Robinson+Cole

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Also admitted in Massachusetts

June 8, 2015

Melanie A. Bachman
Acting Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Facility Modification**
86 Voluntown Road, Stonington, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 140-foot level on an existing 196-foot monopole tower at 86 Voluntown Road in Stonington, Connecticut (the "Property"). The tower is owned by SBA. Cellco's use of the tower was approved by the Council in 2007. Cellco now intends to modify its facility by removing ten (10) existing antennas and installing eleven (11) new antennas (three (3) model LNX-6514DS-VTM, 700 MHz antennas; two (2) model LNX-8513DS-VTM, 850 MHz antennas; three (3) model HBXX-6517DS-VTM, 1900 MHz antennas; and three (3) model HBXX-6517DS-VTM, 2100 MHz antennas) for a total of thirteen (13) antennas, all at the same 140-foot level on the tower. Cellco also intends to install six (6) new remote radio heads ("RRHs"), one (1) each behind its 1900 MHz and 2100 MHz antennas and two (2) HYBRIFLEX™ antenna cables. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cables.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Edward Haberek, Jr., First Selectman for the Town of Stonington. A copy of this letter is also being sent to Blackrock Properties II, LLC, the owner of the Property.

The planned modifications to the facility fall squarely within those activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed modifications will not result in an increase in the height of the existing tower. The replacement antennas and RRHs will be installed on Cellco's existing antenna platform at the 140-foot level on the tower.

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.

3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table with Cellco's modified facility is included in Attachment 2.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. The tower and its foundation can support Cellco's proposed modifications. (*See* Structural Analysis included in Attachment 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Edward Haberek, Jr., Stonington First Selectman
Blackrock Properties II, LLC
Tim Parks

ATTACHMENT 1

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Great solution to maximize network coverage and capacity
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Excellent solution for site sharing and maximizing capacity
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- The RF connectors are designed for IP67 rating and the radome for IP56 rating

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.8	15.9
Beamwidth, Horizontal, degrees	65	64
Beamwidth, Vertical, degrees	12.4	11.2
Beam Tilt, degrees	0–10	0–10
USLS, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	23	23
CPR at Sector, dB	12	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**
Gain by all Beam Tilts, average, dBi	15.6	15.7
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 15.7	0 ° | 15.9
	5 ° | 15.7	5 ° | 15.8
	10 ° | 15.3	10 ° | 15.3
Beamwidth, Horizontal Tolerance, degrees	±0.9	±1.4
Beamwidth, Vertical Tolerance, degrees	±0.8	±0.6
USLS, dB	18	20
Front-to-Back Total Power at 180° ± 30°, dB	25	23
CPR at Boresight, dB	25	24
CPR at Sector, dB	15	12

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®

Product Specifications

LNX-6514DS-VTM

Operating Frequency Band	698 – 896 MHz
Performance Note	Outdoor usage

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	2
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	180.5 mm | 7.1 in
Length	1851.0 mm | 72.9 in
Width	301.0 mm | 11.9 in
Net Weight	14.2 kg | 31.3 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

Product Specifications

COMMSCOPE®

LNX-8513DS-VTM

Andrew® Teletilt® Antenna, 698–896 MHz, 85° horizontal beamwidth, RET compatible

POWERED BY ANDREW.

Electrical Specifications

Frequency Band, MHz	698–806	806–896
Gain, dBi	14.6	15.3
Beamwidth, Horizontal, degrees	85	85
Beamwidth, Vertical, degrees	12.2	11.0
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	17
Front-to-Back Ratio at 180°, dB	25	26
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°

Mechanical Specifications

Color | Radome Material	Light gray | Fiberglass, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 2
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph
Antenna Dimensions, L x W x D	1847.0 mm x 301.0 mm x 181.0 mm | 72.7 in x 11.9 in x 7.1 in
Net Weight	17.8 kg | 39.2 lb
Model with factory installed AISG 2.0 RET	LNX-8513DS-A1M

