COHEN and WOLF P.C.
ATTORNEYS AT LAW

JULIE D. KOHLER

PLEASE REPLY TO: Bridgeport
WRITER'S DIRECT DIAL: (203) 337-4157
E-Mail Address: jkohler@cohenandwolf.com

March 18, 2014

Attorney Melanie Bachman
Acting Executive Director
Connecticut Siting Council
Ten Franklin Square
New Britain, CT 06051

Re: Notice of Exempt Modification
Verizon Wireless/T-Mobile co-location
Site ID CTNH417A
31 New Hartford Road/Rust Road, Barkhamsted, CT

Dear Attorney Bachman:

This office represents T-Mobile Northeast LLC ("T-Mobile") and has been retained to file exempt modification filings with the Connecticut Siting Council on its behalf.

In this case, Cellco Partnership, d/b/a Verizon Wireless owns the existing monopine telecommunications tower and related facility located at 31 New Hartford Road/Rust Road, Barkhamsted, Connecticut (Latitude: 41° 53' 37" Longitude: -72 59' 48"). T-Mobile intends to replace three antennas, add three antennas and related equipment at this existing telecommunications facility in Barkhamsted ("Barkhamsted Facility"). Please accept this letter as notification, pursuant to R.C.S.A. § 16-50j-73, of construction which constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is also being sent to the First Selectman, Donald S. Stein, and the property owner, Regional Refuse Disposal District 1.

The existing Barkhamsted Facility consists of a 145 foot tall monopine tower, approved by the Council in Docket No. 182A.[1] T-Mobile plans to replace three antennas and three TMAs with six antennas at a centerline of 101 feet, six inches. (See the plans revised to February 27, 2014 attached hereto as Exhibit A). T-Mobile will also install fiber cable and reuse existing coax cable. The existing Barkhamsted Facility is structurally capable of supporting T-Mobile's proposed modifications, as indicated in the structural analysis dated March 4, 2014 and attached hereto as Exhibit B.

The planned modifications to the Barkhamsted Facility fall squarely within those

[1] The Decision and Order in this docket (dated May 7, 2002 respectively) contain no relevant requirements or limitations on the configuration of the T-Mobile's replacement equipment at the Barkhamsted Facility.

activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed modification will not increase the height of the tower. T-Mobile's replacement antennas will be installed at a centerline of 101 feet, six inches +/-, merely replacing existing antennas located at the same 101 feet, six inches elevation +/-. The enclosed tower drawing confirms that the proposed modification will not increase the height of the tower.

2. The proposed modifications will not require an extension of the site boundaries. T-Mobile's equipment will be located entirely within the existing compound and leased area as shown on Page 1 of Exhibit A.

3. The proposed modification to the Barkhamsted Facility will not increase the noise levels at the existing facility by six decibels or more.

4. The operation of the replacement antennas will not increase the total radio frequency (RF) power density, measured at the base of the tower, to a level at or above the applicable standard. According to a Radio Frequency Emissions Analysis Report prepared by EBI dated March 18, 2014 T-Mobile's operations would add 1.143% of the FCC Standard. Therefore, the calculated "worst case" power density for the planned combined operation at the site including all of the proposed antennas would be 60.273% of the FCC Standard as calculated for a mixed frequency site as evidenced by the engineering exhibit attached hereto as Exhibit C.

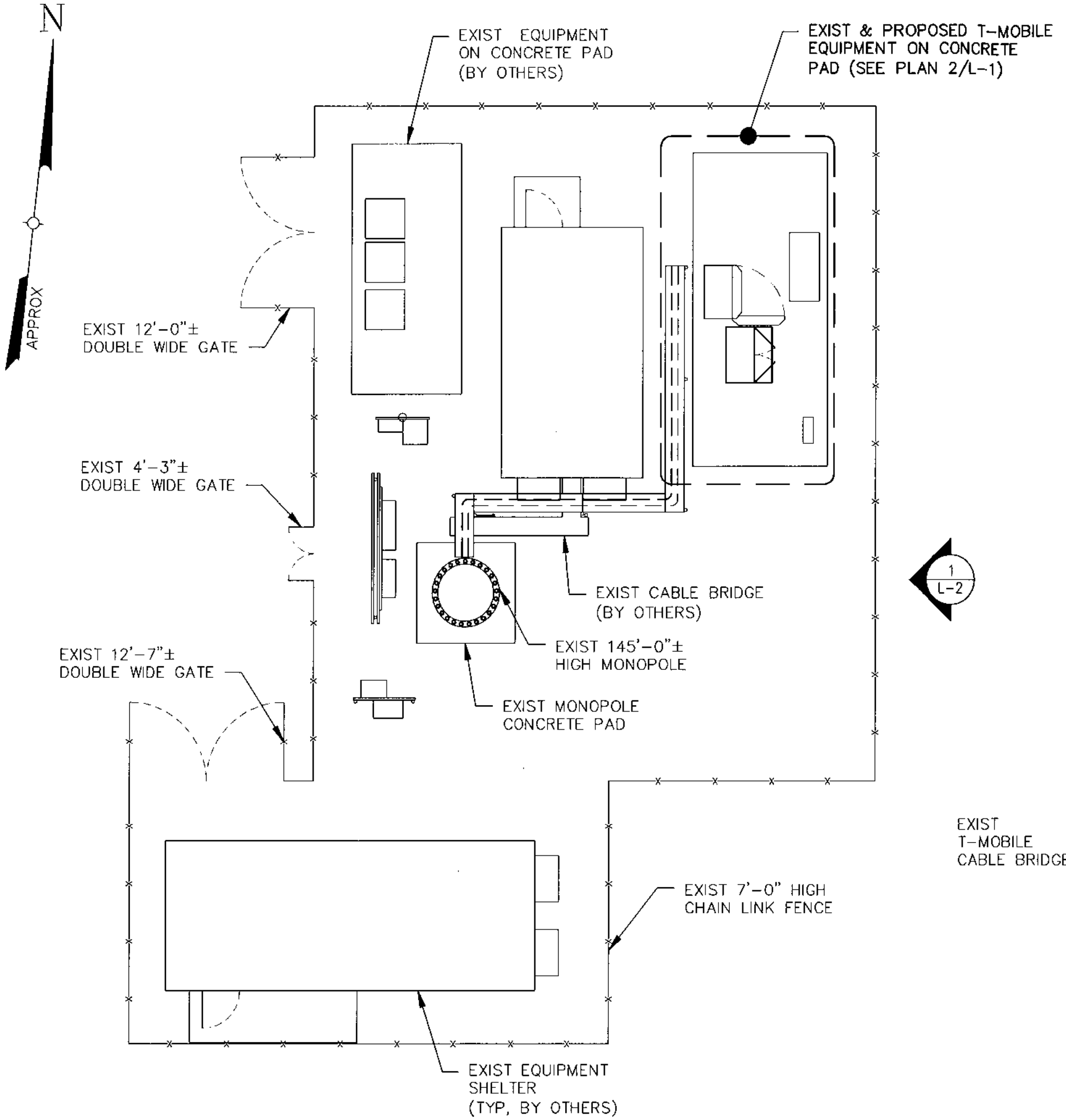
For the foregoing reasons, T-Mobile respectfully submits that the proposed replacement antennas and equipment at the Barkhamsted Facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2). Upon acknowledgement by the Council of this proposed exempt modification, T-Mobile shall commence construction approximately sixty days from the date of the Council's notice of acknowledgement.

Sincerely,

Julie D. Kohler, Esq.

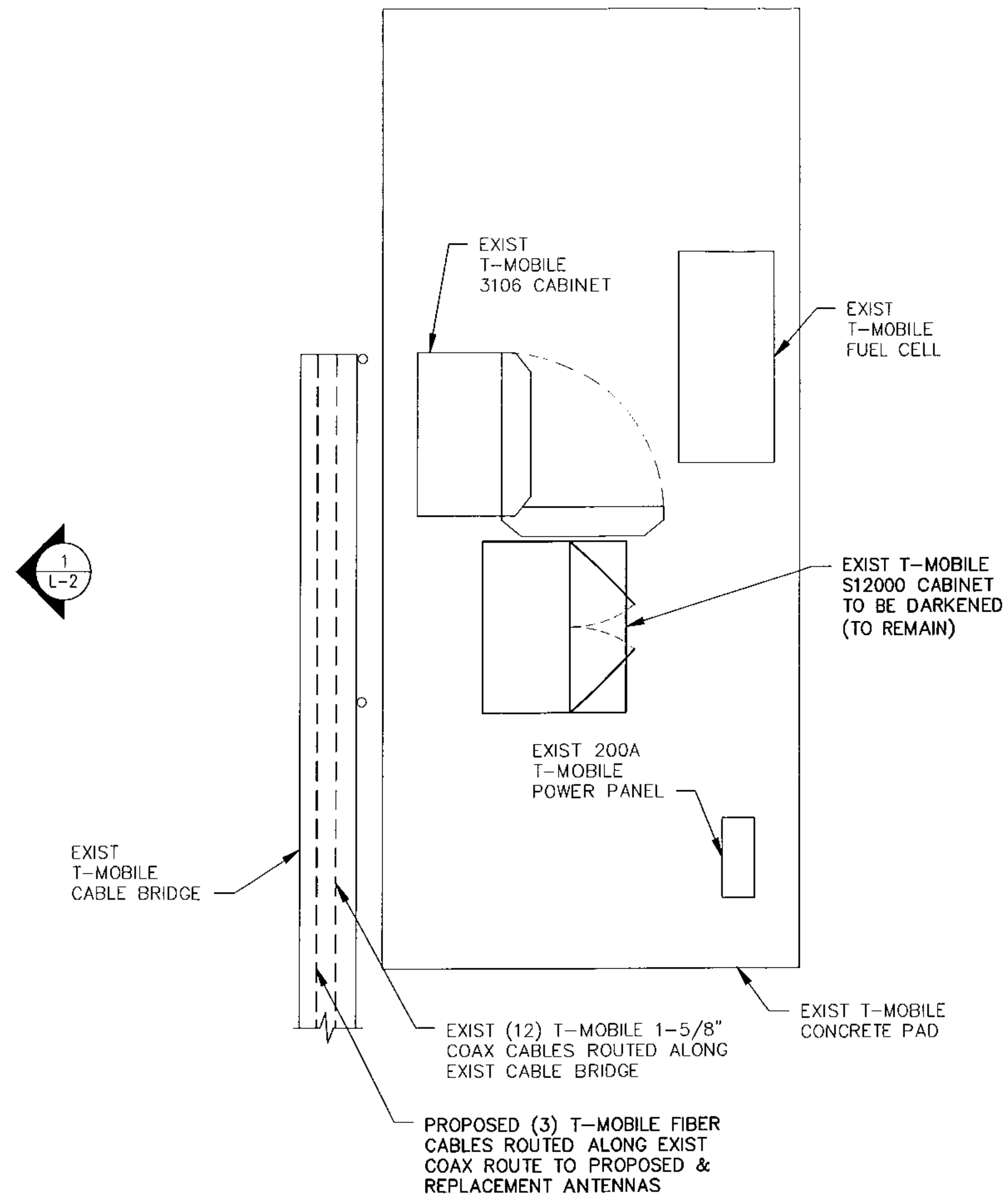
cc: Town of Barkhamsted, First Selectman Donald S. Stein
Cellco Partnership, d/b/a Verizon Wireless
Regional Refuse Disposal District 1
HPC Wireless Solutions, Halene Fujimoto

EXHIBIT A



1 L-1 SITE PLAN

SCALE: 3/32" = 1'-0"



2 L-1 EQUIPMENT PLAN

SCALE: 1/4" = 1'-0"

STRUCTURAL NOTE:
EXIST MOUNTS AND MONOPOLE TO BE VERIFIED FOR STRUCTURAL SUITABILITY OF PROPOSED INSTALLATION BY A STATE LICENSED P.E.

CONFIGURATION
2C

0 1 2 3
ORIGINAL SIZE IN INCHES

TECTONIC
• PLANNING • ENGINEERING • SURVEYING • CONSTRUCTION MANAGEMENT
TECTONIC Engineering & Surveying Consultants P.C.
1279 Route 300
Newburgh, NY 12550
Phone: (845) 567-6656
Fax: (845) 567-8703

T-Mobile
35 GRIFFIN ROAD SOUTH
BLOOMFIELD, CT 06002

APPROVALS
T-MOBILE
LANDLORD
RF
CONSTRUCTION

PROJECT NUMBER	DESIGNED BY
6544.CTNH417A	JQ

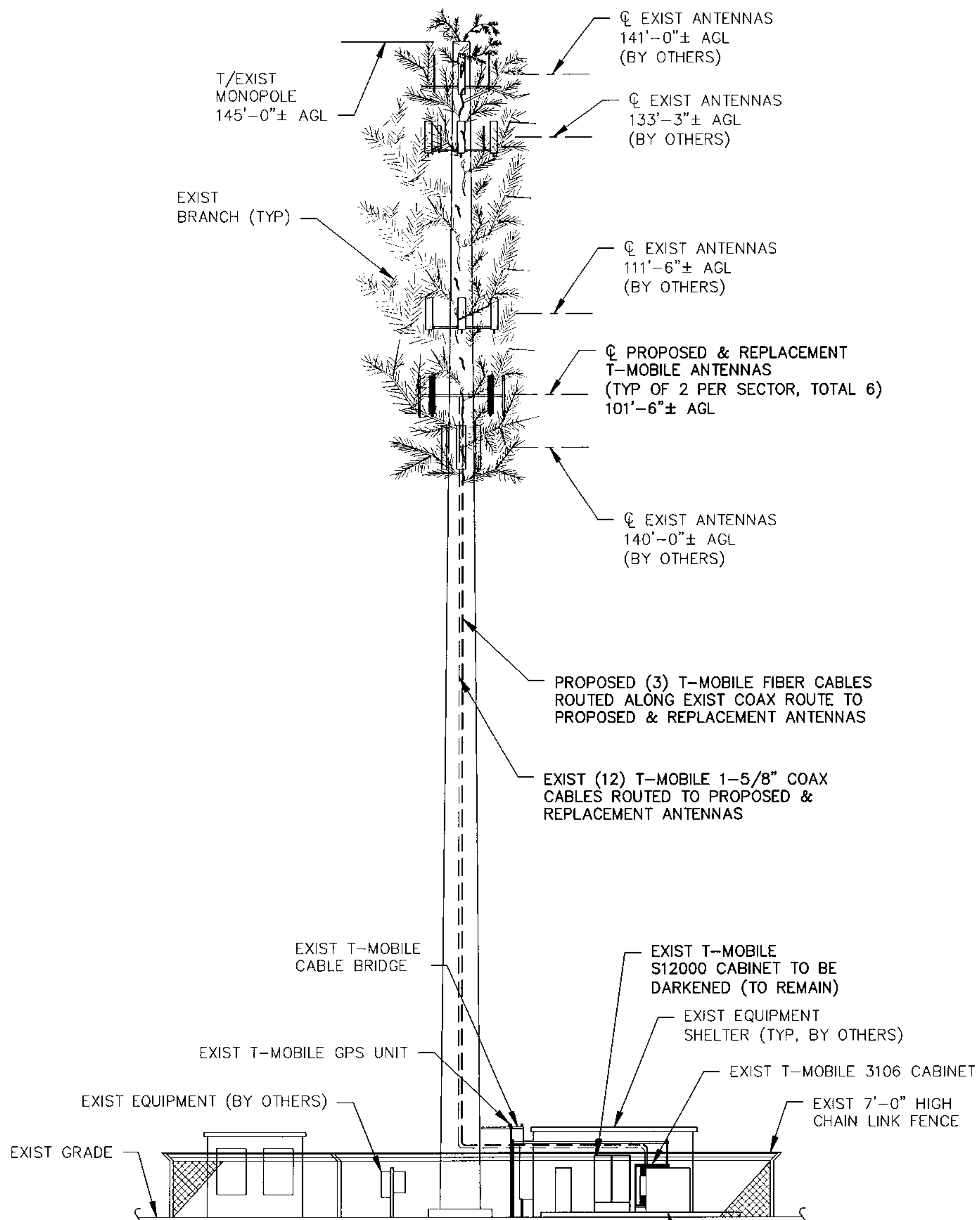
REV	DATE	REVISION	DRAWN BY
0	02/27/14	FOR COMMENT	MP

ISSUED BY	DATE

SITE INFORMATION
CTNH417A
NEW HARTFORD-
VERIZON COLO
31 NEW HARTFORD ROAD
BARKHAMSTED, CT 06063

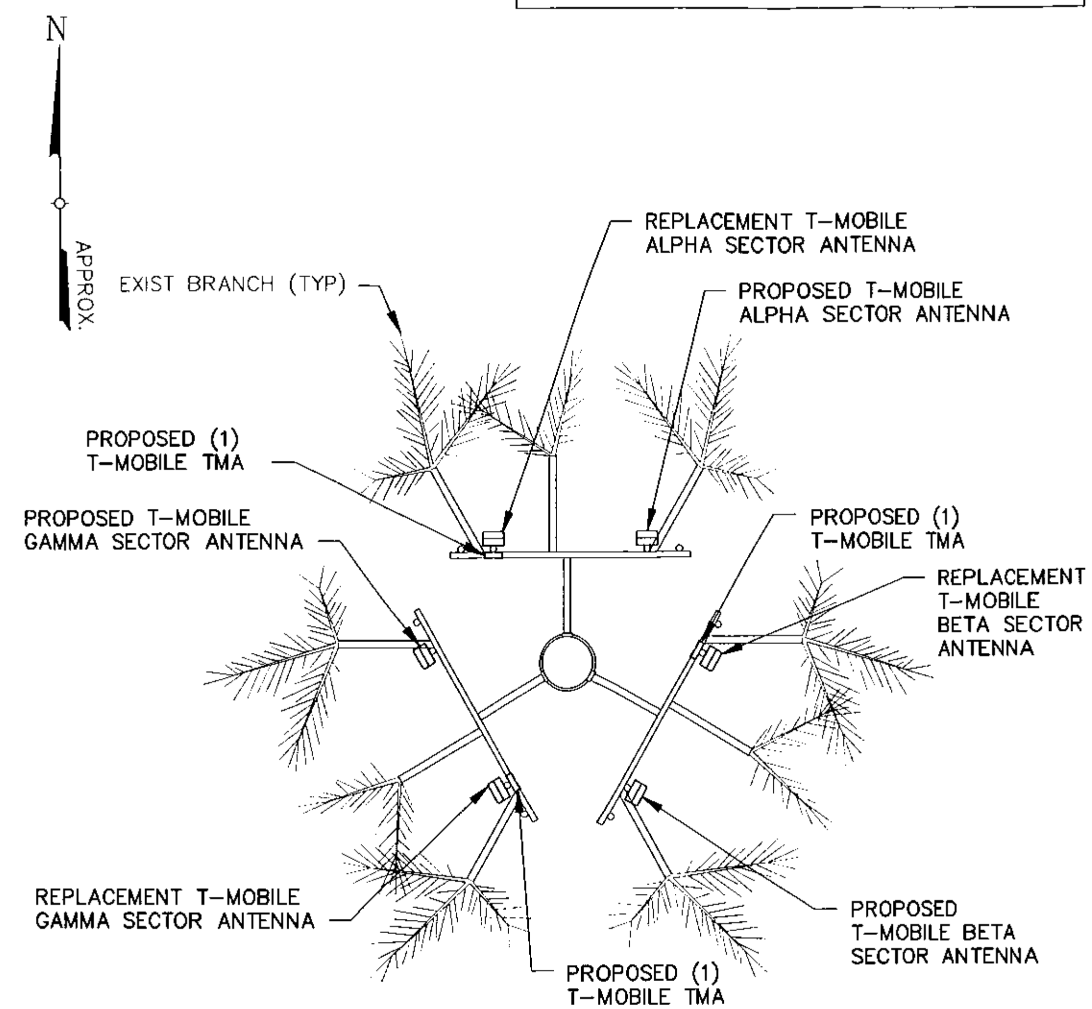
SHEET TITLE
SITE PLAN & EQUIPMENT PLAN

SHEET NUMBER
L-1



1 / L-2 ELEVATION
SCALE: 1/16" = 1'-0"

STRUCTURAL NOTE:
EXIST MOUNTS AND MONOPOLE TO BE VERIFIED FOR STRUCTURAL SUITABILITY OF PROPOSED INSTALLATION BY A STATE LICENSED P.E.



2 / L-2 ANTENNA PLAN
SCALE: 1/8" = 1'-0"

CONFIGURATION
2C

0 1 2 3
ORIGINAL SIZE IN INCHES

TECTONIC
• PLANNING • SURVEYING
• ENGINEERING • CONSTRUCTION MANAGEMENT
TECTONIC Engineering & Surveying Consultants P.C.
1279 Route 300
Newburgh, NY 12550
Phone: (845) 567-6656
Fax: (845) 567-8703

T-Mobile
35 GRIFFIN ROAD SOUTH
BLOOMFIELD, CT 06002

APPROVALS
T-MOBILE
LANDLORD
RF
CONSTRUCTION

PROJECT NUMBER	DESIGNED BY
6644.CTNH417A	JQ

REV	DATE	REVISION	DRAWN BY
0	02/27/14	FOR COMMENT	MP

ISSUED BY	DATE

SITE INFORMATION
CTNH417A
NEW HARTFORD-
VERIZON COLO
31 NEW HARTFORD ROAD
BARKHAMSTED, CT 06063

SHEET TITLE
ELEVATION

SHEET NUMBER
L-2

EXHIBIT B

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

145-ft Existing Summit Monopine

Proposed T-Mobile
Antenna Upgrade

T-Mobile Site Ref: CTNH417A

Verizon Site Ref: Barkhamsted South

31 New Hartford Road (Rust Road)
Barkhamsted, CT

Centek Project No. 14033.004

Date: March 4, 2014

STATE OF CONNECTICUT PROFESSIONAL ENGINEER LICENSED No.16694

Prepared for:
T-Mobile Towers
4 Sylvan Way
Parsippany, NJ 07054

Table of Contents

Introduction

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna installation proposed by T-Mobile on the existing monopine (tower) owned and operated by Verizon Wireless, located in Barkhamsted, CT.

The host tower is a 125-ft tall, three-section, eighteen sided, tapered monopine, originally manufactured by Summit Manufacturing and designed by Paul J. Ford and Company job no; 29200-1316, dated September 7, 2000 with a 20-ft extension manufactured by Summit design no; 10916-D6 dated April 12, 2001. The tower geometry, structure member sizes and foundation system information were obtained from a previous structural report prepared by Centek job no. 12115.CO1 dated October 9, 2012.

Antenna and appurtenance information were obtained from the aforementioned Centek structural report, a tower mapping report prepared by JWB Tower Services, LLC dated February 28, 2014 and a T-Mobile RF data sheet.

The tower consists of four (4) tapered vertical steel sections conforming to ASTM A607-65 (65ksi). The bottom three (3) sections are slip joint connected and the top section is flange connected. The diameter of the pole (flat-flat) is 25.41-in at the top and 66.05-in at the base.

T-Mobile proposes the removal of three (3) panel antennas and three (3) TMA's and the installation of six (6) panel antennas mounted to the existing three (3) T-Arms. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

The existing, proposed and future loads considered in this analysis consist of the following:

- SPRINT (Existing):
  Antennas: Three (3) RFS APXVSPP18-C-A20 panel antennas, three (3) ALU 1900 MHz RRH's and three (3) ALU 800 MHz RRH's mounted on three (3) existing T-Arms with a RAD center elevation of 140-ft above grade.
  Coax Cables: Three (3) 1-1/4" ∅ Hybriflex cables running on the inside of the existing tower.

- VERIZON (Existing/Reserved):
  Antennas: Six (6) Antel LPA-80063-6CF panel antennas, six (6) Antel BXA-70063-6CF panel antennas, six (6) LPA-171063-12CF panel antennas, six (6) RFS FD9R6004/2C-3L Diplexers, six (6) RRH's and one (1) main distribution box mounted on three (3) existing T-Arms with a RAD center elevation of 133-ft above grade.
  Coax Cables: Eighteen (18) 1-5/8" ∅ coax cables and two (2) 1-5/8" ∅ fiber cable running on the inside of the existing tower.

- AT&T (Existing):
  Antennas: Six (6) Powerwave 7770 panel antennas, six (6) Powerwave TT19-08BP111-001 TMA's, two (2) KMW AM-X-CD-16-65-00T-RET panel antennas, one (1) Kathrein Scala 800-10764 panel antenna, six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted on three (3) existing T-Arms with a RAD center elevation of 113-ft above grade.
  Coax Cables: Twelve (12) 1-1/4" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running on the inside of the existing tower.
- METROPCS (EXISTING):
  Antennas: Three (3) RFS APXV18-206517-C panel antennas flush mounted with a RAD center elevation of 92-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- T-MOBILE (Existing to Remain):
  Antenna: Three (3) Ericsson KRY 112 TMA's mounted on three (3) existing T-Arms with a RAD center elevation of 102-ft above grade.
  Coax Cable: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- T-MOBILE (Existing to Remove):
  Antenna: Three (3) RFS APX16DWV-16DWVS-E-A20 panel antennas and three (3) RFS AMAA1412D-1A20 TMA's mounted on three (3) existing T-Arms with a RAD center elevation of 102-ft above grade.
- **T-MOBILE (Proposed):**
  Antennas: Six (6) Ericsson AIR 21 panel antennas mounted on three (3) existing T-Arms with a RAD center elevation of 102-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.

Primary Assumptions Used in the Analysis

- The tower structure's theoretical capacity not including any assessment of the condition of the tower.
- The tower carries the horizontal and vertical loads due to the weight of antennas, ice load and wind.
- Tower is properly installed and maintained.
- Tower is in plumb condition.
- Tower loading for antennas and mounts as listed in this report.
- All bolts are appropriately tightened providing the necessary connection continuity.
- All welds are fabricated with ER-70S-6 electrodes.
- All members are assumed to be as specified in the original tower design documents or reinforcement drawings.
- All members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
- All member protective coatings are in good condition.
- All tower members were properly designed, detailed, fabricated, installed and have been properly maintained since erection.
- Any deviation from the analyzed antenna loading will require a new analysis for verification of structural adequacy.
- All existing coax cables to be installed as indicated in this report.

Analysis

The existing tower was analyzed using a comprehensive computer program entitled tnxTower. The program analyzes the tower, considering the worst case loading condition. The tower is considered as loaded by concentric forces along the tower shaft, and the model assumes that the shaft members are subjected to bending, axial, and shear forces.

The existing tower was analyzed for the controlling basic wind speed (fastest mile) with no ice and a 75% reduction of wind force with ½ inch accumulative ice to determine stresses in members as per guidelines of TIA/EIA-222-F-96 entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix K of the CSBC[1] and the wind speed data available in the TIA/EIA-222-F-96 Standard. The higher of the two wind speeds is utilized in preparation on the tower analysis.

Tower Loading

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA/EIA-222-F, gravity loads of the tower structure and its components, and the application of ½" radial ice on the tower structure and its components.

Basic Wind Speed:	Litchfield; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Barkhamsted; v = 90 mph (3 second gust) equivalent to v = 75 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA-EIA-222-F wind speed controls.	
Load Cases:	<u>Load Case 1</u>; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 2</u>; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	<u>Load Case 3</u>; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 2009 CT State Supplement. (CSBC)

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software tnxTower. Allowable stresses were determined based on Table 5 of the TIA/EIA code with a 1/3 increase per Section 3.1.1.1 of the same code.

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", the maximum tower steel usage was found to be at **77.5%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	125.00'-146.00'	30.7%	**PASS**
Pole Shaft (L2)	82.25'-125.00'	62.1%	**PASS**
Pole Shaft (L3)	43.00'-82.25'	76.2%	**PASS**
Pole Shaft (L4)	1.0'-43.00'	77.5%	**PASS**

Foundation and Anchors

The existing foundation consists of a 8-ft square x 5.5-ft long reinforced concrete pier on a 31.5-ft square x 4.0-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned Centek structural report. The base of the tower is connected to the foundation by means of (24) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-ft into the concrete foundation structure.

