EM-CING-025-121026

HPC Wireless Services
46 Mill Plain Rd.
Floor 2
Danbury, CT, 06811
P.: 203.797.1112

HPC WIRELESS SERVICES

ORIGINAL

October 24, 2012

RECEIVED
OCT 26 2012
CONNECTICUT
SITING COUNCIL

VIA OVERNIGHT COURIER

Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051
Attn: Ms. Linda Roberts, Executive Director

Re: New Cingular Wireless PCS, LLC – Exempt Modification
500 Highland Avenue, Cheshire, Connecticut

Dear Ms. Roberts:

This letter and attachments are submitted on behalf of New Cingular Wireless PCS, LLC ("AT&T"). AT&T is making modifications to certain existing sites in its Connecticut system in order to implement LTE technology. Please accept this letter and attachments as notification, pursuant to Section 16-50j-73 of the Regulations of Connecticut State Agencies ("R.S.C.A."), of construction that constitutes an exempt modification pursuant to R.C.S.A. Section 16-50j-72(b)(2). In compliance with R.C.S.A. Section 16-50j-73, a copy of this letter and attachments is being sent to the Mayor of the Town of Cheshire.

AT&T plans to modify the existing wireless communications facility owned by the Town of Cheshire and located at 500 Highland Avenue, Cheshire (coordinates 41°-30'-40.3" N, 72°-53'-54.5" W). Attached are a compound plan and elevation depicting the planned changes, and documentation of the structural sufficiency of the structure to accommodate the revised antenna configuration. Also included is a power density report reflecting the modification to AT&T's operations at the site.

The changes to the facility do not constitute a modification as defined in Connecticut General Statutes ("C.G.S.") Section 16-50i(d) because the general physical characteristics of the facility will not be significantly changed. Rather, the planned changes to the facility fall squarely within those activities explicitly provided for in R.C.S.A. Section 16-50j-72(b)(2).

1. AT&T will remove (6) existing antennas and replace them with three (3) LTE panel antennas, and three (3) GSM antennas on the existing platform at a center line of approximately 132'. Six (6) RRUs (remote radio units) and one (1) surge arrestor will be mounted to the tower at a centerline height of approximately 125'. AT&T will also place

a DC power and fiber run from the equipment to the antennas along the existing coaxial cable run. These changes will not extend the height of the approximately 160' structure.

2. AT&T will place related equipment in its existing equipment shelter and will mount a new GPS antenna on the shelter. These changes will be within the existing compound and will have no effect on the site boundaries.

3. The proposed changes will not increase the noise level at the existing facility by six (6) decibels or more. The incremental effect of the proposed changes will be negligible.

4. The changes to the facility will not increase the calculated "worst case" power density for the combined operations at the site to a level at or above the applicable standard for uncontrolled environments as calculated for a mixed frequency site. As indicated on the attached report prepared by C Squared Systems, LLC, AT&T's operations at the site will result in a power density of approximately 2.52%; the combined site operations will result in a total power density of approximately 50.87%.

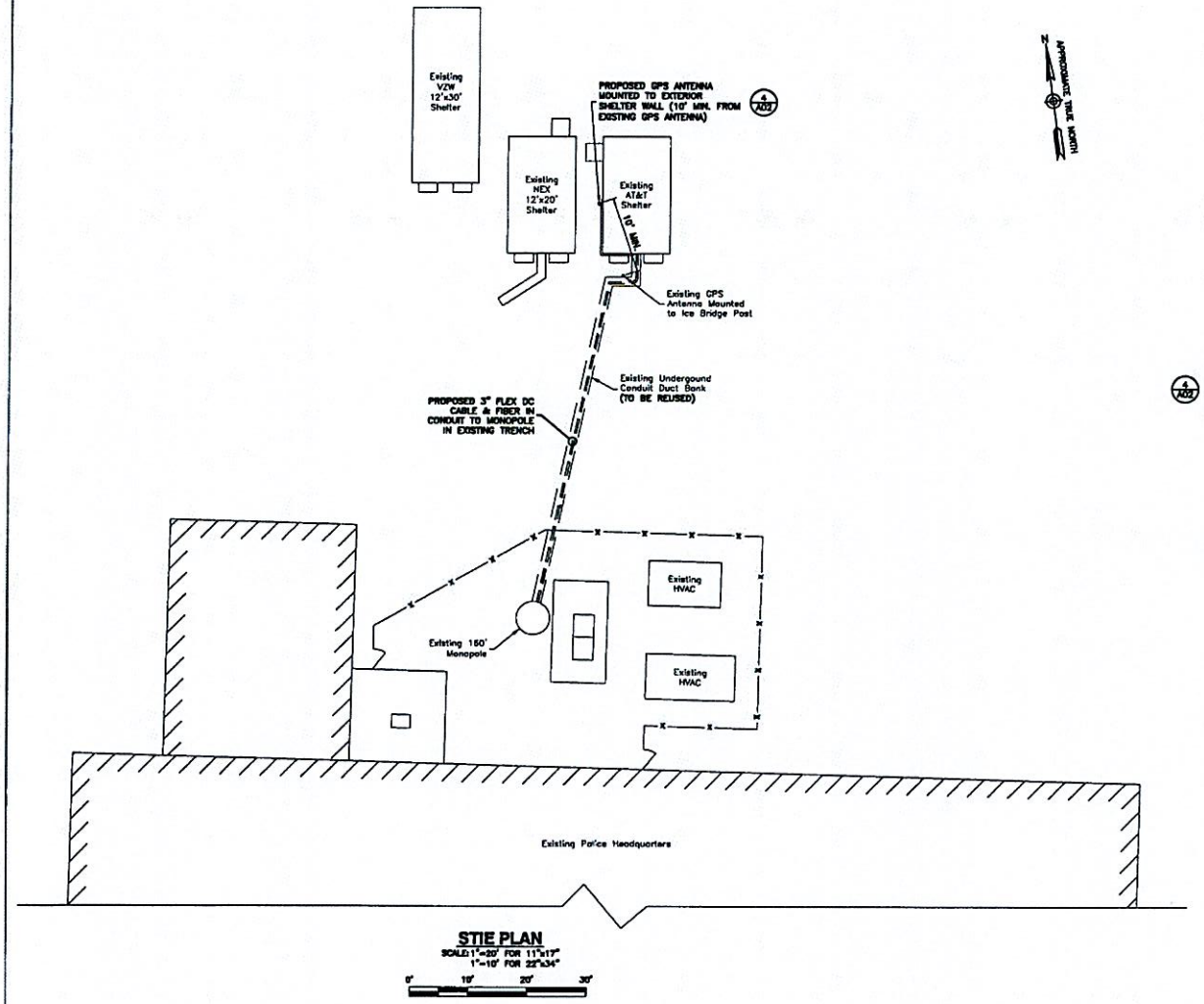
Please feel free to contact me by phone at (860) 798-7454 or by e-mail at jgaudet@hpcwireless.com with questions concerning this matter. Thank you for your consideration.

Respectfully yours,

Jennifer Young Gaudet

Attachments

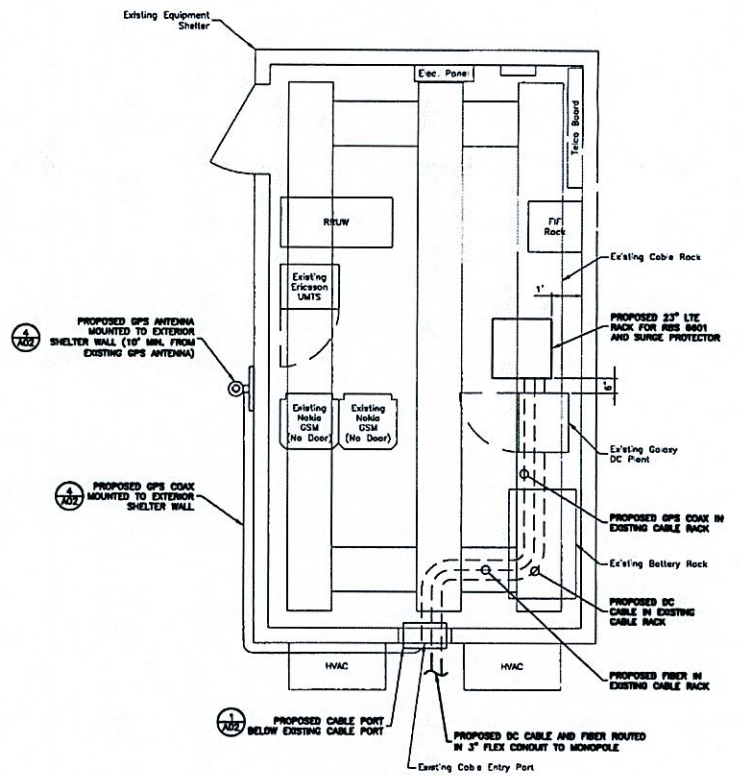
cc: Honorable Tim Slocum, Mayor, Town of Cheshire
Michael A. Milone, Town Manager, Town of Cheshire (underlying property owner)



STIE PLAN

SCALE: 1"=20' FOR 11"x17"
1"=10' FOR 22"x34"

0' 10' 20' 30'



SHELTER LAYOUT

SCALE: 1/4"=1' FOR 11"x17"
1/2"=2' FOR 22"x34"

0' 2' 4'

NOTES:

1. NORTH SHOWN AS APPROXIMATE.
2. MOUNT ALL ANTENNAS, COAX, SURGE ARRESTORS, RRU'S, ETC. IN ACCORDANCE WITH STRUCTURAL ANALYSIS BY URS CORPORATION DATED OCTOBER 15, 2012.
3. NOT ALL INFORMATION SHOWN FOR CLARITY.

Dewberry
Dewberry Engineers Inc.
600 PARSIPPANY ROAD
SUITE 301
PARSIPPANY, NJ 07054
PHONE: 973.739.0400
FAX: 973.739.9710

NEXLINK GLOBAL SERVICES
800 MARSHALL PHELPS ROAD, #3A
WINDSOR, CT 06095

CHESHIRE CENTRAL
SITE NO. CT2081
500 HIGHLAND AVENUE
CHESHIRE, CT 06410

at&t
500 ENTERPRISE DRIVE,
SUITE 3A
ROCKY HILL, CT 06067

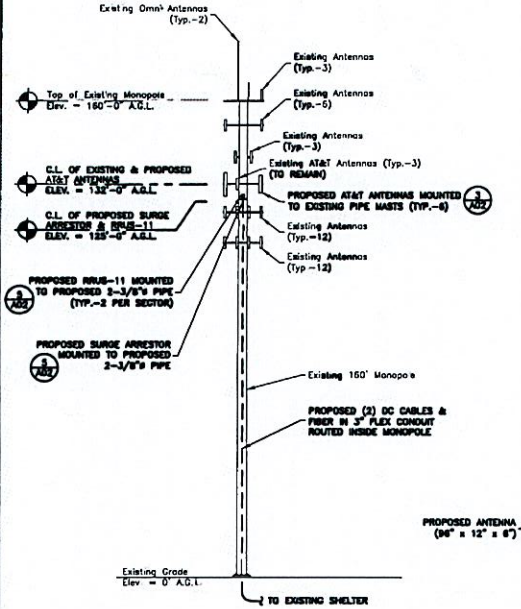
NO.	DATE	REVISIONS	BY	CHK	APP'D
1	10/17/12	ISSUED FOR CONSTRUCTION	JC	CHN	CHN
0	03/18/12	PRELIMINARY SUBMISSION	DHD	CHN	CHN

SCALE: AS SHOWN | DESIGNED BY: CHN | DRAWN BY: DHD

STATE OF CONNECTICUT
ROBERT J. FOLEY
20056
REGISTERED PROFESSIONAL ENGINEER
ROBERT J. FOLEY, P.E.
CT LICENSE No. PEL0020056

SITE PLAN & SHELTER LAYOUT

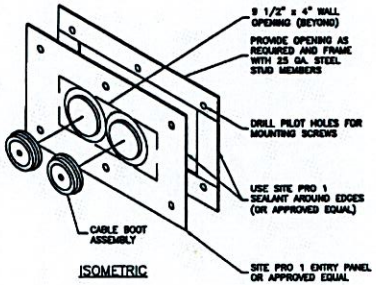
DEWBERRY NO.	DRAWING NUMBER	REV
50048347/50048383	A01	1



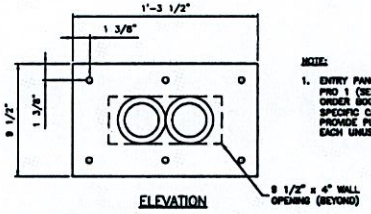
ELEVATION LOOKING EAST

SCALE: 1"=40' FOR 11"x17" 1"=20' FOR 22"x34"

0' 20' 40'



ISOMETRIC



ELEVATION

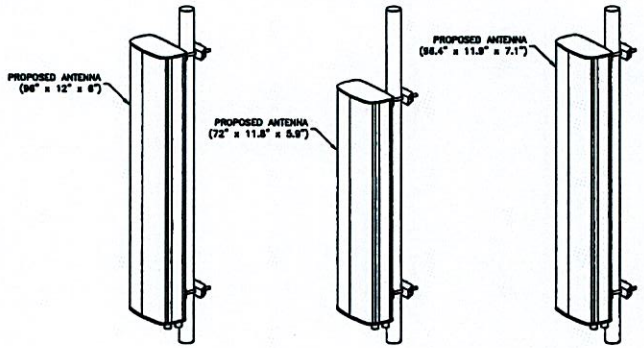
NOTE:

1. ENTRY PANEL AND BOOTS BY SITE PRO 1 (SEE CHART FOR PART #). ORDER BOOTS SEPARATELY FOR SPECIFIC CABLE SIZE(S) & QUANTITY. PROVIDE PLUGS BY SITE PRO 1 FOR EACH UNUSED HOLE IN BOOT.

CABLE ENTRY PANEL CHART
SITE PRO 1 E1448 FOR (2 PORTS)

DUAL COAX PORT

SCALE: N.T.S. 1

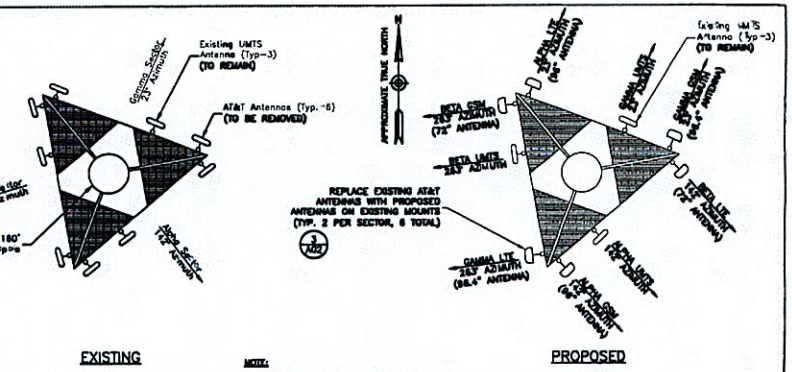


NOTES:

1. PLEASE SEE LATEST RFDS AND STRUCTURAL ANALYSIS FOR SPECIFIC ANTENNA MODEL.
2. CONTROLLER TO VERIFY LENGH OF EXISTING PIPE AND REPLACE IF NECESSARY

ISOMETRIC ANTENNA DETAIL

SCALE: N.T.S. 3

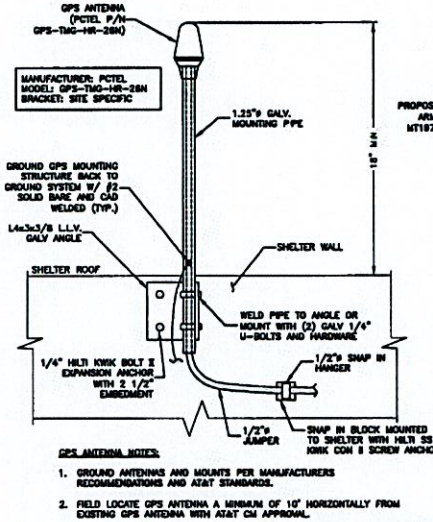


NOTE:

1. AZIMUTHS BASED ON TRUE NORTH.

PLATFORM ANTENNA ORIENTATION

SCALE: N.T.S. 2

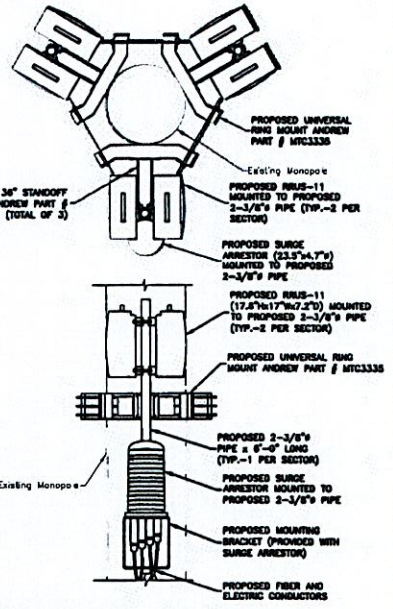


GPS ANTENNA NOTES:

1. GROUND ANTENNAS AND MOUNTS PER MANUFACTURERS RECOMMENDATIONS AND AT&T STANDARDS.
2. FIELD LOCATE GPS ANTENNA A MINIMUM OF 10' HORIZONTALLY FROM EXISTING GPS ANTENNA WITH AT&T CM APPROVAL.
3. SEAL ALL WALL PENETRATIONS WITH SILICONE SEALANT.

GPS ANTENNA

SCALE: N.T.S. 4



RRUS-11 & SURGE ARRESTOR MOUNTING DETAIL

5

A.G.L. = ABOVE GRADE LEVEL
C.L. = CENTER LINE

Dewberry
Dewberry Engineers Inc.
900 FAIRMPHANY ROAD
SUITE 201
FAIRMPHANY, NJ 07054
PHONE: 973.739.9400
FAX: 973.739.9710

NEXLINK GLOBAL SERVICES
600 MARSHALL PHELPS ROAD, #3A
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CHESHIRE CENTRAL
SITE NO. CT2081
500 HIGHLAND AVENUE
CHESHIRE, CT 06410

at&t
500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067

NO.	DATE	REVISIONS	BY	CHK	APP'D
1	10/17/12	ISSUED FOR CONSTRUCTION	JC	GHN	GHN
0	03/16/12	PRELIMINARY SUBMISSION	DHD	GHN	GHN

SCALE: AS SHOWN | DESIGNED BY: GHN | DRAWN BY: EHC

ROBERT J. FOLEY, P.E.
CT LICENSE No. PEN.0026564

ELEVATION & CONSTRUCTION DETAILS

DEWBERRY NO.	DRAWING NUMBER	REV
50048347/50048383	A02	1

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 160' MONOPOLE AND FOUNDATION FOR PROPOSED ANTENNA ARRANGEMENT

Site:	**Cheshire Police Department**
SBA Site No:	**CT33762-M**
AT&T Site No:	**CT-2081**
Address:	**500 Highland Avenue, Cheshire, CT**

prepared for

SBA

SBA Site Management
1480 Route 9 North, Suite 303
Woodbridge, New Jersey 07095

prepared by

URS

URS CORPORATION
500 ENTERPRISE DRIVE, SUITE 3B
ROCKY HILL, CT 06067
TEL. 860-529-8882

36917370
SBA-002

October 15, 2012

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 160' steel tapered monopole structure, located at 500 Highland Avenue in Cheshire, CT. The analysis was conducted in accordance with the 2005 Connecticut State Building Code and the TIA/EIA-222-F standard for a wind velocity of 85 mph (fastest mile) and 74 mph (fastest mile) concurrent with 0.5" ice. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report.

The proposed AT&T installation is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Remove: **(6) CSS DUO4-8686 panel antennas** **(two per sector)** **(6) Diplexers and (6) TMA's**	**AT&T (Existing)**	
Install: **(2) Powerwave P65-16-XL-2 antennas** **(one per sector – Sector A and C)** **(2) KMW AM-X-CD-16-65-00T-RET antennas** **(one per sector – Sector A and B)** **(2) Andrew SBNM-1D6565C antennas** **(one per sector – Sector B and C)** **(6) TMA's** **(6) Kathrein 860 10025 RETs** **(two per sector)** **Mounted on existing platform**	**AT&T (Proposed)**	**@ 132'**
(6) Remote Radio Heads **(1) DC6-48-60-18-8F Surge Arrestor** **Mounted on New Universal Ring Mount**		**@ 125'**

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

This analysis is based on:

1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
2) Tower member sizes and foundation dimensions taken from manufacturers original design prepared by Sabre Communications Corporation, job number 04-09077 signed and sealed September 12, 2003.
3) Structural letter prepared by Sabre Communications Corporation signed and sealed April 15, 2005.
4) Geotechnical information obtained through geotechnical report prepared by Jaworski Geotech, Inc, project number 03349G, dated June 24, 2003.
5) Site visit performed from grade by URS Corporation in March 2010 to verify existing conditions. The base plate was measured to be 3" thick.
6) Structural analysis report, prepared for Sprint, by Hudson Design Group, dated June 14, 2012

1. EXECUTIVE SUMMARY - continued

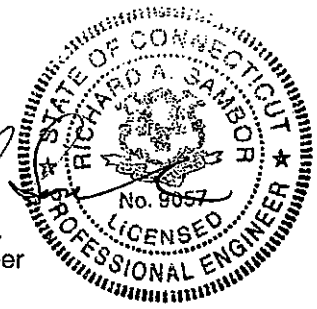
7) Existing inventory taken from Tower Inventory, prepared by Northeast Towers, Inc., dated September 19, 2012

This report is only valid as per the assumptions and data utilized in this report for antenna inventory, mounts and associated cables. The user of this report shall field verify the assumption of the antenna and mount configuration as well as the physical condition of the tower. Notify the engineer in writing immediately if any of the information in this report is found to be other than specified.

