Wind Normal | 66.76 | -66.76 | 0.00 | 0.00 | 9928.66 | 0.00 |
| | | 315 | Wind 45 | 66.76 | -47.21 | -47.21 | -7020.63 | 7020.63 | 0.00 |
| L9 | 145.521-139.104 | 0 | Wind Normal | 66.55 | 0.00 | -66.55 | -9470.21 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 66.55 | 47.06 | -47.06 | -6696.45 | -6696.45 | 0.00 |
| | | 90 | Wind Normal | 66.55 | 66.55 | 0.00 | 0.00 | -9470.21 | 0.00 |
| | | 135 | Wind 45 | 66.55 | 47.06 | 47.06 | 6696.45 | -6696.45 | 0.00 |
| | | 180 | Wind Normal | 66.55 | 0.00 | 66.55 | 9470.21 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 66.55 | -47.06 | 47.06 | 6696.45 | 6696.45 | 0.00 |
| | | 270 | Wind Normal | 66.55 | -66.55 | 0.00 | 0.00 | 9470.21 | 0.00 |
| | | 315 | Wind 45 | 66.55 | -47.06 | -47.06 | -6696.45 | 6696.45 | 0.00 |
| L10 | 139.104-132.687 | 0 | Wind Normal | 66.33 | 0.00 | -66.33 | -9012.67 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 66.33 | 46.90 | -46.90 | -6372.92 | -6372.92 | 0.00 |
| | | 90 | Wind Normal | 66.33 | 66.33 | 0.00 | 0.00 | -9012.67 | 0.00 |
| | | 135 | Wind 45 | 66.33 | 46.90 | 46.90 | 6372.92 | -6372.92 | 0.00 |
| | | 180 | Wind Normal | 66.33 | 0.00 | 66.33 | 9012.67 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 66.33 | -46.90 | 46.90 | 6372.92 | 6372.92 | 0.00 |
| | | 270 | Wind Normal | 66.33 | -66.33 | 0.00 | 0.00 | 9012.67 | 0.00 |
| | | 315 | Wind 45 | 66.33 | -46.90 | -46.90 | -6372.92 | 6372.92 | 0.00 |
| L11 | 132.687-126.271 | 0 | Wind Normal | 66.09 | 0.00 | -66.09 | -8556.15 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 66.09 | 46.73 | -46.73 | -6050.11 | -6050.11 | 0.00 |
| | | 90 | Wind Normal | 66.09 | 66.09 | 0.00 | 0.00 | -8556.15 | 0.00 |
| | | 135 | Wind 45 | 66.09 | 46.73 | 46.73 | 6050.11 | -6050.11 | 0.00 |
| | | 180 | Wind Normal | 66.09 | 0.00 | 66.09 | 8556.15 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 66.09 | -46.73 | 46.73 | 6050.11 | 6050.11 | 0.00 |
| | | 270 | Wind Normal | 66.09 | -66.09 | 0.00 | 0.00 | 8556.15 | 0.00 |
| | | 315 | Wind 45 | 66.09 | -46.73 | -46.73 | -6050.11 | 6050.11 | 0.00 |
| L12 | 126.271-119.854 | 0 | Wind Normal | 65.84 | 0.00 | -65.84 | -8100.75 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 65.84 | 46.55 | -46.55 | -5728.10 | -5728.10 | 0.00 |
| | | 90 | Wind Normal | 65.84 | 65.84 | 0.00 | 0.00 | -8100.75 | 0.00 |
| | | 135 | Wind 45 | 65.84 | 46.55 | 46.55 | 5728.10 | -5728.10 | 0.00 |
| | | 180 | Wind Normal | 65.84 | 0.00 | 65.84 | 8100.75 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 65.84 | -46.55 | 46.55 | 5728.10 | 5728.10 | 0.00 |
| | | 270 | Wind Normal | 65.84 | -65.84 | 0.00 | 0.00 | 8100.75 | 0.00 |
| | | 315 | Wind 45 | 65.84 | -46.55 | -46.55 | -5728.10 | 5728.10 | 0.00 |
| L13 | 119.854-113.437 | 0 | Wind Normal | 65.56 | 0.00 | -65.56 | -7646.58 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 65.56 | 46.36 | -46.36 | -5406.95 | -5406.95 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 90 | Wind Normal | 65.56 | 65.56 | 0.00 | 0.00 | -7646.58 | 0.00 |
| | | 135 | Wind 45 | 65.56 | 46.36 | 46.36 | 5406.95 | -5406.95 | 0.00 |
| | | 180 | Wind Normal | 65.56 | 0.00 | 65.56 | 7646.58 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 65.56 | -46.36 | 46.36 | 5406.95 | 5406.95 | 0.00 |
| | | 270 | Wind Normal | 65.56 | -65.56 | 0.00 | 0.00 | 7646.58 | 0.00 |
| | | 315 | Wind 45 | 65.56 | -46.36 | -46.36 | -5406.95 | 5406.95 | 0.00 |
| L14 | 113.437-107.021 | 0 | Wind Normal | 65.27 | 0.00 | -65.27 | -7193.77 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 65.27 | 46.15 | -46.15 | -5086.77 | -5086.77 | 0.00 |
| | | 90 | Wind Normal | 65.27 | 65.27 | 0.00 | 0.00 | -7193.77 | 0.00 |
| | | 135 | Wind 45 | 65.27 | 46.15 | 46.15 | 5086.77 | -5086.77 | 0.00 |
| | | 180 | Wind Normal | 65.27 | 0.00 | 65.27 | 7193.77 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 65.27 | -46.15 | 46.15 | 5086.77 | 5086.77 | 0.00 |
| | | 270 | Wind Normal | 65.27 | -65.27 | 0.00 | 0.00 | 7193.77 | 0.00 |
| | | 315 | Wind 45 | 65.27 | -46.15 | -46.15 | -5086.77 | 5086.77 | 0.00 |
| L15 | 107.021-100.604 | 0 | Wind Normal | 64.96 | 0.00 | -64.96 | -6742.47 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 64.96 | 45.93 | -45.93 | -4767.64 | -4767.64 | 0.00 |
| | | 90 | Wind Normal | 64.96 | 64.96 | 0.00 | 0.00 | -6742.47 | 0.00 |
| | | 135 | Wind 45 | 64.96 | 45.93 | 45.93 | 4767.64 | -4767.64 | 0.00 |
| | | 180 | Wind Normal | 64.96 | 0.00 | 64.96 | 6742.47 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 64.96 | -45.93 | 45.93 | 4767.64 | 4767.64 | 0.00 |
| | | 270 | Wind Normal | 64.96 | -64.96 | 0.00 | 0.00 | 6742.47 | 0.00 |
| | | 315 | Wind 45 | 64.96 | -45.93 | -45.93 | -4767.64 | 4767.64 | 0.00 |
| L16 | 100.604-98.437 | 0 | Wind Normal | 21.86 | 0.00 | -21.86 | -2174.72 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 21.86 | 15.46 | -15.46 | -1537.76 | -1537.76 | 0.00 |
| | | 90 | Wind Normal | 21.86 | 21.86 | 0.00 | 0.00 | -2174.72 | 0.00 |
| | | 135 | Wind 45 | 21.86 | 15.46 | 15.46 | 1537.76 | -1537.76 | 0.00 |
| | | 180 | Wind Normal | 21.86 | 0.00 | 21.86 | 2174.72 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 21.86 | -15.46 | 15.46 | 1537.76 | 1537.76 | 0.00 |
| | | 270 | Wind Normal | 21.86 | -21.86 | 0.00 | 0.00 | 2174.72 | 0.00 |
| | | 315 | Wind 45 | 21.86 | -15.46 | -15.46 | -1537.76 | 1537.76 | 0.00 |
| L17 | 98.437-93.396 | 0 | Wind Normal | 50.71 | 0.00 | -50.71 | -4862.06 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 50.71 | 35.86 | -35.86 | -3438.00 | -3438.00 | 0.00 |
| | | 90 | Wind Normal | 50.71 | 50.71 | 0.00 | 0.00 | -4862.06 | 0.00 |
| | | 135 | Wind 45 | 50.71 | 35.86 | 35.86 | 3438.00 | -3438.00 | 0.00 |
| | | 180 | Wind Normal | 50.71 | 0.00 | 50.71 | 4862.06 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 50.71 | -35.86 | 35.86 | 3438.00 | 3438.00 | 0.00 |
| | | 270 | Wind Normal | 50.71 | -50.71 | 0.00 | 0.00 | 4862.06 | 0.00 |
| | | 315 | Wind 45 | 50.71 | -35.86 | -35.86 | -3438.00 | 3438.00 | 0.00 |
| L18 | 93.396-87.188 | 0 | Wind Normal | 62.13 | 0.00 | -62.13 | -5608.79 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 62.13 | 43.93 | -43.93 | -3966.01 | -3966.01 | 0.00 |
| | | 90 | Wind Normal | 62.13 | 62.13 | 0.00 | 0.00 | -5608.79 | 0.00 |
| | | 135 | Wind 45 | 62.13 | 43.93 | 43.93 | 3966.01 | -3966.01 | 0.00 |
| | | 180 | Wind Normal | 62.13 | 0.00 | 62.13 | 5608.79 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 62.13 | -43.93 | 43.93 | 3966.01 | 3966.01 | 0.00 |
| | | 270 | Wind Normal | 62.13 | -62.13 | 0.00 | 0.00 | 5608.79 | 0.00 |
| | | 315 | Wind 45 | 62.13 | -43.93 | -43.93 | -3966.01 | 3966.01 | 0.00 |
| L19 | 87.188-80.979 | 0 | Wind Normal | 61.76 | 0.00 | -61.76 | -5192.03 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 61.76 | 43.67 | -43.67 | -3671.32 | -3671.32 | 0.00 |
| | | 90 | Wind Normal | 61.76 | 61.76 | 0.00 | 0.00 | -5192.03 | 0.00 |
| | | 135 | Wind 45 | 61.76 | 43.67 | 43.67 | 3671.32 | -3671.32 | 0.00 |
| | | 180 | Wind Normal | 61.76 | 0.00 | 61.76 | 5192.03 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 61.76 | -43.67 | 43.67 | 3671.32 | 3671.32 | 0.00 |
| | | 270 | Wind Normal | 61.76 | -61.76 | 0.00 | 0.00 | 5192.03 | 0.00 |
| | | 315 | Wind 45 | 61.76 | -43.67 | -43.67 | -3671.32 | 3671.32 | 0.00 |
| L20 | 80.979-74.771 | 0 | Wind Normal | 61.35 | 0.00 | -61.35 | -4777.06 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 61.35 | 43.38 | -43.38 | -3377.89 | -3377.89 | 0.00 |
| | | 90 | Wind Normal | 61.35 | 61.35 | 0.00 | 0.00 | -4777.06 | 0.00 |
| | | 135 | Wind 45 | 61.35 | 43.38 | 43.38 | 3377.89 | -3377.89 | 0.00 |
| | | 180 | Wind Normal | 61.35 | 0.00 | 61.35 | 4777.06 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 61.35 | -43.38 | 43.38 | 3377.89 | 3377.89 | 0.00 |
| | | 270 | Wind Normal | 61.35 | -61.35 | 0.00 | 0.00 | 4777.06 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 315 | Wind 45 | 61.35 | -43.38 | -43.38 | -3377.89 | 3377.89 | 0.00 |
| L21 | 74.771-68.563 | 0 | Wind Normal | 60.91 | 0.00 | -60.91 | -4364.37 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 60.91 | 43.07 | -43.07 | -3086.08 | -3086.08 | 0.00 |
| | | 90 | Wind Normal | 60.91 | 60.91 | 0.00 | 0.00 | -4364.37 | 0.00 |
| | | 135 | Wind 45 | 60.91 | 43.07 | 43.07 | 3086.08 | -3086.08 | 0.00 |
| | | 180 | Wind Normal | 60.91 | 0.00 | 60.91 | 4364.37 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 60.91 | -43.07 | 43.07 | 3086.08 | 3086.08 | 0.00 |
| | | 270 | Wind Normal | 60.91 | -60.91 | 0.00 | 0.00 | 4364.37 | 0.00 |
| | | 315 | Wind 45 | 60.91 | -43.07 | -43.07 | -3086.08 | 3086.08 | 0.00 |
| L22 | 68.563-62.354 | 0 | Wind Normal | 60.42 | 0.00 | -60.42 | -3954.28 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 60.42 | 42.72 | -42.72 | -2796.10 | -2796.10 | 0.00 |
| | | 90 | Wind Normal | 60.42 | 60.42 | 0.00 | 0.00 | -3954.28 | 0.00 |
| | | 135 | Wind 45 | 60.42 | 42.72 | 42.72 | 2796.10 | -2796.10 | 0.00 |
| | | 180 | Wind Normal | 60.42 | 0.00 | 60.42 | 3954.28 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 60.42 | -42.72 | 42.72 | 2796.10 | 2796.10 | 0.00 |
| | | 270 | Wind Normal | 60.42 | -60.42 | 0.00 | 0.00 | 3954.28 | 0.00 |
| | | 315 | Wind 45 | 60.42 | -42.72 | -42.72 | -2796.10 | 2796.10 | 0.00 |
| L23 | 62.354-56.146 | 0 | Wind Normal | 59.88 | 0.00 | -59.88 | -3547.13 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 59.88 | 42.34 | -42.34 | -2508.20 | -2508.20 | 0.00 |
| | | 90 | Wind Normal | 59.88 | 59.88 | 0.00 | 0.00 | -3547.13 | 0.00 |
| | | 135 | Wind 45 | 59.88 | 42.34 | 42.34 | 2508.20 | -2508.20 | 0.00 |
| | | 180 | Wind Normal | 59.88 | 0.00 | 59.88 | 3547.13 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 59.88 | -42.34 | 42.34 | 2508.20 | 2508.20 | 0.00 |
| | | 270 | Wind Normal | 59.88 | -59.88 | 0.00 | 0.00 | 3547.13 | 0.00 |
| | | 315 | Wind 45 | 59.88 | -42.34 | -42.34 | -2508.20 | 2508.20 | 0.00 |
| L24 | 56.146-49.938 | 0 | Wind Normal | 59.28 | 0.00 | -59.28 | -3143.30 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 59.28 | 41.91 | -41.91 | -2222.65 | -2222.65 | 0.00 |
| | | 90 | Wind Normal | 59.28 | 59.28 | 0.00 | 0.00 | -3143.30 | 0.00 |
| | | 135 | Wind 45 | 59.28 | 41.91 | 41.91 | 2222.65 | -2222.65 | 0.00 |
| | | 180 | Wind Normal | 59.28 | 0.00 | 59.28 | 3143.30 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 59.28 | -41.91 | 41.91 | 2222.65 | 2222.65 | 0.00 |
| | | 270 | Wind Normal | 59.28 | -59.28 | 0.00 | 0.00 | 3143.30 | 0.00 |
| | | 315 | Wind 45 | 59.28 | -41.91 | -41.91 | -2222.65 | 2222.65 | 0.00 |
| L25 | 49.938-43.729 | 0 | Wind Normal | 58.59 | 0.00 | -58.59 | -2743.30 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 58.59 | 41.43 | -41.43 | -1939.81 | -1939.81 | 0.00 |
| | | 90 | Wind Normal | 58.59 | 58.59 | 0.00 | 0.00 | -2743.30 | 0.00 |
| | | 135 | Wind 45 | 58.59 | 41.43 | 41.43 | 1939.81 | -1939.81 | 0.00 |
| | | 180 | Wind Normal | 58.59 | 0.00 | 58.59 | 2743.30 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 58.59 | -41.43 | 41.43 | 1939.81 | 1939.81 | 0.00 |
| | | 270 | Wind Normal | 58.59 | -58.59 | 0.00 | 0.00 | 2743.30 | 0.00 |
| | | 315 | Wind 45 | 58.59 | -41.43 | -41.43 | -1939.81 | 1939.81 | 0.00 |
| L26 | 43.729-37.521 | 0 | Wind Normal | 57.81 | 0.00 | -57.81 | -2347.73 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 57.81 | 40.88 | -40.88 | -1660.10 | -1660.10 | 0.00 |
| | | 90 | Wind Normal | 57.81 | 57.81 | 0.00 | 0.00 | -2347.73 | 0.00 |
| | | 135 | Wind 45 | 57.81 | 40.88 | 40.88 | 1660.10 | -1660.10 | 0.00 |
| | | 180 | Wind Normal | 57.81 | 0.00 | 57.81 | 2347.73 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 57.81 | -40.88 | 40.88 | 1660.10 | 1660.10 | 0.00 |
| | | 270 | Wind Normal | 57.81 | -57.81 | 0.00 | 0.00 | 2347.73 | 0.00 |
| | | 315 | Wind 45 | 57.81 | -40.88 | -40.88 | -1660.10 | 1660.10 | 0.00 |
| L27 | 37.521-31.313 | 0 | Wind Normal | 56.90 | 0.00 | -56.90 | -1957.38 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 56.90 | 40.23 | -40.23 | -1384.07 | -1384.07 | 0.00 |
| | | 90 | Wind Normal | 56.90 | 56.90 | 0.00 | 0.00 | -1957.38 | 0.00 |
| | | 135 | Wind 45 | 56.90 | 40.23 | 40.23 | 1384.07 | -1384.07 | 0.00 |
| | | 180 | Wind Normal | 56.90 | 0.00 | 56.90 | 1957.38 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 56.90 | -40.23 | 40.23 | 1384.07 | 1384.07 | 0.00 |
| | | 270 | Wind Normal | 56.90 | -56.90 | 0.00 | 0.00 | 1957.38 | 0.00 |
| | | 315 | Wind 45 | 56.90 | -40.23 | -40.23 | -1384.07 | 1384.07 | 0.00 |
| L28 | 31.313-25.105 | 0 | Wind Normal | 55.80 | 0.00 | -55.80 | -1573.30 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 55.80 | 39.46 | -39.46 | -1112.49 | -1112.49 | 0.00 |
| | | 90 | Wind Normal | 55.80 | 55.80 | 0.00 | 0.00 | -1573.30 | 0.00 |
| | | 135 | Wind 45 | 55.80 | 39.46 | 39.46 | 1112.49 | -1112.49 | 0.00 |

| Section No. | Section Elevation ft | Wind Azimuth ° | Directionality | F lb | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|---|---|---|
| | | 180 | Wind Normal | 55.80 | 0.00 | 55.80 | 1573.30 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 55.80 | -39.46 | 39.46 | 1112.49 | 1112.49 | 0.00 |
| | | 270 | Wind Normal | 55.80 | -55.80 | 0.00 | 0.00 | 1573.30 | 0.00 |
| | | 315 | Wind 45 | 55.80 | -39.46 | -39.46 | -1112.49 | 1112.49 | 0.00 |
| L29 | 25.105-18.896 | 0 | Wind Normal | 54.44 | 0.00 | -54.44 | -1197.00 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 54.44 | 38.50 | -38.50 | -846.41 | -846.41 | 0.00 |
| | | 90 | Wind Normal | 54.44 | 54.44 | 0.00 | 0.00 | -1197.00 | 0.00 |
| | | 135 | Wind 45 | 54.44 | 38.50 | 38.50 | 846.41 | -846.41 | 0.00 |
| | | 180 | Wind Normal | 54.44 | 0.00 | 54.44 | 1197.00 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 54.44 | -38.50 | 38.50 | 846.41 | 846.41 | 0.00 |
| | | 270 | Wind Normal | 54.44 | -54.44 | 0.00 | 0.00 | 1197.00 | 0.00 |
| | | 315 | Wind 45 | 54.44 | -38.50 | -38.50 | -846.41 | 846.41 | 0.00 |
| L30 | 18.896-12.688 | 0 | Wind Normal | 52.65 | 0.00 | -52.65 | -830.80 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 52.65 | 37.23 | -37.23 | -587.46 | -587.46 | 0.00 |
| | | 90 | Wind Normal | 52.65 | 52.65 | 0.00 | 0.00 | -830.80 | 0.00 |
| | | 135 | Wind 45 | 52.65 | 37.23 | 37.23 | 587.46 | -587.46 | 0.00 |
| | | 180 | Wind Normal | 52.65 | 0.00 | 52.65 | 830.80 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 52.65 | -37.23 | 37.23 | 587.46 | 587.46 | 0.00 |
| | | 270 | Wind Normal | 52.65 | -52.65 | 0.00 | 0.00 | 830.80 | 0.00 |
| | | 315 | Wind 45 | 52.65 | -37.23 | -37.23 | -587.46 | 587.46 | 0.00 |
| L31 | 12.688-6.480 | 0 | Wind Normal | 52.49 | 0.00 | -52.49 | -502.33 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 52.49 | 37.12 | -37.12 | -355.20 | -355.20 | 0.00 |
| | | 90 | Wind Normal | 52.49 | 52.49 | 0.00 | 0.00 | -502.33 | 0.00 |
| | | 135 | Wind 45 | 52.49 | 37.12 | 37.12 | 355.20 | -355.20 | 0.00 |
| | | 180 | Wind Normal | 52.49 | 0.00 | 52.49 | 502.33 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 52.49 | -37.12 | 37.12 | 355.20 | 355.20 | 0.00 |
| | | 270 | Wind Normal | 52.49 | -52.49 | 0.00 | 0.00 | 502.33 | 0.00 |
| | | 315 | Wind 45 | 52.49 | -37.12 | -37.12 | -355.20 | 355.20 | 0.00 |
| L32 | 6.480-0.000 | 0 | Wind Normal | 54.87 | 0.00 | -54.87 | -176.97 | 0.00 | 0.00 |
| | | 45 | Wind 45 | 54.87 | 38.80 | -38.80 | -125.14 | -125.14 | 0.00 |
| | | 90 | Wind Normal | 54.87 | 54.87 | 0.00 | 0.00 | -176.97 | 0.00 |
| | | 135 | Wind 45 | 54.87 | 38.80 | 38.80 | 125.14 | -125.14 | 0.00 |
| | | 180 | Wind Normal | 54.87 | 0.00 | 54.87 | 176.97 | 0.00 | 0.00 |
| | | 225 | Wind 45 | 54.87 | -38.80 | 38.80 | 125.14 | 125.14 | 0.00 |
| | | 270 | Wind Normal | 54.87 | -54.87 | 0.00 | 0.00 | 176.97 | 0.00 |
| | | 315 | Wind 45 | 54.87 | -38.80 | -38.80 | -125.14 | 125.14 | 0.00 |

## Mast Totals - Service

| Wind Azimuth ° | $V_x$ lb | $V_z$ lb | $OTM_x$ lb-ft | $OTM_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|
| 0 | 0.00 | -1950.43 | -199746.33 | 0.00 | 0.00 |
| 45 | 1379.16 | -1379.16 | -141241.98 | -141241.98 | 0.00 |
| 90 | 1950.43 | 0.00 | 0.00 | -199746.33 | 0.00 |
| 135 | 1379.16 | 1379.16 | 141241.98 | -141241.98 | 0.00 |
| 180 | 0.00 | 1950.43 | 199746.33 | 0.00 | 0.00 |
| 225 | -1379.16 | 1379.16 | 141241.98 | 141241.98 | 0.00 |
| 270 | -1950.43 | 0.00 | 0.00 | 199746.33 | 0.00 |
| 315 | -1379.16 | -1379.16 | -141241.98 | 141241.98 | 0.00 |

## Force Totals (Does not include forces on guys)

| Load Case | Vertical Forces lb | Sum of Forces X lb | Sum of Forces Z lb | Sum of Torques lb-ft |
|---|---|---|---|---|
| Leg Weight | 2930.86 | | | |
| Bracing Weight | 0.00 | | | |
| Total Member Self-Weight | 2930.86 | | | |
| Guy Weight | 808.96 | | | |
| Total Weight | 4089.77 | | | |
| Wind 0 deg - No Ice | | 0.00 | -9115.23 | 181.00 |
| Wind 45 deg - No Ice | | 6718.27 | -6718.27 | 252.87 |
| Wind 90 deg - No Ice | | 9115.23 | 0.00 | 160.82 |
| Wind 135 deg - No Ice | | 6172.62 | 6172.62 | -14.27 |
| Wind 180 deg - No Ice | | 0.00 | 9115.23 | -181.00 |
| Wind 225 deg - No Ice | | -6718.27 | 6718.27 | -252.87 |
| Wind 270 deg - No Ice | | -9115.23 | 0.00 | -160.82 |
| Wind 315 deg - No Ice | | -6172.62 | -6172.62 | 14.27 |
| Total Weight | 4089.77 | | | |
| Wind 0 deg - Service | | 0.00 | -2330.88 | 39.82 |
| Wind 45 deg - Service | | 1708.20 | -1708.20 | 55.63 |
| Wind 90 deg - Service | | 2330.88 | 0.00 | 35.38 |
| Wind 135 deg - Service | | 1588.16 | 1588.16 | -3.14 |
| Wind 180 deg - Service | | 0.00 | 2330.88 | -39.82 |
| Wind 225 deg - Service | | -1708.20 | 1708.20 | -55.63 |
| Wind 270 deg - Service | | -2330.88 | 0.00 | -35.38 |
| Wind 315 deg - Service | | -1588.16 | -1588.16 | 3.14 |
| Seismic Vertical | 834.47 | | | |
| Seismic Horizontal 0 deg | | 0.00 | -1301.39 | 0.00 |
| Seismic Horizontal 45 deg | | 920.22 | -920.22 | 0.00 |
| Seismic Horizontal 90 deg | | 1301.39 | 0.00 | 0.00 |
| Seismic Horizontal 135 deg | | 920.22 | 920.22 | 0.00 |
| Seismic Horizontal 180 deg | | 0.00 | 1301.39 | 0.00 |
| Seismic Horizontal 225 deg | | -920.22 | 920.22 | 0.00 |
| Seismic Horizontal 270 deg | | -1301.39 | 0.00 | 0.00 |
| Seismic Horizontal 315 deg | | -920.22 | -920.22 | 0.00 |

# Load Combinations

| Comb. No. | Description |
|---|---|
| 1 | Dead Only |
| 2 | 1.2 Dead+1.0 Wind 0 deg - No Ice+1.0 Guy |
| 3 | 1.2 Dead+1.0 Wind 45 deg - No Ice+1.0 Guy |
| 4 | 1.2 Dead+1.0 Wind 90 deg - No Ice+1.0 Guy |
| 5 | 1.2 Dead+1.0 Wind 135 deg - No Ice+1.0 Guy |
| 6 | 1.2 Dead+1.0 Wind 180 deg - No Ice+1.0 Guy |
| 7 | 1.2 Dead+1.0 Wind 225 deg - No Ice+1.0 Guy |
| 8 | 1.2 Dead+1.0 Wind 270 deg - No Ice+1.0 Guy |
| 9 | 1.2 Dead+1.0 Wind 315 deg - No Ice+1.0 Guy |
| 10 | Dead+Wind 0 deg - Service+Guy |
| 11 | Dead+Wind 45 deg - Service+Guy |
| 12 | Dead+Wind 90 deg - Service+Guy |
| 13 | Dead+Wind 135 deg - Service+Guy |
| 14 | Dead+Wind 180 deg - Service+Guy |
| 15 | Dead+Wind 225 deg - Service+Guy |
| 16 | Dead+Wind 270 deg - Service+Guy |
| 17 | Dead+Wind 315 deg - Service+Guy |
| 18 | 1.2 Dead+1.0 Ev+1.0 Eh 0 deg+1.0 Guy |

| Comb. No. | Description |
|---|---|
| 19 | 1.2 Dead+1.0 Ev+1.0 Eh 45 deg+1.0 Guy |
| 20 | 1.2 Dead+1.0 Ev+1.0 Eh 90 deg+1.0 Guy |
| 21 | 1.2 Dead+1.0 Ev+1.0 Eh 135 deg+1.0 Guy |
| 22 | 1.2 Dead+1.0 Ev+1.0 Eh 180 deg+1.0 Guy |
| 23 | 1.2 Dead+1.0 Ev+1.0 Eh 225 deg+1.0 Guy |
| 24 | 1.2 Dead+1.0 Ev+1.0 Eh 270 deg+1.0 Guy |
| 25 | 1.2 Dead+1.0 Ev+1.0 Eh 315 deg+1.0 Guy |