- The tower base reactions developed from the governing Load Case 1 were used in the verification of the foundation and its anchors:

Location	Vector	Proposed Reactions
Base	Shear	54 kips
	Compression	55 kips
	Moment	5575 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)[1]	Proposed Loading (FS)[1]	Result
Reinforced Concrete Pad and Pier	OTM[2]	2.0	2.55	**PASS**

Note 1: FS denotes Factor of Safety.

Note 2: OTM denotes Overturning Moment

- The flange bolts and flange plate were found to be within allowable limits.

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Flange Bolts	Tension	67.0%	**PASS**
Flange Plate	Bending	25.7%	**PASS**

- The anchor bolts and base plate were found to be within allowable limits.

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Axial and Bending	78.3%	**PASS**
Base Plate	Bending	62.9%	**PASS**

Conclusion

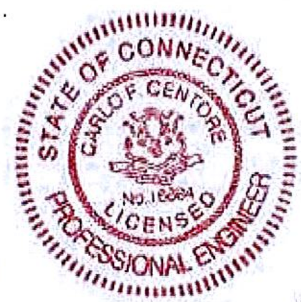
This analysis shows that the subject tower **is adequate** to support the proposed modified antenna configuration.

The analysis is based, in part, on the information provided to this office by T-Mobile. If the existing conditions are different than the information in this report, Centek Engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Carlo F. Centore, PE
Principal ~ Structural Engineer



Prepared by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

All engineering services are performed on the basis that the information used is current and correct. This information may consist of, but is not necessarily limited to:

- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information provided to Centek Engineering, Inc. and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that all structures were constructed in accordance with the drawings and specifications and are in an un-corroded condition and have not deteriorated. It is therefore assumed that its capacity has not significantly changed from the "as new" condition.
- All services will be performed to the codes specified by the client, and we do not imply to meet any other codes or requirements unless explicitly agreed in writing. If wind and ice loads or other relevant parameters are to be different from the minimum values recommended by the codes, the client shall specify the exact requirement. In the absence of information to the contrary, all work will be performed in accordance with the latest revision of ANSI/ASCE10 & ANSI/EIA-222
- All services performed, results obtained, and recommendations made are in accordance with generally accepted engineering principles and practices. Centek Engineering, Inc. is not responsible for the conclusions, opinions and recommendations made by others based on the information we supply.

GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly RISATower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

tnxTower Features:

- tnxTower can analyze and design 3- and 4-sided guyed towers, 3- and 4-sided self-supporting towers and either round or tapered ground mounted poles with or without guys.
- The program analyzes towers using the TIA-222-G (2005) standard or any of the previous TIA/EIA standards back to RS-222 (1959). Steel design is checked using the AISC ASD 9th Edition or the AISC LRFD specifications.
- Linear and non-linear (P-delta) analyses can be used in determining displacements and forces in the structure. Wind pressures and forces are automatically calculated.
- Extensive graphics plots include material take-off, shear-moment, leg compression, displacement, twist, feed line, guy anchor and stress plots.
- tnxTower contains unique features such as True Cable behavior, hog rod take-up, foundation stiffness and much more.

Section	1	2	3	4
Length (ft)	21.000	42.750	45.000	49.000
Number of Sides	18	18	18	18
Thickness (in)	0.250	0.375	0.438	0.500
Socket Length (ft)		5.750	7.000	
Top Dia (in)	25.410	32.508	42.251	52.154
Bot Dia (in)	32.508	44.632	55.014	66.050
Grade	A607-65			
Weight (K) 34.0	1.6	6.6	10.2	15.5

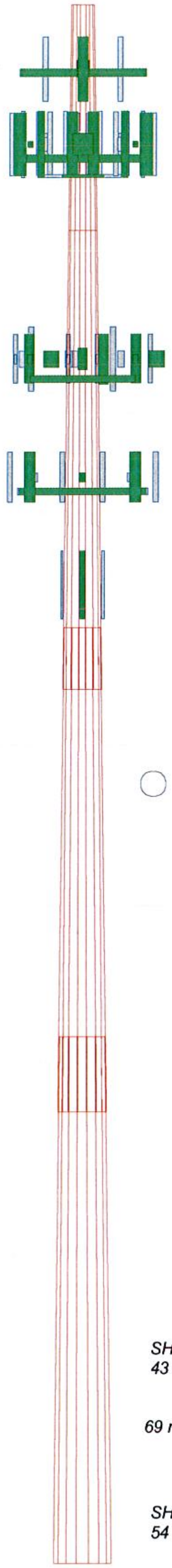
146.0 ft

125.0 ft

82.3 ft

43.0 ft

1.0 ft



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Barhamsted Branch 1	153.26	Valmont T-Arm (1) (Verizon - Existing)	132
APXVSPP18-C-A20 (Sprint - Existing)	140	Valmont T-Arm (1) (Verizon - Existing)	132
APXVSPP18-C-A20 (Sprint - Existing)	140	4-ft Standoff (Empty)	130
FD-RRH 2x50 800 (Sprint - Existing)	140	4-ft Standoff (Empty)	130
FD-RRH 2x50 800 (Sprint - Existing)	140	4-ft Standoff (Empty)	130
FD-RRH 2x50 800 (Sprint - Existing)	140	Barhamsted Branch 3	121.39
FD-RRH 4x45 1900 (Sprint - Existing)	140	(2) TT19-08BP111-001 TMA (ATT - Existing)	113
FD-RRH 4x45 1900 (Sprint - Existing)	140	(2) TT19-08BP111-001 TMA (ATT - Existing)	113
FD-RRH 4x45 1900 (Sprint - Existing)	140	(2) TT19-08BP111-001 TMA (ATT - Existing)	113
Valmont T-Arm (1) (Sprint - Existing)	140	AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	113
Valmont T-Arm (1) (Sprint - Existing)	140	AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	113
Valmont T-Arm (1) (Sprint - Existing)	140	800-10764 (ATT - Existing)	113
APXVSPP18-C-A20 (Sprint - Existing)	140	(2) RRUS-11 (ATT - Existing)	113
Barhamsted Branch 2	138.16	(2) RRUS-11 (ATT - Existing)	113
BXA-70063/6CF (Verizon - Reserved)	133	(2) RRUS-11 (ATT - Existing)	113
BXA-70063/6CF (Verizon - Reserved)	133	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	113
LPA-171063-12CF (Verizon - Reserved)	133	(2) 7770.00 (ATT - Existing)	113
LPA-80063/6CF (Verizon - Reserved)	133	(2) 7770.00 (ATT - Existing)	113
LPA-80063/6CF (Verizon - Reserved)	133	(2) 7770.00 (ATT - Existing)	113
LPA-171063-12CF (Verizon - Reserved)	133	EEI 10' Universal T-Arm (ATT - Existing)	111.5
BXA-70063/6CF (Verizon - Reserved)	133	EEI 10' Universal T-Arm (ATT - Existing)	111.5
BXA-70063/6CF (Verizon - Reserved)	133	EEI 10' Universal T-Arm (ATT - Existing)	111.5
LPA-171063-12CF (Verizon - Reserved)	133	Barhamsted Branch 4	109.85
LPA-80063/6CF (Verizon - Reserved)	133	KRY 112 TMA (T-Mobile - Existing)	102
LPA-80063/6CF (Verizon - Reserved)	133	KRY 112 TMA (T-Mobile - Existing)	102
LPA-171063-12CF (Verizon - Reserved)	133	(2) AIR21 (T-Mobile - Proposed)	102
BXA-70063/6CF (Verizon - Reserved)	133	(2) AIR21 (T-Mobile - Proposed)	102
BXA-70063/6CF (Verizon - Reserved)	133	(2) AIR21 (T-Mobile - Proposed)	102
LPA-171063-12CF (Verizon - Reserved)	133	KRY 112 TMA (T-Mobile - Existing)	102
LPA-80063/6CF (Verizon - Reserved)	133	Valmont T-Arm (1) (T-Mobile - Existing)	101
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	133	Valmont T-Arm (1) (T-Mobile - Existing)	101
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	133	Valmont T-Arm (1) (T-Mobile - Existing)	101
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	133	APXV18-206517-C (MetroPCS - Existing)	92
RRH2x40-AWS (Verizon - Reserved)	133	APXV18-206517-C (MetroPCS - Existing)	92
RRH2x40-AWS (Verizon - Reserved)	133	Valmont Uni-Tri Bracket (MetroPCS - Existing)	92
RRH2x40-AWS (Verizon - Reserved)	133	APXV18-206517-C (MetroPCS - Existing)	92
RRH2x40-07-U (Verizon - Reserved)	133	Barhamsted Branch 5	91.6
RRH2x40-07-U (Verizon - Reserved)	133	Barhamsted Branch 6	82.8
RRH2x40-07-U (Verizon - Reserved)	133		
DB-T1-6Z-8AB-0Z (Verizon - Reserved)	133		
LPA-80063/6CF (Verizon - Reserved)	133		
LPA-171063-12CF (Verizon - Reserved)	133		
Valmont T-Arm (1) (Verizon - Existing)	132		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A607-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 77.5%

AXIAL 67 K
SHEAR 43 K
MOMENT 4...
TORQUE 48 kip-ft
69 mph WIND - 0.500 in ICE

AXIAL 55 K
SHEAR 54 K
MOMENT 5575 kip-ft
TORQUE 64 kip-ft
REACTIONS - 80 mph WIND

Centek Engineering Inc.	Job: 14033.004 - CTNH417A		
63-2 North Branford Rd.	Project: 145-ft Summit Monopine - Rust Rd., Barkhamsted, CT		
Branford, CT 06405	Client: T-Mobile	Drawn by: TJL	App'd:
Phone: (203) 488-0580	Code: TIA/EIA-222-F	Date: 03/04/14	Scale: NTS
FAX: (203) 488-8587	Path:		Dwg No. E-1

Tower Input Data

There is a pole section.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

Basic wind speed of 80 mph.
Nominal ice thickness of 0.500 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
Weld together tower sections have flange connections..
Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Welds are fabricated with ER-70S-6 electrodes..
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.333.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
√ Use Code Stress Ratios
Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
Secondary Horizontal Braces Leg
Use Diamond Inner Bracing (4 Sided)
Add IBC .6D+W Combination

Distribute Leg Loads As Uniform
Assume Legs Pinned
√ Assume Rigid Index Plate
Use Clear Spans For Wind Area
Use Clear Spans For KL/r
Retension Guys To Initial Tension
√ Bypass Mast Stability Checks
Use Azimuth Dish Coefficients
√ Project Wind Area of Appurt.
Autocalc Torque Arm Areas
SR Members Have Cut Ends
√ Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing

Treat Feedline Bundles As Cylinder
Use ASCE 10 X-Brace Ly Rules
Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
Consider Feedline Torque
Include Angle Block Shear Check

Poles

√ Include Shear-Torsion Interaction
√ Always Use Sub-Critical Flow
Use Top Mounted Sockets

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	146.000-125.00 0	21.000	0.000	18	25.410	32.508	0.250	1.000	A607-65 (65 ksi)
L2	125.000-82.250	42.750	5.750	18	32.508	44.632	0.375	1.500	A607-65 (65 ksi)
L3	82.250-43.000	45.000	7.000	18	42.251	55.014	0.438	1.750	A607-65 (65 ksi)

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
L4	43.000-1.000	49.000		18	52.154	66.050	0.500	2.000	A607-65 (65 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	25.802	19.964	1596.674	8.932	12.908	123.694	3195.449	9.984	4.032	16.129
	33.009	25.597	3365.090	11.452	16.514	203.771	6734.608	12.801	5.281	21.126
L2	33.009	38.246	4989.183	11.407	16.514	302.117	9984.932	19.127	5.061	13.497
	45.321	52.677	13035.316	15.711	22.673	574.925	26087.784	26.343	7.195	19.187
L3	44.559	58.064	12825.695	14.844	21.464	597.554	25668.266	29.037	6.666	15.237
	55.863	75.786	28519.340	19.375	27.947	1020.475	57076.207	37.900	8.912	20.371
L4	54.974	81.974	27632.387	18.337	26.494	1042.965	55301.134	40.995	8.299	16.598
	67.069	104.028	56471.908	23.270	33.553	1683.046	113018.124	52.024	10.745	21.49

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
L1 146.000-125.000				1	1	1		
L2 125.000-82.250				1	1	1		
L3 82.250-43.000				1	1	1		
L4 43.000-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
HYBRIFLEX 1-1/4" (Sprint - Existing)	C	No	Inside Pole	141.000 - 4.000	3	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	B	No	Inside Pole	134.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Reserved)	B	No	Inside Pole	134.000 - 4.000	6	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8" (Verizon - Reserved)	C	No	Inside Pole	134.000 - 1.000	2	No Ice	0.000	0.002
						1/2" Ice	0.000	0.002
1 1/4 (AT&T - Existing)	B	No	Inside Pole	115.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
RG6-Fiber (AT&T - Existing)	C	No	Inside Pole	114.000 - 4.000	1	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	114.000 - 4.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
1 5/8	B	No	Inside Pole	104.000 - 4.000	12	No Ice	0.000	0.001

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement* *ft*	*Total Number*		*C_AA_A* *ft^2/ft*	*Weight* *klf*
(T-Mobile - Existing)						1/2" Ice	0.000	0.001
1 5/8	B	No	Inside Pole	94.000 - 4.000	6	No Ice	0.000	0.001
(MetroPCS - Existing)						1/2" Ice	0.000	0.001
HYBRIFLEX 1-5/8"	B	No	Inside Pole	104.000 - 4.000	1	No Ice	0.000	0.002
(T-Mobile - Proposed)						1/2" Ice	0.000	0.002

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* *K*
L1	146.000-125.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.168
		C	0.000	0.000	0.000	0.000	0.097
L2	125.000-82.250	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.446
		C	0.000	0.000	0.000	0.000	0.364
L3	82.250-43.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.855
		C	0.000	0.000	0.000	0.000	0.345
L4	43.000-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.843
		C	0.000	0.000	0.000	0.000	0.355

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* *K*
L1	146.000-125.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.168
		C		0.000	0.000	0.000	0.000	0.097
L2	125.000-82.250	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.446
		C		0.000	0.000	0.000	0.000	0.364
L3	82.250-43.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.855
		C		0.000	0.000	0.000	0.000	0.345
L4	43.000-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.843
		C		0.000	0.000	0.000	0.000	0.355

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* *K*

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 K
APXVSPP18-C-A20 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
APXVSPP18-C-A20 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
APXVSPP18-C-A20 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	8.260 8.807	5.283 5.736	0.057 0.107
FD-RRH 2x50 800 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 2x50 800 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 2x50 800 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.401 2.613	2.254 2.460	0.064 0.086
FD-RRH 4x45 1900 (Sprint - Existing)	A	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.705 2.944	2.781 3.022	0.060 0.084
FD-RRH 4x45 1900 (Sprint - Existing)	B	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.705 2.944	2.781 3.022	0.060 0.084
FD-RRH 4x45 1900 (Sprint - Existing)	C	From Face	3.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	2.705 2.944	2.781 3.022	0.060 0.084
Valmont T-Arm (1) (Sprint - Existing)	A	From Face	2.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (Sprint - Existing)	B	From Face	2.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (Sprint - Existing)	C	From Face	2.000 0.000 0.000	0.000	140.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
LPA-80063/6CF (Verizon - Reserved)	A	From Face	3.000 6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-171063-12CF (Verizon - Reserved)	A	From Face	3.000 4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
BXA-70063/6CF (Verizon - Reserved)	A	From Face	3.000 1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
BXA-70063/6CF (Verizon - Reserved)	A	From Face	3.000 -1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-171063-12CF (Verizon - Reserved)	A	From Face	3.000 -4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
LPA-80063/6CF (Verizon - Reserved)	A	From Face	3.000 -6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063/6CF (Verizon - Reserved)	B	From Face	3.000 6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101

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* K
LPA-171063-12CF (Verizon - Reserved)	B	From Face	3.000 4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
BXA-70063/6CF (Verizon - Reserved)	B	From Face	3.000 1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
BXA-70063/6CF (Verizon - Reserved)	B	From Face	3.000 -1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-171063-12CF (Verizon - Reserved)	B	From Face	3.000 -4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
LPA-80063/6CF (Verizon - Reserved)	B	From Face	3.000 -6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-80063/6CF (Verizon - Reserved)	C	From Face	3.000 6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
LPA-171063-12CF (Verizon - Reserved)	C	From Face	3.000 4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
BXA-70063/6CF (Verizon - Reserved)	C	From Face	3.000 1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
BXA-70063/6CF (Verizon - Reserved)	C	From Face	3.000 -1.000 0.000	0.000	133.000	No Ice 1/2" Ice	7.731 8.268	4.158 4.595	0.017 0.059
LPA-171063-12CF (Verizon - Reserved)	C	From Face	3.000 -4.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.994 6.462	6.054 6.523	0.012 0.055
LPA-80063/6CF (Verizon - Reserved)	C	From Face	3.000 -6.000 0.000	0.000	133.000	No Ice 1/2" Ice	10.308 10.868	9.005 9.554	0.027 0.101
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	A	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	B	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
(2) FD9R6004/2C-3L Diplexer (Verizon - Reserved)	C	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	0.367 0.451	0.085 0.136	0.003 0.005
RRH2x40-AWS (Verizon - Reserved)	A	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Reserved)	B	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-AWS (Verizon - Reserved)	C	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.522 2.753	1.589 1.795	0.044 0.061
RRH2x40-07-U (Verizon - Reserved)	A	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067
RRH2x40-07-U (Verizon - Reserved)	B	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
RRH2x40-07-U (Verizon - Reserved)	C	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	2.246 2.447	1.228 1.385	0.050 0.067
DB-T1-6Z-8AB-0Z (Verizon - Reserved)	C	From Face	3.000 0.000 0.000	0.000	133.000	No Ice 1/2" Ice	5.600 5.915	2.333 2.558	0.044 0.080
Valmont T-Arm (1) (Verizon - Existing)	A	From Face	2.000 0.000 0.000	0.000	132.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (Verizon - Existing)	B	From Face	2.000 0.000 0.000	0.000	132.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (Verizon - Existing)	C	From Face	2.000 0.000 0.000	0.000	132.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
4-ft Standoff (Empty)	A	From Face	2.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	1.400 1.735	0.087 0.131	0.030 0.041
4-ft Standoff (Empty)	B	From Face	2.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	1.400 1.735	0.087 0.131	0.030 0.041
4-ft Standoff (Empty)	C	From Face	2.000 0.000 0.000	0.000	130.000	No Ice 1/2" Ice	1.400 1.735	0.087 0.131	0.030 0.041
(2) 7770.00 (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) 7770.00 (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	5.882 6.314	2.928 3.273	0.035 0.068
(2) TT19-08BP111-001 TMA (AT&T - Existing)	A	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
(2) TT19-08BP111-001 TMA (AT&T - Existing)	B	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
(2) TT19-08BP111-001 TMA (AT&T - Existing)	C	From Face	3.000 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	0.645 0.757	0.520 0.623	0.016 0.022
AM-X-CD-16-65-00T-RET(7 2") (AT&T - Existing)	A	From Face	3.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
AM-X-CD-16-65-00T-RET(7 2") (AT&T - Existing)	B	From Face	3.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	8.260 8.807	4.642 5.088	0.050 0.096
800-10764 (AT&T - Existing)	C	From Face	3.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	6.333 6.771	3.389 3.740	0.041 0.078
(2) RRUS-11 (AT&T - Existing)	A	From Face	1.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
(2) RRUS-11 (AT&T - Existing)	B	From Face	1.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* ft ft ft	*Azimuth Adjustment* °	*Placement* ft		*C_AA_A Front* ft²	*C_AA_A Side* ft²	*Weight* K
(2) RRUS-11 (AT&T - Existing)	C	From Face	1.000 -2.000 0.000	0.000	113.000	No Ice 1/2" Ice	2.994 3.226	1.246 1.412	0.050 0.070
DC6-48-60-18-8F Surge Arrestor (AT&T - Existing)	C	From Face	0.500 0.000 0.000	0.000	113.000	No Ice 1/2" Ice	2.228 2.447	2.228 2.447	0.020 0.039
EEI 10' Universal T-Arm (AT&T - Existing)	A	None		0.000	111.500	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (AT&T - Existing)	B	None		0.000	111.500	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
EEI 10' Universal T-Arm (AT&T - Existing)	C	None		0.000	111.500	No Ice 1/2" Ice	13.340 16.800	13.340 16.800	0.450 0.600
(2) AIR21 (T-Mobile - Proposed)	A	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
(2) AIR21 (T-Mobile - Proposed)	B	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
(2) AIR21 (T-Mobile - Proposed)	C	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	6.533 6.978	4.356 4.775	0.083 0.125
KRY 112 TMA (T-Mobile - Existing)	A	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
KRY 112 TMA (T-Mobile - Existing)	B	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
KRY 112 TMA (T-Mobile - Existing)	C	From Face	3.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice	0.778 0.899	0.486 0.588	0.025 0.031
Valmont T-Arm (1) (T-Mobile - Existing)	A	From Face	2.000 0.000 0.000	0.000	101.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (T-Mobile - Existing)	B	From Face	2.000 0.000 0.000	0.000	101.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
Valmont T-Arm (1) (T-Mobile - Existing)	C	From Face	2.000 0.000 0.000	0.000	101.000	No Ice 1/2" Ice	10.540 14.450	10.540 14.450	0.336 0.412
APXV18-206517-C (MetroPCS - Existing)	A	From Face	0.500 0.000 0.000	0.000	92.000	No Ice 1/2" Ice	5.513 5.983	3.929 4.385	0.022 0.053
APXV18-206517-C (MetroPCS - Existing)	B	From Face	0.500 0.000 0.000	0.000	92.000	No Ice 1/2" Ice	5.513 5.983	3.929 4.385	0.022 0.053
APXV18-206517-C (MetroPCS - Existing)	C	From Face	0.500 0.000 0.000	0.000	92.000	No Ice 1/2" Ice	5.513 5.983	3.929 4.385	0.022 0.053
Valmont Uni-Tri Bracket (MetroPCS - Existing)	A	From Face	0.500 0.000 0.000	0.000	92.000	No Ice 1/2" Ice	1.750 1.940	1.750 1.940	0.290 0.306
Barhamsted Branch 1	A	From Face	3.000 0.000 0.000	0.000	153.260	No Ice 1/2" Ice	48.510 48.150	48.510 48.510	0.320 0.730
Barhamsted Branch 2	A	From Face	3.000 0.000 0.000	0.000	138.160	No Ice 1/2" Ice	120.490 120.490	120.490 120.490	2.290 3.830

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* *K*
Barhamsted Branch 3	A	From Face	3.000 0.000 0.000	0.000	121.390	No Ice 1/2" Ice	13.860 13.860	13.860 13.860	0.090 0.210
Barhamsted Branch 4	A	From Face	3.000 0.000 0.000	0.000	109.850	No Ice 1/2" Ice	134.660 134.660	134.660 134.660	2.560 4.280
Barhamsted Branch 5	A	From Face	3.000 0.000 0.000	0.000	91.600	No Ice 1/2" Ice	28.620 28.620	28.620 28.620	0.900 1.440
Barhamsted Branch 6	A	From Face	3.000 0.000 0.000	0.000	82.800	No Ice 1/2" Ice	22.070 22.070	22.070 22.070	0.770 1.300

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation *ft*	*z* *ft*	K_Z	q_z *ksf*	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
L1 146.000-125.000	135.071	1.496	0.025	50.678	A	0.000	50.678	50.678	100.00	0.000	0.000
					B	0.000	50.678		100.00	0.000	0.000
					C	0.000	50.678		100.00	0.000	0.000
L2 125.000-82.250	102.819	1.384	0.023	137.406	A	0.000	137.406	137.406	100.00	0.000	0.000
					B	0.000	137.406		100.00	0.000	0.000
					C	0.000	137.406		100.00	0.000	0.000
L3 82.250-43.000	62.331	1.199	0.020	161.736	A	0.000	161.736	161.736	100.00	0.000	0.000
					B	0.000	161.736		100.00	0.000	0.000
					C	0.000	161.736		100.00	0.000	0.000
L4 43.000-1.000	21.306	1	0.016	210.331	A	0.000	210.331	210.331	100.00	0.000	0.000
					B	0.000	210.331		100.00	0.000	0.000
					C	0.000	210.331		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation *ft*	*z* *ft*	K_Z	q_z *ksf*	t_Z *in*	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
L1 146.000-125.000	135.071	1.496	0.018	0.500	52.428	A	0.000	52.428	52.428	100.00	0.000	0.000
						B	0.000	52.428		100.00	0.000	0.000
						C	0.000	52.428		100.00	0.000	0.000
L2 125.000-82.250	102.819	1.384	0.017	0.500	140.968	A	0.000	140.968	140.968	100.00	0.000	0.000
						B	0.000	140.968		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	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
						C	0.000	140.968		100.00	0.000	0.000
L3 82.250-43.000	62.331	1.199	0.015	0.500	165.007	A	0.000	165.007	165.007	100.00	0.000	0.000
						B	0.000	165.007		100.00	0.000	0.000
						C	0.000	165.007		100.00	0.000	0.000
L4 43.000-1.000	21.306	1	0.012	0.500	213.831	A	0.000	213.831	213.831	100.00	0.000	0.000
						B	0.000	213.831		100.00	0.000	0.000
						C	0.000	213.831		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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
L1 146.000-125.000	135.071	1.496	0.010	50.678	A	0.000	50.678	50.678	100.00	0.000	0.000
					B	0.000	50.678		100.00	0.000	0.000
					C	0.000	50.678		100.00	0.000	0.000
L2 125.000-82.250	102.819	1.384	0.009	137.406	A	0.000	137.406	137.406	100.00	0.000	0.000
					B	0.000	137.406		100.00	0.000	0.000
					C	0.000	137.406		100.00	0.000	0.000
L3 82.250-43.000	62.331	1.199	0.008	161.736	A	0.000	161.736	161.736	100.00	0.000	0.000
					B	0.000	161.736		100.00	0.000	0.000
					C	0.000	161.736		100.00	0.000	0.000
L4 43.000-1.000	21.306	1	0.006	210.331	A	0.000	210.331	210.331	100.00	0.000	0.000
					B	0.000	210.331		100.00	0.000	0.000
					C	0.000	210.331		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	2.519	0.120	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	6.305	0.147	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	6.415	0.163	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	6.989	0.166	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	1514.985 kip-ft	22.227		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	2.519	0.120	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	6.305	0.147	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	6.415	0.163	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	6.989	0.166	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	1514.985 kip-ft	22.227		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	2.519	0.120	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	6.305	0.147	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	6.415	0.163	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	6.989	0.166	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	1514.985 kip-ft	22.227		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	2.519	0.120	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.25	1.810	6.613	A	1	1.2	1	1	1	137.406	6.305	0.147	C
			B	1	1.2	1	1	1	137.406			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
0			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	6.415	0.163	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	6.989	0.166	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	1514.985 kip-ft	22.227		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	2.010	A	1	1.2	1	1	1	52.428	1.954	0.093	C
			B	1	1.2	1	1	1	52.428			
			C	1	1.2	1	1	1	52.428			
L2 125.000-82.250	1.810	7.644	A	1	1.2	1	1	1	140.968	4.851	0.113	C
			B	1	1.2	1	1	1	140.968			
			C	1	1.2	1	1	1	140.968			
L3 82.250-43.000	2.200	11.458	A	1	1.2	1	1	1	165.007	4.909	0.125	C
			B	1	1.2	1	1	1	165.007			
			C	1	1.2	1	1	1	165.007			
L4 43.000-1.000	2.198	17.077	A	1	1.2	1	1	1	213.831	5.329	0.127	C
			B	1	1.2	1	1	1	213.831			
			C	1	1.2	1	1	1	213.831			
Sum Weight:	6.473	38.189						OTM	1165.205 kip-ft	17.043		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 146.000-125.000	0.265	2.010	A	1	1.2	1	1	1	52.428	1.954	0.093	C
			B	1	1.2	1	1	1	52.428			
			C	1	1.2	1	1	1	52.428			
L2 125.000-82.250	1.810	7.644	A	1	1.2	1	1	1	140.968	4.851	0.113	C
			B	1	1.2	1	1	1	140.968			
			C	1	1.2	1	1	1	140.968			
L3 82.250-43.000	2.200	11.458	A	1	1.2	1	1	1	165.007	4.909	0.125	C
			B	1	1.2	1	1	1	165.007			
			C	1	1.2	1	1	1	165.007			
L4 43.000-1.000	2.198	17.077	A	1	1.2	1	1	1	213.831	5.329	0.127	C
			B	1	1.2	1	1	1	213.831			
			C	1	1.2	1	1	1	213.831			
Sum Weight:	6.473	38.189						OTM	1165.205 kip-ft	17.043		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.265	2.010	A	1	1.2	1	1	1	52.428	1.954	0.093	C
146.000-125.0			B	1	1.2	1	1	1	52.428			
00			C	1	1.2	1	1	1	52.428			
L2	1.810	7.644	A	1	1.2	1	1	1	140.968	4.851	0.113	C
125.000-82.25			B	1	1.2	1	1	1	140.968			
0			C	1	1.2	1	1	1	140.968			
L3	2.200	11.458	A	1	1.2	1	1	1	165.007	4.909	0.125	C
82.250-43.000			B	1	1.2	1	1	1	165.007			
			C	1	1.2	1	1	1	165.007			
L4	2.198	17.077	A	1	1.2	1	1	1	213.831	5.329	0.127	C
43.000-1.000			B	1	1.2	1	1	1	213.831			
			C	1	1.2	1	1	1	213.831			
Sum Weight:	6.473	38.189						OTM	1165.205 kip-ft	17.043		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.265	2.010	A	1	1.2	1	1	1	52.428	1.954	0.093	C
146.000-125.0			B	1	1.2	1	1	1	52.428			
00			C	1	1.2	1	1	1	52.428			
L2	1.810	7.644	A	1	1.2	1	1	1	140.968	4.851	0.113	C
125.000-82.25			B	1	1.2	1	1	1	140.968			
0			C	1	1.2	1	1	1	140.968			
L3	2.200	11.458	A	1	1.2	1	1	1	165.007	4.909	0.125	C
82.250-43.000			B	1	1.2	1	1	1	165.007			
			C	1	1.2	1	1	1	165.007			
L4	2.198	17.077	A	1	1.2	1	1	1	213.831	5.329	0.127	C
43.000-1.000			B	1	1.2	1	1	1	213.831			
			C	1	1.2	1	1	1	213.831			
Sum Weight:	6.473	38.189						OTM	1165.205 kip-ft	17.043		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.265	1.628	A	1	1.2	1	1	1	50.678	0.984	0.047	C
146.000-125.0			B	1	1.2	1	1	1	50.678			
00			C	1	1.2	1	1	1	50.678			