If you should have any questions, please call.

Sincerely,

URS Corporation



Richard A. Sambor, P.E.
Senior Structural Engineer

RAS/jcf
cc: ICA – URS, CF/Book

2. INTRODUCTION

The subject tower is located at 500 Highland Ave in Cheshire, CT. The structure is an existing 160' steel tapered monopole structure, designed and manufactured by Sabre Communications Corporation

The inventory is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(1) 20' Omni	Town (existing)	T-Arm	170'	(1) 1/2" Coax
(2) DB224 Dipoles	Town (existing)	T-Arm	168'	(2) 1/2" Coax
(1) 6' Omni	Town (existing)	T-Arm	166'-2"	(1) 1/2" Coax
(3) RFS APXVSPP18 (6) RRH's	Sprint (existing)	Low Profile Platform	162'	(6) 1-5/8" coax (3) Hybriflex Cables
(3) EMS RR90-17-02DP and (3) RFS APX16DWVS	T-Mobile (existing)	Low Profile Platform	152'	(18) 1-5/8" coax
(3) RFS APXV18-206517S-C	Pocket (existing)	(3) T-Arms	141'-1"	(6) 1-5/8" coax (outside of monopole)
(3) Kathrein 80010121 (6) TMA's	AT&T (existing)	Low Profile Platform	132'	(12) 1-5/8" coax
(2) Powerwave P65-16-XL-2 antennas (2) KMW AM-X-CD-16-65-00T-RET antennas (2) Andrew SBNM-1D6565C antennas (6) TMA's (6) 860 10025 RETs	**AT&T (proposed)**	**Low Profile Platform (same as above)**	**132'**	**Same as above**
(6) Remote Radio Heads (1) DC6-48-60-18-8F Surge Arrestor	**AT&T (proposed)**	**Universal Ring Mount with 8" Standoff**	**125'**	**(1) 3" Innerduct with DC and Power Cables (Inside Monopole)**
(2) LPA-80090/4CF (3) P65-16-XL-2 (4) DB844G65ZAXY (3) BXA-185063/8CF	Verizon (existing)	Low Profile Platform	122'-6"	(12) 1-5/8" coax
(12) 844G65VTZASX	Nextel (existing)	Low Profile Platform	112'-2"	(12) 1-5/8" coax
(1) Dipole Antenna	Town (existing)	Collar Mount	89'-1"	(1) 1/2" Coax
(1) GPS Antenna	Town (existing)	Collar Mount	83'-2"	(1) 1/2" Coax
(1) Yagi Antenna	Town (existing)	Same as Dipole	81'-3"	(1) 1/2" Coax
(1) Yagi Antenna	Town (existing)	Same as GPS	81'-2"	(1) 1/2" Coax
(1) Yagi Antenna	Town (existing)	Same as Dipole	79'-4"	(1) 1/2" Coax

This structural analysis of the communications tower was performed by URS Corporation (URS) for SBA. The purpose of this analysis was to investigate the structural integrity of the existing tower with its existing and proposed antenna loads. This analysis was conducted to evaluate stress on the tower and the effect of forces to the foundation of the tower resulting from existing and proposed antenna arrangement.

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

The structural analysis was conducted in accordance with the 2005 Connecticut State Building Code, TIA/EIA-222-F - Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, and the American Institute of Steel Construction (AISC) Manual of Steel Construction - Allowable Stress Design (ASD).

The analysis was conducted using TNX Tower 6.0. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 85 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 74 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

Please note that wind pressure is a function of velocity squared. Under Load Condition 2, a 25 percent reduction in wind pressure is allowed by code to account for the unlikelihood of the full wind pressure and ice load occurring at the same time. The same results may be achieved by utilizing a lower wind pressure without taking the 25 percent reduction, as shown above.

The TIA/EIA standard permits a one-third increase in allowable stresses for towers and monopoles less than 700 feet tall. For the purposes of this analysis, in computing the load capacity the allowable stresses of the tower members were increased by one-third.

4. FINDINGS AND EVALUATION

Combined axial and bending stresses on the monopole structure were evaluated to compare with allowable stresses in accordance with AISC. The calculated stresses under the proposed loading were **below** the allowable stresses (see table below). Detailed analysis and calculations for the proposed load condition are provided in section 6 of this report. The anchor bolts, base plate and foundation were all found to be within the allowable limits.

TABLE 1: Proposed Tower Component Stress vs. Capacity Summary

Component (Section No.)	Controlling Component / Elevation	Stress Ratio (% capacity)	Pass/Fail	Comments:
Pole Shaft (L3)	46.75'-95.75'	91.8%	**Pass**	
Anchor Bolts	Compression	87%	**Pass**	
Base Plate	Bending	96%	**Pass**	
Pier and Pad Foundation	Overturning Moment	88.9% / 2.25	**Pass**	Min OTM FOS is 2.0 per IBC 3108.4.2

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

Limitations/Assumptions:

This report is based on the following:

1. Tower inventory as listed in this report.
2. Tower is properly installed and maintained.
3. All members are as specified in the original design documents and are in good condition.
4. All required members are in place.
5. All bolts are in place and are properly tightened.
6. Tower is in plumb condition.
7. All member protective coatings are in good condition.
8. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
9. Foundations were properly constructed to support original design loads as specified in the original design documents.
10. All coaxial cable is installed within the monopole unless specified otherwise.

URS is not responsible for any modifications completed prior to or hereafter in which URS is not or was not directly involved. Modifications include but are not limited to:

A. Adding antennas
B. Removing/replacing antennas
C. Adding coaxial cables

URS hereby states that this document represents the entire report and that it assumes no liability for any factual changes that may occur after the date of this report. All representations, recommendations, and conclusions are based upon information contained and set forth herein. If you are aware of any information which conflicts with that which is contained herein, or you are aware of any defects arising from original design, material, fabrication, or erection deficiencies, you should disregard this report and immediately contact URS. URS disclaims all liability for any representation, recommendation, or conclusion not expressly stated herein.

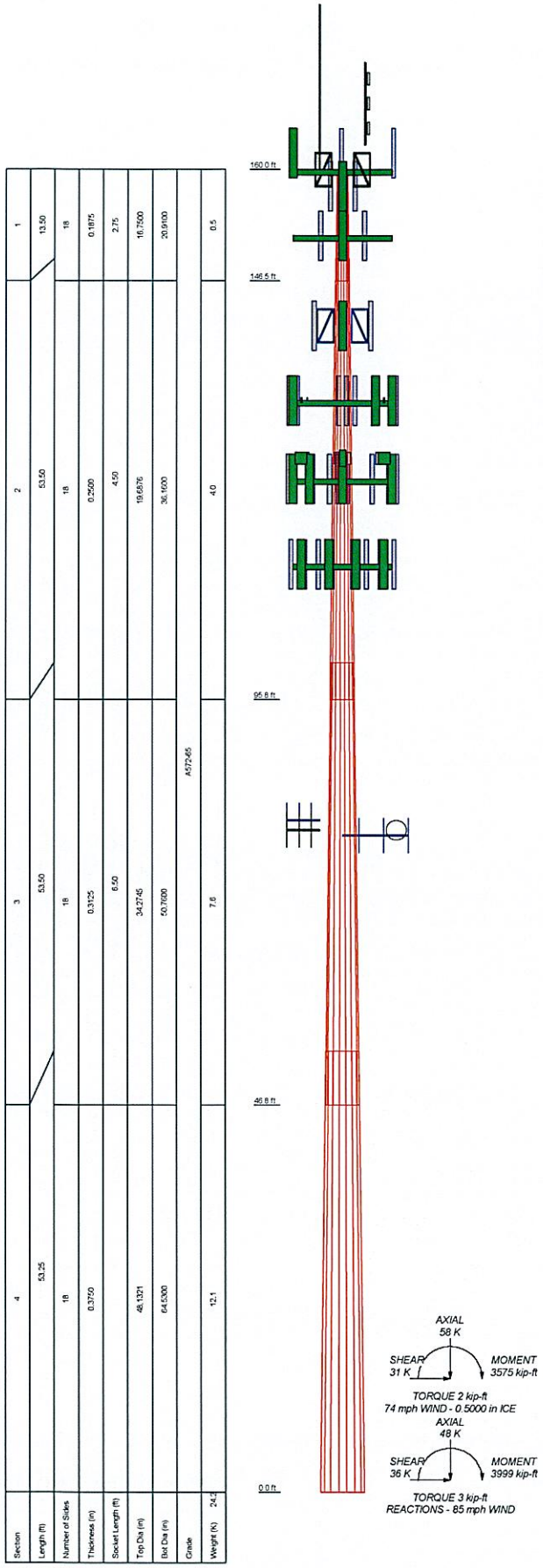
Ongoing and Periodic Inspection and Maintenance:

After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire tower structural system be performed at least yearly and more frequently as conditions warrant. According to TIA/EIA-222-F section 14.1, Note 1: It is recommended that the structure be inspected after severe wind and/or ice storms or other extreme loading conditions.

6. DRAWINGS AND DATA

TNX TOWER INPUT/OUTPUT SUMMARY



Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	13.50	18	0.1875	2.75	16.7500	20.9100		0.5
2	53.50	18	0.2500	4.50	19.6576	30.1600		4.0
3	53.50	18	0.3125	6.50	34.2745	50.7600	A572-65	7.8
4	53.25	18	0.3750		48.1321	64.5300		12.1

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
3' Dia 20' Omni (Town)	170	SABRE 12' Low Profile Platform (ATI)	132
DB224 (Town)	168	800 10121 (ATI)	132
DB224 (Town)	168	SBNH-1D6565C (ATI)	132
7' Whip (Town)	166.17	P65-15-XLH-RR (ATI)	132
APXVSPP18-C-A20 (Sprint)	162	800 10121 (ATI)	132
APXVSPP18-C-A20 (Sprint)	162	(2) 860 10025 RET (ATI)	132
APXVSPP18-C-A20 (Sprint)	162	(2) 860 10025 RET (ATI)	132
3' Stand-off (Town)	160	(2) 860 10025 RET (ATI)	132
3' Stand-off (Town)	160	(2) TMA (ATI)	132
SABRE 12' Low Profile Platform (Sprint)	160	(2) TMA (ATI)	132
3' Stand-off (Town)	160	(2) TMA (ATI)	132
(2) RRH (Sprint)	158	(2) RRH (ATI)	125
(2) RRH (Sprint)	158	(2) RRH (ATI)	125
(2) RRH (Sprint)	158	(2) RRH (ATI)	125
RR90-17-02DP w/Mount Pipe (T-Mobile)	152	DC6-48-60-18-8F (ATI)	125
RR90-17-02DP w/Mount Pipe (T-Mobile)	152	Cluster Mount (ATI)	125
SABRE 12' Low Profile Platform (T-Mobile)	152	SABRE 12' Low Profile Platform (Verizon)	122.5
RR90-17-02DP w/Mount Pipe (T-Mobile)	152	P65-16-XL-2 (Verizon)	122.5
APX16DWV-S (T-Mobile)	152	P65-16-XL-2 (Verizon)	122.5
APX16DWV-S (T-Mobile)	152	P65-16-XL-2 (Verizon)	122.5
APX16DWV-S (T-Mobile)	152	DB844G65ZAXY w/Mount Pipe (Verizon)	122.5
3' Stand-off (Pocket)	141.08	BXA-185063/8CF (Verizon)	122.5
3' Stand-off (Pocket)	141.08	BXA-185063/8CF (Verizon)	122.5
APXV18-206517S-C w/ mounting hardware (Pocket)	141.08	DB844G65ZAXY w/Mount Pipe (Verizon)	122.5
		DB844G65ZAXY w/Mount Pipe (Verizon)	122.5
APXV18-206517S-C w/ mounting hardware (Pocket)	141.08	DB844G65ZAXY w/Mount Pipe (Verizon)	122.5
		LPA-80090/4CF w/Mount Pipe (Verizon)	122.5
APXV18-206517S-C w/ mounting hardware (Pocket)	141.08	LPA-80090/4CF w/Mount Pipe (Verizon)	122.5
		BXA-185063/8CF (Verizon)	122.5
3' Stand-off (Pocket)	141.08	(4) 844G65VTZASX w/Mount Pipe (Nextel)	112.17
AM-X-CD-16-65-00T-RET (6) (ATI)	132	(4) 844G65VTZASX w/Mount Pipe (Nextel)	112.17
SBNH-1D6565C (ATI)	132	(4) 844G65VTZASX w/Mount Pipe (Nextel)	112.17
800 10121 (ATI)	132	SABRE 12' Low Profile Platform (Nextel)	112.17
SBNH-1D6565C (ATI)	132	GPS (Town)	83.17
P65-15-XLH-RR (ATI)	132	14' Dipole (Town)	81.25
(2) TMA (ATI)	132	3' Yag (Town)	81.17
(2) TMA (ATI)	132	3' Yag (Town)	80
(2) TMA (ATI)	132	3' Yag (Town)	79.33

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower is located in New Haven County, Connecticut.
2. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 91.8%

URS Corporation
500 Enterprise Drive, Suite 3B
Rocky Hill, CT 06067
Phone: 860-529-8882
FAX: 860-529-3991

Job	160' Monopole
Project	Cheshire Police Department
Client	SBA - AT&T
Drawn by	J.Falivene
Appd	
Code	TIA/EIA-222-F
Date	10/15/12
Scale	NTS
Path	
Dwg No	E-1

TNX TOWER DETAILED OUTPUT

tnxTower	Job	Page
URS Corporation 500 Enterprise Drive, Suite 3B Rocky Hill, CT 06067 Phone: 860-529-8882 FAX: 860-529-3991	160' Monopole	1 of 22
	Project Cheshire Police Department	Date 11:15:59 10/15/12
	Client SBA - AT&T	Designed by J.Falivene

Tower Input Data

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

Tower is located in New Haven County, Connecticut.
Basic wind speed of 85 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 74 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
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		Distribute Leg Loads As Uniform		Treat Feedline Bundles As Cylinder
	Consider Moments - Horizontals		Assume Legs Pinned		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Calculate Redundant Bracing Forces
	Use Moment Magnification		Use Clear Spans For Wind Area		Ignore Redundant Members in FEA
√	Use Code Stress Ratios		Use Clear Spans For KL/r		SR Leg Bolts Resist Compression
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		All Leg Panels Have Same Allowable
	Escalate Ice	√	Bypass Mast Stability Checks		Offset Girt At Foundation
	Always Use Max Kz		Use Azimuth Dish Coefficients		Consider Feedline Torque
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Include Angle Block Shear Check
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Poles
	Leg Bolts Are At Top Of Section		SR Members Have Cut Ends		Include Shear-Torsion Interaction
	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Always Use Sub-Critical Flow
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Use Top Mounted Sockets
	Add IBC .6D+W Combination				

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	160.00-146.50	13.50	2.75	18	16.7500	20.9100	0.1875	0.7500	A572-65 (65 ksi)
L2	146.50-95.75	53.50	4.50	18	19.6876	36.1600	0.2500	1.0000	A572-65 (65 ksi)
L3	95.75-46.75	53.50	6.50	18	34.2745	50.7600	0.3125	1.2500	A572-65 (65 ksi)
L4	46.75-0.00	53.25		18	48.1321	64.5300	0.3750	1.5000	A572-65 (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	17.0084	9.8568	341.6043	5.8797	8.5090	40.1462	683.6581	4.9293	2.6180	13.963
	21.2326	12.3325	669.0708	7.3565	10.6223	62.9875	1339.0220	6.1674	3.3502	17.868
L2	20.8511	15.4237	736.2272	6.9003	10.0013	73.6132	1473.4231	7.7133	3.0250	12.1
	36.7178	28.4946	4642.2721	12.7480	18.3693	252.7193	9290.6527	14.2500	5.9242	23.697
L3	36.2112	33.6860	4908.7738	12.0565	17.4114	281.9282	9824.0066	16.8462	5.4823	17.543
	51.5431	50.0376	16088.4180	17.9089	25.7861	623.9187	32198.0056	25.0236	8.3838	26.828
L4	50.9071	56.8429	16379.0637	16.9538	24.4511	669.8702	32779.6794	28.4268	7.8112	20.83
	65.5255	76.3605	39707.0084	22.7750	32.7812	1211.2723	79466.2644	38.1875	10.6973	28.526

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 160.00-146.50				1	1	1		
L2 146.50-95.75				1	1	1		
L3 95.75-46.75				1	1	1		
L4 46.75-0.00				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 plf
1 5/8 (Sprint)	C	No	Inside Pole	160.00 - 0.00	6	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (T-Mobile)	C	No	Inside Pole	152.00 - 0.00	18	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (AT&T)	C	No	Inside Pole	132.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 1/4 (Nextel)	C	No	Inside Pole	112.17 - 0.00	12	No Ice	0.00	0.66
						1/2" Ice	0.00	0.66
1 5/8 (Verizon)	C	No	Inside Pole	122.50 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (Town)	C	No	Inside Pole	160.00 - 0.00	3	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (Pocket)	C	No	CaAa (Out Of Face)	137.50 - 0.00	1	No Ice	0.20	1.04
						1/2" Ice	0.30	2.55
1 5/8 (Pocket)	C	No	CaAa (Out Of Face)	137.50 - 0.00	5	No Ice	0.00	1.04
						1/2" Ice	0.00	2.55
1/2 (Town)	C	No	Inside Pole	80.00 - 0.00	3	No Ice	0.00	0.25
						1/2" Ice	0.00	0.25
2 1/4 (Town)	C	No	Inside Pole	80.00 - 0.00	1	No Ice	0.00	1.16
						1/2" Ice	0.00	1.16
1/2	C	No	Inside Pole	83.00 - 0.00	1	No Ice	0.00	0.25
						1/2" Ice	0.00	0.25
1/2	C	No	Inside Pole	89.00 - 0.00	1	No Ice	0.00	0.25
						1/2" Ice	0.00	0.25
3" Flex Conduit w 3 Fiber & 6 DC (AT&T)	C	No	Inside Pole	132.00 - 0.00	1	No Ice	0.00	3.00
						1/2" Ice	0.00	3.00

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
3" Flex Conduit w 3 Fiber & 6 DC (Sprint)	C	No	Inside Pole	160.00 - 0.00	1	No Ice	0.00	3.00
						1/2" Ice	0.00	3.00

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	160.00-146.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.27
L2	146.50-95.75	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	8.267	2.86
L3	95.75-46.75	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	9.702	3.67
L4	46.75-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	9.257	3.53

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	160.00-146.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.27
L2	146.50-95.75	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	12.441	3.24
L3	95.75-46.75	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	14.602	4.11
L4	46.75-0.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	13.931	3.96

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
DB224	A	From Leg	2.50	0.0000	168.00	No Ice	3.15	3.15	0.03
(Town)			0.00			1/2" Ice	5.67	5.67	0.04