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

Andrew® Quad Port Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression

Electrical Specifications

Frequency Band, MHz	1710–1880	1850–1990	1920–2180
Gain, dBi	19.0	19.1	19.2
Beamwidth, Horizontal, degrees	67	66	65
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beam Tilt, degrees	0–6	0–6	0–6
USLS, dB	18	18	18
Front-to-Back Ratio at 180°, dB	30	30	30
CPR at Boresight, dB	21	22	21
CPR at Sector, dB	10	11	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	1710–1880	1850–1990	1920–2180
Gain by all Beam Tilts, average, dBi	18.5	18.6	18.8
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 18.4	0 ° | 18.4	0 ° | 18.7
	3 ° | 18.7	3 ° | 18.7	3 ° | 18.9
	6 ° | 18.4	6 ° | 18.5	6 ° | 18.6
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	25	26	26
CPR at Boresight, dB	22	23	22
CPR at Sector, dB	10	10	9

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz

Product Specifications

HBXX-6517DS-VTM

Performance Note	Outdoor usage

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1903.0 mm | 74.9 in
Width	305.0 mm | 12.0 in
Net Weight	19.5 kg | 43.0 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	HBXX-6517DS-A2M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

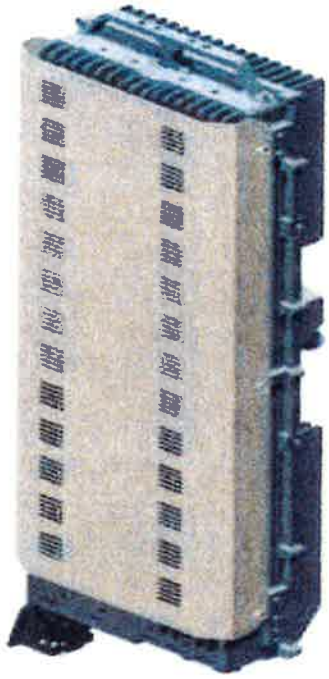
600899A-2 — Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

ALCATEL-LUCENT
WIRELESS PRODUCT DATASHEET
RRH2X60-AWS FOR BAND 4 APPLICATIONS

The Alcatel-Lucent RRH2x60-AWS is a high power, small form factor Remote Radio Head operating in the AWS frequency band (3GPP Band 4) for LTE technology. It is designed with an eco-efficient approach, providing operators with the means to achieve high quality and high capacity coverage with minimum site requirements and efficient operation.



A distributed Node B expands the deployment options by using two components, a Base Band Unit (BBU) containing the digital assets and a separate RRH containing the radio-frequency (RF) elements. This modular design optimizes available space and allows the main components of a Node B to be installed separately, within the same site or several kilometers apart.

The Alcatel-Lucent RRH2x60-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information.

SUPERIOR RF PERFORMANCE

The Alcatel-Lucent RRH2x60-AWS integrates all the latest technologies. This allows to offer best-in-class characteristics.

It delivers an outstanding 120 watts of total RF power thanks to its two transmit RF paths of 60 W each.

It is ideally suited to support multiple-input multiple-output (MIMO) 2x2 operation.

It includes four RF receivers to natively support 4-way uplink reception diversity. This improves the radio uplink coverage and this can be used to extend the cell radius commensurate with 2x2MIMO 2x60 W for the downlink.

It supports multiple discontinuous LTE carriers within an instantaneous bandwidth of 45 MHz corresponding to the entire AWS B4 spectrum.

The latest generation power amplifiers (PA) used in this product achieve high efficiency (>40%), resulting in improved power consumption figures.

OPTIMIZED TCO

The Alcatel-Lucent RRH2x60-AWS is designed to make available all the benefits of a distributed Node B, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX).

The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

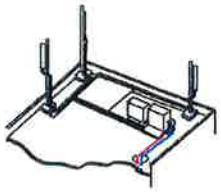
EASY INSTALLATION

The RRH2x60-AWS includes a reversible mounting bracket which allows for ease of installation behind an antenna, or on a rooftop knee wall while providing easy access to the mid body RF connectors.