Section Elevation ft	*Add Weight K*	*Self Weight K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F K*	*w klf*	*Ctrl. Face*
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	2.463	0.058	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	2.506	0.064	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	2.730	0.065	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	591.791 kip-ft	8.682		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	*Add Weight K*	*Self Weight K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F K*	*w klf*	*Ctrl. Face*
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	0.984	0.047	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	2.463	0.058	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	2.506	0.064	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	2.730	0.065	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	591.791 kip-ft	8.682		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	*Add Weight K*	*Self Weight K*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F K*	*w klf*	*Ctrl. Face*
L1 146.000-125.000	0.265	1.628	A	1	1.2	1	1	1	50.678	0.984	0.047	C
			B	1	1.2	1	1	1	50.678			
			C	1	1.2	1	1	1	50.678			
L2 125.000-82.250	1.810	6.613	A	1	1.2	1	1	1	137.406	2.463	0.058	C
			B	1	1.2	1	1	1	137.406			
			C	1	1.2	1	1	1	137.406			
L3 82.250-43.000	2.200	10.248	A	1	1.2	1	1	1	161.736	2.506	0.064	C
			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4 43.000-1.000	2.198	15.507	A	1	1.2	1	1	1	210.331	2.730	0.065	C
			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
Sum Weight:	6.473	33.996						OTM	591.791 kip-ft	8.682		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.265	1.628	A	1	1.2	1	1	1	50.678	0.984	0.047	C
146.000-125.0			B	1	1.2	1	1	1	50.678			
00			C	1	1.2	1	1	1	50.678			
L2	1.810	6.613	A	1	1.2	1	1	1	137.406	2.463	0.058	C
125.000-82.25			B	1	1.2	1	1	1	137.406			
0			C	1	1.2	1	1	1	137.406			
L3	2.200	10.248	A	1	1.2	1	1	1	161.736	2.506	0.064	C
82.250-43.000			B	1	1.2	1	1	1	161.736			
			C	1	1.2	1	1	1	161.736			
L4	2.198	15.507	A	1	1.2	1	1	1	210.331	2.730	0.065	C
43.000-1.000			B	1	1.2	1	1	1	210.331			
			C	1	1.2	1	1	1	210.331			
Sum Weight:	6.473	33.996						OTM	591.791 kip-ft	8.682		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	33.996					
Bracing Weight	0.000					
Total Member Self-Weight	33.996			-15.569	27.306	
Total Weight	54.782			-15.569	27.306	
Wind 0 deg - No Ice		0.000	-54.449	-5471.510	27.306	-56.200
Wind 30 deg - No Ice		27.170	-47.154	-4740.552	-2693.260	-64.669
Wind 45 deg - No Ice		38.425	-38.501	-3873.502	-3820.156	-62.365
Wind 60 deg - No Ice		47.060	-27.224	-2743.539	-4684.853	-55.811
Wind 90 deg - No Ice		54.341	0.000	-15.569	-5413.827	-31.998
Wind 120 deg - No Ice		47.060	27.224	2712.402	-4684.853	0.389
Wind 135 deg - No Ice		38.425	38.501	3842.364	-3820.156	17.113
Wind 150 deg - No Ice		27.170	47.154	4709.415	-2693.260	32.671
Wind 180 deg - No Ice		0.000	54.449	5440.372	27.306	56.200
Wind 210 deg - No Ice		-27.170	47.154	4709.415	2747.873	64.669
Wind 225 deg - No Ice		-38.425	38.501	3842.364	3874.768	62.365
Wind 240 deg - No Ice		-47.060	27.224	2712.402	4739.466	55.811
Wind 270 deg - No Ice		-54.341	0.000	-15.569	5468.439	31.998
Wind 300 deg - No Ice		-47.060	-27.224	-2743.539	4739.466	-0.389
Wind 315 deg - No Ice		-38.425	-38.501	-3873.502	3874.768	-17.113
Wind 330 deg - No Ice		-27.170	-47.154	-4740.552	2747.873	-32.671
Member Ice	4.193					

Load Case	*Vertical Forces* *K*	*Sum of Forces X* *K*	*Sum of Forces Z* *K*	*Sum of Overturning Moments, M_x* *kip-ft*	*Sum of Overturning Moments, M_z* *kip-ft*	*Sum of Torques* *kip-ft*
Total Weight Ice	67.277			-26.213	46.018	
Wind 0 deg - Ice		0.005	-43.321	-4403.582	45.253	-42.166
Wind 30 deg - Ice		21.620	-37.520	-3817.508	-2137.172	-48.504
Wind 45 deg - Ice		30.573	-30.636	-3122.021	-3041.082	-46.769
Wind 60 deg - Ice		37.442	-21.665	-2215.560	-3734.613	-41.846
Wind 90 deg - Ice		43.232	-0.005	-26.978	-4319.037	-23.975
Wind 120 deg - Ice		37.437	21.656	2161.809	-3733.848	0.321
Wind 135 deg - Ice		30.566	30.629	3068.514	-3040.002	12.864
Wind 150 deg - Ice		21.612	37.515	3764.317	-2135.848	24.530
Wind 180 deg - Ice		-0.005	43.321	4351.156	46.782	42.166
Wind 210 deg - Ice		-21.620	37.520	3765.082	2229.207	48.504
Wind 225 deg - Ice		-30.573	30.636	3069.594	3133.118	46.769
Wind 240 deg - Ice		-37.442	21.665	2163.133	3826.648	41.846
Wind 270 deg - Ice		-43.232	0.005	-25.449	4411.073	23.975
Wind 300 deg - Ice		-37.437	-21.656	-2214.236	3825.884	-0.321
Wind 315 deg - Ice		-30.566	-30.629	-3120.940	3132.037	-12.864
Wind 330 deg - Ice		-21.612	-37.515	-3816.744	2227.883	-24.530
Total Weight	54.782			-15.569	27.306	
Wind 0 deg - Service		0.000	-21.269	-2146.796	27.306	-21.953
Wind 30 deg - Service		10.613	-18.420	-1861.265	-1035.415	-25.261
Wind 45 deg - Service		15.010	-15.039	-1522.574	-1475.609	-24.361
Wind 60 deg - Service		18.383	-10.635	-1081.182	-1813.381	-21.801
Wind 90 deg - Service		21.227	0.000	-15.569	-2098.136	-12.499
Wind 120 deg - Service		18.383	10.635	1050.045	-1813.381	0.152
Wind 135 deg - Service		15.010	15.039	1491.436	-1475.609	6.685
Wind 150 deg - Service		10.613	18.420	1830.128	-1035.415	12.762
Wind 180 deg - Service		0.000	21.269	2115.658	27.306	21.953
Wind 210 deg - Service		-10.613	18.420	1830.128	1090.028	25.261
Wind 225 deg - Service		-15.010	15.039	1491.436	1530.221	24.361
Wind 240 deg - Service		-18.383	10.635	1050.045	1867.994	21.801
Wind 270 deg - Service		-21.227	0.000	-15.569	2152.749	12.499
Wind 300 deg - Service		-18.383	-10.635	-1081.182	1867.994	-0.152
Wind 315 deg - Service		-15.010	-15.039	-1522.574	1530.221	-6.685
Wind 330 deg - Service		-10.613	-18.420	-1861.265	1090.028	-12.762

Load Combinations

Comb. No.	*Description*
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice

Comb. No.	Description
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	146 - 125	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-12.050	16.615	9.251
			Max. Mx	14	-6.600	264.536	4.735
			Max. My	2	-6.594	8.489	261.451
			Max. Vy	14	-20.242	264.536	4.735
			Max. Vx	2	-20.375	8.489	261.451
			Max. Torque	11			-29.106
L2	125 - 82.25	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-31.631	41.566	23.634
			Max. Mx	14	-20.806	1407.957	13.400
			Max. My	2	-20.803	23.538	1402.944
			Max. Vy	14	-40.194	1407.957	13.400
			Max. Vx	2	-40.301	23.538	1402.944
			Max. Torque	11			-60.473
L3	82.25 - 43	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-45.601	47.738	27.192
			Max. Mx	14	-33.776	3080.447	15.834
			Max. My	2	-33.773	27.771	3078.162
			Max. Vy	14	-47.004	3080.447	15.834
			Max. Vx	2	-47.112	27.771	3078.162

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Torque	11			-64.385
L4	43 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-67.277	48.030	27.358
			Max. Mx	14	-54.752	5563.954	15.962
			Max. My	2	-54.752	27.997	5566.977
			Max. Vy	14	-54.370	5563.954	15.962
			Max. Vx	2	-54.479	27.997	5566.977
			Max. Torque	11			-64.304

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	67.277	43.232	-0.005
	Max. H_x	14	54.782	54.341	0.000
	Max. H_z	2	54.782	0.000	54.449
	Max. M_x	2	5566.977	0.000	54.449
	Max. M_z	6	5507.846	-54.341	0.000
	Max. Torsion	3	64.268	-27.170	47.154
	Min. Vert	1	54.782	0.000	0.000
	Min. H_x	6	54.782	-54.341	0.000
	Min. H_z	10	54.782	0.000	-54.449
	Min. M_x	10	-5534.988	0.000	-54.449
	Min. M_z	14	-5563.954	54.341	0.000
	Min. Torsion	11	-64.271	27.170	-47.154

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	54.782	-0.000	-0.000	-16.030	28.116	0.000
Dead+Wind 0 deg - No Ice	54.782	-0.000	-54.449	-5566.977	27.988	-55.845
Dead+Wind 30 deg - No Ice	54.782	27.170	-47.154	-4823.255	-2739.953	-64.268
Dead+Wind 45 deg - No Ice	54.782	38.425	-38.501	-3941.091	-3886.462	-61.982
Dead+Wind 60 deg - No Ice	54.782	47.060	-27.224	-2791.441	-4766.204	-55.471
Dead+Wind 90 deg - No Ice	54.782	54.341	0.000	-15.960	-5507.846	-31.809
Dead+Wind 120 deg - No Ice	54.782	47.060	27.224	2759.503	-4766.171	0.381
Dead+Wind 135 deg - No Ice	54.782	38.425	38.501	3909.136	-3886.424	17.005
Dead+Wind 150 deg - No Ice	54.782	27.170	47.154	4791.283	-2739.919	32.469
Dead+Wind 180 deg - No Ice	54.782	-0.000	54.449	5534.988	27.991	55.854
Dead+Wind 210 deg - No Ice	54.782	-27.170	47.154	4791.340	2795.933	64.271
Dead+Wind 225 deg - No Ice	54.782	-38.425	38.501	3909.202	3942.469	61.980
Dead+Wind 240 deg - No Ice	54.782	-47.060	27.224	2759.561	4822.248	55.465
Dead+Wind 270 deg - No Ice	54.782	-54.341	0.000	-15.957	5563.954	31.800
Dead+Wind 300 deg - No Ice	54.782	-47.060	-27.224	-2791.493	4822.279	-0.384
Dead+Wind 315 deg - No Ice	54.782	-38.425	-38.501	-3941.153	3942.504	-17.003
Dead+Wind 330 deg - No Ice	54.782	-27.170	-47.154	-4823.309	2795.962	-32.463
Dead+Ice+Temp	67.277	-0.000	-0.000	-27.358	48.030	0.000
Dead+Wind 0 deg+Ice+Temp	67.277	0.005	-43.321	-4512.103	47.112	-41.934
Dead+Wind 30 deg+Ice+Temp	67.277	21.620	-37.520	-3911.630	-2188.847	-48.247
Dead+Wind 45 deg+Ice+Temp	67.277	30.573	-30.636	-3199.070	-3114.923	-46.526

Load Combination	*Vertical*	*Shear$_x$*	*Shear$_z$*	*Overturning Moment, M_x*	*Overturning Moment, M_z*	*Torque*
	K	*K*	*K*	*kip-ft*	*kip-ft*	*kip-ft*
Dead+Wind 60 deg+Ice+Temp	67.277	37.442	-21.665	-2270.362	-3825.457	-41.633
Dead+Wind 90 deg+Ice+Temp	67.277	43.232	-0.005	-28.077	-4424.199	-23.860
Dead+Wind 120 deg+Ice+Temp	67.277	37.437	21.656	2214.410	-3824.648	0.312
Dead+Wind 135 deg+Ice+Temp	67.277	30.566	30.629	3143.359	-3113.785	12.793
Dead+Wind 150 deg+Ice+Temp	67.277	21.612	37.515	3856.236	-2187.459	24.401
Dead+Wind 180 deg+Ice+Temp	67.277	-0.005	43.321	4457.488	48.694	41.947
Dead+Wind 210 deg+Ice+Temp	67.277	-21.620	37.520	3857.058	2284.654	48.249
Dead+Wind 225 deg+Ice+Temp	67.277	-30.573	30.636	3144.514	3210.747	46.521
Dead+Wind 240 deg+Ice+Temp	67.277	-37.442	21.665	2215.811	3921.302	41.623
Dead+Wind 270 deg+Ice+Temp	67.277	-43.232	0.005	-26.496	4520.082	23.847
Dead+Wind 300 deg+Ice+Temp	67.277	-37.437	-21.656	-2269.026	3920.532	-0.314
Dead+Wind 315 deg+Ice+Temp	67.277	-30.566	-30.629	-3197.991	3209.651	-12.787
Dead+Wind 330 deg+Ice+Temp	67.277	-21.612	-37.515	-3910.873	2283.303	-24.390
Dead+Wind 0 deg - Service	54.782	0.000	-21.269	-2185.521	28.143	-21.900
Dead+Wind 30 deg - Service	54.782	10.613	-18.420	-1894.862	-1053.640	-25.202
Dead+Wind 45 deg - Service	54.782	15.010	-15.039	-1550.091	-1501.727	-24.305
Dead+Wind 60 deg - Service	54.782	18.383	-10.635	-1100.779	-1845.555	-21.751
Dead+Wind 90 deg - Service	54.782	21.227	-0.000	-16.046	-2135.413	-12.472
Dead+Wind 120 deg - Service	54.782	18.383	10.635	1068.683	-1845.549	0.150
Dead+Wind 135 deg - Service	54.782	15.010	15.039	1517.993	-1501.720	6.668
Dead+Wind 150 deg - Service	54.782	10.613	18.420	1862.761	-1053.633	12.732
Dead+Wind 180 deg - Service	54.782	0.000	21.269	2153.418	28.144	21.902
Dead+Wind 210 deg - Service	54.782	-10.613	18.420	1862.771	1109.927	25.203
Dead+Wind 225 deg - Service	54.782	-15.010	15.039	1518.004	1558.019	24.305
Dead+Wind 240 deg - Service	54.782	-18.383	10.635	1068.693	1901.853	21.751
Dead+Wind 270 deg - Service	54.782	-21.227	-0.000	-16.045	2191.720	12.471
Dead+Wind 300 deg - Service	54.782	-18.383	-10.635	-1100.786	1901.857	-0.150
Dead+Wind 315 deg - Service	54.782	-15.010	-15.039	-1550.100	1558.023	-6.668
Dead+Wind 330 deg - Service	54.782	-10.613	-18.420	-1894.870	1109.931	-12.731

Solution Summary

	Sum of Applied Forces			*Sum of Reactions*			
Load Comb.	*PX K*	*PY K*	*PZ K*	*PX K*	*PY K*	*PZ K*	*% Error*
1	0.000	-54.782	0.000	0.000	54.782	0.000	0.000%
2	0.000	-54.782	-54.449	0.000	54.782	54.449	0.000%
3	27.170	-54.782	-47.154	-27.170	54.782	47.154	0.000%
4	38.425	-54.782	-38.501	-38.425	54.782	38.501	0.000%
5	47.060	-54.782	-27.224	-47.060	54.782	27.224	0.000%
6	54.341	-54.782	0.000	-54.341	54.782	0.000	0.000%
7	47.060	-54.782	27.224	-47.060	54.782	-27.224	0.000%
8	38.425	-54.782	38.501	-38.425	54.782	-38.501	0.000%
9	27.170	-54.782	47.154	-27.170	54.782	-47.154	0.000%
10	0.000	-54.782	54.449	0.000	54.782	-54.449	0.000%
11	-27.170	-54.782	47.154	27.170	54.782	-47.154	0.000%
12	-38.425	-54.782	38.501	38.425	54.782	-38.501	0.000%
13	-47.060	-54.782	27.224	47.060	54.782	-27.224	0.000%
14	-54.341	-54.782	0.000	54.341	54.782	0.000	0.000%
15	-47.060	-54.782	-27.224	47.060	54.782	27.224	0.000%
16	-38.425	-54.782	-38.501	38.425	54.782	38.501	0.000%
17	-27.170	-54.782	-47.154	27.170	54.782	47.154	0.000%
18	0.000	-67.277	0.000	0.000	67.277	0.000	0.000%
19	0.005	-67.277	-43.321	-0.005	67.277	43.321	0.000%
20	21.620	-67.277	-37.520	-21.620	67.277	37.520	0.000%
21	30.573	-67.277	-30.636	-30.573	67.277	30.636	0.000%
22	37.442	-67.277	-21.665	-37.442	67.277	21.665	0.000%
23	43.232	-67.277	-0.005	-43.232	67.277	0.005	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
24	37.437	-67.277	21.656	-37.437	67.277	-21.656	0.000%
25	30.566	-67.277	30.629	-30.566	67.277	-30.629	0.000%
26	21.612	-67.277	37.515	-21.612	67.277	-37.515	0.000%
27	-0.005	-67.277	43.321	0.005	67.277	-43.321	0.000%
28	-21.620	-67.277	37.520	21.620	67.277	-37.520	0.000%
29	-30.573	-67.277	30.636	30.573	67.277	-30.636	0.000%
30	-37.442	-67.277	21.665	37.442	67.277	-21.665	0.000%
31	-43.232	-67.277	0.005	43.232	67.277	-0.005	0.000%
32	-37.437	-67.277	-21.656	37.437	67.277	21.656	0.000%
33	-30.566	-67.277	-30.629	30.566	67.277	30.629	0.000%
34	-21.612	-67.277	-37.515	21.612	67.277	37.515	0.000%
35	0.000	-54.782	-21.269	0.000	54.782	21.269	0.000%
36	10.613	-54.782	-18.420	-10.613	54.782	18.420	0.000%
37	15.010	-54.782	-15.039	-15.010	54.782	15.039	0.000%
38	18.383	-54.782	-10.635	-18.383	54.782	10.635	0.000%
39	21.227	-54.782	0.000	-21.227	54.782	0.000	0.000%
40	18.383	-54.782	10.635	-18.383	54.782	-10.635	0.000%
41	15.010	-54.782	15.039	-15.010	54.782	-15.039	0.000%
42	10.613	-54.782	18.420	-10.613	54.782	-18.420	0.000%
43	0.000	-54.782	21.269	0.000	54.782	-21.269	0.000%
44	-10.613	-54.782	18.420	10.613	54.782	-18.420	0.000%
45	-15.010	-54.782	15.039	15.010	54.782	-15.039	0.000%
46	-18.383	-54.782	10.635	18.383	54.782	-10.635	0.000%
47	-21.227	-54.782	0.000	21.227	54.782	0.000	0.000%
48	-18.383	-54.782	-10.635	18.383	54.782	10.635	0.000%
49	-15.010	-54.782	-15.039	15.010	54.782	15.039	0.000%
50	-10.613	-54.782	-18.420	10.613	54.782	18.420	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	5	0.00000001	0.00010548
3	Yes	5	0.00000001	0.00011225
4	Yes	5	0.00000001	0.00014418
5	Yes	5	0.00000001	0.00015141
6	Yes	5	0.00000001	0.00005975
7	Yes	5	0.00000001	0.00006015
8	Yes	5	0.00000001	0.00007485
9	Yes	5	0.00000001	0.00006209
10	Yes	5	0.00000001	0.00010519
11	Yes	5	0.00000001	0.00016917
12	Yes	5	0.00000001	0.00014542
13	Yes	5	0.00000001	0.00009735
14	Yes	5	0.00000001	0.00006006
15	Yes	5	0.00000001	0.00006284
16	Yes	5	0.00000001	0.00007852
17	Yes	5	0.00000001	0.00011254
18	Yes	4	0.00000001	0.00005720
19	Yes	5	0.00000001	0.00020364
20	Yes	5	0.00000001	0.00021804
21	Yes	5	0.00000001	0.00026833
22	Yes	5	0.00000001	0.00027539
23	Yes	5	0.00000001	0.00011989
24	Yes	5	0.00000001	0.00013557

25	Yes	5	0.00000001	0.00016308
26	Yes	5	0.00000001	0.00014147
27	Yes	5	0.00000001	0.00020032
28	Yes	5	0.00000001	0.00030904
29	Yes	5	0.00000001	0.00027382
30	Yes	5	0.00000001	0.00019713
31	Yes	5	0.00000001	0.00012346
32	Yes	5	0.00000001	0.00015089
33	Yes	5	0.00000001	0.00018114
34	Yes	5	0.00000001	0.00022217
35	Yes	5	0.00000001	0.00002854
36	Yes	5	0.00000001	0.00002921
37	Yes	5	0.00000001	0.00003164
38	Yes	5	0.00000001	0.00003119
39	Yes	4	0.00000001	0.00070210
40	Yes	4	0.00000001	0.00030158
41	Yes	4	0.00000001	0.00050445
42	Yes	4	0.00000001	0.00062361
43	Yes	5	0.00000001	0.00002779
44	Yes	5	0.00000001	0.00003623
45	Yes	5	0.00000001	0.00003224
46	Yes	5	0.00000001	0.00002519
47	Yes	4	0.00000001	0.00073797
48	Yes	4	0.00000001	0.00035828
49	Yes	4	0.00000001	0.00057339
50	Yes	4	0.00000001	0.00097728

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	146 - 125	25.336	48	1.506	0.083
L2	125 - 82.25	18.857	48	1.409	0.058
L3	88 - 43	9.258	48	1.020	0.028
L4	50 - 1	2.900	49	0.542	0.011

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
153.260	Barhamsted Branch 1	48	25.336	1.506	0.083	28646
140.000	APXVSPP18-C-A20	48	23.451	1.484	0.076	23872
138.160	Barhamsted Branch 2	48	22.875	1.477	0.074	18269
133.000	LPA-80063/6CF	48	21.276	1.454	0.067	11017
132.000	Valmont T-Arm (1)	48	20.969	1.449	0.066	10230
130.000	4-ft Standoff	48	20.358	1.439	0.064	8951
121.390	Barhamsted Branch 3	48	17.799	1.383	0.054	6577
113.000	(2) 7770.00	48	15.435	1.309	0.046	6061
111.500	EEI 10' Universal T-Arm	48	15.026	1.295	0.045	5978
109.850	Barhamsted Branch 4	48	14.582	1.278	0.044	5889
102.000	(2) AIR21	48	12.547	1.191	0.037	5500
101.000	Valmont T-Arm (1)	48	12.298	1.180	0.037	5454
92.000	APXV18-206517-C	48	10.151	1.071	0.031	5073
91.600	Barhamsted Branch 5	48	10.060	1.066	0.030	5058

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
82.800	Barhamsted Branch 6	48	8.155	0.954	0.025	4720

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	146 - 125	63.552	16	3.745	0.213
L2	125 - 82.25	47.424	16	3.524	0.148
L3	88 - 43	23.373	16	2.568	0.072
L4	50 - 1	7.342	17	1.370	0.027

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
153.260	Barhamsted Branch 1	16	63.552	3.745	0.213	12140
140.000	APXVSPP18-C-A20	16	58.864	3.697	0.194	10116
138.160	Barhamsted Branch 2	16	57.432	3.681	0.188	7742
133.000	LPA-80063/6CF	16	53.451	3.630	0.172	4668
132.000	Valmont T-Arm (1)	16	52.686	3.618	0.169	4335
130.000	4-ft Standoff	16	51.166	3.595	0.163	3792
121.390	Barhamsted Branch 3	16	44.784	3.461	0.139	2768
113.000	(2) 7770.00	16	38.873	3.283	0.118	2519
111.500	EEI 10' Universal T-Arm	16	37.851	3.246	0.115	2480
109.850	Barhamsted Branch 4	16	36.739	3.205	0.111	2437
102.000	(2) AIR21	16	31.638	2.992	0.095	2255
101.000	Valmont T-Arm (1)	16	31.011	2.964	0.094	2233
92.000	APXV18-206517-C	16	25.619	2.693	0.078	2058
91.600	Barhamsted Branch 5	16	25.390	2.680	0.077	2051
82.800	Barhamsted Branch 6	16	20.598	2.403	0.064	1901