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00						
DB224	B	From Leg	2.50	0.0000	168.00	No Ice	3.15	3.15	0.03
(Town)			0.00			1/2" Ice	5.67	5.67	0.04
			0.00						
3" Dia 20' Omni	C	From Leg	2.50	0.0000	170.00	No Ice	4.00	4.00	0.06
(Town)			0.00			1/2" Ice	6.00	6.00	0.10
			0.00						
3' Stand-off	A	From Leg	2.00	0.0000	160.00	No Ice	1.00	2.00	0.05
(Town)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
3' Stand-off	B	From Leg	2.00	0.0000	160.00	No Ice	1.00	2.00	0.05
(Town)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
3' Stand-off	C	From Leg	2.00	0.0000	160.00	No Ice	1.00	2.00	0.05
(Town)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
APXVSPP18-C-A20	A	From Face	3.00	0.0000	162.00	No Ice	8.26	5.28	0.03
(Sprint)			6.00			1/2" Ice	8.81	5.74	0.07
			0.00						
APXVSPP18-C-A20	B	From Face	3.00	0.0000	162.00	No Ice	8.26	5.28	0.03
(Sprint)			6.00			1/2" Ice	8.81	5.74	0.07
			0.00						
APXVSPP18-C-A20	C	From Face	3.00	0.0000	162.00	No Ice	8.26	5.28	0.03
(Sprint)			6.00			1/2" Ice	8.81	5.74	0.07
			0.00						
(2) RRH	A	From Face	1.00	0.0000	158.00	No Ice	2.94	1.25	0.10
(Sprint)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
(2) RRH	B	From Face	1.00	0.0000	158.00	No Ice	2.94	1.25	0.10
(Sprint)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
(2) RRH	C	From Face	1.00	0.0000	158.00	No Ice	2.94	1.25	0.10
(Sprint)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
SABRE 12' Low Profile Platform	C	None		0.0000	160.00	No Ice	26.30	26.30	1.92
(Sprint)						1/2" Ice	35.60	35.60	2.34
RR90-17-02DP w/Mount Pipe	C	From Face	2.30	0.0000	152.00	No Ice	4.91	3.64	0.04
(T-Mobile)			0.00			1/2" Ice	5.57	4.70	0.08
			0.00						
RR90-17-02DP w/Mount Pipe	B	From Face	2.30	0.0000	152.00	No Ice	4.91	3.64	0.04
(T-Mobile)			0.00			1/2" Ice	5.57	4.70	0.08
			0.00						
RR90-17-02DP w/Mount Pipe	A	From Face	2.30	0.0000	152.00	No Ice	4.91	3.64	0.04
(T-Mobile)			0.00			1/2" Ice	5.57	4.70	0.08
			0.00						
SABRE 12' Low Profile Platform	C	None		0.0000	152.00	No Ice	26.30	26.30	1.92
(T-Mobile)						1/2" Ice	35.60	35.60	2.34
APXV18-206517S-C w/ mounting hardware	A	From Face	3.00	0.0000	141.08	No Ice	5.08	4.46	0.05
(Pocket)			0.00			1/2" Ice	5.53	5.39	0.09
			0.00						
APXV18-206517S-C w/ mounting hardware	B	From Face	3.00	0.0000	141.08	No Ice	5.08	4.46	0.05
(Pocket)			0.00			1/2" Ice	5.53	5.39	0.09
			0.00						
APXV18-206517S-C w/ mounting hardware	C	From Face	3.00	0.0000	141.08	No Ice	5.08	4.46	0.05
			0.00			1/2" Ice	5.53	5.39	0.09

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Pocket)			0.00						
3' Stand-off	A	From Face	1.50	0.0000	141.08	No Ice	1.00	2.00	0.05
(Pocket)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
3' Stand-off	B	From Face	1.50	0.0000	141.08	No Ice	1.00	2.00	0.05
(Pocket)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
3' Stand-off	C	From Face	1.50	0.0000	141.08	No Ice	1.00	2.00	0.05
(Pocket)			0.00			1/2" Ice	1.20	2.70	0.07
			0.00						
800 10121	A	From Face	3.00	0.0000	132.00	No Ice	5.46	3.29	0.05
(AT&T)			-6.00			1/2" Ice	5.88	3.64	0.08
			0.00						
SBNH-1D6565C	A	From Face	3.00	0.0000	132.00	No Ice	11.41	7.70	0.06
(AT&T)			-4.00			1/2" Ice	12.02	8.29	0.13
			0.00						
P65-15-XLH-RR	A	From Face	3.00	0.0000	132.00	No Ice	8.40	4.70	0.02
(AT&T)			6.00			1/2" Ice	8.95	5.15	0.07
			0.00						
800 10121	B	From Face	3.00	0.0000	132.00	No Ice	5.46	3.29	0.05
(AT&T)			-6.00			1/2" Ice	5.88	3.64	0.08
			0.00						
AM-X-CD-16-65-00T-RET	B	From Face	3.00	0.0000	132.00	No Ice	8.26	4.64	0.05
(6')			-4.00			1/2" Ice	8.81	5.09	0.10
(AT&T)			0.00						
SBNH-1D6565C	B	From Face	3.00	0.0000	132.00	No Ice	11.41	7.70	0.06
(AT&T)			6.00			1/2" Ice	12.02	8.29	0.13
			0.00						
800 10121	C	From Face	3.00	0.0000	132.00	No Ice	5.46	3.29	0.05
(AT&T)			-6.00			1/2" Ice	5.88	3.64	0.08
			0.00						
SBNH-1D6565C	C	From Face	3.00	0.0000	132.00	No Ice	11.41	7.70	0.06
(AT&T)			-4.00			1/2" Ice	12.02	8.29	0.13
			0.00						
P65-15-XLH-RR	C	From Face	3.00	0.0000	132.00	No Ice	8.40	4.70	0.02
(AT&T)			6.00			1/2" Ice	8.95	5.15	0.07
			0.00						
(2) TMA	A	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						
(2) TMA	B	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						
(2) TMA	C	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						
SABRE 12' Low Profile	C	None		0.0000	132.00	No Ice	26.30	26.30	1.92
Platform						1/2" Ice	35.60	35.60	2.34
(AT&T)									
P65-16-XL-2	A	From Face	3.00	0.0000	122.50	No Ice	8.54	5.99	0.08
(Verizon)			0.00			1/2" Ice	9.13	6.89	0.14
			0.00						
P65-16-XL-2	B	From Face	3.00	0.0000	122.50	No Ice	8.54	5.99	0.08
(Verizon)			0.00			1/2" Ice	9.13	6.89	0.14
			0.00						
P65-16-XL-2	C	From Face	3.00	0.0000	122.50	No Ice	8.54	5.99	0.08
(Verizon)			0.00			1/2" Ice	9.13	6.89	0.14

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)
			0.00						
DB844G65ZAXY w/Mount Pipe	A	From Face	3.00	0.0000	122.50	No Ice	5.38	5.40	0.04
			6.00			1/2" Ice	6.07	6.49	0.09
(Verizon)			0.00						
DB844G65ZAXY w/Mount Pipe	A	From Face	3.00	0.0000	122.50	No Ice	5.38	5.40	0.04
			-6.00			1/2" Ice	6.07	6.49	0.09
(Verizon)			0.00						
DB844G65ZAXY w/Mount Pipe	B	From Face	3.00	0.0000	122.50	No Ice	5.38	5.40	0.04
			6.00			1/2" Ice	6.07	6.49	0.09
(Verizon)			0.00						
DB844G65ZAXY w/Mount Pipe	B	From Face	3.00	0.0000	122.50	No Ice	5.38	5.40	0.04
			-6.00			1/2" Ice	6.07	6.49	0.09
(Verizon)			0.00						
LPA-80090/4CF w/Mount Pipe	C	From Face	3.00	0.0000	122.50	No Ice	3.35	5.98	0.04
			6.00			1/2" Ice	3.97	7.08	0.08
(Verizon)			0.00						
LPA-80090/4CF w/Mount Pipe	C	From Face	3.00	0.0000	122.50	No Ice	3.35	5.98	0.04
			-6.00			1/2" Ice	3.97	7.08	0.08
(Verizon)			0.00						
BXA-185063/8CF	A	From Face	3.00	0.0000	122.50	No Ice	2.10	1.10	0.01
(Verizon)			4.00			1/2" Ice	2.40	1.40	0.03
			0.00						
BXA-185063/8CF	B	From Face	3.00	0.0000	122.50	No Ice	2.10	1.10	0.01
(Verizon)			4.00			1/2" Ice	2.40	1.40	0.03
			0.00						
BXA-185063/8CF	C	From Face	3.00	0.0000	122.50	No Ice	2.10	1.10	0.01
(Verizon)			4.00			1/2" Ice	2.40	1.40	0.03
			0.00						
(4) 844G65VTZASX w/Mount Pipe	A	From Face	3.00	0.0000	112.17	No Ice	6.55	5.63	0.04
			0.00			1/2" Ice	7.25	6.73	0.10
(Nextel)			0.00						
(4) 844G65VTZASX w/Mount Pipe	B	From Face	3.00	0.0000	112.17	No Ice	6.55	5.63	0.04
			0.00			1/2" Ice	7.25	6.73	0.10
(Nextel)			0.00						
(4) 844G65VTZASX w/Mount Pipe	C	From Face	3.00	0.0000	112.17	No Ice	6.55	5.63	0.04
			0.00			1/2" Ice	7.25	6.73	0.10
(Nextel)			0.00						
SABRE 12' Low Profile Platform	C	None		0.0000	112.17	No Ice	26.30	26.30	1.92
						1/2" Ice	35.60	35.60	2.34
(Nextel)									
3' Yagi	A	From Leg	1.50	0.0000	79.33	No Ice	2.08	2.08	0.03
(Town)			0.00			1/2" Ice	3.79	3.79	0.05
			0.00						
3' Yagi	A	From Face	1.50	0.0000	81.17	No Ice	2.08	2.08	0.03
(Town)			0.00			1/2" Ice	3.79	3.79	0.05
			0.00						
3' Yagi	C	From Leg	1.50	0.0000	80.00	No Ice	2.08	2.08	0.03
(Town)			0.00			1/2" Ice	3.79	3.79	0.05
			0.00						
14' Dipole	C	From Face	1.00	0.0000	81.25	No Ice	2.80	2.80	0.07
(Town)			0.00			1/2" Ice	4.22	4.22	0.10
			0.00						
GPS	B	From Face	1.00	0.0000	83.17	No Ice	1.00	1.00	0.01
(Town)			0.00			1/2" Ice	1.50	1.50	0.01
			0.00						
SABRE 12' Low Profile Platform	C	None		0.0000	122.50	No Ice	26.30	26.30	1.92
						1/2" Ice	35.60	35.60	2.34

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizonr)									
7' Whip	C	From Leg	2.50	0.0000	166.17	No Ice	1.74	1.74	0.04
(Town)			0.00			1/2" Ice	2.60	2.60	0.05
			0.00						
APX16DWVS	C	From Face	2.30	0.0000	152.00	No Ice	7.23	2.15	0.00
(T-Mobile)			0.00			1/2" Ice	7.68	2.49	0.03
			0.00						
APX16DWVS	B	From Face	2.30	0.0000	152.00	No Ice	7.23	2.15	0.00
(T-Mobile)			0.00			1/2" Ice	7.68	2.49	0.03
			0.00						
APX16DWVS	A	From Face	2.30	0.0000	152.00	No Ice	7.23	2.15	0.00
(T-Mobile)			0.00			1/2" Ice	7.68	2.49	0.03
			0.00						
(2) RRH	C	From Face	1.00	0.0000	125.00	No Ice	2.94	1.25	0.10
(AT&T)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
(2) RRH	B	From Face	1.00	0.0000	125.00	No Ice	2.94	1.25	0.10
(AT&T)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
(2) RRH	A	From Face	1.00	0.0000	125.00	No Ice	2.94	1.25	0.10
(AT&T)			0.00			1/2" Ice	3.17	1.41	0.12
			0.00						
DC6-48-60-18-8F	C	From Face	1.00	0.0000	125.00	No Ice	1.33	1.33	0.03
(AT&T)			0.00			1/2" Ice	1.53	1.53	0.05
			0.00						
(2) 860 10025 RET	A	From Face	1.00	0.0000	132.00	No Ice	0.16	0.14	0.00
(AT&T)			0.00			1/2" Ice	0.23	0.20	0.00
			0.00						
(2) 860 10025 RET	B	From Face	1.00	0.0000	132.00	No Ice	0.16	0.14	0.00
(AT&T)			0.00			1/2" Ice	0.23	0.20	0.00
			0.00						
(2) 860 10025 RET	C	From Face	1.00	0.0000	132.00	No Ice	0.16	0.14	0.00
(AT&T)			0.00			1/2" Ice	0.23	0.20	0.00
			0.00						
Cluster Mount	C	None		0.0000	125.00	No Ice	1.00	1.00	0.05
(AT&T)						1/2" Ice	1.50	1.50	0.07
(2) TMA	C	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						
(2) TMA	C	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						
(2) TMA	C	From Face	3.00	0.0000	132.00	No Ice	1.91	0.95	0.03
(AT&^T)			0.00			1/2" Ice	2.09	1.09	0.04
			0.00						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	153.00	1.55	29	21.184	A	0.000	21.184	21.184	100.00	0.000	0.000
160.00-146.50					B	0.000	21.184		100.00	0.000	0.000
					C	0.000	21.184		100.00	0.000	0.000
L2	119.17	1.443	27	119.885	A	0.000	119.885	119.885	100.00	0.000	0.000
146.50-95.75					B	0.000	119.885		100.00	0.000	0.000
					C	0.000	119.885		100.00	0.000	8.267
L3 95.75-46.75	70.43	1.242	23	176.443	A	0.000	176.443	176.443	100.00	0.000	0.000
					B	0.000	176.443		100.00	0.000	0.000
					C	0.000	176.443		100.00	0.000	9.702
L4 46.75-0.00	22.49	1	19	223.355	A	0.000	223.355	223.355	100.00	0.000	0.000
					B	0.000	223.355		100.00	0.000	0.000
					C	0.000	223.355		100.00	0.000	9.257

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	153.00	1.55	22	0.5000	22.309	A	0.000	22.309	22.309	100.00	0.000	0.000
160.00-146.50						B	0.000	22.309		100.00	0.000	0.000
						C	0.000	22.309		100.00	0.000	0.000
L2 146.50-95.75	119.17	1.443	20	0.5000	124.114	A	0.000	124.114	124.114	100.00	0.000	0.000
						B	0.000	124.114		100.00	0.000	0.000
						C	0.000	124.114		100.00	0.000	12.441
L3 95.75-46.75	70.43	1.242	17	0.5000	180.526	A	0.000	180.526	180.526	100.00	0.000	0.000
						B	0.000	180.526		100.00	0.000	0.000
						C	0.000	180.526		100.00	0.000	14.602
L4 46.75-0.00	22.49	1	14	0.5000	227.251	A	0.000	227.251	227.251	100.00	0.000	0.000
						B	0.000	227.251		100.00	0.000	0.000
						C	0.000	227.251		100.00	0.000	13.931

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	153.00	1.55	10	21.184	A	0.000	21.184	21.184	100.00	0.000	0.000
160.00-146.50					B	0.000	21.184		100.00	0.000	0.000
					C	0.000	21.184		100.00	0.000	0.000
L2	119.17	1.443	9	119.885	A	0.000	119.885	119.885	100.00	0.000	0.000
146.50-95.75					B	0.000	119.885		100.00	0.000	0.000
					C	0.000	119.885		100.00	0.000	8.267
L3 95.75-46.75	70.43	1.242	8	176.443	A	0.000	176.443	176.443	100.00	0.000	0.000
					B	0.000	176.443		100.00	0.000	0.000
					C	0.000	176.443		100.00	0.000	9.702
L4 46.75-0.00	22.49	1	6	223.355	A	0.000	223.355	223.355	100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
					B	0.000	223.355		100.00	0.000	0.000
					C	0.000	223.355		100.00	0.000	9.257

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 ft²	F K	w plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.67	49.42	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	3.88	76.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	4.80	98.00	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	4.86	104.00	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	1012.00 kip-ft	14.21		

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 plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.67	49.42	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	3.88	76.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	4.80	98.00	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	4.86	104.00	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	1012.00 kip-ft	14.21		

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 ft^2	F K	w plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.67	49.42	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	3.88	76.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	4.80	98.00	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	4.86	104.00	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	1012.00 kip-ft	14.21		

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 ft^2	F K	w plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.67	49.42	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	3.88	76.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	4.80	98.00	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	4.86	104.00	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	1012.00 kip-ft	14.21		

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 ft^2	F K	w plf	Ctrl. Face
L1	0.27	0.67	A	1	0.65	1	1	1	22.309	0.53	39.03	C
160.00-146.50			B	1	0.65	1	1	1	22.309			
			C	1	0.65	1	1	1	22.309			
L2	3.24	4.90	A	1	0.65	1	1	1	124.114	3.14	61.95	C
146.50-95.75			B	1	0.65	1	1	1	124.114			
			C	1	0.65	1	1	1	124.114			
L3	4.11	8.94	A	1	0.65	1	1	1	180.526	3.82	77.96	C
95.75-46.75			B	1	0.65	1	1	1	180.526			
			C	1	0.65	1	1	1	180.526			

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 plf	Ctrl. Face
L4 46.75-0.00	3.96	13.74	A	1	0.65	1	1	1	227.251	3.82	81.64	C
			B	1	0.65	1	1	1	227.251			
			C	1	0.65	1	1	1	227.251			
Sum Weight:	11.58	28.25						OTM	810.16 kip-ft	11.31		

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 plf	Ctrl. Face
L1	0.27	0.67	A	1	0.65	1	1	1	22.309	0.53	39.03	C
160.00-146.50			B	1	0.65	1	1	1	22.309			
			C	1	0.65	1	1	1	22.309			
L2	3.24	4.90	A	1	0.65	1	1	1	124.114	3.14	61.95	C
146.50-95.75			B	1	0.65	1	1	1	124.114			
			C	1	0.65	1	1	1	124.114			
L3	4.11	8.94	A	1	0.65	1	1	1	180.526	3.82	77.96	C
95.75-46.75			B	1	0.65	1	1	1	180.526			
			C	1	0.65	1	1	1	180.526			
L4 46.75-0.00	3.96	13.74	A	1	0.65	1	1	1	227.251	3.82	81.64	C
			B	1	0.65	1	1	1	227.251			
			C	1	0.65	1	1	1	227.251			
Sum Weight:	11.58	28.25						OTM	810.16 kip-ft	11.31		

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 ft²	F K	w plf	Ctrl. Face
L1	0.27	0.67	A	1	0.65	1	1	1	22.309	0.53	39.03	C
160.00-146.50			B	1	0.65	1	1	1	22.309			
			C	1	0.65	1	1	1	22.309			
L2	3.24	4.90	A	1	0.65	1	1	1	124.114	3.14	61.95	C
146.50-95.75			B	1	0.65	1	1	1	124.114			
			C	1	0.65	1	1	1	124.114			
L3	4.11	8.94	A	1	0.65	1	1	1	180.526	3.82	77.96	C
95.75-46.75			B	1	0.65	1	1	1	180.526			
			C	1	0.65	1	1	1	180.526			
L4 46.75-0.00	3.96	13.74	A	1	0.65	1	1	1	227.251	3.82	81.64	C
			B	1	0.65	1	1	1	227.251			
			C	1	0.65	1	1	1	227.251			
Sum Weight:	11.58	28.25						OTM	810.16 kip-ft	11.31		

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 plf	Ctrl. Face
L1	0.27	0.67	A	1	0.65	1	1	1	22.309	0.53	39.03	C
160.00-146.50			B	1	0.65	1	1	1	22.309			
			C	1	0.65	1	1	1	22.309			
L2	3.24	4.90	A	1	0.65	1	1	1	124.114	3.14	61.95	C
146.50-95.75			B	1	0.65	1	1	1	124.114			
			C	1	0.65	1	1	1	124.114			
L3	4.11	8.94	A	1	0.65	1	1	1	180.526	3.82	77.96	C
95.75-46.75			B	1	0.65	1	1	1	180.526			
			C	1	0.65	1	1	1	180.526			
L4 46.75-0.00	3.96	13.74	A	1	0.65	1	1	1	227.251	3.82	81.64	C
			B	1	0.65	1	1	1	227.251			
			C	1	0.65	1	1	1	227.251			
Sum Weight:	11.58	28.25						OTM	810.16 kip-ft	11.31		

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 plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.23	17.10	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	1.34	26.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	1.66	33.91	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	1.68	35.99	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	350.17 kip-ft	4.92		

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 plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.23	17.10	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	1.34	26.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			

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 plf	Ctrl. Face
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	1.66	33.91	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	1.68	35.99	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	350.17 kip-ft	4.92		

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 ft²	F K	w plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.23	17.10	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	1.34	26.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	1.66	33.91	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	1.68	35.99	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	350.17 kip-ft	4.92		

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 ft²	F K	w plf	Ctrl. Face
L1	0.27	0.51	A	1	0.65	1	1	1	21.184	0.23	17.10	C
160.00-146.50			B	1	0.65	1	1	1	21.184			
			C	1	0.65	1	1	1	21.184			
L2	2.86	4.00	A	1	0.65	1	1	1	119.885	1.34	26.46	C
146.50-95.75			B	1	0.65	1	1	1	119.885			
			C	1	0.65	1	1	1	119.885			
L3	3.67	7.62	A	1	0.65	1	1	1	176.443	1.66	33.91	C
95.75-46.75			B	1	0.65	1	1	1	176.443			
			C	1	0.65	1	1	1	176.443			
L4 46.75-0.00	3.53	12.07	A	1	0.65	1	1	1	223.355	1.68	35.99	C
			B	1	0.65	1	1	1	223.355			
			C	1	0.65	1	1	1	223.355			
Sum Weight:	10.34	24.20						OTM	350.17 kip-ft	4.92		