## Maximum Member Forces

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 21 | -131.47 | -237.50 | -237.49 |
| | | | Max. Mx | 8 | -100.10 | 1451.23 | 14.85 |
| | | | Max. My | 2 | -100.10 | 14.38 | 1451.23 |
| | | | Max. Vy | 8 | -395.42 | 1451.23 | 14.85 |
| | | | Max. Vx | 2 | -395.42 | 14.38 | 1451.23 |
| | | | Max. Torque | 3 | | | 314.51 |
| L2 | 190.438 - 184.021 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -8201.56 | 14.35 | -3159.65 |
| | | | Max. Mx | 4 | -8200.16 | 3195.30 | 13.09 |
| | | | Max. My | 6 | -8199.93 | 14.40 | 3194.77 |
| | | | Max. Vy | 4 | -1104.66 | -1347.39 | 15.02 |
| | | | Max. Vx | 6 | -1104.56 | 13.60 | -1347.48 |
| | | | Max. Torque | 7 | | | -315.06 |
| | | Guy A | Bottom Tension | 5 | 4632.83 | | |
| | | | Top Tension | 5 | 4661.95 | | |
| | | | Top Cable Vert | 5 | 3635.31 | | |
| | | | Top Cable Norm | 5 | 2918.61 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -3335.80 | | |
| | | | Bot Cable Norm | 5 | 3214.90 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |
| | | Guy B | Bottom Tension | 7 | 5035.30 | | |
| | | | Top Tension | 7 | 5064.07 | | |
| | | | Top Cable Vert | 7 | 3934.82 | | |
| | | | Top Cable Norm | 7 | 3187.79 | | |
| | | | Top Cable Tan | 7 | 0.02 | | |
| | | | Bot Cable Vert | 7 | -3635.31 | | |
| | | | Bot Cable Norm | 7 | 3484.08 | | |
| | | | Bot Cable Tan | 7 | 0.02 | | |
| | | Guy C | Bottom Tension | 9 | 4634.82 | | |
| | | | Top Tension | 9 | 4663.94 | | |
| | | | Top Cable Vert | 9 | 3636.79 | | |
| | | | Top Cable Norm | 9 | 2919.94 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -3337.28 | | |
| | | | Bot Cable Norm | 9 | 3216.23 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 5035.67 | | |
| | | | Top Tension | 3 | 5064.44 | | |
| | | | Top Cable Vert | 3 | 3935.09 | | |
| | | | Top Cable Norm | 3 | 3188.03 | | |
| | | | Top Cable Tan | 3 | 0.02 | | |
| | | | Bot Cable Vert | 3 | -3635.58 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Bot Cable Norm | 3 | 3484.32 | | |
| | | | Bot Cable Tan | 3 | 0.02 | | |
| L3 | 184.021 - 177.604 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -8369.48 | 14.78 | -7123.91 |
| | | | Max. Mx | 4 | -8368.19 | 7158.87 | 11.46 |
| | | | Max. My | 6 | -8367.96 | 14.83 | 7157.72 |
| | | | Max. Vy | 4 | -885.00 | 3950.79 | 12.81 |
| | | | Max. Vx | 2 | 885.01 | 13.97 | -3915.10 |
| | | | Max. Torque | 7 | | | -315.12 |
| L4 | 177.604 - 171.187 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -8494.40 | 8.92 | -7061.42 |
| | | | Max. Mx | 4 | -8436.62 | 7499.62 | 10.06 |
| | | | Max. My | 6 | -8436.39 | 13.79 | 7498.16 |
| | | | Max. Vy | 4 | 248.32 | 7090.80 | 10.30 |
| | | | Max. Vx | 6 | 248.40 | 8.97 | 7094.72 |
| | | | Max. Torque | 7 | | | -315.25 |
| L5 | 171.187 - 164.771 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -8586.35 | 4.41 | -4360.38 |
| | | | Max. Mx | 4 | -8515.05 | 6862.50 | 9.50 |
| | | | Max. My | 6 | -8514.83 | 7.85 | 6866.35 |
| | | | Max. Vy | 4 | 605.02 | 4385.80 | 6.20 |
| | | | Max. Vx | 6 | 605.13 | 4.45 | 4389.06 |
| | | | Max. Torque | 7 | | | -307.52 |
| L6 | 164.771 - 158.354 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -8693.25 | -1.44 | 1180.66 |
| | | | Max. Mx | 4 | -8621.20 | 3796.97 | 5.08 |
| | | | Max. My | 6 | -8620.98 | 3.08 | 3800.12 |
| | | | Max. Vy | 4 | 1015.92 | -1165.00 | 1.52 |
| | | | Max. Vx | 6 | 1016.07 | -1.41 | -1162.62 |
| | | | Max. Torque | 7 | | | -307.56 |
| L7 | 158.354 - 151.937 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -15228.45 | -2290.45 | -3.91 |
| | | | Max. Mx | 8 | -8752.76 | 4607.27 | -5.68 |
| | | | Max. My | 2 | -8752.99 | -9.41 | 4609.17 |
| | | | Max. Vy | 4 | 1180.76 | -4601.44 | -5.67 |
| | | | Max. Vx | 6 | 1180.92 | -9.39 | -4599.54 |
| | | | Max. Torque | 7 | | | -86.28 |
| | | Guy A | Bottom Tension | 5 | 4032.38 | | |
| | | | Top Tension | 5 | 4057.42 | | |
| | | | Top Cable Vert | 5 | 2893.99 | | |
| | | | Top Cable Norm | 5 | 2843.85 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -2648.44 | | |
| | | | Bot Cable Norm | 5 | 3040.70 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |
| | | Guy B | Bottom Tension | 7 | 4336.77 | | |
| | | | Top Tension | 7 | 4361.66 | | |
| | | | Top Cable Vert | 7 | 3101.14 | | |
| | | | Top Cable Norm | 7 | 3067.08 | | |
| | | | Top Cable Tan | 7 | 0.02 | | |
| | | | Bot Cable Vert | 7 | -2855.58 | | |
| | | | Bot Cable Norm | 7 | 3263.93 | | |
| | | | Bot Cable Tan | 7 | 0.02 | | |
| | | Guy C | Bottom Tension | 9 | 4030.08 | | |
| | | | Top Tension | 9 | 4055.13 | | |
| | | | Top Cable Vert | 9 | 2892.43 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Top Cable Norm | 9 | 2842.17 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -2646.87 | | |
| | | | Bot Cable Norm | 9 | 3039.02 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 4336.52 | | |
| | | | Top Tension | 3 | 4361.41 | | |
| | | | Top Cable Vert | 3 | 3100.97 | | |
| | | | Top Cable Norm | 3 | 3066.90 | | |
| | | | Top Cable Tan | 3 | 0.01 | | |
| | | | Bot Cable Vert | 3 | -2855.41 | | |
| | | | Bot Cable Norm | 3 | 3263.75 | | |
| | | | Bot Cable Tan | 3 | 0.01 | | |
| L8 | 151.937 - 145.521 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -15323.80 | -642.58 | -1.97 |
| | | | Max. Mx | 8 | -15250.47 | 2005.50 | -3.09 |
| | | | Max. My | 2 | -15250.56 | -5.71 | 2007.35 |
| | | | Max. Vy | 8 | 337.83 | 2005.50 | -3.09 |
| | | | Max. Vx | 2 | 337.86 | -5.71 | 2007.35 |
| | | | Max. Torque | 7 | | | -86.29 |
| L9 | 145.521 - 139.104 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -15419.91 | -450.70 | -2.06 |
| | | | Max. Mx | 8 | -15346.09 | 539.36 | -0.83 |
| | | | Max. My | 2 | -15346.18 | -2.20 | 540.89 |
| | | | Max. Vy | 8 | 115.78 | 539.36 | -0.83 |
| | | | Max. Vx | 2 | 115.84 | -2.20 | 540.89 |
| | | | Max. Torque | 7 | | | -86.29 |
| L10 | 139.104 - 132.687 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -15523.75 | -4.70 | 1956.54 |
| | | | Max. Mx | 4 | -15523.75 | -1960.89 | -3.77 |
| | | | Max. My | 6 | -15523.67 | -4.70 | -1960.38 |
| | | | Max. Vy | 4 | 390.10 | -1960.89 | -3.77 |
| | | | Max. Vx | 6 | 390.21 | -4.70 | -1960.38 |
| | | | Max. Torque | 3 | | | -137.09 |
| L11 | 132.687 - 126.271 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -15637.74 | -11.36 | 5459.60 |
| | | | Max. Mx | 4 | -15637.73 | -5465.78 | -9.85 |
| | | | Max. My | 6 | -15637.64 | -11.37 | -5465.94 |
| | | | Max. Vy | 4 | 726.78 | -5465.78 | -9.85 |
| | | | Max. Vx | 6 | 726.90 | -11.37 | -5465.94 |
| | | | Max. Torque | 3 | | | -137.08 |
| L12 | 126.271 - 119.854 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20158.87 | -4808.20 | -8.91 |
| | | | Max. Mx | 4 | -15676.57 | -6911.49 | -12.32 |
| | | | Max. My | 6 | -15676.48 | -14.15 | -6911.86 |
| | | | Max. Vy | 4 | 770.40 | -6911.49 | -12.32 |
| | | | Max. Vx | 6 | 770.51 | -14.15 | -6911.86 |
| | | | Max. Torque | 3 | | | -136.99 |
| | | Guy A | Bottom Tension | 5 | 2723.21 | | |
| | | | Top Tension | 5 | 2744.11 | | |
| | | | Top Cable Vert | 5 | 1746.40 | | |
| | | | Top Cable Norm | 5 | 2116.66 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -1557.01 | | |
| | | | Bot Cable Norm | 5 | 2234.18 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | Guy B | Bottom Tension | 7 | 2917.03 | | |
| | | | Top Tension | 7 | 2937.87 | | |
| | | | Top Cable Vert | 7 | 1863.03 | | |
| | | | Top Cable Norm | 7 | 2271.61 | | |
| | | | Top Cable Tan | 7 | 0.02 | | |
| | | | Bot Cable Vert | 7 | -1673.64 | | |
| | | | Bot Cable Norm | 7 | 2389.13 | | |
| | | | Bot Cable Tan | 7 | 0.02 | | |
| | | Guy C | Bottom Tension | 9 | 2723.15 | | |
| | | | Top Tension | 9 | 2744.05 | | |
| | | | Top Cable Vert | 9 | 1746.36 | | |
| | | | Top Cable Norm | 9 | 2116.61 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -1556.98 | | |
| | | | Bot Cable Norm | 9 | 2234.13 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 2916.89 | | |
| | | | Top Tension | 3 | 2937.74 | | |
| | | | Top Cable Vert | 3 | 1862.95 | | |
| | | | Top Cable Norm | 3 | 2271.50 | | |
| | | | Top Cable Tan | 3 | 0.02 | | |
| | | | Bot Cable Vert | 3 | -1673.56 | | |
| | | | Bot Cable Norm | 3 | 2389.03 | | |
| | | | Bot Cable Tan | 3 | 0.02 | | |
| L13 | 119.854 - 113.437 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20257.55 | -3223.85 | -6.19 |
| | | | Max. Mx | 4 | -20181.30 | -4555.17 | -7.03 |
| | | | Max. My | 6 | -20181.28 | -7.51 | -4555.68 |
| | | | Max. Vy | 8 | 302.08 | 4548.07 | -7.02 |
| | | | Max. Vx | 2 | 302.10 | -7.52 | 4547.55 |
| | | | Max. Torque | 3 | | | -132.69 |
| L14 | 113.437 - 107.021 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20358.06 | -2601.68 | -5.51 |
| | | | Max. Mx | 4 | -20280.40 | -3085.90 | -5.26 |
| | | | Max. My | 6 | -20280.38 | -5.22 | -3086.55 |
| | | | Max. Vy | 4 | -159.72 | -3085.90 | -5.26 |
| | | | Max. Vx | 6 | -159.70 | -5.22 | -3086.55 |
| | | | Max. Torque | 3 | | | -132.64 |
| L15 | 107.021 - 100.604 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20459.89 | -3020.71 | -6.44 |
| | | | Max. Mx | 4 | -20459.89 | -3020.71 | -6.44 |
| | | | Max. My | 6 | -20459.87 | -6.85 | -3021.36 |
| | | | Max. Vy | 8 | -149.61 | 3016.27 | -6.44 |
| | | | Max. Vx | 2 | -149.62 | -6.84 | 3015.62 |
| | | | Max. Torque | 3 | | | -132.62 |
| L16 | 100.604 - 98.4375 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20496.05 | -3355.03 | -6.98 |
| | | | Max. Mx | 4 | -20496.05 | -3355.03 | -6.98 |
| | | | Max. My | 6 | -20496.03 | -7.58 | -3355.64 |
| | | | Max. Vy | 8 | -204.93 | 3351.31 | -6.97 |
| | | | Max. Vx | 2 | -204.94 | -7.57 | 3350.70 |
| | | | Max. Torque | 3 | | | -132.60 |
| L17 | 98.4375 - 93.3959 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -20614.57 | -5181.54 | -9.27 |
| | | | Max. Mx | 4 | -20614.57 | -5181.54 | -9.27 |
| | | | Max. My | 6 | -20614.55 | -10.60 | -5182.03 |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Max. Vy | 8 | -527.15 | 5179.83 | -9.26 |
| | | | Max. Vx | 2 | -527.17 | -10.59 | 5179.33 |
| | | | Max. Torque | 3 | | | -132.60 |
| | | Guy A | Bottom Tension | 5 | 2189.98 | | |
| | | | Top Tension | 5 | 2205.98 | | |
| | | | Top Cable Vert | 5 | 1248.73 | | |
| | | | Top Cable Norm | 5 | 1818.52 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -1114.73 | | |
| | | | Bot Cable Norm | 5 | 1885.05 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |
| | | Guy B | Bottom Tension | 7 | 2286.05 | | |
| | | | Top Tension | 7 | 2302.03 | | |
| | | | Top Cable Vert | 7 | 1300.21 | | |
| | | | Top Cable Norm | 7 | 1899.68 | | |
| | | | Top Cable Tan | 7 | 0.01 | | |
| | | | Bot Cable Vert | 7 | -1166.22 | | |
| | | | Bot Cable Norm | 7 | 1966.20 | | |
| | | | Bot Cable Tan | 7 | 0.01 | | |
| | | Guy C | Bottom Tension | 9 | 2190.74 | | |
| | | | Top Tension | 9 | 2206.74 | | |
| | | | Top Cable Vert | 9 | 1249.13 | | |
| | | | Top Cable Norm | 9 | 1819.16 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -1115.14 | | |
| | | | Bot Cable Norm | 9 | 1885.69 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 2286.08 | | |
| | | | Top Tension | 3 | 2302.06 | | |
| | | | Top Cable Vert | 3 | 1300.23 | | |
| | | | Top Cable Norm | 3 | 1899.71 | | |
| | | | Top Cable Tan | 3 | 0.01 | | |
| | | | Bot Cable Vert | 3 | -1166.24 | | |
| | | | Bot Cable Norm | 3 | 1966.23 | | |
| | | | Bot Cable Tan | 3 | 0.01 | | |
| L18 | 93.3959 - 87.1876 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -24007.69 | -7.19 | 1658.58 |
| | | | Max. Mx | 4 | -23916.92 | -4097.01 | -9.71 |
| | | | Max. My | 6 | -23916.88 | -11.12 | -4097.51 |
| | | | Max. Vy | 8 | 565.77 | 4095.10 | -9.71 |
| | | | Max. Vx | 2 | 565.77 | -11.10 | 4094.61 |
| | | | Max. Torque | 3 | | | -129.50 |
| L19 | 87.1876 - 80.9793 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -24135.76 | -5.57 | 111.49 |
| | | | Max. Mx | 4 | -24043.76 | -1292.88 | -7.41 |
| | | | Max. My | 6 | -24043.73 | -8.34 | -1293.32 |
| | | | Max. Vy | 8 | 333.94 | 1290.64 | -7.40 |
| | | | Max. Vx | 2 | 333.94 | -8.33 | 1290.21 |
| | | | Max. Torque | 3 | | | -129.50 |
| L20 | 80.9793 - 74.771 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -24264.15 | -5.11 | 176.16 |
| | | | Max. Mx | 3 | -24103.52 | -321.09 | 307.90 |
| | | | Max. My | 7 | -24103.49 | 308.20 | -321.12 |
| | | | Max. Vy | 8 | -140.68 | 176.39 | -4.61 |
| | | | Max. Vx | 2 | -140.70 | -5.11 | 176.16 |
| | | | Max. Torque | 3 | | | -129.50 |
| L21 | 74.771 - 68.5627 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Max. Compression | 2 | -24392.76 | -5.59 | 1825.39 |
| | | | Max. Mx | 4 | -24392.48 | -1827.53 | -4.90 |
| | | | Max. My | 6 | -24392.45 | -5.59 | -1827.62 |
| | | | Max. Vy | 8 | -387.44 | 1825.48 | -4.90 |
| | | | Max. Vx | 2 | -387.46 | -5.59 | 1825.39 |
| | | | Max. Torque | 3 | | | -129.49 |
| L22 | 68.5627 - 62.3544 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -26692.06 | -5.92 | 3109.71 |
| | | | Max. Mx | 4 | -24503.26 | -4297.02 | -5.65 |
| | | | Max. My | 6 | -24503.23 | -6.62 | -4296.98 |
| | | | Max. Vy | 4 | -829.57 | -3946.51 | -6.47 |
| | | | Max. Vx | 6 | -829.58 | -7.60 | -3946.48 |
| | | | Max. Torque | 3 | | | -129.49 |
| | | Guy A | Bottom Tension | 5 | 2011.86 | | |
| | | | Top Tension | 5 | 2022.88 | | |
| | | | Top Cable Vert | 5 | 846.23 | | |
| | | | Top Cable Norm | 5 | 1837.37 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -765.27 | | |
| | | | Bot Cable Norm | 5 | 1860.63 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |
| | | Guy B | Bottom Tension | 7 | 2013.49 | | |
| | | | Top Tension | 7 | 2024.51 | | |
| | | | Top Cable Vert | 7 | 846.88 | | |
| | | | Top Cable Norm | 7 | 1838.87 | | |
| | | | Top Cable Tan | 7 | 0.01 | | |
| | | | Bot Cable Vert | 7 | -765.91 | | |
| | | | Bot Cable Norm | 7 | 1862.12 | | |
| | | | Bot Cable Tan | 7 | 0.01 | | |
| | | Guy C | Bottom Tension | 9 | 2011.76 | | |
| | | | Top Tension | 9 | 2022.78 | | |
| | | | Top Cable Vert | 9 | 846.19 | | |
| | | | Top Cable Norm | 9 | 1837.28 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -765.23 | | |
| | | | Bot Cable Norm | 9 | 1860.54 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 2013.51 | | |
| | | | Top Tension | 3 | 2024.53 | | |
| | | | Top Cable Vert | 3 | 846.89 | | |
| | | | Top Cable Norm | 3 | 1838.89 | | |
| | | | Top Cable Tan | 3 | 0.01 | | |
| | | | Bot Cable Vert | 3 | -765.92 | | |
| | | | Bot Cable Norm | 3 | 1862.15 | | |
| | | | Bot Cable Tan | 3 | 0.01 | | |
| L23 | 62.3544 - 56.1461 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -26820.72 | -2.38 | -1091.17 |
| | | | Max. Mx | 4 | -26728.08 | -2307.11 | -5.20 |
| | | | Max. My | 6 | -26728.04 | -6.12 | -2307.08 |
| | | | Max. Vy | 4 | -755.69 | -2307.11 | -5.20 |
| | | | Max. Vx | 6 | -755.70 | -6.12 | -2307.08 |
| | | | Max. Torque | 3 | | | -127.41 |
| L24 | 56.1461 - 49.9378 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -26950.31 | 0.18 | -3669.69 |
| | | | Max. Mx | 4 | -26950.05 | 3670.86 | 0.30 |
| | | | Max. My | 6 | -26950.01 | 0.18 | 3670.94 |
| | | | Max. Vy | 4 | -507.49 | 1645.06 | -2.04 |
| | | | Max. Vx | 6 | -507.49 | -2.49 | 1645.12 |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Max. Torque | 3 | | | -127.40 |
| L25 | 49.9378 - 43.7295 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -27085.07 | 0.29 | -4324.57 |
| | | | Max. Mx | 8 | -27066.51 | -4354.99 | -0.01 |
| | | | Max. My | 2 | -27066.55 | 0.02 | -4354.90 |
| | | | Max. Vy | 4 | -216.52 | 3926.67 | 0.34 |
| | | | Max. Vx | 6 | -216.53 | 0.21 | 3926.75 |
| | | | Max. Torque | 3 | | | -135.36 |
| L26 | 43.7295 - 37.5212 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -27212.69 | 1.62 | -3072.54 |
| | | | Max. Mx | 8 | -27121.45 | -4242.70 | 0.38 |
| | | | Max. My | 2 | -27121.50 | 0.45 | -4242.61 |
| | | | Max. Vy | 8 | -343.96 | -3072.63 | 1.46 |
| | | | Max. Vx | 2 | -343.96 | 1.62 | -3072.54 |
| | | | Max. Torque | 3 | | | -135.35 |
| L27 | 37.5212 - 31.3129 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 2 | -27339.91 | 2.51 | -108.68 |
| | | | Max. Mx | 4 | -27248.67 | 2687.57 | 1.67 |
| | | | Max. My | 6 | -27248.63 | 1.85 | 2687.67 |
| | | | Max. Vy | 8 | -599.91 | -108.77 | 2.31 |
| | | | Max. Vx | 2 | -599.91 | 2.51 | -108.68 |
| | | | Max. Torque | 3 | | | -135.35 |
| | | Guy A | Bottom Tension | 5 | 1729.91 | | |
| | | | Top Tension | 5 | 1735.48 | | |
| | | | Top Cable Vert | 5 | 390.39 | | |
| | | | Top Cable Norm | 5 | 1691.00 | | |
| | | | Top Cable Tan | 5 | 0.00 | | |
| | | | Bot Cable Vert | 5 | -351.02 | | |
| | | | Bot Cable Norm | 5 | 1693.92 | | |
| | | | Bot Cable Tan | 5 | 0.00 | | |
| | | Guy B | Bottom Tension | 7 | 1714.38 | | |
| | | | Top Tension | 7 | 1719.95 | | |
| | | | Top Cable Vert | 7 | 387.07 | | |
| | | | Top Cable Norm | 7 | 1675.83 | | |
| | | | Top Cable Tan | 7 | 0.01 | | |
| | | | Bot Cable Vert | 7 | -347.71 | | |
| | | | Bot Cable Norm | 7 | 1678.74 | | |
| | | | Bot Cable Tan | 7 | 0.01 | | |
| | | Guy C | Bottom Tension | 9 | 1727.78 | | |
| | | | Top Tension | 9 | 1733.35 | | |
| | | | Top Cable Vert | 9 | 389.93 | | |
| | | | Top Cable Norm | 9 | 1688.92 | | |
| | | | Top Cable Tan | 9 | 0.00 | | |
| | | | Bot Cable Vert | 9 | -350.57 | | |
| | | | Bot Cable Norm | 9 | 1691.84 | | |
| | | | Bot Cable Tan | 9 | 0.00 | | |
| | | Guy D | Bottom Tension | 3 | 1714.37 | | |
| | | | Top Tension | 3 | 1719.94 | | |
| | | | Top Cable Vert | 3 | 387.07 | | |
| | | | Top Cable Norm | 3 | 1675.82 | | |
| | | | Top Cable Tan | 3 | 0.01 | | |
| | | | Bot Cable Vert | 3 | -347.71 | | |
| | | | Bot Cable Norm | 3 | 1678.74 | | |
| | | | Bot Cable Tan | 3 | 0.01 | | |
| L28 | 31.3129 - 25.1046 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -28489.52 | 4319.33 | 8.96 |
| | | | Max. Mx | 4 | -28489.52 | 4319.33 | 8.96 |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial lb | Major Axis Moment lb-ft | Minor Axis Moment lb-ft |
|---|---|---|---|---|---|---|---|
| | | | Max. My | 6 | -28489.47 | 9.41 | 4319.42 |
| | | | Max. Vy | 4 | -733.30 | 1069.65 | 3.64 |
| | | | Max. Vx | 6 | -733.30 | 3.91 | 1069.74 |
| | | | Max. Torque | 3 | | | -134.35 |
| L29 | 25.1046 - 18.8963 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -28617.87 | 6604.89 | 14.18 |
| | | | Max. Mx | 4 | -28617.87 | 6604.89 | 14.18 |
| | | | Max. My | 6 | -28617.82 | 14.75 | 6604.97 |
| | | | Max. Vy | 4 | -462.59 | 4832.34 | 10.05 |
| | | | Max. Vx | 6 | -462.59 | 10.55 | 4832.42 |
| | | | Max. Torque | 3 | | | -134.35 |
| L30 | 18.8963 - 12.688 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -28744.75 | 6972.00 | 17.74 |
| | | | Max. Mx | 4 | -28708.47 | 7069.42 | 16.90 |
| | | | Max. My | 6 | -28708.43 | 17.51 | 7069.48 |
| | | | Max. Vy | 4 | -155.38 | 6801.83 | 15.04 |
| | | | Max. Vx | 6 | -155.37 | 15.63 | 6801.90 |
| | | | Max. Torque | 3 | | | -134.34 |
| L31 | 12.688 - 6.47966 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -28869.77 | 5432.83 | 19.41 |
| | | | Max. Mx | 4 | -28780.74 | 6845.07 | 18.29 |
| | | | Max. My | 6 | -28780.70 | 18.88 | 6845.12 |
| | | | Max. Vy | 8 | -391.23 | -5399.70 | 19.40 |
| | | | Max. Vx | 2 | -391.22 | 19.92 | -5399.66 |
| | | | Max. Torque | 3 | | | -134.33 |
| L32 | 6.47966 - 0 | Pole | Max Tension | 1 | 0.00 | 0.00 | 0.00 |
| | | | Max. Compression | 4 | -29070.89 | -0.14 | 3.54 |
| | | | Max. Mx | 4 | -28905.43 | 4996.21 | 19.60 |
| | | | Max. My | 6 | -28905.39 | 20.12 | 4996.24 |
| | | | Max. Vy | 8 | -945.02 | 0.14 | 3.53 |
| | | | Max. Vx | 2 | -945.02 | 3.92 | 0.14 |
| | | | Max. Torque | 3 | | | -235.92 |

## Maximum Reactions

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| Mast | Max. Vert | 4 | 29085.07 | -261.30 | 0.59 |
| | Max. $H_x$ | 8 | 29084.94 | 262.71 | 0.59 |
| | Max. $H_z$ | 2 | 29084.98 | 0.57 | 262.71 |
| | Max. $M_x$ | 1 | 0.00 | 0.43 | 0.43 |
| | Max. $M_z$ | 1 | 0.00 | 0.43 | 0.43 |
| | Max. Torsion | 7 | 233.98 | 228.58 | -227.38 |
| | Min. Vert | 1 | 7096.49 | 0.43 | 0.43 |
| | Min. $H_x$ | 4 | 29085.07 | -261.30 | 0.59 |
| | Min. $H_z$ | 6 | 29085.03 | 0.57 | -261.30 |
| | Min. $M_x$ | 1 | 0.00 | 0.43 | 0.43 |
| | Min. $M_z$ | 1 | 0.00 | 0.43 | 0.43 |
| | Min. Torsion | 3 | -235.97 | -227.38 | 228.58 |
| Guy D @ 164.04 ft<br>Elev 0 ft<br>Azimuth 225 deg | Max. Vert | 23 | -268.05 | -246.69 | 246.69 |

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| | Max. $H_x$ | 15 | -368.87 | -205.15 | 205.15 |
| | Max. $H_z$ | 3 | -8164.55 | -6460.91 | 6460.90 |
| | Min. Vert | 3 | -8164.55 | -6460.91 | 6460.90 |
| | Min. $H_x$ | 3 | -8164.55 | -6460.91 | 6460.90 |
| | Min. $H_z$ | 15 | -368.87 | -205.15 | 205.15 |
| Guy C @ 164.04 ft<br>Elev 0 ft<br>Azimuth 135 deg | Max. Vert | 21 | -268.05 | 246.68 | 246.68 |
| | Max. $H_x$ | 9 | -7541.13 | 6002.89 | 6002.90 |
| | Max. $H_z$ | 9 | -7541.13 | 6002.89 | 6002.90 |
| | Min. Vert | 9 | -7541.13 | 6002.89 | 6002.90 |
| | Min. $H_x$ | 13 | -384.05 | 215.94 | 215.94 |
| | Min. $H_z$ | 13 | -384.05 | 215.94 | 215.94 |
| Guy B @ 164.04 ft<br>Elev 0 ft<br>Azimuth 45 deg | Max. Vert | 19 | -268.05 | 246.69 | -246.69 |
| | Max. $H_x$ | 7 | -8164.53 | 6460.93 | -6460.95 |
| | Max. $H_z$ | 11 | -368.87 | 205.15 | -205.15 |
| | Min. Vert | 7 | -8164.53 | 6460.93 | -6460.95 |
| | Min. $H_x$ | 11 | -368.87 | 205.15 | -205.15 |
| | Min. $H_z$ | 7 | -8164.53 | 6460.93 | -6460.95 |
| Guy A @ 164.04 ft<br>Elev 0 ft<br>Azimuth -45 deg | Max. Vert | 25 | -268.06 | -246.70 | -246.70 |
| | Max. $H_x$ | 17 | -384.03 | -215.94 | -215.94 |
| | Max. $H_z$ | 17 | -384.03 | -215.94 | -215.94 |
| | Min. Vert | 5 | -7541.25 | -6003.18 | -6003.18 |
| | Min. $H_x$ | 5 | -7541.25 | -6003.18 | -6003.18 |
| | Min. $H_z$ | 5 | -7541.25 | -6003.18 | -6003.18 |
| Guy D @ 147.67 ft<br>Elev 0 ft<br>Azimuth 225 deg | Max. Vert | 15 | -55.31 | -167.12 | 167.12 |
| | Max. $H_x$ | 15 | -55.31 | -167.12 | 167.12 |
| | Max. $H_z$ | 2 | -2155.65 | -3544.93 | 3982.76 |
| | Min. Vert | 3 | -2279.87 | -3894.14 | 3894.11 |
| | Min. $H_x$ | 4 | -2155.42 | -3982.69 | 3544.82 |
| | Min. $H_z$ | 15 | -55.31 | -167.12 | 167.12 |
| Guy C @ 147.67 ft<br>Elev 0 ft<br>Azimuth 135 deg | Max. Vert | 13 | -55.93 | 167.69 | 167.69 |
| | Max. $H_x$ | 8 | -2155.39 | 3982.20 | 3544.34 |
| | Max. $H_z$ | 2 | -2155.37 | 3544.33 | 3982.20 |
| | Min. Vert | 9 | -2230.94 | 3845.29 | 3845.29 |
| | Min. $H_x$ | 13 | -55.93 | 167.69 | 167.69 |
| | Min. $H_z$ | 13 | -55.93 | 167.69 | 167.69 |
| Guy B @ 147.67 ft<br>Elev 0 ft<br>Azimuth 45 deg | Max. Vert | 11 | -55.31 | 167.12 | -167.12 |
| | Max. $H_x$ | 8 | -2155.61 | 3982.73 | -3544.90 |
| | Max. $H_z$ | 11 | -55.31 | 167.12 | -167.12 |
| | Min. Vert | 7 | -2279.84 | 3894.07 | -3894.10 |
| | Min. $H_x$ | 11 | -55.31 | 167.12 | -167.12 |
| | Min. $H_z$ | 6 | -2155.38 | 3544.79 | -3982.66 |
| Guy A @ 147.67 ft | Max. Vert | 17 | -55.97 | -167.82 | -167.82 |

| Location | Condition | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|---|---|---|---|---|---|
| Elev 0 ft<br>Azimuth -45 deg | | | | | |
| | Max. $H_x$ | 17 | -55.97 | -167.82 | -167.82 |
| | Max. $H_z$ | 17 | -55.97 | -167.82 | -167.82 |
| | Min. Vert | 5 | -2231.02 | -3846.38 | -3846.37 |
| | Min. $H_x$ | 4 | -2155.65 | -3983.22 | -3545.38 |
| | Min. $H_z$ | 6 | -2155.66 | -3545.38 | -3983.22 |

# Tower Mast Reaction Summary

| Load Combination | Vertical lb | $Shear_x$ lb | $Shear_z$ lb | Overturning Moment, $M_x$ lb-ft | Overturning Moment, $M_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|
| Dead Only | 7096.49 | -0.43 | -0.43 | 0.00 | 0.00 | 0.00 |
| 1.2 Dead+1.0 Wind 0 deg - No Ice+1.0 Guy | 29084.98 | -0.57 | -262.71 | 0.00 | 0.00 | 167.48 |
| 1.2 Dead+1.0 Wind 45 deg - No Ice+1.0 Guy | 28842.28 | 227.38 | -228.58 | 0.00 | 0.00 | 235.97 |
| 1.2 Dead+1.0 Wind 90 deg - No Ice+1.0 Guy | 29085.07 | 261.30 | -0.59 | 0.00 | 0.00 | 150.88 |
| 1.2 Dead+1.0 Wind 135 deg - No Ice+1.0 Guy | 28222.83 | 231.11 | 231.10 | 0.00 | 0.00 | -12.60 |
| 1.2 Dead+1.0 Wind 180 deg - No Ice+1.0 Guy | 29085.03 | -0.57 | 261.30 | 0.00 | 0.00 | -167.48 |
| 1.2 Dead+1.0 Wind 225 deg - No Ice+1.0 Guy | 28842.23 | -228.58 | 227.38 | 0.00 | 0.00 | -233.98 |
| 1.2 Dead+1.0 Wind 270 deg - No Ice+1.0 Guy | 29084.94 | -262.71 | -0.59 | 0.00 | 0.00 | -150.88 |
| 1.2 Dead+1.0 Wind 315 deg - No Ice+1.0 Guy | 28222.69 | -232.48 | -232.49 | 0.00 | 0.00 | 11.05 |
| Dead+Wind 0 deg - Service+Guy | 11597.92 | -0.48 | -151.35 | 0.00 | 0.00 | 38.77 |
| Dead+Wind 45 deg - Service+Guy | 11390.49 | 113.01 | -113.95 | 0.00 | 0.00 | 54.26 |
| Dead+Wind 90 deg - Service+Guy | 11597.98 | 150.39 | -0.48 | 0.00 | 0.00 | 34.60 |
| Dead+Wind 135 deg - Service+Guy | 11263.72 | 113.64 | 113.64 | 0.00 | 0.00 | -2.97 |
| Dead+Wind 180 deg - Service+Guy | 11597.96 | -0.48 | 150.39 | 0.00 | 0.00 | -38.77 |
| Dead+Wind 225 deg - Service+Guy | 11390.47 | -113.95 | 113.01 | 0.00 | 0.00 | -54.23 |
| Dead+Wind 270 deg - Service+Guy | 11597.89 | -151.35 | -0.48 | 0.00 | 0.00 | -34.60 |
| Dead+Wind 315 deg - Service+Guy | 11263.60 | -114.61 | -114.61 | 0.00 | 0.00 | 2.94 |
| 1.2 Dead+1.0 Ev+1.0 Eh 0 deg+1.0 Guy | 9368.40 | -0.53 | 5.97 | 0.00 | 0.00 | -0.04 |
| 1.2 Dead+1.0 Ev+1.0 Eh 45 deg+1.0 Guy | 9235.14 | -5.33 | 4.21 | 0.00 | 0.00 | -0.05 |
| 1.2 Dead+1.0 Ev+1.0 Eh 90 deg+1.0 Guy | 9368.27 | -7.25 | -0.56 | 0.00 | 0.00 | -0.04 |
| 1.2 Dead+1.0 Ev+1.0 Eh 135 deg+1.0 Guy | 9235.05 | -5.33 | -5.33 | 0.00 | 0.00 | -0.00 |
| 1.2 Dead+1.0 Ev+1.0 Eh 180 deg+1.0 Guy | 9368.22 | -0.56 | -7.24 | 0.00 | 0.00 | 0.04 |
| 1.2 Dead+1.0 Ev+1.0 Eh 225 | 9235.08 | 4.21 | -5.33 | 0.00 | 0.00 | 0.06 |

| Load Combination | Vertical lb | $Shear_x$ lb | $Shear_z$ lb | Overturning Moment, $M_x$ lb-ft | Overturning Moment, $M_z$ lb-ft | Torque lb-ft |
|---|---|---|---|---|---|---|
| deg+1.0 Guy | | | | | | |
| 1.2 Dead+1.0 Ev+1.0 Eh 270 deg+1.0 Guy | 9368.35 | 5.97 | -0.53 | 0.00 | 0.00 | 0.03 |
| 1.2 Dead+1.0 Ev+1.0 Eh 315 deg+1.0 Guy | 9235.18 | 4.10 | 4.10 | 0.00 | 0.00 | -0.01 |

## Solution Summary

| | Sum of Applied Forces | | | Sum of Reactions | | | |
|---|---|---|---|---|---|---|---|
| Load Comb. | PX lb | PY lb | PZ lb | PX lb | PY lb | PZ lb | % Error |
| 1 | 0.00 | -4089.76 | 0.00 | -0.00 | 4089.76 | -0.00 | 0.000% |
| 2 | 0.00 | -4745.92 | -15694.24 | -0.01 | 4745.92 | 15694.20 | 0.000% |
| 3 | 11796.40 | -4745.92 | -11796.40 | -11796.45 | 4745.92 | 11796.44 | 0.000% |
| 4 | 15694.24 | -4745.92 | 0.00 | -15694.20 | 4745.92 | -0.01 | 0.000% |
| 5 | 11250.74 | -4745.92 | 11250.74 | -11250.85 | 4745.93 | -11250.85 | 0.001% |
| 6 | 0.00 | -4745.92 | 15694.24 | -0.01 | 4745.92 | -15694.20 | 0.000% |
| 7 | -11796.40 | -4745.92 | 11796.40 | 11796.44 | 4745.92 | -11796.45 | 0.000% |
| 8 | -15694.24 | -4745.92 | 0.00 | 15694.20 | 4745.92 | -0.01 | 0.000% |
| 9 | -11250.74 | -4745.92 | -11250.74 | 11250.85 | 4745.93 | 11250.85 | 0.001% |
| 10 | 0.00 | -4089.76 | -3778.27 | -0.00 | 4089.76 | 3778.26 | 0.000% |
| 11 | 2825.40 | -4089.76 | -2825.40 | -2825.40 | 4089.76 | 2825.40 | 0.000% |
| 12 | 3778.27 | -4089.76 | 0.00 | -3778.26 | 4089.76 | -0.00 | 0.000% |
| 13 | 2705.36 | -4089.76 | 2705.36 | -2705.36 | 4089.76 | -2705.36 | 0.000% |
| 14 | 0.00 | -4089.76 | 3778.27 | -0.00 | 4089.76 | -3778.26 | 0.000% |
| 15 | -2825.40 | -4089.76 | 2825.40 | 2825.40 | 4089.76 | -2825.40 | 0.000% |
| 16 | -3778.27 | -4089.76 | 0.00 | 3778.26 | 4089.76 | -0.00 | 0.000% |
| 17 | -2705.36 | -4089.76 | -2705.36 | 2705.36 | 4089.76 | 2705.36 | 0.000% |
| 18 | 0.00 | -5580.39 | -1301.39 | 0.00 | 5580.41 | 1301.37 | 0.000% |
| 19 | 920.22 | -5580.39 | -920.22 | -920.22 | 5580.39 | 920.22 | 0.000% |
| 20 | 1301.39 | -5580.39 | 0.00 | -1301.39 | 5580.39 | 0.00 | 0.000% |
| 21 | 920.22 | -5580.39 | 920.22 | -920.22 | 5580.39 | -920.22 | 0.000% |
| 22 | 0.00 | -5580.39 | 1301.39 | 0.00 | 5580.39 | -1301.39 | 0.000% |
| 23 | -920.22 | -5580.39 | 920.22 | 920.22 | 5580.39 | -920.22 | 0.000% |
| 24 | -1301.39 | -5580.39 | 0.00 | 1301.37 | 5580.41 | 0.00 | 0.000% |
| 25 | -920.22 | -5580.39 | -920.22 | 920.21 | 5580.41 | 920.21 | 0.000% |

## Non-Linear Convergence Results

| Load Combination | Converged? | Number of Cycles | Displacement Tolerance | Force Tolerance |
|---|---|---|---|---|
| 1 | Yes | 4 | 0.00000001 | 0.00004509 |
| 2 | Yes | 9 | 0.00005938 | 0.00007161 |
| 3 | Yes | 9 | 0.00000001 | 0.00004907 |
| 4 | Yes | 9 | 0.00005958 | 0.00005915 |
| 5 | Yes | 8 | 0.00005417 | 0.00002458 |
| 6 | Yes | 9 | 0.00005959 | 0.00007185 |
| 7 | Yes | 9 | 0.00000001 | 0.00004836 |
| 8 | Yes | 9 | 0.00005940 | 0.00005898 |
| 9 | Yes | 8 | 0.00005386 | 0.00002358 |
| 10 | Yes | 5 | 0.00000001 | 0.00008192 |
| 11 | Yes | 5 | 0.00000001 | 0.00008096 |
| 12 | Yes | 5 | 0.00000001 | 0.00006783 |

| | | | | |
|---|---|---|---|---|
| 13 | Yes | 5 | 0.00000001 | 0.00001553 |
| 14 | Yes | 5 | 0.00000001 | 0.00008260 |
| 15 | Yes | 5 | 0.00000001 | 0.00008081 |
| 16 | Yes | 5 | 0.00000001 | 0.00006734 |
| 17 | Yes | 5 | 0.00000001 | 0.00001516 |
| 18 | Yes | 5 | 0.00000001 | 0.00001922 |
| 19 | Yes | 5 | 0.00000001 | 0.00001680 |
| 20 | Yes | 5 | 0.00000001 | 0.00001538 |
| 21 | Yes | 5 | 0.00000001 | 0.00001677 |
| 22 | Yes | 5 | 0.00000001 | 0.00001537 |
| 23 | Yes | 5 | 0.00000001 | 0.00001679 |
| 24 | Yes | 5 | 0.00000001 | 0.00001921 |
| 25 | Yes | 5 | 0.00000001 | 0.00002037 |

## Maximum Tower Deflections - Service Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 | 8.492 | 10 | 0.1986 | 0.0062 |
| L2 | 191.271 - 184.021 | 8.272 | 10 | 0.1883 | 0.0050 |
| L3 | 184.854 - 177.604 | 8.071 | 10 | 0.1841 | 0.0095 |
| L4 | 178.437 - 171.187 | 7.815 | 12 | 0.2699 | 0.0155 |
| L5 | 172.021 - 164.771 | 7.422 | 12 | 0.3829 | 0.0215 |
| L6 | 165.604 - 158.354 | 6.889 | 14 | 0.4741 | 0.0273 |
| L7 | 159.187 - 151.937 | 6.277 | 14 | 0.4965 | 0.0322 |
| L8 | 152.771 - 145.521 | 5.695 | 14 | 0.4398 | 0.0338 |
| L9 | 146.354 - 139.104 | 5.163 | 14 | 0.4233 | 0.0353 |
| L10 | 139.937 - 132.687 | 4.634 | 14 | 0.4303 | 0.0368 |
| L11 | 133.521 - 126.271 | 4.095 | 14 | 0.4296 | 0.0356 |
| L12 | 127.104 - 119.854 | 3.582 | 14 | 0.3811 | 0.0329 |
| L13 | 120.687 - 113.437 | 3.165 | 14 | 0.2876 | 0.0303 |
| L14 | 114.271 - 107.021 | 2.832 | 16 | 0.2319 | 0.0276 |
| L15 | 107.854 - 100.604 | 2.540 | 16 | 0.2066 | 0.0250 |
| L16 | 101.437 - 98.4375 | 2.280 | 16 | 0.1752 | 0.0223 |
| L17 | 99.4792 - 93.3959 | 2.210 | 16 | 0.1633 | 0.0217 |
| L18 | 94.4376 - 87.1876 | 2.053 | 16 | 0.1290 | 0.0205 |
| L19 | 88.2293 - 80.9793 | 1.908 | 10 | 0.0964 | 0.0192 |
| L20 | 82.021 - 74.771 | 1.792 | 10 | 0.0828 | 0.0180 |
| L21 | 75.8127 - 68.5627 | 1.689 | 10 | 0.0753 | 0.0167 |
| L22 | 69.6044 - 62.3544 | 1.598 | 12 | 0.0613 | 0.0155 |
| L23 | 63.3961 - 56.1461 | 1.536 | 12 | 0.0494 | 0.0142 |
| L24 | 57.1878 - 49.9378 | 1.508 | 12 | 0.0488 | 0.0129 |
| L25 | 50.9795 - 43.7295 | 1.479 | 12 | 0.0311 | 0.0117 |
| L26 | 44.7712 - 37.5212 | 1.431 | 13 | 0.0570 | 0.0104 |
| L27 | 38.5629 - 31.3129 | 1.383 | 13 | 0.0821 | 0.0090 |
| L28 | 32.3546 - 25.1046 | 1.293 | 13 | 0.0933 | 0.0077 |
| L29 | 26.1463 - 18.8963 | 1.172 | 13 | 0.1115 | 0.0064 |
| L30 | 19.938 - 12.688 | 1.000 | 13 | 0.1603 | 0.0051 |
| L31 | 13.7297 - 6.47966 | 0.757 | 13 | 0.2162 | 0.0037 |
| L32 | 7.52136 - 0 | 0.445 | 13 | 0.2653 | 0.0024 |