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	146 - 125 (1)	TP32.508x25.41x0.25	21.000	0.000	0.0	39.000	25.597	-6.592	998.272	0.007
L2	125 - 82.25 (2)	TP44.632x32.508x0.375	42.750	0.000	0.0	39.000	50.736	-20.799	1978.700	0.011
L3	82.25 - 43 (3)	TP55.014x42.251x0.438	45.000	0.000	0.0	39.000	73.029	-33.772	2848.150	0.012
L4	43 - 1 (4)	TP66.05x52.154x0.5	49.000	0.000	0.0	39.000	104.028	-54.752	4057.090	0.013

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	146 - 125 (1)	TP32.508x25.41x0.25	266.048	15.667	39.000	0.402	0.000	0.000	39.000	0.000
L2	125 - 82.25 (2)	TP44.632x32.508x0.375	1413.383	31.811	39.000	0.816	0.000	0.000	39.000	0.000
L3	82.25 - 43 (3)	TP55.014x42.251x0.438	3088.383	39.122	39.000	1.003	0.000	0.000	39.000	0.000
L4	43 - 1 (4)	TP66.05x52.154x0.5	5575.100	39.750	39.000	1.019	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	146 - 125 (1)	TP32.508x25.41x0.25	20.311	0.793	26.000	0.061	7.817	0.225	26.000	0.009
L2	125 - 82.25 (2)	TP44.632x32.508x0.375	40.251	0.793	26.000	0.061	16.020	0.176	26.000	0.007
L3	82.25 - 43 (3)	TP55.014x42.251x0.438	47.060	0.644	26.000	0.050	17.014	0.105	26.000	0.004
L4	43 - 1 (4)	TP66.05x52.154x0.5	54.452	0.523	26.000	0.040	32.463	0.113	26.000	0.004

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	146 - 125 (1)	0.007	0.402	0.000	0.061	0.009	0.410 ✔	1.333	H1-3+VT ✔
L2	125 - 82.25 (2)	0.011	0.816	0.000	0.061	0.007	0.828 ✔	1.333	H1-3+VT ✔
L3	82.25 - 43 (3)	0.012	1.003	0.000	0.050	0.004	1.016 ✔	1.333	H1-3+VT ✔
L4	43 - 1 (4)	0.013	1.019	0.000	0.040	0.004	1.033 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF^*P_{allow} K	% Capacity	Pass Fail
L1	146 - 125	Pole	TP32.508x25.41x0.25	1	-6.592	1330.697	30.7	Pass
L2	125 - 82.25	Pole	TP44.632x32.508x0.375	2	-20.799	2637.607	62.1	Pass
L3	82.25 - 43	Pole	TP55.014x42.251x0.438	3	-33.772	3796.584	76.2	Pass

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*SF^*P_{allow} K*	*% Capacity*	*Pass Fail*
L4	43 - 1	Pole	TP66.05x52.154x0.5	4	-54.752	5408.101	77.5	Pass
							Summary	
						Pole (L4)	77.5	Pass
						RATING =	**77.5**	**Pass**

Flange Bolt and Flange Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 265 \cdot ft \cdot kips$	(Input From tnxTower)
Shear Force =	$Shear := 20.4 \cdot kips$	(Input From tnxTower)
Axial Force =	$Axial := 12.1 \cdot kips$	(Input From tnxTower)

Flange Bolt Data:

Use ASTM A325

Number of Flange Bolts =	$N := 12$	(User Input)
Diameter of Bolt Circle =	$D_{bc} := 37.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 120 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 92 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Flange Bolts =	$D := 1.0 \cdot in$	(User Input)
Threads per Inch =	$n := 8$	(User Input)

Flange Plate Data:

Use ASTM A572 Mod 50

Plate Yield Strength =	$Fy_{bp} := 50 \cdot ksi$	(User Input)
Flange Plate Thickness =	$t_{bp} := 1.25 \cdot in$	(User Input)
Flange Plate Diameter =	$D_{bp} := 41.0 \cdot in$	(User Input)
Outer Pole Diameter =	$D_{pole} := 32.508 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 18.5 \cdot in$

Distance to Bolts = $i := 1..N$

$$d_i := \begin{vmatrix} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{vmatrix}$$

$d_1 = 9.25 \cdot in$ $d_7 = -9.25 \cdot in$

$d_2 = 16.02 \cdot in$ $d_8 = -16.02 \cdot in$

$d_3 = 18.50 \cdot in$ $d_9 = -18.50 \cdot in$

$d_4 = 16.02 \cdot in$ $d_{10} = -16.02 \cdot in$

$d_5 = 9.25 \cdot in$ $d_{11} = -9.25 \cdot in$

$d_6 = 0.00 \cdot in$ $d_{12} = -0.00 \cdot in$

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 16.3 \cdot in$

Moment Arms of Bolts about Neutral Axis = $MA_i := if\left(d_i \ge R_{pole}, d_i - R_{pole}, 0in\right)$

$MA_1 = 0.00 \cdot in$ $MA_7 = 0.00 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 2.25 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 0.00 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 0.00 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 0.00 \cdot in$ $MA_{12} = 0.00 \cdot in$

Effective Width of Flangeplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 20 \cdot in$

Flange Bolt Analysis:

Calculated Flange Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i (d_i)^2 = 2.053 \times 10^3 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 0.785 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 0.606 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 0.878 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.22 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^3}{32} = 0.066 \cdot in^3$

Check Flange Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 27.6 \cdot kips$

Allowable Tensile Force = $T_{ALL.Gross} := 1.333 \cdot (0.33 \cdot A_g \cdot F_u) = 41.5 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Gross}} = 67 \cdot \%$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Gross}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Flange Plate Analysis:

Force from Bolts = $C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$

$C_1 = 15.3 \cdot kips$

$C_2 = 25.8 \cdot kips$

$C_3 = 29.7 \cdot kips$

$C_4 = 25.8 \cdot kips$

$C_5 = 15.3 \cdot kips$

$C_6 = 1.0 \cdot kips$

$C_7 = -13.3 \cdot kips$

$C_8 = -23.8 \cdot kips$

$C_9 = -27.6 \cdot kips$

$C_{10} = -23.8 \cdot kips$

$C_{11} = -13.3 \cdot kips$

$C_{12} = 1.0 \cdot kips$

Maximum Bending Stress in Plate =

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^{\,2}\right)} = 12.8 \cdot ksi$$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 49.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 25.7 \cdot \%$

Condition3 = Condition2 := if$\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition2 = "Ok"

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 5575\cdot ft\cdot kips$	(Input From RisaTower)
Shear Force =	$Shear := 54\cdot kips$	(Input From RisaTower)
Axial Force =	$Axial := 55\cdot kips$	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	$N := 24$	(User Input)
Bolt "Column" Distance =	$l := 3.0\cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 100\cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 75\cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000\cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25\cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 Gr. 55

Plate Yield Strength =	$Fy_{bp} := 55\cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.25\cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 36.875in$ (User Input)

$d_2 := 35.75in$ (User Input)

$d_3 := 33.75in$ (User Input)

$d_4 := 15.125in$ (User Input)

$d_5 := 9.375in$ (User Input)

$d_6 := 3.0in$ (User Input)

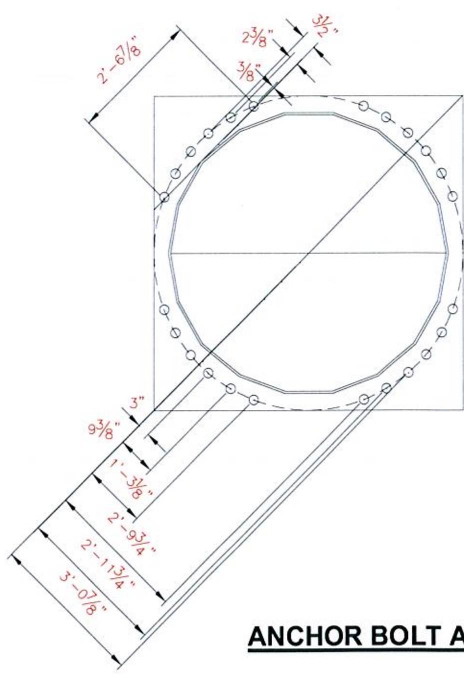
Critical Distances For Bending in Plate:

$ma_1 := 3.5in$ (User Input)

$ma_2 := 2.375in$ (User Input)

$ma_3 := 0.375in$ (User Input)

Effective Width of Baseplate for Bending = $B_{eff} := 30.875in$ (User Input)



ANCHOR BOLT AND PLATE GEOMETRY

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \left[(d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4 + (d_5)^2 \cdot 4 + (d_6)^2 \cdot 4\right] = 16410 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 3.248 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 2.033 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^{\,3}}{32} = 0.826 \cdot in^3$

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{d_1}{I_p} - \frac{Axial}{N} = 148 \cdot kips$

Allowable Tensile Force (Gross Area) = $T_{ALL.Gross} := 1.333 \cdot (0.33 \cdot A_g \cdot F_u) = 174.9 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Allowable Tensile Force (Net Area) = $T_{ALL.Net} := 1.333 \cdot (0.60 \cdot A_n \cdot F_y) = 194.812 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 76.0 \cdot \%$ Bolts are "upset bolts". Use net area per AISC

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Net}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK" Note Shear stress is negligible

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.562 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 8.2 \cdot ksi$

Allowable Bending Stress = $F_{bx} := 1.333 \cdot 0.6 \cdot F_y = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Check Combined Stress Requirement:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required.

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot in$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot ksi$$

Check Anchor Bolt Compression/Combined Stress:

Applied Compressive Force = $C_{Max} := OM \cdot \frac{d_1}{I_p} + \frac{Axial}{N} = 152.6 \cdot kips$

Applied Compressive Stress = $f_a := \frac{C_{Max}}{A_n} = 47 \cdot ksi$

$K := 0.65$

$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_y}} = 87.364$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^2}\right] \cdot F_y}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^3}} & \text{if } \frac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \frac{K \cdot l}{r} > C_c \end{cases} = 45 \cdot ksi$$

Allowable Compressive Stress = $F_a := 1.333 \cdot F_a = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity = $\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 78.3 \cdot \%$

Condition 2 = $Condition2 := if\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition2 = "OK"

Base Plate Analysis:

Force from Bolts = $C_1 := \frac{OM \cdot d_1}{I_p} + \frac{Axial}{N} = 152.621 \cdot kips$

$C_2 := \frac{OM \cdot d_2}{I_p} + \frac{Axial}{N} = 148.035 \cdot kips$

$C_3 := \frac{OM \cdot d_3}{I_p} + \frac{Axial}{N} = 139.882 \cdot kips$

Applied Bending Stress in Plate = $f_{bp} := \frac{6 \cdot \left(2C_1 \cdot ma_1 + 2C_2 \cdot ma_2 + 2C_3 \cdot ma_3\right)}{B_{eff} \cdot t_{bp}^{2}} = 34.52 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 54.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 62.9 \cdot \%$

Condition3 = $Condition3 := if\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition3 = "Ok"

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 5575 \cdot ft \cdot kips$	(User Input from tnxTower)
Shear Force =	$Shear := 54 \cdot kip$	(User Input from tnxTower)
Axial Force =	$Axial := 55 \cdot kip$	(User Input from tnxTower)
Tower Height =	$H_t := 145 \cdot ft$	(User Input)

Footing Data:

Overall Depth of Footing =	$D_f := 9.0 \cdot ft$	(User Input)
Length of Pier =	$L_p := 5.5 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)
Diameter of Pier =	$d_p := 8.0 \cdot ft$	(User Input)
Thickness of Footing =	$T_f := 4 \cdot ft$	(User Input)
Width of Footing =	$W_f := 31.5 \cdot ft$	(User Input)
Water Depth Below Grade =	$WD := 3.5 \cdot ft$	(User Input)

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12 \cdot in$	(User Input)
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)
Base Plate Bolt Circle =	$MP := 74.0 \cdot in$	(User Input)

Material Properties:

Concrete Compressive Strength =	$f_c := 3000 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 4000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 120 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 1$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Pier Reinforcement:

Bar Size =	$BS_{pier} := 11$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.41 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 60$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 3 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 11$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.41 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 48$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 11$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.41 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 48$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area = $A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 1.561 \cdot in^2$

Pad Top Reinforcement Bar Area = $A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 1.561 \cdot in^2$

Pad Bottom Reinforcement Bar Area = $A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 1.561 \cdot in^2$

Coefficient of Lateral Soil Pressure = $K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$

Load Factor =
$$LF := \begin{cases} 1.333 & \text{if } H_t \le 700 \cdot ft \\ 1.7 & \text{if } H_t \ge 1200 \cdot ft \\ 1.333 + \left(\frac{H_t - 700ft}{1200ft - 700ft}\right) \cdot 0.4 & \text{otherwise} \end{cases} = 1.333$$

Adjusted Concrete Unit Weight = $\gamma_c := if(Bouyancy = 1, \gamma_{conc} - 62.4pcf, \gamma_{conc}) = 87.6 \cdot pcf$

Adjusted Soil Unit Weight = $\gamma_s := if(Bouyancy = 1, \gamma_{soil} - 62.4pcf, \gamma_{soil}) = 57.6 \cdot pcf$

Stability of Footing:

Passive Pressure = $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} = 0 \cdot ksf$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p} = 0.864 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}] = 0.864 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} = 1.555 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.21 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)] = 4$

$A_p := W_f \cdot T_p = 126$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 152.41 \cdot kip$

Weight of the Concrete Pier = $WTc_{pier} := \begin{cases} d_p^2 \cdot (L_p - L_{pag} - WD) \cdot \gamma_c + d_p^2 \cdot (L_{pag} + WD) \cdot \gamma_{conc} & \text{if } (D_f - T_f) > WD \\ d_p^2 \cdot (L_p) \cdot \gamma_{conc} & \text{if } D_f - T_f \le WD \end{cases} = 46.8 \cdot kips$

Weight of the Concrete Pad = $WTc_{pad} := \begin{cases} W_f^2 \cdot T_f \cdot \gamma_c & \text{if } (D_f - T_f) > WD \\ W_f^2 \cdot (D_f - WD) \cdot \gamma_c + W_f^2 \cdot [WD - (D_f - T_f)] \cdot \gamma_{conc} & \text{if } D_f - T_f \le WD < D_f \\ W_f^2 \cdot T_f \cdot \gamma_{conc} & \text{if } D_f \le WD \end{cases} = 347.7 \cdot kips$

Weight of the Soil Above Footing = $WT_{soil1} := \begin{cases} (W_f^2 - d_p^2) \cdot (D_f - T_f - WD) \cdot \gamma_s + (W_f^2 - d_p^2) \cdot (WD) \cdot \gamma_{soil} & \text{if } (D_f - T_f) > WD \\ [(W_f^2 - d_p^2) \cdot (|L_p - L_{pag} - n|)] \cdot \gamma_{soil} & \text{if } D_f - T_f \le WD \end{cases} = 470.1 \cdot kips$

Weight of the Soil Wedge at Back Face = $WT_{soil2} := \begin{cases} (WD)\tan(\Phi_s) \cdot (D_f - T_f - 0.5 \cdot WD) \cdot W_f \cdot \gamma_{soil} + \left[\frac{(D_f - T_f - WD)^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right] \cdot \gamma_s & \text{if } (D_f - T_f) > WD \\ \left[\frac{(D_f - T_f)^2 \cdot \tan(\Phi_s)}{2} \cdot W_f\right] \cdot \gamma_{soil} & \text{if } (D_f - T_f) \le WD \end{cases} = 26 \cdot kips$

Total Weight = $WT_{tot} := WTc_{pier} + WTc_{pad} + WT_{soil1} + Axial = 919.6 \cdot kips$

Resisting Moment = $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + \left[(WT_{soil2}) \cdot \left[W_f + \frac{(D_f - T_f) \cdot \tan(\Phi_s)}{3}\right]\right] = 15530 \cdot kip \cdot ft$

Overturning Moment = $M_{ot} := OM + Shear \cdot (L_p + T_f) = 6088 \cdot kip \cdot ft$

Factor of Safety Actual = $FS := \frac{M_r}{M_{ot}} = 2.55$

Factor of Safety Required = $FS_{req} := 2$

OverTurning_Moment_Check := if(FS ≥ FS_{req}, "Okay", "No Good")

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS_{req}} = 283.106 \cdot kips$

Shear_Check := if(S_p > Shear, "Okay", "No Good")

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 992.25$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 5209.31 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.095 \cdot ksf$

Max_Pressure_Check := if($P_{max} < q_s$, "Okay", "No Good")

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.242 \cdot ksf$

Min_Pressure_Check := if[($P_{min} \geq 0$)·($P_{min} < q_s$), "Okay", "No Good"]

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 9.413$

Distance to Kern = $X_k := \frac{W_f}{6} = 5.25$

Since Resultant Force is Not in Kern, Area to which Pressure is Applied Must be Reduced.

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 6.621$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 2.132 \cdot ksf$

$q_{adj} := \text{if}(P_{min} < 0, P_a, P_{max}) = 2.132 \cdot ksf$

Pressure_Check := if($q_{adj} < q_s$, "Okay", "No Good")

Pressure_Check = "Okay"

Concrete Bearing Capacity:

Strength Reduction Factor = $\Phi_c := 0.65$ (ACI-2008 9.3.2.2)

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^{\,2}}{4} = 1.2 \times 10^4 \cdot kips$ (ACI-2008 10.14)

$Bearing\_Check := if(P_b > LF \cdot Axial, \text{"Okay"}, \text{"No Good"})$

$Bearing\_Check = \text{"Okay"}$

Shear Strength of Concrete:

Beam Shear: (Critical section located at a distance d from the face of Pier) (ACI 11.3.1.1)

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot}$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$

$d_2 := d_1 - d$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d$ (ACI-2008 11.2.1.1)

$Beam\_Shear\_Check := if(V_{req} < V_{Avail}, \text{"Okay"}, \text{"No Good"})$

$Beam\_Shear\_Check = \text{"Okay"}$

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.11.1.2)

Critical Perimeter of Punching Shear = $b_o := (d_p + d) \cdot \pi = 36.5$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4} = 106.3$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 886$

Guess Value = $v_u := 1ksf$ (From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

Given $d^2 + d_p \cdot d = \frac{WT_{tot}}{\pi \cdot v_u}$

$v_u := Find(v_u) = 6.9 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 792.6 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 1.1 \times 10^3 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 3559.8 \cdot kip$ (ACI-2008 11.11.2.1)

Punching_Shear_Check := if(V_req < V_Avail, "Okay", "No Good")

Punching_Shear_Check = "Okay"

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

Strength Reduction Factor = $\phi_m := .90$ (ACI-2008 9.3.2.1)

$q_b := q_{adj} - d_1 \cdot Slope = 1.217 \cdot ksf$

Maximum Bending at Face of Pier = $M_n := \frac{1}{\phi_m} \cdot \left[\left(q_{adj} - q_b\right) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 4413.9 \cdot kip \cdot ft$

$$\beta := \begin{cases} 0.85 & \text{if } 2500 \cdot psi \le f_c \le 4000 \cdot psi \\ 0.65 & \text{if } f_c > 8000 \cdot psi \\ \left[0.85 - \left[\frac{\left(\frac{f_c}{psi} - 4000 \right)}{1000} \right] \cdot 0.5 \right] & \text{otherwise} \end{cases} = 0.85$$

(ACI-200810.2.7.3)

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2} = 81.9 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f_c}} \right) = 0.0014$

$\rho_{min} := 1.333 \cdot \rho = 0.00185$

Required Reinforcement for Temperature and Shrinkage:

$\rho_{sh} := \begin{cases} .0018 & \text{if } f_y \geq 60000 \cdot psi \\ .0020 & \text{otherwise} \end{cases}$ (ACI -2008 7.12.2.1)

Check Bottom Bars:

$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 30.494 \cdot in^2$

$As_{prov} := A_{bbot} \cdot NB_{bot} = 74.9 \cdot in^2$

Pad_Reinforcement_Bot := if($As_{prov} > As$, "Okay", "No Good")

Pad_Reinforcement_Bot = "Okay"

Check top Bars:

$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2} \right) = 14.8 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top} = 74.9 \cdot in^2$

Pad_Reinforcement_Top := if($As_{prov} > As$, "Okay", "No Good")

Pad_Reinforcement_Top = "Okay"

Developement Length Pad Reinforcement:

Bar Spacing = $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 6.47 \cdot in$

Spacing or Cover Dimension = $c := \text{if}\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2} \right) = 3 \cdot in$

Transverse Reinforcement Index = $k_{tr} := 0$ (ACI-2008 12.2.3)

$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 54.4 \cdot in$

Minimum Development Length = $L_{dbmin} := 12 \cdot in$ (ACI-2008 12.2.1)

$L_{dbtCheck}$:= if($L_{dbt} \geq L_{dbmin}$, "Use L.dbt", "Use L.dbmin")

Available Length in Pad = $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 138 \cdot in$

Lpad_Check := if($L_{Pad} > L_{dbt}$, "Okay", "No Good")

Lpad_Check = "Okay"

Steel Reinforcement in Pier:

Area of Pier = $A_p := \frac{\pi \cdot d_p^2}{4} = 7238.23 \cdot in^2$

$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 36.19 \cdot in^2$ (ACI-2008 10.8.4 & 10.9.1)

$A_{sprov} := NB_{pier} \cdot A_{bpier} = 93.69 \cdot in^2$

Steel_Area_Check := if($A_{sprov} > A_{smin}$, "Okay" , "No Good")

Steel_Area_Check = "Okay"

Bar Spacing In Pier = $B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 3.617 \cdot in$

Diameter of Reinforcement Cage = $Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 90 \cdot in$

Maximum Moment in Pier = $M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF = 94360.4 \cdot in \cdot kips$

Pier Check evaluated from outside program and results are listed below;

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) := \left(d_p \cdot 12 \;\; NB_{pier} \;\; BS_{pier} \;\; \frac{Axial \cdot 1.333}{kips} \;\; \frac{M_p}{in \cdot kips}\right)$$

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) = (96 \;\; 60 \;\; 11 \;\; 73.3 \;\; 94360.4)$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := (0 \;\; 0 \;\; 0 \;\; 0)$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := \phi P'_n\left(D, N, n, P_u, M_{xu}\right)^T$$

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = \left(148 \;\; 1.9 \times 10^5 \;\; -60 \;\; 0\right)$$

Axial_Load_Check := if($\phi P_n \geq P_u$, "Okay" , "No Good")

Axial_Load_Check = "Okay"

Bending_Check := if($\phi M_{xn} \geq M_{xu}$, "Okay" , "No Good")

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 63 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 45 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension = $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 1.808 \cdot in$

Transverse Reinforcement = $k_{tr} := 0$ (ACI-2008 12.2.3)

$$L_{dbt} := \frac{3 \cdot f_y \cdot \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 90.33 \cdot in$$

Minimum Development Length = $L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 21.624 \cdot in$ (ACI 12.2.1)

Pier reinforcement bars are standard 90 degree hooks and therefore developement in the pad is computed as follows:

$L_{db} := max(L_{dbt}, L_{dbmin})$

$L_{tension\_Check} := if(L_{pier} + L_{pad} > L_{dbt}, \text{"Okay"}, \text{"No Good"})$

$L_{tension\_Check} = \text{"Okay"}$

Compression: (ACI-2008 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 30.892 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot (d_{bpier} \cdot f_y) = 25.38 \cdot in$

$L_{dbc} := if(L_{dbc1} \ge L_{dbmin}, L_{dbc1}, L_{dbmin}) = 30.892 \cdot in$

$L_{compression\_Check} := if(L_{pier} + L_{pad} > L_{dbc}, \text{"Okay"}, \text{"No Good"})$

$L_{compression\_Check} = \text{"Okay"}$

Tie Size and Spacing in Column:

Minimum Tie Size = $Tie_{min} := if(BS_{pier} \le 10, 3, 4) = 4$

Used #3 Ties

Seismic Factor = $z := if(Z \le 2, 1, 0.5) = 1$ (ACI-2008 21.10.5)

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 22.56 \cdot in$

$s_{lim2} := \frac{48 \cdot d_{Tie}}{8} \cdot z = 18 \cdot in$

$s_{lim3} := D_f \cdot z = 108 \cdot in$

$s_{lim4} := 18in$

Maximum Spacing = $s_{tie} := min\left(\begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix}\right) = 18 \cdot in$

Number of Ties Required = $n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 4.333$

Check Anchor Steel Embedment:

Depth Available = $D_{ab} := L_{st} - A_{BP} = 7 \cdot ft$

Length of Anchor Bolt = $L_{anchor} := \frac{(0.11 \cdot f_{ya}) \cdot in}{\sqrt{f_c \cdot psi}} = 12.552 \cdot ft$

$Depth\_Check := if(D_{ab} \ge L_{anchor}, \text{"Okay"}, \text{"No Good"})$

Depth_Check = "No Good"

Note: Anchor plate is provided

Network Modernization RFDS v3.0

T-Mobile

Site ID	CTNH417A	Latitude	41.89361
		Longitude	-72.99667
Site Name	New Hartford-Verizon colo	Site Type	Structure (Non-Building)
Address	31 New Hartford Road, Barkhamsted, CONNECTICUT, 06063	Site Class	Monopole
Market	CONNECTICUT	Landlord	Verizon Wireless

Configuration
2C

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date: 01/21/2014

Work Order #:

NOC#: (888) 218-6664

Site Information

Existing 1	Existing 2	Existing 3	Existing 4	Cabinet #	Proposed 1	Proposed 2	Proposed 3	Proposed 4
UMTS	GSM			Technology	GSM/UMTS/LTE	GSM		
3106	S12000			Cabinet type	3106	S12000		
1				CBU				
				DUW30	2			
				DUL20	1			
				DUG20	1			
				DUS41				
				RBS6601				
	6			dTRU/TRX				
6				RU22 B4	6			
				RUS01 B2				
				RUS01 B4				

- [ ] Relocate cabinet
- [ ] Add cabinet
- [ ] Swap cabinet
- [ ] Remove cabinet
- [X] Make cabinet dark

Scope of Work

Keep existing 3106 UMTS cabinet, replace CBU and RAX/TX boards with DUW30. Turn off and keep in place existing S12000 GSM cabinet. Add another DUW30, DUL20 and DUG20 and keep 6 RU22 B4 radios in the existing 3106 cabinet. Install 3 E/// TMAs, remove all existing TMAs. Install power upgrade kit 6131. .