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	24.20					
Bracing Weight	0.00					
Total Member Self-Weight	24.20			1.17	0.07	
Total Weight	48.18			1.17	0.07	
Wind 0 deg - No Ice		-0.00	-35.62	-3859.08	0.29	-0.03
Wind 30 deg - No Ice		17.80	-30.85	-3341.80	-1926.76	1.40
Wind 45 deg - No Ice		25.17	-25.19	-2728.29	-2725.00	2.00
Wind 60 deg - No Ice		30.83	-17.81	-1928.77	-3337.52	2.45
Wind 90 deg - No Ice		35.59	0.00	1.38	-3853.97	2.85
Wind 120 deg - No Ice		30.83	17.81	1931.48	-3337.74	2.48
Wind 135 deg - No Ice		25.17	25.19	2730.93	-2725.30	2.03
Wind 150 deg - No Ice		17.80	30.85	3344.35	-1927.14	1.45
Wind 180 deg - No Ice		0.00	35.62	3861.41	-0.15	0.03
Wind 210 deg - No Ice		-17.80	30.85	3344.13	1926.91	-1.40
Wind 225 deg - No Ice		-25.17	25.19	2730.62	2725.14	-2.00
Wind 240 deg - No Ice		-30.83	17.81	1931.10	3337.66	-2.45
Wind 270 deg - No Ice		-35.59	-0.00	0.95	3854.12	-2.85
Wind 300 deg - No Ice		-30.83	-17.81	-1929.15	3337.88	-2.48
Wind 315 deg - No Ice		-25.17	-25.19	-2728.59	2725.45	-2.03
Wind 330 deg - No Ice		-17.80	-30.85	-3342.01	1927.28	-1.45
Member Ice	4.06					
Total Weight Ice	58.45			1.68	0.24	
Wind 0 deg - Ice		-0.00	-30.86	-3410.96	0.40	-0.29
Wind 30 deg - Ice		15.42	-26.73	-2953.67	-1703.29	0.87
Wind 45 deg - Ice		21.80	-21.82	-2411.30	-2409.01	1.38
Wind 60 deg - Ice		26.71	-15.43	-1704.50	-2950.53	1.80
Wind 90 deg - Ice		30.84	0.00	1.84	-3407.11	2.24
Wind 120 deg - Ice		26.71	15.43	1708.14	-2950.69	2.09
Wind 135 deg - Ice		21.81	21.83	2414.89	-2409.24	1.79
Wind 150 deg - Ice		15.42	26.73	2957.19	-1703.58	1.37
Wind 180 deg - Ice		0.00	30.86	3414.31	0.07	0.29
Wind 210 deg - Ice		-15.42	26.73	2957.02	1703.77	-0.87
Wind 225 deg - Ice		-21.80	21.82	2414.66	2409.48	-1.38
Wind 240 deg - Ice		-26.71	15.43	1707.85	2951.01	-1.80
Wind 270 deg - Ice		-30.84	-0.00	1.51	3407.59	-2.24
Wind 300 deg - Ice		-26.71	-15.43	-1704.78	2951.17	-2.09
Wind 315 deg - Ice		-21.81	-21.83	-2411.53	2409.71	-1.79
Wind 330 deg - Ice		-15.42	-26.73	-2953.83	1704.05	-1.37
Total Weight	48.18			1.17	0.07	
Wind 0 deg - Service		-0.00	-12.33	-1334.56	0.15	-0.01
Wind 30 deg - Service		6.16	-10.68	-1155.57	-666.65	0.48
Wind 45 deg - Service		8.71	-8.72	-943.28	-942.86	0.69
Wind 60 deg - Service		10.67	-6.16	-666.63	-1154.80	0.85
Wind 90 deg - Service		12.32	0.00	1.24	-1333.51	0.99
Wind 120 deg - Service		10.67	6.16	669.09	-1154.88	0.86
Wind 135 deg - Service		8.71	8.72	945.72	-942.96	0.70
Wind 150 deg - Service		6.16	10.68	1157.98	-666.78	0.50
Wind 180 deg - Service		0.00	12.33	1336.89	-0.00	0.01
Wind 210 deg - Service		-6.16	10.68	1157.90	666.80	-0.48
Wind 225 deg - Service		-8.71	8.72	945.61	943.00	-0.69
Wind 240 deg - Service		-10.67	6.16	668.96	1154.95	-0.85
Wind 270 deg - Service		-12.32	-0.00	1.09	1333.65	-0.99
Wind 300 deg - Service		-10.67	-6.16	-666.76	1155.02	-0.86
Wind 315 deg - Service		-8.71	-8.72	-943.39	943.11	-0.70

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
Wind 330 deg - Service		-6.16	-10.68	-1155.64	666.93	-0.50

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
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

Comb. No.	Description
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	160 - 146.5	Pole	Max Tension	18	0.00	-0.00	0.00
			Max. Compression	18	-7.16	0.31	-0.19
			Max. Mx	14	-4.83	59.69	-0.10
			Max. My	10	-4.82	0.14	-59.63
			Max. Vy	14	-7.36	59.69	-0.10
			Max. Vx	10	7.37	0.14	-59.63
			Max. Torque	17			0.43
L2	146.5 - 95.75	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-26.61	-0.01	-1.67
			Max. Mx	6	-18.67	-869.01	-1.08
			Max. My	10	-18.66	-0.11	-873.39
			Max. Vy	14	-26.45	868.87	-0.97
			Max. Vx	10	26.48	-0.11	-873.39
			Max. Torque	6			-2.83
L3	95.75 - 46.75	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-38.92	0.24	-1.75
			Max. Mx	14	-30.09	2218.89	-1.08
			Max. My	10	-30.09	-0.06	-2224.89
			Max. Vy	14	-30.95	2218.89	-1.08
			Max. Vx	10	30.99	-0.06	-2224.89
			Max. Torque	6			-2.82
L4	46.75 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-58.45	0.24	-1.75
			Max. Mx	14	-48.16	3990.94	-1.00
			Max. My	10	-48.16	-0.15	-3998.59
			Max. Vy	14	-35.62	3990.94	-1.00
			Max. Vx	10	35.65	-0.15	-3998.59
			Max. Torque	6			-2.79

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	58.45	-0.00	-30.86
	Max. H_x	14	48.18	35.59	0.00
	Max. H_z	2	48.18	0.00	35.62
	Max. M_x	2	3996.10	0.00	35.62
	Max. M_z	6	3990.79	-35.59	-0.00
	Max. Torsion	14	2.79	35.59	0.00
	Min. Vert	1	48.18	0.00	0.00
	Min. H_x	6	48.18	-35.59	-0.00
	Min. H_z	10	48.18	-0.00	-35.62
	Min. M_x	10	-3998.59	-0.00	-35.62
	Min. M_z	14	-3990.94	35.59	0.00
	Min. Torsion	6	-2.79	-35.59	-0.00

Tower Mast Reaction Summary

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 Only	48.18	0.00	0.00	1.19	0.07	0.00
Dead+Wind 0 deg - No Ice	48.18	-0.00	-35.62	-3996.10	0.30	-0.05
Dead+Wind 30 deg - No Ice	48.18	17.80	-30.85	-3460.47	-1995.14	1.34
Dead+Wind 45 deg - No Ice	48.18	25.17	-25.19	-2825.18	-2821.71	1.93
Dead+Wind 60 deg - No Ice	48.18	30.83	-17.81	-1997.27	-3455.99	2.38
Dead+Wind 90 deg - No Ice	48.18	35.59	0.00	1.45	-3990.79	2.79
Dead+Wind 120 deg - No Ice	48.18	30.83	17.81	2000.11	-3456.23	2.44
Dead+Wind 135 deg - No Ice	48.18	25.17	25.19	2827.96	-2822.05	2.01
Dead+Wind 150 deg - No Ice	48.18	17.80	30.85	3463.17	-1995.55	1.44
Dead+Wind 180 deg - No Ice	48.18	0.00	35.62	3998.59	-0.15	0.05
Dead+Wind 210 deg - No Ice	48.18	-17.80	30.85	3462.95	1995.31	-1.35
Dead+Wind 225 deg - No Ice	48.18	-25.17	25.19	2827.65	2821.89	-1.94
Dead+Wind 240 deg - No Ice	48.18	-30.83	17.81	1999.72	3456.16	-2.39
Dead+Wind 270 deg - No Ice	48.18	-35.59	-0.00	1.00	3990.94	-2.79
Dead+Wind 300 deg - No Ice	48.18	-30.83	-17.81	-1997.65	3456.36	-2.44
Dead+Wind 315 deg - No Ice	48.18	-25.17	-25.19	-2825.49	2822.18	-2.01
Dead+Wind 330 deg - No Ice	48.18	-17.80	-30.85	-3460.69	1995.68	-1.44
Dead+Ice+Temp	58.45	0.00	0.00	1.75	0.24	0.00
Dead+Wind 0 deg+Ice+Temp	58.45	-0.00	-30.86	-3571.30	0.43	-0.33
Dead+Wind 30 deg+Ice+Temp	58.45	15.42	-26.73	-3092.52	-1783.35	0.80
Dead+Wind 45 deg+Ice+Temp	58.45	21.80	-21.82	-2524.65	-2522.23	1.31
Dead+Wind 60 deg+Ice+Temp	58.45	26.71	-15.43	-1784.60	-3089.22	1.72
Dead+Wind 90 deg+Ice+Temp	58.45	30.84	0.00	2.00	-3567.27	2.18
Dead+Wind 120 deg+Ice+Temp	58.45	26.71	15.43	1788.56	-3089.40	2.06
Dead+Wind 135 deg+Ice+Temp	58.45	21.81	21.83	2528.55	-2522.49	1.78
Dead+Wind 150 deg+Ice+Temp	58.45	15.42	26.73	3096.36	-1783.66	1.38
Dead+Wind 180 deg+Ice+Temp	58.45	0.00	30.86	3574.98	0.08	0.33
Dead+Wind 210 deg+Ice+Temp	58.45	-15.42	26.73	3096.19	1783.87	-0.81
Dead+Wind 225 deg+Ice+Temp	58.45	-21.80	21.82	2528.31	2522.76	-1.31
Dead+Wind 240 deg+Ice+Temp	58.45	-26.71	15.43	1788.26	3089.75	-1.73
Dead+Wind 270 deg+Ice+Temp	58.45	-30.84	-0.00	1.65	3567.78	-2.18
Dead+Wind 300 deg+Ice+Temp	58.45	-26.71	-15.43	-1784.90	3089.90	-2.06
Dead+Wind 315 deg+Ice+Temp	58.45	-21.81	-21.83	-2524.89	2522.99	-1.78
Dead+Wind 330 deg+Ice+Temp	58.45	-15.42	-26.73	-3092.69	1784.16	-1.38
Dead+Wind 0 deg - Service	48.18	-0.00	-12.33	-1383.51	0.15	-0.02
Dead+Wind 30 deg - Service	48.18	6.16	-10.68	-1197.95	-691.11	0.47
Dead+Wind 45 deg - Service	48.18	8.71	-8.72	-977.87	-977.45	0.68
Dead+Wind 60 deg - Service	48.18	10.67	-6.16	-691.06	-1197.17	0.83
Dead+Wind 90 deg - Service	48.18	12.32	0.00	1.33	-1382.43	0.97
Dead+Wind 120 deg - Service	48.18	10.67	6.16	693.71	-1197.26	0.85
Dead+Wind 135 deg - Service	48.18	8.71	8.72	980.49	-977.56	0.70
Dead+Wind 150 deg - Service	48.18	6.16	10.68	1200.54	-691.25	0.50
Dead+Wind 180 deg - Service	48.18	0.00	12.33	1386.02	-0.00	0.02
Dead+Wind 210 deg - Service	48.18	-6.16	10.68	1200.46	691.26	-0.47
Dead+Wind 225 deg - Service	48.18	-8.71	8.72	980.38	977.60	-0.68
Dead+Wind 240 deg - Service	48.18	-10.67	6.16	693.57	1197.33	-0.84
Dead+Wind 270 deg - Service	48.18	-12.32	-0.00	1.18	1382.58	-0.97
Dead+Wind 300 deg - Service	48.18	-10.67	-6.16	-691.19	1197.40	-0.85
Dead+Wind 315 deg - Service	48.18	-8.71	-8.72	-977.98	977.71	-0.70
Dead+Wind 330 deg - Service	48.18	-6.16	-10.68	-1198.03	691.40	-0.50

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	0.00	-48.18	0.00	0.00	48.18	0.00	0.000%
2	-0.00	-48.18	-35.62	0.00	48.18	35.62	0.000%
3	17.80	-48.18	-30.85	-17.80	48.18	30.85	0.000%
4	25.17	-48.18	-25.19	-25.17	48.18	25.19	0.000%
5	30.83	-48.18	-17.81	-30.83	48.18	17.81	0.000%
6	35.59	-48.18	0.00	-35.59	48.18	-0.00	0.000%
7	30.83	-48.18	17.81	-30.83	48.18	-17.81	0.000%
8	25.17	-48.18	25.19	-25.17	48.18	-25.19	0.000%
9	17.80	-48.18	30.85	-17.80	48.18	-30.85	0.000%
10	0.00	-48.18	35.62	-0.00	48.18	-35.62	0.000%
11	-17.80	-48.18	30.85	17.80	48.18	-30.85	0.000%
12	-25.17	-48.18	25.19	25.17	48.18	-25.19	0.000%
13	-30.83	-48.18	17.81	30.83	48.18	-17.81	0.000%
14	-35.59	-48.18	-0.00	35.59	48.18	0.00	0.000%
15	-30.83	-48.18	-17.81	30.83	48.18	17.81	0.000%
16	-25.17	-48.18	-25.19	25.17	48.18	25.19	0.000%
17	-17.80	-48.18	-30.85	17.80	48.18	30.85	0.000%
18	0.00	-58.45	0.00	0.00	58.45	-0.00	0.000%
19	-0.00	-58.45	-30.86	0.00	58.45	30.86	0.000%
20	15.42	-58.45	-26.73	-15.42	58.45	26.73	0.000%
21	21.80	-58.45	-21.82	-21.80	58.45	21.82	0.000%
22	26.71	-58.45	-15.43	-26.71	58.45	15.43	0.000%
23	30.84	-58.45	0.00	-30.84	58.45	-0.00	0.000%
24	26.71	-58.45	15.43	-26.71	58.45	-15.43	0.000%
25	21.81	-58.45	21.83	-21.81	58.45	-21.83	0.000%
26	15.42	-58.45	26.73	-15.42	58.45	-26.73	0.000%
27	0.00	-58.45	30.86	-0.00	58.45	-30.86	0.000%
28	-15.42	-58.45	26.73	15.42	58.45	-26.73	0.000%
29	-21.80	-58.45	21.82	21.80	58.45	-21.82	0.000%
30	-26.71	-58.45	15.43	26.71	58.45	-15.43	0.000%
31	-30.84	-58.45	-0.00	30.84	58.45	0.00	0.000%
32	-26.71	-58.45	-15.43	26.71	58.45	15.43	0.000%
33	-21.81	-58.45	-21.83	21.81	58.45	21.83	0.000%
34	-15.42	-58.45	-26.73	15.42	58.45	26.73	0.000%
35	-0.00	-48.18	-12.33	0.00	48.18	12.33	0.000%
36	6.16	-48.18	-10.68	-6.16	48.18	10.68	0.000%
37	8.71	-48.18	-8.72	-8.71	48.18	8.72	0.000%
38	10.67	-48.18	-6.16	-10.67	48.18	6.16	0.000%
39	12.32	-48.18	0.00	-12.32	48.18	-0.00	0.000%
40	10.67	-48.18	6.16	-10.67	48.18	-6.16	0.000%
41	8.71	-48.18	8.72	-8.71	48.18	-8.72	0.000%
42	6.16	-48.18	10.68	-6.16	48.18	-10.68	0.000%
43	0.00	-48.18	12.33	-0.00	48.18	-12.33	0.000%
44	-6.16	-48.18	10.68	6.16	48.18	-10.68	0.000%
45	-8.71	-48.18	8.72	8.71	48.18	-8.72	0.000%
46	-10.67	-48.18	6.16	10.67	48.18	-6.16	0.000%
47	-12.32	-48.18	-0.00	12.32	48.18	0.00	0.000%
48	-10.67	-48.18	-6.16	10.67	48.18	6.16	0.000%
49	-8.71	-48.18	-8.72	8.71	48.18	8.72	0.000%
50	-6.16	-48.18	-10.68	6.16	48.18	10.68	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	4	0.00000001	0.00027106
3	Yes	5	0.00000001	0.00071549
4	Yes	5	0.00000001	0.00076717
5	Yes	5	0.00000001	0.00066937
6	Yes	5	0.00000001	0.00006307
7	Yes	5	0.00000001	0.00073272
8	Yes	5	0.00000001	0.00076912
9	Yes	5	0.00000001	0.00068211
10	Yes	4	0.00000001	0.00027056
11	Yes	5	0.00000001	0.00068437
12	Yes	5	0.00000001	0.00076915
13	Yes	5	0.00000001	0.00073153
14	Yes	5	0.00000001	0.00006287
15	Yes	5	0.00000001	0.00066873
16	Yes	5	0.00000001	0.00076787
17	Yes	5	0.00000001	0.00071831
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00020914
20	Yes	6	0.00000001	0.00007829
21	Yes	6	0.00000001	0.00008576
22	Yes	6	0.00000001	0.00007483
23	Yes	5	0.00000001	0.00022896
24	Yes	6	0.00000001	0.00008016
25	Yes	6	0.00000001	0.00008615
26	Yes	6	0.00000001	0.00007580
27	Yes	5	0.00000001	0.00020945
28	Yes	6	0.00000001	0.00007635
29	Yes	6	0.00000001	0.00008619
30	Yes	6	0.00000001	0.00007991
31	Yes	5	0.00000001	0.00022893
32	Yes	6	0.00000001	0.00007467
33	Yes	6	0.00000001	0.00008591
34	Yes	6	0.00000001	0.00007893
35	Yes	4	0.00000001	0.00006689
36	Yes	5	0.00000001	0.00005453
37	Yes	5	0.00000001	0.00005982
38	Yes	4	0.00000001	0.00090562
39	Yes	4	0.00000001	0.00023485
40	Yes	5	0.00000001	0.00005796
41	Yes	5	0.00000001	0.00006054
42	Yes	4	0.00000001	0.00094378
43	Yes	4	0.00000001	0.00006994
44	Yes	4	0.00000001	0.00095037
45	Yes	5	0.00000001	0.00006051
46	Yes	5	0.00000001	0.00005773
47	Yes	4	0.00000001	0.00023463
48	Yes	4	0.00000001	0.00090420
49	Yes	5	0.00000001	0.00005998
50	Yes	5	0.00000001	0.00005504

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 146.5	35.721	43	2.1575	0.0080
L2	149.25 - 95.75	30.923	43	2.0924	0.0074
L3	100.25 - 46.75	12.733	43	1.3377	0.0026
L4	53.25 - 0	3.241	43	0.5770	0.0007

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
170.00	3" Dia 20' Omni	43	35.721	2.1575	0.0080	11954
168.00	DB224	43	35.721	2.1575	0.0080	11954
166.17	7' Whip	43	35.721	2.1575	0.0080	11954
162.00	APXVSPP18-C-A20	43	35.721	2.1575	0.0080	11954
160.00	3' Stand-off	43	35.721	2.1575	0.0080	11954
158.00	(2) RRH	43	34.821	2.1471	0.0079	11954
152.00	RR90-17-02DP w/Mount Pipe	43	32.137	2.1122	0.0076	7529
141.08	APXV18-206517S-C w/ mounting hardware	43	27.415	2.0128	0.0067	4895
132.00	800 10121	43	23.709	1.8931	0.0058	4318
125.00	(2) RRH	43	21.008	1.7836	0.0051	3958
122.50	P65-16-XL-2	43	20.078	1.7418	0.0048	3843
112.17	(4) 844G65VTZASX w/Mount Pipe	43	16.451	1.5581	0.0037	3432
83.17	GPS	43	8.352	1.0352	0.0015	3243
81.25	14' Dipole	43	7.929	1.0028	0.0015	3266
81.17	3' Yagi	43	7.911	1.0014	0.0014	3267
80.00	3' Yagi	43	7.660	0.9819	0.0014	3281
79.33	3' Yagi	43	7.519	0.9707	0.0014	3289

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 146.5	102.738	10	6.2032	0.0230
L2	149.25 - 95.75	88.963	10	6.0169	0.0211
L3	100.25 - 46.75	36.688	10	3.8532	0.0074
L4	53.25 - 0	9.347	10	1.6637	0.0020

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
170.00	3" Dia 20' Omni	10	102.738	6.2032	0.0230	4266
168.00	DB224	10	102.738	6.2032	0.0230	4266
166.17	7' Whip	10	102.738	6.2032	0.0230	4266
162.00	APXVSPP18-C-A20	10	102.738	6.2032	0.0230	4266
160.00	3' Stand-off	10	102.738	6.2032	0.0230	4266
158.00	(2) RRH	10	100.154	6.1735	0.0227	4266
152.00	RR90-17-02DP w/Mount Pipe	10	92.448	6.0737	0.0217	2687
141.08	APXV18-206517S-C w/ mounting hardware	10	78.890	5.7892	0.0192	1739

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
132.00	800 10121	10	68.245	5.4464	0.0167	1530
125.00	(2) RRH	10	60.482	5.1327	0.0145	1399
122.50	P65-16-XL-2	10	57.811	5.0126	0.0138	1358
112.17	(4) 844G65VTZASX w/Mount Pipe	10	47.384	4.4859	0.0106	1209
83.17	GPS	10	24.077	2.9834	0.0044	1134
81.25	14' Dipole	10	22.857	2.8901	0.0042	1141
81.17	3' Yagi	10	22.807	2.8862	0.0041	1142
80.00	3' Yagi	10	22.083	2.8299	0.0040	1146
79.33	3' Yagi	10	21.675	2.7978	0.0039	1149