## Critical Deflections and Radius of Curvature - Service Wind

| Elevation<br>ft | Appurtenance | Gov. Load Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|---|---|---|---|---|---|---|
| 198.491 | Properllor Anemometer/Wind Vane | 10 | 8.492 | 0.1986 | 0.0062 | 16566 |
| 196.194 | 95" Boom Mount | 10 | 8.439 | 0.1971 | 0.0051 | 16566 |
| 194.063 | CCISeismic Tower Section 1 - 1 | 10 | 8.365 | 0.1944 | 0.0050 | 16566 |
| 192.913 | NRG #40C Anemometer | 10 | 8.326 | 0.1923 | 0.0050 | 16566 |
| 192.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (188ft to196ft) | 10 | 8.295 | 0.1902 | 0.0050 | 16503 |
| 190.913 | 95" Boom Mount | 10 | 8.260 | 0.1872 | 0.0052 | 18889 |
| 189.321 | Guy | 10 | 8.211 | 0.1822 | 0.0062 | 41635 |
| 187.646 | CCISeismic Tower Section 2 - 1 | 10 | 8.160 | 0.1785 | 0.0072 | 21784 |
| 183.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (178ft to188ft) | 10 | 8.007 | 0.2003 | 0.0114 | 5206 |
| 181.229 | CCISeismic Tower Section 3 - 1 | 12 | 7.939 | 0.2237 | 0.0130 | 4109 |
| 180.770 | Aircraft Marker Balls (21" Dia - Orange) | 12 | 7.920 | 0.2308 | 0.0134 | 3917 |
| 174.812 | CCISeismic Tower Section 4 - 1 | 12 | 7.612 | 0.3343 | 0.0189 | 3208 |
| 173.885 | Temperature Probe w/ Shield | 12 | 7.552 | 0.3507 | 0.0197 | 3263 |
| 173.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (168ft to178ft) | 12 | 7.492 | 0.3661 | 0.0206 | 3337 |
| 168.396 | CCISeismic Tower Section 5 - 1 | 14 | 7.136 | 0.4399 | 0.0248 | 4073 |
| 167.323 | NRG 200P Wind Vane | 14 | 7.043 | 0.4543 | 0.0258 | 4453 |
| 165.323 | 95" Boom Mount | 14 | 6.863 | 0.4769 | 0.0276 | 5894 |
| 163.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (158ft to168ft) | 14 | 6.644 | 0.4945 | 0.0296 | 13021 |
| 161.979 | CCISeismic Tower Section 6 - 1 | 14 | 6.545 | 0.4987 | 0.0304 | 27857 |
| 160.761 | NRG 200P Wind Vane | 14 | 6.428 | 0.5003 | 0.0313 | 40824 |
| 158.761 | 95" Boom Mount | 14 | 6.236 | 0.4942 | 0.0324 | 11900 |
| 156.121 | Guy | 14 | 5.991 | 0.4718 | 0.0332 | 8251 |
| 155.562 | CCISeismic Tower Section 7 - 1 | 14 | 5.940 | 0.4661 | 0.0333 | 8059 |
| 153.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (148ft to158ft) | 14 | 5.714 | 0.4415 | 0.0337 | 8452 |
| 149.146 | CCISeismic Tower Section 8 - 1 | 14 | 5.391 | 0.4244 | 0.0345 | 18739 |
| 143.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (138ft to148ft) | 14 | 4.888 | 0.4262 | 0.0363 | 42328 |
| 142.729 | CCISeismic Tower Section 9 - 1 | 14 | 4.866 | 0.4265 | 0.0364 | 41588 |
| 137.795 | NRG 200P Wind Vane | 14 | 4.454 | 0.4328 | 0.0367 | 100368 |
| 136.312 | CCISeismic Tower Section 10 - 1 | 14 | 4.330 | 0.4334 | 0.0365 | 52595 |
| 135.795 | 95" Boom Mount | 14 | 4.286 | 0.4333 | 0.0363 | 39145 |
| 133.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (128ft to138ft) | 14 | 4.052 | 0.4279 | 0.0354 | 13115 |
| 131.234 | NRG #40C Anemometer | 14 | 3.905 | 0.4194 | 0.0347 | 8084 |
| 129.896 | CCISeismic Tower Section 11 - 1 | 14 | 3.797 | 0.4100 | 0.0341 | 6155 |
| 129.234 | 95" Boom Mount | 14 | 3.744 | 0.4043 | 0.0339 | 5543 |
| 125.154 | Guy | 14 | 3.444 | 0.3537 | 0.0321 | 4232 |
| 123.479 | CCISeismic Tower Section 12 - 1 | 14 | 3.333 | 0.3279 | 0.0314 | 4318 |
| 123.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (118ft to128ft) | 14 | 3.303 | 0.3206 | 0.0312 | 4380 |
| 117.062 | CCISeismic Tower Section 13 - 1 | 16 | 2.970 | 0.2513 | 0.0288 | 6411 |
| 113.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (108ft to118ft) | 16 | 2.772 | 0.2243 | 0.0271 | 8621 |
| 110.646 | CCISeismic Tower Section 14 - 1 | 16 | 2.663 | 0.2164 | 0.0261 | 8897 |
| 104.229 | CCISeismic Tower Section 15 - 1 | 16 | 2.388 | 0.1903 | 0.0234 | 6797 |
| 103.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (98ft to108ft) | 16 | 2.339 | 0.1839 | 0.0229 | 6483 |
| 99.937 | CCISeismic Tower Section 16 - 1 | 16 | 2.226 | 0.1662 | 0.0218 | 6404 |
| 98.425 | NRG #40C Anemometer | 16 | 2.175 | 0.1564 | 0.0214 | 6459 |
| 96.438 | CCISeismic Tower Section 17 - 1 | 16 | 2.111 | 0.1426 | 0.0209 | 6442 |
| 96.425 | 95" Boom Mount | 16 | 2.111 | 0.1425 | 0.0209 | 6442 |
| 94.438 | Guy | 16 | 2.053 | 0.1290 | 0.0205 | 6573 |
| 93.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (88ft to98ft) | 16 | 2.015 | 0.1199 | 0.0202 | 7000 |
| 90.813 | CCISeismic Tower Section 18 - 1 | 16 | 1.963 | 0.1077 | 0.0198 | 8438 |

| Elevation<br>ft | Appurtenance | Gov. Load Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|---|---|---|---|---|---|---|
| 84.604 | CCISeismic Tower Section 19 - 1 | 10 | 1.838 | 0.0869 | 0.0185 | 18127 |
| 83.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (78ft to88ft) | 10 | 1.809 | 0.0842 | 0.0182 | 22365 |
| 78.396 | CCISeismic Tower Section 20 - 1 | 10 | 1.730 | 0.0784 | 0.0172 | 36944 |
| 73.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (68ft to78ft) | 12 | 1.645 | 0.0710 | 0.0161 | 25311 |
| 72.188 | CCISeismic Tower Section 21 - 1 | 12 | 1.634 | 0.0693 | 0.0160 | 22406 |
| 65.979 | CCISeismic Tower Section 22 - 1 | 12 | 1.558 | 0.0432 | 0.0147 | 12505 |
| 64.429 | Guy | 12 | 1.544 | 0.0466 | 0.0144 | 12326 |
| 63.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (58ft to68ft) | 12 | 1.534 | 0.0503 | 0.0141 | 13394 |
| 59.771 | CCISeismic Tower Section 23 - 1 | 12 | 1.518 | 0.0531 | 0.0135 | 29006 |
| 53.563 | CCISeismic Tower Section 24 - 1 | 12 | 1.493 | 0.0336 | 0.0122 | 12763 |
| 53.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (48ft to58ft) | 12 | 1.491 | 0.0309 | 0.0121 | 12069 |
| 49.200 | Temperature Probe w/ Shield | 12 | 1.467 | 0.0378 | 0.0113 | 9480 |
| 47.354 | CCISeismic Tower Section 25 - 1 | 12 | 1.451 | 0.0455 | 0.0109 | 8953 |
| 43.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (38ft to48ft) | 13 | 1.423 | 0.0651 | 0.0100 | 8900 |
| 41.146 | CCISeismic Tower Section 26 - 1 | 13 | 1.409 | 0.0730 | 0.0096 | 9392 |
| 34.938 | CCISeismic Tower Section 27 - 1 | 13 | 1.335 | 0.0895 | 0.0083 | 14566 |
| 33.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (28ft to38ft) | 13 | 1.304 | 0.0923 | 0.0079 | 16231 |
| 32.355 | Guy | 13 | 1.293 | 0.0933 | 0.0077 | 16160 |
| 28.730 | CCISeismic Tower Section 28 - 1 | 13 | 1.227 | 0.1013 | 0.0069 | 11417 |
| 23.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (18ft to28ft) | 13 | 1.093 | 0.1354 | 0.0057 | 7282 |
| 22.521 | CCISeismic Tower Section 29 - 1 | 13 | 1.079 | 0.1394 | 0.0056 | 7135 |
| 16.313 | CCISeismic Tower Section 30 - 1 | 13 | 0.867 | 0.1883 | 0.0043 | 6430 |
| 13.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (8ft to18ft) | 13 | 0.724 | 0.2264 | 0.0036 | 6675 |
| 10.105 | CCISeismic Tower Section 31 - 1 | 13 | 0.583 | 0.2643 | 0.0030 | 7264 |
| 5.000 | Data Logger | 13 | 0.301 | 0.2113 | 0.0017 | 12006 |
| 4.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (0ft to8ft) | 13 | 0.242 | 0.1770 | 0.0014 | 12006 |
| 3.761 | CCISeismic Tower Section 32 - 1 | 13 | 0.228 | 0.1679 | 0.0013 | 12006 |

## Maximum Tower Deflections - Design Wind

| Section No. | Elevation<br>ft | Horz. Deflection<br>in | Gov. Load Comb. | Tilt<br>° | Twist<br>° |
|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 | 40.223 | 2 | 0.8838 | 0.0341 |
| L2 | 191.271 - 184.021 | 39.073 | 2 | 0.8416 | 0.0196 |
| L3 | 184.854 - 177.604 | 37.995 | 2 | 0.8391 | 0.0328 |
| L4 | 178.437 - 171.187 | 36.646 | 4 | 1.2375 | 0.0600 |
| L5 | 172.021 - 164.771 | 34.663 | 6 | 1.7471 | 0.0871 |
| L6 | 165.604 - 158.354 | 32.041 | 6 | 2.1526 | 0.1137 |
| L7 | 159.187 - 151.937 | 29.038 | 6 | 2.2664 | 0.1360 |
| L8 | 152.771 - 145.521 | 26.125 | 6 | 2.0587 | 0.1433 |
| L9 | 146.354 - 139.104 | 23.429 | 6 | 1.9685 | 0.1506 |
| L10 | 139.937 - 132.687 | 20.803 | 6 | 1.9402 | 0.1580 |
| L11 | 133.521 - 126.271 | 18.233 | 6 | 1.8671 | 0.1526 |
| L12 | 127.104 - 119.854 | 15.859 | 6 | 1.6189 | 0.1408 |
| L13 | 120.687 - 113.437 | 13.951 | 8 | 1.2195 | 0.1292 |
| L14 | 114.271 - 107.021 | 12.498 | 8 | 0.9488 | 0.1177 |

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L15 | 107.854 - 100.604 | 11.353 | 8 | 0.7654 | 0.1062 |
| L16 | 101.437 - 98.4375 | 10.458 | 2 | 0.6120 | 0.0947 |
| L17 | 99.4792 - 93.3959 | 10.236 | 2 | 0.5684 | 0.0921 |
| L18 | 94.4376 - 87.1876 | 9.753 | 2 | 0.4573 | 0.0871 |
| L19 | 88.2293 - 80.9793 | 9.319 | 2 | 0.3647 | 0.0816 |
| L20 | 82.021 - 74.771 | 8.965 | 2 | 0.3424 | 0.0762 |
| L21 | 75.8127 - 68.5627 | 8.621 | 2 | 0.3364 | 0.0708 |
| L22 | 69.6044 - 62.3544 | 8.291 | 2 | 0.2936 | 0.0655 |
| L23 | 63.3961 - 56.1461 | 8.044 | 4 | 0.1712 | 0.0601 |
| L24 | 57.1878 - 49.9378 | 7.906 | 4 | 0.1223 | 0.0548 |
| L25 | 50.9795 - 43.7295 | 7.727 | 4 | 0.1913 | 0.0496 |
| L26 | 44.7712 - 37.5212 | 7.396 | 4 | 0.3308 | 0.0440 |
| L27 | 38.5629 - 31.3129 | 6.886 | 4 | 0.4575 | 0.0384 |
| L28 | 32.3546 - 25.1046 | 6.251 | 6 | 0.5115 | 0.0328 |
| L29 | 26.1463 - 18.8963 | 5.547 | 6 | 0.5969 | 0.0272 |
| L30 | 19.938 - 12.688 | 4.664 | 6 | 0.7858 | 0.0216 |
| L31 | 13.7297 - 6.47966 | 3.504 | 6 | 1.0172 | 0.0160 |
| L32 | 7.52136 - 0 | 2.049 | 6 | 1.2267 | 0.0105 |

## Critical Deflections and Radius of Curvature - Design Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 198.491 | Properllor Anemometer/Wind Vane | 2 | 40.223 | 0.8838 | 0.0341 | 4048 |
| 196.194 | 95" Boom Mount | 2 | 39.949 | 0.8776 | 0.0299 | 4048 |
| 194.063 | CCISeismic Tower Section 1 - 1 | 2 | 39.562 | 0.8663 | 0.0239 | 4048 |
| 192.913 | NRG #40C Anemometer | 2 | 39.357 | 0.8579 | 0.0216 | 4048 |
| 192.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (188ft to196ft) | 2 | 39.198 | 0.8495 | 0.0216 | 4059 |
| 190.913 | 95" Boom Mount | 2 | 39.012 | 0.8372 | 0.0216 | 4743 |
| 189.321 | Guy | 2 | 38.748 | 0.8174 | 0.0216 | 12095 |
| 187.646 | CCISeismic Tower Section 2 - 1 | 2 | 38.472 | 0.8042 | 0.0231 | 4719 |
| 183.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (178ft to188ft) | 2 | 37.652 | 0.9178 | 0.0415 | 1180 |
| 181.229 | CCISeismic Tower Section 3 - 1 | 4 | 37.294 | 1.0268 | 0.0490 | 936 |
| 180.770 | Aircraft Marker Balls (21" Dia - Orange) | 4 | 37.195 | 1.0590 | 0.0508 | 893 |
| 174.812 | CCISeismic Tower Section 4 - 1 | 4 | 35.610 | 1.5288 | 0.0752 | 720 |
| 173.885 | Temperature Probe w/ Shield | 4 | 35.310 | 1.6026 | 0.0791 | 731 |
| 173.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (168ft to178ft) | 4 | 35.010 | 1.6720 | 0.0829 | 745 |
| 168.396 | CCISeismic Tower Section 5 - 1 | 6 | 33.249 | 2.0005 | 0.1022 | 919 |
| 167.323 | NRG 200P Wind Vane | 6 | 32.796 | 2.0645 | 0.1066 | 1006 |
| 165.323 | 95" Boom Mount | 6 | 31.914 | 2.1651 | 0.1148 | 1315 |
| 163.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (158ft to168ft) | 6 | 30.841 | 2.2446 | 0.1241 | 2619 |
| 161.979 | CCISeismic Tower Section 6 - 1 | 6 | 30.359 | 2.2647 | 0.1278 | 5000 |
| 160.761 | NRG 200P Wind Vane | 6 | 29.782 | 2.2757 | 0.1318 | 15983 |
| 158.761 | 95" Boom Mount | 6 | 28.838 | 2.2590 | 0.1369 | 2948 |
| 156.121 | Guy | 6 | 27.618 | 2.1798 | 0.1406 | 1909 |
| 155.562 | CCISeismic Tower Section 7 - 1 | 6 | 27.365 | 2.1588 | 0.1412 | 1845 |
| 153.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (148ft to158ft) | 6 | 26.225 | 2.0657 | 0.1431 | 1820 |
| 149.146 | CCISeismic Tower Section 8 - 1 | 6 | 24.584 | 1.9889 | 0.1469 | 3013 |
| 143.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (138ft to148ft) | 6 | 22.052 | 1.9536 | 0.1554 | 13565 |

| Elevation<br>ft | Appurtenance | Gov. Load Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|---|---|---|---|---|---|---|
| 142.729 | CCISeismic Tower Section 9 - 1 | 6 | 21.941 | 1.9525 | 0.1557 | 13488 |
| 137.795 | NRG 200P Wind Vane | 6 | 19.935 | 1.9270 | 0.1576 | 6373 |
| 136.312 | CCISeismic Tower Section 10 - 1 | 6 | 19.339 | 1.9130 | 0.1564 | 4756 |
| 135.795 | 95" Boom Mount | 6 | 19.133 | 1.9066 | 0.1558 | 4281 |
| 133.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (128ft to138ft) | 6 | 18.029 | 1.8548 | 0.1518 | 2384 |
| 131.234 | NRG #40C Anemometer | 6 | 17.349 | 1.8033 | 0.1487 | 1676 |
| 129.896 | CCISeismic Tower Section 11 - 1 | 6 | 16.848 | 1.7537 | 0.1462 | 1346 |
| 129.234 | 95" Boom Mount | 6 | 16.606 | 1.7256 | 0.1449 | 1233 |
| 125.154 | Guy | 6 | 15.224 | 1.5008 | 0.1372 | 973 |
| 123.479 | CCISeismic Tower Section 12 - 1 | 8 | 14.718 | 1.3920 | 0.1342 | 987 |
| 123.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (118ft to128ft) | 8 | 14.580 | 1.3609 | 0.1333 | 997 |
| 117.062 | CCISeismic Tower Section 13 - 1 | 8 | 13.084 | 1.0489 | 0.1227 | 1343 |
| 113.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (108ft to118ft) | 8 | 12.250 | 0.9080 | 0.1155 | 1744 |
| 110.646 | CCISeismic Tower Section 14 - 1 | 8 | 11.819 | 0.8365 | 0.1113 | 1902 |
| 104.229 | CCISeismic Tower Section 15 - 1 | 2 | 10.816 | 0.6774 | 0.0994 | 1952 |
| 103.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (98ft to108ft) | 2 | 10.652 | 0.6481 | 0.0973 | 1967 |
| 99.937 | CCISeismic Tower Section 16 - 1 | 2 | 10.286 | 0.5786 | 0.0926 | 2177 |
| 98.425 | NRG #40C Anemometer | 2 | 10.124 | 0.5446 | 0.0908 | 2291 |
| 96.438 | CCISeismic Tower Section 17 - 1 | 2 | 9.929 | 0.4999 | 0.0889 | 2374 |
| 96.425 | 95" Boom Mount | 2 | 9.928 | 0.4996 | 0.0888 | 2374 |
| 94.438 | Guy | 2 | 9.753 | 0.4573 | 0.0871 | 2500 |
| 93.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (88ft to98ft) | 2 | 9.639 | 0.4298 | 0.0858 | 2770 |
| 90.813 | CCISeismic Tower Section 18 - 1 | 2 | 9.484 | 0.3944 | 0.0839 | 3675 |
| 84.604 | CCISeismic Tower Section 19 - 1 | 2 | 9.108 | 0.3460 | 0.0784 | 16023 |
| 83.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (78ft to88ft) | 2 | 9.019 | 0.3433 | 0.0771 | 27611 |
| 78.396 | CCISeismic Tower Section 20 - 1 | 2 | 8.764 | 0.3399 | 0.0731 | 51607 |
| 73.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (68ft to78ft) | 2 | 8.466 | 0.3270 | 0.0684 | 8446 |
| 72.188 | CCISeismic Tower Section 21 - 1 | 2 | 8.422 | 0.3219 | 0.0677 | 6970 |
| 65.979 | CCISeismic Tower Section 22 - 1 | 4 | 8.132 | 0.2229 | 0.0623 | 3182 |
| 64.429 | Guy | 4 | 8.076 | 0.1905 | 0.0610 | 3095 |
| 63.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (58ft to68ft) | 4 | 8.033 | 0.1646 | 0.0598 | 3344 |
| 59.771 | CCISeismic Tower Section 23 - 1 | 4 | 7.959 | 0.1284 | 0.0570 | 7414 |
| 53.563 | CCISeismic Tower Section 24 - 1 | 4 | 7.815 | 0.1460 | 0.0518 | 3903 |
| 53.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (48ft to58ft) | 4 | 7.798 | 0.1540 | 0.0513 | 3636 |
| 49.200 | Temperature Probe w/ Shield | 4 | 7.650 | 0.2286 | 0.0480 | 2728 |
| 47.354 | CCISeismic Tower Section 25 - 1 | 4 | 7.556 | 0.2701 | 0.0463 | 2571 |
| 43.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (38ft to48ft) | 4 | 7.268 | 0.3721 | 0.0424 | 2651 |
| 41.146 | CCISeismic Tower Section 26 - 1 | 4 | 7.119 | 0.4124 | 0.0407 | 2908 |
| 34.938 | CCISeismic Tower Section 27 - 1 | 6 | 6.524 | 0.4935 | 0.0351 | 6435 |
| 33.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (28ft to38ft) | 6 | 6.320 | 0.5069 | 0.0334 | 8129 |
| 32.355 | Guy | 6 | 6.251 | 0.5115 | 0.0328 | 7982 |
| 28.730 | CCISeismic Tower Section 28 - 1 | 6 | 5.853 | 0.5486 | 0.0295 | 3869 |
| 23.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (18ft to28ft) | 6 | 5.130 | 0.6875 | 0.0244 | 1915 |
| 22.521 | CCISeismic Tower Section 29 - 1 | 6 | 5.061 | 0.7030 | 0.0240 | 1858 |
| 16.313 | CCISeismic Tower Section 30 - 1 | 6 | 4.023 | 0.8984 | 0.0183 | 1553 |
| 13.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (8ft to18ft) | 6 | 3.348 | 1.0618 | 0.0154 | 1581 |
| 10.105 | CCISeismic Tower Section 31 - 1 | 6 | 2.688 | 1.2276 | 0.0130 | 1702 |
| 5.000 | Data Logger | 6 | 1.385 | 0.9747 | 0.0074 | 2789 |

| Elevation<br>ft | Appurtenance | Gov. Load Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|---|---|---|---|---|---|---|
| 4.000 | CCISeismic (12) miscl Cat5 From 0 to 196 (0ft to8ft) | 6 | 1.114 | 0.8161 | 0.0060 | 2789 |
| 3.761 | CCISeismic Tower Section 32 - 1 | 6 | 1.048 | 0.7743 | 0.0056 | 2789 |

## Guy Design Data

| Section No. | Elevation<br>ft | Size | Initial Tension<br>lb | Breaking Load<br>lb | Actual $T_u$<br>lb | Allowable $\phi T_n$<br>lb | Required S.F. | Actual S.F. |
|---|---|---|---|---|---|---|---|---|
| L2 | 189.321 (A) (36) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4661.95 | 5880.00 | 1.000 | 1.261 ✔ |
| | 189.321 (B) (35) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 5064.07 | 5880.00 | 1.000 | 1.161 ✔ |
| | 189.321 (C) (34) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4663.94 | 5880.00 | 1.000 | 1.261 ✔ |
| | 189.321 (D) (33) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 5064.44 | 5880.00 | 1.000 | 1.161 ✔ |
| L7 | 156.121 (A) (40) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4057.42 | 5880.00 | 1.000 | 1.449 ✔ |
| | 156.121 (B) (39) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4361.66 | 5880.00 | 1.000 | 1.348 ✔ |
| | 156.121 (C) (38) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4055.13 | 5880.00 | 1.000 | 1.450 ✔ |
| | 156.121 (D) (37) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 4361.41 | 5880.00 | 1.000 | 1.348 ✔ |
| L12 | 125.154 (A) (44) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2744.11 | 5880.00 | 1.000 | 2.143 ✔ |
| | 125.154 (B) (43) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2937.87 | 5880.00 | 1.000 | 2.001 ✔ |
| | 125.154 (C) (42) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2744.05 | 5880.00 | 1.000 | 2.143 ✔ |
| | 125.154 (D) (41) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2937.74 | 5880.00 | 1.000 | 2.002 ✔ |
| L17 | 94.438 (A) (48) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2205.98 | 5880.00 | 1.000 | 2.665 ✔ |
| | 94.438 (B) (47) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2302.03 | 5880.00 | 1.000 | 2.554 ✔ |
| | 94.438 (C) (46) | NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2206.74 | 5880.00 | 1.000 | 2.665 ✔ |
| | 94.438 (D) (45) | NRG Guy 5/16 13MM | 254.80 | 9800.00 | 2302.06 | 5880.00 | 1.000 | 2.554 ✔ |

| Section No. | Elevation ft | Size | Initial Tension lb | Breaking Load lb | Actual $T_u$ lb | Allowable $\phi T_n$ lb | Required S.F. | Actual S.F. |
|---|---|---|---|---|---|---|---|---|
| L22 | 64.429 (A) (52) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2022.88 | 5880.00 | 1.000 | 2.907 ✔ |
| | 64.429 (B) (51) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2024.51 | 5880.00 | 1.000 | 2.904 ✔ |
| | 64.429 (C) (50) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2022.78 | 5880.00 | 1.000 | 2.907 ✔ |
| | 64.429 (D) (49) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 2024.53 | 5880.00 | 1.000 | 2.904 ✔ |
| L27 | 32.355 (A) (56) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 1735.48 | 5880.00 | 1.000 | 3.388 ✔ |
| | 32.355 (B) (55) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 1719.95 | 5880.00 | 1.000 | 3.419 ✔ |
| | 32.355 (C) (54) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 1733.35 | 5880.00 | 1.000 | 3.392 ✔ |
| | 32.355 (D) (53) | Miscl NRG Guy 5/16 13MM Miscl | 254.80 | 9800.00 | 1719.94 | 5880.00 | 1.000 | 3.419 ✔ |

## Compression Checks

## Pole Design Data

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ lb | $\phi P_n$ lb | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 (1) | TP8.05x8x0.134 | 7.250 | 0.000 | 0.0 | 3.3300 | -99.47 | 134865.00 | 0.001 |
| L2 | 190.438 - 184.021 (2) | TP8.05x7.7763x0.134 | 7.250 | 0.000 | 0.0 | 3.3192 | -7819.06 | 134427.00 | 0.058 |
| L3 | 184.021 - 177.604 (3) | TP8.05x7.7505x0.134 | 7.250 | 0.000 | 0.0 | 3.3179 | -8368.19 | 134376.00 | 0.062 |
| L4 | 177.604 - 171.187 (4) | TP8.05x7.7476x0.134 | 7.250 | 0.000 | 0.0 | 3.2394 | -8414.02 | 131194.00 | 0.064 |
| L5 | 171.187 - 164.771 (5) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -8522.15 | 130395.00 | 0.065 |
| L6 | 164.771 - 158.354 (6) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -8628.17 | 130394.00 | 0.066 |
| L7 | 158.354 - 151.937 (7) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2589 | -15025.40 | 131984.00 | 0.114 |
| L8 | 151.937 - 145.521 (8) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -15091.00 | 130394.00 | 0.116 |
| L9 | 145.521 - 139.104 (9) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -15187.00 | 130394.00 | 0.116 |
| L10 | 139.104 - 132.687 (10) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.3178 | -15523.80 | 134370.00 | 0.116 |

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ lb | $\phi P_n$ lb | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| L11 | 132.687 - 126.271 (11) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.3178 | -15637.60 | 134370.00 | 0.116 |
| L12 | 126.271 - 119.854 (12) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2392 | -20106.70 | 131189.00 | 0.153 |
| L13 | 119.854 - 113.437 (13) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -20188.90 | 130394.00 | 0.155 |
| L14 | 113.437 - 107.021 (14) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.2196 | -20288.10 | 130394.00 | 0.156 |
| L15 | 107.021 - 100.604 (15) | TP8.05x7.7472x0.134 | 7.250 | 0.000 | 0.0 | 3.3178 | -20459.90 | 134370.00 | 0.152 |
| L16 | 100.604 - 98.4375 (16) | TP10.04x7.7472x0.109 | 3.000 | 0.000 | 0.0 | 2.8337 | -20488.80 | 113431.00 | 0.181 |
| L17 | 98.4375 - 93.3959 (17) | TP10.04x9.0259x0.134 | 6.083 | 0.000 | 0.0 | 4.0971 | -20614.50 | 165931.00 | 0.124 |
| L18 | 93.3959 - 87.1876 (18) | TP10.04x9.5983x0.134 | 7.250 | 0.000 | 0.0 | 4.0110 | -23925.90 | 162443.00 | 0.147 |
| L19 | 87.1876 - 80.9793 (19) | TP10.04x9.7085x0.134 | 7.250 | 0.000 | 0.0 | 4.0507 | -24052.80 | 164052.00 | 0.147 |
| L20 | 80.9793 - 74.771 (20) | TP10.04x9.7244x0.134 | 7.250 | 0.000 | 0.0 | 4.1511 | -24103.50 | 167880.00 | 0.144 |
| L21 | 74.771 - 68.5627 (21) | TP10.04x9.7267x0.134 | 7.250 | 0.000 | 0.0 | 4.1512 | -24231.90 | 167883.00 | 0.144 |
| L22 | 68.5627 - 62.3544 (22) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.1325 | -26459.20 | 167364.00 | 0.158 |
| L23 | 62.3544 - 56.1461 (23) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.0573 | -26513.80 | 164322.00 | 0.161 |
| L24 | 56.1461 - 49.9378 (24) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.1512 | -26950.00 | 167884.00 | 0.161 |
| L25 | 49.9378 - 43.7295 (25) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.1137 | -27057.30 | 166604.00 | 0.162 |
| L26 | 43.7295 - 37.5212 (26) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.0573 | -27130.60 | 164322.00 | 0.165 |
| L27 | 37.5212 - 31.3129 (27) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.0573 | -27257.70 | 164322.00 | 0.166 |
| L28 | 31.3129 - 25.1046 (28) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.1512 | -28489.50 | 167884.00 | 0.170 |
| L29 | 25.1046 - 18.8963 (29) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.1512 | -28617.80 | 167884.00 | 0.170 |
| L30 | 18.8963 - 12.688 (30) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.0949 | -28690.30 | 165843.00 | 0.173 |
| L31 | 12.688 - 6.47966 (31) | TP10.04x9.727x0.134 | 7.250 | 0.000 | 0.0 | 4.0573 | -28789.60 | 164322.00 | 0.175 |
| L32 | 6.47966 - 0 (32) | TP10.04x9.727x0.134 | 7.521 | 0.000 | 0.0 | 4.0567 | -28914.60 | 164295.00 | 0.176 |

## Pole Bending Design Data

| Section No. | Elevation ft | Size | $M_{ux}$ lb-ft | $\phi M_{nx}$ lb-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ lb-ft | $\phi M_{ny}$ lb-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 (1) | TP8.05x8x0.134 | 1613.54 | 26719.42 | 0.060 | 0.00 | 26719.42 | 0.000 |
| L2 | 190.438 - 184.021 (2) | TP8.05x7.7763x0.134 | 3349.26 | 26560.00 | 0.126 | 0.00 | 26560.00 | 0.000 |
| L3 | 184.021 - 177.604 (3) | TP8.05x7.7505x0.134 | 7158.88 | 26541.75 | 0.270 | 0.00 | 26541.75 | 0.000 |

| Section No. | Elevation<br>ft | Size | $M_{ux}$<br>lb-ft | $\phi M_{nx}$<br>lb-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$<br>lb-ft | $\phi M_{ny}$<br>lb-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| L4 | 177.604 - 171.187 (4) | TP8.05x7.7476x0.134 | 7425.23 | 25399.50 | 0.292 | 0.00 | 25399.50 | 0.000 |
| L5 | 171.187 - 164.771 (5) | TP8.05x7.7472x0.134 | 6866.35 | 25116.50 | 0.273 | 0.00 | 25116.50 | 0.000 |
| L6 | 164.771 - 158.354 (6) | TP8.05x7.7472x0.134 | 3800.12 | 25116.25 | 0.151 | 0.00 | 25116.25 | 0.000 |
| L7 | 158.354 - 151.937 (7) | TP8.05x7.7472x0.134 | 4246.15 | 25680.83 | 0.165 | 0.00 | 25680.83 | 0.000 |
| L8 | 151.937 - 145.521 (8) | TP8.05x7.7472x0.134 | 2398.98 | 25116.25 | 0.096 | 0.00 | 25116.25 | 0.000 |
| L9 | 145.521 - 139.104 (9) | TP8.05x7.7472x0.134 | 642.61 | 25116.25 | 0.026 | 0.00 | 25116.25 | 0.000 |
| L10 | 139.104 - 132.687 (10) | TP8.05x7.7472x0.134 | 1960.89 | 26539.33 | 0.074 | 0.00 | 26539.33 | 0.000 |
| L11 | 132.687 - 126.271 (11) | TP8.05x7.7472x0.134 | 5465.96 | 26539.33 | 0.206 | 0.00 | 26539.33 | 0.000 |
| L12 | 126.271 - 119.854 (12) | TP8.05x7.7472x0.134 | 6369.46 | 25397.75 | 0.251 | 0.00 | 25397.75 | 0.000 |
| L13 | 119.854 - 113.437 (13) | TP8.05x7.7472x0.134 | 4555.69 | 25116.25 | 0.181 | 0.00 | 25116.25 | 0.000 |
| L14 | 113.437 - 107.021 (14) | TP8.05x7.7472x0.134 | 3086.56 | 25116.25 | 0.123 | 0.00 | 25116.25 | 0.000 |
| L15 | 107.021 - 100.604 (15) | TP8.05x7.7472x0.134 | 3021.37 | 26539.33 | 0.114 | 0.00 | 26539.33 | 0.000 |
| L16 | 100.604 - 98.4375 (16) | TP10.04x7.7472x0.109 | 3150.65 | 22918.42 | 0.137 | 0.00 | 22918.42 | 0.000 |
| L17 | 98.4375 - 93.3959 (17) | TP10.04x9.0259x0.134 | 5182.04 | 39206.83 | 0.132 | 0.00 | 39206.83 | 0.000 |
| L18 | 93.3959 - 87.1876 (18) | TP10.04x9.5983x0.134 | 4097.53 | 37687.50 | 0.109 | 0.00 | 37687.50 | 0.000 |
| L19 | 87.1876 - 80.9793 (19) | TP10.04x9.7085x0.134 | 1293.34 | 38384.75 | 0.034 | 0.00 | 38384.75 | 0.000 |
| L20 | 80.9793 - 74.771 (20) | TP10.04x9.7244x0.134 | 445.09 | 40175.08 | 0.011 | 0.00 | 40175.08 | 0.000 |
| L21 | 74.771 - 68.5627 (21) | TP10.04x9.7267x0.134 | 2271.76 | 40177.58 | 0.057 | 0.00 | 40177.58 | 0.000 |
| L22 | 68.5627 - 62.3544 (22) | TP10.04x9.727x0.134 | 4522.28 | 39839.92 | 0.114 | 0.00 | 39839.92 | 0.000 |
| L23 | 62.3544 - 56.1461 (23) | TP10.04x9.727x0.134 | 2963.18 | 38502.33 | 0.077 | 0.00 | 38502.33 | 0.000 |
| L24 | 56.1461 - 49.9378 (24) | TP10.04x9.727x0.134 | 3670.94 | 40178.00 | 0.091 | 0.00 | 40178.00 | 0.000 |
| L25 | 49.9378 - 43.7295 (25) | TP10.04x9.727x0.134 | 4331.52 | 39503.50 | 0.110 | 0.00 | 39503.50 | 0.000 |
| L26 | 43.7295 - 37.5212 (26) | TP10.04x9.727x0.134 | 4242.61 | 38502.42 | 0.110 | 0.00 | 38502.42 | 0.000 |
| L27 | 37.5212 - 31.3129 (27) | TP10.04x9.727x0.134 | 2687.67 | 38502.42 | 0.070 | 0.00 | 38502.42 | 0.000 |
| L28 | 31.3129 - 25.1046 (28) | TP10.04x9.727x0.134 | 4319.43 | 40178.00 | 0.108 | 0.00 | 40178.00 | 0.000 |
| L29 | 25.1046 - 18.8963 (29) | TP10.04x9.727x0.134 | 6604.98 | 40178.00 | 0.164 | 0.00 | 40178.00 | 0.000 |
| L30 | 18.8963 - 12.688 (30) | TP10.04x9.727x0.134 | 7035.27 | 39168.42 | 0.180 | 0.00 | 39168.42 | 0.000 |
| L31 | 12.688 - 6.47966 (31) | TP10.04x9.727x0.134 | 6845.15 | 38502.42 | 0.178 | 0.00 | 38502.42 | 0.000 |
| L32 | 6.47966 - 0 (32) | TP10.04x9.727x0.134 | 4996.28 | 38490.33 | 0.130 | 0.00 | 38490.33 | 0.000 |

# Pole Shear Design Data

| Section No. | Elevation ft | Size | Actual $V_u$ lb | $\phi V_n$ lb | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ lb-ft | $\phi T_n$ lb-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 (1) | TP8.05x8x0.134 | 431.91 | 40459.60 | 0.011 | 314.51 | 28137.83 | 0.011 |
| L2 | 190.438 - 184.021 (2) | TP8.05x7.7763x0.134 | 934.98 | 40112.40 | 0.023 | 0.73 | 27955.17 | 0.000 |
| L3 | 184.021 - 177.604 (3) | TP8.05x7.7505x0.134 | 232.40 | 40077.00 | 0.006 | 213.42 | 27934.25 | 0.008 |
| L4 | 177.604 - 171.187 (4) | TP8.05x7.7476x0.134 | 81.00 | 39358.20 | 0.002 | 213.45 | 26626.75 | 0.008 |
| L5 | 171.187 - 164.771 (5) | TP8.05x7.7472x0.134 | 341.61 | 39356.90 | 0.009 | 199.07 | 26303.33 | 0.008 |
| L6 | 164.771 - 158.354 (6) | TP8.05x7.7472x0.134 | 810.41 | 39356.80 | 0.021 | 199.16 | 26303.08 | 0.008 |
| L7 | 158.354 - 151.937 (7) | TP8.05x7.7472x0.134 | 505.60 | 39595.30 | 0.013 | 84.83 | 26948.58 | 0.003 |
| L8 | 151.937 - 145.521 (8) | TP8.05x7.7472x0.134 | 380.76 | 39118.20 | 0.010 | 84.85 | 26303.08 | 0.003 |
| L9 | 145.521 - 139.104 (9) | TP8.05x7.7472x0.134 | 162.83 | 39118.20 | 0.004 | 84.86 | 26303.08 | 0.003 |
| L10 | 139.104 - 132.687 (10) | TP8.05x7.7472x0.134 | 390.10 | 40310.90 | 0.010 | 80.03 | 27931.50 | 0.003 |
| L11 | 132.687 - 126.271 (11) | TP8.05x7.7472x0.134 | 726.91 | 40310.90 | 0.018 | 97.94 | 27931.50 | 0.004 |
| L12 | 126.271 - 119.854 (12) | TP8.05x7.7472x0.134 | 391.87 | 39595.30 | 0.010 | 94.72 | 26624.83 | 0.004 |
| L13 | 119.854 - 113.437 (13) | TP8.05x7.7472x0.134 | 301.96 | 39356.70 | 0.008 | 94.64 | 26303.08 | 0.004 |
| L14 | 113.437 - 107.021 (14) | TP8.05x7.7472x0.134 | 159.70 | 39356.70 | 0.004 | 94.60 | 26303.08 | 0.004 |
| L15 | 107.021 - 100.604 (15) | TP8.05x7.7472x0.134 | 149.24 | 40072.40 | 0.004 | 94.57 | 27931.50 | 0.003 |
| L16 | 100.604 - 98.4375 (16) | TP10.04x7.7472x0.109 | 204.53 | 34429.10 | 0.006 | 94.56 | 23928.67 | 0.004 |
| L17 | 98.4375 - 93.3959 (17) | TP10.04x9.0259x0.134 | 526.71 | 48642.40 | 0.011 | 94.55 | 42593.67 | 0.002 |
| L18 | 93.3959 - 87.1876 (18) | TP10.04x9.5983x0.134 | 565.72 | 48733.00 | 0.012 | 92.32 | 40822.17 | 0.002 |
| L19 | 87.1876 - 80.9793 (19) | TP10.04x9.7085x0.134 | 333.93 | 49215.70 | 0.007 | 92.31 | 41634.75 | 0.002 |
| L20 | 80.9793 - 74.771 (20) | TP10.04x9.7244x0.134 | 171.86 | 50435.50 | 0.003 | 127.52 | 43724.17 | 0.003 |
| L21 | 74.771 - 68.5627 (21) | TP10.04x9.7267x0.134 | 413.95 | 50437.20 | 0.008 | 127.51 | 43727.08 | 0.003 |
| L22 | 68.5627 - 62.3544 (22) | TP10.04x9.727x0.134 | 790.13 | 50209.20 | 0.016 | 127.41 | 43332.75 | 0.003 |
| L23 | 62.3544 - 56.1461 (23) | TP10.04x9.727x0.134 | 718.79 | 49296.70 | 0.015 | 127.41 | 41771.83 | 0.003 |
| L24 | 56.1461 - 49.9378 (24) | TP10.04x9.727x0.134 | 314.88 | 50209.30 | 0.006 | 90.77 | 43727.58 | 0.002 |
| L25 | 49.9378 - 43.7295 (25) | TP10.04x9.727x0.134 | 42.48 | 49981.20 | 0.001 | 96.40 | 42939.92 | 0.002 |
| L26 | 43.7295 - 37.5212 (26) | TP10.04x9.727x0.134 | 146.26 | 49296.70 | 0.003 | 96.39 | 41771.92 | 0.002 |
| L27 | 37.5212 - 31.3129 (27) | TP10.04x9.727x0.134 | 432.60 | 49296.70 | 0.009 | 96.39 | 41771.92 | 0.002 |
| L28 | 31.3129 - 25.1046 (28) | TP10.04x9.727x0.134 | 556.44 | 50209.30 | 0.011 | 95.64 | 43727.58 | 0.002 |

| Section No. | Elevation ft | Size | Actual $V_u$ lb | $\phi V_n$ lb | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ lb-ft | $\phi T_n$ lb-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| L29 | 25.1046 - 18.8963 (29) | TP10.04x9.727x0.134 | 255.62 | 50209.30 | 0.005 | 95.63 | 43727.58 | 0.002 |
| L30 | 18.8963 - 12.688 (30) | TP10.04x9.727x0.134 | 102.18 | 49524.90 | 0.002 | 95.63 | 42548.83 | 0.002 |
| L31 | 12.688 - 6.47966 (31) | TP10.04x9.727x0.134 | 186.37 | 49296.70 | 0.004 | 95.63 | 41771.92 | 0.002 |
| L32 | 6.47966 - 0 (32) | TP10.04x9.727x0.134 | 481.30 | 49518.20 | 0.010 | 95.63 | 41757.83 | 0.002 |