ALPHA - Scope of Work

- [ ] Add new mount
- [ ] Relocate antenna
- [X] Add antenna
- [X] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [X] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [X] Consolidate coax cables
- [ ] Add coax cables
- [X] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

BETA - Scope of Work

- [ ] Add new mount
- [ ] Relocate antenna
- [X] Add antenna
- [X] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [X] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [X] Consolidate coax cables
- [ ] Add coax cables
- [X] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

GAMMA - Scope of Work

- [ ] Add new mount
- [ ] Relocate antenna
- [X] Add antenna
- [X] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [X] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [X] Consolidate coax cables
- [ ] Add coax cables
- [X] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

DELTA - Scope of Work

- [ ] Add new mount
- [ ] Relocate antenna
- [ ] Add antenna
- [ ] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [ ] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [ ] Consolidate coax cables
- [ ] Add coax cables
- [ ] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Network Modernization RFDS v3.0

T-Mobile

Site ID	**CTNH417A**	Latitude	41.89361
		Longitude	-72.99667
Site Name	New Hartford-Verizon colo	Site Type	Structure (Non-Building)
Address	31 New Hartford Road, Barkhamsted, CONNECTICUT, 06063	Site Class	Monopole
Market	CONNECTICUT	Landlord	Verizon Wireless

Configuration
2C

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date 01/21/2014

ALPHA (view from behind)

	Existing Configuration 1	Existing Configuration 2	Existing Configuration 3	Existing Configuration 4		Proposed Configuration 1	Proposed Configuration 2	Proposed Configuration 3	Proposed Configuration 4
Mount	X	X	X		Mount	X	X		X
Technology		GSM | UMTS			Technology	GSM/UMTS | UMTS			LTE
Band		B2 | B4			Band	B2 | B4			B4
Active/Passive		P | P			Active/Passive	A | P			A
Ant. Type		Quad pole			Ant. Type	Quad pole			Quad pole
Ant. Model		APX16DWV-16DWV-S			Ant. Model	AIR21 B2A/B4P			AIR21 B4A/B2P
Ant. Vendor		RFS			Ant. Vendor	Ericsson			Ericsson
Ant. Height		101.5			Ant. Height	101.5			101.5
Azimuth		0			Azimuth	0			0
RET deployed		Yes | Yes			RET deployed	Yes | Yes			Yes
E-Tilt		2 | 2			E-Tilt	2 | 2			2
M-Tilt					M-Tilt				
TMA #					TMA #	| 1			
TMA Type					TMA Type	| dd B4			
RRU #					RRU #				
RRU Type					RRU Type				
Used Coax #		2 | 2			Used Coax #	2 (LMU) | 2			
Coax Type		1 5/8" | 1 5/8"			Coax Type	1 5/8" | 1 5/8"			
Coax Length (ft)		150			Coax Length (ft)	150			
Fiber (CPRI) #					Fiber (CPRI) #	2			2
Splitter #					Splitter #				
Combiner #					Combiner #				
Combiner Type					Combiner Type				

- [ ] Add new mount
- [ ] Relocate antenna
- [x] Add antenna
- [x] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [x] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [x] Consolidate coax cables
- [ ] Add coax cables
- [x] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Scope of work

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

BETA (view from behind)

	Existing Configuration 1	Existing Configuration 2	Existing Configuration 3	Existing Configuration 4		Proposed Configuration 1	Proposed Configuration 2	Proposed Configuration 3	Proposed Configuration 4
Mount	X	X	X	X	Mount	X	X	X	X
Technology		GSM | UMTS			Technology	GSM/UMTS | UMTS			LTE
Band		B2 | B4			Band	B2 | B4			B4
Active/Passive		P | P			Active/Passive	A | P			A
Ant. Type		Quad pole			Ant. Type	Quad pole			Quad pole
Ant. Model		APX16DWV-16DWV-S			Ant. Model	AIR21 B2A/B4P			AIR21 B4A/B2P
Ant. Vendor		RFS			Ant. Vendor	Ericsson			Ericsson
Ant. Height		101.5			Ant. Height	101.5			101.5
Azimuth		120			Azimuth	120			120
RET deployed		Yes | Yes			RET deployed	Yes | Yes			Yes
E-Tilt		2 | 2			E-Tilt	2 | 2			2
M-Tilt					M-Tilt				
TMA #					TMA #	| 1			
TMA Type					TMA Type	| dd B4			
RRU #					RRU #				
RRU Type					RRU Type				
Used Coax #		2 | 2			Used Coax #	2 (LMU) | 2			
Coax Type		1 5/8" | 1 5/8"			Coax Type	1 5/8" | 1 5/8"			
Coax Length (ft)		150			Coax Length (ft)	150			
Fiber (CPRI) #					Fiber (CPRI) #	2			2
Splitter #					Splitter #				
Combiner #					Combiner #				
Combiner Type					Combiner Type				

- [ ] Add new mount
- [ ] Relocate antenna
- [x] Add antenna
- [x] Swap antenna
- [ ] Remove antenna
- [ ] Add TMA
- [x] Swap TMA
- [ ] Remove TMA
- [ ] Add RRU
- [ ] Swap existing RRU
- [ ] Remove RRU
- [x] Consolidate coax cables
- [ ] Add coax cables
- [x] Add fiber cables
- [ ] Add hybrid combiner
- [ ] Add filter combiner

Scope of work

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

Network Modernization RFDS v3.0

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Site ID	CTNH417A	Latitude	41.89361
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Market	CONNECTICUT	Landlord	Verizon Wireless

Configuration

2C

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date 01/21/2014

GAMMA (view from behind)

	Existing Configuration 1	Existing Configuration 2	Existing Configuration 3	Existing Configuration 4	Proposed Configuration 1	Proposed Configuration 2	Proposed Configuration 3	Proposed Configuration 4
Mount	X	X	X	X	X	X	X	X
Technology		GSM / UMTS			GSM/UMTS / UMTS			LTE
Band		B2 / B4			B2 / B4			B4
Active/Passive		P / P			A / P			A
Ant. Type		Quad pole			Quad pole			Quad pole
Ant. Model		APX16DWV-16DWV-S			AIR21 B2A/B4P			AIR21 B4A/B2P
Ant. Vendor		RFS			Ericsson			Ericsson
Ant. Height		101.5			101.5			101.5
Azimuth		240			240			240
RET deployed		Yes / Yes			Yes / Yes			Yes
E-Tilt		2 / 2			2 / 2			2
M-Tilt								
TMA #					/ 1			
TMA Type					/ dd B4			
RRU #								
RRU Type								
Used Coax #		2 / 2			2 (LMU) / 2			
Coax Type		1 5/8" / 1 5/8"			1 5/8" / 1 5/8"			
Coax Length (ft)		150			150			
Fiber (CPRI) #					2			2
Splitter #								
Combiner #								
Combiner Type								

	Add new mount		Add RRU
	Relocate antenna		Swap existing RRU
X	Add antenna		Remove RRU
X	Swap antenna	X	Consolidate coax cables
	Remove antenna		Add coax cables
	Add TMA	X	Add fiber cables
X	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

Swap existing existing antenna with AIR21 B2A|B4P antenna at position 1. Add AWS dd B4 TMA at position 1/right. Consolidate 2 existing coax lines at position 1/left for LMU. Consolidate 2 existing coax lines at position 1/right for AWS UMTS. Connect DATA (CPRI) active ports of AIR21 B2A/B4P antenna to DUG20 and PCS UMTS DUW30 via fiber lines. Connect RF passive port of AIR21 B2A/B4P antenna to in cabinet radio/filter units via coax lines. Add AIR21 B4A|B2P antenna at position 4. Connect DATA 1 (CPRI) active port of AIR21 B4A/B2P antenna to DUL20 via fiber line. Connect spare (yellow) fiber jumper to DATA 2 (CPRI) active port of AIR B4A/B2P antenna to allow future implementation of AWS UMTS over fiber. Install 1 E/// TMA remove existing TMAs.

DELTA (view from behind)

	Existing Configuration 1	Existing Configuration 2	Existing Configuration 3	Existing Configuration 4	Proposed Configuration 1	Proposed Configuration 2	Proposed Configuration 3	Proposed Configuration 4
Technology								
Band								
Active/Passive								
Ant. Type								
Ant. Model								
Ant. Vendor								
Ant. Height								
Azimuth								
RET deployed								
E-Tilt								
M-Tilt								
TMA #								
TMA Type								
RRU #								
RRU Type								
Used Coax #								
Coax Type								
Coax Length (ft)								
Fiber (CPRI) #								
Splitter #								
Combiner #								
Combiner Type								

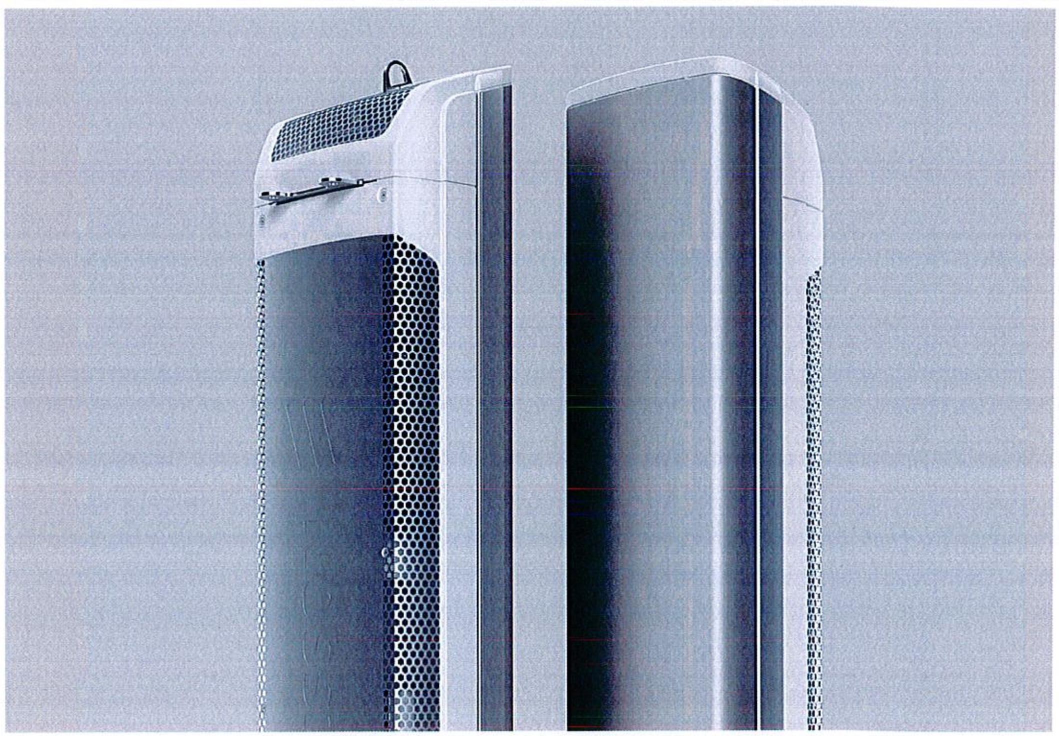
	Add new mount		Add RRU
	Relocate antenna		Swap existing RRU
	Add antenna		Remove RRU
	Swap antenna		Consolidate coax cables
	Remove antenna		Add coax cables
	Add TMA		Add fiber cables
	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

ERICSSON

DATA-SHEET FOR

AIR 21, 1.3 M, B2A B4P



The Antenna-Integrated Radio (AIR) is a single tower-mounted unit that can replace the antenna/s and radio for one sector. Additional electronics such as ASC? and a RET Actuator and control are also included. A passive antenna function for an extra band is optional.

ericsson.
com

ANTENNA-INTEGRATED RADIO

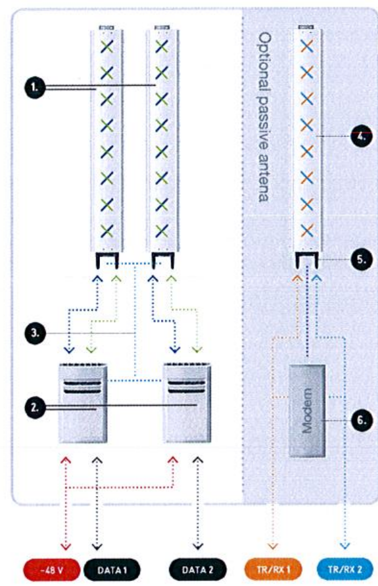
Figure 2 →
Three-sector tower site with three AIR units.e

The Antenna-Integrated Radio (AIR) is a single tower-mounted unit that can replace the antenna/s and radio for one sector. Additional electronics such as ASC? and a RET Actuator and control are also included. A passive antenna function for an extra band is optional. (The option has to be specified when ordering, retrofit is not possible).
The height and width are the same as for a passive antenna with similar characteristics. The depth is increased to house the radios' electronics. Digital Units (DUs) from Ericsson's RBS 6000 family provide the baseband function and support GSM, WCDMA and LTE.

Digital Units (DUs) from Ericsson's RBS 6000 family provide the baseband function and support GSM, WCDMA and LTE.

One or two DUs, depending on capacity and the standards to be supported, are needed for a three-sector site with AIR units.

The AIR is especially suited for state of the art mobile broadband basestations utilizing advanced MIMO techniques. Less tower-mounted equipment is required and the unit's attractive appearance enables it to blend in well with other existing equipment. The same applies to sites with multiple access technologies on different frequency bands. With Air, it is only necessary to swap antennas in order to add new 3G/4G technology on-site or at a new site. The AIR also saves power compared to traditional macro RBSs that use long feeders for antenna connections.



← Figure 2
Example of hardware that a single AIR unit can replace

Functionality for the AIR unit

Figure 2 shows an example of the hardware that a single AIR unit can replace. The function of the AIR unit is the same, but the implementation is different.
The AIR unit's active band has two radios (2) connected to a pair of cross-polarized antenna arrays (1). Remote electrical tilt (3) is included. Air supports 2 TX for the down-link and 4 RX for the up-link.
The passive antenna function on the frequency band not used by the AIR unit's active part is optional. The passive function includes an antenna array (4) and a RET motor (5) with a modem to control it (6).
The tilts for the active part and the passive part are controlled independently, but each band has the same tilt for both arrays and for both polarizations.

Configuration Example

Figure 3 shows a typical configuration with WCDMA with 2 x 2 MIMO for Band 1.
One AIR unit is deployed in each sector.
A common base band unit with a DUW inside provides base band processing and back-haul.
The AIR units can be specified with passive antennas for Band 4.

Figure 3 →
Three sector configuration example: RBS 6601 with three AIR units.

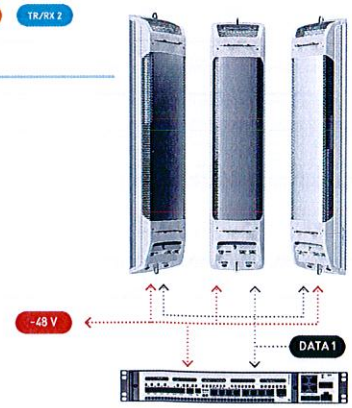
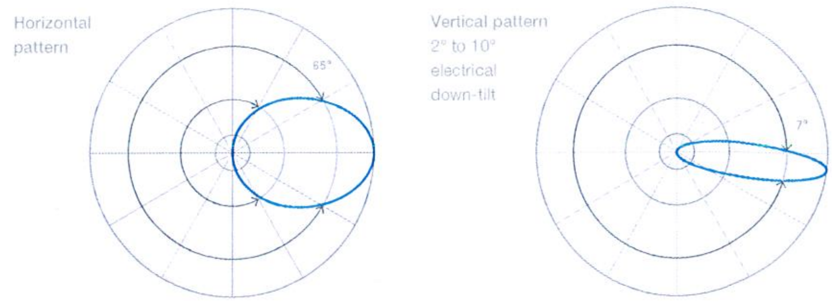


Figure 4
Antenna
Characteristics



Technical Specification

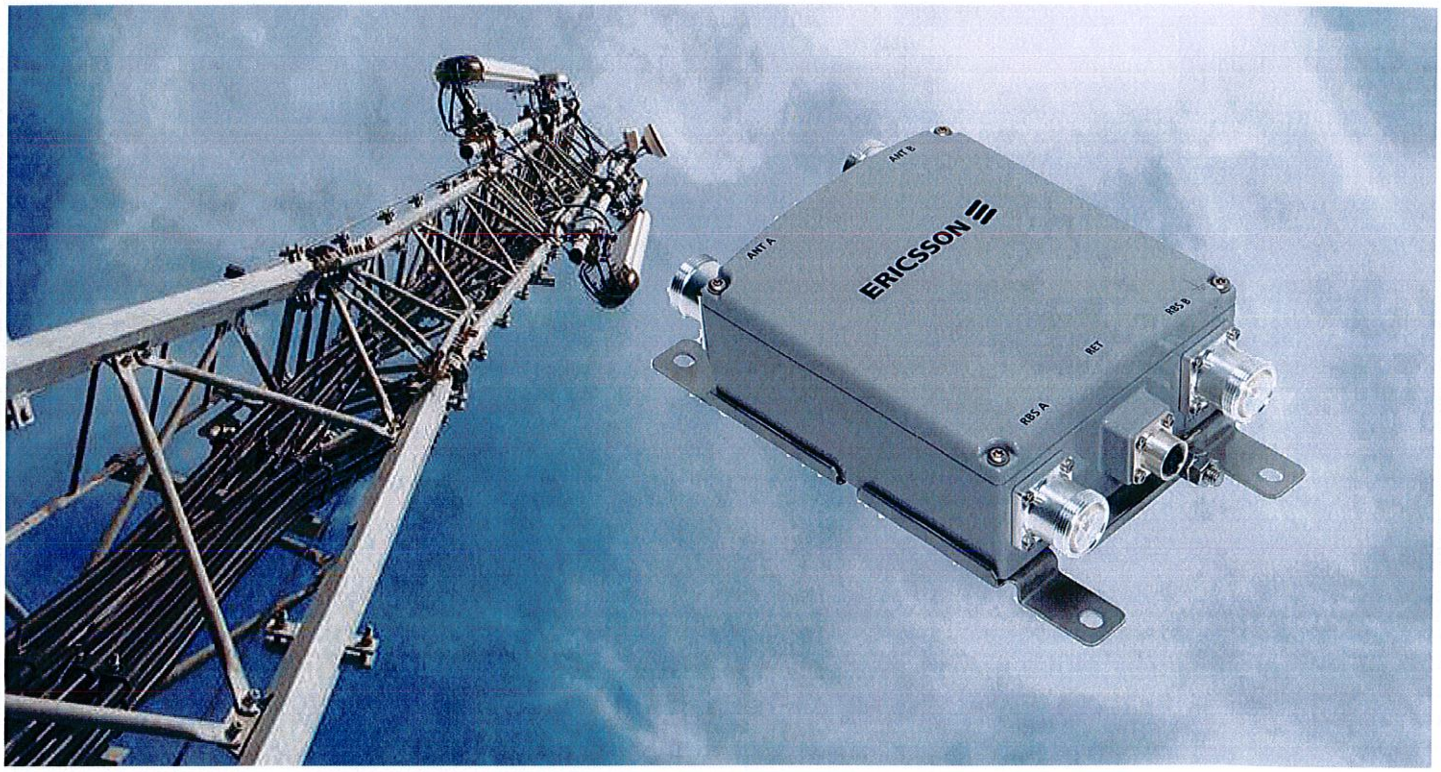
RADIO	
Active frequency band	Band 2 (1850-1910 / 1930-1990 MHz)
Passive frequency band (optional)	Band 4 (1710-1755 / 2110-2155 MHz)
Downlink EIRP in bore-sight direction for the active band	2 x 63 dBm
Uplink sensitivity	TBD*
Remote electrical tilt	-2° to -12°, independently controlled per frequency band
MIMO	2 x 2 for DL 4 RX branches to be used for diversity/beam-steering
Instantaneous bandwidth	20 MHz
Capacity (single standard per sector)	Up to 8 carriers GSM Up to 4 carriers WCDMA with 2 x 2 DL MIMO Up to 20 MHz LTE with 2 x 2 DL MIMO
Multi-RAT capability	Single standard or two simultaneous standards (Capacity above is reduced for multi-RAT)
Bore-sight antenna gain for passive antenna option	17.5 dBi
Nominal beam-width, azimuth	65°
Nominal beam-width, elevation	7°
Additional antenna parameters	See Figure 3
MECHANICAL	
Weight	32 kg (70 lb) for active only 38 kg (83 lb) for active and passive
Size (H x W x D)	56" x 12" x 8" (1422 mm x 300 mm x 200 mm)
Wind load (frontal/lateral/rear-side) @ 150 km/h wind speed	580 N / 300 N / 720 N
INTERFACES	
AIR – DU	DATA 1, Data 2: CPRI links (SFP modules with LC socket + flanges that match protective cover TYCO C20611458)
Power	- 48 V DC (TYCO/Ericsson RPT 447 04)
Passive antenna (option)	TX/RX 1, TX/RX 2: RF connectors (7/16 female)
SUPPORTING BASE-BAND	
RBS 6601	One or two units depending on configuration.

* Target: 1 dB better than best-in-class RRU connected to same size best-in-class antenna

** Other base-band configurations are available

DOUBLE TMA 17/21, PREMIUM

3GPP/AISG compatible with RET interface



Improving a radio uplink by using tower mounted amplifiers is perceived as a key method of optimizing radio networks. By ensuring maximum coverage including in-door penetration, a TMA supports the design of cost-efficient networks and extended talk-time handsets, low dropped call rates and high traffic billing.

TMA design
This Double Premium TMA for 17/2100 MHz has 12dB gain and is 3GPP/AISG 2.0 compatible, with a RET interface. It has superior RF performance, small size and low weight. There is a corresponding TMA version called ASC that has a higher gain and a VSWR measuring coupler.

System integration
The Double TMA 17/2100 is a part of Ericsson's TMA family. Power, control and supervision are provided by the RBS 3000. If sold to other RBS brand installations, it can be controlled and supervised from the "Antenna System & TMA Control Module", AST-CM, via the RF feeder.

3GPP/AISG
TMA communication is based on the 3GPP/AISG protocol standard and has a RET port for controlling antenna RET units. The communication port allows multiple RETs or Antenna Line Devices to be supervised and controlled via the TMA.

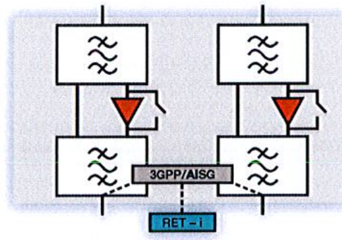
Future-proof
The Double TMA 17/21 Premium is designed for co-existence with future complementary, mast-mounted devices.

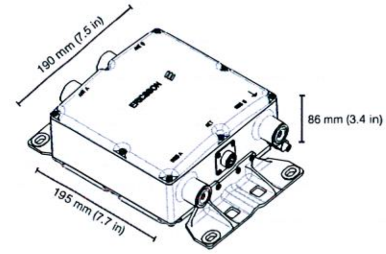
Excellent reliability
As the world's largest supplier of TMAs, Ericsson has a well-proven track record of reliable TMA designs. Reliability enhancing features include dual LNAs, weatherproof design, integrated alarm and lightning protection.

ERICSSON

Features

- Specified and verified as an integrated system solution for Ericsson RBSs
- Possible to power both TMAs from one feeder, or from both feeders
- High power capacity
- Automatic LNA by-pass function
- Built in lightning protection
- Excellent RF performance
- Connectors "in line"
- Distance between connectors simplifies sealing work
- A range of accessories for flexible site configurations





Technical Specifications for Double TMA 1700/2100, MHz Premium

Product name Double TMA 17/21, Premium 3GPP/ASIG compatible with RET interface	**Product number** KRY 112 144/1
Radio performance	
Bandwidth:	45 MHz
Receiving pass band:	1710 - 1755 MHz
Transmitting pass band:	2110 - 2155 MHz
RX Gain:	12± 1 dB
Input IP3:	16 dBm*
IM3 at antenna port (2x43dBM):	-128 dBm
Noise figure midband:	1.0 dB*
TX max input power (Max Peak):	57 dBm
TX insertion loss:	0.25 dB*
RX return loss:	22 dB*
TX return loss:	22 dB*
Electrical specifications	
Input power:	+12 - 32 VDC
Power consumption:	< 4.5 W
Mechanical specifications	
Dimensions (W x H x D):	155 x 176 x 71 mm
Weight:	5 kg
RF connectors:	7-16 DIN female
Ground connectors:	M8
DC/Alarm:	Superimposed on the RF signal
Mounting:	Pole or wall mounting
RET connectors:	Din con. IEC 60130-9 - Ed. 3.0 female
Environmental specifications	
Temperature range, full performance:	-40°C - +55°C
MTBF:	80 years
Sealing:	IP67
Lightning protection:	IEC 62305-1, IEC 61000-6
Safety approval:	International: CB certified, IEC 60 529 Europe: EN 60 529 North America: NRTL, NEMA 3R
Safety standard:	UL 60950-1, IEC 60950-1

* Typical values

Subject to change without notice

JWB Tower Services, LLC
148 Governor Street
New Britain, CT 06053
(800) 819-3084

Monopine Inventory
General Information

Site Name:		Barkhamsted South
Site Number:		
FCC Number:		1250429
Manufacturer ID #		
Street Address:		31 New Hartford Rd (Access off Rust Rd)
City/State/Zip Code:		Barkhamsted, CT
County:		
Lat:	N/S	41° 53' 37"
Long:	E/W	72° 59' 48"
Performed By:		JWB
Date:		2/28/2014

Antenna Information: All Heights are AGL

CARRIER	Sprint	PIC #	7

MOUNT

Type:	T-Arm	Manf.:					
Elev. C/L:	140'	Bottom:		Top:		Leg:	
Face Width:	12'	Height:	4"	Projection:	3'	Azimuth/s:	

ANTENNA

Type:	Panel	Manf.:	RFS	Model:		APXVSPP18-C-A20	
Elev. C/L:	140'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)	72"x12"x8"			Azimuth/s:	

RET

Quantity:	9 (3 per ant)	Manf.:	RFS	Model:	3"x3"x1.5"

RRH

Quantity:	3	Manf.:	Alcatel-Lucent	Model:	FD-RRH 4X45 1900

RRH

Quantity:	3	Manf.:	Alcatel-Lucent	Model:	FD-RRH-2X50 800

COAX

Quantity:	3	Size:	1 1/4" HYBRIFLEX	Jumper:	N/A	Color:	N/A

CARRIER	Verizon	PIC #	6

MOUNT

Type:	T-Arm	Manf.:					
Elev. C/L:	132'	Bottom:		Top:		Leg:	
Face Width:	12'	Height:	4"	Projection:	3'	Azimuth/s:	

ANTENNA 1 - Outer

Type:	Panel	Manf.:	Antel/Amphenol	Model:		LPA-80063-4CF	
Elev. C/L:	133'	Bottom:		Top:		Leg:	
Quantity:	4	Dim: (HxWxD)	48"x15"x13.5"			Azimuth/s:	

ANTENNA 2 - Outer

Type:	Panel	Manf.:	Antel/Amphenol	Model:		LPA-80080-4CF	
Elev. C/L:	133'	Bottom:		Top:		Leg:	
Quantity:	2	Dim: (HxWxD)	48"x6"x13"			Azimuth/s:	

ANTENNA 3 - Inner

Type:	Panel	Manf.:	Antel/Amphenol	Model:		BXA-171063-8BF-EDIN-2	
Elev. C/L:	133'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)	48"x6"x4"			Azimuth/s:	

ANTENNA 4 - Inner

Type:	Panel	Manf.:	Antel/Amphenol	Model:		BXA-70063-6CF	
Elev. C/L:	133'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)	71"x11"x6"			Azimuth/s:	

COAX

Quantity:	12	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

		CARRIER	Empty			PIC #	5, 6

MOUNT

Type:	(3) Standoffs	Manf.:					
Elev. C/L:	130'	Bottom:		Top:		Leg:	
Face Width:	3"	Height:	4"	Projection:	3'	Azimuth/s:	

		CARRIER	AT&T			PIC #	4

MOUNT

Type:	T-Arm	Manf.:					
Elev. C/L:	111.5'	Bottom:		Top:		Leg:	
Face Width:	12'	Height:	4"	Projection:	3'	Azimuth/s:	

ANTENNA 1 Outer

Type:	Panel	Manf.:	Powerwave	Model:	7770 w/RET		
Elev. C/L:	113'	Bottom:		Top:		Leg:	
Quantity:	6	Dim: (HxWxD)				Azimuth/s:	

TMA'S

Quantity:	6	Manf.:	Powerwave	Model:	TT19-08BP111-001

ANTENNA 2 Inner

Type:	Panel	Manf.:	Kathrein	Model:	80010764V01		
Elev. C/L:	113'	Bottom:		Top:		Leg:	
Quantity:	1	Dim: (HxWxD)				Azimuth/s:	

ANTENNA 3 Inner

Type:	Panel	Manf.:	KMW	Model:	AM-X-CD-16-65-00T		
Elev. C/L:	113'	Bottom:		Top:		Leg:	
Quantity:	2	Dim: (HxWxD)	72"x12"x6"			Azimuth/s:	

RRU

Quantity:	3	Manf.:	Ericsson	Model:	RRUS 11 B12

Surge Arrester

Quantity:	1	Manf.:	Striksorb	Model:	