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	160 - 146.5 (1)	TP20.91x16.75x0.1875	13.50	0.00	0.0	39.000	11.8282	-6.51	461.30	0.014
L2	146.5 - 95.75 (2)	TP36.16x19.6876x0.25	53.50	0.00	0.0	39.000	27.3952	-18.66	1068.41	0.017
L3	95.75 - 46.75 (3)	TP50.76x34.2745x0.3125	53.50	0.00	0.0	38.446	48.0510	-30.09	1847.36	0.016
L4	46.75 - 0 (4)	TP64.53x48.1321x0.375	53.25	0.00	0.0	36.648	76.3605	-48.16	2798.47	0.017

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	160 - 146.5 (1)	TP20.91x16.75x0.1875	59.11	-12.246	39.000	0.314	0.00	0.000	39.000	0.000
L2	146.5 - 95.75 (2)	TP36.16x19.6876x0.25	873.38	-44.879	39.000	1.151	0.00	0.000	39.000	0.000
L3	95.75 - 46.75 (3)	TP50.76x34.2745x0.3125	2224.89	-46.415	38.446	1.207	0.00	0.000	38.446	0.000
L4	46.75 - 0 (4)	TP64.53x48.1321x0.375	3998.59	-39.614	36.648	1.081	0.00	0.000	36.648	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	160 - 146.5 (1)	TP20.91x16.75x0.1875	0.014	0.314	0.000	0.328 ✔	1.333	H1-3 ✔
L2	146.5 - 95.75 (2)	TP36.16x19.6876x0.25	0.017	1.151	0.000	1.168 ✔	1.333	H1-3 ✔
L3	95.75 - 46.75 (3)	TP50.76x34.2745x0.3125	0.016	1.207	0.000	1.224 ✔	1.333	H1-3 ✔

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L4	46.75 - 0 (4)	TP64.53x48.1321x0.375	0.017	1.081	0.000	1.098 ✔	1.333	H1-3 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	160 - 146.5	Pole	TP20.91x16.75x0.1875	1	-6.51	614.91	24.6	Pass
L2	146.5 - 95.75	Pole	TP36.16x19.6876x0.25	2	-18.66	1424.19	87.6	Pass
L3	95.75 - 46.75	Pole	TP50.76x34.2745x0.3125	3	-30.09	2462.53	91.8	Pass
L4	46.75 - 0	Pole	TP64.53x48.1321x0.375	4	-48.16	3730.36	82.4	Pass
							Summary	
						Pole (L3)	91.8	Pass
						RATING =	**91.8**	**Pass**

ANCHOR BOLT AND
BASE PLATE ANALYSIS

ANCHOR BOLT AND BASEPLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 3999 \cdot kips \cdot ft$	*user input*
Shear Force:	$Shear := 36 \cdot kips$	*user input*
Axial Force:	$Axial := 48 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts = N	$N := 16$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot ksi$	*user input*
Bolt Allowable Strength:	$Fy := 75 \cdot ksi$	*user input*
Diameter Of Anchor Bolts	$D := 2.25in$	*user input*
Threaded length per inch	$n := 4.5$	*user input*
Bolt "Column" Distance:	$l := 3in$	*user input*
Bolt Modulus:	$E := 29000 \cdot ksi$	*user input*

Base Plate Data:

Use ASTM A633-60

Plate Yield Strength:	$Fy_{bp} := 60 \cdot ksi$	*user input*
Base Plate Thickness:	$PlateThicknessProvide := 3.0 \cdot in$	*user input*

Note: Base plate measured to be 3.0" during site visit on 3/2/2010 not 2.75" per manufacturers drawing number 04-09077-01 signed and sealed 9/12/2003.

Geometric Layout Data:

Distance from the center of gravity of the group to bolt in question = d(i)

Distances for loading condition (see detail):

$d_1 := 35.8254 \cdot in$ *user input*

$d_2 := 34.7189 \cdot in$ *user input*

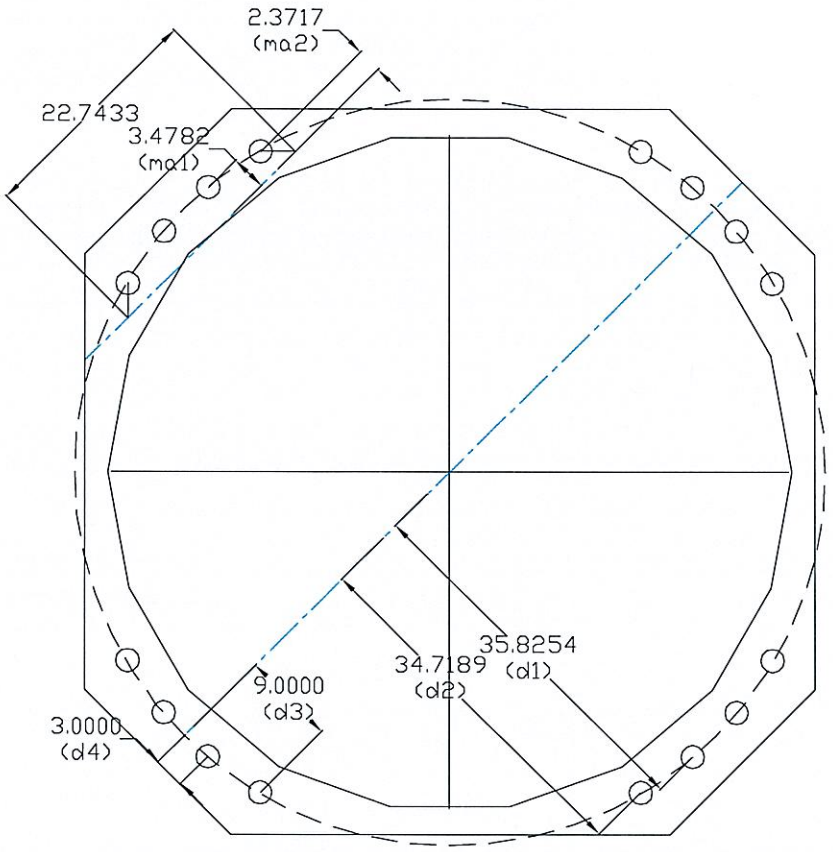
$d_3 := 9.000 \cdot in$ *user input*

$d_4 := 3.000 \cdot in$ *user input*

$MomentArm_1 := 3.4782 \cdot in$ *user input*

$MomentArm_2 := 2.3717 \cdot in$ *user input*

$EffectiveWidth := 22.7433 \cdot in$ *user input*



DETAIL - ANCHOR BOLT AND PLATE

Anchor Bolt Section Properties:

Polar Moment of Inertia (J) divided by Area (A) = Σd

$\Sigma d := (d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4$ $\quad \Sigma d = 1.03 \times 10^4 \cdot in^2$

Gross Area of Bolt:

$A_g := \frac{\pi}{4} \cdot D^2$ $\quad A_g = 3.98 \cdot in^2$

Net Area of Bolt:

$A_{net} := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n} \right)^2$ $\quad A_{net} = 3.25 \cdot in^2$

Net Diameter:

$D_n := \frac{2 \cdot \sqrt{A_{net}}}{\sqrt{\pi}}$ $\quad D_n = 2.03 \cdot in$

Radius of Gyration of Bolt:

$r := \frac{D_n}{4}$ $\quad r = 0.51 \cdot in$

Section Modulus of Bolt:

$S_x := \frac{\pi \cdot D_n^3}{32}$ $\quad S_x = 0.83 \cdot in^3$

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$M_x := \left(\frac{Shear}{N} \right) \cdot l$ $\quad M_x = 0.56 \cdot kips \cdot ft$

$f_{bx} := \frac{M_x}{S_x}$ $\quad f_{bx} = 8.18 \cdot ksi$

Allowable Bending

$F_{bx} := 1.333 \cdot 0.60 \cdot Fy$ $\quad F_{bx} = 59.98 \cdot ksi$

Note: 1.333 increase allowed per TIA/EIA

Anchor Bolt Tensile Stress Check:

Maximum Tensile Force (Gross Area):

$AllowableTension := 1.333 \cdot (0.33 \cdot A_g \cdot F_u)$ $AllowableTension = 174.9 \cdot kips$

Note: 1.333 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$F_{net.area} := 1.333 \cdot (0.60 \cdot A_{net} \cdot Fy)$ $F_{net.area} = 194.81 \cdot kips$

Note: 1.333 increase allowed per TIA/EIA

Maximum Applied Tension:

$$MaxTension := \frac{OM \cdot d_1}{\Sigma d} - \frac{Axial}{N} \qquad MaxTension = 164.19 \cdot kips$$

Check Stresses:

Note: Bolts supplied are "upset bolts." Use net area for checking per AISC.

$AnchorBoltStress := if(F_{net.area} > MaxTension, "Not Overstressed", "Overstressed")$

$AnchorBoltStress = "Not Overstressed"$

$$PercentStressed := 100 \cdot \frac{MaxTension}{F_{net.area}}$$

$PercentStressed = 84.3$

Note: Shear Stress is negligible

Check Compression & Combined Stresses (if required):

Check to see if a complete combined stress analysis is required:

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."

Set the clear space between the plate and bolt to zero if a combined stress analysis is not required and set the bending stress to zero:

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0.0\,\text{in} & \text{otherwise} \end{cases} \qquad l = 0 \qquad f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0.0\,\text{ksi} & \text{otherwise} \end{cases} \qquad f_{bx} = 0 \cdot \text{ksi}$$

Allowable Compressive Force:

$$K := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{Fy}} \qquad C_c = 87.36$$

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

$F_a := 1.333 \cdot F_a$ Note: 1.333 increase allowed per TIA/EIA $\qquad F_a = 59.98 \cdot \text{ksi}$

Applied Compressive Force:

$$\text{MaxCompression} := \frac{OM \cdot d_1}{\Sigma d} + \frac{\text{Axial}}{N} \qquad \text{MaxCompression} = 170.19 \cdot \text{kips}$$

$$f_a := \frac{\text{MaxCompression}}{A_{net}} \qquad f_a = 52.4 \cdot \text{ksi}$$

Check Combined Stresses:

$$\text{StressRatio} := \frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \qquad \text{StressRatio} = 0.87$$

Condition := if(StressRatio ≤ 1.0, "Not Overstressed", "Overstressed")

Condition = "Not Overstressed"

Base Plate Analysis:

Force From Bolt(s):

$$C_1 := \frac{OM \cdot d_1}{\Sigma d} + \frac{Axial}{N} \qquad C_1 = 170.19 \cdot kips$$

$$C_2 := \frac{OM \cdot d_2}{\Sigma d} + \frac{Axial}{N} \qquad C_2 = 165.02 \cdot kips$$

Bending Stress In Plate:

$$f_{bp} := \frac{6 \cdot \left(2C_1 \cdot MomentArm_1 + 2C_2 \cdot MomentArm_2\right)}{EffectiveWidth \cdot PlateThicknessProvide^2} \qquad f_{bp} = 57.65 \cdot ksi$$

Check Stresses:

$$BasePlateRatio := \frac{f_{bp}}{1.333 \cdot 0.75 Fy_{bp}} \qquad BasePlateRatio = 0.96$$

BasePlateStress := if(BasePlateRatio < 1, "Not Over Stress", "Is Over Stress")

BasePlateStress = "Not Over Stress"

FOUNDATION ANALYSIS

URS

Job	160' Sabre Monopole - Cheshire, CT	Project No.	SBA-002	Page	of
Description	Spread Footing w/ Pier Analysis	Computed by	JCF	Sheet 1	of 9
		Checked by		Date	10/15/12

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 3999 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 36kip$
Max Compressive Force	$C_t := 48 \cdot kip$
Height of Tower	$H_t := 160 \cdot ft$
Base Plate Bolt Circle	$MP := 72in$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 13.25ft$
Length of Pier	$L_p := 7.9166 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 0.0 \cdot ft$
Diameter of Pier	$d_p := 8 \cdot ft$
Thickness of Footing	$T_f := 5 \cdot ft$
Width of Footing:	$W_f := 27ft$
Length of Anchor Bolts:	$L_{st} := 84in$
Projection of anchor bolts above pier	$A_{BP} := 12.0 \cdot in$
Anchor Bolt Diameter	$d_{anchor} := 2.25in$
Anchor bolt area	$A_{anchor} := 3.98 \cdot in^2$

PROPERTIES:

Compressive Strength of Concrete	$fc := 4000psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Yield Strength of Anchor Bolt	$fya := 75000 \cdot psi$
Internal Friction Angle of Soil	$\phi_s := 35 \cdot deg$
Allowable Bearing Capacity	$q_s := 4000 \cdot psf$
Unit Weight of Soil	$\gamma_{soil} := 100 \cdot pcf$
Unit Weight of Concrete	$\gamma_{conc} := 150 \cdot pcf$
Is foundation subject to bouyancy (Yes=1/N=0):	$Bouyancy := 1$
Depth to Neglect	$n := 1.0ft$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c := 0 \cdot ksf$
Seismic Zone Factor: IBC Fig 23-2	$Z := 2$
Coefficient of Friction between Concrete:	$\mu := 0.45$
Clear Cover of Reinforcement Pier:	$Cvr_{pier} := 3 \cdot in$
Clear Cover of Reinforcement Pad:	$Cvr_{pad} := 3 \cdot in$

PIER REINFORCEMENT:

Bar Size	$BSpier := 9$	Bar Diameter	$d_{bpier} := 1.125 \cdot in$
Number of Bars	$NBpier := 38$	Bar Area	$A_{bpier} := 1.0 \cdot in^2$

PAD REINFORCEMENT:

TOP:	Bar Size	$BS_{top} := 8$	Bar Diameter	$d_{btop} := 1.000 \cdot in$
	Number of Bars	$NB_{top} := 42$	Bar Area	$A_{btop} := 0.790 \cdot in^2$
BOTTOM:	Bar Size	$BS_{bot} := 8$	Bar Diameter	$d_{bbot} := 1.000 \cdot in$
	Number of Bars	$NB_{bot} := 42$	Bar Area	$A_{bot} := 0.790 \cdot in^2$

Coefficient of Lateral Soil Pressure: $K_p := \frac{1 + \sin(\phi_s)}{1 - \sin(\phi_s)}$ $K_p = 3.6902$

Load Factor (EIA 3.1.1): $LF := \text{if}\left[H_t \le 700 \cdot ft, 1.333, \text{if}\left[H_t \ge 1200, 1.7, 1.333 + \left(\frac{H_t - 700}{1200 - 700}\right) \cdot 0.4\right]\right]$ $LF = 1.333$

STABILITY OF FOOTING

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

$\gamma_s := if(Bouyancy = 1, \gamma_{soil} - 62.4pcf, \gamma_{soil})$ $\gamma_s = 37.6 \cdot pcf$

Passive Pressure: $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pn} = 0.1388 \cdot ksf$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pt} = 1.1447 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}]$ $P_{top} = 1.1447 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 1.8384 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 1.4916 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)]$ $T_p = 5 \cdot ft$

$A_p := W_f \cdot T_p$ $A_p = 135 \cdot ft^2$

Ultimate Shear: $S_u := P_{ave} \cdot A_p$ $S_u = 201.3616 \cdot kip$

Weight of Concrete Pad: $WT_c := \left[\left(W_f^2 \cdot T_f \right) + \frac{d_p^2 \cdot \pi}{4} L_p \right] \cdot \gamma_c$ $WT_c = 354.1608 \cdot kip$

Weight of Soil: above Footing: $WT_{s1} := \left[W_f^2 \cdot \left(\left| L_p - L_{pag} - n \right| \right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(\left| L_p - L_{pag} - n \right| \right) \right] \cdot \gamma_s$ $WT_{s1} = 176.5145 \cdot kip$

Weight of Soil Wedge at back face: $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\phi_s)}{2} \cdot W_f \right) \cdot \gamma_s$ $WT_{s2} = 62.3994 \cdot kip$

Total Weight: $WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 578.6753 \cdot kip$

Resisting Moment: $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\phi_s)}{3} \right)$ $M_r = 10025.4778 \cdot kip \cdot ft$

Overturning Moment: $M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 4463.9976 \cdot kip \cdot ft$

Factor of Safety: $FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 2.25$

$SafetyCheck := if(FS > FS_{req}, "Okay", "No Good")$ $SafetyCheck = "Okay"$

SHEAR CAPACITY IN PIER

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS_{req}} \qquad S_p = 230.8828 \cdot kips$$

$$ShearCheck := if(S_p > S_t, "Okay", "No Good") \qquad ShearCheck = "Okay"$$

BEARING PRESSURE CAUSED BY FOOTING

$$A_{mat} := W_f^2 \qquad A_{mat} = 729 \cdot ft^2$$

$$S := \frac{W_f^3}{6} \qquad S = 3280.5 \cdot ft^3$$

$$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} \qquad P_{max} = 2.1546 \cdot ksf$$

$$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} \qquad P_{min} = -0.567 \cdot ksf$$

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

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

Distance to Resultant of Pressure Distribution:

$$X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} \qquad X_p = 7.125 \cdot ft$$

Distance to Kern:

$$X_k := \frac{W_f}{6} \qquad X_k = 4.5 \cdot ft$$

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

Eccentricity:

$$e := \frac{M_{ot}}{WT_{tot}} \qquad e = 7.7142$$

Adjusted Soil Pressure:

$$P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \left(\frac{W_f}{2} - e \right)} \qquad P_a = 2.4695 \cdot ksf$$

$$q_{adj} := if\left(P_{min} < 0, P_a, \frac{P_{max}}{ft^2}\right) \qquad q_{adj} = 2.4695 \cdot ksf$$

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

CONCRETE BEARING CAPACITY (ACI 10.17)

(ACI 9.3.2.2) $\phi_c := 0.75$

$$P_b := \phi_c \cdot 0.85 \cdot f'c \cdot \frac{d_p^{\,2} \cdot \pi}{4} \qquad P_b = 18457.4852 \cdot kip$$

$$BearingCheck := if\left(P_b > LF \cdot C_t, "Okay", "No\ Good"\right) \qquad BearingCheck = "Okay"$$

SHEAR STRENGTH OF CONCRETE

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

(ACI 9.3.2.3) $\phi_{vc} := .85$

$$d := T_f - Cvr_{pad} - d_{bbot} \qquad d = 56 \cdot in$$

$$d_1 := \frac{W_f}{2} - \frac{d_p}{2} \qquad d_1 = 9.5 \cdot ft$$

$$d_2 := d_1 - d \qquad d_2 = 4.8333 \cdot ft$$

$$L := \left(\frac{W_f}{2} - e\right) \cdot 3 \qquad L = 17.3575 \cdot ft$$

$$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right) \qquad Slope = 0.1423 \cdot kcf$$

$$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1 \qquad V_{req} = 613.3005 \cdot kip$$

ACI 11.3.1.1 $V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f'c \cdot psi} \cdot W_f \cdot d \qquad V_{Avail} = 1950.7964 \cdot kip$

$$BeamShearCheck := if\left(V_{req} < V_{Avail}, "Okay", "No\ Good"\right) \qquad BeamShearCheck = "Okay"$$

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.12.2.1)

$$b_o := \left(d_p + d\right) \cdot \pi \qquad b_o = 39.7935 \cdot ft$$

Area included inside bo: $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} \qquad A_{bo} = 126.0128 \cdot ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo} \qquad A_{out} = 602.9872 \cdot ft^2$

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

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

$v_u := Find(v_u)$ $v_u = 3.1161 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 392.6328 \cdot kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 523.3795 \cdot kips$

$V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f'c \cdot psi} \cdot b_o \cdot d$ $V_{Avail} = 5750.2986 \cdot kips$

$PunchingShearCheck := if(V_{req} < V_{Avail}, "Okay", "No Good")$ $PunchingShearCheck = "Okay"$

STEEL REINFORCEMENT IN THE PAD

ACI 9.3.2.2 $\phi_m := .90$

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 1.1179 \cdot ksf$

$M_n := \frac{1}{LF \cdot \phi_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f$ $M_n = 2050.421 \cdot kip \cdot ft$

ACI 10.2.7.3 $\beta := if\left[f'c \le 4000 \cdot psi, .85, if\left[f'c \ge 8000 \cdot psi, .65, .85 - \left(\frac{\frac{f'c}{psi} - 4000}{1000} \right) \cdot .05 \right] \right]$ $\beta = 0.85$

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2}$ $R_u = 3874.6\,lbf$

$\rho := \frac{0.85 \cdot f'c}{fy} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f'c}} \right)$ $\rho = 0.0005$

$\rho_{min} := 1.333 \cdot \rho$ $\rho_{min} = 0.0006$

TEMPERATURE AND SHRINKAGE

$\rho_{sh} := if(fy \geq 60000 \cdot psi, 0.0018, 0.0020)$ $\rho_{sh} = 0.0018$

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $As := \max(\rho\rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 32.6592 \cdot in^2$

$As_{prov} := A_{bot} \cdot NB_{bot}$ $As_{prov} = 33.18 \cdot in^2$

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

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 32.6592 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 33.18 \cdot in^2$

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

DEVELOPMENT LENGTH OF PAD REINFORCEMENT

TENSION (ACI 12.2.3)

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 6.7317 \cdot in$

Development Length Factors:

Reinforcement Location Factor $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\gamma := 1.0$

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

Transverse Reinforcement Index:

As allowed by ACI 12.2.4 $k_{tr} := 0$

$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot}$ $L_{dbt} = 23.7171 \cdot in$

$L_{dbmin} := 12 \cdot in$

Minimum Development Length: (ACI 12.2.1) $L_{dbtCheck} := if(L_{dbt} \geq L_{dbmin}, "Use L.dbt", "Use L.dbmin")$ $L_{dbtCheck} = "Use L.dbt"$

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad}$ $L_{Pad} = 111 \cdot in$

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

REINFORCEMENT IN PIER

Pier Area:

$$A_p := \frac{\pi \cdot d_p^{\,2}}{4} \qquad A_p = 7238.2295 \cdot in^2$$

(ACI 10.8.4 and 10.9.1)

$A_{smin} := 0.01 \cdot 0.05 \cdot A_p$ $\quad A_{smin} = 3.6191 \cdot in^2$

$A_{sprov} := NBpier \cdot A_{bpier}$ $\quad A_{sprov} = 38 \cdot in^2$

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

NOTE: Anchor Bolts are not accounted for in reinforcement calculation and will provide additional reinforcement to satisfy minimum requirement of steel.