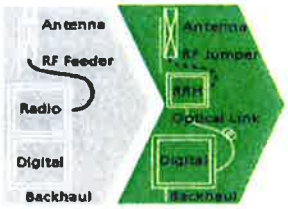
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

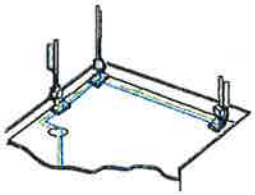
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control

BENEFITS

- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and silent solutions, with minimum impact on the neighborhood, which ease the deployment
- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

TECHNICAL SPECIFICATIONS

Specifications listed are hardware capabilities. Some capabilities depend on support in a specific software release or future release.

Dimensions and weights

- HxWxD : 510x285x186mm (27 l with solar shield)
- Weight : 20 kg (44 lbs)

Electrical Data

- Power Supply : -48V DC (-40.5 to -57V)
- Power Consumption (ETSI average traffic load reference) : 250W @2x60W

RF Characteristics

- Frequency band: 1710-1755, UL / 2110-2155 MHz, DL (3GPP band 4)
- Output power: 2x60W at antenna connectors
- Technology supported: LTE
- Instantaneous bandwidth: 45 MHz
- Rx diversity: 2-way and 4-way uplink reception
- Typical sensitivity without Rx diversity: -105 dBm for LTE

Connectivity

- Two CPRI optical ports for daisychaining and up to six RRHs per fiber
- Type of optical fiber: Single-Mode (SM) and Multi-Mode (MM) SFPs
- Optical fiber length: up to 500m using MM fiber, up to 20km using SM fiber
- TMA/RETA : AISG 2.0 (RS485 connector and internal Bias-Tee)
- Six external alarms
- Surge protection for all external ports (DC and RF)

Environmental specifications

- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection : IEC 60529 IP65
- Acoustic Noise : Noiseless (natural convection cooling)

Safety and Regulatory Data

- EMC : 3GPP 25113, EN 301 489-1, EN 301 489-23, GR 1089, GR 3108, OET-65
- Safety : IEC60950-1, EN 60825-1, UL, ANSI/NFPA 70, CAN/CSA-C22.2
- Regulatory : FCC Part 15 Class B, CE Mark – European Directive : 2002/95/EC (ROHS); 2002/96/EC (WEEE); 1999/5/EC (R&TTE)
- Health : EN 50385

Alcatel·Lucent

AT THE SPEED OF IDEAS™

Product Data Sheet HB158-1-08U8-S8J18

HYBRIFLEX™ RRH Hybrid Feeder Cabling Solution, 1-5/8", Single-Mode Fiber

Product Description

RFS' HYBRIFLEX Remote Radio Head (RRH) hybrid feeder cabling solution combines optical fiber and DC power for RRHs in a single lightweight aluminum corrugated cable, making it the world's most innovative solution for RRH deployments.

It was developed to reduce installation complexity and costs at Cellular sites. HYBRIFLEX allows mobile operators deploying an RRH architecture to standardize the RRH installation process and eliminate the need for and cost of cable grounding. HYBRIFLEX combines optical fiber (multi-mode or single-mode) and power in a single corrugated cable. It eliminates the need for junction boxes and can connect multiple RRHs with a single feeder. Standard RFS CELLFLEX® accessories can be used with HYBRIFLEX cable. Both pre-connectorized and on-site options are available.

Figure 1: HYBRIFLEX Series

Features/Benefits

- Aluminum corrugated armor with outstanding bending characteristics – minimizes installation time and enables mechanical protection and shielding
- Same accessories as 1 5/8" coaxial cable
- Outer conductor grounding – Eliminates typical grounding requirements and saves on installation costs
- Lightweight solution and compact design – Decreases tower loading
- Robust cabling – Eliminates need for expensive cable trays and ducts
- Installation of tight bundled fiber optic cable pairs directly to the RRH – Reduces CAPEX and wind load by eliminating need for interconnection
- Optical fiber and power cables housed in single corrugated cable – Saves CAPEX by standardizing RRH cable installation and reducing installation requirements
- Outdoor polyethylene jacket – Ensures long-lasting cable protection