COAX

Quantity:	12	Size:	1 1/4"	Jumper:	1/2"	Color:	N/A
Quantity:	2	Size:	7/8"	Jumper:	N/A	Color:	N/A
Quantity:	1	Size:	3/8"	Jumper:	N/A	Color:	N/A

CARRIER	T-Mobile	PIC #	3

MOUNT

Type:	T-Arm	Manf.:					
Elev. C/L:	101.5'	Bottom:		Top:		Leg:	
Face Width:	12'	Height:	4"	Projection:	N/A	Azimuth/s:	

ANTENNA

Type:	Panel	Manf.:	RFS		Model:	APX16DWV-16DWVS-E-A20	
Elev. C/L:	102'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)	56"x13"x3"			Azimuth/s:	

TMA'S

Quantity:	3	Manf.:	RFS	Model:	KRY 112 144/1

TMA'S

Quantity:	3	Manf.:	RFS	Model:	ATMAA1412D-1A20

RET

Quantity:	6 (2 per Ant)	Manf.:	RFS	Model:	4"x3"x1.5"

COAX

Quantity:	12	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

CARRIER	MetroPCS	PIC #	2

MOUNT

Type:	Flush	Manf.:	Unknown/Chain Mount				
Elev. C/L:	92'	Bottom:		Top:		Leg:	
Face Width:	2.5"	Height:	N/A	Projection:	N/A	Azimuth/s:	

ANTENNA

Type:	Panel	Manf.:	RFS		Model:	APXV18-206517-C	
Elev. C/L:	92'	Bottom:		Top:		Leg:	
Quantity:	3	Dim: (HxWxD)	72"x7"x3"			Azimuth/s:	

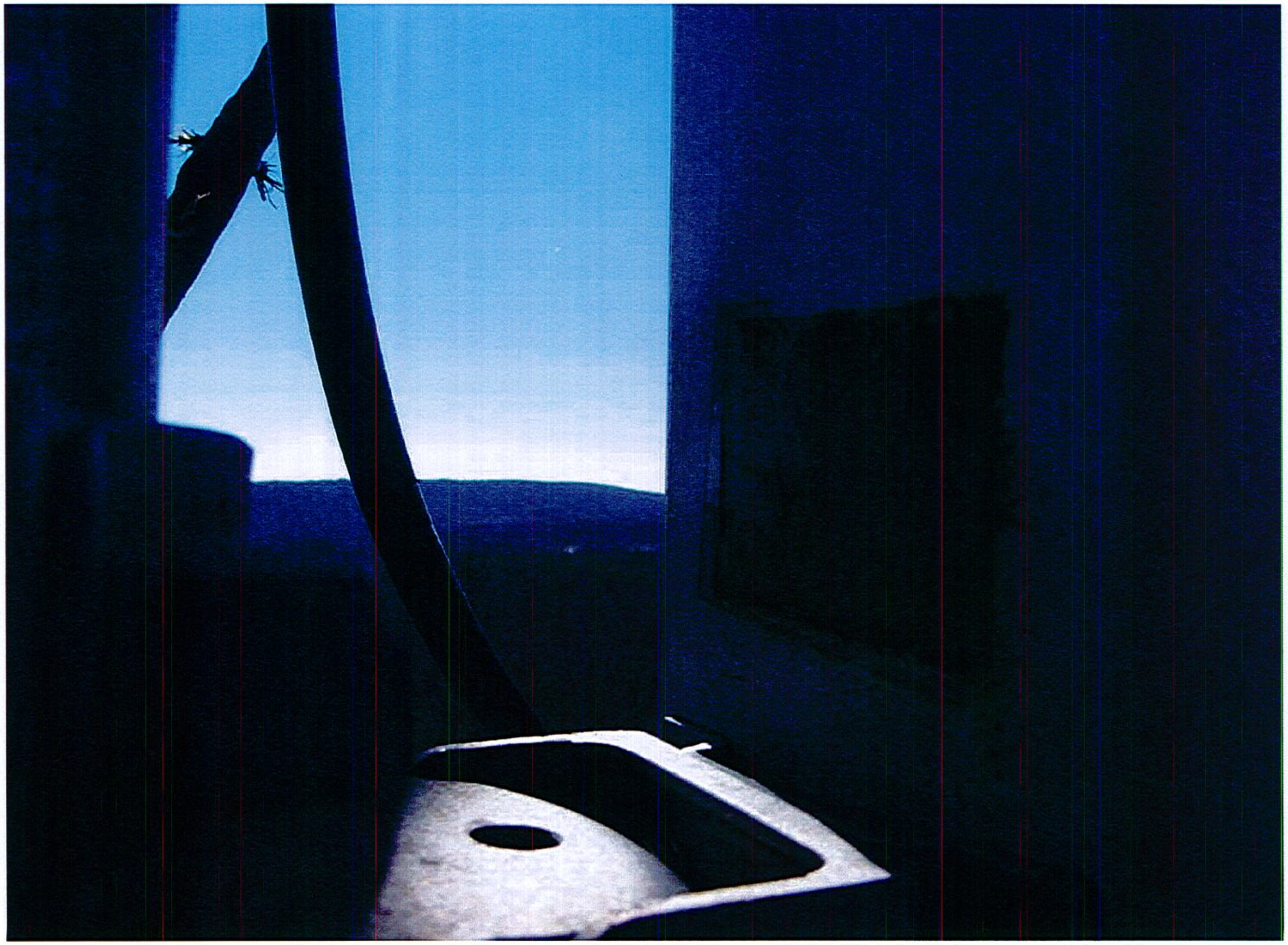
COAX

Quantity:	6	Size:	1 5/8"	Jumper:	1/2"	Color:	N/A

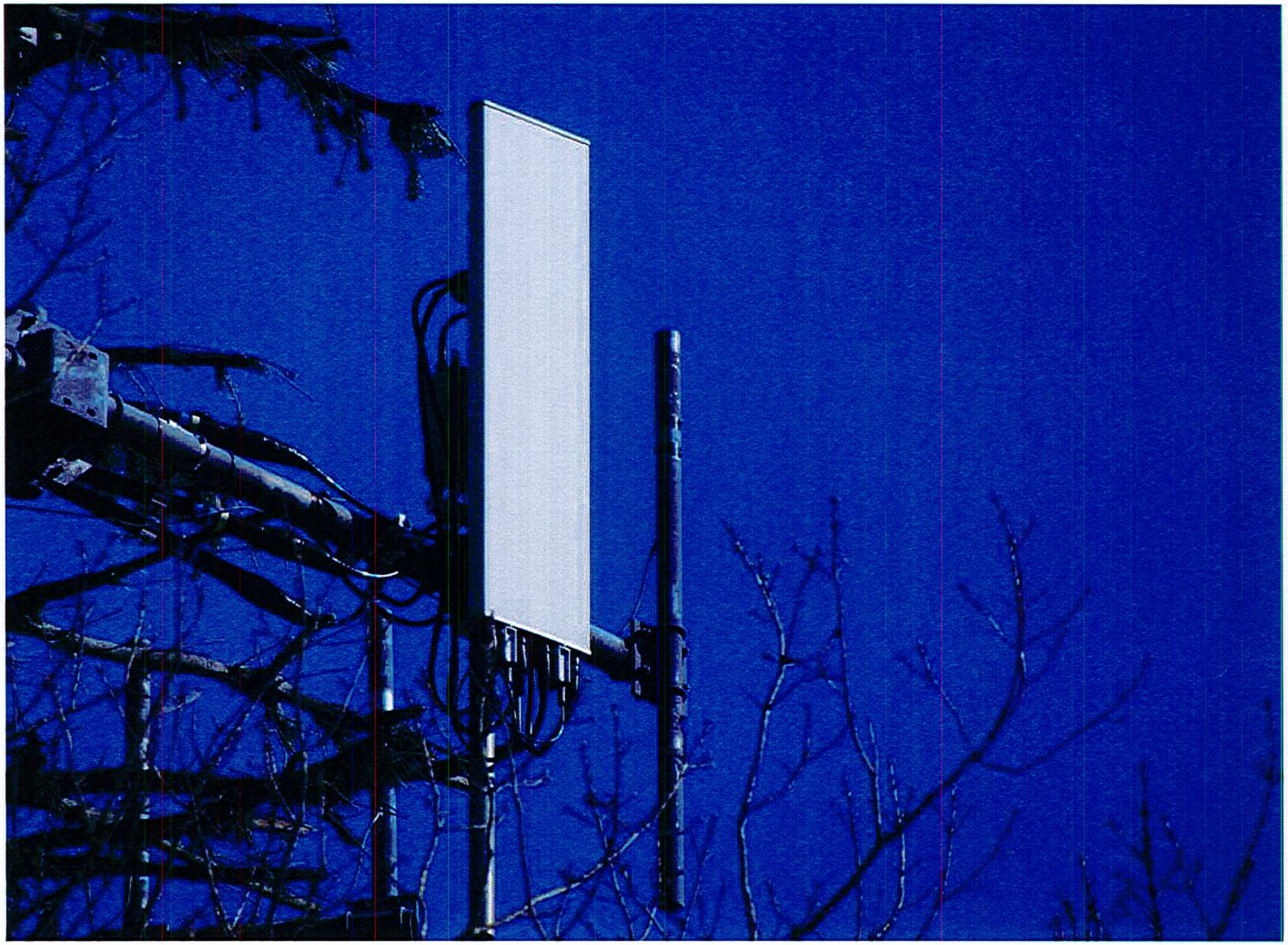
1.0 Elevation

2.0 MetroPCS

2.1 MetroPCS

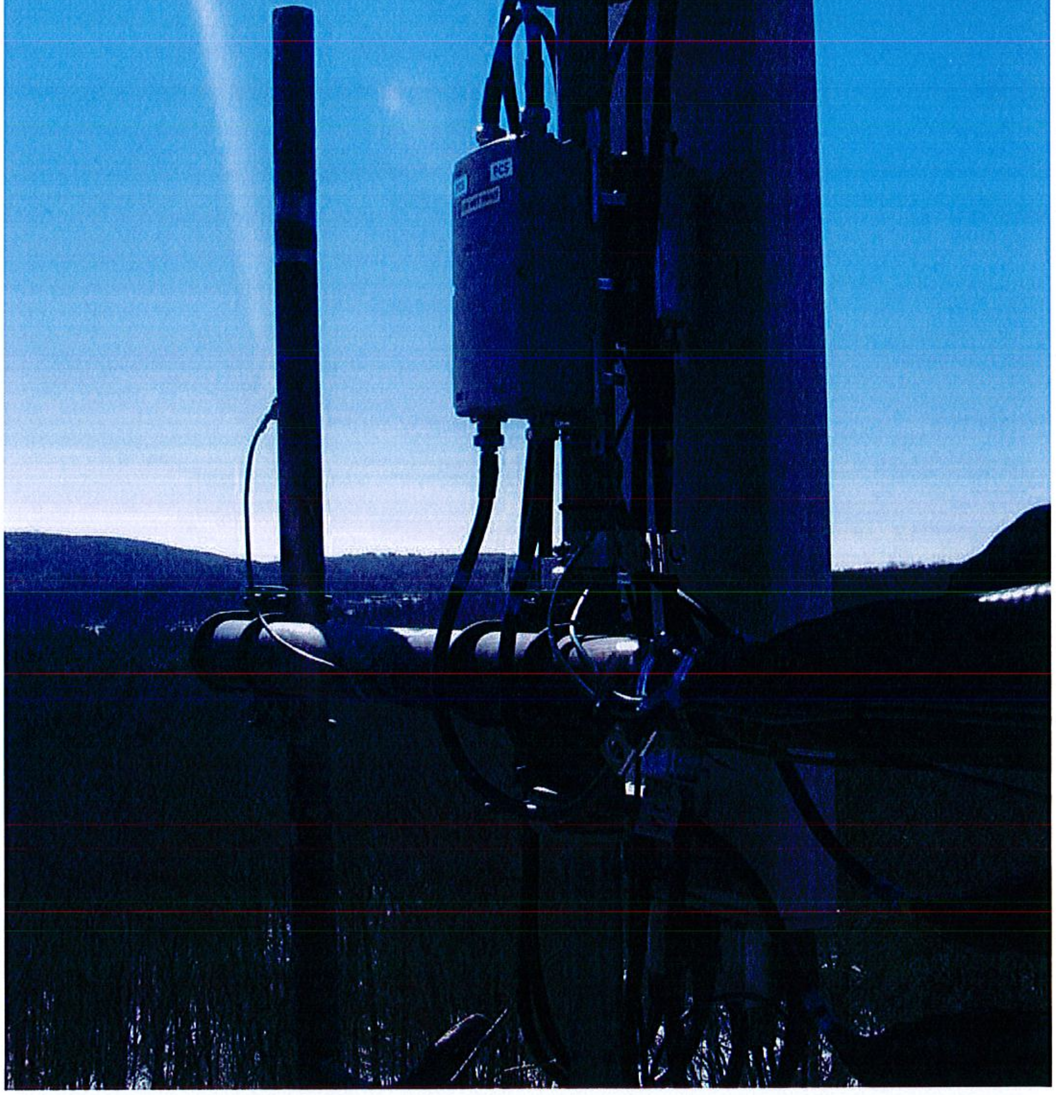


2.2 MetroPCS

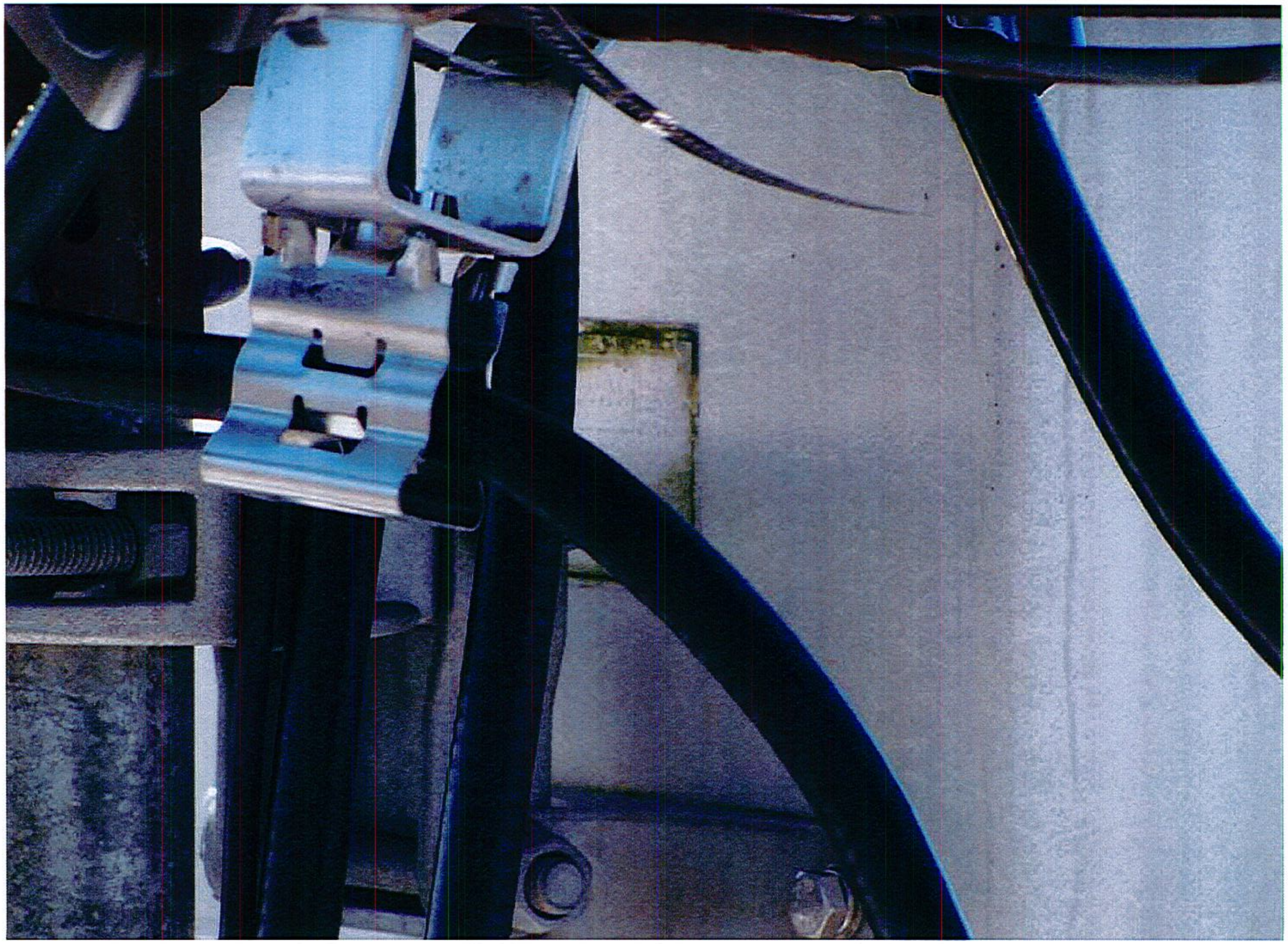


3.0 T-Mobile

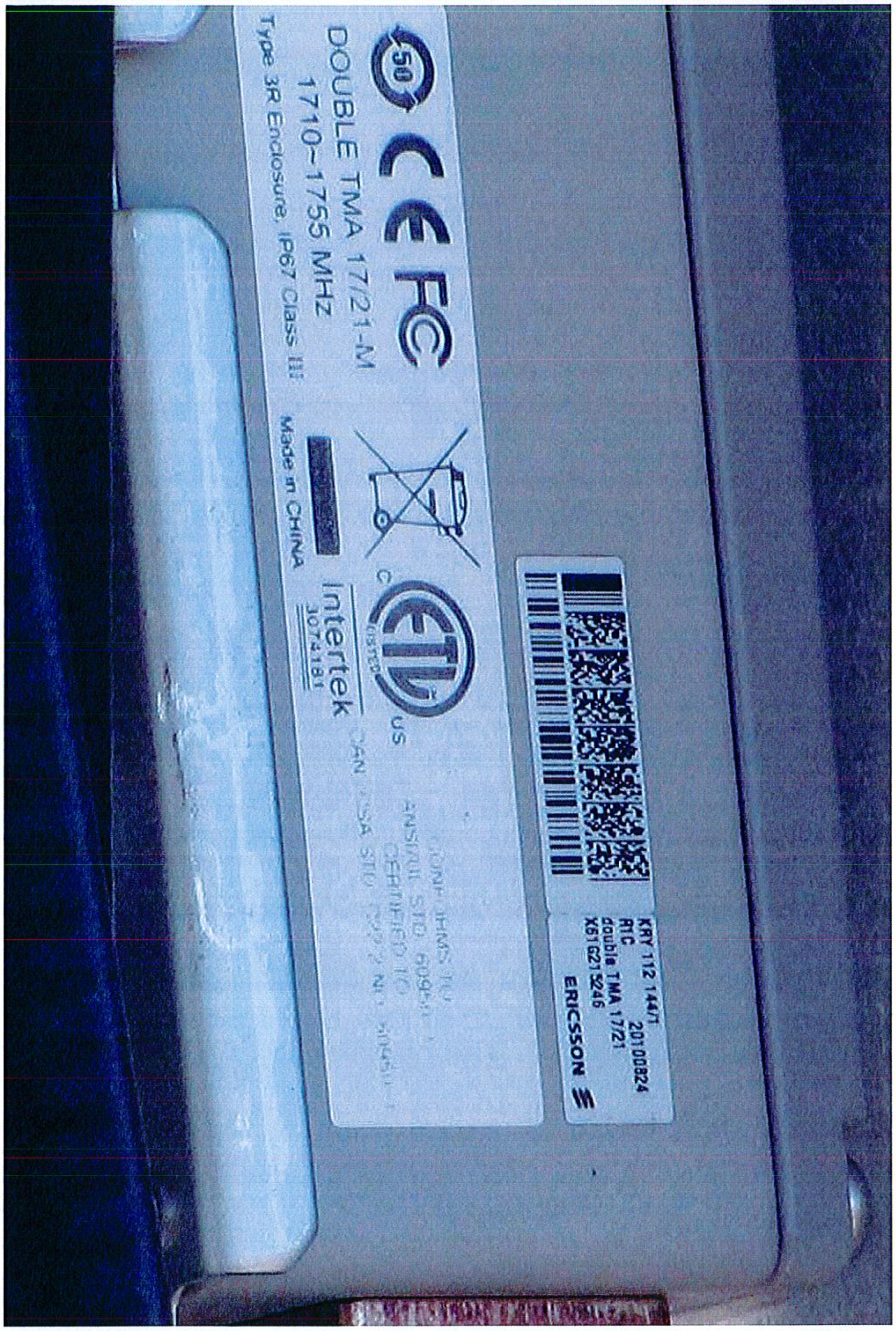
3.1 T-Mobile



3.1 T-Mobile



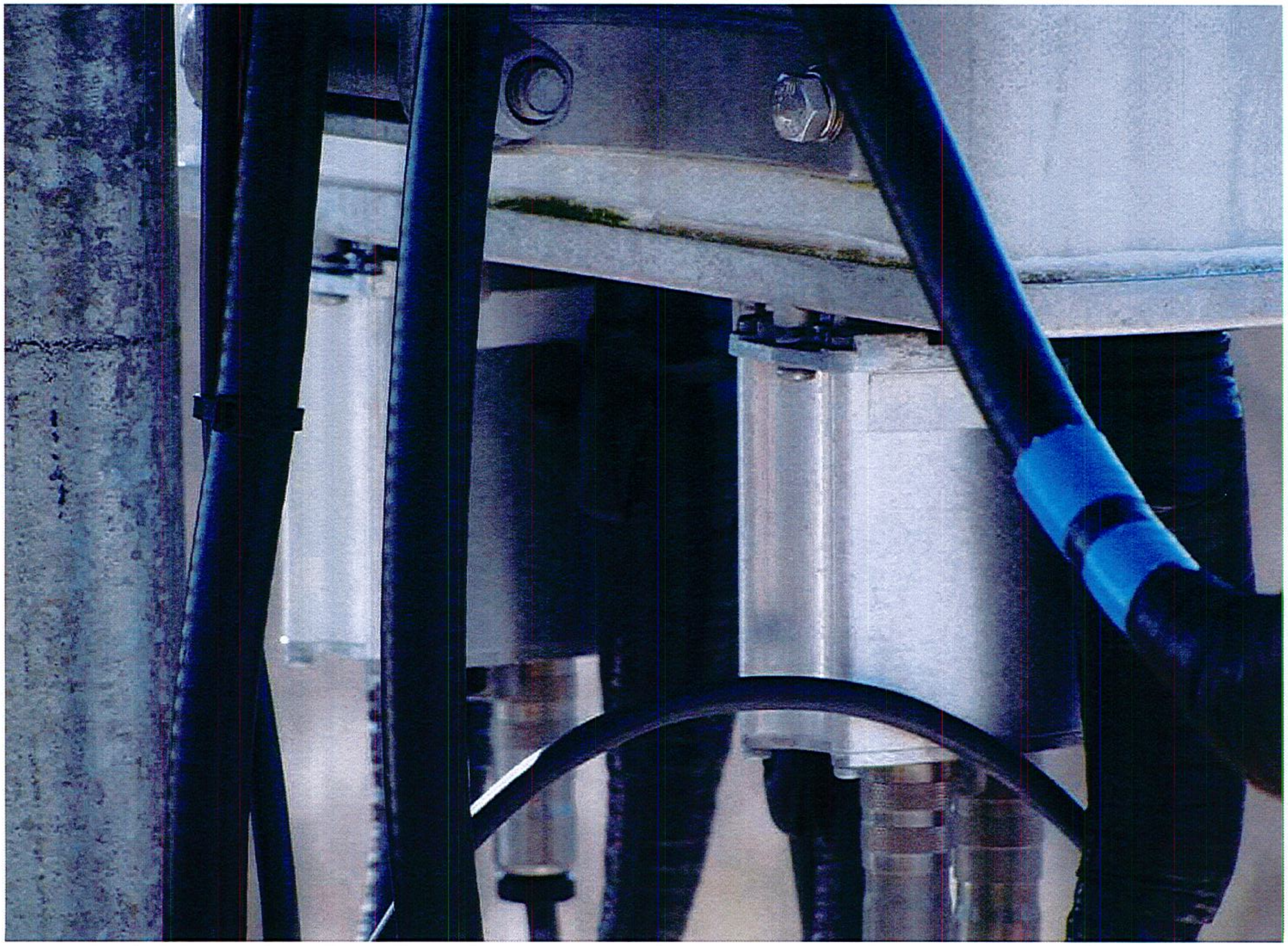
3.2 T-Mobile



DOUBLE TMA 17/21-M
1710~1755 MHz
Type 3R Enclosure, IP67 Class III
Made in CHINA
Intertek
3074181
KRY 112 144/1
ERICSSON