Bar Spacing In Pier:

$$B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier} \qquad B_{sPier} = 6.8117 \cdot in$$

Diameter of Reinforcement Cage:

$Diam_{cage} := d_p - 2 \cdot Cvr_{pier}$ $\quad Diam_{cage} = 90 \cdot in$

Maximum Moment in Pier:

$$M_p := \left[M_t + S_t \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF \qquad M_p = 68814.7536 \cdot in \cdot kips$$

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

(defined variables) $\quad (f_c \;\; f_y \;\; cl \;\; Spiral) = (3 \;\; 60 \;\; 3 \;\; 0)$

The required input is column diameter in inches, number of reinforcing bars, bar size number, factored axial load in kips and moment in kip inches:

$(D \;\; N \;\; n \;\; P_u \;\; M_{xu}) := (96 \;\; 38 \;\; 8 \;\; 45.4 \;\; 43224)$

Clears any previous output:

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

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

The Output is given as useable axial load in kips, moment capacity in kip inches, splicing stress in ksi, and reinforcement ratio:

$(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho) = (72.9323 \;\; 69436.6555 \;\; -60 \;\; 0.0041)$

Column size and reinforcement may be changed to match capacity to the applied load.

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

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

DEVELOPMENT LENGTH OF PIER REINFORCEMENT

TENSION (ACI 12.2.3)

Factors for development:

Reinforcement Location Factor $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\gamma := 1.0$

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

Transverse Reinforcement:

As allowed by ACI 12.2.4 $k_{tr} := 0$

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\frac{c + k_{tr}}{d_{bpier}}} \cdot d_{bpier} \qquad L_{dbt} = 30.0169 \cdot in$$

$L_{dbmin} := 12 \cdot in$

Minimum Development Length: (ACI 12.2.1)

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

$$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f'c}{psi}}} \cdot .7 \qquad L_{dh} = 14.9418 \cdot in$$

$L_{db} := \max\left(L_{dbt}, L_{dbmin}\right)$ $L_{db} = 30.0169 \cdot in$

COMPRESSION: (ACI 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot fy}{\sqrt{f'c \cdot psi}} \qquad L_{dbc1} = 21.3454 \cdot in$$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot fy\right)$ $L_{dbmin} = 20.25 \cdot in$

$L_{dbc} := \text{if}\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right)$ $L_{dbc} = 21.3454 \cdot in$

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier}$ $L_{pier} = 91.9992 \cdot in$

$L_{pad} := T_f - Cvr_{pad}$ $L_{pad} = 57 \cdot in$

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

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

NOTE: Anchor bolts and plate provided

TIE SIZE AND SPACING IN COLUMN

Minimum Tie Size:

$Tie_{min} := if(BSpier \le 10, 3, 4)$ $\quad Tie_{min} = 3$

Used #4 Ties

$d_{Tie} := 4$

Seismic factor:
(ACI 21.10.5)

$z := if(Z \le 2, 1, 0.5)$ $\quad z = 1$

$s_{lim1} := 16 \cdot d_{bpier} \cdot z$ $\quad s_{lim1} = 18 \cdot in$

$s_{lim2} := \frac{48 \cdot d_{Tie} \cdot in}{8} \cdot z$ $\quad s_{lim2} = 24 \cdot in$

$s_{lim3} := D_f \cdot z$ $\quad s_{lim3} = 159 \cdot in$

$s_{lim4} := 18in$ $\quad s_{lim4} = 18 \cdot in$

Maximum Spacing:

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

Number of Ties Required:

$$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 \quad n_{tie} = 5.9444$$

CHECK ANCHOR STEEL EMBEDMENT

Depth:

$D_{ab} := L_{st} - A_{BP}$ $\quad D_{ab} = 6 \cdot ft$ $\quad L_{anchor} := \frac{(0.11 \cdot fya) \cdot in}{\sqrt{f'c \cdot psi}}$ $\quad L_{anchor} = 10.8703 \cdot ft$

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

$DepthCheck = "No Good"$

Note: Anchor plate is provided

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Calculated Radio Frequency Emissions

CT2081

(Cheshire Police Department)

500 Highland Ave, Cheshire, CT 06410

a.k.a (490/500 Highland Ave)

October 16, 2012

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1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed modifications to the existing AT&T antenna arrays mounted on the monopole tower located on 500 Highland Avenue in Cheshire, CT. The coordinates of the tower are 41° 30' 40.32" N, 72° 53' 54.60" W.

AT&T is proposing the following modifications:

1) Remove six dual-band (850/1900) antennas (two per sector),
2) Install three multi-band (700/850/1900/2100 MHz) antennas for their GSM network (one per sector),
3) Install three multi-band (700/850/1900/2100 MHz) antennas for their LTE network (one per sector).

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. RF Exposure Prediction Methods

The emission field calculation results displayed in the following figures were generated using the following formula as outlined in FCC bulletin OET 65:

$$\text{Power Density} = \left(\frac{1.6^2 \times EIRP}{4\pi \times R^2} \right) \text{x Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power

R = Radial Distance = $\sqrt{(H^2 + V^2)}$

H = Horizontal Distance from antenna in meters

V = Vertical Distance from radiation center of antenna in meters

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and power, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the predicted signal levels reported below are much higher than the actual signal levels will be from the finished modifications.

4. Calculation Results

Table 1 below outlines the power density information for the site. Because the proposed AT&T antennas are directional in nature, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the tower. Please refer to Attachment C for the vertical patterns of the proposed AT&T antennas. The calculated results for AT&T in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
Cingular GSM	*127*	*880*	*2*	*296*	*0.0132*	*0.5867*	*2.25%*
Cingular GSM	*127*	*1930*	*2*	*427*	*0.0190*	*1.0000*	*1.90%*
Cingular UMTS	*127*	*880*	*1*	*500*	*0.0111*	*0.5867*	*1.90%*
Sprint CDMA	157.5	1962.5	11	411	0.0655	1.0000	6.55%
Sprint WiMAX	157.5	2657	3	562	0.0244	1.0000	2.44%
Sprint microwave antenna	157.5	22500	2	4.42	0.0001	1.0000	0.01%
Pocket	137.5	2130	3	631	0.0360	1.0000	3.60%
Town Emergency Svcs	167.5	450	1	1200	0.0154	0.3000	5.13%
T-Mobile GSM	147.5	1945	8	123	0.0163	1.0000	1.63%
T-Mobile UMTS	147.5	2100	2	692	0.0229	1.0000	2.29%
Nextel	107	851	12	100	0.0377	0.5673	6.64%
Verizon	117	869	9	319	0.0754	0.5793	13.02%
Verizon	117	1970	3	436	0.0344	1.0000	3.44%
Verizon	117	757	1	692	0.0182	0.5047	3.60%
AT&T UMTS	132	880	2	565	0.0023	0.5867	0.40%
AT&T UMTS	132	1900	2	1077	0.0044	1.0000	0.44%
AT&T LTE	132	734	1	1615	0.0033	0.4893	0.68%
AT&T GSM	132	880	1	647	0.0013	0.5867	0.23%
AT&T GSM	132	1900	4	934	0.0077	1.0000	0.77%
						Total	**50.87%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

[2] In the case where antenna models are not uniform across all 3 sectors for the same frequency band, the antenna model with the highest gain was used for the calculations to present a worse-case scenario.

[3] Antenna height listed for AT&T is in reference to the URS Corporation Structural Analysis dated October 15, 2012.

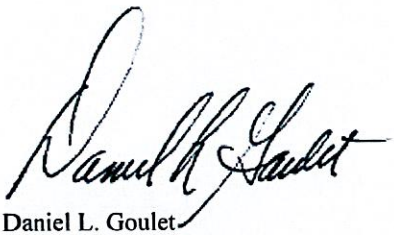
5. Conclusion

The above analysis verifies that emissions from the existing site will be below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Even when using conservative methods, the cumulative power density from the proposed transmit antennas at the existing facility is well below the limits for the general public. The highest expected percent of Maximum Permissible Exposure at ground level is **50.87% of the FCC limit**.

As noted previously, obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. As a result, the predicted signal levels are more conservative (higher) than the actual signal levels will be from the finished modifications.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1 and FCC OET Bulletin 65 Edition 97-01.



Daniel L. Goulet
C Squared Systems, LLC

October 16, 2012
Date

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

ANSI C95.1-1982, American National Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. IEEE-SA Standards Board

IEEE Std C95.3-1991 (Reaff 1997), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. IEEE-SA Standards Board

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[4]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

[4] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

[5] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

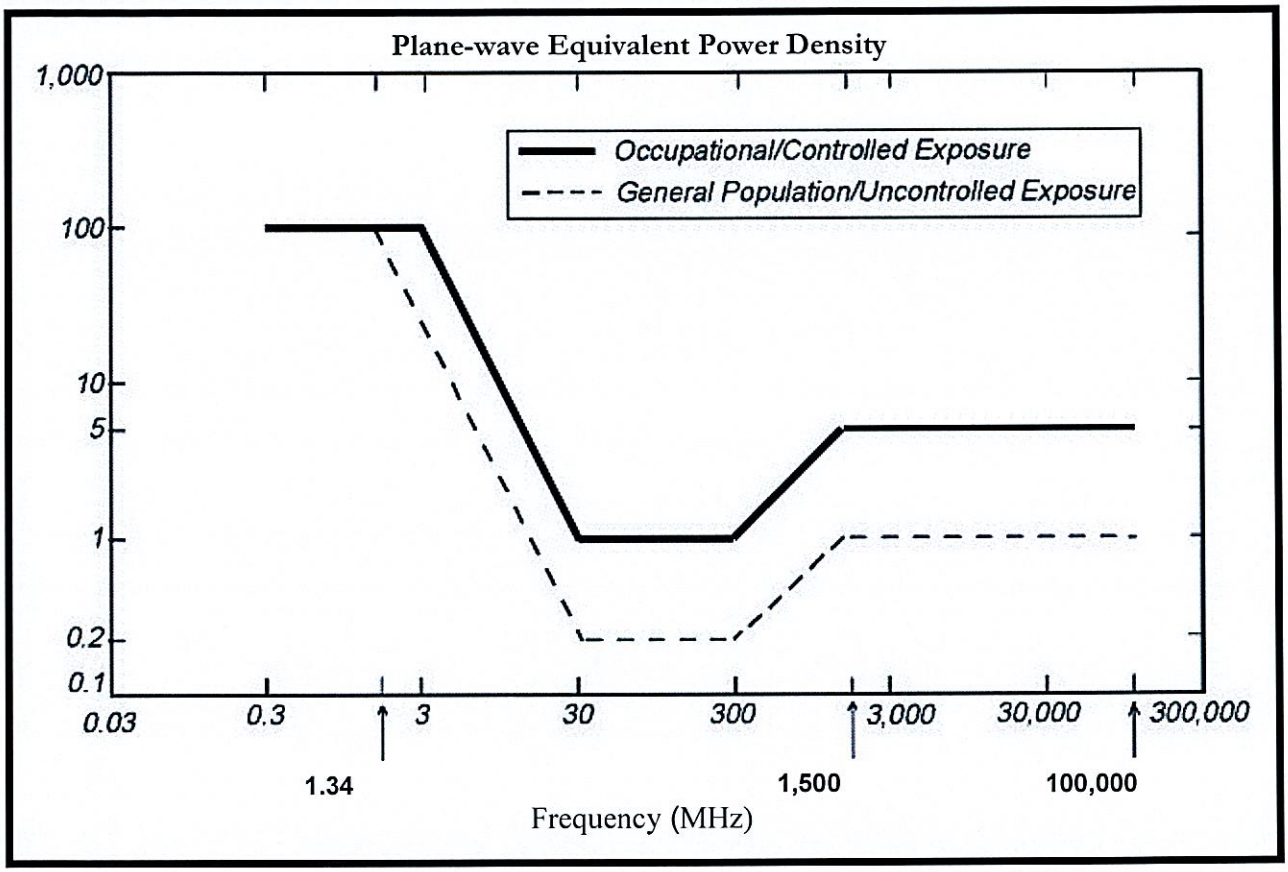
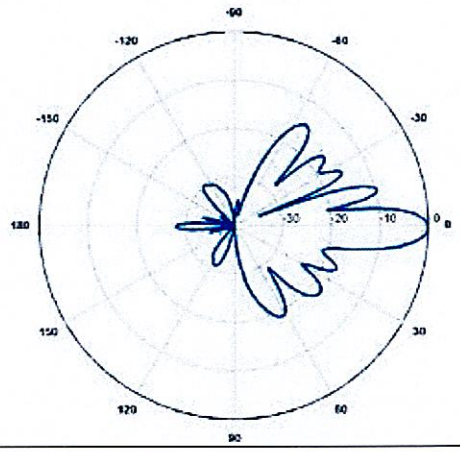


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Antenna Data Sheets and Electrical Patterns

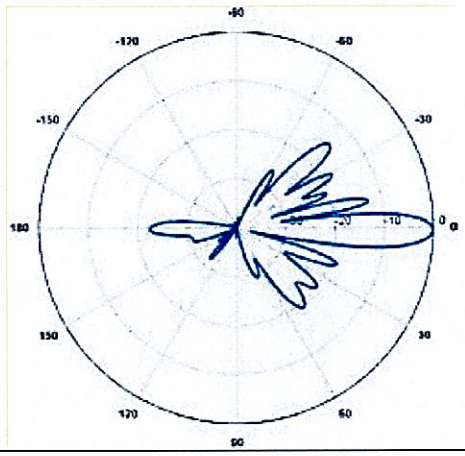
700 MHz

Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	698-806 MHz
Gain:	14.3 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	70°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



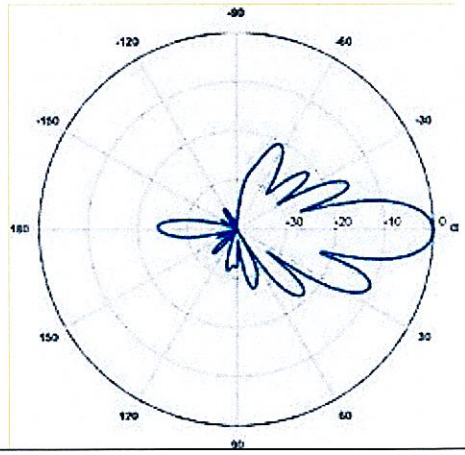
850 MHz GSM

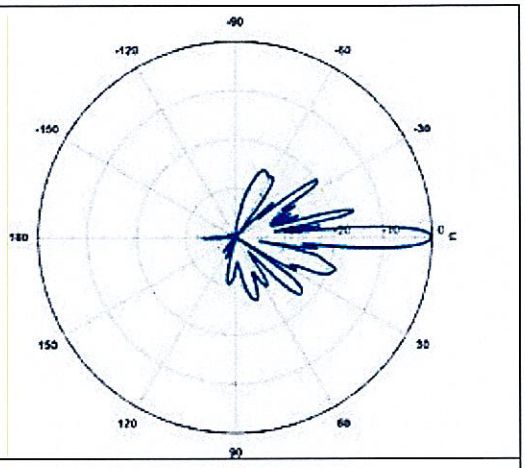
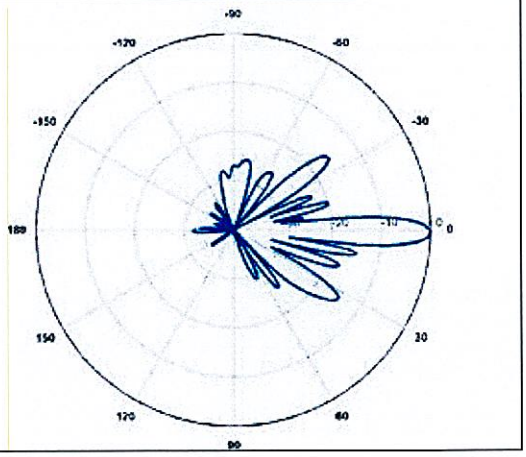
Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	806-894 MHz
Gain:	15.1 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	63°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



850 MHz UMTS

Manufacturer:	Kathrein
Model #:	800-10121
Frequency Band:	824-896 MHz
Gain:	11.5 dBd
Vertical Beamwidth:	14.5°
Horizontal Beamwidth:	86°
Polarization:	± 45°
Size L x W x D:	54.5" x 10.3" x 5.9"



1900 MHz GSM Manufacturer: Commscope Model #: SBNH-1D6565C Frequency Band: 1850-1990 MHz Gain: 15.9 dBd Vertical Beamwidth: 5.1° Horizontal Beamwidth: 57° Polarization: ± 45° Size L x W x D: 96.42" x 11.85" x 7.1"	
1900 MHz UMTS Manufacturer: Kathrein Model #: 800-10121 Frequency Band: 1850-1990 MHz Gain: 14.3 dBd Vertical Beamwidth: 6.6° Horizontal Beamwidth: 85° Polarization: ± 45° Size L x W x D: 54.5" x 10.3" x 5.9"	

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Calculated Radio Frequency Emissions

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500 Highland Ave, Cheshire, CT 06410

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October 16, 2012

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1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed modifications to the existing AT&T antenna arrays mounted on the monopole tower located on 500 Highland Avenue in Cheshire, CT. The coordinates of the tower are 41° 30' 40.32" N, 72° 53' 54.60" W.

AT&T is proposing the following modifications:

1) Remove six dual-band (850/1900) antennas (two per sector),

2) Install three multi-band (700/850/1900/2100 MHz) antennas for their GSM network (one per sector),

3) Install three multi-band (700/850/1900/2100 MHz) antennas for their LTE network (one per sector).

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. RF Exposure Prediction Methods

The emission field calculation results displayed in the following figures were generated using the following formula as outlined in FCC bulletin OET 65:

$$\text{Power Density} = \left(\frac{1.6^2 \times EIRP}{4\pi \times R^2} \right) \text{x Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power

R = Radial Distance = $\sqrt{(H^2 + V^2)}$

H = Horizontal Distance from antenna in meters

V = Vertical Distance from radiation center of antenna in meters

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and power, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the predicted signal levels reported below are much higher than the actual signal levels will be from the finished modifications.

4. Calculation Results

Table 1 below outlines the power density information for the site. Because the proposed AT&T antennas are directional in nature, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the tower. Please refer to Attachment C for the vertical patterns of the proposed AT&T antennas. The calculated results for AT&T in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
Cingular GSM	*127*	*880*	*2*	*296*	*0.0132*	*0.5867*	*2.25%*
Cingular GSM	*127*	*1930*	*2*	*427*	*0.0190*	*1.0000*	*1.90%*
Cingular UMTS	*127*	*880*	*1*	*500*	*0.0111*	*0.5867*	*1.90%*
Sprint CDMA	157.5	1962.5	11	411	0.0655	1.0000	6.55%
Sprint WiMAX	157.5	2657	3	562	0.0244	1.0000	2.44%
Sprint microwave antenna	157.5	22500	2	4.42	0.0001	1.0000	0.01%
Pocket	137.5	2130	3	631	0.0360	1.0000	3.60%
Town Emergency Svcs	167.5	450	1	1200	0.0154	0.3000	5.13%
T-Mobile GSM	147.5	1945	8	123	0.0163	1.0000	1.63%
T-Mobile UMTS	147.5	2100	2	692	0.0229	1.0000	2.29%
Nextel	107	851	12	100	0.0377	0.5673	6.64%
Verizon	117	869	9	319	0.0754	0.5793	13.02%
Verizon	117	1970	3	436	0.0344	1.0000	3.44%
Verizon	117	757	1	692	0.0182	0.5047	3.60%
AT&T UMTS	132	880	2	565	0.0023	0.5867	0.40%
AT&T UMTS	132	1900	2	1077	0.0044	1.0000	0.44%
AT&T LTE	132	734	1	1615	0.0033	0.4893	0.68%
AT&T GSM	132	880	1	647	0.0013	0.5867	0.23%
AT&T GSM	132	1900	4	934	0.0077	1.0000	0.77%
						Total	**50.87%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

[2] In the case where antenna models are not uniform across all 3 sectors for the same frequency band, the antenna model with the highest gain was used for the calculations to present a worse-case scenario.