## Pole Interaction Design Data

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 (1) | 0.001 | 0.060 | 0.000 | 0.011 | 0.011 | 0.062 ✔ | 1.000 | ✔ |
| L2 | 190.438 - 184.021 (2) | 0.058 | 0.126 | 0.000 | 0.023 | 0.000 | 0.185 ✔ | 1.000 | ✔ |
| L3 | 184.021 - 177.604 (3) | 0.062 | 0.270 | 0.000 | 0.006 | 0.008 | 0.332 ✔ | 1.000 | ✔ |
| L4 | 177.604 - 171.187 (4) | 0.064 | 0.292 | 0.000 | 0.002 | 0.008 | 0.357 ✔ | 1.000 | ✔ |
| L5 | 171.187 - 164.771 (5) | 0.065 | 0.273 | 0.000 | 0.009 | 0.008 | 0.339 ✔ | 1.000 | ✔ |
| L6 | 164.771 - 158.354 (6) | 0.066 | 0.151 | 0.000 | 0.021 | 0.008 | 0.218 ✔ | 1.000 | ✔ |
| L7 | 158.354 - 151.937 (7) | 0.114 | 0.165 | 0.000 | 0.013 | 0.003 | 0.279 ✔ | 1.000 | ✔ |
| L8 | 151.937 - 145.521 (8) | 0.116 | 0.096 | 0.000 | 0.010 | 0.003 | 0.211 ✔ | 1.000 | ✔ |
| L9 | 145.521 - 139.104 (9) | 0.116 | 0.026 | 0.000 | 0.004 | 0.003 | 0.142 ✔ | 1.000 | ✔ |
| L10 | 139.104 - 132.687 (10) | 0.116 | 0.074 | 0.000 | 0.010 | 0.003 | 0.190 ✔ | 1.000 | ✔ |
| L11 | 132.687 - 126.271 (11) | 0.116 | 0.206 | 0.000 | 0.018 | 0.004 | 0.323 ✔ | 1.000 | ✔ |
| L12 | 126.271 - 119.854 (12) | 0.153 | 0.251 | 0.000 | 0.010 | 0.004 | 0.404 ✔ | 1.000 | ✔ |
| L13 | 119.854 - 113.437 (13) | 0.155 | 0.181 | 0.000 | 0.008 | 0.004 | 0.336 ✔ | 1.000 | ✔ |
| L14 | 113.437 - 107.021 (14) | 0.156 | 0.123 | 0.000 | 0.004 | 0.004 | 0.279 ✔ | 1.000 | ✔ |
| L15 | 107.021 - 100.604 (15) | 0.152 | 0.114 | 0.000 | 0.004 | 0.003 | 0.266 ✔ | 1.000 | ✔ |
| L16 | 100.604 - 98.4375 (16) | 0.181 | 0.137 | 0.000 | 0.006 | 0.004 | 0.318 ✔ | 1.000 | ✔ |
| L17 | 98.4375 - 93.3959 (17) | 0.124 | 0.132 | 0.000 | 0.011 | 0.002 | 0.257 ✔ | 1.000 | ✔ |
| L18 | 93.3959 - 87.1876 (18) | 0.147 | 0.109 | 0.000 | 0.012 | 0.002 | 0.256 | 1.000 | ✔ |

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| L19 | 87.1876 - 80.9793 (19) | 0.147 | 0.034 | 0.000 | 0.007 | 0.002 | 0.180 | 1.000 | ✔ |
| L20 | 80.9793 - 74.771 (20) | 0.144 | 0.011 | 0.000 | 0.003 | 0.003 | 0.155 | 1.000 | ✔ |
| L21 | 74.771 - 68.5627 (21) | 0.144 | 0.057 | 0.000 | 0.008 | 0.003 | 0.201 | 1.000 | ✔ |
| L22 | 68.5627 - 62.3544 (22) | 0.158 | 0.114 | 0.000 | 0.016 | 0.003 | 0.272 | 1.000 | ✔ |
| L23 | 62.3544 - 56.1461 (23) | 0.161 | 0.077 | 0.000 | 0.015 | 0.003 | 0.239 | 1.000 | ✔ |
| L24 | 56.1461 - 49.9378 (24) | 0.161 | 0.091 | 0.000 | 0.006 | 0.002 | 0.252 | 1.000 | ✔ |
| L25 | 49.9378 - 43.7295 (25) | 0.162 | 0.110 | 0.000 | 0.001 | 0.002 | 0.272 | 1.000 | ✔ |
| L26 | 43.7295 - 37.5212 (26) | 0.165 | 0.110 | 0.000 | 0.003 | 0.002 | 0.275 | 1.000 | ✔ |
| L27 | 37.5212 - 31.3129 (27) | 0.166 | 0.070 | 0.000 | 0.009 | 0.002 | 0.236 | 1.000 | ✔ |
| L28 | 31.3129 - 25.1046 (28) | 0.170 | 0.108 | 0.000 | 0.011 | 0.002 | 0.277 | 1.000 | ✔ |
| L29 | 25.1046 - 18.8963 (29) | 0.170 | 0.164 | 0.000 | 0.005 | 0.002 | 0.335 | 1.000 | ✔ |
| L30 | 18.8963 - 12.688 (30) | 0.173 | 0.180 | 0.000 | 0.002 | 0.002 | 0.353 | 1.000 | ✔ |
| L31 | 12.688 - 6.47966 (31) | 0.175 | 0.178 | 0.000 | 0.004 | 0.002 | 0.353 | 1.000 | ✔ |
| L32 | 6.47966 - 0 (32) | 0.176 | 0.130 | 0.000 | 0.010 | 0.002 | 0.306 | 1.000 | ✔ |

## Section Capacity Table

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $\phi P_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 197.688 - 190.438 | Pole | TP8.05x8x0.134 | 1 | -99.47 | 134865.00 | 6.2 | Pass |
| L2 | 190.438 - 184.021 | Pole | TP8.05x7.7763x0.134 | 2 | -7819.06 | 134427.00 | 18.5 | Pass |
| | | Guy A@189.321 | NRG Guy 5/16 13MM | 36 | 4661.95 | 5880.00 | 79.3 | Pass |
| | | Guy B@189.321 | NRG Guy 5/16 13MM | 35 | 5064.07 | 5880.00 | 86.1 | Pass |
| | | Guy C@189.321 | NRG Guy 5/16 13MM | 34 | 4663.94 | 5880.00 | 79.3 | Pass |
| | | Guy D@189.321 | NRG Guy 5/16 13MM | 33 | 5064.44 | 5880.00 | 86.1 | Pass |
| L3 | 184.021 - 177.604 | Pole | TP8.05x7.7505x0.134 | 3 | -8368.19 | 134376.00 | 33.2 | Pass |
| L4 | 177.604 - 171.187 | Pole | TP8.05x7.7476x0.134 | 4 | -8414.02 | 131194.00 | 35.7 | Pass |
| L5 | 171.187 - 164.771 | Pole | TP8.05x7.7472x0.134 | 5 | -8522.15 | 130395.00 | 33.9 | Pass |
| L6 | 164.771 - | Pole | TP8.05x7.7472x0.134 | 6 | -8628.17 | 130394.00 | 21.8 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | $øP_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| | 158.354 | | | | | | | |
| L7 | 158.354 - 151.937 | Pole | TP8.05x7.7472x0.134 | 7 | -15025.40 | 131984.00 | 27.9 | Pass |
| | | Guy A@156.121 | NRG Guy 5/16 13MM | 40 | 4057.42 | 5880.00 | 69.0 | Pass |
| | | Guy B@156.121 | NRG Guy 5/16 13MM | 39 | 4361.66 | 5880.00 | 74.2 | Pass |
| | | Guy C@156.121 | NRG Guy 5/16 13MM | 38 | 4055.13 | 5880.00 | 69.0 | Pass |
| | | Guy D@156.121 | NRG Guy 5/16 13MM | 37 | 4361.41 | 5880.00 | 74.2 | Pass |
| L8 | 151.937 - 145.521 | Pole | TP8.05x7.7472x0.134 | 8 | -15091.00 | 130394.00 | 21.1 | Pass |
| L9 | 145.521 - 139.104 | Pole | TP8.05x7.7472x0.134 | 9 | -15187.00 | 130394.00 | 14.2 | Pass |
| L10 | 139.104 - 132.687 | Pole | TP8.05x7.7472x0.134 | 10 | -15523.80 | 134370.00 | 19.0 | Pass |
| L11 | 132.687 - 126.271 | Pole | TP8.05x7.7472x0.134 | 11 | -15637.60 | 134370.00 | 32.3 | Pass |
| L12 | 126.271 - 119.854 | Pole | TP8.05x7.7472x0.134 | 12 | -20106.70 | 131189.00 | 40.4 | Pass |
| | | Guy A@125.154 | NRG Guy 5/16 13MM | 44 | 2744.11 | 5880.00 | 46.7 | Pass |
| | | Guy B@125.154 | NRG Guy 5/16 13MM | 43 | 2937.87 | 5880.00 | 50.0 | Pass |
| | | Guy C@125.154 | NRG Guy 5/16 13MM | 42 | 2744.05 | 5880.00 | 46.7 | Pass |
| | | Guy D@125.154 | NRG Guy 5/16 13MM | 41 | 2937.74 | 5880.00 | 50.0 | Pass |
| L13 | 119.854 - 113.437 | Pole | TP8.05x7.7472x0.134 | 13 | -20188.90 | 130394.00 | 33.6 | Pass |
| L14 | 113.437 - 107.021 | Pole | TP8.05x7.7472x0.134 | 14 | -20288.10 | 130394.00 | 27.9 | Pass |
| L15 | 107.021 - 100.604 | Pole | TP8.05x7.7472x0.134 | 15 | -20459.90 | 134370.00 | 26.6 | Pass |
| L16 | 100.604 - 98.4375 | Pole | TP10.04x7.7472x0.109 | 16 | -20488.80 | 113431.00 | 31.8 | Pass |
| L17 | 98.4375 - 93.3959 | Pole | TP10.04x9.0259x0.134 | 17 | -20614.50 | 165931.00 | 25.7 | Pass |
| | | Guy A@94.4376 | NRG Guy 5/16 13MM | 48 | 2205.98 | 5880.00 | 37.5 | Pass |
| | | Guy B@94.4376 | NRG Guy 5/16 13MM | 47 | 2302.03 | 5880.00 | 39.2 | Pass |
| | | Guy C@94.4376 | NRG Guy 5/16 13MM | 46 | 2206.74 | 5880.00 | 37.5 | Pass |
| | | Guy D@94.4376 | NRG Guy 5/16 13MM | 45 | 2302.06 | 5880.00 | 39.2 | Pass |
| L18 | 93.3959 - 87.1876 | Pole | TP10.04x9.5983x0.134 | 18 | -23925.90 | 162443.00 | 25.6 | Pass |
| L19 | 87.1876 - 80.9793 | Pole | TP10.04x9.7085x0.134 | 19 | -24052.80 | 164052.00 | 18.0 | Pass |
| L20 | 80.9793 - 74.771 | Pole | TP10.04x9.7244x0.134 | 20 | -24103.50 | 167880.00 | 15.5 | Pass |
| L21 | 74.771 - 68.5627 | Pole | TP10.04x9.7267x0.134 | 21 | -24231.90 | 167883.00 | 20.1 | Pass |
| L22 | 68.5627 - 62.3544 | Pole | TP10.04x9.727x0.134 | 22 | -26459.20 | 167364.00 | 27.2 | Pass |
| | | Guy A@64.4294 | NRG Guy 5/16 13MM | 52 | 2022.88 | 5880.00 | 34.4 | Pass |
| | | Guy B@64.4294 | NRG Guy 5/16 13MM | 51 | 2024.51 | 5880.00 | 34.4 | Pass |
| | | Guy C@64.4294 | NRG Guy 5/16 13MM | 50 | 2022.78 | 5880.00 | 34.4 | Pass |
| | | Guy D@64.4294 | NRG Guy 5/16 13MM | 49 | 2024.53 | 5880.00 | 34.4 | Pass |
| L23 | 62.3544 - 56.1461 | Pole | TP10.04x9.727x0.134 | 23 | -26513.80 | 164322.00 | 23.9 | Pass |
| L24 | 56.1461 - 49.9378 | Pole | TP10.04x9.727x0.134 | 24 | -26950.00 | 167884.00 | 25.2 | Pass |
| L25 | 49.9378 - 43.7295 | Pole | TP10.04x9.727x0.134 | 25 | -27057.30 | 166604.00 | 27.2 | Pass |
| L26 | 43.7295 - 37.5212 | Pole | TP10.04x9.727x0.134 | 26 | -27130.60 | 164322.00 | 27.5 | Pass |
| L27 | 37.5212 - 31.3129 | Pole | TP10.04x9.727x0.134 | 27 | -27257.70 | 164322.00 | 23.6 | Pass |
| | | Guy A@32.3546 | NRG Guy 5/16 13MM | 56 | 1735.48 | 5880.00 | 29.5 | Pass |
| | | Guy B@32.3546 | NRG Guy 5/16 13MM | 55 | 1719.95 | 5880.00 | 29.3 | Pass |
| | | Guy C@32.3546 | NRG Guy 5/16 13MM | 54 | 1733.35 | 5880.00 | 29.5 | Pass |
| | | Guy D@32.3546 | NRG Guy 5/16 13MM | 53 | 1719.94 | 5880.00 | 29.3 | Pass |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | øP$_{allow}$ lb | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L28 | 31.3129 - 25.1046 | Pole | TP10.04x9.727x0.134 | 28 | -28489.50 | 167884.00 | 27.7 | Pass |
| L29 | 25.1046 - 18.8963 | Pole | TP10.04x9.727x0.134 | 29 | -28617.80 | 167884.00 | 33.5 | Pass |
| L30 | 18.8963 - 12.688 | Pole | TP10.04x9.727x0.134 | 30 | -28690.30 | 165843.00 | 35.3 | Pass |
| L31 | 12.688 - 6.47966 | Pole | TP10.04x9.727x0.134 | 31 | -28789.60 | 164322.00 | 35.3 | Pass |
| L32 | 6.47966 - 0 | Pole | TP10.04x9.727x0.134 | 32 | -28914.60 | 164295.00 | 30.6 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L12) | 40.4 | Pass |
| | | | | | | Guy A (L2) | 79.3 | Pass |
| | | | | | | Guy B (L2) | 86.1 | Pass |
| | | | | | | Guy C (L2) | 79.3 | Pass |
| | | | | | | Guy D (L2) | 86.1 | Pass |
| | | | | | | **RATING =** | **86.1** | **Pass** |

# Element Map

| Section No. | Section Elevation ft | Component Type | Element List |
|---|---|---|---|
| L1 | 197.688-190.438 | Pole | 1 |
| L2 | 190.438-184.021 | Pole | 2 |
| | | Guy A | 36 |
| | | Guy B | 35 |
| | | Guy C | 34 |
| | | Guy D | 33 |
| L3 | 184.021-177.604 | Pole | 3 |
| L4 | 177.604-171.187 | Pole | 4 |
| L5 | 171.187-164.771 | Pole | 5 |
| L6 | 164.771-158.354 | Pole | 6 |
| L7 | 158.354-151.937 | Pole | 7 |
| | | Guy A | 40 |
| | | Guy B | 39 |
| | | Guy C | 38 |
| | | Guy D | 37 |
| L8 | 151.937-145.521 | Pole | 8 |
| L9 | 145.521-139.104 | Pole | 9 |
| L10 | 139.104-132.687 | Pole | 10 |
| L11 | 132.687-126.271 | Pole | 11 |
| L12 | 126.271-119.854 | Pole | 12 |
| | | Guy A | 44 |
| | | Guy B | 43 |
| | | Guy C | 42 |
| | | Guy D | 41 |
| L13 | 119.854-113.43 | Pole | 13 |

| Section No. | Section Elevation ft | Component Type | Element List |
|---|---|---|---|
| | 7 | | |
| L14 | 113.437-107.021 | Pole | 14 |
| L15 | 107.021-100.604 | Pole | 15 |
| L16 | 100.604-98.437 | Pole | 16 |
| L17 | 98.437-93.396 | Pole | 17 |
| | | Guy A | 48 |
| | | Guy B | 47 |
| | | Guy C | 46 |
| | | Guy D | 45 |
| L18 | 93.396-87.188 | Pole | 18 |
| L19 | 87.188-80.979 | Pole | 19 |
| L20 | 80.979-74.771 | Pole | 20 |
| L21 | 74.771-68.563 | Pole | 21 |
| L22 | 68.563-62.354 | Pole | 22 |
| | | Guy A | 52 |
| | | Guy B | 51 |
| | | Guy C | 50 |
| | | Guy D | 49 |
| L23 | 62.354-56.146 | Pole | 23 |
| L24 | 56.146-49.938 | Pole | 24 |
| L25 | 49.938-43.729 | Pole | 25 |
| L26 | 43.729-37.521 | Pole | 26 |
| L27 | 37.521-31.313 | Pole | 27 |
| | | Guy A | 56 |
| | | Guy B | 55 |
| | | Guy C | 54 |
| | | Guy D | 53 |
| L28 | 31.313-25.105 | Pole | 28 |
| L29 | 25.105-18.896 | Pole | 29 |
| L30 | 18.896-12.688 | Pole | 30 |
| L31 | 12.688-6.480 | Pole | 31 |
| L32 | 6.480-0.000 | Pole | 32 |
| | | | Total number of elements: 56 |

| | | | |
|---|---|---|---|
| BU: | LMS 105 thru 110 | Structure: | D |
| WO: | anuska Susitna Borough | | |
| Order: | Longroad Energy | Rev: | H |

## Location

| | Decimal Degrees | | Deg | Min | Sec |
|---|---|---|---|---|---|
| Lat: | 61.473061 | + | 61 | 28 | 23.02 |
| Long: | -150.988808 | - | 150 | 59 | 19.71 |

## Code and Site Parameters

| | | |
|---|---|---|
| Seismic Design Code: | TIA-222-H | |
| Site Soil: | D (Default) | Default |
| Risk Category: | II | |

| USGS Seismic Reference | | | |
|---|---|---|---|
| | $S_S$: | 1.6180 | g |
| | $S_1$: | 0.7570 | g |
| | $T_L$: | 16 | s |

## Seismic Design Category Determination

| | | |
|---|---|---|
| Importance Factor, $I_e$: | 1 | |
| Acceleration-based site coefficient, $F_a$: | 1.2000 | |
| Velocity-based site coefficient, $F_v$: | 1.7000 | |
| Design spectral response acceleration short period, $S_{DS}$: | 1.2944 | g |
| Design spectral response acceleration 1 s period, $S_{D1}$: | 0.8579 | g |
| Seismic Design Category Based on $S_{DS}$: | D | |
| Seismic Design Category Based on $S_{D1}$: | D | |
| Seismic Design Category Based on $S_1$: | E | |
| Controlling Seismic Design Category: | E | |

| | | | |
|---|---|---|---|
| BU: | LMS 105 thru 110 | Structure: | D |
| WO: | atanuska Susitna Borough | | |
| Order: | Longroad Energy | Rev: | H |

## Tower Details

| | | | |
|---|---|---|---|
| Tower Type: | Tapered Monopole | | |
| Height, h: | 198 | ft | |
| Effective Seismic Weight, W: | 3.22 | kips | |
| Amplification Factor, $A_s$: | 1.0 | | 2.7.8.1 |

## Seismic Base Shear

| | | | |
|---|---|---|---|
| Response Modification Factor, R: | 1.5 | | |
| Discrete Appurtenance Weight in Top 1/3 of Structure, $W_u$: | 0.14455 | kips | |
| $W_L$: | 3.078835518 | kips | |
| E: | 29000.0 | ksi | |
| g: | 386.088 | $in/s^2$ | |
| Average Moment of Inertia, $I_{avg}$: | 36.87798227 | $in^4$ | |
| $F_a$: | 0.051819005 | hz | |
| Approximate Fundamental Period Monopole, $T_a$: | 19.2979 | s | 2.7.7.1.3.3 |
| Seismic Response Coefficient, $C_s$ | 0.8629 | | 2.7.7.1.1 |
| Seismic Response Coefficient Max 1, $C_{smax}$ | N/A | | 2.7.7.1.1 |
| Seismic Response Coefficient Max 2, $C_{smax}$ | 0.024573126 | | 2.7.7.1.1 |
| Seismic Response Coefficient Min 1, $C_{smin}$ | 0.0570 | | 2.7.7.1.1 |
| Seismic Response Coefficient Min 2, $C_{smin}$ | 0.4037 | | 2.7.7.1.1 |
| Controlling Seismic Response Coefficient, $C_{sc}$ | 0.4037 | | |
| Seismic Base Shear, V | 1.301 | kips | 2.7.7.1.1 |

## Vertical Distribution Factors

| | | | |
|---|---|---|---|
| Period Related Exponent, k: | 2.000 | | 2.7.7.1.2 |
| Sum of $w_i h_i^k$ | 40253.99 | | 2.7.7.1.2 |

| Tower Section Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Section Number | Length | Top Height | Mid Height, $h_x$ | Section Weight, $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| 1 - 1 | 7.25 | 197.69 | 194.06 | 0.0841 | 3168.84 | 0.0787 | 0.1024 | 0.0218 |
| 2 - 1 | 7.25 | 191.27 | 187.65 | 0.0817 | 2878.48 | 0.0715 | 0.0931 | 0.0212 |
| 3 - 1 | 7.25 | 184.85 | 181.23 | 0.0815 | 2675.94 | 0.0665 | 0.0865 | 0.0211 |
| 4 - 1 | 7.25 | 178.44 | 174.81 | 0.0814 | 2488.84 | 0.0618 | 0.0805 | 0.0211 |
| 5 - 1 | 7.25 | 172.02 | 168.40 | 0.0814 | 2309.38 | 0.0574 | 0.0747 | 0.0211 |
| 6 - 1 | 7.25 | 165.60 | 161.98 | 0.0814 | 2136.73 | 0.0531 | 0.0691 | 0.0211 |
| 7 - 1 | 7.25 | 159.19 | 155.56 | 0.0814 | 1970.79 | 0.0490 | 0.0637 | 0.0211 |
| 8 - 1 | 7.25 | 152.77 | 149.15 | 0.0814 | 1811.56 | 0.0450 | 0.0586 | 0.0211 |
| 9 - 1 | 7.25 | 146.35 | 142.73 | 0.0814 | 1659.04 | 0.0412 | 0.0536 | 0.0211 |
| 10 - 1 | 7.25 | 139.94 | 136.31 | 0.0814 | 1513.22 | 0.0376 | 0.0489 | 0.0211 |
| 11 - 1 | 7.25 | 133.52 | 129.90 | 0.0814 | 1374.11 | 0.0341 | 0.0444 | 0.0211 |
| 12 - 1 | 7.25 | 127.10 | 123.48 | 0.0814 | 1241.70 | 0.0308 | 0.0401 | 0.0211 |
| 13 - 1 | 7.25 | 120.69 | 117.06 | 0.0814 | 1116.00 | 0.0277 | 0.0361 | 0.0211 |
| 14 - 1 | 7.25 | 114.27 | 110.65 | 0.0814 | 997.01 | 0.0248 | 0.0322 | 0.0211 |
| 15 - 1 | 7.25 | 107.85 | 104.23 | 0.0814 | 884.73 | 0.0220 | 0.0286 | 0.0211 |
| 16 - 1 | 3.00 | 101.44 | 99.94 | 0.0275 | 274.67 | 0.0068 | 0.0089 | 0.0071 |
| 17 - 1 | 6.08 | 99.48 | 96.44 | 0.0798 | 742.25 | 0.0184 | 0.0240 | 0.0207 |
| 18 - 1 | 7.25 | 94.44 | 90.81 | 0.1012 | 834.92 | 0.0207 | 0.0270 | 0.0262 |
| 19 - 1 | 7.25 | 88.23 | 84.60 | 0.1024 | 733.10 | 0.0182 | 0.0237 | 0.0265 |
| 20 - 1 | 7.25 | 82.02 | 78.40 | 0.1026 | 630.50 | 0.0157 | 0.0204 | 0.0266 |
| 21 - 1 | 7.25 | 75.81 | 72.19 | 0.1026 | 534.72 | 0.0133 | 0.0173 | 0.0266 |
| 22 - 1 | 7.25 | 69.60 | 65.98 | 0.1026 | 446.72 | 0.0111 | 0.0144 | 0.0266 |
| 23 - 1 | 7.25 | 63.40 | 59.77 | 0.1026 | 366.61 | 0.0091 | 0.0119 | 0.0266 |
| 24 - 1 | 7.25 | 57.19 | 53.56 | 0.1026 | 294.41 | 0.0073 | 0.0095 | 0.0266 |
| 25 - 1 | 7.25 | 50.98 | 47.35 | 0.1026 | 230.11 | 0.0057 | 0.0074 | 0.0266 |
| 26 - 1 | 7.25 | 44.77 | 41.15 | 0.1026 | 173.73 | 0.0043 | 0.0056 | 0.0266 |
| 27 - 1 | 7.25 | 38.56 | 34.94 | 0.1026 | 125.26 | 0.0031 | 0.0040 | 0.0266 |
| 28 - 1 | 7.25 | 32.35 | 28.73 | 0.1026 | 84.70 | 0.0021 | 0.0027 | 0.0266 |
| 29 - 1 | 7.25 | 26.15 | 22.52 | 0.1026 | 52.05 | 0.0013 | 0.0017 | 0.0266 |
| 30 - 1 | 7.25 | 19.94 | 16.31 | 0.1026 | 27.31 | 0.0007 | 0.0009 | 0.0266 |
| 31 - 1 | 7.25 | 13.73 | 10.10 | 0.1026 | 10.48 | 0.0003 | 0.0003 | 0.0266 |
| 32 - 1 | 7.52 | 7.52 | 3.76 | 0.1065 | 1.51 | 0.0000 | 0.0000 | 0.0276 |
| | | | Sum | 2.8734 | 33789.42 | | | |

| Discrete Loads | | | | | | |
|---|---|---|---|---|---|---|
| Name | $h_x$ | $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| Properllor Anemometer/Wind Vane | 198.49 | 0.0022 | 86.68 | 0.0022 | 0.0028 | 0.0006 |
| 95" Boom Mount | 196.19 | 0.0080 | 307.94 | 0.0076 | 0.0100 | 0.0021 |
| NRG #40C Anemometer | 192.91 | 0.0002 | 7.44 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 190.91 | 0.0080 | 291.58 | 0.0072 | 0.0094 | 0.0021 |
| NRG #40C Anemometer | 192.91 | 0.0002 | 7.44 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 190.91 | 0.0080 | 291.58 | 0.0072 | 0.0094 | 0.0021 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| NRG 200P Wind Vane | 167.32 | 0.0003 | 7.00 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 165.32 | 0.0080 | 218.65 | 0.0054 | 0.0071 | 0.0021 |
| NRG #40C Anemometer | 167.32 | 0.0002 | 5.60 | 0.0001 | 0.0002 | 0.0001 |
| 95" Boom Mount | 165.32 | 0.0080 | 218.65 | 0.0054 | 0.0071 | 0.0021 |
| Temperature Probe w/ Shield | 173.89 | 0.0050 | 151.18 | 0.0038 | 0.0049 | 0.0013 |
| Relative Humidty Sensor | 173.89 | 0.0100 | 302.36 | 0.0075 | 0.0098 | 0.0026 |
| Barometric Pressure | 173.89 | 0.0100 | 302.36 | 0.0075 | 0.0098 | 0.0026 |
| NRG 200P Wind Vane | 160.76 | 0.0003 | 6.46 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 158.76 | 0.0080 | 201.64 | 0.0050 | 0.0065 | 0.0021 |
| NRG 200P Wind Vane | 137.80 | 0.0003 | 4.75 | 0.0001 | 0.0002 | 0.0001 |
| 95" Boom Mount | 135.80 | 0.0080 | 147.52 | 0.0037 | 0.0048 | 0.0021 |
| NRG #40C Anemometer | 131.23 | 0.0002 | 3.44 | 0.0001 | 0.0001 | 0.0001 |
| 95" Boom Mount | 129.23 | 0.0080 | 133.61 | 0.0033 | 0.0043 | 0.0021 |
| NRG #40C Anemometer | 131.23 | 0.0002 | 3.44 | 0.0001 | 0.0001 | 0.0001 |
| 95" Boom Mount | 129.23 | 0.0080 | 133.61 | 0.0033 | 0.0043 | 0.0021 |
| NRG #40C Anemometer | 98.43 | 0.0002 | 1.94 | 0.0000 | 0.0001 | 0.0001 |
| 95" Boom Mount | 96.43 | 0.0080 | 74.38 | 0.0018 | 0.0024 | 0.0021 |
| NRG #40C Anemometer | 98.43 | 0.0002 | 1.94 | 0.0000 | 0.0001 | 0.0001 |
| 95" Boom Mount | 96.43 | 0.0080 | 74.38 | 0.0018 | 0.0024 | 0.0021 |
| Temperature Probe w/ Shield | 49.20 | 0.0050 | 12.10 | 0.0003 | 0.0004 | 0.0013 |
| Data Logger | 5.00 | 0.0500 | 1.25 | 0.0000 | 0.0000 | 0.0129 |
| | Sum | 0.2324 | 4959.61 | | | |

| Linear Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Name | Start Height | End Height | $h_x$ | $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| (12) miscl Cat5 From 0 to 196 | 188.00 | 196.00 | 192.00 | 0.0048 | 176.95 | 0.0044 | 0.0057 | 0.0012 |
| (12) miscl Cat5 From 0 to 196 | 178.00 | 188.00 | 183.00 | 0.0060 | 200.93 | 0.0050 | 0.0065 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 168.00 | 178.00 | 173.00 | 0.0060 | 179.57 | 0.0045 | 0.0058 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 158.00 | 168.00 | 163.00 | 0.0060 | 159.41 | 0.0040 | 0.0052 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 148.00 | 158.00 | 153.00 | 0.0060 | 140.45 | 0.0035 | 0.0045 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 138.00 | 148.00 | 143.00 | 0.0060 | 122.69 | 0.0030 | 0.0040 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 128.00 | 138.00 | 133.00 | 0.0060 | 106.13 | 0.0026 | 0.0034 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 118.00 | 128.00 | 123.00 | 0.0060 | 90.77 | 0.0023 | 0.0029 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 108.00 | 118.00 | 113.00 | 0.0060 | 76.61 | 0.0019 | 0.0025 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 98.00 | 108.00 | 103.00 | 0.0060 | 63.65 | 0.0016 | 0.0021 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 88.00 | 98.00 | 93.00 | 0.0060 | 51.89 | 0.0013 | 0.0017 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 78.00 | 88.00 | 83.00 | 0.0060 | 41.33 | 0.0010 | 0.0013 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 68.00 | 78.00 | 73.00 | 0.0060 | 31.97 | 0.0008 | 0.0010 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 58.00 | 68.00 | 63.00 | 0.0060 | 23.81 | 0.0006 | 0.0008 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 48.00 | 58.00 | 53.00 | 0.0060 | 16.85 | 0.0004 | 0.0005 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 38.00 | 48.00 | 43.00 | 0.0060 | 11.09 | 0.0003 | 0.0004 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 28.00 | 38.00 | 33.00 | 0.0060 | 6.53 | 0.0002 | 0.0002 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 18.00 | 28.00 | 23.00 | 0.0060 | 3.17 | 0.0001 | 0.0001 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 8.00 | 18.00 | 13.00 | 0.0060 | 1.01 | 0.0000 | 0.0000 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 0.00 | 8.00 | 4.00 | 0.0048 | 0.08 | 0.0000 | 0.0000 | 0.0012 |
| | | | Sum | 0.1176 | 1504.96 | | | |

| | | | |
|---|---|---|---|
| BU: | LMS 105 thru 110 | Structure: | D |
| WO: | atanuska Susitna Borough | | |
| Order: | Longroad Energy | Rev: | H |

## Tower Details

| | | | |
|---|---|---|---|
| Tower Type: | Tapered Monopole | | |
| Height, h: | 198 | ft | |
| Effective Seismic Weight, W: | 3.22 | kips | |
| Amplification Factor, $A_s$: | 1.0 | | 2.7.8.1 |

## Seismic Base Shear

| | | | |
|---|---|---|---|
| Response Modification Factor, R: | 1.5 | | |
| Discrete Appurtenance Weight in Top 1/3 of Structure, $W_u$: | 0.14455 | kips | |
| $W_L$: | 3.078835518 | kips | |
| E: | 29000.0 | ksi | |
| g: | 386.088 | $in/s^2$ | |
| Average Moment of Inertia, $I_{avg}$: | 36.87798227 | $in^4$ | |
| $F_a$: | 0.051819005 | hz | |
| Approximate Fundamental Period Monopole, $T_a$: | 19.2979 | s | 2.7.7.1.3.3 |
| Seismic Response Coefficient, $C_s$ | 0.8629 | | 2.7.7.1.1 |
| Seismic Response Coefficient Max 1, $C_{smax}$ | N/A | | 2.7.7.1.1 |
| Seismic Response Coefficient Max 2, $C_{smax}$ | 0.024573126 | | 2.7.7.1.1 |
| Seismic Response Coefficient Min 1, $C_{smin}$ | 0.0570 | | 2.7.7.1.1 |
| Seismic Response Coefficient Min 2, $C_{smin}$ | 0.4037 | | 2.7.7.1.1 |
| Controlling Seismic Response Coefficient, $C_{sc}$ | 0.4037 | | |
| Seismic Base Shear, V | 1.301 | kips | 2.7.7.1.1 |