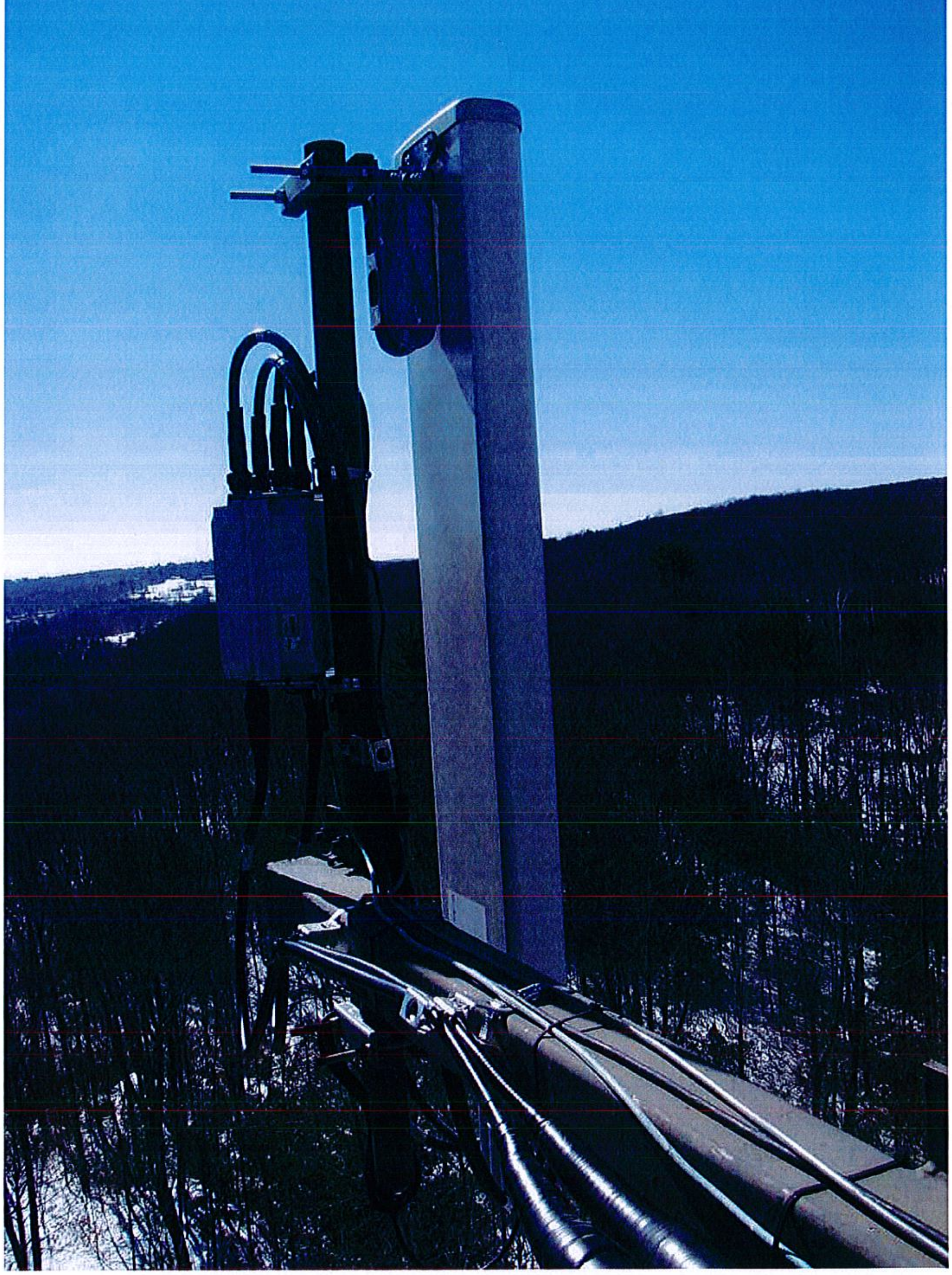
3.3 T-Mobile

3.4 T-Mobile

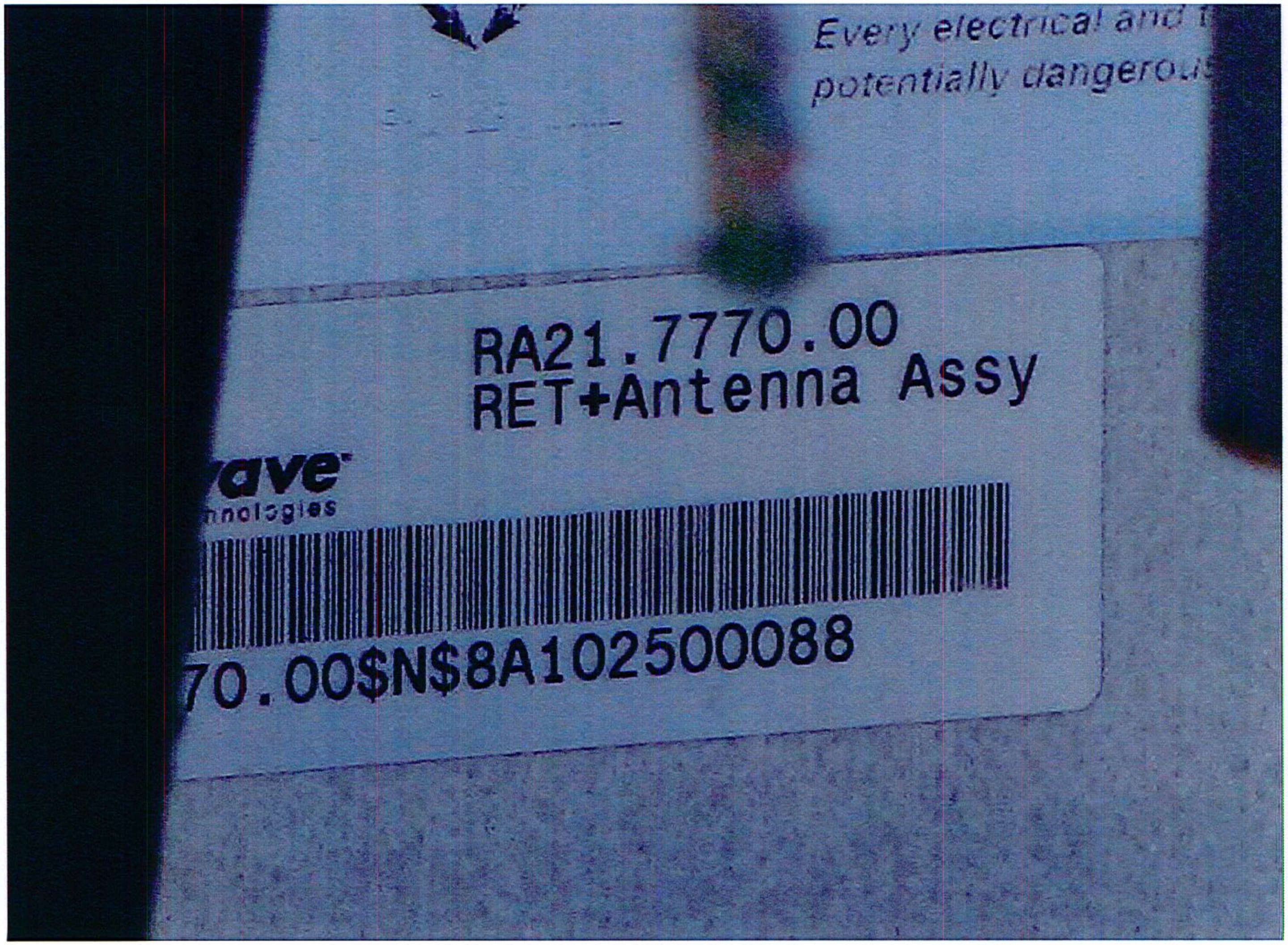


3.5 T-Mobile

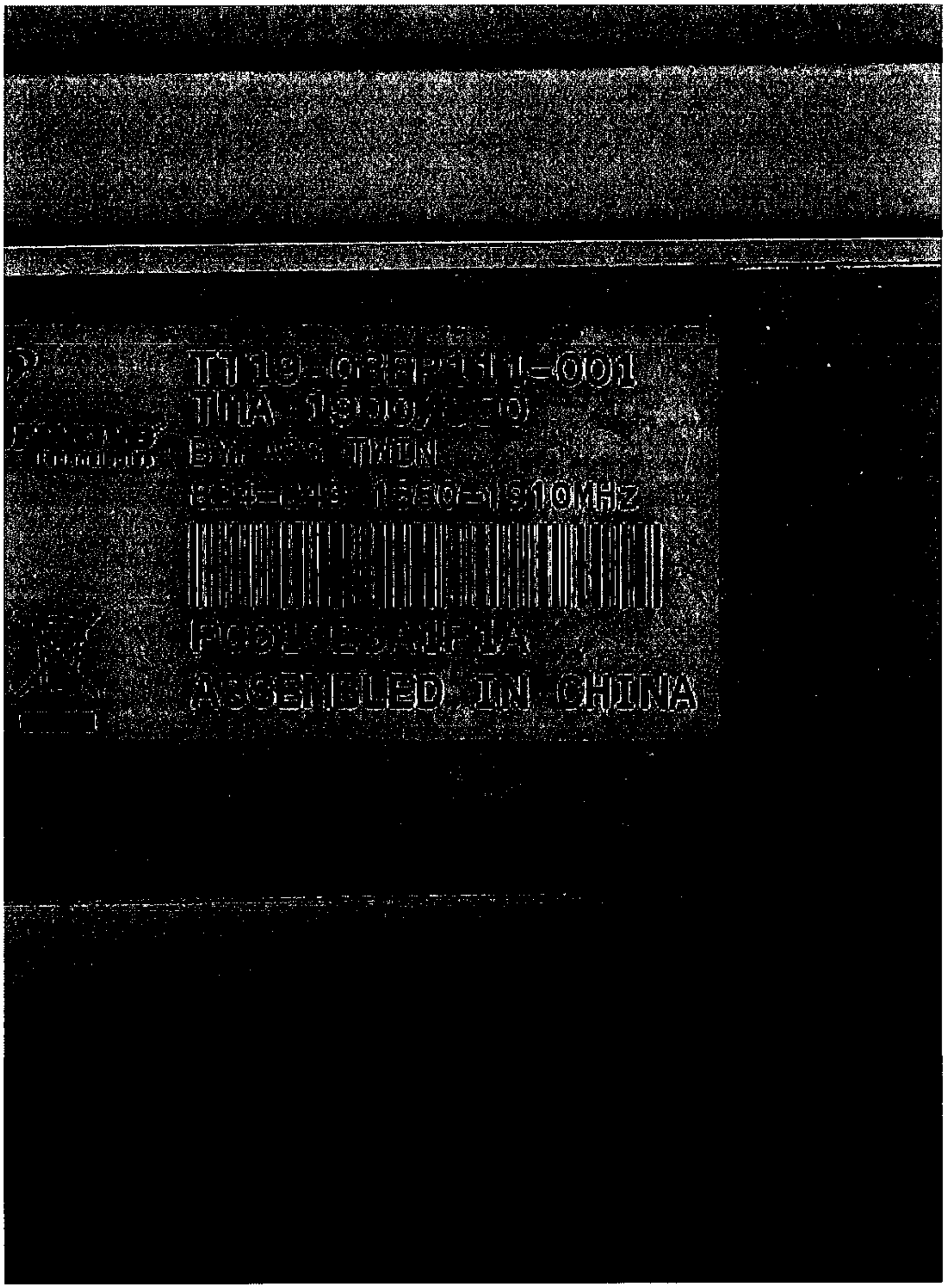
4.0 AT&T



4.1 AT&T

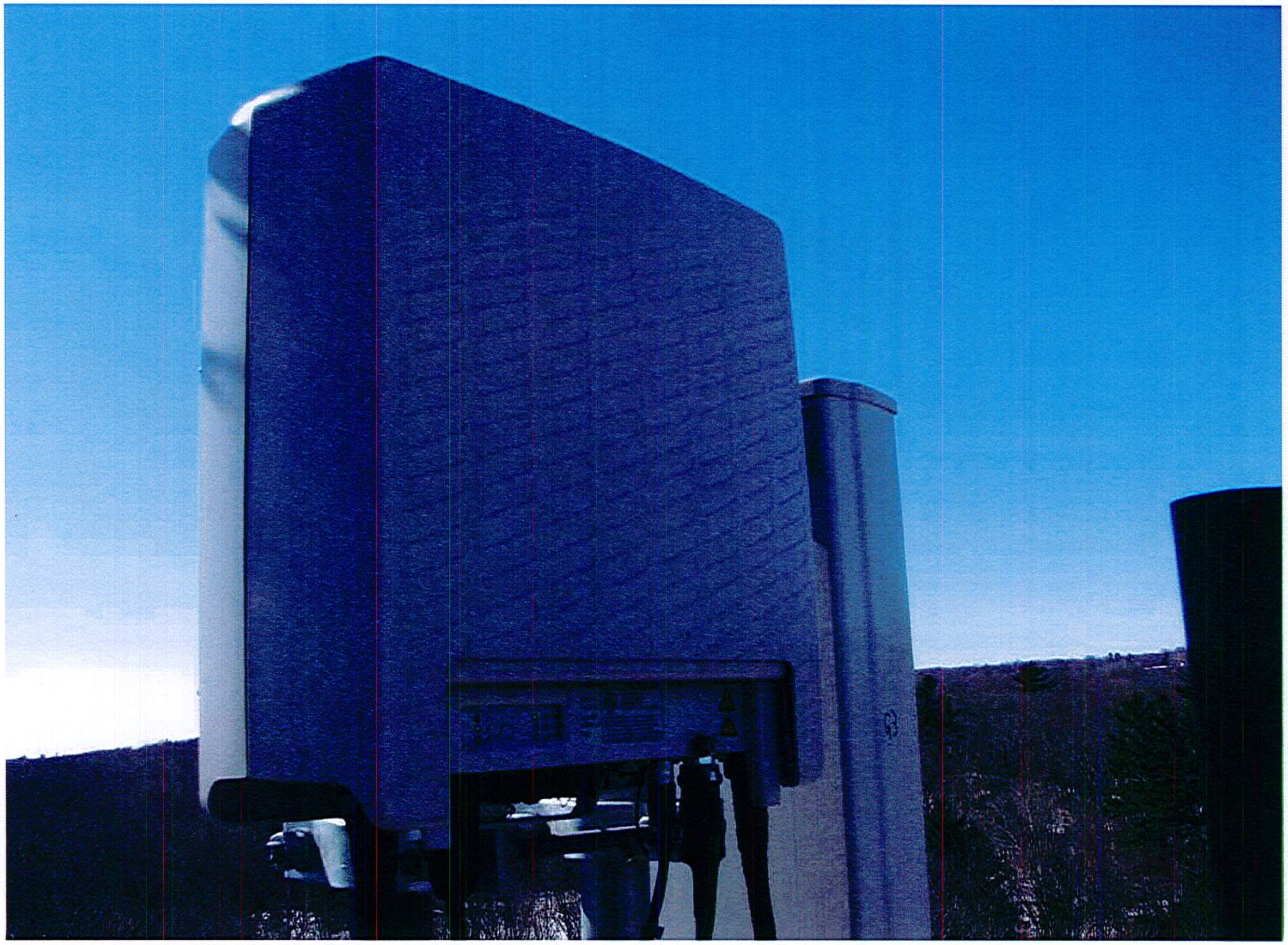

Every electrical and
potentially dangerous
RA21.7770.00
RET+Antenna Assy
70.00N8A102500088

4.2 AT&T



4.3 AT&T

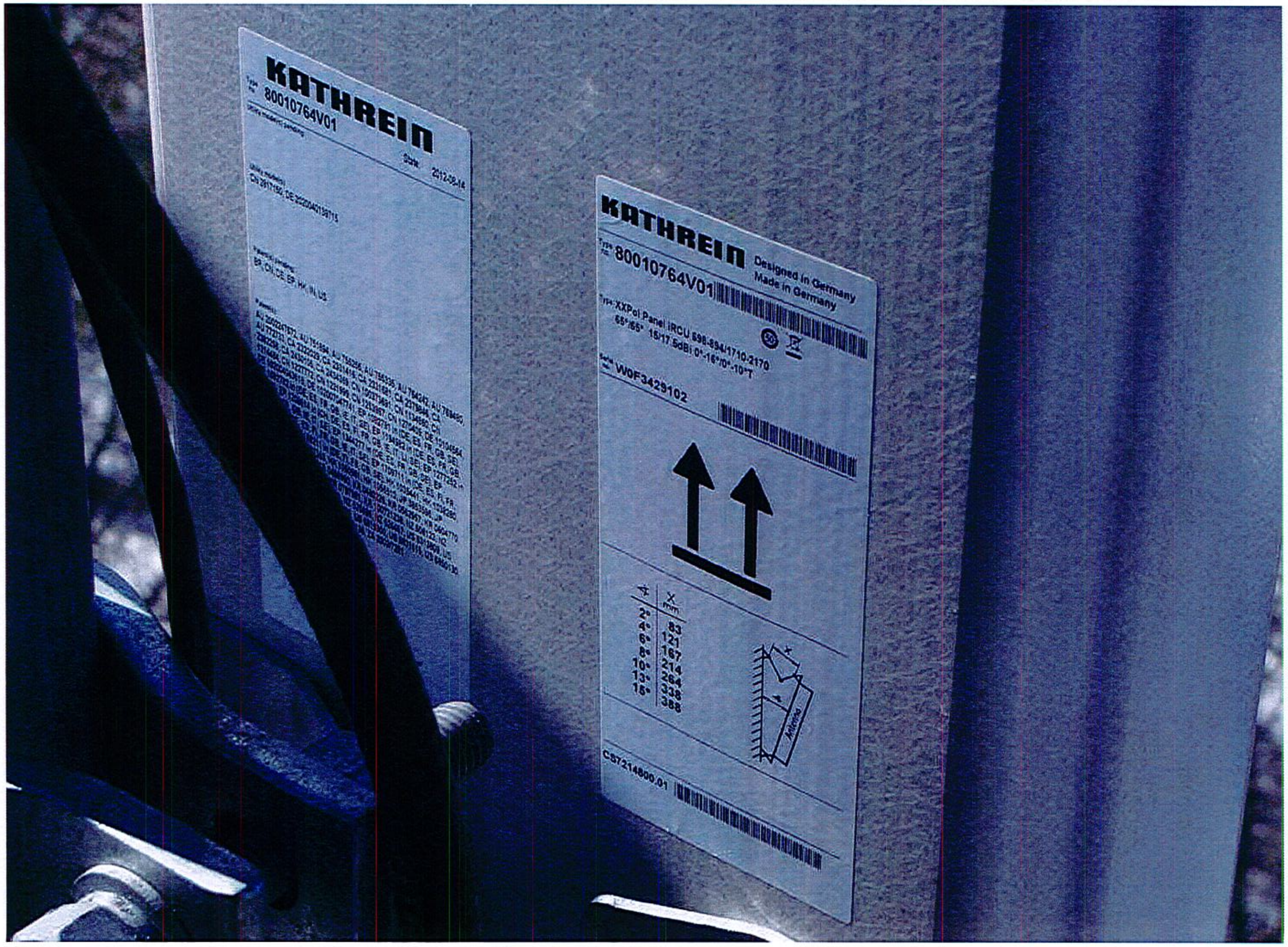
4.4 AT&T



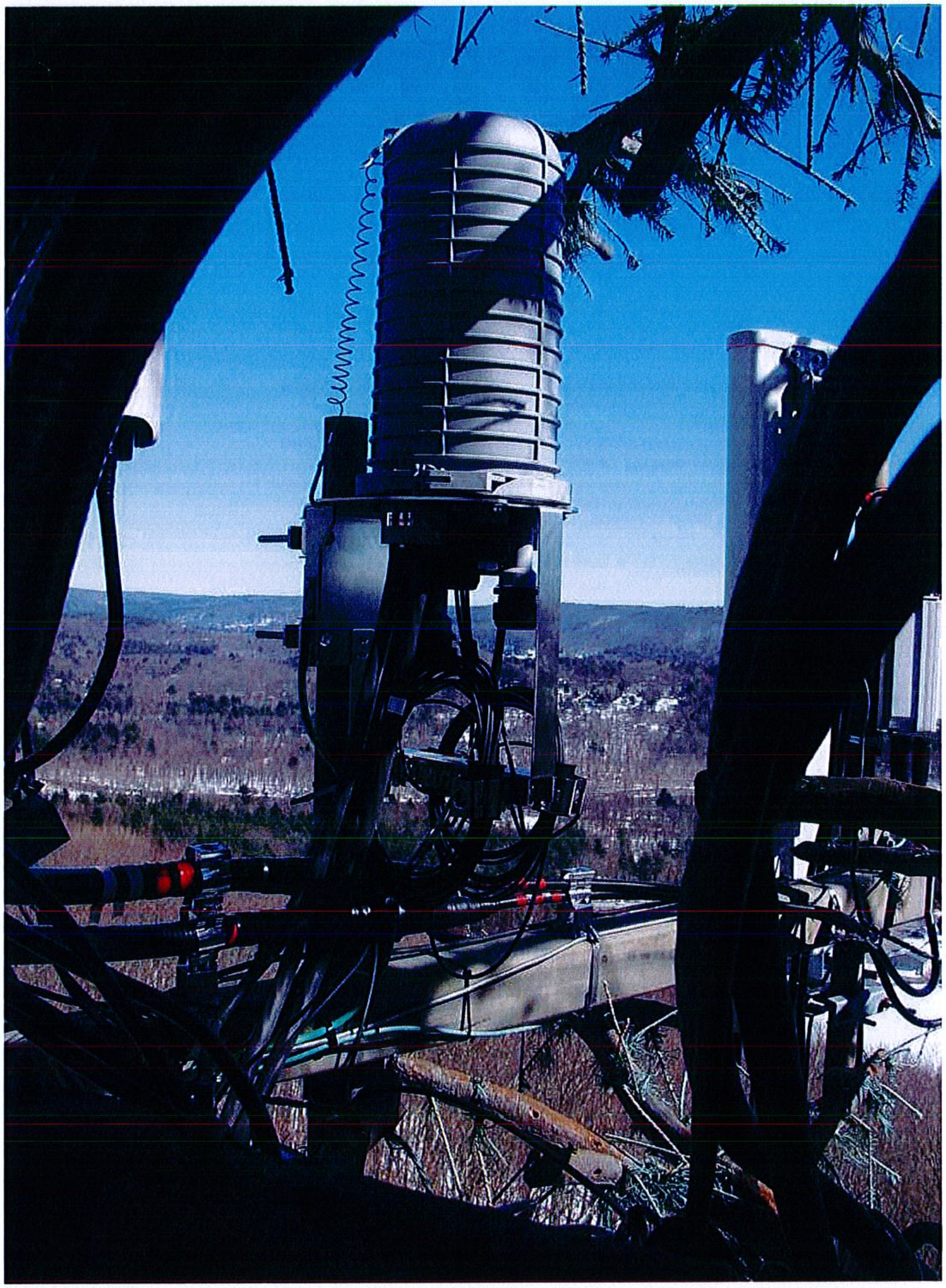
4.5 AT&T

RRUS 11 B12
- 48V
Max: 12A
Type 3R
Enclosure
IP55
CONFORMS TO
ANSI/UL 60950-1
CERTIFIED TO
CAN/CSA-C22.2 NO. 60950-1
c us
113613
This device complies with Part 15 of the FCC rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device accepts any interference received
including interference that may cause undesired operation
This Class B apparatus complies with Canadian ICES-003
1
2
LMT

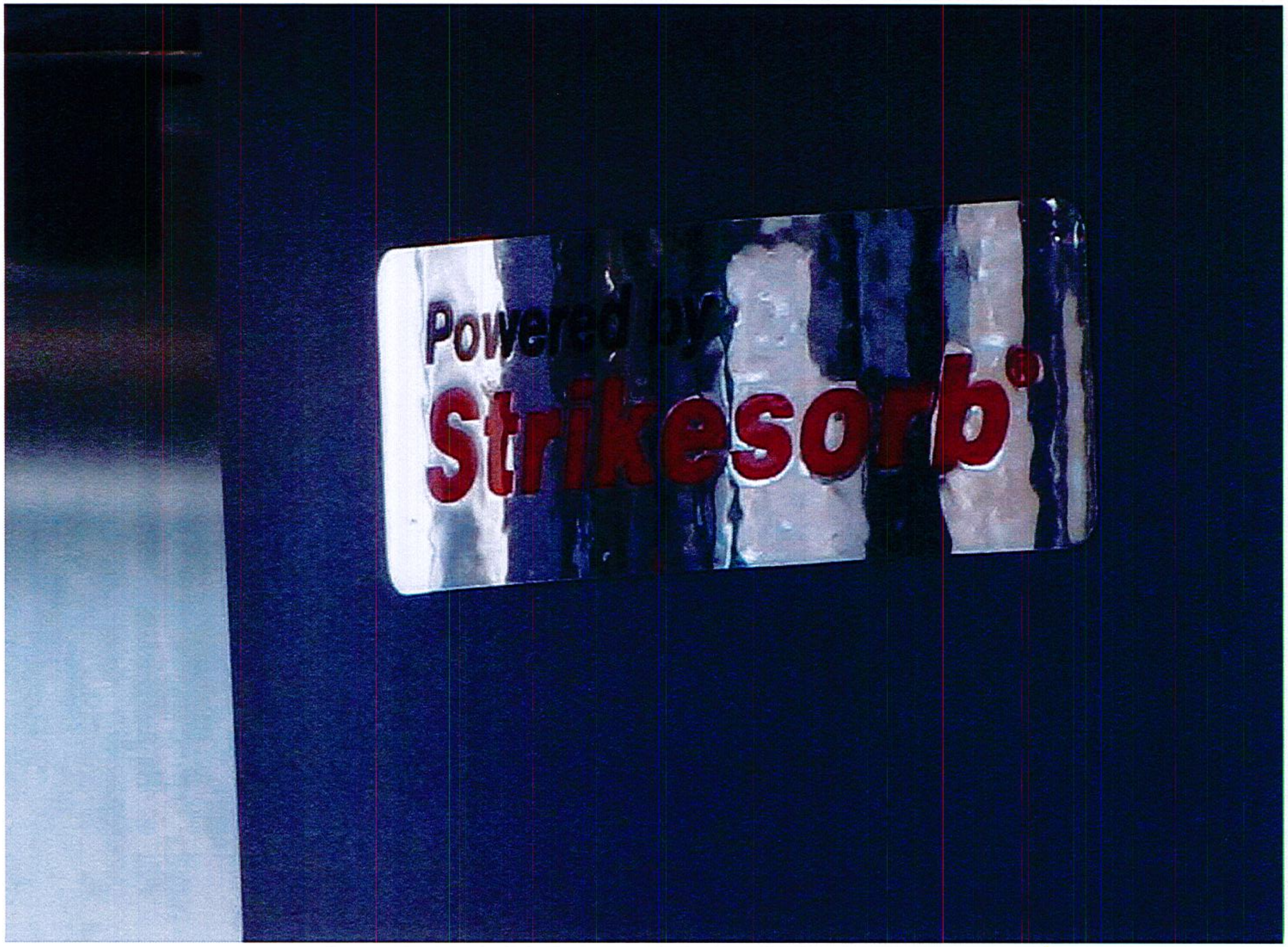
4.6 AT&T


KATHREIN
80010764V01
KATHREIN
80010764V01
Designed in Germany
Made in Germany
W0F3429102