[3] Antenna height listed for AT&T is in reference to the URS Corporation Structural Analysis dated October 15, 2012.

5. Conclusion

The above analysis verifies that emissions from the existing site will be below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Even when using conservative methods, the cumulative power density from the proposed transmit antennas at the existing facility is well below the limits for the general public. The highest expected percent of Maximum Permissible Exposure at ground level is **50.87% of the FCC limit**.

As noted previously, obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. As a result, the predicted signal levels are more conservative (higher) than the actual signal levels will be from the finished modifications.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1 and FCC OET Bulletin 65 Edition 97-01.

Daniel L. Goulet
C Squared Systems, LLC

October 16, 2012
Date

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Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[4]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

[4] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

[5] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

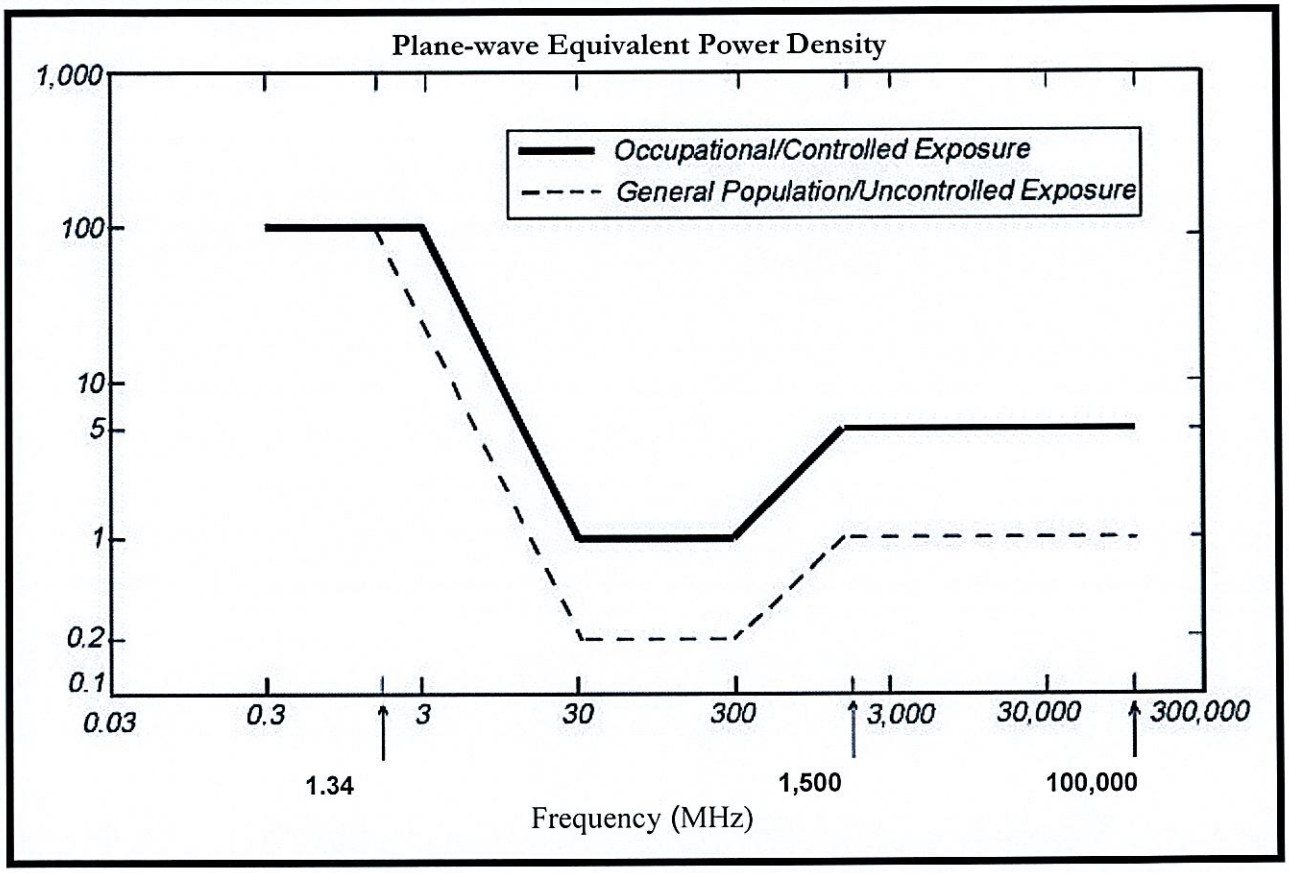
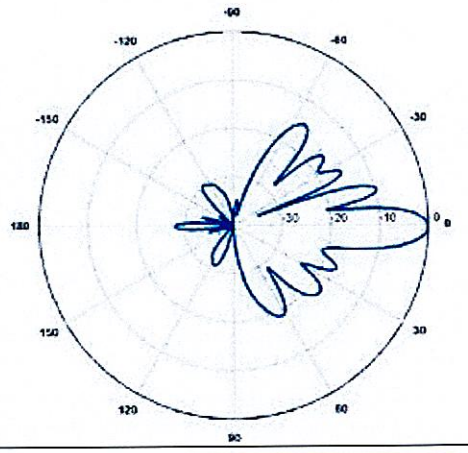


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Antenna Data Sheets and Electrical Patterns

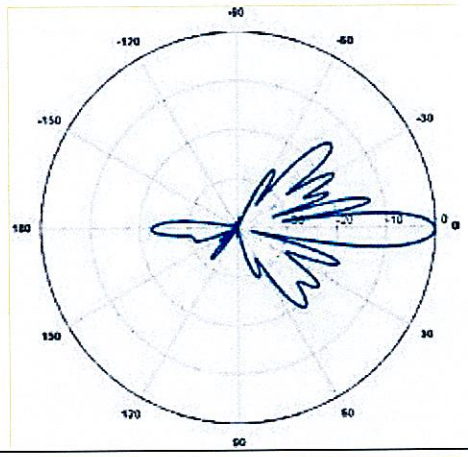
700 MHz

Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	698-806 MHz
Gain:	14.3 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	70°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



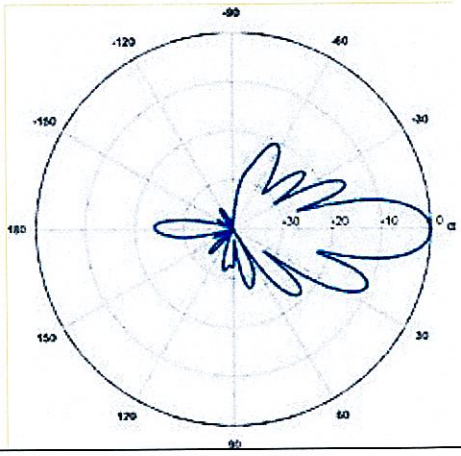
850 MHz GSM

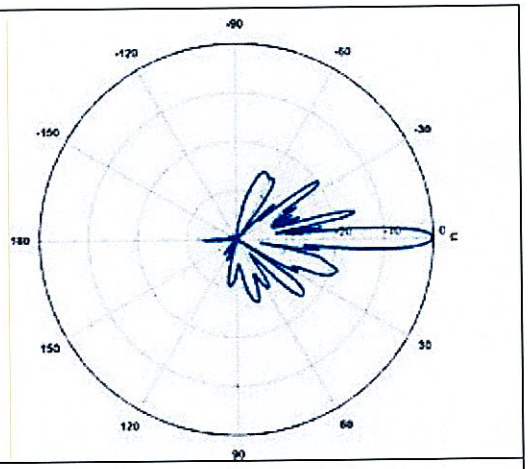
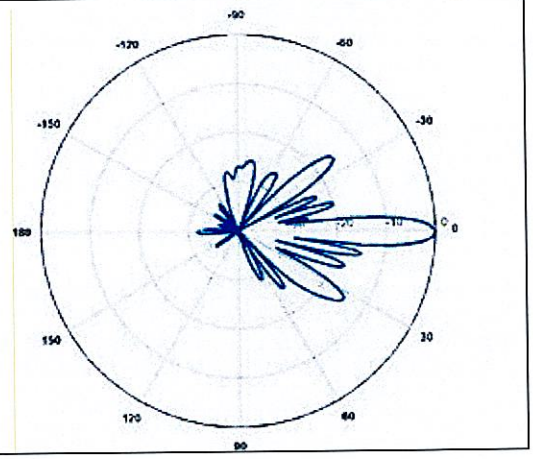
Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	806-894 MHz
Gain:	15.1 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	63°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



850 MHz UMTS

Manufacturer:	Kathrein
Model #:	800-10121
Frequency Band:	824-896 MHz
Gain:	11.5 dBd
Vertical Beamwidth:	14.5°
Horizontal Beamwidth:	86°
Polarization:	± 45°
Size L x W x D:	54.5" x 10.3" x 5.9"



1900 MHz GSM Manufacturer: Commscope Model #: SBNH-1D6565C Frequency Band: 1850-1990 MHz Gain: 15.9 dBd Vertical Beamwidth: 5.1° Horizontal Beamwidth: 57° Polarization: ± 45° Size L x W x D: 96.42" x 11.85" x 7.1"	
1900 MHz UMTS Manufacturer: Kathrein Model #: 800-10121 Frequency Band: 1850-1990 MHz Gain: 14.3 dBd Vertical Beamwidth: 6.6° Horizontal Beamwidth: 85° Polarization: ± 45° Size L x W x D: 54.5" x 10.3" x 5.9"	

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H = Horizontal Distance from antenna in meters

V = Vertical Distance from radiation center of antenna in meters

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and power, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the predicted signal levels reported below are much higher than the actual signal levels will be from the finished modifications.

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Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
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						Total	**50.87%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

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October 16, 2012
Date

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(A) Limits for Occupational/Controlled Exposure[4]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

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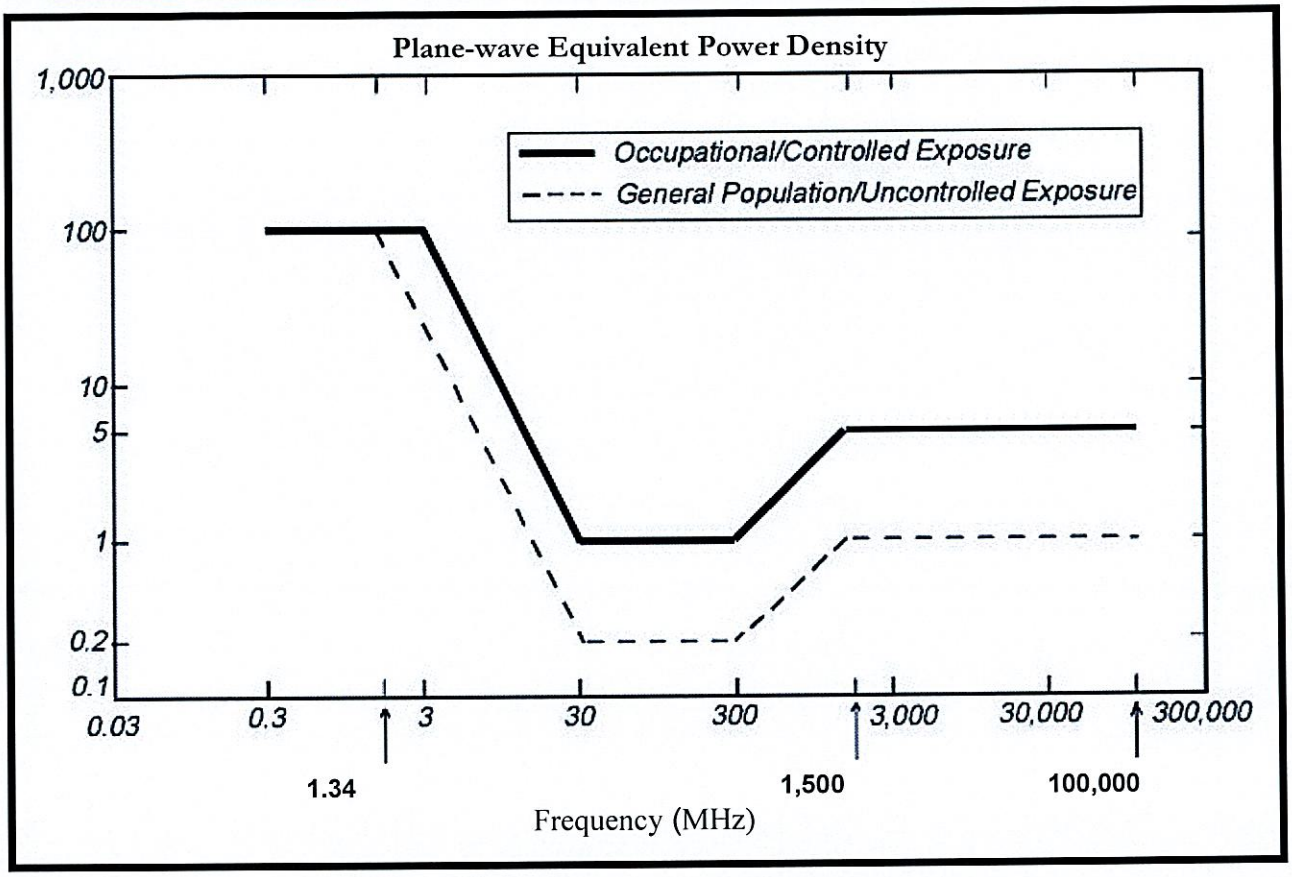
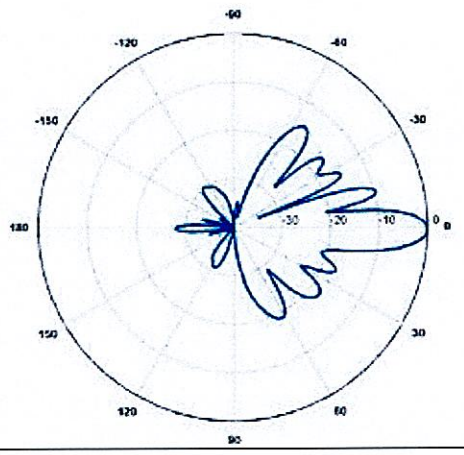


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Antenna Data Sheets and Electrical Patterns

700 MHz

Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	698-806 MHz
Gain:	14.3 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	70°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



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Model #:	P65-17-XLH-RR
Frequency Band:	806-894 MHz
Gain:	15.1 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	63°
Polarization:	Dual Linear ± 45°
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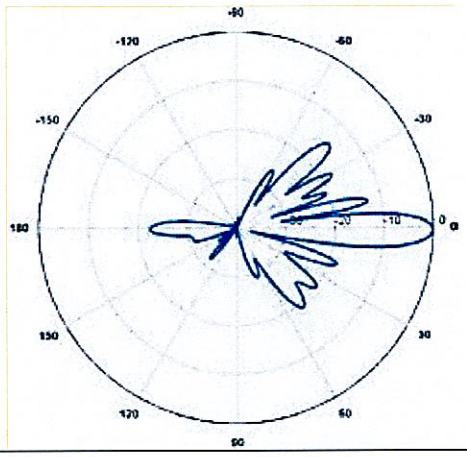

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Model #:	800-10121
Frequency Band:	824-896 MHz
Gain:	11.5 dBd
Vertical Beamwidth:	14.5°
Horizontal Beamwidth:	86°
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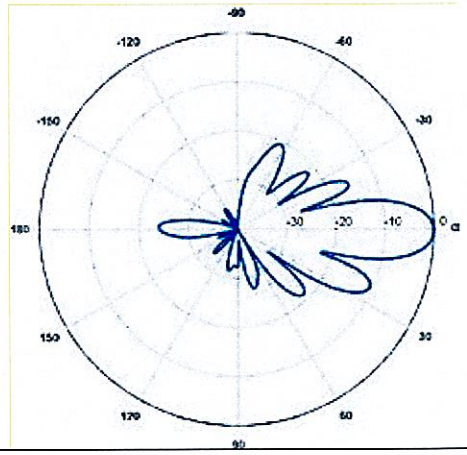
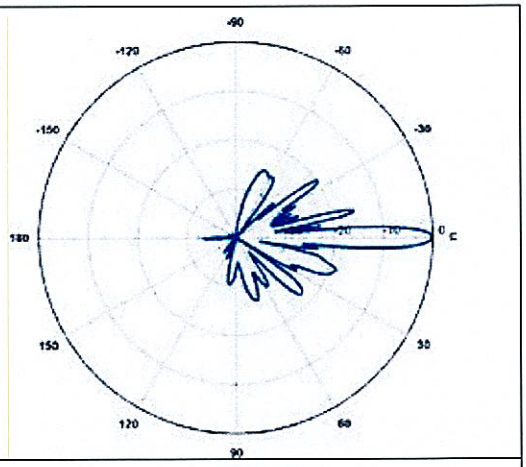
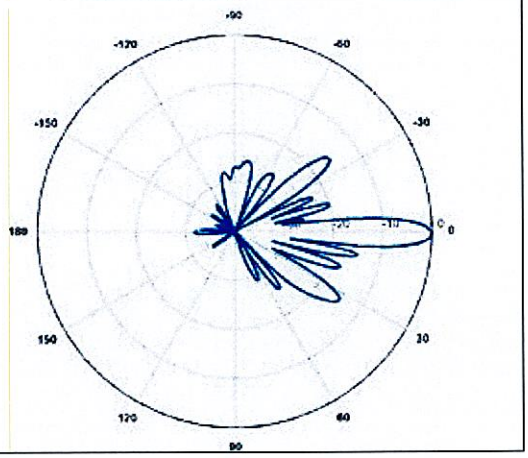


1900 MHz GSM Manufacturer: Commscope Model #: SBNH-1D6565C Frequency Band: 1850-1990 MHz Gain: 15.9 dBd Vertical Beamwidth: 5.1° Horizontal Beamwidth: 57° Polarization: ± 45° Size L x W x D: 96.42" x 11.85" x 7.1"	
1900 MHz UMTS Manufacturer: Kathrein Model #: 800-10121 Frequency Band: 1850-1990 MHz Gain: 14.3 dBd Vertical Beamwidth: 6.6° Horizontal Beamwidth: 85° Polarization: ± 45° Size L x W x D: 54.5" x 10.3" x 5.9"	

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Calculated Radio Frequency Emissions

CT2081

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500 Highland Ave, Cheshire, CT 06410

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October 16, 2012

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AT&T is proposing the following modifications:

1) Remove six dual-band (850/1900) antennas (two per sector),

2) Install three multi-band (700/850/1900/2100 MHz) antennas for their GSM network (one per sector),

3) Install three multi-band (700/850/1900/2100 MHz) antennas for their LTE network (one per sector).

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. RF Exposure Prediction Methods

The emission field calculation results displayed in the following figures were generated using the following formula as outlined in FCC bulletin OET 65:

$$\text{Power Density} = \left(\frac{1.6^2 \times EIRP}{4\pi \times R^2} \right) \text{x Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power

R = Radial Distance = $\sqrt{(H^2 + V^2)}$

H = Horizontal Distance from antenna in meters

V = Vertical Distance from radiation center of antenna in meters

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and power, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the predicted signal levels reported below are much higher than the actual signal levels will be from the finished modifications.

4. Calculation Results

Table 1 below outlines the power density information for the site. Because the proposed AT&T antennas are directional in nature, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the tower. Please refer to Attachment C for the vertical patterns of the proposed AT&T antennas. The calculated results for AT&T in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
Cingular GSM	*127*	*880*	*2*	*296*	*0.0132*	*0.5867*	*2.25%*
Cingular GSM	*127*	*1930*	*2*	*427*	*0.0190*	*1.0000*	*1.90%*
Cingular UMTS	*127*	*880*	*1*	*500*	*0.0111*	*0.5867*	*1.90%*
Sprint CDMA	157.5	1962.5	11	411	0.0655	1.0000	6.55%
Sprint WiMAX	157.5	2657	3	562	0.0244	1.0000	2.44%
Sprint microwave antenna	157.5	22500	2	4.42	0.0001	1.0000	0.01%
Pocket	137.5	2130	3	631	0.0360	1.0000	3.60%
Town Emergency Svcs	167.5	450	1	1200	0.0154	0.3000	5.13%
T-Mobile GSM	147.5	1945	8	123	0.0163	1.0000	1.63%
T-Mobile UMTS	147.5	2100	2	692	0.0229	1.0000	2.29%
Nextel	107	851	12	100	0.0377	0.5673	6.64%
Verizon	117	869	9	319	0.0754	0.5793	13.02%
Verizon	117	1970	3	436	0.0344	1.0000	3.44%
Verizon	117	757	1	692	0.0182	0.5047	3.60%
AT&T UMTS	132	880	2	565	0.0023	0.5867	0.40%
AT&T UMTS	132	1900	2	1077	0.0044	1.0000	0.44%
AT&T LTE	132	734	1	1615	0.0033	0.4893	0.68%
AT&T GSM	132	880	1	647	0.0013	0.5867	0.23%
AT&T GSM	132	1900	4	934	0.0077	1.0000	0.77%
						Total	**50.87%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

[2] In the case where antenna models are not uniform across all 3 sectors for the same frequency band, the antenna model with the highest gain was used for the calculations to present a worse-case scenario.