## Vertical Distribution Factors

| | | |
|---|---|---|
| Period Related Exponent, k: | 2.000 | 2.7.7.1.2 |
| Sum of $w_i h_i^k$ | 40253.99 | 2.7.7.1.2 |

| Tower Section Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Section Number | Length | Top Height | Mid Height, $h_x$ | Section Weight, $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| 1 - 1 | 7.25 | 197.69 | 194.06 | 0.0841 | 3168.84 | 0.0787 | 0.1024 | 0.0218 |
| 2 - 1 | 7.25 | 191.27 | 187.65 | 0.0817 | 2878.48 | 0.0715 | 0.0931 | 0.0212 |
| 3 - 1 | 7.25 | 184.85 | 181.23 | 0.0815 | 2675.94 | 0.0665 | 0.0865 | 0.0211 |
| 4 - 1 | 7.25 | 178.44 | 174.81 | 0.0814 | 2488.84 | 0.0618 | 0.0805 | 0.0211 |
| 5 - 1 | 7.25 | 172.02 | 168.40 | 0.0814 | 2309.38 | 0.0574 | 0.0747 | 0.0211 |
| 6 - 1 | 7.25 | 165.60 | 161.98 | 0.0814 | 2136.73 | 0.0531 | 0.0691 | 0.0211 |
| 7 - 1 | 7.25 | 159.19 | 155.56 | 0.0814 | 1970.79 | 0.0490 | 0.0637 | 0.0211 |
| 8 - 1 | 7.25 | 152.77 | 149.15 | 0.0814 | 1811.56 | 0.0450 | 0.0586 | 0.0211 |
| 9 - 1 | 7.25 | 146.35 | 142.73 | 0.0814 | 1659.04 | 0.0412 | 0.0536 | 0.0211 |
| 10 - 1 | 7.25 | 139.94 | 136.31 | 0.0814 | 1513.22 | 0.0376 | 0.0489 | 0.0211 |
| 11 - 1 | 7.25 | 133.52 | 129.90 | 0.0814 | 1374.11 | 0.0341 | 0.0444 | 0.0211 |
| 12 - 1 | 7.25 | 127.10 | 123.48 | 0.0814 | 1241.70 | 0.0308 | 0.0401 | 0.0211 |
| 13 - 1 | 7.25 | 120.69 | 117.06 | 0.0814 | 1116.00 | 0.0277 | 0.0361 | 0.0211 |
| 14 - 1 | 7.25 | 114.27 | 110.65 | 0.0814 | 997.01 | 0.0248 | 0.0322 | 0.0211 |
| 15 - 1 | 7.25 | 107.85 | 104.23 | 0.0814 | 884.73 | 0.0220 | 0.0286 | 0.0211 |
| 16 - 1 | 3.00 | 101.44 | 99.94 | 0.0275 | 274.67 | 0.0068 | 0.0089 | 0.0071 |
| 17 - 1 | 6.08 | 99.48 | 96.44 | 0.0798 | 742.25 | 0.0184 | 0.0240 | 0.0207 |
| 18 - 1 | 7.25 | 94.44 | 90.81 | 0.1012 | 834.92 | 0.0207 | 0.0270 | 0.0262 |
| 19 - 1 | 7.25 | 88.23 | 84.60 | 0.1024 | 733.10 | 0.0182 | 0.0237 | 0.0265 |
| 20 - 1 | 7.25 | 82.02 | 78.40 | 0.1026 | 630.50 | 0.0157 | 0.0204 | 0.0266 |
| 21 - 1 | 7.25 | 75.81 | 72.19 | 0.1026 | 534.72 | 0.0133 | 0.0173 | 0.0266 |
| 22 - 1 | 7.25 | 69.60 | 65.98 | 0.1026 | 446.72 | 0.0111 | 0.0144 | 0.0266 |
| 23 - 1 | 7.25 | 63.40 | 59.77 | 0.1026 | 366.61 | 0.0091 | 0.0119 | 0.0266 |
| 24 - 1 | 7.25 | 57.19 | 53.56 | 0.1026 | 294.41 | 0.0073 | 0.0095 | 0.0266 |
| 25 - 1 | 7.25 | 50.98 | 47.35 | 0.1026 | 230.11 | 0.0057 | 0.0074 | 0.0266 |
| 26 - 1 | 7.25 | 44.77 | 41.15 | 0.1026 | 173.73 | 0.0043 | 0.0056 | 0.0266 |
| 27 - 1 | 7.25 | 38.56 | 34.94 | 0.1026 | 125.26 | 0.0031 | 0.0040 | 0.0266 |
| 28 - 1 | 7.25 | 32.35 | 28.73 | 0.1026 | 84.70 | 0.0021 | 0.0027 | 0.0266 |
| 29 - 1 | 7.25 | 26.15 | 22.52 | 0.1026 | 52.05 | 0.0013 | 0.0017 | 0.0266 |
| 30 - 1 | 7.25 | 19.94 | 16.31 | 0.1026 | 27.31 | 0.0007 | 0.0009 | 0.0266 |
| 31 - 1 | 7.25 | 13.73 | 10.10 | 0.1026 | 10.48 | 0.0003 | 0.0003 | 0.0266 |
| 32 - 1 | 7.52 | 7.52 | 3.76 | 0.1065 | 1.51 | 0.0000 | 0.0000 | 0.0276 |
| | | | Sum | 2.8734 | 33789.42 | | | |

| Discrete Loads | | | | | | |
|---|---|---|---|---|---|---|
| Name | $h_x$ | $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| Properllor Anemometer/Wind Vane | 198.49 | 0.0022 | 86.68 | 0.0022 | 0.0028 | 0.0006 |
| 95" Boom Mount | 196.19 | 0.0080 | 307.94 | 0.0076 | 0.0100 | 0.0021 |
| NRG #40C Anemometer | 192.91 | 0.0002 | 7.44 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 190.91 | 0.0080 | 291.58 | 0.0072 | 0.0094 | 0.0021 |
| NRG #40C Anemometer | 192.91 | 0.0002 | 7.44 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 190.91 | 0.0080 | 291.58 | 0.0072 | 0.0094 | 0.0021 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| Aircraft Marker Balls (21" Dia - Orange) | 180.77 | 0.0150 | 490.17 | 0.0122 | 0.0158 | 0.0039 |
| NRG 200P Wind Vane | 167.32 | 0.0003 | 7.00 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 165.32 | 0.0080 | 218.65 | 0.0054 | 0.0071 | 0.0021 |
| NRG #40C Anemometer | 167.32 | 0.0002 | 5.60 | 0.0001 | 0.0002 | 0.0001 |
| 95" Boom Mount | 165.32 | 0.0080 | 218.65 | 0.0054 | 0.0071 | 0.0021 |
| Temperature Probe w/ Shield | 173.89 | 0.0050 | 151.18 | 0.0038 | 0.0049 | 0.0013 |
| Relative Humidty Sensor | 173.89 | 0.0100 | 302.36 | 0.0075 | 0.0098 | 0.0026 |
| Barometric Pressure | 173.89 | 0.0100 | 302.36 | 0.0075 | 0.0098 | 0.0026 |
| NRG 200P Wind Vane | 160.76 | 0.0003 | 6.46 | 0.0002 | 0.0002 | 0.0001 |
| 95" Boom Mount | 158.76 | 0.0080 | 201.64 | 0.0050 | 0.0065 | 0.0021 |
| NRG 200P Wind Vane | 137.80 | 0.0003 | 4.75 | 0.0001 | 0.0002 | 0.0001 |
| 95" Boom Mount | 135.80 | 0.0080 | 147.52 | 0.0037 | 0.0048 | 0.0021 |
| NRG #40C Anemometer | 131.23 | 0.0002 | 3.44 | 0.0001 | 0.0001 | 0.0001 |
| 95" Boom Mount | 129.23 | 0.0080 | 133.61 | 0.0033 | 0.0043 | 0.0021 |
| NRG #40C Anemometer | 131.23 | 0.0002 | 3.44 | 0.0001 | 0.0001 | 0.0001 |
| 95" Boom Mount | 129.23 | 0.0080 | 133.61 | 0.0033 | 0.0043 | 0.0021 |
| NRG #40C Anemometer | 98.43 | 0.0002 | 1.94 | 0.0000 | 0.0001 | 0.0001 |
| 95" Boom Mount | 96.43 | 0.0080 | 74.38 | 0.0018 | 0.0024 | 0.0021 |
| NRG #40C Anemometer | 98.43 | 0.0002 | 1.94 | 0.0000 | 0.0001 | 0.0001 |
| 95" Boom Mount | 96.43 | 0.0080 | 74.38 | 0.0018 | 0.0024 | 0.0021 |
| Temperature Probe w/ Shield | 49.20 | 0.0050 | 12.10 | 0.0003 | 0.0004 | 0.0013 |
| Data Logger | 5.00 | 0.0500 | 1.25 | 0.0000 | 0.0000 | 0.0129 |
| | Sum | 0.2324 | 4959.61 | | | |

| Linear Loads | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Name | Start Height | End Height | $h_x$ | $w_x$ | $w_x h_x^k$ | $C_{vx}$ | $F_{xh}$ | $F_{xv}$ |
| (12) miscl Cat5 From 0 to 196 | 188.00 | 196.00 | 192.00 | 0.0048 | 176.95 | 0.0044 | 0.0057 | 0.0012 |
| (12) miscl Cat5 From 0 to 196 | 178.00 | 188.00 | 183.00 | 0.0060 | 200.93 | 0.0050 | 0.0065 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 168.00 | 178.00 | 173.00 | 0.0060 | 179.57 | 0.0045 | 0.0058 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 158.00 | 168.00 | 163.00 | 0.0060 | 159.41 | 0.0040 | 0.0052 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 148.00 | 158.00 | 153.00 | 0.0060 | 140.45 | 0.0035 | 0.0045 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 138.00 | 148.00 | 143.00 | 0.0060 | 122.69 | 0.0030 | 0.0040 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 128.00 | 138.00 | 133.00 | 0.0060 | 106.13 | 0.0026 | 0.0034 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 118.00 | 128.00 | 123.00 | 0.0060 | 90.77 | 0.0023 | 0.0029 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 108.00 | 118.00 | 113.00 | 0.0060 | 76.61 | 0.0019 | 0.0025 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 98.00 | 108.00 | 103.00 | 0.0060 | 63.65 | 0.0016 | 0.0021 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 88.00 | 98.00 | 93.00 | 0.0060 | 51.89 | 0.0013 | 0.0017 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 78.00 | 88.00 | 83.00 | 0.0060 | 41.33 | 0.0010 | 0.0013 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 68.00 | 78.00 | 73.00 | 0.0060 | 31.97 | 0.0008 | 0.0010 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 58.00 | 68.00 | 63.00 | 0.0060 | 23.81 | 0.0006 | 0.0008 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 48.00 | 58.00 | 53.00 | 0.0060 | 16.85 | 0.0004 | 0.0005 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 38.00 | 48.00 | 43.00 | 0.0060 | 11.09 | 0.0003 | 0.0004 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 28.00 | 38.00 | 33.00 | 0.0060 | 6.53 | 0.0002 | 0.0002 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 18.00 | 28.00 | 23.00 | 0.0060 | 3.17 | 0.0001 | 0.0001 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 8.00 | 18.00 | 13.00 | 0.0060 | 1.01 | 0.0000 | 0.0000 | 0.0016 |
| (12) miscl Cat5 From 0 to 196 | 0.00 | 8.00 | 4.00 | 0.0048 | 0.08 | 0.0000 | 0.0000 | 0.0012 |
| | | | Sum | 0.1176 | 1504.96 | | | |

# ASCE 7 Hazards Report

**Address:**
No Address at This Location

**Standard:** ASCE/SEI 7-16
**Risk Category:** II
**Soil Class:** D - Default (see Section 11.4.3)

**Elevation:** 0 ft (NAVD 88)
**Latitude:** 61.473061
**Longitude:** -150.988809

## Wind

**Results:**

| | |
|---|---|
| Wind Speed | 121 Vmph |
| 10-year MRI | 86 Vmph |
| 25-year MRI | 94 Vmph |
| 50-year MRI | 99 Vmph |
| 100-year MRI | 105 Vmph |

| | |
|---|---|
| Data Source: | ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2 |
| Date Accessed: | Wed May 29 2024 |

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

# Seismic

**Site Soil Class:** D - Default (see Section 11.4.3)

**Results:**

| | | | |
|---|---|---|---|
| $S_S$ : | 1.618 | $S_{D1}$ : | N/A |
| $S_1$ : | 0.757 | $T_L$ : | 16 |
| $F_a$ : | 1.2 | PGA : | 0.661 |
| $F_v$ : | N/A | $PGA_M$ : | 0.794 |
| $S_{MS}$ : | 1.941 | $F_{PGA}$ : | 1.2 |
| $S_{M1}$ : | N/A | $I_e$ : | 1 |
| $S_{DS}$ : | 1.294 | $C_v$ : | 1.424 |

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

**Data Accessed:** Wed May 29 2024

**Date Source:** USGS Seismic Design Maps

# Ice

**Results:**

| | |
|---|---|
| Ice Thickness: | 0.50 in. |
| Concurrent Temperature: | -15 F |
| Gust Speed | 60 mph |
| **Data Source:** | Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8 |
| **Date Accessed:** | Wed May 29 2024 |

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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# APPENDIX B

# EQUIPMENT DETAILS

# Heavy Duty Wind Monitor-HD-Alpine

05108-45

The Heavy Duty Wind Monitor HD-Alpine combines the features of the HD unit along with the ice resistant coating of our popular Alpine Wind Monitor. Robust, reliable, durable . . . . all words to describe the latest addition of the YOUNG family of wind monitors developed to endure the most extreme environments.

| | | | |
|---|---|---|---|
| 0 | WIND MONITOR-HD ALPINE<br>3M Cable | 05108-45 | $1,710.00 |

| | | | |
|---|---|---|---|
| 0 | WIND MONITOR-HD ALPINE<br>8M Cable | 05108-45-8M | $1,730.00 |
| 0 | WIND MONITOR-HD ALPINE<br>12M Cable | 05108-45-12M | $1,756.00 |
| 0 | SURGE PROTECTION ASSEMBLY<br>6 Channel | 19120 | $220.00 |
| 0 | WIND SENSOR INTERFACE (for use with Model 05108)<br>0-5 VDC Outputs (recommended cable: 18446) | 05608C | $526.00 |
| 0 | WIND LINE DRIVER (for use with Model 05108)<br>4-20 mA Outputs (recommended cable: 18723) | 05638C | $572.00 |
| 0 | SENSOR CABLE, 5 CONDUCTOR SHIELDED<br>22 AWG, Per Ft. | 18446 | $1.24 |
| 0 | SENSOR CABLE, 2 PAIR SHIELDED<br>22 AWG, Per Ft. | 18723 | $1.02 |
| 0 | SENSOR CABLE, 6 CONDUCTOR SHIELDED<br>22 AWG, Per Ft. | 18721 | $1.50 |

Add to cart

*Quantity discounts applied during checkout. Excludes sensor cables.*

Categories: **All Wind Products**, **Mechanical Wind Sensors**

Description

Specifications

Brochures & Manuals

Replacement Parts

| | |
|---|---|
| **Range:** | *Wind speed: 0-100 m/s (224 mph)*<br>*Azimuth: 360° mechanical, 355° electrical (5° open)* |
| **Accuracy:** | *Wind speed: ± 0.3 m/s (0.6 mph) or 1% of reading*<br>*Wind direction: ± 3 degrees* |
| **Threshold: *** | *Propeller: 1.0 m/s (2.2 mph)*<br>*Vane: 1.0 m/s (2.2 mph)* |
| **Dynamic Response: *** | *Propeller distance constant (63% recovery) 2.7 m (8.9 ft)*<br>*Vane delay distance (50% recovery) 1.3 m (4.3 ft)*<br>*Damping ratio: 0.3*<br>*Damped natural wavelength: 7.4 m (24.3 ft)*<br>*Undamped natural wavelength: 7.2 m (23.6 ft)* |
| **Signal Output:** | *Wind speed: magnetically induced AC voltage, 3 pulses per revolution. 1800 rpm (90 Hz) = 15.0 m/s (33.6 mph)*<br>*Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω , linearity 0.25%, life expectancy – 50 million revolutions* |
| **Power Requirement:** | *Potentiometer excitation: 15 VDC maximum* |
| **Operating Temperature:** | *-50 to 60°C* |
| **Sensor Cable:** | *A water tight pigtail cable is supplied for electrical connections. Available in standard lengths of 3, 8 and 12 meters.*<br>*For longer cable lengths a user supplied junction box or connector may be used.* |
| **Dimensions:** | *Overall height: 37 cm (14.6 in)*<br>*Overall length: 55 cm (21.7 in)*<br>*Propeller: 18 cm (7 in) diameter*<br>*Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)* |
| **Weight:** | *1.0 kg (2.2 lbs)* |
| **Shipping Weight:** | *2.3 kg (5 lbs)* |
| **Model 05608C** | *Wind Sensor Interface*<br>*Signal outputs: 0-5.00 VDC full scale*<br>*Power requirement: 8-24 VDC (5 mA @ 12 VDC)*<br>*Operating temperature: -50 to 60°C* |
| **Model 05638C:** | *Wind Line Driver*<br>*Signal outputs: 4-20 mA full scale*<br>*Power Requirement: 12-30 VDC (40 mA max.)*<br>*Operating Temperature: -50 to 60°C* |
| * | *Nominal values, determined in accordance with ASTM standard procedures.* |

# NRG #40C Anemometer

## FEATURES

- The standard anemometer used in the wind energy industry
- Short distance constant
- Simple, durable design

The NRG #40C anemometer is the industry standard anemometer used worldwide. NRG #40 anemometers have recorded wind speeds of 96 m/s (214 mph). Their low moment of inertia and unique bearings permit very rapid response to gusts and lulls. Because of their output linearity, these sensors are ideal for use with various data retrieval systems. A four pole magnet induces a sine wave voltage into a coil producing an output signal with a frequency proportional to wind speed. The #40C is constructed of rugged Lexan cups molded in one piece for repeatable performance. A protective rubber terminal boot is included.

## SPECIFICATIONS

| | | |
|---|---|---|
| Description | Sensor type | 3-cup anemometer |
| | Applications | • wind resource assessment<br>• meteorological studies<br>• environmental monitoring |
| | Sensor range | 1 m/s to 96 m/s (2.2 mph to 214 mph) (highest recorded) |
| | Instrument compatibility | all NRG loggers |
| Output signal | Signal type | low level AC sine wave, frequency linearly proportional to windspeed |
| | Transfer function | m/s = (Hz x 0.765) + 0.35<br>[miles per hour = (Hz x 1.711) + 0.78] |
| | Accuracy | within 0.1 m/s (0.2 mph) for the range 5 m/s to 25 m/s (11 mph to 55 mph) |
| | Calibration | each anemometer individually calibrated, calibration reports provided via electronic download |
| | Output signal range | 0 Hz to 125 Hz (highest recorded) |

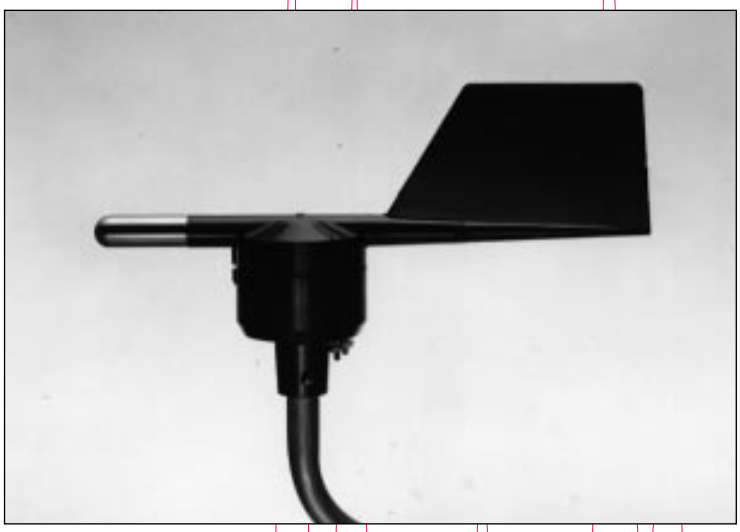
| | | |
|---|---|---|
| Response characteristics | Threshold | 0.78 m/s (1.75 miles per hour) |
| | Distance constant (63% recovery) | 3.0 m (10 feet) |
| | Moment of inertia | 68 x $10^{-6}$ S-$ft^2$ |
| | Swept diameter of rotor | 190 mm (7.5 inches) |
| Installation | Mounting | onto a 13 mm (0.5 inch) diameter mast with cotter pin and set screw |
| | Tools required | 0.25 inch nut driver, petroleum jelly, electrical tape |
| Environmental | Operating temperature range | -55 °C to 60 °C (-67 °F to 140 °F) |
| | Operating humidity range | 0 to 100% RH |
| Physical | Connections | 4-40 brass hex nut/post terminals |
| | Weight | 0.14 kg (0.3 pounds) |
| | Dimensions | • 3 cups of conical cross-section, 51 mm (2 inches) dia.<br>• 81 mm (3.2 inches) overall assembly height |
| Materials | Cups | one piece injection-molded black polycarbonate |
| | Body | housing is black ABS plastic |
| | Shaft | beryllium copper, fully hardened |
| | Bearing | modified Teflon, self-lubricating |
| | Magnet | Indox 1, 25 mm (1 inch) diameter, 13 mm (0.5 inch) long, 4 poles |
| | Coil | single coil, bobbin wound, 4100 turns of #40 wire, shielded for ESD protection |
| | Boot | protective PVC sensor terminal boot included |
| | Terminals | brass |

# 200 SERIES WIND VANE

Wind Direction Sensor

NRG Systems

*MEASURING THE WIND'S ENERGY*



■ The 200 Series Wind Direction Vane is a professional quality sensor, originally designed for use in some of the world's largest wind power plants. Its unique qualities make it ideal for use in many other applications in environmental testing and meteorology. ■ Although moderately priced, these sensors offer a level of quality and reliability often found only at a very high premium. The thermoplastic and stainless steel components resist corrosion, and contribute to a high strength-to-weight ratio. ■ As with all NRG Systems products, the 200 Series Vane is elegantly engineered, employing a minimum number of parts while maximizing functional performance. ■ The vane is directly connected to a precision conductive plastic potentiometer located in the main body. An analog voltage output directly proportional to the wind direction is produced when a constant DC excitation voltage is applied to the potentiometer. Several different yaw vane configurations are available for wind turbine control. ■ Field proven, the #200 is the wind industry de facto standard.

**NRG SYSTEMS**

110 Commerce Street

Hinesburg, VT 05461 USA

(802) 482-2255

FAX (802) 482-2272

Email: sales@nrgsystems.com

# 200 SERIES WIND VANE
## Wind Direction Sensor

## APPLICATIONS
- Wind direction sensor for wind data loggers
- Yaw control on wind turbines
- Environmental monitoring instrumentation
- Meteorological studies

## FEATURES
- Simple mechanical construction
- Long life, professional quality potentiometer
- No slip rings or brushes result in high reliability, low cost
- Corrosion-resistant materials
- Multiple mechanical and contact seals
- No setscrews to vibrate loose
- Very stable and smooth response to wind changes
- Fully balanced sensor vane

## SPECIFICATIONS
**MECHANICAL:**

*Range:* Direction–360° mechanical, continuous rotation
*Sensitivity:* Approx. 1 m/s (2.2 mph)
*Materials:*
Direction vane and housing–black UV stabilized injection molded plastic
Balance weight–stainless steel
Terminals–three #4-40 solid brass studs with nuts
Potentiometer–stainless steel shaft in two shielded precision grade, stainless steel ball bearings, conductive plastic potentiometer element mounted in a machined aluminum housing
Hardware–all stainless steel construction
*Dimensions:*
Overall length–21cm (8.3")
Swept diameter–27cm (10.5")
Overall height–12cm (4.3")
Vane size–6cm high x 10cm long (2.3" x 3.8")
Main housing diameter–5cm (2")
Mounting–13mm (0.5") diameter mast with cotter pin and mast set screw
*Weight:* 0.1kg (0.25 lb)
*Shipping Weight:* 0.5kg (1 lb)

**ELECTRICAL:**

*Range:*
Direction– #200: 340° elecrical (20° open); #200P: 352° electrical (8° open)
*Signal:*
Analog DC voltage from conductive plastic potentiometer 1K(#200), 10K(#200P); linearity 1.0%, life expectancy of 50 million revolutions (2-6 years normal operation)
*Power Requirements:*
Regulated potentiometer excitation of 1 to 15 VDC

**#200YZ YAW CONTROL WIND VANE**

The #200YZ Vane is built with standard #200 Series vane and body with an opto-interrupter type switching system. This yaw control sensor has an open collector, sinking output. Switch points are +/- 10° right or left. Also will control wind turbine yaw at 90° out of the wind.

*SPECIFICATIONS MAY CHANGE WITHOUT NOTICE.*

**ORDERING INFORMATION:**

| | |
|---|---|
| Wind Direction Vane–1K | Cat. No. 200 |
| Precision Wind Direction Vane–10K | Cat. No. 200P |

NRG Systems

*MEASURING THE WIND'S ENERGY*

**110 Commerce Street**

**Hinesburg, VT 05461 USA**

**(802) 482-2255**

**FAX (802) 482-2272**

**Email: sales@nrgsystems.com**

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# Barometric Pressure Sensors

**090D**
**091**

Barometric Pressure Sensors convert absolute atmospheric pressure into a linear, proportional voltage, which may be used in any meteorological program.

## Features

- Compact size
- Weatherproof enclosure
- Remote output
- Permanent calibration
- Robust construction

These sensors are inherently stable devices that do not require periodic service or routine recalibration.

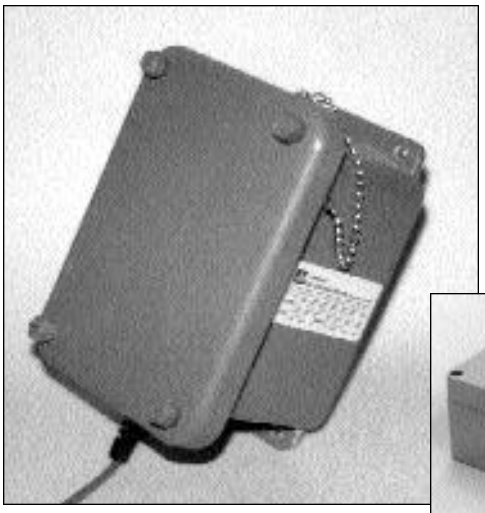
## Operation

The enclosure houses a solid-state pressure transducer, with linearization and amplification electronics.

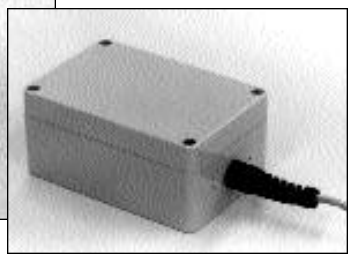
The Model 090D is housed in a heavy duty fiberglass enclosure, suitable for harsh and severe environments. A hose barb is provided to enable the connection of a 1/4" sampling tube to the outside environment.

The Model 091 is contained within a small polycarbonate enclosure, and may be mounted outside or inside a building or other enclosure. Small inlet holes allow the atmospheric pressure access to the sensing element.

The standard range of the 090D/ 091 is 26-32 in. Hg,* suitable for elevations sea level to 1500 ft. Other ranges are available.



090D



091

## Specifications

### Performance

| | |
|---|---|
| Resolution: | Infinite |
| Temp. Operating Range: | -40°C to 65°C |
| Temp. Compensated Range: | -18°C to 65°C |
| Accuracy: | ±0.04 in Hg (±1.35 mbar) or ±0.125% FS |

### Electrical Characteristics

| | |
|---|---|
| Power Requirement: | 11 mA @ 12 VDC, Typical |
| Sensor Output: | 0-1 VDC, Standard<br>0-5 VDC, Optional |

### Physical Characteristics

| | | |
|---|---|---|
| 090D | Weight: | 2 lbs, 5 oz (1.05 Kg) |
| | Dimensions: | 5.5 x 5 x 7.5 in (14 x 12 x 19 cm) |
| 091 | Weight: | 8.8 oz. (250 g) |
| | Dimensions: | 2.1 x 3.2 x 5 in (5.4 x 8.3 x 13 cm) |

### Ordering Information

| | |
|---|---|
| | Specify elevation |
| | Specify output voltage |
| Cable: | #1169-xx (xx = length in feet) |
| | Specify length in feet |

Specifications subject to change without notice.
*Conversions: 1 in. Hg = 3.3864 kPa, 1 in. Hg = 33.864 mbar, 1 in. Hg = 25.4 mm/Hg


Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

# 107 and 108

## Temperature Probes

The 107 and 108 are rugged, accurate probes that measure air, soil, and water temperature in a variety of applications. These probes consist of a thermistor encapsulated in an epoxy-filled aluminum housing. The housing protects the thermistor allowing the probes to be buried or submerged. The 107 measures from -35° to +50°C, the 108 from -5° to +95°C.

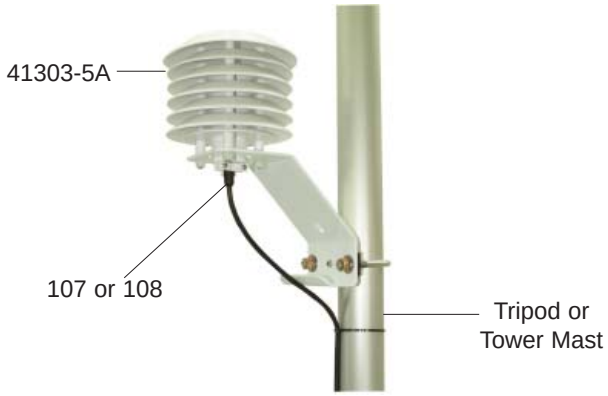
Please note that the 107 and 108 are not compatible with the CR200(X)-series dataloggers. However, a similar thermistor, the 109, has been developed specifically for our CR200(X)-series dataloggers.

Each 107 or 108 probe requires one single-ended channel for measurement.

## Installation

*Air Temperature*

When exposed to sunlight, the 107 and 108 probes should be housed in a 41303-5A 6-plate Gill Radiation Shield. The 41303-5A's louvered construction allows air to pass freely through the shield thereby keeping the probe at or near ambient temperature. The shield's white color reflects solar radiation. The 41303-5A attaches to a crossarm, mast, or user-supplied pipe with a 1.0-in. to 2.1-in. outer diameter.




Above is a probe housed in the 41303-5A radiation shield. The U-bolt is placed in the holes on the side of the bracket to allow the 41303-5A to be attached to a mast or vertical pole.

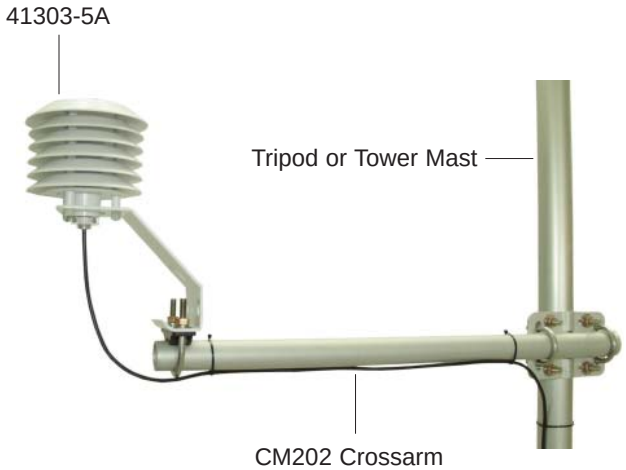
*Water Temperature*

The probes can be submerged to 50 feet (21 psi). Please note that neither the 107 nor 108 is weighted. Therefore, the installer should either add a weighting system or secure the probe to a fixed, submerged object, such as a piling.

*Soil Temperature*

The 107 and 108 are suitable for shallow burial only. Placement of the probe's cable inside a rugged conduit may be advisable for long cable runs—especially in locations subject to digging, mowing, traffic, use of power tools, or lightning strikes.

To attach the 41303-5A to a CM202, CM204, or CM206 crossarm, place the 41303-5A's U-bolt in the bottom holes.



## Recommended Cable Lengths for Air Temperature Measurements

| 2-m Height | | Atop a tripod or tower via a 2-ft crossarm such as the CM202 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mast/Leg** | **CM202** | **CM6** | **CM106** | **CM10** | **CM110** | **CM115** | **CM120** | **UT10** | **UT20** | **UT30** |
| 9 ft | 11 ft | 11 ft | 14 ft | 14 ft | 14 ft | 19 ft | 24 ft | 14 ft | 24 ft | 37 ft |

***Note:*** *Add two feet to the cable length if mounting the enclosure to the leg base of a CM106, CM110, CM115, or CM120 tripod.*

## Ordering Information

### Temperature Probes

**107-L** Temperature Probe (-35° to +50°C) with a user-specified cable length; enter the cable length (in feet) after the -L. Recommended cable length is shown above. Must choose a cable termination option (see below).

**108-L** Temperature Probe (-5° to +95°C) with a user-specified cable length; enter the cable length (in feet) after the -L. Recommended cable length is shown above. Must choose a cable termination option (see below).

### Cable Termination Options (choose one)

**-PT** Cable terminates in stripped and tinned leads for direct connection to a datalogger's terminals.

**-PW** Cable terminates in connector for attachment to a prewired enclosure.

### Solar Radiation Shield for Air Temperature Measurements

**41303-5A** 6-Plate Gill Radiation Shield that houses a 107 or 108 for air temperature measurements.

## Specifications

**Sensor:** BetaTherm 100K6A1B Thermistor

**Tolerance**
- **107:** ±0.2°C over 0° to 50°C range
- **108:** ±0.2°C over 0° to 70°C range

**Temperature Measurement Range**
- **107:** -35° to +50°C
- **108:** -5° to +95°C

**Steinhart-Hart Equation Error (CRBasic loggers only):** ≤±0.01°C over measurement range

**Polynomial Linearization Error (Edlog loggers only)**
- **107:** Typically <±0.5°C over measurement range
- **108:** Typically <±0.5°C over -5° to +90°C range

**Time Constant in Air:** 30 to 60 seconds in a wind speed of 5 m $sec^{-1}$

**Maximum Cable Length:** 1000 ft (305 m)

**Probe Length:** 4.1 in. (10.4 cm)

**Probe Diameter:** 0.3 in. (0.762 cm)

**Weight with 10-ft cable:** 5 oz (136 g)



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# NRG Side Mount Boom, 2.4 m (95")

Made of galvanized steel, the 2.4 m (95") side mount boom resists corrosion and is designed to securely mount NRG sensors away from NRG TallTowers to minimize tower shadowing effects.

## FEATURES

- For use with NRG #40C or NRG #200P sensors
- Easy to assemble
- Robust, dual-beam support structure
- Mounting bracket tabs assure proper boom installation
- Self-aligning mounting bracket assures secure, 90-degree vertical orientation
- Meets or exceeds industry IEC 61400-12-1 recommendations for tower and boom offset distances
  - » *Horizontal mast offset:* 12.38D on 8" tube; 10D on 10" tube [1]
  - » *Vertical boom offset:* 20D above boom for an NRG #40C anemometer, exceeding IEC 61400-12-1 minimum recommendation of 15D [2]

*Self-orienting mounting bracket* *Mounting bracket tab*

## SPECIFICATIONS

| | | |
|---|---|---|
| **Description** | Boom type | Sensor mounting boom for standard NRG sensors on NRG TallTowers 8" or 10" diameter |
| | Applications | Wind resource assessment; for mounting NRG #40C anemometer or NRG #200P wind direction vane on NRG TallTowers |
| | Sensor compatibility | • NRG #40C anemometer<br>• NRG #200P wind direction vane |
| | Tower compatibility | NRG TallTowers with 8" or 10" diameter tubing sections |
| **Installation** | Mounting | • Mounting bracket attaches to tower with three heavy-duty, stainless steel hose clamps<br>• Sensor mounts to boom with set screw and cotter pin |
| | Tools required | • 5/16 inch hex driver or flat blade (-) screwdriver for hose clamps<br>• Phillips head (+) screwdriver to mount sensor |
| | Recommended for installation | • Electric drill with 5/16 nut driver bit for tightening hose clamps<br>• Sheet metal shears or similar for trimming hose clamps |
| **Environmental** | Lifespan | 2 years + |
| **Physical** | Weight | 3.6 kg (8 lbs) |
| | Boom diameter | 15.875 mm (0.625 inch) dual beam support at mounting bracket location<br>19.05 mm (0.75 inch) at boom extension sleeve<br>12.7 mm (0.50 inch) at sensor mount location |
| | Offset distance | 2.4 m (95 inches) |
| | Offset height | 381 mm (15.0 inches) |
| **Materials** | Boom | 15.8 mm (0.625 inch) galvanized steel tube |
| | Mounting bracket | Galvanized steel |
| **Shipping** | Shipping weight | 3.8 kg (8.4 lbs) for one boom in one box |

*Note:*

[1] *Horizontal offset value, D refers to diameter of the tube tower. Per IEC 61400-12-1 horizontal mast offset is defined as the boom distance from the center of a tubular mast divided by the mast diameter (R/d).*

[2] *Vertical offset value, D refers to the diameter of the mounting boom tube directly below the sensor. Per IEC 61400-12-1 vertical boom offset is defined as the distance from top of the mounting boom tube to the centerline of anemometer cup rotor.*

***Global leader in wind measurement technology***

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# High Visibility Cable Balls

## Introduction

These instructions will assist you in installing high visibility cable balls on TallTower guy wires. The items included are:

- 8 orange plastic cable ball ½ (part number 3814)
- 24 bolts, truss-head #10-32x5/8, stainless steel (part number 3842)
- 48 washers, stainless steel (part number 3843)
- 24 nuts, #10-32 stainless steel Nylock (part number 3844)
- 1/4" cable kit
    - 4 short wire rope cables ¼", 26 inches long (part number 1513) [*compatible with 3/16" or ¼" guy wires*]
    - 8 wire rope clips for ¼" cable (part number 1596)

The tools required are:
(1) #2 Phillips head (+) screwdriver
(1) 3/8 inch nut driver or socket
(1) 1/2 inch nut driver or socket

## Installing the Cable Balls

Balls should be installed on each guy wire 3 m (10 feet) below the guy ring on the top set of guy wires. An additional set of balls can be installed lower on the same guy wires at least 3 m (10 feet) above highest point vegetation is likely to reach.

Place one half of a cable ball (part number 3814) in position with the TallTower guy wire cable running through the two grooves molded into the plastic to accept the cable.

Position the short wire rope cable next to the tower guy wire cable (marked with white tape in the photo below) in the grooves. Electrical tape may be used to hold this cable in place (as shown in photo 1).

**PHOTO 1**

**PHOTO 2**

Position the top half of the ball over the two cables (photo 2).

Install the bolts, washers and locknuts to secure the plastic pieces together (photo 3). Use a washer under the head of each bolt and another under each locknut. Tighten only enough to secure the plastic pieces together. Avoid over-tightening because this will crack the plastic.

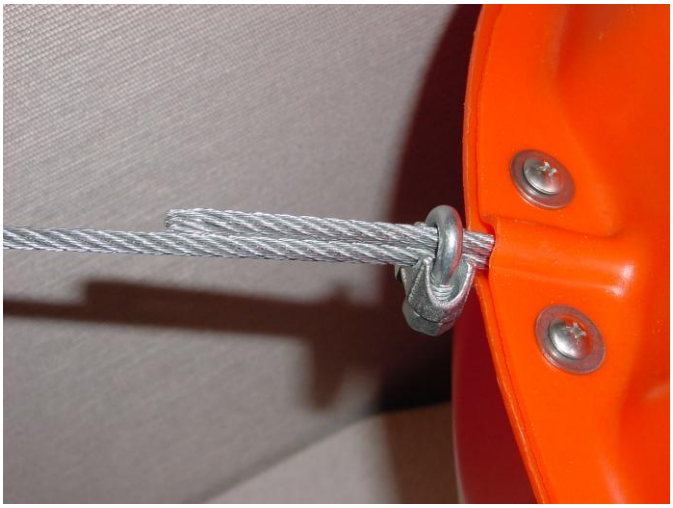


**PHOTO 3**

Place the u-bolt part of the wire rope clip over the 'dead' cable (the short wire rope cable). Place the saddle part of the wire rope clip over the 'live' cable (the TallTower guy wire cable) and tighten nuts. If you installed the wire rope clip correctly, the nuts will be on the same side as the TallTower guy wire cable (Photo 3). Pull the short cable tight and install another wire rope clip on the other side of the ball as described above.