Technical Specifications

Outer Conductor Armor	Corrugated Aluminum	[mm (in)]	46.5 (1.83)
Jacket	Polyethylene, PE	[mm (in)]	50.3 (1.98)
UV-Protection	Individual and External Jacket		Yes
Weight, Approximate		[kg/m (lb/ft)]	1.9 (1.30)
Minimum Bending Radius, Single Bending		[mm (in)]	200 (8)
Minimum Bending Radius, Repeated Bending		[mm (in)]	500 (20)
Recommended/Maximum Clamp Spacing		[m (ft)]	1.0 / 1.2 (3.25 / 4.0)
DC-Resistance Outer Conductor Armor		[Ω/km (Ω/1000ft)]	068 (0.205)
DC-Resistance Power Cable, 8.4mm²(8AWG)		[Ω/km (Ω/1000ft)]	2.1 (0.307)
Version			Single-mode OM3
Quantity, Fiber Count			16 (8 pairs)
Core/Clad		[µm]	50/125
Primary Coating (Acrylate)		[µm]	245
Buffer Diameter, Nominal		[µm]	900
Secondary Protection, Jacket, Nominal		[mm (in)]	2.0 (0.08)
Minimum Bending Radius		[mm (in)]	104 (4.1)
Insertion Loss @ wavelength 850nm		dB/km	3.0
Insertion Loss @ wavelength 1310nm		dB/km	1.0
Standards (Meets or exceeds)			UL94-V0, UL1666 RoHS Compliant
Size (Power)		[mm² (AWG)]	8.4 (8)
Quantity, Wire Count (Power)			16 (8 pairs)
Size (Alarm)		[mm² (AWG)]	0.8 (18)
Quantity, Wire Count (Alarm)			4 (2 pairs)
Type			UV protected
Strands			19
Primary Jacket Diameter, Nominal		[mm (in)]	6.8 (0.27)
Standards (Meets or exceeds)			NFPA 130, ICEA S-95-658 UL Type XHHW-2, UL 44 UL-LS Limited Smoke, UL VW-1 IEEE-383 (1974), IEEE1202/FT4 RoHS Compliant
Installation Temperature		[°C (°F)]	-40 to +65 (-40 to149)
Operation Temperature		[°C (°F)]	-40 to +65 (-40 to149)

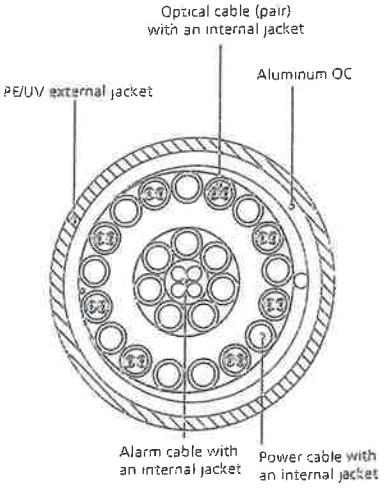


Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: Stonington E								
Tower Height: 196Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Nextel	9	100	180	0.0100	851	0.5673	1.76%	
*Sprint CDMA/LTE	3	347	195	0.0098	1900	1.0000	0.98%	
*Sprint CDMA/LTE	1	195	195	0.0018	850	0.5667	0.33%	
*Sprint CDMA/LTE	2	347	195	0.0066	2500	1.0000	0.66%	
*T-Mobile GSM/UMTS	2	12.0815	167	0.0003	1950	1.0000	0.03%	
*T-Mobile UMTS	2	16.108	167	0.0004	2100	1.0000	0.04%	
*T-Mobile LTE	2	24.16301	167	0.0006	2100	1.0000	0.06%	
*MetroPCS	3	727	130	0.0464	2140	1.0000	4.64%	
*AT&T GSM	2	565	150	0.0181	880	0.5867	3.08%	
*AT&T GSM	2	875	150	0.0280	1900	1.0000	2.80%	
*AT&T UMTS	1	283	150	0.0045	880	0.5867	0.77%	
*AT&T UMTS	4	525	150	0.0336	1900	1.0000	3.36%	
*AT&T LTE	1	1615	150	0.0258	740	0.4933	5.23%	
Verizon PCS	**11**	**418**	**140**	**0.0844**	**1970**	**1.0000**	**8.44%**	
Verizon Cellular	**9**	**392**	**140**	**0.0647**	**869**	**0.5793**	**11.17%**	
Verizon AWS	**1**	**1750**	**140**	**0.0321**	**2145**	**1.0000**	**3.21%**	
Verizon 700	**1**	**1050**	**140**	**0.0193**	**746**	**0.4973**	**3.87%**	
								50.43%
* Source: Siting Council								

ATTACHMENT 3

FDH Engineering, Inc., 6521 Meridien Drive Raleigh, NC 27616, Ph. 919.755.1012

Structural Analysis for SBA Network Services, Inc.