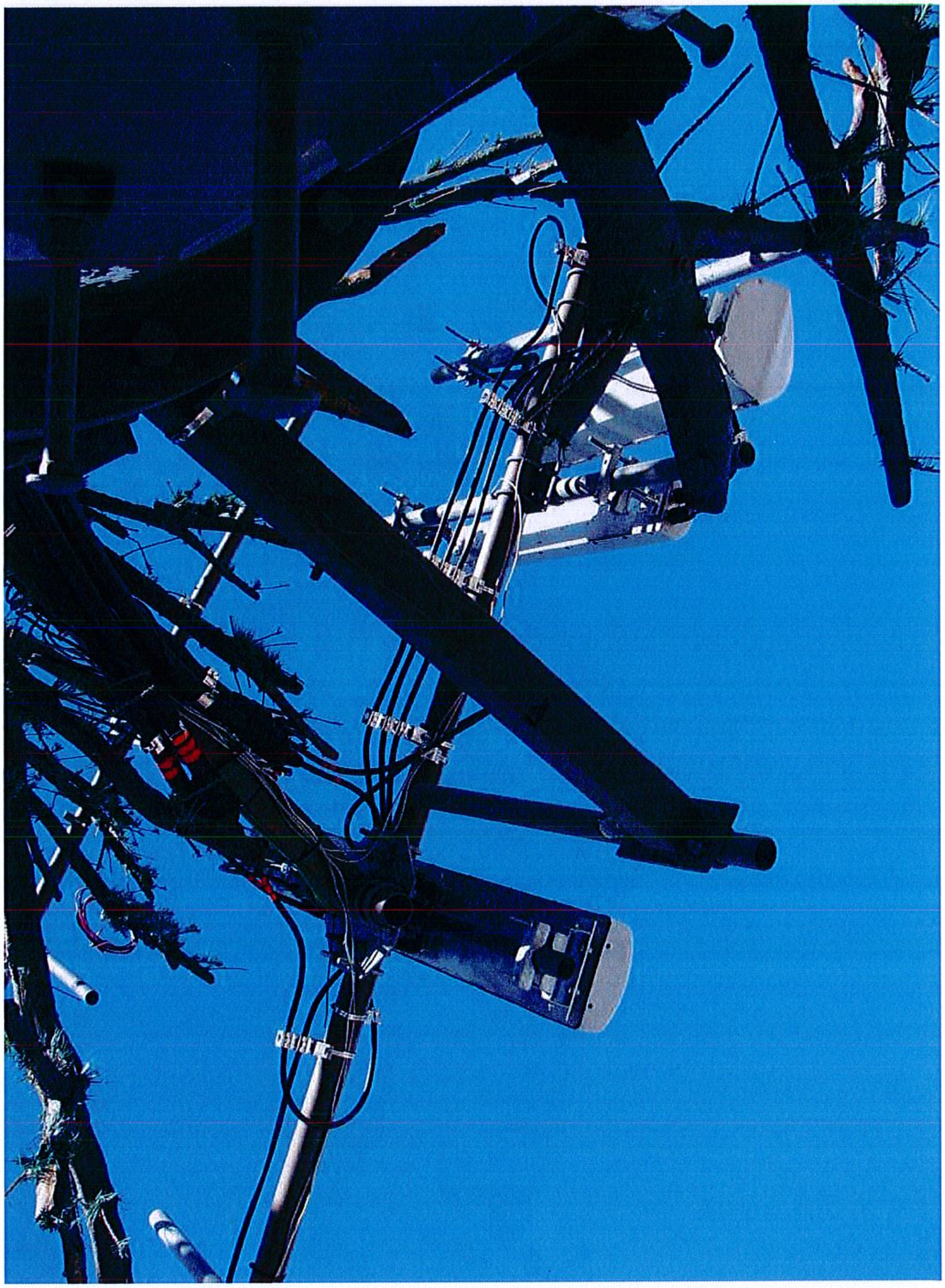
4.7 AT&T



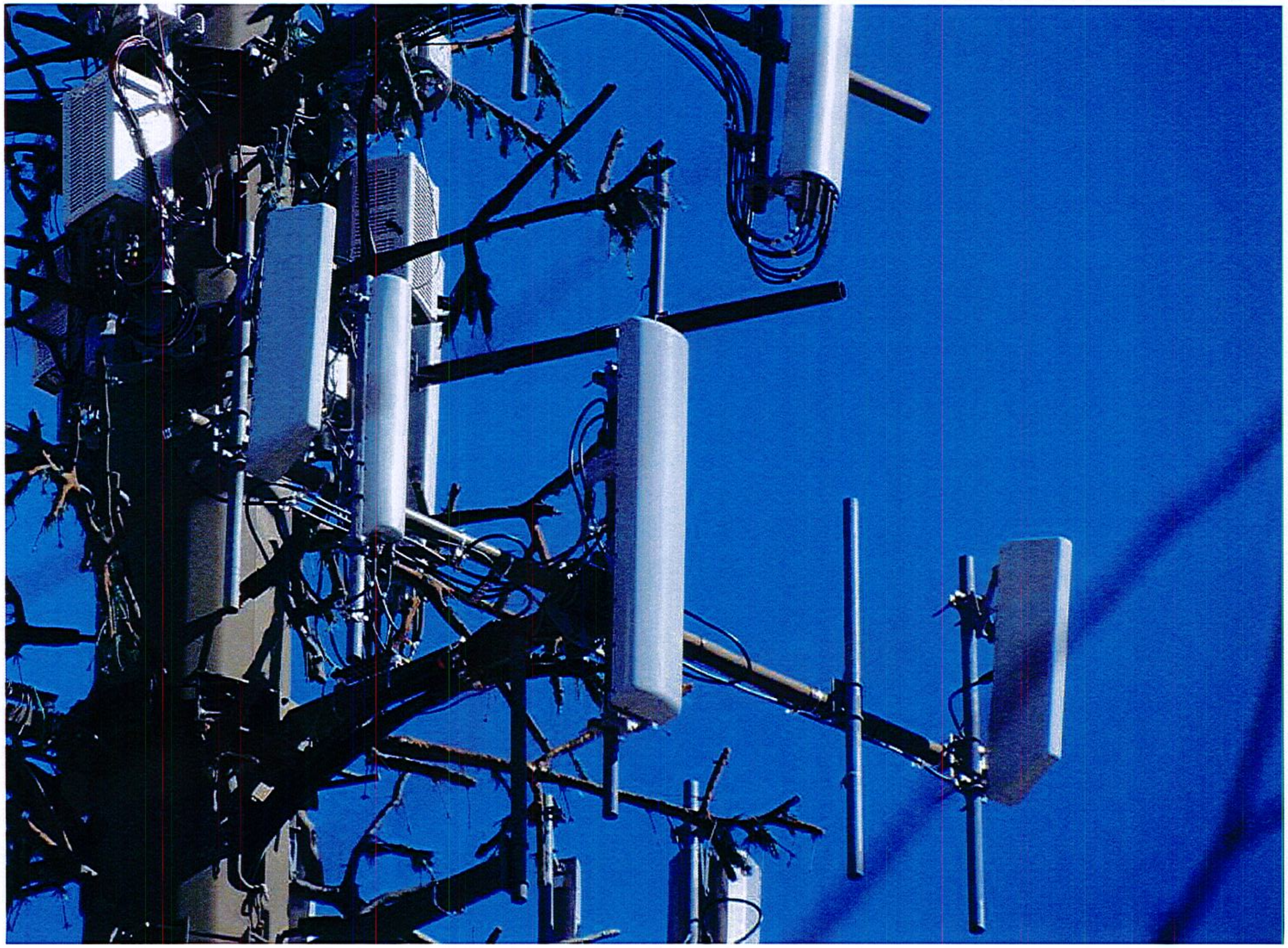
4.8 AT&T



4.9 AT&T



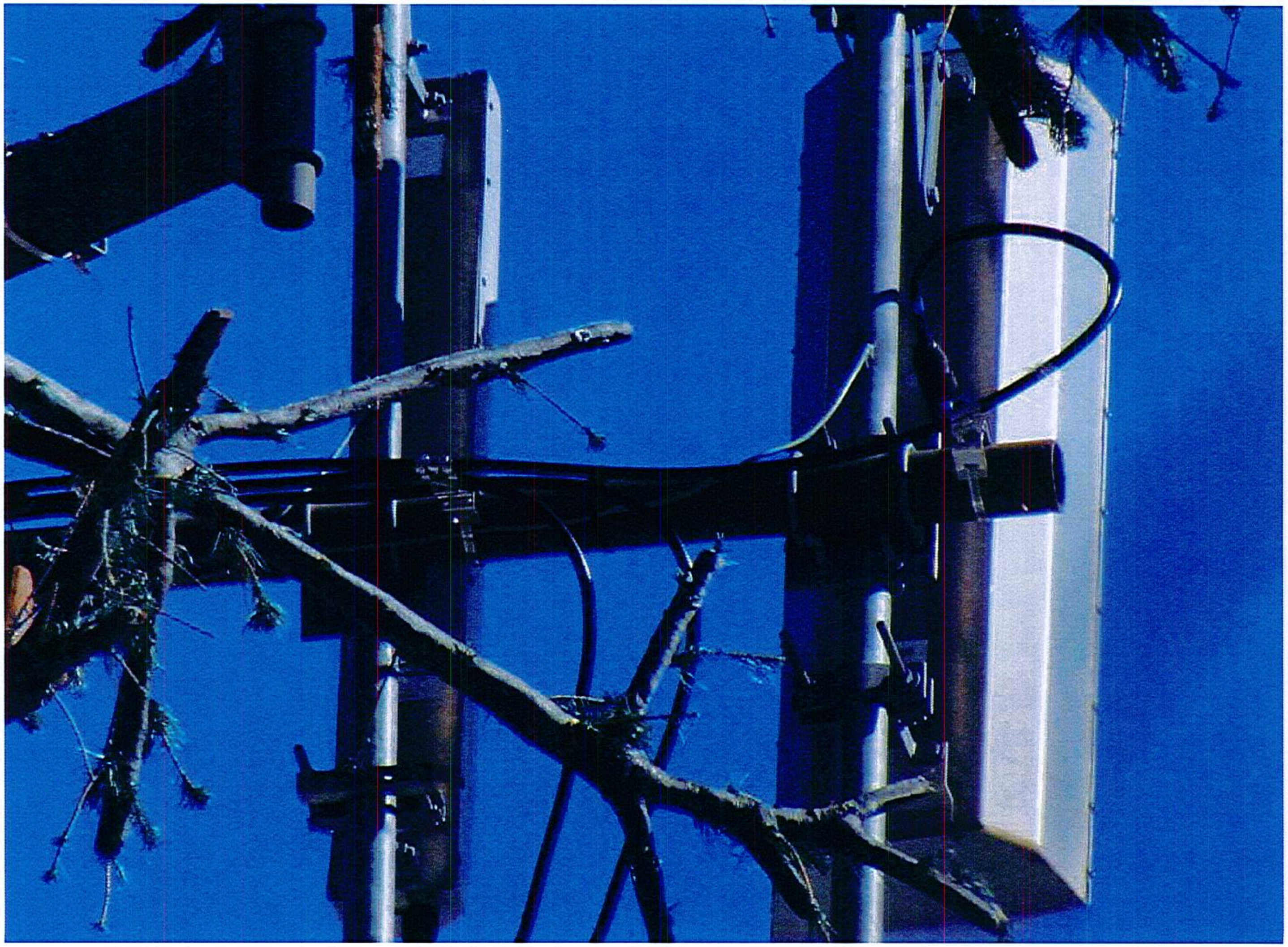
5.0 Empty Mount



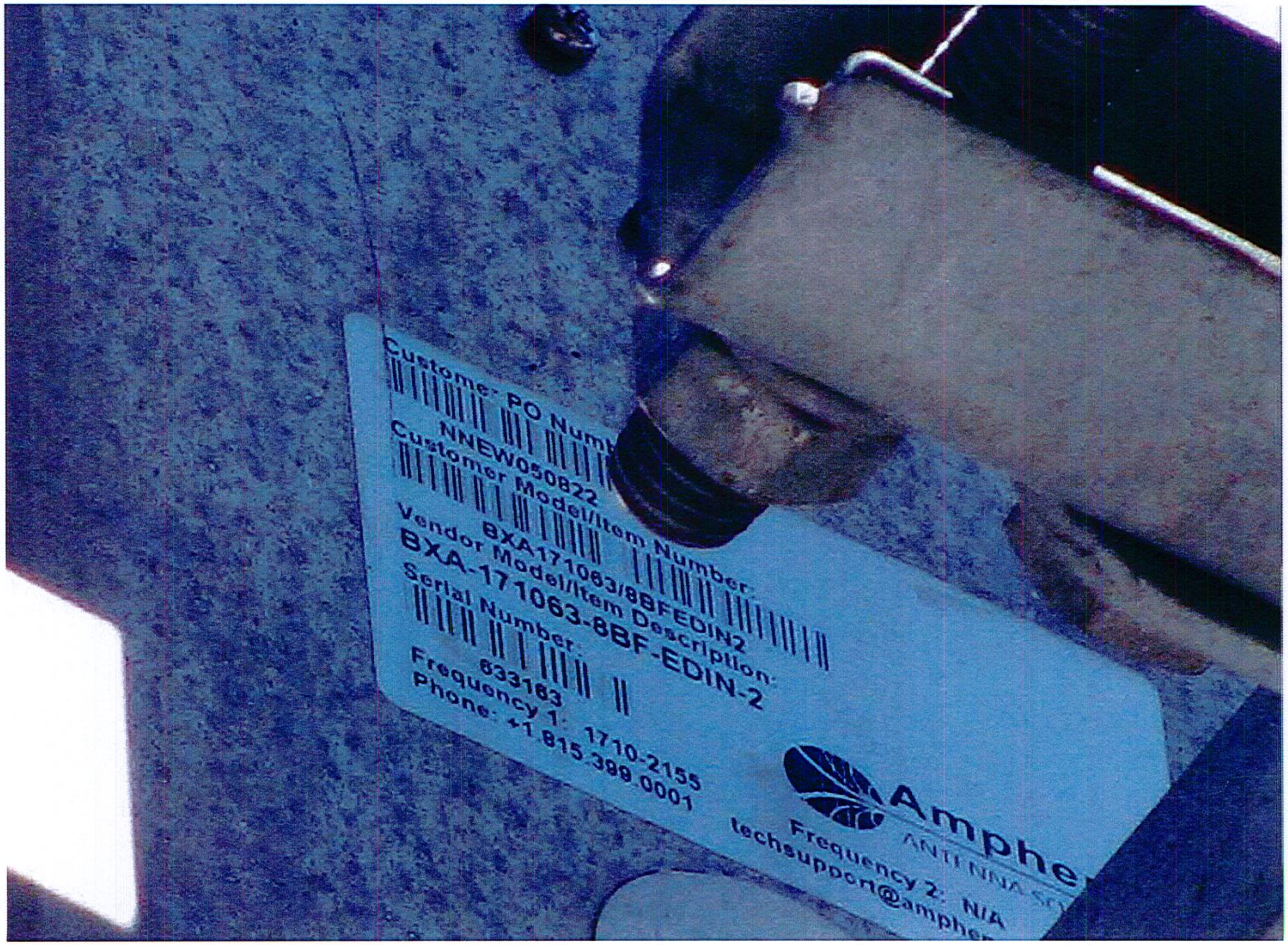
6.0 Verizon and Empty Mount

6.1 Verizon and Empty Mount

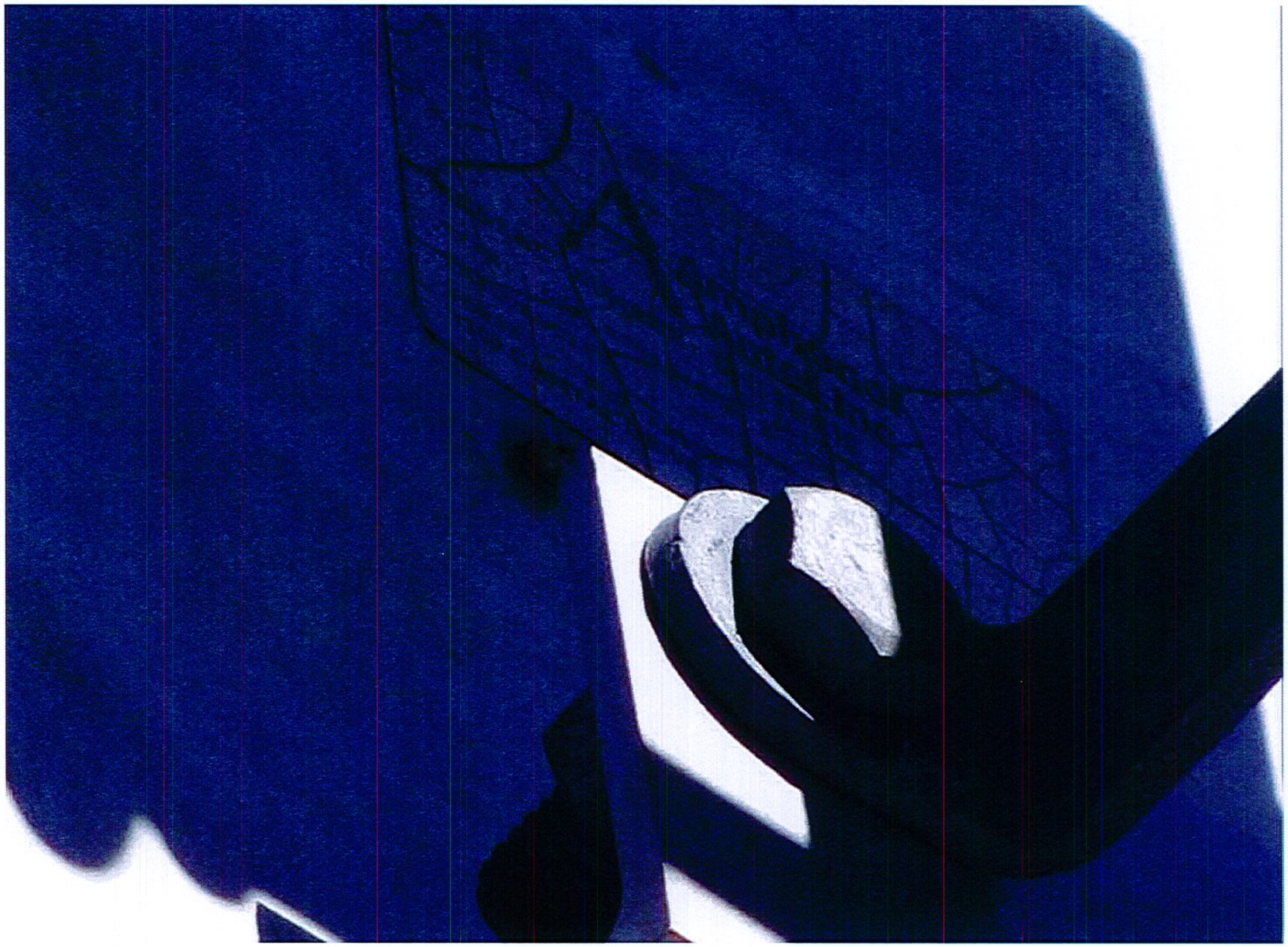
6.2 Verizon and Empty Mount



6.3 Verizon

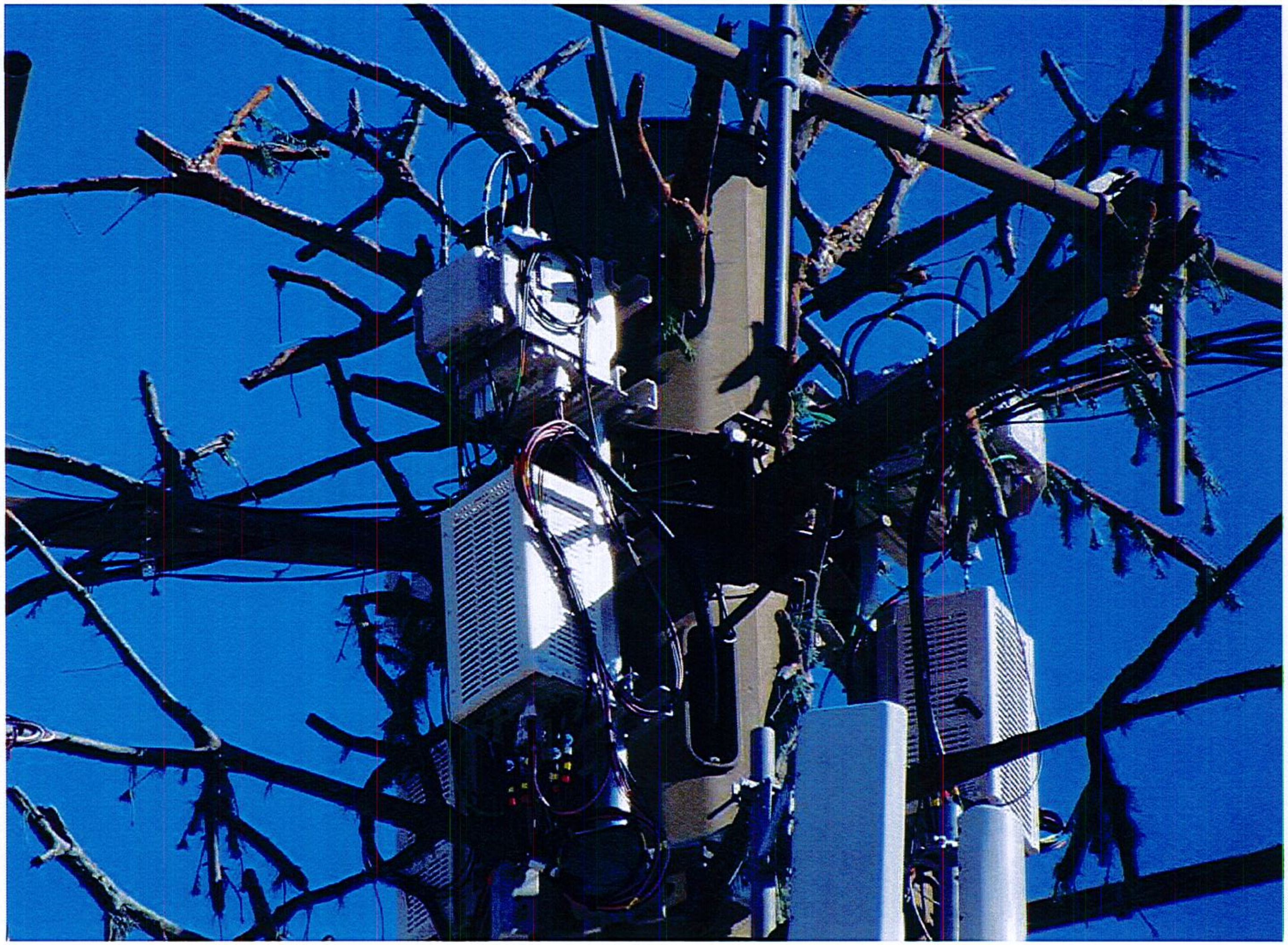

Customer PO Numb
NNEW050822
Customer Model/Item Number:
BXA171063/8BFEDIN2
Vendor Model/Item Description:
BXA-171063-8BF-EDIN-2
Serial Number:
633183
Frequency 1: 1710-2155
Phone: +1.815.399.0001
Frequency 2: N/A
techsupport@amphe

6.4 Verizon



6.5 Verizon

7.0 Sprint



7.1 Sprint

EXHIBIT C

EBI Consulting
environmental | engineering | due diligence

RADIO FREQUENCY EMISSIONS ANALYSIS REPORT EVALUATION OF HUMAN EXPOSURE POTENTIAL TO NON-IONIZING EMISSIONS

T-Mobile Existing Facility

Site ID: CTNH417A

New Hartford / Verizon Colo

31 New Hartford Road
Barkhamsted, CT 06063

March 18, 2014

EBI PROJECT NUMBER: 62141314

21 B Street Burlington, MA 01803 Tel: (781) 273.2500 Fax: (781) 273.3311

EBI Consulting

environmental | engineering | due diligence

March 18, 2014

T-Mobile USA
Attn: Jason Overbey, RF Manager
35 Griffin Road South
Bloomfield, CT 06002

Re: Emissions Values for Site: **CTNH417A - New Hartford / Verizon Colo**

EBI Consulting was directed to analyze the proposed T-Mobile facility located at 31 New Hartford Road, Barkhamsted, CT, for the purpose of determining whether the emissions from the Proposed T-Mobile Antenna Installation located on this property are within specified federal limits.

All information used in this report was analyzed as a percentage of current Maximum Permissible Exposure (% MPE) as listed in the FCC OET Bulletin 65 Edition 97-01and ANSI/IEEE Std C95.1. The FCC regulates Maximum Permissible Exposure in units of microwatts per square centimeter (μW/cm2). The number of μW/cm2 calculated at each sample point is called the power density. The exposure limit for power density varies depending upon the frequencies being utilized. Wireless Carriers and Paging Services use different frequency bands each with different exposure limits, therefore it is necessary to report results and limits in terms of percent MPE rather than power density.

All results were compared to the FCC (Federal Communications Commission) radio frequency exposure rules, 47 CFR 1.1307(b)(1) – (b)(3), to determine compliance with the Maximum Permissible Exposure (MPE) limits for General Population/Uncontrolled environments as defined below.

General population/uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

Public exposure to radio frequencies is regulated and enforced in units of microwatts per square centimeter (μW/cm2). The general population exposure limit for the cellular band is 567 μW/cm2, and the general population exposure limit for the PCS and AWS bands is 1000 μW/cm2. Because each carrier will be using different frequency bands, and each frequency band has different exposure limits, it is necessary to report percent of MPE rather than power density.

Occupational/controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Additional details can be found in FCC OET 65.

CALCULATIONS

Calculations were done for the proposed T-Mobile Wireless antenna facility located at 31 New Hartford Road, Barkhamsted, CT, using the equipment information listed below. All calculations were performed per the specifications under FCC OET 65. Since T-Mobile is proposing highly focused directional panel antennas, which project most of the emitted energy out toward the horizon, the actual antenna pattern gain value in the direction of the sample area was used. For this report the sample point is a 6 foot person standing at the base of the tower

For all calculations, all equipment was calculated using the following assumptions:

1) 2 GSM channels (1935.000 MHz—to 1945.000 MHz / 1980.000 MHz—to 1985.000 MHz) were considered for each sector of the proposed installation.
2) 2 UMTS channels (2110.000 to 2120.000 MHz / 2140.000 MHz to 2145.000 MHz) were considered for each sector of the proposed installation.
3) 2 LTE channels (2110.000 to 2120.000 MHz / 2140.000 MHz to 2145.000 MHz) were considered for each sector of the proposed installation.
4) All radios at the proposed installation were considered to be running at full power and were uncombined in their RF transmissions paths per carrier prescribed configuration. Per FCC OET Bulletin No. 65 - Edition 97-01 recommendations to achieve the maximum anticipated value at each sample point, all power levels emitting from the proposed antenna installation are increased by a factor of 2.56 to account for possible in-phase reflections from the surrounding environment. This is rarely the case, and if so, is never continuous.
5) For the following calculations the sample point was the top of a six foot person standing at the base of the tower. The actual gain in this direction was used per the manufactures supplied specifications.
6) The antenna used in this modeling is the Ericsson AIR21 for LTE, UMTS and GSM. This is based on feedback from the carrier with regards to anticipated antenna selection. This antenna has a 15.6 dBd gain value at its main lobe. Actual antenna gain values were used for all calculations as per the manufacturers specifications

7) The antenna mounting height centerline of the proposed antennas is **101.5 feet** above ground level (AGL)
8) Emissions values for additional carriers were taken from the Connecticut Siting Council active database. Values in this database are provided by the individual carriers themselves.

All calculation were done with respect to uncontrolled / general public threshold limits

Site ID	CTNH417A - New Hartford / Verizon Colo
Site Addresss	31 New Hartford Road, Barkhamsted, CT 06063
Site Type	Monopole

Sector 1

Antenna Number	Antenna Make	Antenna Model	Status	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
1a	Ericsson	AIR21 B4A/B2P	Active	AWS - 2100 MHz	LTE	60	2	120	-3.95	101.5	95.5	None	0	0	48.3260441	1.904936	0.19049%
1b	Ericsson	AIR21 B4A/B2P	Not Used	-	-			0	-3.95	101.5	95.5	None	0	0	0	0	0.00000%
2a	Ericsson	AIR21 B2A / B4P	Active	PCS - 1950 MHz	GSM / UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
2B	Ericsson	AIR21 B2A / B4P	Passive	AWS - 2100 MHz	UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
													Sector total Power Density Value:		0.381%		

Sector 2

Antenna Number	Antenna Make	Antenna Model	Status	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
1a	Ericsson	AIR21 B4A/B2P	Active	AWS - 2100 MHz	LTE	60	2	120	-3.95	101.5	95.5	None	0	0	48.3260441	1.904936	0.19049%
1b	Ericsson	AIR21 B4A/B2P	Not Used	-	-			0	-3.95	101.5	95.5	None	0	0	0	0	0.00000%
2a	Ericsson	AIR21 B2A / B4P	Active	PCS - 1950 MHz	GSM / UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
28	Ericsson	AIR21 B2A / B4P	Passive	AWS - 2100 MHz	UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
													Sector total Power Density Value:		0.381%		

Sector 3

Antenna Number	Antenna Make	Antenna Model	Status	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
1a	Ericsson	AIR21 B4A/B2P	Active	AWS - 2100 MHz	LTE	60	2	120	-3.95	101.5	95.5	None	0	0	48.3260441	1.904936	0.19049%
1b	Ericsson	AIR21 B4A/B2P	Not Used	-	-			0	-3.95	101.5	95.5	None	0	0	0	0	0.00000%
2a	Ericsson	AIR21 B2A / B4P	Active	PCS - 1950 MHz	GSM / UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
28	Ericsson	AIR21 B2A / B4P	Passive	AWS - 2100 MHz	UMTS	30	2	60	-3.95	101.5	95.5	1-5/8"	0	0	24.1630221	0.952468	0.09525%
													Sector total Power Density Value:		0.381%		

Site Composite MPE %

Carrier	MPE %
T-Mobile	1.143%
AT&T	24.740%
MetroPCS	7.870%
Sprint	4.020%
Nextel	3.540%
Verizon Wireless	18.960%
Total Site MPE %	**60.273%**

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Summary

All calculations performed for this analysis yielded results that were well within the allowable limits for general public exposure to RF Emissions.

The anticipated Maximum Composite contributions from the T-Mobile facility are **1.143% (0.381% from each sector)** of the allowable FCC established general public limit considering all three sectors simultaneously sampled at the ground level.

The anticipated composite MPE value for this site assuming all carriers present is **60.273%** of the allowable FCC established general public limit sampled at the ground level. This is based upon values listed in the Connecticut Siting Council database for existing carrier emissions.

FCC guidelines state that if a site is found to be out of compliance (over allowable thresholds), that carriers over a 5% contribution to the composite value will require measures to bring the site into compliance. For this facility, the composite values calculated were within the allowable 100% threshold standard per the federal government.

Scott Heffernan
RF Engineering Director

EBI Consulting
21 B Street
Burlington, MA 01803