*CAUTION:* Incorrect installation of the wire rope clip can severely weaken the cable and cause premature cable failure.

# APPENDIX C

# TYPICAL GUY ANCHORS AND TOWER BASE PLATE DETAIL

# Appendix B: Anchoring Guidelines

### B.1 DETERMINE SITE SOIL AND ANCHOR TYPE BEFORE YOU ORDER YOUR TOWER

Per ANSI/TIA-222-G, for design purposes, one can assume Class 6 soils. However, the Standard requires that soil parameters and assumptions be validated prior to installing the tower.

Before your tower is ordered, determine the soil type, preferably through soil sampling. Order the correct anchors based on the results of the soil sample.

The purpose of this section is to give you the information needed to provide suitable anchoring for your Super 60 m XHD TallTower. **Because anchor requirements are site specific, it is the responsibility of the customer to determine suitable anchors. If you are not sure what is required, seek professional guidance.**

Local utility companies can often provide useful information regarding anchoring used in the site area. Do not use rebar anchors, especially when the surface soils are loose or wet.

**Table B-1: Soil Classes**

| Class | Common Soil Types | Geological Soil Classification |
|---|---|---|
| 3 | Dense clays, sands and gravel; hard silts and clays | Glacial till; weathered shales, schist, gneiss and siltstone |
| 4 | Medium dense sandy gravel; very stiff to hard silts and clays | Glacial till; hardpan; marls |
| 5 | Medium dense coarse sand and sandy gravels; stiff to very stiff silts and clays | Saprolites, residual soils |
| 6 | Loose to medium dense fine to coarse sand; firm to stiff clays and silts | Dense hydraulic fill; compacted fill; residual soils |
| 7** | Loose fine sand; Alluvium; loess; soil-firm clays; varied clays; fill | Flood plain soils; lake clays; adobe; gumbo; fill |

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.
Charts reproduced by permission, The A.B. Chance Company.

## B.2 ANCHOR CHOICES AND OTHER CONSIDERATIONS

The choice of anchors must take into consideration soil type, maximum winds expected, icing or other weather that may affect the tower, and a safety factor suitable for the location and to meet any legal requirements. Considerations include but are not limited to: tornadoes, hurricanes or typhoons, locations where very high winds are expected, potential for flooding or periodic soaking of the soil, soil erosion, and icing events.

## B.3 Screw-In Anchor Description

Screw-in anchors are the most commonly used anchors for normal clay soils without rocks. The 8 inch single helix anchors are installed by hand, using a cross bar to screw them into the earth like a corkscrew. The 8 inch twin helix anchors require machinery.

The Super 60 m XHD tower employs two (2), 8 inch diameter screw-in anchors and sixteen (12), 8 inch twin helix anchors.

**Table B-2: Specifications for 203 mm (8 inches) diameter Screw-In Anchors**

| | |
|---|---|
| Length Overall: | **203 mm (8 inches) Anchor** |
| Helix diameter: | 203 mm (8.0 inches) |
| Length Overall: | 1.65 m (66 inches) |
| Rod diameter: | 25 mm (1 inch) |
| Material: | Galvanized steel |
| **Holding Power:** (These anchors are not suitable for soils denser than class 5.) | |
| Class 5 soils * | 44.5 kN (10000 pounds) |
| Class 6 soils * | 31.1 kN (7000 pounds) |
| Class 7 soils ** | 17.8 kN (4000 pounds) |

* See Table  for soil class descriptions

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.

**Table B-3: Specifications for Mid-Strength 203 mm (8 inches) diameter Twin Helix**

| | |
|---|---|
| Length Overall: | 2.7 m ( 9 feet) (including 7 foot rod) |
| Helix Diameter: | 203 mm (8.0 inches) |
| Materials: | TBD |
| **Holding Power:** | |
| Class 3 soils * | 12700 kg (28000 pounds) |
| Class 4 soils * | 10900 kg (24000 pounds) |
| Class 5 soils * | 9090 kg (20000 pounds) |
| Class 6 soils * | 6800 kg (15000 pounds) |
| Class 7 soils * | 5450 kg (12000 pounds) |

* See Table 13 for soil class descriptions

** In class 7 soils, it is advisable to place anchors deep enough to penetrate underlying class 5 or 6 soil.

Products > Anchors - Utility > Manta Ray® Earth Anchor

# MANTA RAY® EARTH ANCHOR

The Manta Ray Utility Anchor System is used by utilities worldwide. Manta Rays are driven into the ground using a jackhammer, not augured or torqued. No excavation is necessary. The anchors are driven with conventional hydraulic equipment that is readily available.

## Description

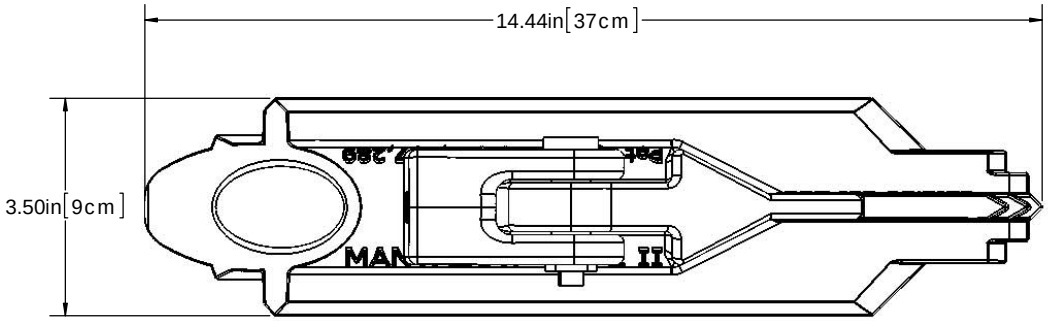
Manta Ray Anchors are RUS approved, rugged and versatile driven plate anchors for all types of soil conditions. They can be installed in extremely tough soils such as caliche, decomposed rock, glacial till, and permafrost. Larger models are also available for swamp application. Fully portable installation equipment which can fit in the back of a standard pickup truck can be used to access difficult to reach anchor locations. They can also be installed using the line truck's hydraulic system. Every anchor is proof tested during standard installation procedures for a verified tension load measurement. Manta Ray anchors are compatible with standard power hub anchor rods and eyenuts for distribution guy anchors.

## Links & PDFs

## Manta Ray Anchors

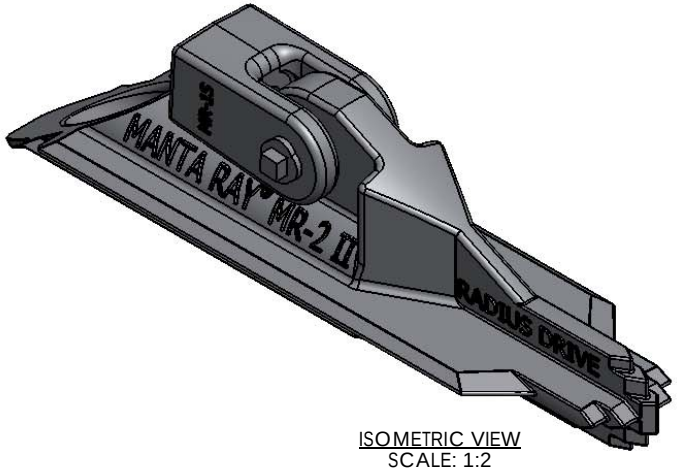
| Catalog Number | Model | For PH Rod Size | Ultimate Load Rating (lbs) | Weight (lbs) |
|---|---|---|---|---|
| 20036-UT-II | MR-1 | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 13 |
| 20199-UT-II | MR-2 | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 11 |
| 20210-UT-II | MR-3 | D62 (5/8") | 16,000 | 7 |
| 20229-UT-II | MR-SR | D75 (3/4") or D100 (1") | 23,000 or 36,000 | 21 |

| PAPER SIZE | CATALOG NUMBER |
|---|---|
| B | 20199-UT-II |

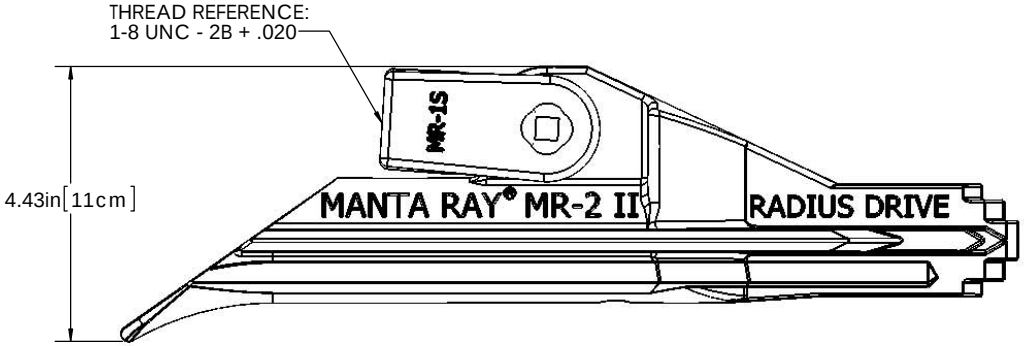



NOTES: UNLESS OTHERWISE SPECIFIED:

1) MECHANICAL ULTIMATE CAPACITY: 40,000 LBS [177.9kN]
2) MAXIMUM WORKING LOAD: UP TO 27,000 LBS [120.1 kN]
   (THIS VALUE IS SOIL AND ANCHOR ROD DEPENDANT)
3) AVERAGE WEIGHT: 10.2 LBS [4.6 kg]
4) FINISH: HOT DIP GALVANIZED




ISOMETRIC VIEW
SCALE: 1:2

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| | |
|---|---|
| DRAWING NUMBER: | 20199-UT-II |
| SHEET NAME: SHEET1 | 1 OF 1 |
| PRODUCT DESCRIPTION | MR-2-1"-UTILITY-II ANCHOR/SHACKLE ASSEMBLY |
| DRAWN BY: JFD | DATE: 03/06/13 |

MANTA RAY®
EARTH ANCHOR SYSTEMS

Manta Ray® anchor load ultimate tension capacity with 5/8” (16,000 lb-force), ¾” (23,000 lb-force) and 1” (36,000 lb-force) power hub anchor rods.

**Manta Ray anchor ultimate load capacity with power hub anchor rods (lbs-force)**

| Soil Description | Standard Penetrometer Blow Count (N) | MR-1 (3/4” or 1” rod) | MR-2 (3/4” or 1” rod) | MR-3 (5/8” rod) | MR-SR (3/4” or 1” rod) |
|---|---|---|---|---|---|
| Very dense/cemented sands; coarse gravel and cobbles | 60-100+ | 36,000 (1) | 36,000 (1) | 16,000 (1) | NA |
| Dense fine compacted sands, very hard silts or clays | 45-60 | 36,000 (1) | 28,000 (2) | 16,000 (1) | 36,000 (1) |
| Dense clays, sands and gravels, hard silts and clays | 35-40 | 36,000 (1) | 22,000 (2) | 16,000 (1) | 36,000 (1) |
| Medium dense sandy gravel, stiff to hard silts and clays | 24-40 | 20,000 (2) | 18,000 (2) | 14,000 (2) | 34,000 (2) |
| Medium dense coarse sandy gravel, stiff to very still silts and clays | 14-25 | 20,000 (2) | 12,000 (2) | 9,000 (2) | 24,000 (2) |
| Loose to medium dense fine to coarse sand: firm to stiff clays and silts | 7-14 | 15,000 (2) | 10,000 (2) | 8,000 (2) | 18,000 (2) |
| Loose fine sand, alluvium, soft clays, fine saturated silty sand | 4-8 | 12,000 (2) | 8,000 (2) | 5,000 (2) | 14,000 (2) |
| Peat, organic silts: inundates silts fly ash | 0-5 | 8,000 (2) | 5,000 (2) | 2,000 (2) | 12,000 (2) |

Notes: (1) Manta Ray anchor holding capacity limited by rod tension strength rating
(2) Manta Ray anchor holding capacity limited by soil capacity

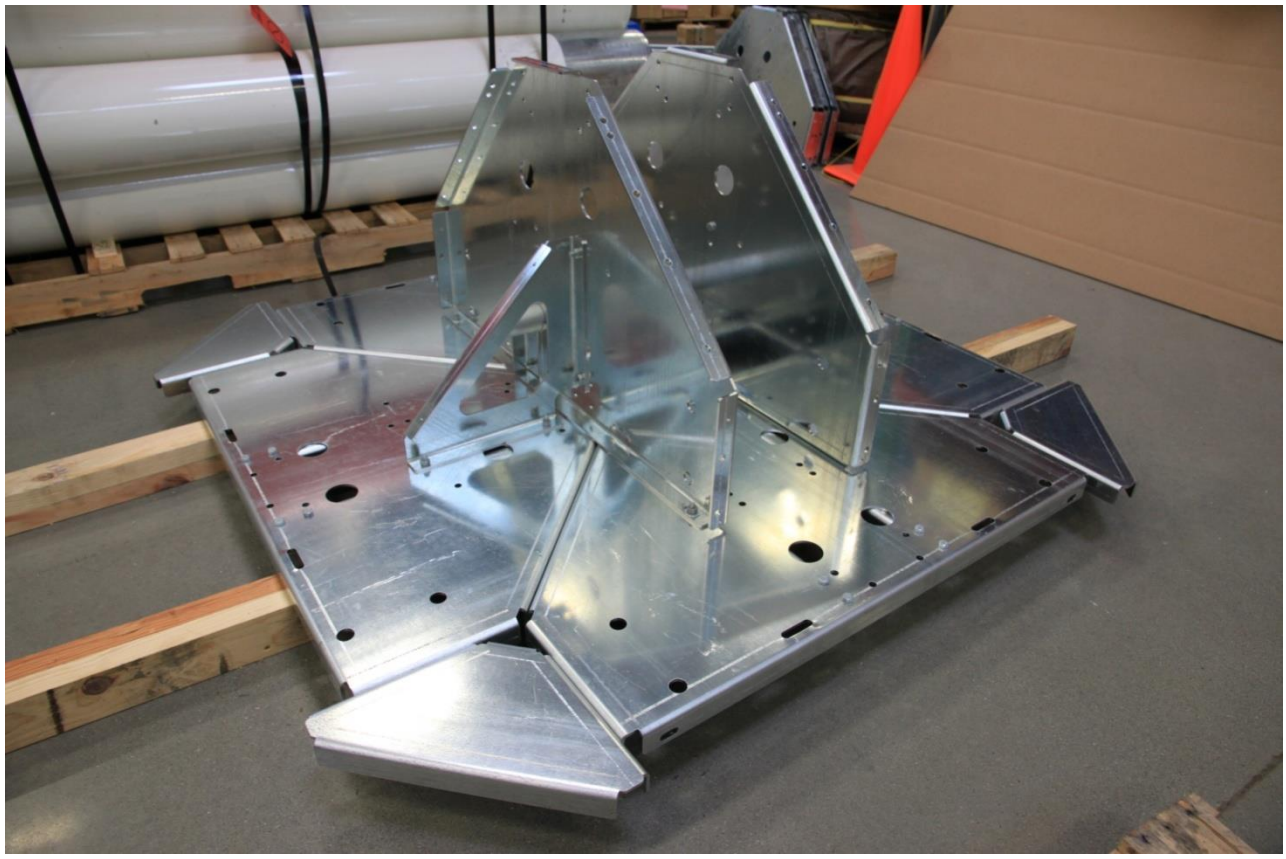
Manta Ray® anchor load ultimate tension capacity with 5/8” (71.2 kn), ¾” (102.3 kn) and 1” (160.1 kn) power hub anchor rods.

| **Manta Ray anchor ultimate load capacity with power hub anchor rods (kn)** | | | | | |
|---|---|---|---|---|---|
| Soil Description | Standard Penetrometer Blow Count (N) | MR-1 kn | MR-2 kn | MR-3 kn | MR-SR kn |
| Very dense/cemented sands; coarse gravel and cobbles | 60-100+ | 160.1 (1) | 160.1 (1) | 71.2 (1) | NA |
| Dense fine compacted sands, very hard silts or clays | 45-60 | 160.1 (1) | 124.6 (2) | 71.2 (1) | 160.1 (1) |
| Dense clays, sands and gravels, hard silts and clays | 35-40 | 160.1 (1)) | 97.9 (2) | 71.2 (1) | 160.1 (1) |
| Medium dense sandy gravel, stiff to hard silts and clays | 24-40 | 89 (2) | 80.1 (2) | 62.3 (2) | 151.2 (2) |
| Medium dense coarse sandy gravel, stiff to very still silts and clays | 14-25 | 89 (2) | 53.4 (2) | 40.0 (2) | 106.8 (2) |
| Loose to medium dense fine to coarse sand: firm to stiff clays and silts | 7-14 | 66.7 (2) | 44.5 (2) | 35.6 (2) | 80.1 (2) |
| Loose fine sand, alluvium, soft clays, fine saturated silty sand | 4-8 | 53.4 (2) | 35.6 (2) | 22.2 (2) | 62.3 (2) |
| Peat, organic silts: inundates silts fly ash | 0-5 | 35.6 (2) | 22.2 (2) | 8.9 (2) | 53.4 (2) |

Notes: (1) Manta Ray anchor holding capacity limited by rod tension strength rating
(2) Manta Ray anchor holding capacity limited by soil capacity

# Appendix G: ANSI/TIA-222-G Foundation Considerations

**Baseplate Geometry (with ground surface area of 19.5 $ft^2$ )**



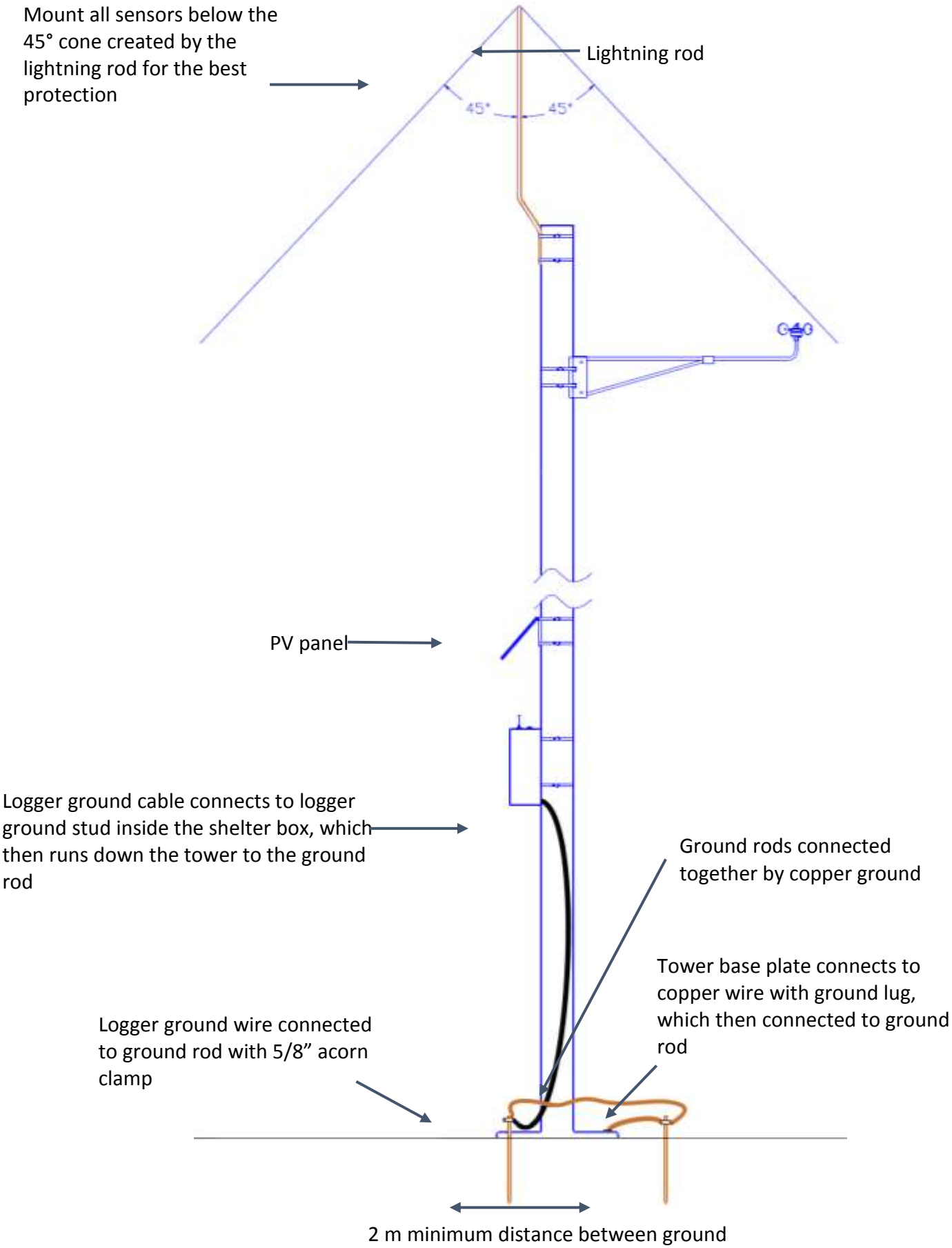
**Picture H-1: Baseplate**

Per
ANSI/TIA-222-G, for design purposes, one can assume Class 6 (Clay) soils. However, the Standard requires that soil parameters and assumptions be validated prior to installing the tower. Prior to tower installation, determine the soil type, preferably through soil sampling.

The baseplate cross-sectional area is 19.5 $ft^2$. The cross-sectional area was sized to ensure the factored resistance of Clay soil is greater than the reactions from the factored load combinations listed in section 2.3.2 of ANSI/TIA-222-G. The presumptive soil parameters per ANSI/TIA-222-G assume dry soil conditions. If your soil can develop a significant ice lens (due to poor soil drainage) during freezing, it may be necessary to provide a foundation to ensure adequate bearing strength. Foundation details must be approved for the specific application and site by a qualified professional.

# APPENDIX D

# TOWER GROUNDING AND TOWER DETAILS


Mount all sensors below the 45° cone created by the lightning rod for the best protection
Lightning rod
45°
45°
PV panel
Logger ground cable connects to logger ground stud inside the shelter box, which then runs down the tower to the ground rod
Ground rods connected together by copper ground
Tower base plate connects to copper wire with ground lug, which then connected to ground rod
Logger ground wire connected to ground rod with 5/8" acorn clamp
2 m minimum distance between ground

# Appendix A: Super 60 m XHD TallTower with Standard Footprint Tower Layout

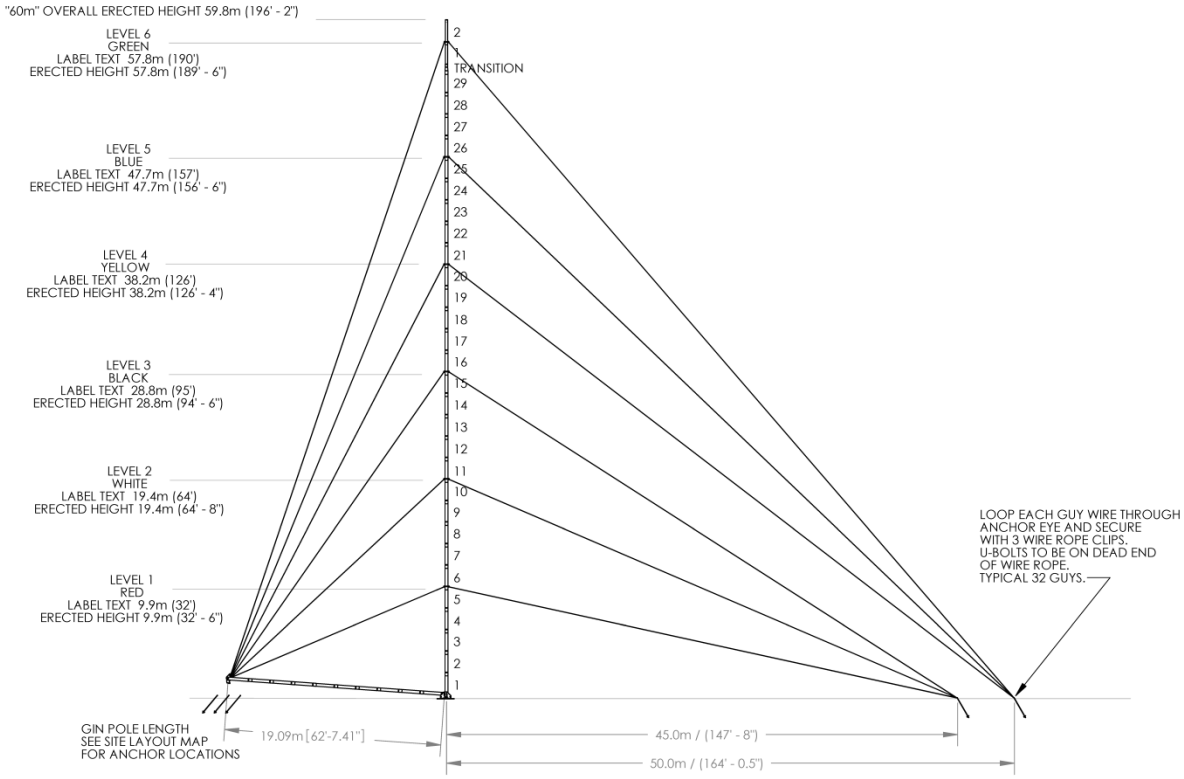
TUBE SPECS (in order of assmbly):

Tower:

| | |
|---|---|
| Base Tube (with pivot pin hole) | 10" Ø x 87"L (1 tube) |
| Plain Tubes | 10" Ø x 87"L ( 28 tubes) |
| 10" - 8" Transition, 36"L | |
| Plain Tubes | 8" Ø x 87"L ( 2 tubes) |

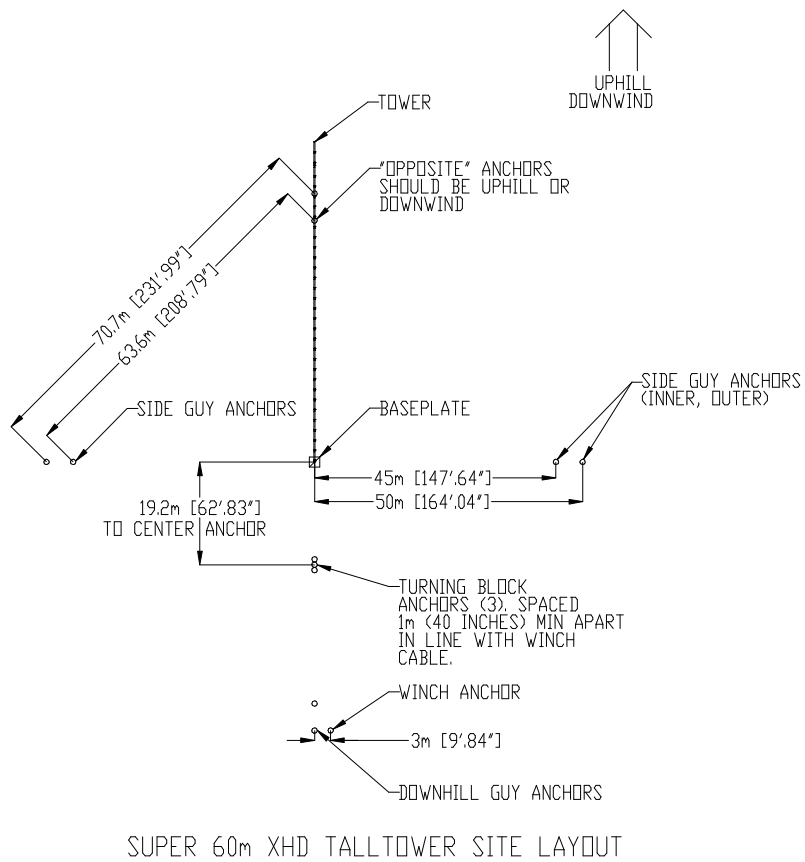
Gin Pole:

| | |
|---|---|
| Base Tube (with pivot pin hole) | 10" Ø x 87"L (1 tube) |
| Plain Tubes | 10" Ø x 87"L ( 8 tubes) |
| Top Tube | 10" Ø x 87"L (1 tube) |




**Picture A-1: Super 60 m XHD TallTower Layout**

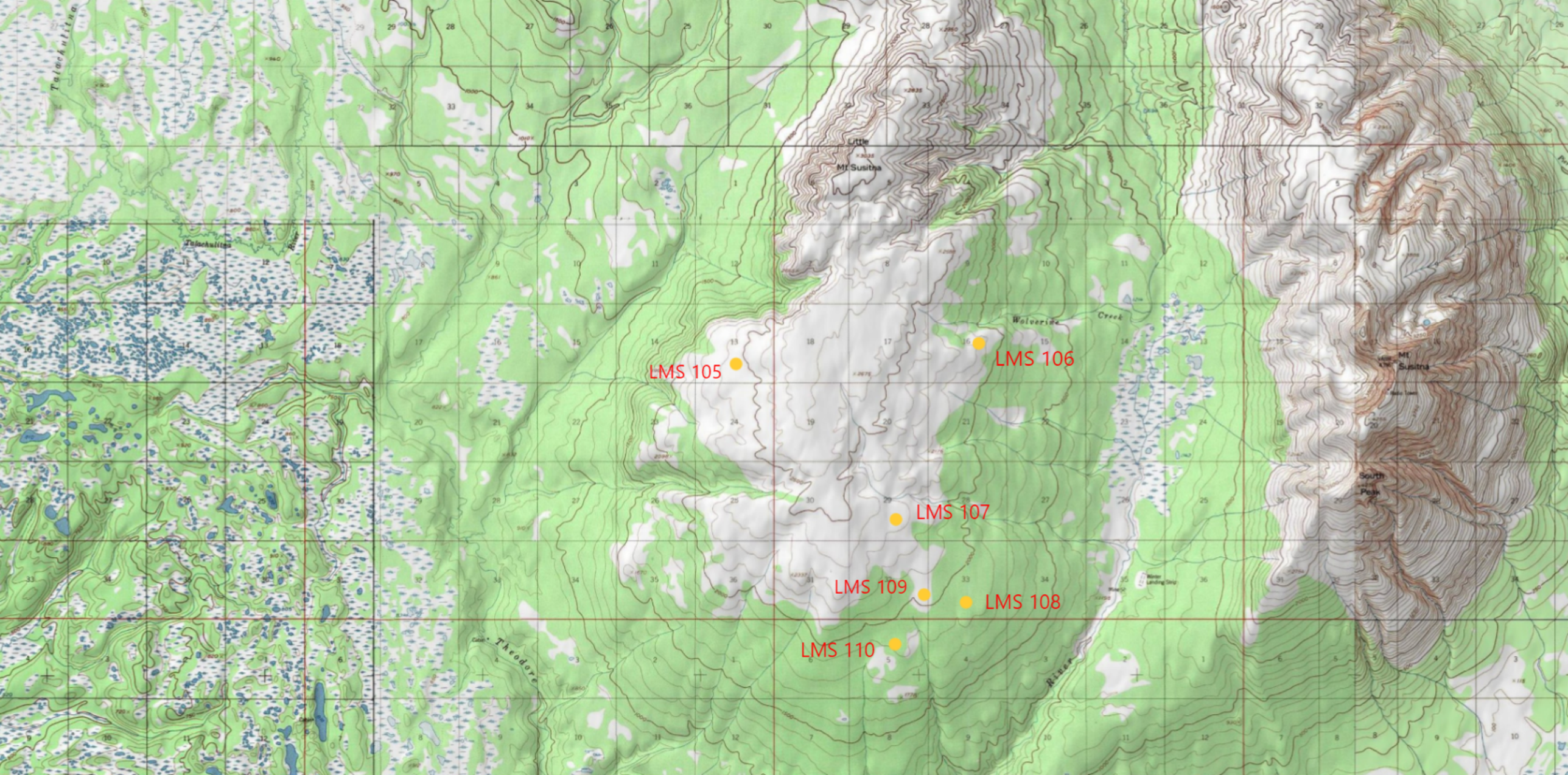
**SITE LAYOUT**




**Picture A-2: Super 60m Site Layout**

# APPENDIX E

# PROPOSED MET TOWER SITE LOCATION MAP


LMS 105
LMS 106
LMS 107
LMS 108
LMS 109
LMS 110
Little
Mt Susitna
Wolverine
Creek
Mt
Susitna
South
Peak
Talachulitna
River
Theodore
River

Federal Aviation Administration

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« OE/AAA

# Notice Criteria Tool

Notice Criteria Tool - Desk Reference Guide V_2018.2.0

The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, and frequencies emitted from the structure, etc. For more details, please reference CFR Title 14 Part 77.9.

You must file with the FAA at least 45 days prior to construction if:

- your structure will exceed 200ft above ground level
- your structure will be in proximity to an airport and will exceed the slope ratio
- your structure involves construction of a traverseway (i.e. highway, railroad, waterway etc...) and once adjusted upward with the appropriate vertical distance would exceed a standard of 77.9(a) or (b)
- your structure will emit frequencies, and does not meet the conditions of the FAA Co-location Policy
- your structure will be in an instrument approach area and might exceed part 77 Subpart C
- your proposed structure will be in proximity to a navigation facility and may impact the assurance of navigation signal reception
- your structure will be on an airport or heliport
- filing has been requested by the FAA

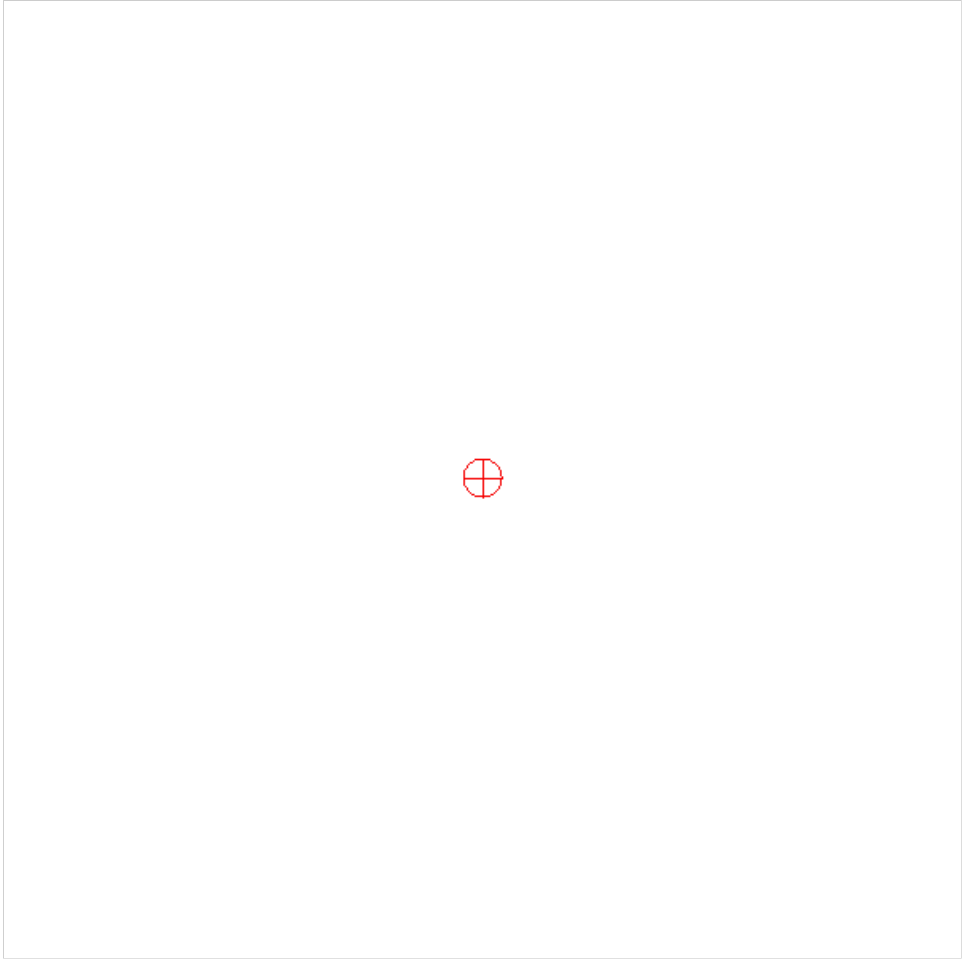
If you require additional information regarding the filing requirements for your structure, please identify and contact the appropriate FAA representative using the Air Traffic Areas of Responsibility map for Off Airport construction, or contact the FAA Airports Region / District Office for On Airport construction.

The tool below will assist in applying Part 77 Notice Criteria.

| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 28 M 23.02 S N |
| **Longitude:** | 150 Deg 59 M 19.71 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 2466 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.