196' Monopole Tower

SBA Site Name: Stonington East
SBA Site ID: CT00595-S-05
Verizon Site Name: Stonington East
Verizon Site ID: 117846

FDH Project Number 15BGXI1400

Analysis Results

Tower Components	99.0%	Sufficient
Foundation	98.7%	Sufficient

Prepared By:

Tyler Ferguson
Project Engineer I

Reviewed By:

Dennis D. Abel, PE
Director of Structural Engineering
CT PE License No. 23247

FDH Engineering, Inc.
6521 Meridien Drive
Raleigh, NC 27616
(919) 755-1012
info@fdh-inc.com

March 20, 2015

03-20-2015

Prepared pursuant to TIA/EIA-222-F Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and 2005 Connecticut Building Code

TABLE OF CONTENTS

EXECUTIVE SUMMARY

At the request of SBA Network Services, Inc., FDH Engineering, Inc. performed a structural analysis of the monopole located in Stonington, CT to determine whether the tower is structurally adequate to support both the existing and proposed loads pursuant to the *Structural Standards for Steel Antenna Towers and Antenna Supporting Structures, TIA/EIA-222-F and 2005 Connecticut Building Code (2005 CT Building Code)*. Information pertaining to the existing/proposed antenna loading, current tower geometry, foundation dimensions, geotechnical data, and member sizes was obtained from:

- Valmont Industries, Inc. (Order No. 17507-98) Communication Pole Record Drawings dated June 23, 1998
- SAGE Environmental, Inc. (Project No. G004) geotechnical report dated June 10, 1998
- SBA Network Services, Inc.

The *basic design wind speed* per the *TIA/EIA-222-F* standards and *2005 CT Building Code* is 85 mph without ice and 38 mph with 3/4" radial ice. Ice is considered to increase in thickness with height.

Conclusions

With the existing and proposed antennas from Verizon in place at 140 ft, the tower meets the requirements of the *TIA/EIA-222-F* standards and *2005 CT Building Code* provided the **Recommendations** listed below are satisfied. Furthermore, given the existing foundation dimensions (see Valmont Order No. 17507-98), and utilizing the existing soil parameters (see SAGE Project No. G004) the foundation should have the necessary capacity to support both the proposed and existing loading. For a more detailed description of the analysis of the tower, see the **Results** section of this report.

Our structural analysis has been performed assuming all information provided to FDH Engineering, Inc. is accurate (i.e., the steel data, tower layout, existing antenna loading, and proposed antenna loading) and that the tower has been properly erected and maintained per the original design drawings.

Recommendations

To ensure the requirements of the *TIA/EIA-222-F* standards and *2005 CT Building Code* are met with the existing and proposed loading in place, we have the following recommendations:

1. The proposed feedlines should be installed inside the pole's shaft, but may be installed outside stacked on top of the existing coax.
2. RRU/RRH Stipulation: The equipment may be installed in any arrangement as determined by the client.

APPURTENANCE LISTING

The proposed and existing antennas with their corresponding cables/coax lines are shown in **Table 1**. *If the actual layout determined in the field deviates from the layout, FDH Engineering, Inc. should be contacted to perform a revised analysis.*

Table 1 - Appurtenance Loading

Existing Loading:

Antenna Elevation (ft)	Description	Feedlines[1]	Carrier	Mount Elevation (ft)	Mount Type
195	(3) RFS APXVSPP18-C-A20 (3) RFS APXVTM14-C-I20 (3) ALU 1900MHZ RRHs (3) Alcatel Lucent TD-RRH8x20-25 (3) ALU 800MHZ (3) ALU 800MHZ RRH Filters (4) RFS ACU-A20-N	(4) 1-1/4"	Sprint	193	(1) Low Profile Platform
167	(3) Ericsson AIR B2A B4P (3) Ericsson AIR B4A B2P (3) Ericsson KRY 112 144 TMAs	(12) 1-5/8" (1) 1-5/8" Fiber	T-Mobile	165	(1) Low Profile Platform
150	(6) Powerwave 7700.00 (2) Powerwave P65-17-XLH-RR (1) KMW AM-X-CD-14-65-00T (6) Powerwave LGP21401 (6) Powerwave LGP13519 (6) Ericsson RRUS-11 (1) Raycap DC6-48-60-18-8F	(12) 1-5/8" (2) DC (1) Fiber	New Cingular	150	(1) Low Profile Platform
140	(6) Antel RWA-80014 (3) Rymsa MG D5-800TX (3) Commscope LNX-6514DS-AIM (3) ALU RRH 2x40-700U (1) RFS Celwave DB-T1-6Z-8AB-0Z	(12) 1-5/8" (1) 1 5/8" Hybrid Fiber	Verizon[2]	140	(1) Low Profile Platform
130	(6) Kathrein 742 351	(12) 1-5/8"	Metro PCS[3]	130	(1) Low Profile Platform
30	(1) GPS	---	Sprint	30	(1) Standoff

1. Feedlines installed inside the pole's shaft unless otherwise noted.
2. Verizon's feedlines are installed outside the pole's shaft double-stacked 1 on 12.
3. Metro PCS's feedlines are installed outside the pole's shaft in a single row.

Proposed Carrier Final Loading:

Antenna Elevation (ft)	Description	Feedlines	Carrier	Mount Elevation (ft)	Mount Type
140	(2) Commscope LNX-8513DS-VTM (2) RFS Celwave APL866513 (6) Commscope HBXX-6517DS-A2M (3) Commscope LNX-6414DS-AIM (3) Alcatel Lucent RRH 2x40-700 w/ Solar (3) Alcatel Lucent RRH 2x60-2100 w/ Solar (1) RFS Celwave DB-T1-6Z-8AB-0Z	(12) 1-5/8" (2) 1 5/8" Hybrid Fiber	Verizon[1]	140	(1) Low Profile Platform

1. Verizon's coax will be installed double-stacked 2 on 12.

RESULTS

The following yield strength of steel for individual members was used for analysis:

Table 2 - Material Strength

Member Type	Yield Strength
Tower Shaft Sections	65 ksi
Base Plate	60 ksi
Anchor Bolts	75 ksi (assumed)

Table 3 displays the summary of the ratio (as a percentage) of force in the member to their capacities. Values greater than 100% indicate locations where the maximum force in the member exceeds its capacity. *Note: Capacities up to 100% are considered acceptable.* **Table 4** displays the maximum foundation reactions.

If the assumptions outlined in this report differ from actual field conditions, FDH Engineering, Inc. should be contacted to perform a revised analysis. Furthermore, as no information pertaining to the allowable twist and sway requirements for the existing or proposed appurtenances was provided, deflection and rotation were not taken into consideration when performing this analysis.

See the **Appendix** for detailed modeling information

Table 3 - Summary of Working Percentage of Structural Components

Section No.	Elevation ft	Component Type	Size	% Capacity*	Pass Fail
L1	196 - 154.75	Pole	TP27.76x17.39x0.1875	65.1	Pass
L2	154.75 - 118.75	Pole	TP36.42x26.3166x0.3125	77.1	Pass
L3	118.75 - 74.5	Pole	TP46.91x34.4772x0.375	94.1	Pass
L4	74.5 - 35.5	Pole	TP55.97x44.5274x0.4375	93.2	Pass
L5	35.5 - 0	Pole	TP64x53.2089x0.4688	99.0	Pass
-	0	Anchor Bolts	(24) 2.25"Ø on a 72.76" BC	82.3	Pass
-	0	Base Plate	PL 2.5" x 78.77"Ø	84.4	Pass

**Capacities utilize 1/3 allowable stress increase for wind per TIA/EIA-222-F.*

Table 4 - Maximum Base Reactions

Base Reactions	Current Analysis* *(TIA/EIA-222-F)*	Original Design *(TIA/EIA-222-F)*
Axial	56 k	60 k
Shear	50 k	45 k
Moment	5,926 k-ft	5,768 k-ft

** Foundation determined to be adequate per independent analysis.*

GENERAL COMMENTS

This engineering analysis is based upon the theoretical capacity of the structure. It is not a condition assessment of the tower and its foundation. It is the responsibility of SBA Network Services, Inc. to verify that the tower modeled and analyzed is the correct structure (with accurate antenna loading information) modeled. If there are substantial modifications to be made or the assumptions made in this analysis are not accurate, FDH Engineering, Inc. should be notified immediately to perform a revised analysis.