[3] Antenna height listed for AT&T is in reference to the URS Corporation Structural Analysis dated October 15, 2012.

5. Conclusion

The above analysis verifies that emissions from the existing site will be below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Even when using conservative methods, the cumulative power density from the proposed transmit antennas at the existing facility is well below the limits for the general public. The highest expected percent of Maximum Permissible Exposure at ground level is **50.87% of the FCC limit**.

As noted previously, obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. As a result, the predicted signal levels are more conservative (higher) than the actual signal levels will be from the finished modifications.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1 and FCC OET Bulletin 65 Edition 97-01.

Daniel L. Goulet
C Squared Systems, LLC

October 16, 2012
Date

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

ANSI C95.1-1982, American National Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. IEEE-SA Standards Board

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Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[4]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

[4] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

[5] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

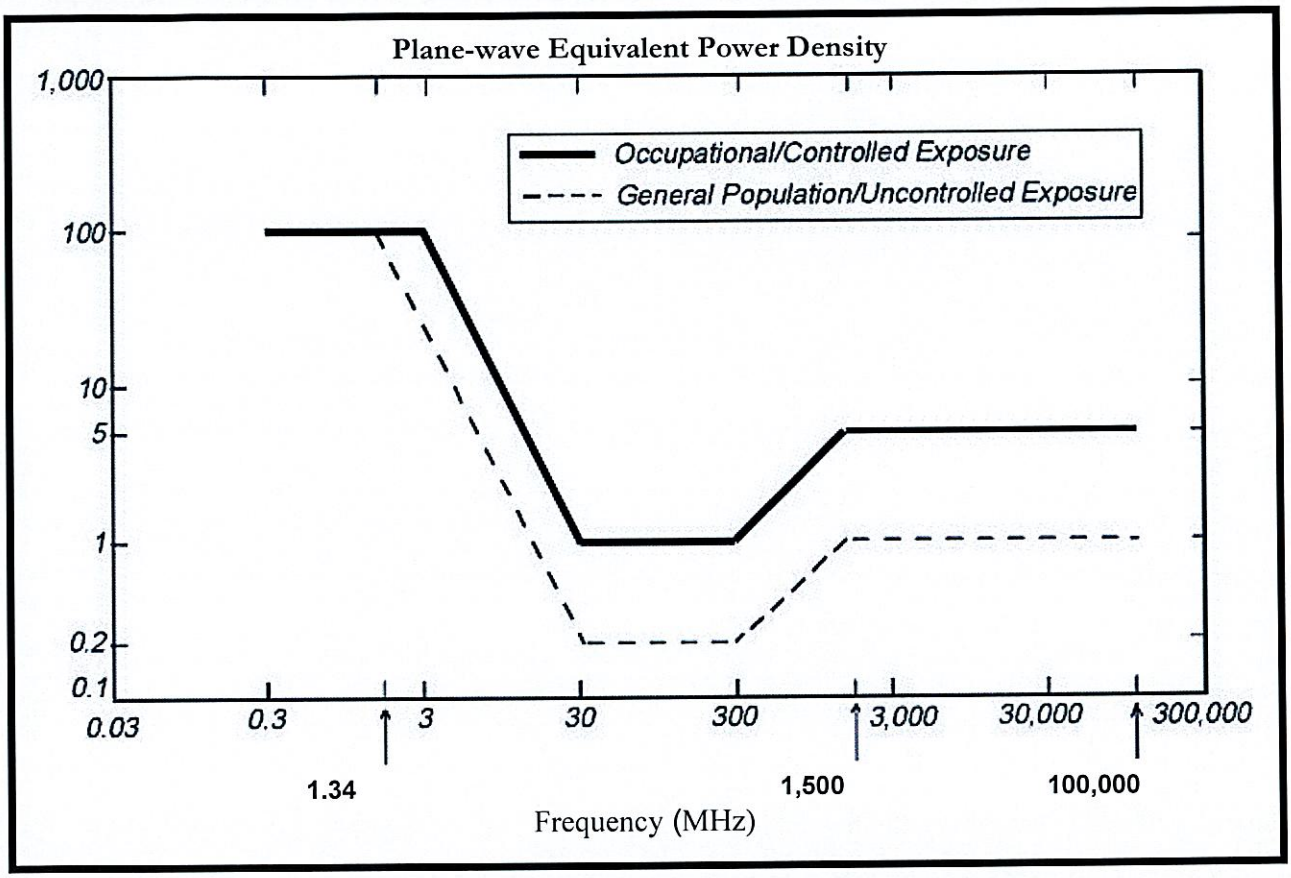
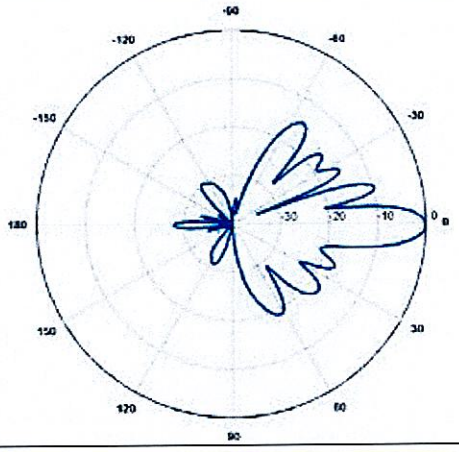


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Antenna Data Sheets and Electrical Patterns

700 MHz

Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	698-806 MHz
Gain:	14.3 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	70°
Polarization:	Dual Linear ± 45°
Size L x W x D:	96.0" x 12.0" x 6.0"



850 MHz GSM

Manufacturer:	Powerwave
Model #:	P65-17-XLH-RR
Frequency Band:	806-894 MHz
Gain:	15.1 dBd
Vertical Beamwidth:	8.4°
Horizontal Beamwidth:	63°
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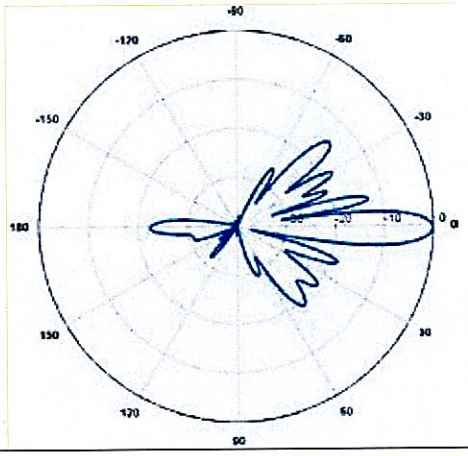
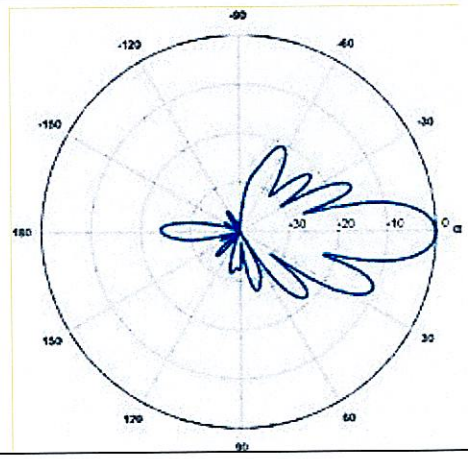
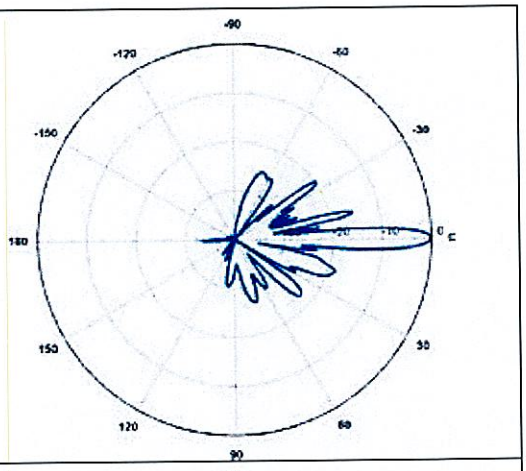
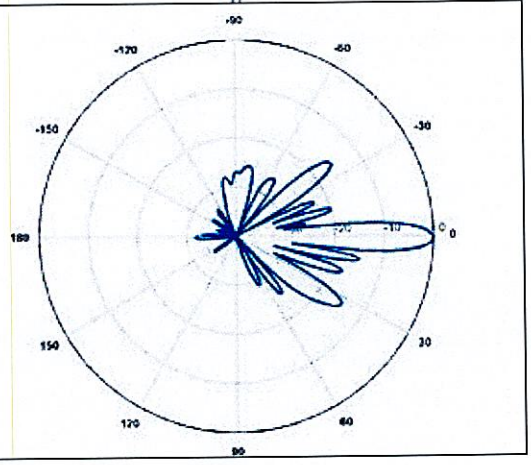
Size L x W x D:	96.0" x 12.0" x 6.0"



850 MHz UMTS

Manufacturer:	Kathrein
Model #:	800-10121
Frequency Band:	824-896 MHz
Gain:	11.5 dBd
Vertical Beamwidth:	14.5°
Horizontal Beamwidth:	86°
Polarization:	± 45°
Size L x W x D:	54.5" x 10.3" x 5.9"



1900 MHz GSM Manufacturer: Commscope Model #: SBNH-1D6565C Frequency Band: 1850-1990 MHz Gain: 15.9 dBd Vertical Beamwidth: 5.1° Horizontal Beamwidth: 57° Polarization: ± 45° Size L x W x D: 96.42" x 11.85" x 7.1"	
1900 MHz UMTS Manufacturer: Kathrein Model #: 800-10121 Frequency Band: 1850-1990 MHz Gain: 14.3 dBd Vertical Beamwidth: 6.6° Horizontal Beamwidth: 85° Polarization: ± 45° Size L x W x D: 54.5" x 10.3" x 5.9"	

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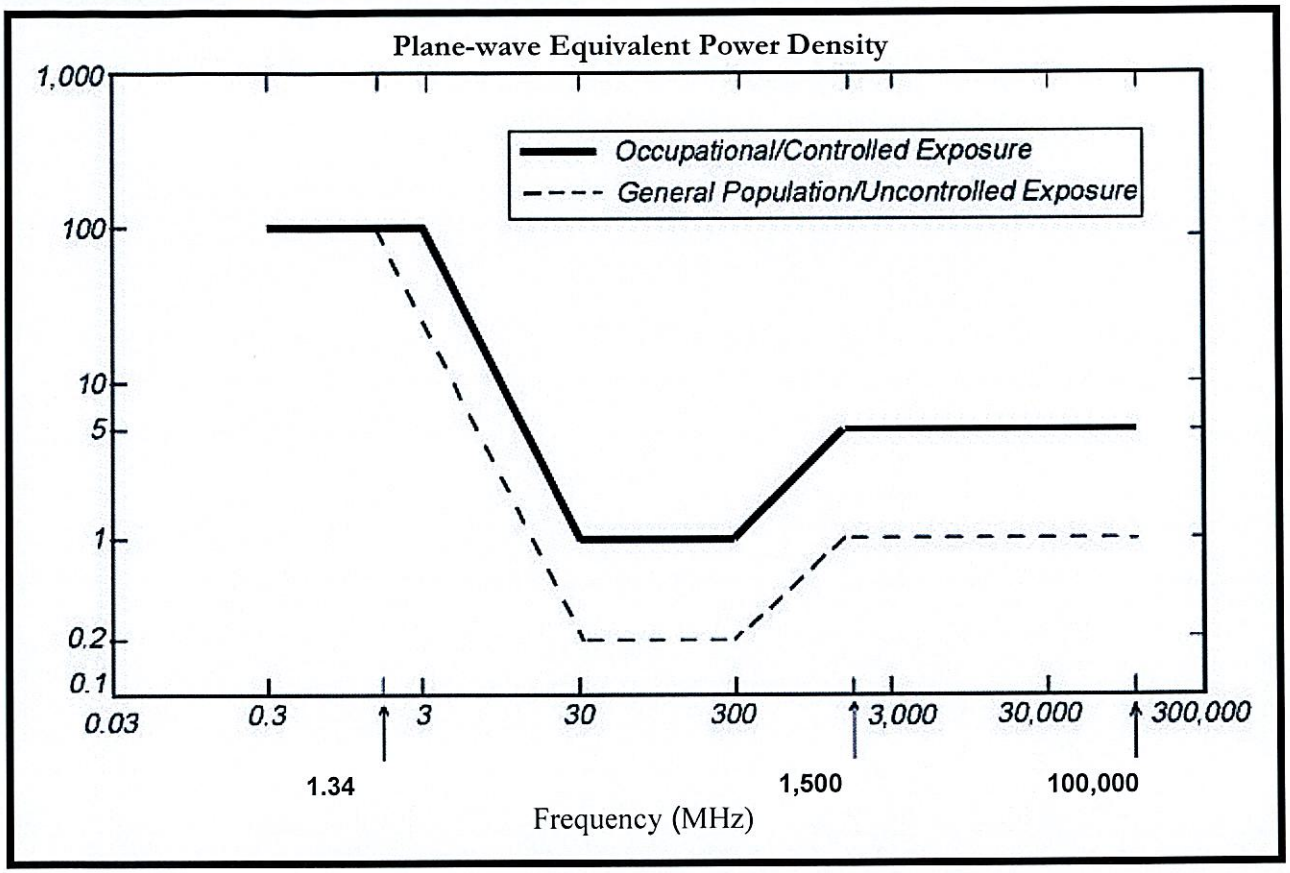

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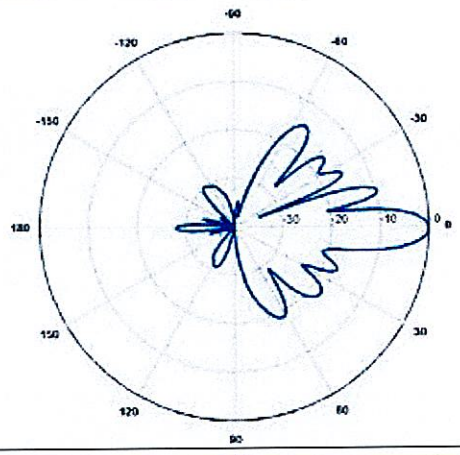

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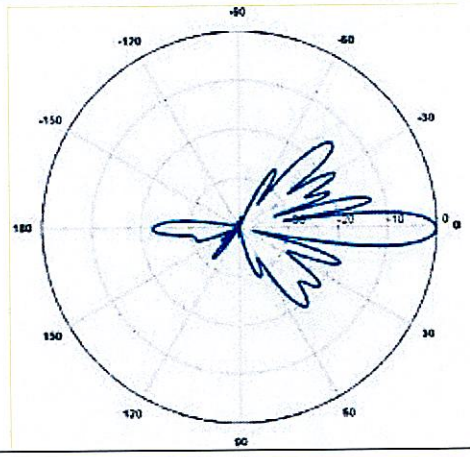

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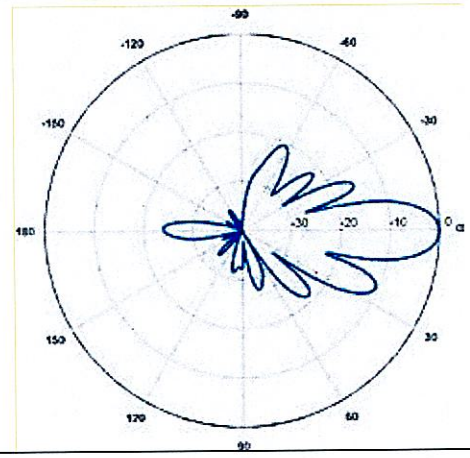
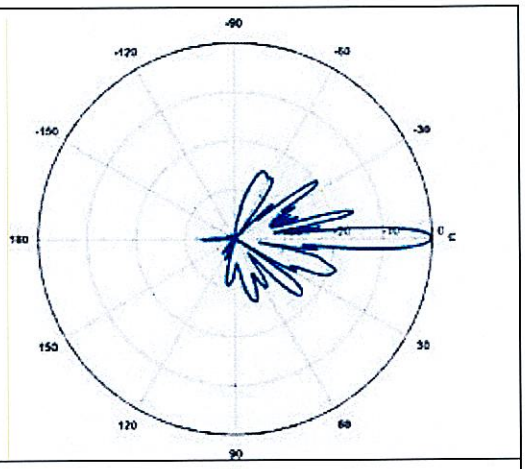
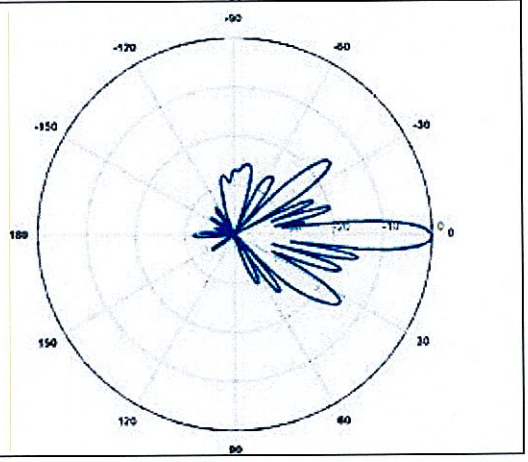


1900 MHz GSM Manufacturer: Commscope Model #: SBNH-1D6565C Frequency Band: 1850-1990 MHz Gain: 15.9 dBd Vertical Beamwidth: 5.1° Horizontal Beamwidth: 57° Polarization: ± 45° Size L x W x D: 96.42" x 11.85" x 7.1"	
1900 MHz UMTS Manufacturer: Kathrein Model #: 800-10121 Frequency Band: 1850-1990 MHz Gain: 14.3 dBd Vertical Beamwidth: 6.6° Horizontal Beamwidth: 85° Polarization: ± 45° Size L x W x D: 54.5" x 10.3" x 5.9"	

4. Calculation Results

Table 1 below outlines the power density information for the site. Because the proposed AT&T antennas are directional in nature, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the tower. Please refer to Attachment C for the vertical patterns of the proposed AT&T antennas. The calculated results for AT&T in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
Cingular GSM	*127*	*880*	*2*	*296*	*0.0132*	*0.5867*	*2.25%*
Cingular GSM	*127*	*1930*	*2*	*427*	*0.0190*	*1.0000*	*1.90%*
Cingular UMTS	*127*	*880*	*1*	*500*	*0.0111*	*0.5867*	*1.90%*
Sprint CDMA	157.5	1962.5	11	411	0.0655	1.0000	6.55%
Sprint WiMAX	157.5	2657	3	562	0.0244	1.0000	2.44%
Sprint microwave antenna	157.5	22500	2	4.42	0.0001	1.0000	0.01%
Pocket	137.5	2130	3	631	0.0360	1.0000	3.60%
Town Emergency Svcs	167.5	450	1	1200	0.0154	0.3000	5.13%
T-Mobile GSM	147.5	1945	8	123	0.0163	1.0000	1.63%
T-Mobile UMTS	147.5	2100	2	692	0.0229	1.0000	2.29%
Nextel	107	851	12	100	0.0377	0.5673	6.64%
Verizon	117	869	9	319	0.0754	0.5793	13.02%
Verizon	117	1970	3	436	0.0344	1.0000	3.44%
Verizon	117	757	1	692	0.0182	0.5047	3.60%
AT&T UMTS	132	880	2	565	0.0023	0.5867	0.40%
AT&T UMTS	132	1900	2	1077	0.0044	1.0000	0.44%
AT&T LTE	132	734	1	1615	0.0033	0.4893	0.68%
AT&T GSM	132	880	1	647	0.0013	0.5867	0.23%
AT&T GSM	132	1900	4	934	0.0077	1.0000	0.77%
						Total	**50.87%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

[2] In the case where antenna models are not uniform across all 3 sectors for the same frequency band, the antenna model with the highest gain was used for the calculations to present a worse-case scenario.

[3] Antenna height listed for AT&T is in reference to the URS Corporation Structural Analysis dated October 15, 2012.

5. Conclusion

The above analysis verifies that emissions from the existing site will be below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Even when using conservative methods, the cumulative power density from the proposed transmit antennas at the existing facility is well below the limits for the general public. The highest expected percent of Maximum Permissible Exposure at ground level is **50.87% of the FCC limit**.

As noted previously, obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. As a result, the predicted signal levels are more conservative (higher) than the actual signal levels will be from the finished modifications.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1 and FCC OET Bulletin 65 Edition 97-01.

Daniel L. Goulet
C Squared Systems, LLC

October 16, 2012
Date