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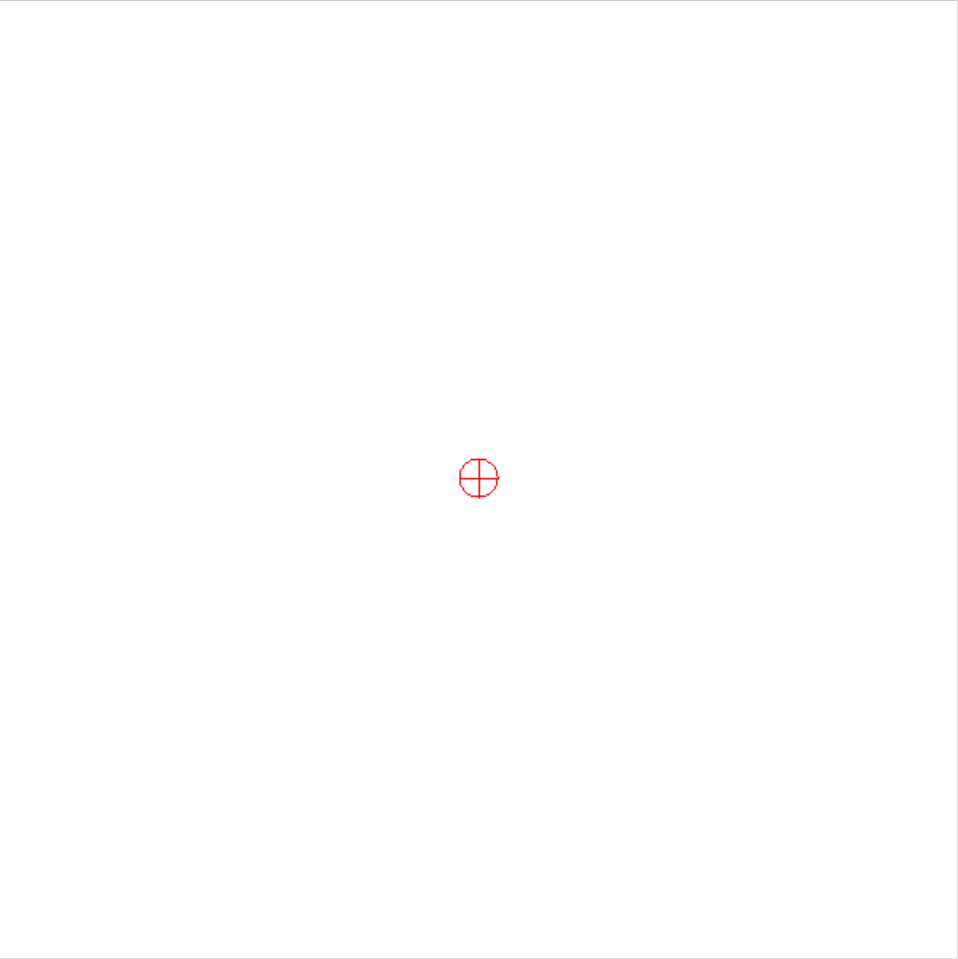
The tool below will assist in applying Part 77 Notice Criteria.

| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 28 M 36.13 S N |
| **Longitude:** | 150 Deg 53 M 45.26 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 2200 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.



Federal Aviation Administration

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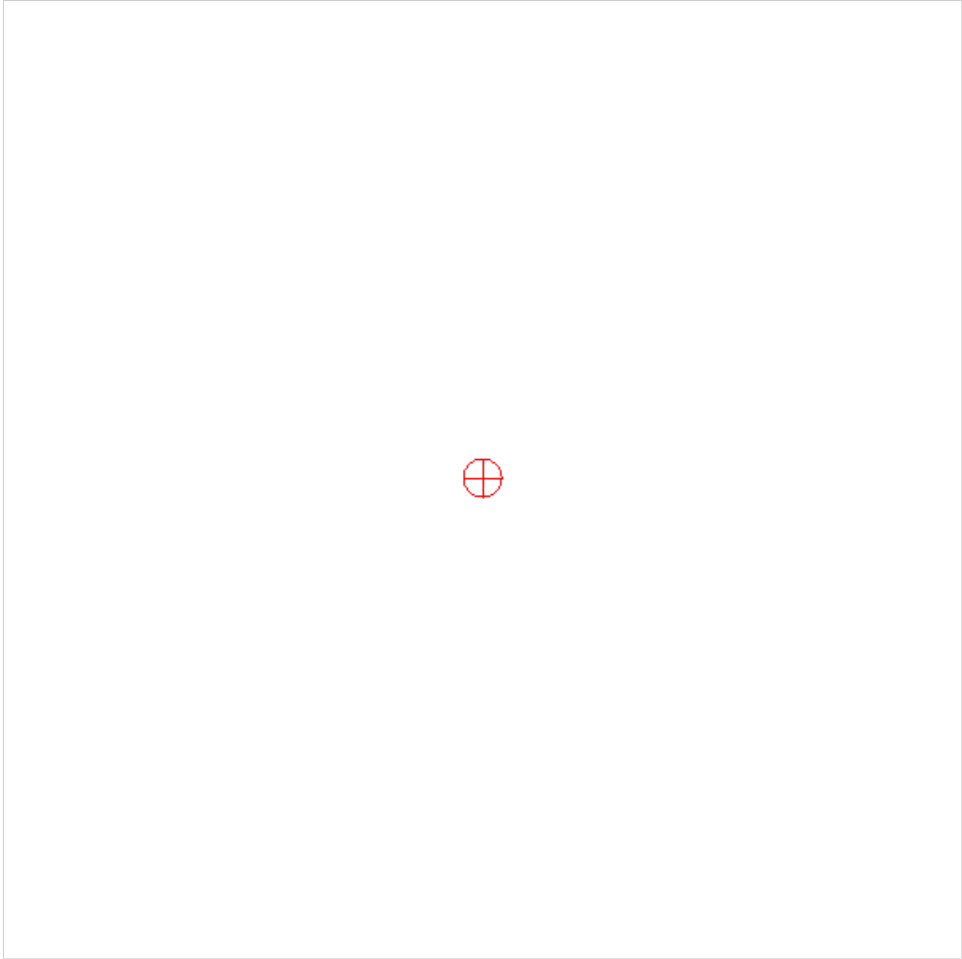
The tool below will assist in applying Part 77 Notice Criteria.

| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 26 M 40.70 S N |
| **Longitude:** | 150 Deg 55 M 40.32 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 2339 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.



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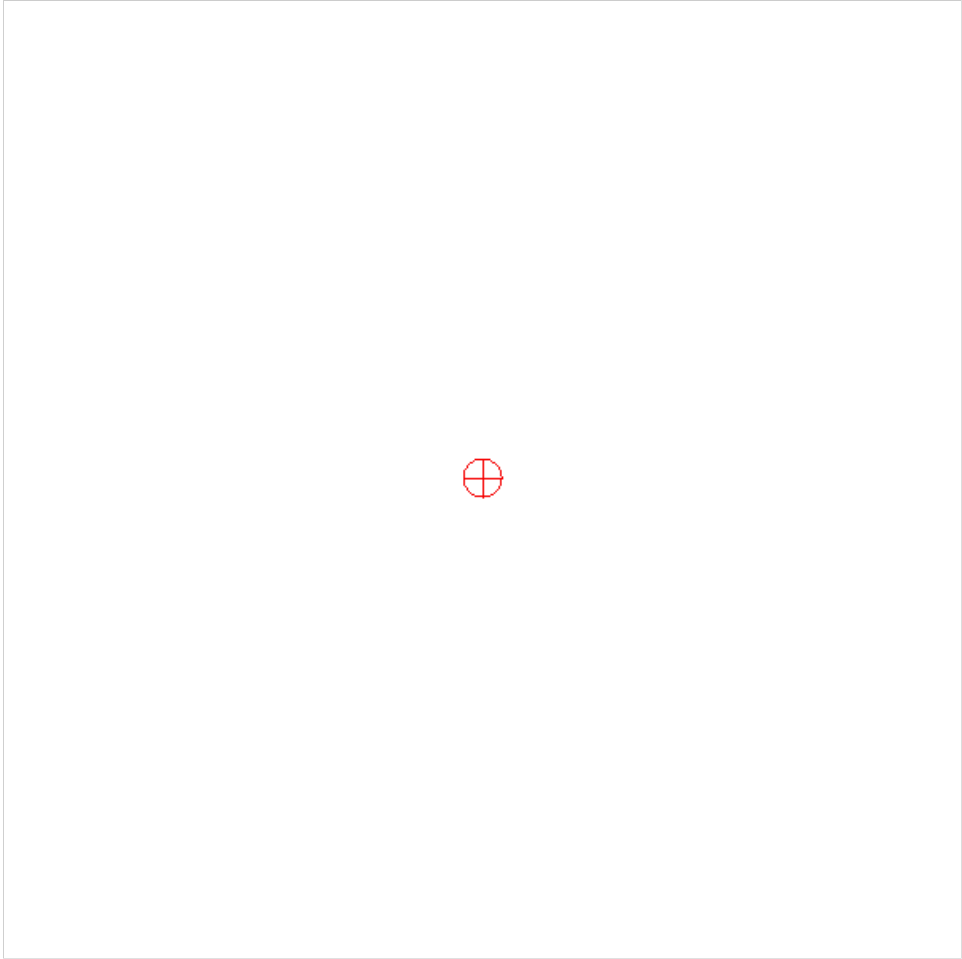
The tool below will assist in applying Part 77 Notice Criteria.

| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 25 M 45.74 S N |
| **Longitude:** | 150 Deg 54 M 03.16 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 1934 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.



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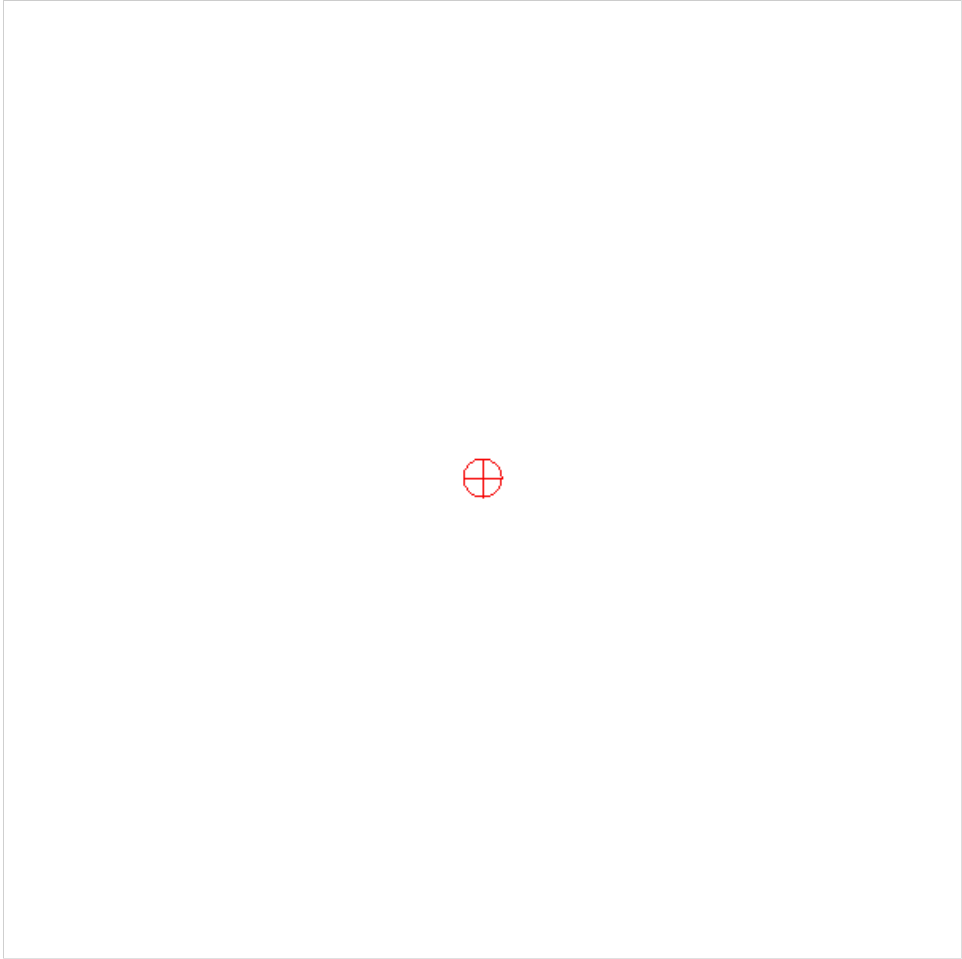
The tool below will assist in applying Part 77 Notice Criteria.

| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 25 M 51.20 S N |
| **Longitude:** | 150 Deg 55 M 01.12 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 2037 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.



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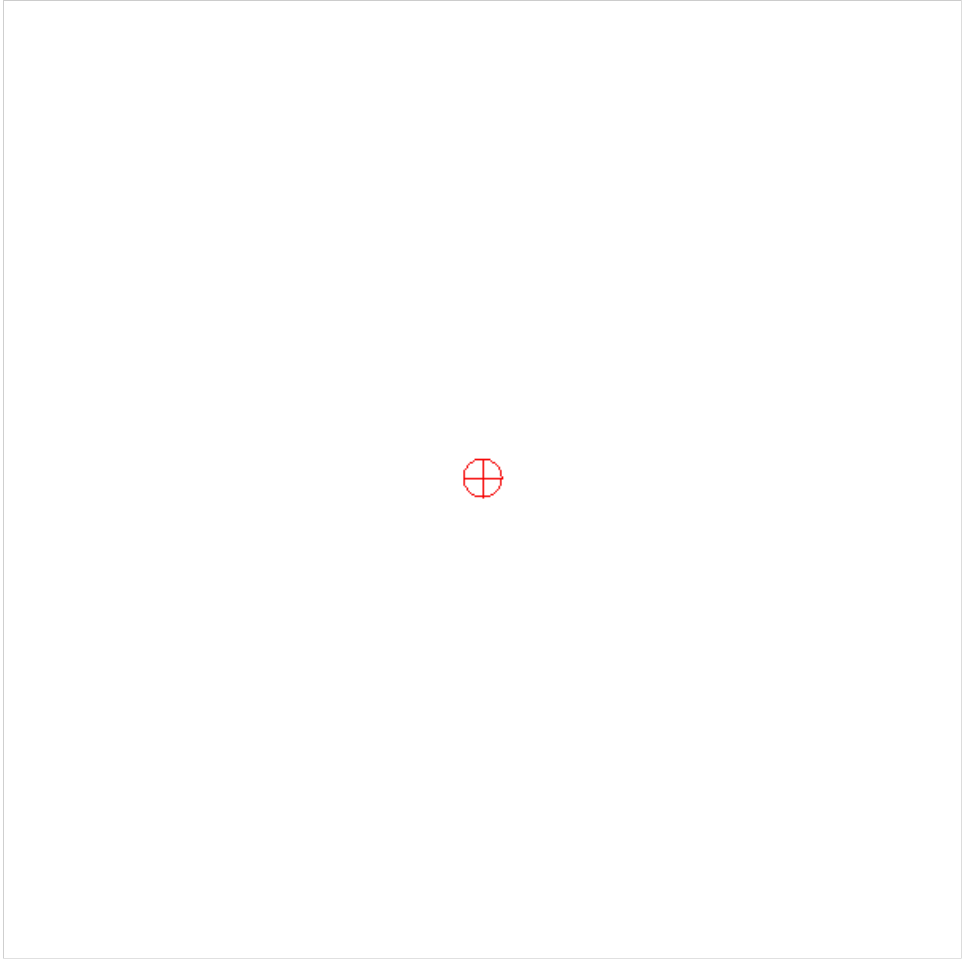
| | |
|---|---|
| * **Structure Type:** | TOWER \| Met Tower<br>Please select structure type and complete location point information. |
| **Latitude:** | 61 Deg 25 M 18.54 S N |
| **Longitude:** | 150 Deg 55 M 40.81 S W |
| **Horizontal Datum:** | NAD83 |
| **Site Elevation (SE):** | 1903 (nearest foot) |
| **Structure Height :** | 199 (nearest foot) |
| **Is structure on airport:** | (●) No<br>( ) Yes |

## Results

You do not exceed Notice Criteria.

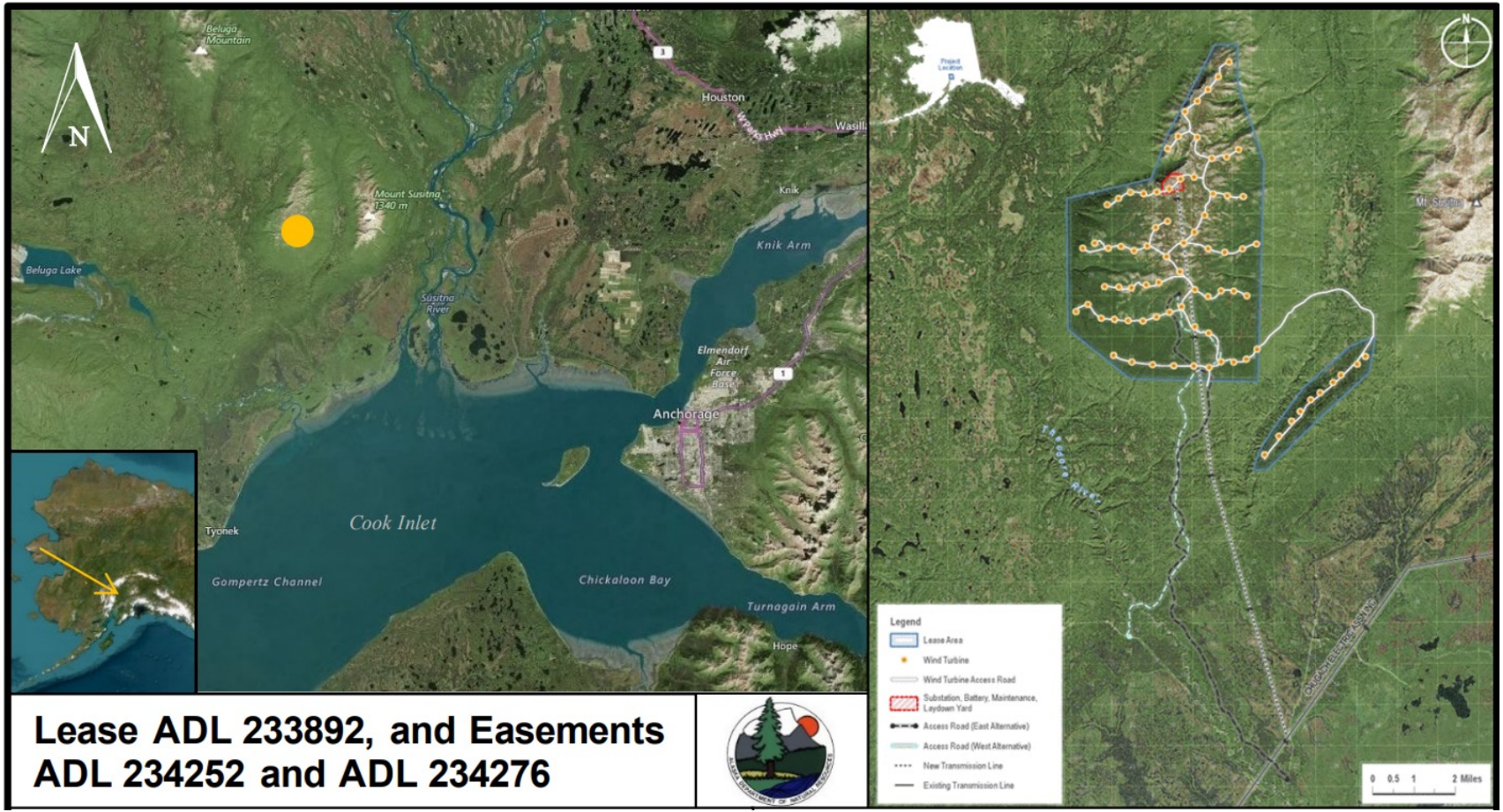


longroad ENERGY

# Our motivation

- Locally driven sustainable energy solutions
- Reducing energy costs for Alaska
- Increase energy security
- Building a sustainable economy

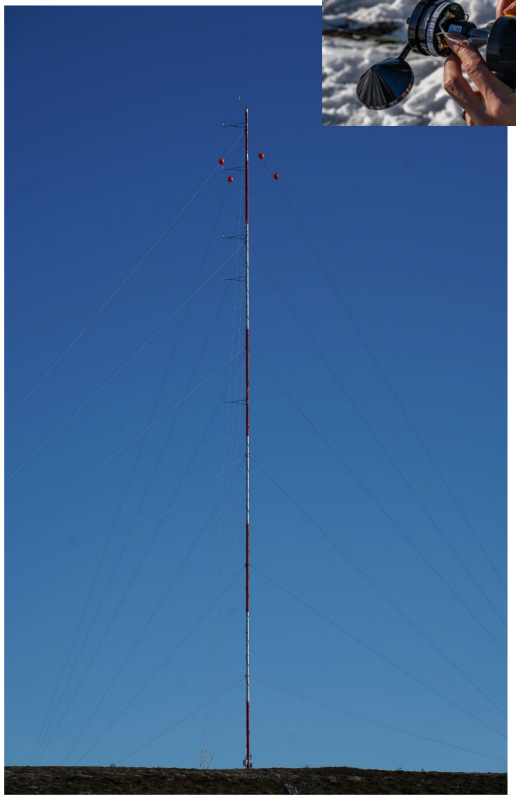
# Little Mount Susitna Wind Project




**Lease ADL 233892, and Easements ADL 234252 and ADL 234276**

# Meteorological Towers

- Used to measure wind speed and direction for resource assessment
- Each tower is 50-60m (164-197 ft. ) tall with 4 sets of guy wires
- Painted with FAA-compliant paint, and marked with guy guards and marker balls
- No lighting required
- Towers are engineered for harsh climates

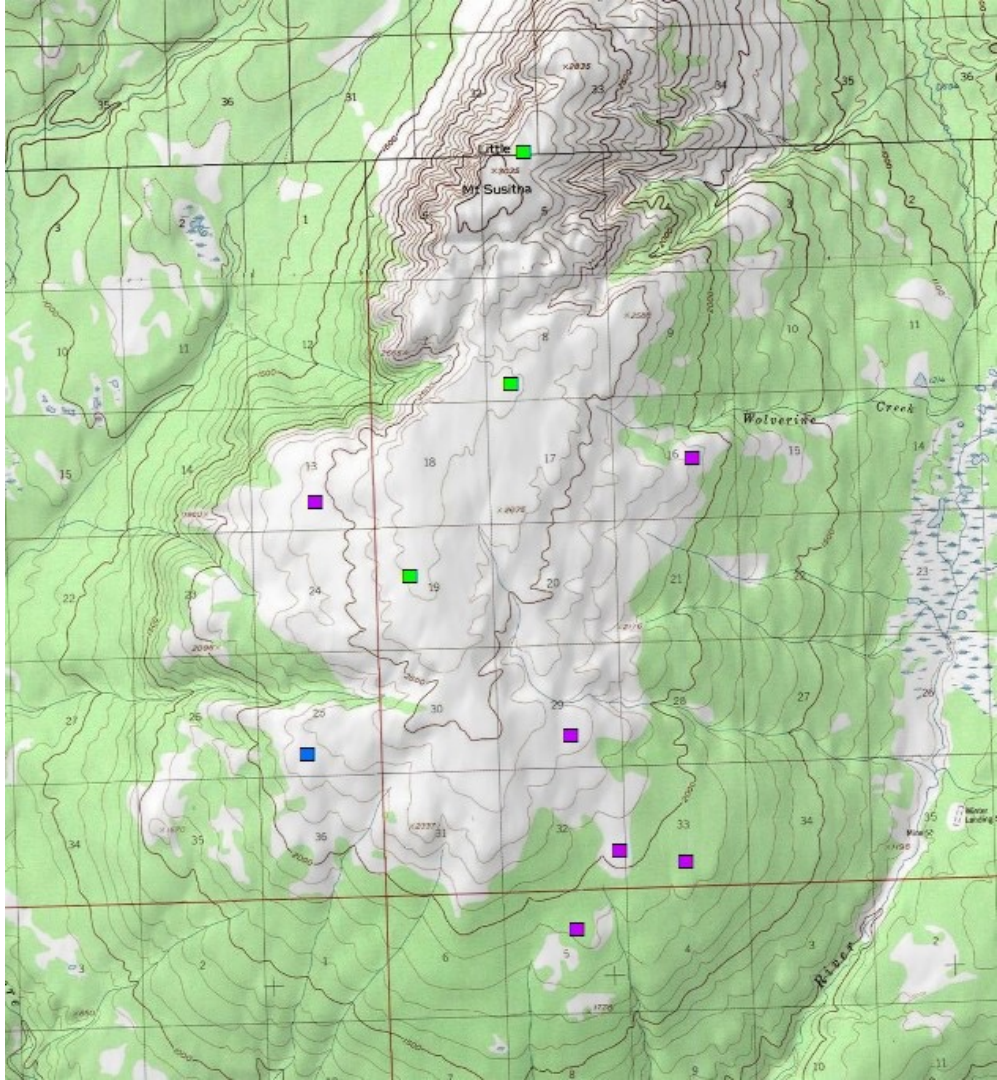


# Meteorological Campaign

- Currently 3 meteorological towers installed on Little Mt. Susitna (Green Points)

- Permitting 6 additional tower locations (Purple Points) to collect additional wind data

- MSB Chapter 17.67 requires a permit for tall towers over 85 feet



# Proposed Meteorological Tower Locations

**Latitude/Longitude (WGS84)**

61.473061N, 150.988809W

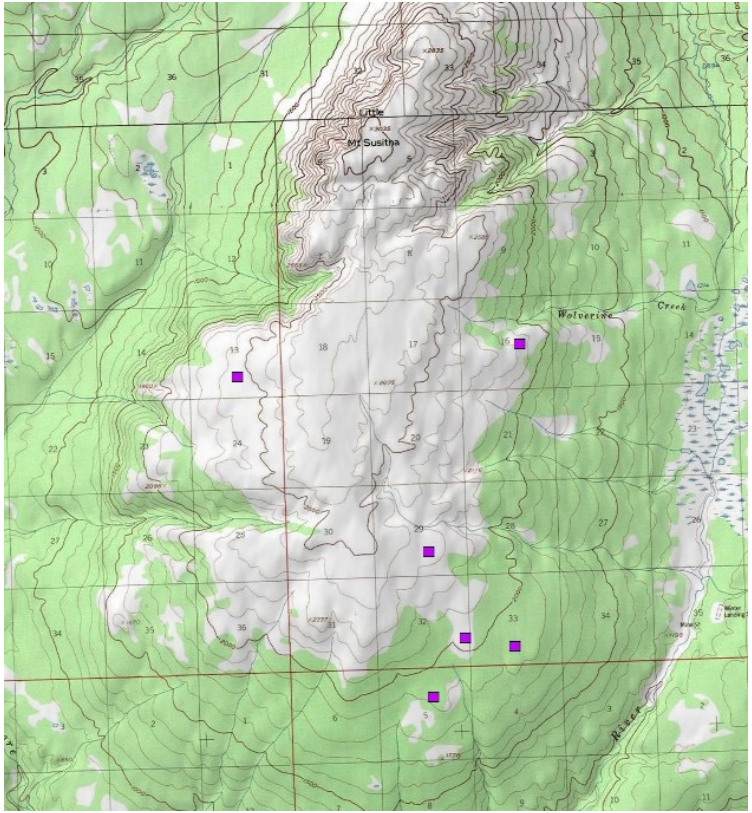
61.476704N, 150.895905W

61.444640N, 150.927867W

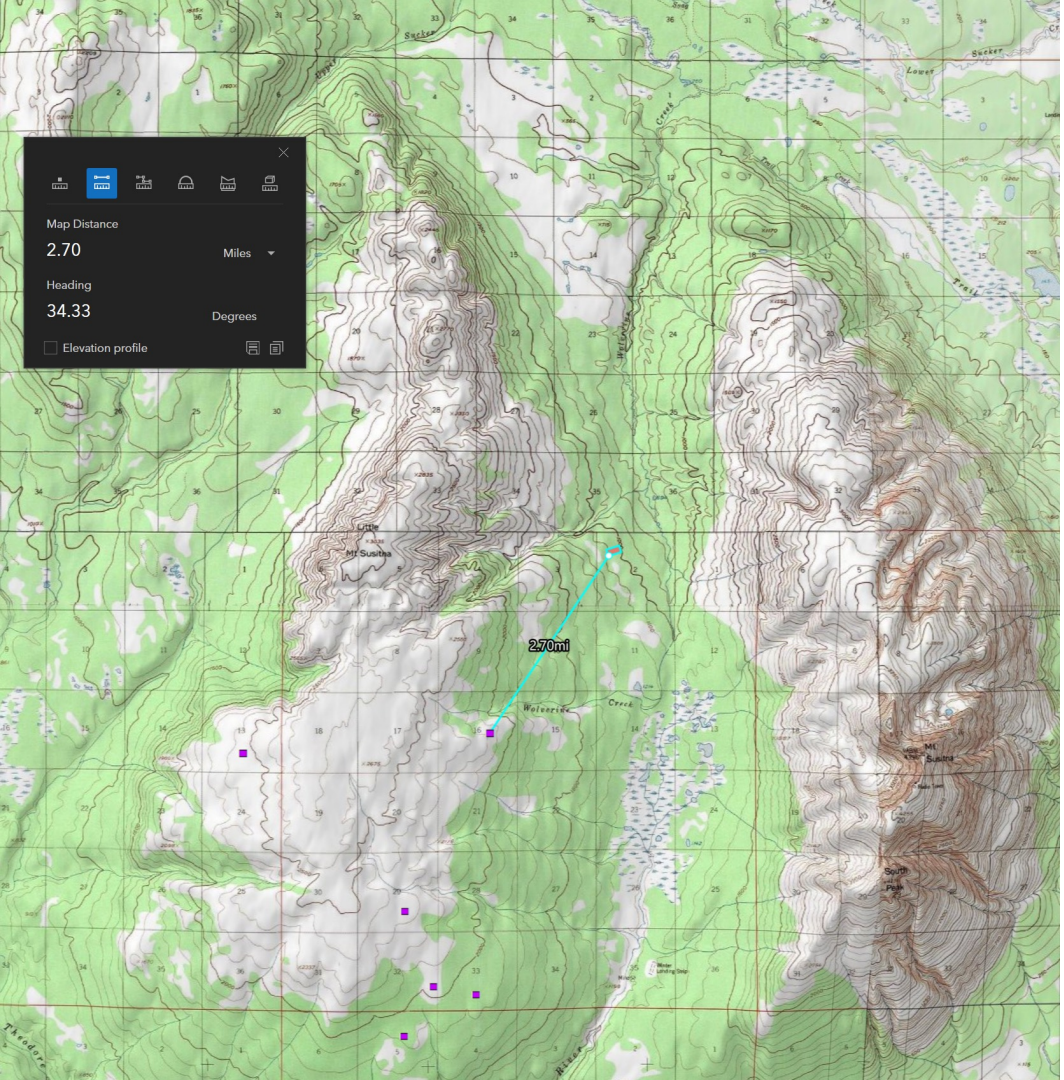
61.429372N, 150.900878W

61.430890N, 150.916978W

61.421817N, 150.928003W



# Visibility

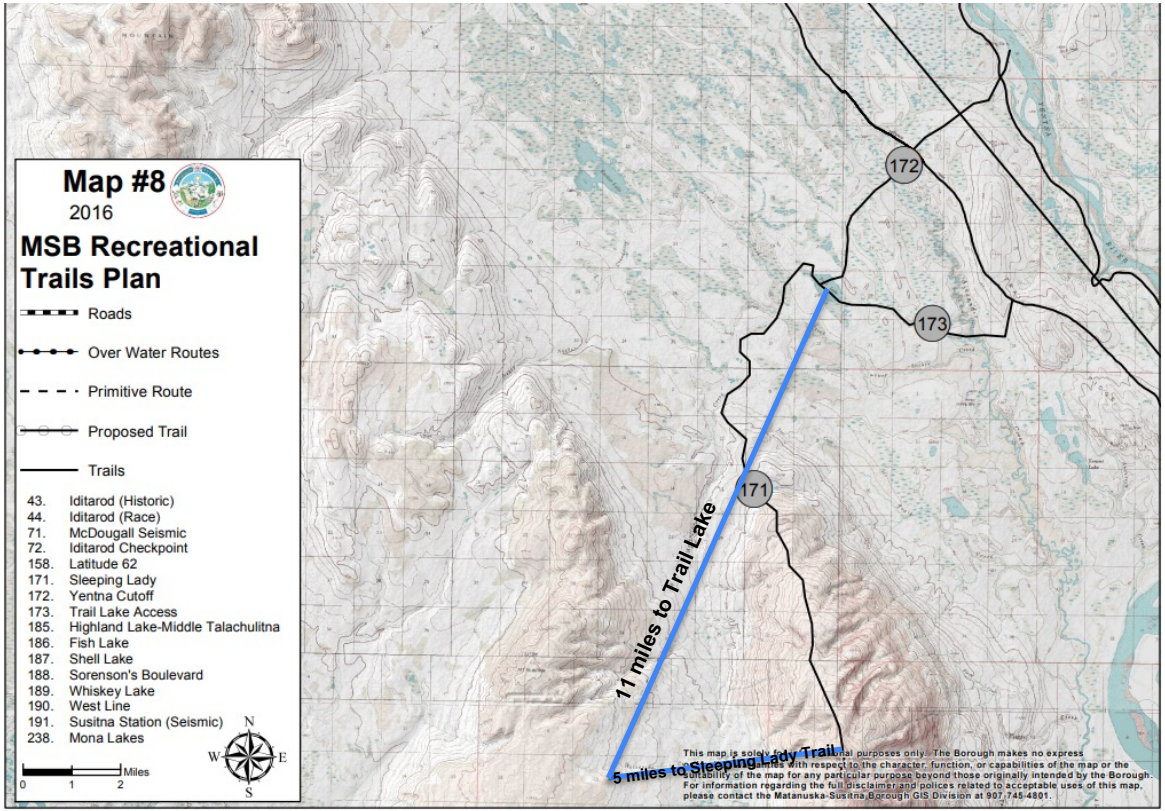



# Nearest Property

- The nearest private property is 2.7 miles away from the northeasternmost tower site
- Towers are not expected to be visible from this location
- One tower may be barely visible from Trail Lake, at a distance of over 11 miles

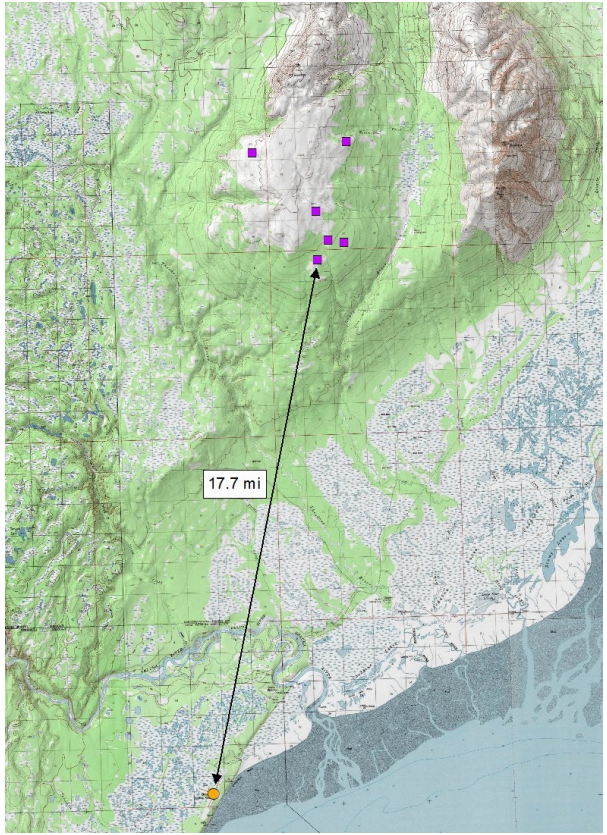
# Nearest Recreation Site

- 5 miles to the nearest trail (Sleeping Lady)
- 11 miles from the named lake (Trail Lake)



# Nearest Airport

- 17.7 miles from the Beluga Airport
- Compliant with FAA criteria



# Questions?

hello@alaskarenewables.com

# Written Community Meeting Report
06/3/2024

1. **Written Meeting Summary**
2. **Notice Letter**
3. **Certificate of Mailings**
4. **Comments Received**
5. **Response to Written Comments**
6. **Meeting Roster**

**Written Summary of Community Meeting**

Hosts: Andrew McDonnell + Jeremy Vander Meer from Alaska Renewables,

representing Little Mount Susitna Wind LLC

Willow Community Center

6/3/2024, 5:30-6:45pm

Little Mount Susitna Wind LLC sent out 110 notices to the tax parcels identified by Rick Benedict, Current Planner at the Matanuska-Susitna Borough (see notice letter and certificate of mailings below). Additionally, as a courtesy, Little Mount Susitna Wind LLC notified Mike Williams, although he falls outside of the mandated contact area. Three people attended the meeting, and one person submitted a written comment. All attendees requested to receive updates via email.

**Meeting Attendees:**

**1. Allen and Cindi Thomas:** Owners of a remote cabin above Wolverine Creek, approximately 5.5 miles NNE of the northeastern-most proposed tower location. They also attended last year's meeting for the 2023 CUP. The Thomas' had seen the existing towers last fall when they were still on the ground but not yet erected. During the meeting, we shared photos and additional information about the existing towers, and reviewed plans for the new towers, including materials from the slide deck. We discussed the likely lack of visibility of the towers from their property, using line-of-sight analysis in ArcGIS Earth. They had no opposition to the project or towers but were interested in learning more and suggested the utility of installing an electric bear fence to protect equipment. They also invited project personnel to visit their cabin.

**2. Taunnie Boothby**: A Willow resident and MSB employee (Planner, focusing on floodplains and natural hazards). Little Mount Susitna Wind LLC provided her with a full walkthrough of the slide deck, answered questions, and discussed various topics, including the potential use of wind data to understand weather-related risks in the borough and the nature of wind energy. Taunnie inquired about the impact of wind turbines on birds, and we provided a verbal response based on current scientific data regarding birds and wind turbines.

**Written Comment:**

Mike Williams expressed concerns that the Little Mount Susitna Wind project is being rushed without sufficient study, particularly in terms of wind patterns and actual benefits. He worries the wind farm could interfere with low-level military training, which is becoming increasingly important as the U.S. military expands its Arctic presence. Williams also raised safety concerns due to the project's location in a busy airspace

used by both military and private aircraft, especially during bad weather. His environmental concerns include the proximity to fault lines and volcanoes, potential impacts on wildlife such as moose and migratory birds, and possible disturbance to bat habitats. He feels the local population, including his family, would bear the negative consequences without benefiting from the project. Additionally, he questions why alternative sites haven't been explored. Williams is also concerned about the potential for property value declines and the destruction of culturally significant areas. He criticized the lack of sufficient local consultation and called for a more balanced, fact-based approach to the project.

**Response to Written Comment:**

Little Mount Susitna Wind LLC responded to Williams' concerns via email. They acknowledged his concerns and emphasized their commitment to understanding the local area and addressing potential issues. The developers clarified that the project is still in the data-gathering phase, with additional meteorological towers planned to further assess wind conditions. They assured Williams that military operations and private aviation routes have been considered in the planning process, with filings already submitted to the Department of Defense and the FAA to ensure aviation safety. The response also addressed concerns about seismic risks, wildlife impacts, and cultural heritage, noting that the company is working with relevant agencies to mitigate these risks. While recognizing local economic concerns, the developers are exploring ways to benefit nearby communities and remain open to further dialogue to ensure that all voices are heard. The letter concluded by reaffirming their commitment to transparency and collaboration as the project progresses.

Little Mount Susitna Wind LLC
MSB CUP for Tall Towers Community Meeting
6/3/2024 | 530pm-630pm

# Sign in Sheet

| | Name | Email | Address | Sign up for Newsletter? |
|---|---|---|---|---|
| 1 | Allen + Cindi Thomas | alaskaallen@Hotmail.com | P.O. Box 693 willow, AK 99688 | ✓ |
| 2 | Tawnnie Boothby | tlboothby@gmail.com | PO Box 962 willow, AK 99688 | ✓ |
| 3 | | | | |
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| **From:** | Faith Tyson |
| **To:** | eagle@eaglesongalaska.com |
| **Cc:** | Rick Benedict |
| **Subject:** | Re: FW: Little Mount Susitna Wind Farm Public Comment |
| **Date:** | Monday, September 16, 2024 9:13:29 AM |
| **Attachments:** | 20240912 - LMS - CUP #2 - Response to Mike Williams (1).pdf |

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[**EXTERNAL EMAIL** - CAUTION: Do not open unexpected attachments or links.]
Dear Mr. Williams,

Thank you for your written comment. Please find Little Mount Susitna Wind's response attached.

Best,

**Faith Tyson (she/they)**
Community Engagement and Accountability Manager
Alaska Renewables LLC
[c] +1-907-202-0507 [e] faith@alaskarenewables.com

Alaska Renewables LLC occupies the ancestral, traditional, and contemporary lands of Alaska Native people that have resided, occupied, and called this land home. I recognize the historic Indigenous individuals and communities who live here now and those who were forcibly removed from their homes. In offering this land acknowledgement, I affirm Indigenous sovereignty, history and experiences.

On Mon, Jun 3, 2024 at 10:01 AM Rick Benedict <Rick.Benedict@matsugov.us> wrote:

> Hello,
>
> Comments were received concerning the proposed Little Mount Susitna Wind project for tonight's community meeting.
>
> Respectfully,
>
> Rick Benedict – Current Planner
>
> Development Services Division
>
> Matanuska-Susitna Borough
>
> (907)861-8527 direct

**From:** Permit Center <Permit.Center@matsugov.us>
**Sent:** Monday, June 3, 2024 8:32 AM
**To:** Peggy Horton <Peggy.Horton@matsugov.us>; Rick Benedict <Rick.Benedict@matsugov.us>
**Subject:** FW: Little Mount Susitna Wind Farm Public Comment

Good morning. Is this for one of you, or someone else?

Thanks.

**Brandon Tucker**

Permit Technician

Matanuska-Susitna Borough Permit Center

350 E Dahlia Ave

Palmer AK 99645

P (907) 861-7871

F (907) 861-8158

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**From:** eagle@eaglesongalaska.com <eagle@eaglesongalaska.com>
**Sent:** Sunday, June 2, 2024 10:34 AM
**To:** Permit Center <Permit.Center@matsugov.us>
**Subject:** Little Mount Susitna Wind Farm Public Comment

[**EXTERNAL EMAIL** - CAUTION: Do not open unexpected attachments or links.]

Please find attached comments for the community meeting to be held at the Willow Area Community Center, June 3, 2024.

The location and short notice of the Willow meeting make it impossible for my family to attend. We would hope that those remote stakeholders living in the vicinity of the wind farm project will have an opportunity to comment in a more direct manner in days to come. Might I suggest the Mat-Su Borough Development Services Division and Planning and Land Use Department offer an online meeting opportunity to take public comment.

Regards,

Michael W. Williams

EagleSong Peony Farm

200 W. 34th Ave. Ste 295

Anchorage, AK 99503

(907) 521-0034

eaglesongalaska.com

Instagram.com/eaglesongalaska

facebook.com/eaglesongalaska

www.tiktok.com/@alaskapeony

youtube.com/eaglesongalaska

September 12, 2024

Dear Mr. Williams,

Thank you for sharing your detailed concerns with Matanuska Susitna Borough regarding the proposed Little Mount Susitna Wind Project. I appreciate your deep connection to the land and the thoughtfulness with which you've approached this matter. As developers, we strive to consider the impact of our projects on the local community and environment, and your input is invaluable in this process.

Firstly, I want to address your concern that our company lacks sufficient knowledge of the Little Mt. Susitna area. While it is true that our company was founded in Fairbanks, we are committed to understanding the unique characteristics of the regions where we work. Our visit to your home and the subsequent conversations were part of our efforts to gather local insights and ensure that our plans are informed by those who know the area best.

The development of a wind farm is indeed a complex process and every step is being taken with careful consideration and thorough study. The meteorological towers installed last year are just the beginning of a comprehensive process to gather data over multiple seasons before any concrete conclusions are drawn. The additional meteorological towers that we seek to permit and install would build on that effort to expand our understanding of the weather conditions at additional locations across the project site.

We are aware of the regular low-level military operations west of the Susitna River involving the Army, Air Force, and Alaska National Guard, particularly around Mt. Susitna, Little Mt. Susitna, and Beluga Mountain. The proximity of these training areas to Joint Base Elmendorf-Richardson is crucial, and we have factored this into our planning process.

Additionally, we recognize Little Mount Susitna as a popular route for private pilots, especially during challenging weather conditions. Safety is paramount, and our wind farm design considers these flight patterns. We have completed the initial Department of Defense (DoD) screening and initiated a filing with the FAA, ensuring that all regulatory requirements for aviation safety are being adhered to. Little Mount Susitna Wind remains fully committed to the safety of all airspace users, including both military and civilian aircraft.

Regarding the project's proximity to the Castle Mountain Fault and Mt. Spur, these factors have been taken into account in our initial assessments and are an important part of our ongoing work. It is standard practice in the wind energy industry to conduct

detailed meteorological, geotechnical and mechanical engineering studies in order to quantify the expected forces on the turbines and identify the appropriate design considerations for these conditions. The field and engineering studies we are currently conducting will provide the appropriate design basis to ensure project infrastructure is resilient to potential seismic events.

The potential impact on wildlife, including moose, ptarmigan, and migratory birds, is another area where we are proceeding with caution. We have engaged with the Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (USFWS) to develop appropriate wildlife impact assessments and mitigation strategies. This includes measures to minimize disruptions to migratory patterns and protect critical habitats.

It is important to note that the construction of any energy infrastructure involves a balance between the need for energy and the preservation of local ecosystems. We are committed to implementing best practices and mitigation measures to reduce the impact on wildlife and their habitats.

Your concern about the economic impact on the local community is reasonable. We recognize that large-scale projects can bring significant changes, and we are working to ensure that these changes are positive. While the primary beneficiaries of the power generated may be in the Anchorage area, we are exploring ways to provide direct benefits to the communities like yours that are nearest to the project site. Our visit to your home was a first step in developing an understanding of what those benefits might look like, and we will continue to consider your input on the matter.

We are also committed to ongoing dialogue with residents, including those who may not have been able to attend meetings in Willow. We are open to organizing additional meetings closer to the Little Mt. Susitna area to ensure that all voices are heard.

The presence of any artifacts and the cultural significance of the area is an issue we take very seriously. As part of the project permitting process, we have begun consultations with cultural and historical experts, agencies, and tribes, and initiated archaeological field work to identify any historically important sites within the project area. Through this work we are committed to design the project to in a way that avoids and minimizes impacts and complies will all relevant laws and regulations.

We understand that no project of this magnitude is without its challenges and concerns. Our aim is to ensure that the Little Mt. Susitna Wind Project is developed in a way that respects the environment, honors the local community, and contributes positively to Alaska’s renewable energy future. We are committed to transparency and collaboration as we move forward, and we welcome continued dialogue with you and other stakeholders.

Thank you again for your feedback. We look forward to working together to find the best possible outcomes for this project and the community.

Sincerely,

Faith Tyson

On behalf of Little Mount Susitna Wind LLC

Faith@alaskarenewables.com

Matanuska-Susitna Borough
Planning & Land Use Department
Development Services Division
350 East Dahlia Avenue
Palmer, Alaska 99645

FIRST CLASS MAIL

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A community meeting will be conducted regarding the following new tall structure/cell tower:

**Name of Company:** Little Mount Susitna Wind LLC
**Height of Tower:** 60 meters
**Tower Design:** The meteorological towers are 60m tubular structures with multiple guy wires. The towers have FAA-compliant industrial paint, guy guards, and marker balls. Painting is with alternate bands of aviation orange and white paint. High visibility guy guards (yellow plastic sleeves) will be placed around the base of the guy wires. Four high visibility aviation orange marker balls will be placed on the top-level guy wires within approximately 10m of the top of the tower.
**Lighting:** N/A
**Site Access:** The site will be accessed by helicopter.
**Proposed Service:** The purpose of these installations is to allow for the quantitative assessment of the wind resources to enable the development of a future utility-scale wind energy generation project that would provide reliable, low-cost renewable energy to Southcentral Alaska.

A community meeting will be held on **June 3, 2024, from 5:30-6:30pm at the Willow Area Community Center, located at Mile 69 South Parks Highway, Willow Alaska.** Please come to the meeting to obtain more information and give feedback about this proposed project.

For additional information regarding the proposed tower please contact:

**Faith Tyson**
**907-202-0507**
**3300 Arctic Blvd**
**Suite 201, PMB 1451**
**Anchorage, AK 99503**

If you would like to submit comments, this form may be used for your convenience by filling in the information below and mailing it to the Matanuska-Susitna Borough, Development Services Division, 350 E. Dahlia Avenue, Palmer, AK 99745. You may e-mail to permitcenter@matsugov.us. Comments must be received by **June 3, 2024.**

***Name:*** Michael W. Williams ***Address:*** 200 W. 34th Ave. Ste 295, Anchorage, AK 99503

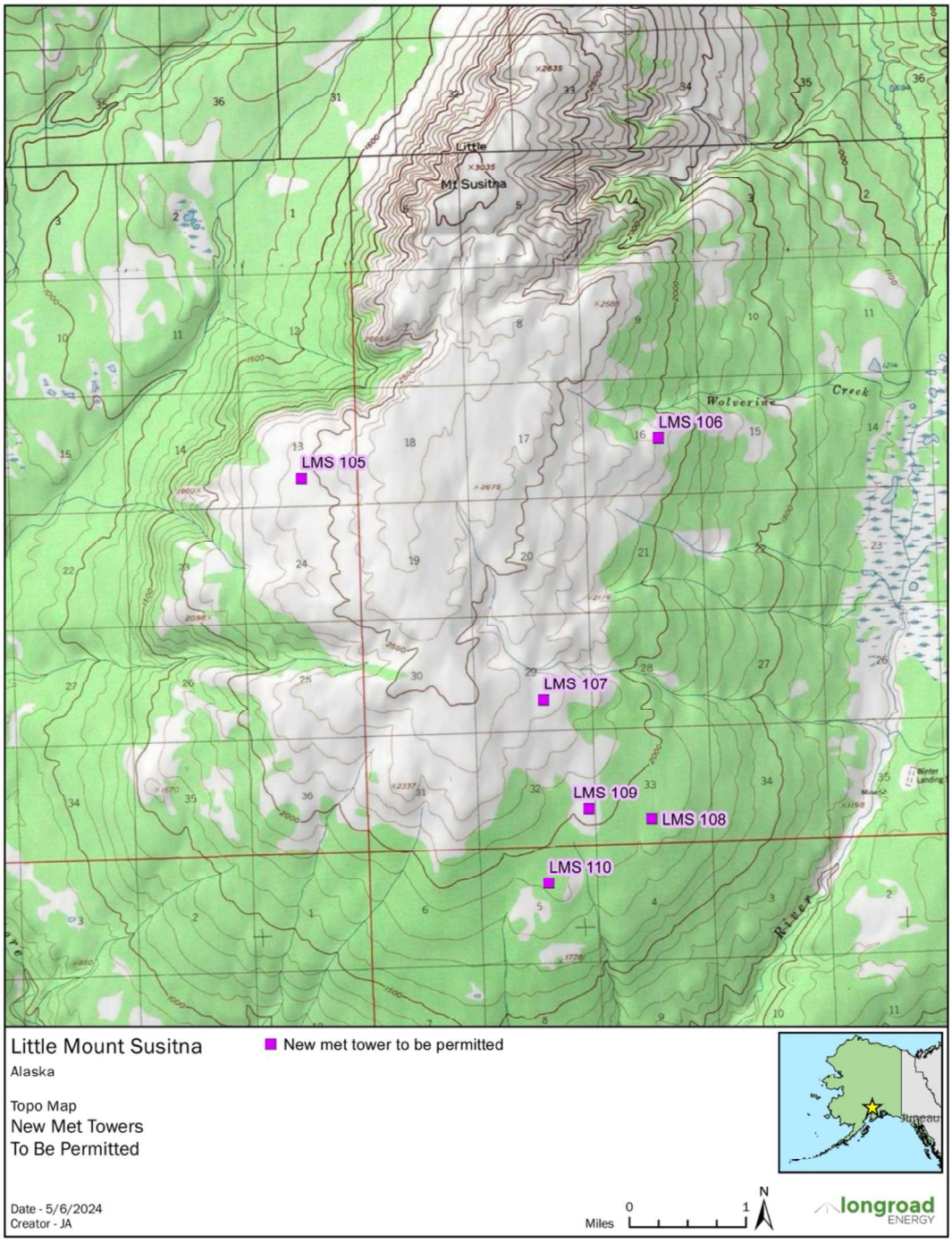
***Location/Legal Description of your property:*** Tract D & E, ASL77-149, Trail Lake, AK (Alexander Creek Drainage)

***Comments:*** See attached

*Note: Vicinity Map Located on Reverse Side*

**Detailed topographic map of the meteorological tower sites proposed on Little Mt Susitna**

| Site Name | Lat/Lon (WGS84) | Elevation (ft) | MTRS |
|---|---|---|---|
| LMS_105 | 61.473061N, 150.988809W | 2466 | S016N010W13 |
| LMS_106 | 61.476704N, 150.895905W | 2200 | S016N009W16 |
| LMS_107 | 61.444640N, 150.927867W | 2339 | S016N009W29 |
| LMS_108 | 61.429372N, 150.900878W | 1934 | S016N009W33 |
| LMS_109 | 61.430890N, 150.916978W | 2037 | S016N009W32 |
| LMS_110 | 61.421817N, 150.928003W | 1903 | S015N009W05 |



To: Mat-Su Borough, Planning and Land Use Department June 2, 2024

Subject: Little Mt. Susitna Wind Farm Project Comments

My family has lived at the northeast base of Little Mt. Susitna for the past 31 years. I look out the picture windows of my log cabin farm home and gaze upon Little Mt. Susitna every day. I think I can safely say there are few Alaskans alive today that have spent more time on and around that mountain than me. We built a successful peony farm after losing the prolific Alexander Creek drainage salmon runs to northern pike and closing our 15-year business as EagleSong Lodge.

I recently read an opinion piece written by New Energy Alaska. In that article it was stated that had the Little Mt. Susitna Wind Farm project been operational that up to 20% of the electric demand could have been met reducing natural gas demand during an extreme cold snap in the Anchorage area this past winter. This was a statement created by Alaska Renewable Inc., the developers of the proposed Little Mt. Susitna Wind Farm.

I am concerned with the apparent rush to develop the Little Mt. Susitna Wind Farm without looking at all sides of the picture. Claims like this project could have off-set a potential shortage in Cook Inlet natural gas this winter is a sound bite created to sway the public without any basis in fact and prey on public fear. How do I know? Alaska Renewable Inc. (wind farm developers) constructed 3 meteorological towers in October 2023 to study wind patterns. It is not possible to draw conclusions in such a short period of time. That is a statement made before the facts are even known.

The owners of Alaska Renewable Inc. flew out and visited me last August. We sat in my yard on the shores of Trail Lake and looked directly at Little Mt. Susitna while we discussed the project for more than 2 hours. From that conversation I noted several issues.

- First, this Fairbanks owned company appears to know very little about the area they picked to pursue their project. In their own words they revealed that their job was to get the project started and then, if successful, pass it on to an international company to finance, build, own, and operate. Alaska Renewable Inc. will hype the project with a goal of a big payday and a residual that should make their lives quite comfortable.
- The proposed wind farm project sets directly on top of the active Castle Mountain Fault and its juncture with the Beluga Fault. In the event of a significant seismic event when the rail belt could need reliable power the most it may not be available from this site. Keep in mind we had a 7.1 earthquake in November 2018 centered just 25 miles east of the proposed site. Why would one build such an important and expensive wind farm directly on top of a seismic fault line? At a minimum it will significantly increase costs to try and build to withstand significant earthquakes. "It's the only active fault that comes to the surface in southcentral Alaska," said geologist Peter Haeussler, a leading earthquake researcher with the U.S. Geological Survey in Anchorage. "I'd personally try to avoid living within six miles of this thing," Haeussler said. "You wouldn't want to put any critical facilities on top of it."(Associated Press, Dec 29, 2002)
- The proposed site is less than 35 miles from the active volcano Mt. Spur. It last erupted June 27, 1992 after being quiet for 39 years. It is considered one of the most active volcanoes in Alaska

and last rumbled awake in 2012. Does it make sense to locate a critical energy production facility so close?

- The Army, Air Force and Alaska National Guard conduct low level (nap of the earth) operations west of the Susitna River. Mt. Susitna, Little Mt. Susitna and Beluga Mountain experience almost weekly helicopter and fixed wing training activities. Helicopters conduct low level operations and landings all over Little Mt. Susitna and the proposed wind farm site. At a time when the U.S. military is increasing a significant arctic presence in Alaska it stands to lose a training area within minutes of Joint Base Elmendorf/Richardson. We even see significant presence of the massive twin rotor Chinook helicopters stationed in the Fairbanks area. Their presence was last noted on June 1st.
- The impact on wildlife will likely be significant. At this moment Alaska Department of Fish and Game (ADF&G) is imposing restrictions on moose hunting in game management unit 16B. ADF&G has eliminated the permit and youth hunts for the coming year. They have indicated they will narrowly approve a fall general and subsistence hunt for the region. ADF&G established a minimum population of 6000 moose for a sustained hunt. In January they counted under 6200 moose. The population continues to decline for a variety of reasons. This is the second crash of the moose population in 20 years. Little Mt. Susitna is significant summer habitat for moose. The wind farm is asking for over 19,000 acres (lease) to build up to 80 wind turbines. That essentially consumes Little Mt. Susitna and the critical habitat for moose survival.
- The impact on moose is not the only wildlife issue. There are significant flocks of ptarmigan that call Little Mt. Susitna home. The wind farm project will be located less than 3 miles from the Susitna Flats Game Refuge. The Susitna Flats State Game Refuge encompasses approximately 300,800 acres and supports spectacular spring and fall concentrations of migrating waterfowl and shorebirds. The massive wind turbines will be in the direct migratory flight path of Upper Cook Inlet. U.S. Fish and Wildlife Service in their comments expressed concerns about the impact of the wind turbines, flashing navigation lighting and miles of roads, transmission lines and wind turbine sites on migratory birds. USFWS called for development of appropriate bird (and bat) strike mitigation strategies to ensure compliance with the Migratory Bird Treaty Act. This includes bird diversion measures on the guy wires. The three current towers and the proposed towers do not have or address this issue.
- Little is known about bats in Alaska. EagleSong Farm is currently working with Alaska Dept of Fish and Game to install audio monitoring equipment and conduct census counts as it is thought our farm may support a bat nursery. No one knows where these bats currently winter over. It is very possible Mt. Susitna, Little Mt. Susitna and Beluga Mountain offers winter refuge to Alaska's tiny brown bats.
- Little Mt. Susitna sees significant private air traffic in addition to the military air traffic identified above. It is a popular area to fly and land for ski and wheel planes. Small planes often transit between the north and south side of Mt. Susitna during inclement weather conditions trying to get to/from the Anchorage area. The wind farm site is in direct line of pilots trying to navigate the weather that Mt. Susitna often generates. Various Alaska aviation organizations have already sent correspondence to their members warning of the 3 meteorological towers that currently stand there.
- The West Susitna region covers 14,150 square miles. It is larger than 9 U.S. states. In all this vastness according to a demographer from the Alaska Department of Labor and Workforce Development the population (fulltime) in the immediate vicinity of Little Mt. Susitna is approximately 70 people. We are a group so small that we are insignificant in the political world. The area is extremely poor…especially so after the invasion of northern pike and loss of

the once prolific salmon runs. We often don't even qualify as an afterthought, especially by developers and politicians. We are the ones that will experience the negative results of this project but appear to be of little concern to Alaska Renewables or our local and state governments. It appears this project will drive the immediate area further into poverty.

- Alaska Renewable Inc. highlights the fact that "Anchorage" will not see the wind turbines. That has become a key selling point to the Rail Belt audience. What about those west of the Susitna River? We don't even get the benefit of the power it will generate. When I pressed Alaska Renewable Inc. representatives to give me one positive outcome for our region, they admitted there were none they could think of. I guess this is a case of the sacrifice of a few for the betterment of the many. I estimate after 31 years of building our lives and business here we stand to lose over $200,000 in value by this project's development after a lifetime of work. Let's be honest, what Alaskan wants to live in the shadow of 80 wind turbines. It was a fight to get the wind turbines constructed on Fire Island and that was just off the end of Ted Stevens Anchorage Intl. Airport. That was an area teeming with development. People don't want to see them.
- Alaska Renewable Inc. indicated they had an alternate site to the south by the village of Tyonek. It doesn't appear they are doing any real evaluation of alternate sites. The average person doesn't understand the massive heavy industrial road system that will have to be built, the rivers it will span or the amount of gravel that will have to be mined to support the massive, specialized equipment that will be needed to move and construct the towers.
- Over the years we have discovered artifacts on Little Mt. Susitna that the University of Alaska estimate to be over 11,000 years old. It is believed Mt. Susitna, Little Mt. Susitna and Beluga Mountain was the only land overlooking the glaciers that covered the southern Susitna Valley at that time. What is likely to be destroyed if Little Mt. Susitna has its top ripped off?
- When it comes to wildfire and wildfire suppression the project proposes to brush the entire project area annually. That is a massive and expensive undertaking. It will impact wildlife, especially the flocks of ptarmigan that call that mountain home.
- The current project development plan submitted to Department of Natural Resources supporting Alaska Renewables land use request only identifies the Lewis and Theodore Rivers as potential impacted waterways. If the request for these new towers is approved a portion of them will potentially impact Wolverine, Sucker and Alexander Creeks on the northeast side of the mountain. These drainages have not been identified in the current development plan.
- I would like to direct the Mat-Su Borough Planning and Land Use Department to the Department of Natural Resources "Preliminary Decision" document dated 5/22/2024. In that document numerous issues have been identified by several state and federal agencies with this project. The meteorological towers already constructed and the new ones proposed are being constructed before any of these issues are addressed.
- We are not aware of any meeting previously held by the Mat-Su Borough Planning and Land Use Department for the three towers currently on Little Mt. Susitna. If there was no meeting, why? It appears the three existing towers were constructed prior to Mat-Su Borough approval.
- Finally, the community meeting being held in Willow ignores the fact that the majority of stakeholders that will be directly impacted by construction of the towers are being ignored. Most stakeholders in the vicinity of Little Mt. Susitna cannot make it to a meeting held 40 miles away in Willow.

My family is not anti-development but feel it must be a measured and fact-based approach. We are very much in favor of Alaska's move to renewable energy.

Let's not lose sight of the fact that development of the West Susitna Access Road, Little Mt. Susitna Wind Farm, coal power plant, Donlin gas line, mining, drilling and other projects will require the destruction of the lower west Susitna Valley. A valley that to this point has been little touched by civilization. It will require us to destroy a region that is still in its natural state. Is it worth the price? Are the Alaskans that call this place home to be tossed aside? Once it happens there is no going back.

Does my family and I have a bias regarding these projects? Of course we do, this has been our home for over 31 years. I am approaching my 70th birthday and hope to retire someday, but that may not be possible if the wilderness that enticed us to come here is turned into an industrial park. Our hope is this wind farm, and the other projects are measured by their pros and cons and decisions are based on merit, but that rarely happens today does it. The Little Mt. Susitna Wind Farm project is not a benign project. Let's make sure the benefit is worth the sacrifice.

Michael W. Williams
General Partner

EagleSong Peony Farm
200 W. 34th Ave. Ste 295
Anchorage, AK 99503
(907) 521-0034
eagle@eaglesongalaska.com

Landowner
17409 Four Corner Rd
Prairie Grove, AR 72753-9765

Landowner
8420 Ruth Dr
Eagle River, AK 99577

Landowner
11340 Elmore Rd
Anchorage, AK 99516

Landowner
1920 6th St #347
Santa Monica, CA 90405

Landowner
850 Howard St TRLR 41
Raymond, WA 98577-1500

Landowner
130 Woodland Ave
Reno, NV 89523

Landowner
229 E Commonwealth #235
Fullerton, CA 92832

Landowner
Po box 1047
Willow, AK 99688

Landowner
13030 Admiralty Pl
Anchorage, AK 99515

Landowner
26994 Johansen Dr
Kasilof, AK 99610

Landowner
Po box 167
Cantwell, AK 99729

Landowner
13301 E Jensen Ave
Palmer, AK 99645

Landowner
37830 Luscombe Cir
Sterling, AK 99672

Landowner
Po box 415
Girdwood, AK 99587

Landowner
1510 Oceanview Dr
Anchorage, AK 99515

Landowner
3810 Wildrose Ave
Kenai, AK 99611-8400

Landowner
Po box 4225
Fort Eustis, VA 23604

Landowner
1948 Champion Cir
Virginia Beach, VA 23456

Landowner
402A W Palm Valley Blvd #153
Round Rock, TX 78664

Landowner
Po box 661
Whittier, AK 99693

Landowner
2028 S 17th St
Tacoma, WI 98405

State of AK - ATTN: DNR
550 7th Ave
Anchorage AK 99501

Landowner
Po box 693
Willow, AK 99688

Landowner
2046 Westlake N #235
Seattle, AK 98109

ACS Internet Inc
ATTN: Tax Dept
600 Telephone Ave
Anchorage, AK 99503

Landowner
Po box 93330
Anchorage, AK 99509

Landowner
21017 Scenic Dr
Chugiak, AK 99567

Landowner
6215 Kanan-Dume Rd
Malibu, CA 90265

Landowner
Po Box ACR Alexander Cree
Anchorage, AK 99695

Landowner
21786 425th Ave
Clitherall, MN 56524

Landowner
2230 Steeple Dr
Anchorage, AK 99516

Ruth Wendula Couillard, c/o Bente
Schnellstr, 24, 22765
Hamburg, Germany

Landowner(s)
23010 Blackstone Pk Rd
Katy, TX 77493

Landowner(s)
2440 Benz Cir
Anchorage, AK 99502

Landowner(s)
2499 N Seward Meridian
Wasilla, AK 99654

Landowner(s)
335 N Juanita Ave #103
Los Angeles, CA 90004

Landowner(s)
341 N Alaska
Palmer, AK 99645

Matanuska Susitna Borough
350 E Dahlia Ave
Palmer, AK 99645

Landowner(s)
3617 Inspiration Loop

Wasilla, AK 99654

Landowner(s)
3800 Boniface Pky

Anchorage, AK 99504

Landowner(s)
4020 Defiance St

Anchorage, AK 99504

Landowner(s)
4101 Coventry Dr

Anchorage, AK 99507

Landowner(s)
4119 Vista Ct

Anchorage, AK 99508

Landowner(s)
4351 E Bogard Rd

Wasilla, AK 99654

Landowner(s)
44747 21st ST W

Lancaster, CA 93536

Landowner(s)
5131 Alder Dr

Wasilla, AK 99654

Landowner(s)
5716 Craig Dr

Anchorage, AK 99504

Landowner(s)
8050 Pioneer Dr #602

Anchorage, AK 99504

Landowner(s)
8103 E US Highway 36, #145

Avon, IN 46123

Landowner(s)
8677 Villa La Jolla Dr, #245

La Jolla, CA 92037

Landowner(s)
90480 Peter Johnson Rd

Astoria, OR 97103

Landowner(s)
Po Box 161

Anchor Point, AK 99556

Landowner(s)
Po box 1636

Columbia Falls, MT 59912

Landowner(s)
Po box 220071

Anchorage, AK 99522

Landowner(s)
Po box 39209

Denver, CO 89239

Landowner(s)
Po box 3974

Palmer, AK 99645

Landowner(s)
Po box 520491

Big Lake, AK 99652

Landowner(s)
Po box 553

Crosby, TX 77532

Landowner(s)
Po box 62262

Virginia Beach, VA 23466

Landowner(s)
W 4028 HWY 2

Powers, MI 49874

Landowner(s)
110 Pettis Dr
Anchorage, AK 99515

Landowner(s)
7031 Clairmont Cir

Anchorage, AK 99507

Landowner(s)
Po box 261

Seward, AK 99664

Landowner(s)
3501 Iowa St
Anchorage, AK 99517

Landowner(s)
7302 Oakmont Dr

Santa Rosa, CA 95409

Landowner(s)
Po box 310

Laguna Beach, CA 92652

Landowner(s)
4821 Becharof

Anchorage, AK 99507

Landowner(s)
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Ivins, UT 84738

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Landowner(s)
7202 N Carl Paulsen Pl

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Calistoga, CA 94515

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Po box 875513

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12333 NE Morris St

Portland, OR 97230

Landowner(s)
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267 Meiggs Backus Rd

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1301 W 72nd Cir

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Landowner(s)
28323 Eagle River Rd

Eagle River, AK 99577

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1303 NW Hawk Creek Dr

Blue Springs, MO 64015

Landowner(s)
298 Rachel Rd

Kennewick, WA 99338

Landowner(s)
1408 Fairmont Dr
Neosho, MO 64850

Landowner(s)
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Landowner(s)
200 Middletown Rd

Colchester, CT 06415

Landowner(s)
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Landowner(s)
3170 N Snow Goose Dr

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Landowner(s)
2028 S 17th St
Tacoma, WA 98405

Landowner(s)
4618 E Ardmore Rd

Phoenix, AZ 85044

Landowner(s)
20632 David Ave

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Landowner(s)
478 Lewis & Clark Trail

Bozeman, MT 59718

Matanuska-Susitna Borough
Planning & Land Use Department
Development Services Division
350 East Dahlia Avenue
Palmer, Alaska 99645

FIRST CLASS MAIL

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A community meeting will be conducted regarding the following new tall structure/cell tower:

**Name of Company:** Little Mount Susitna Wind LLC
**Height of Tower:** 60 meters
**Tower Design:** The meteorological towers are 60m tubular structures with multiple guy wires. The towers have FAA-compliant industrial paint, guy guards, and marker balls. Painting is with alternate bands of aviation orange and white paint. High visibility guy guards (yellow plastic sleeves) will be placed around the base of the guy wires. Four high visibility aviation orange marker balls will be placed on the top-level guy wires within approximately 10m of the top of the tower.
**Lighting:** N/A
**Site Access:** The site will be accessed by helicopter.
**Proposed Service:** The purpose of these installations is to allow for the quantitative assessment of the wind resources to enable the development of a future utility-scale wind energy generation project that would provide reliable, low-cost renewable energy to Southcentral Alaska.

A community meeting will be held on **June 3, 2024, from 5:30-6:30pm at the Willow Area Community Center, located at Mile 69 South Parks Highway, Willow Alaska.** Please come to the meeting to obtain more information and give feedback about this proposed project.

For additional information regarding the proposed tower please contact:

**Faith Tyson**
**907-202-0507**
**3300 Arctic Blvd**
**Suite 201, PMB 1451**
**Anchorage, AK 99503**

If you would like to submit comments, this form may be used for your convenience by filling in the information below and mailing it to the Matanuska-Susitna Borough, Development Services Division, 350 E. Dahlia Avenue, Palmer, AK 99745. You may e-mail to permitcenter@matsugov.us. Comments must be received by **June 3, 2024.**

***Name:*** _____ ***Address:*** _____

***Location/Legal Description of your property:*** _____

***Comments:*** _____

_____

_____

_____

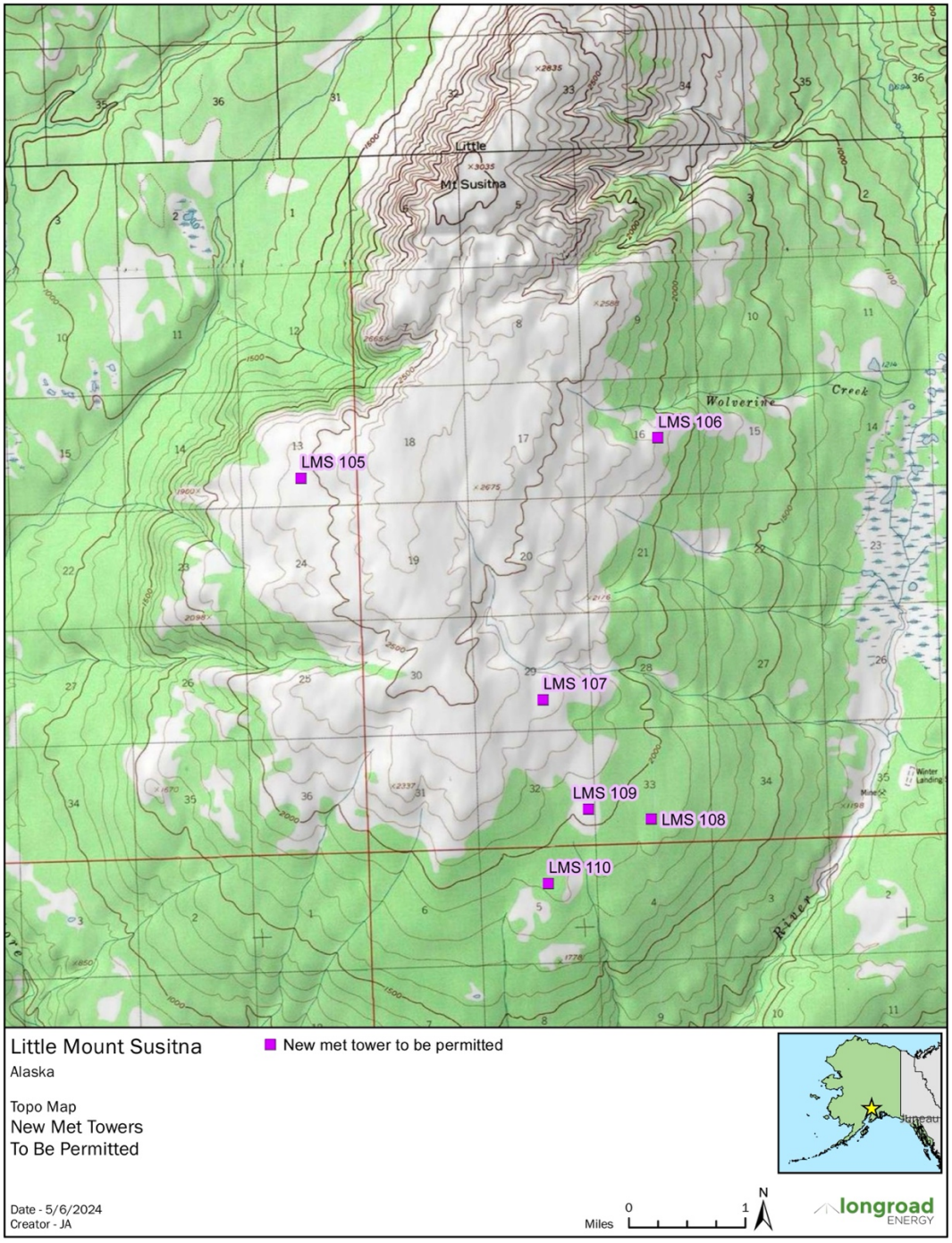
_____

_____

*Note: Vicinity Map Located on Reverse Side*

**Detailed topographic map of the meteorological tower sites proposed on Little Mt Susitna**

| Site Name | Lat/Lon (WGS84) | Elevation (ft) | MTRS |
|---|---|---|---|
| LMS_105 | 61.473061N, 150.988809W | 2466 | S016N010W13 |
| LMS_106 | 61.476704N, 150.895905W | 2200 | S016N009W16 |
| LMS_107 | 61.444640N, 150.927867W | 2339 | S016N009W29 |
| LMS_108 | 61.429372N, 150.900878W | 1934 | S016N009W33 |
| LMS_109 | 61.430890N, 150.916978W | 2037 | S016N009W32 |
| LMS_110 | 61.421817N, 150.928003W | 1903 | S015N009W05 |



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37830 Luscombe Cir
Sterling, AK 99672

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To:

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402A W Palm Valley Blvd #153
Round Rock, TX 78664

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Anchorage, AK 99503

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Landowner
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Kenai, AK 99611-8400

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To:

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Ruth Wendula Couillard, c/o Bente
Schnellstr, 24, 22765
Hamburg, Germany

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To:

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20632 David Ave

Eagle River, AK 99577

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200 Middletown Rd

Colchester, CT 06415

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From:

**ALASKA RENEWABLES**
3300 Arctic Blvd
Suite 201 PMB 1451
Anchorage, AK 99503

To:

Landowner(s)
4618 E Ardmore Rd

Phoenix, AZ 85044

ADC 99

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FCM LETTER
ANCHORAGE, AK
99530
MAY 16 24
AMOUNT
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MAY 16 2024

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To:

Landowner(s)
478 Lewis & Clark Trail

Bozeman, MT 59718

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To:

Landowner(s)
30 Maple Ave

Meriden, CT 06450

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To:
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2440 Benz Cir
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To:

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To:

Landowner(s)
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Anchorage, AK 99504

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To:

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4119 Vista Ct

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To:

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44747 21st ST W

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To:

Landowner(s)
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Anchorage, AK 99504

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To:

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Avon, IN 46123

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To:

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90480 Peter Johnson Rd

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To:

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Columbia Falls, MT 59912

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Wasilla, AK 99654

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Landowner
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