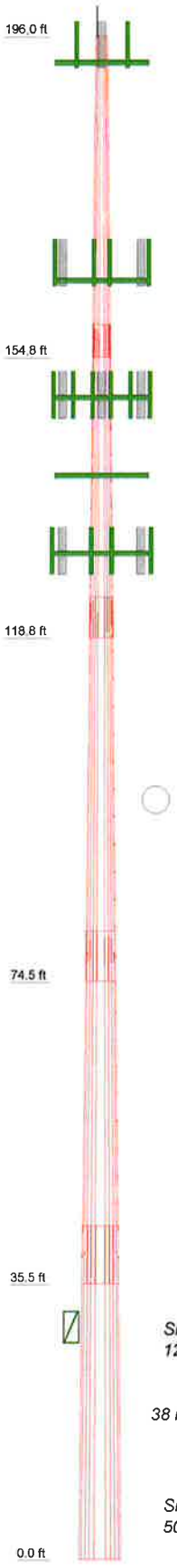
LIMITATIONS

All opinions and conclusions are considered accurate to a reasonable degree of engineering certainty based upon the evidence available at the time of this report. All opinions and conclusions are subject to revision based upon receipt of new or additional/updated information. All services are provided exercising a level of care and diligence equivalent to the standard and care of our profession. No other warranty or guarantee, expressed or implied, is offered. Our services are confidential in nature and we will not release this report to any other party without the client's consent. The use of this engineering work is limited to the express purpose for which it was commissioned and it may not be reused, copied, or distributed for any other purpose without the written consent of FDH Engineering, Inc.

APPENDIX

Section	1	2	3	4	5
Length (ft)	41.25	40.25	49.50	45.50	43.00
Number of Sides	12	12	12	12	12
Thickness (in)	0.1875	0.3125	0.3750	0.4375	0.4688
Socket Length (ft)	4.25	5.25	6.50	7.50	
Top Dia (in)	17.3900	26.3166	34.4772	44.5274	53.2089
Bot Dia (in)	27.7600	36.4200	46.9100	55.9700	64.0000
Grade			A572-65		
Weight (K)	1.9	4.3	8.2	10.9	12.8

38.1



AXIAL
75 K

SHEAR
12 K

MOMENT
1431 kip-ft

TORQUE 0 kip-ft
38 mph WIND - 0.7500 in ICE

AXIAL
56 K

SHEAR
50 K

MOMENT
5926 kip-ft

TORQUE 1 kip-ft
REACTIONS - 85 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod	196	(2) Powerwave LGP21401 TMAs	150
APXVSPP18-C-A20 w/Mount Pipe	193	(2) Powerwave LGP21401 TMAs	150
APXVSPP18-C-A20 w/Mount Pipe	193	(2) Powerwave LGP21401 TMAs	150
APXVSPP18-C-A20 w/Mount Pipe	193	(2) Powerwave LGP13519 TMA Diplexers	150
1900 MHz RRH	193		
1900 MHz RRH	193	(2) Powerwave LGP13519 TMA Diplexers	150
1900 MHz RRH	193		
800 MHz RRH	193	(2) Powerwave LGP13519 TMA Diplexers	150
800 MHz RRH	193		
800 MHz RRH	193	(2) RRUS-11	150
800 MHz Filter	193	(2) RRUS-11	150
800 MHz Filter	193	(2) RRUS-11	150
800 MHz Filter	193	DC6-48-60-18-8F Surge Arrestor	150
ACU-A20-N RET	193	(1) Low Profile Platform MNT	150
ACU-A20-N RET	193	(1) Low Profile Platform MNT	140
(2) ACU-A20-N RET	193	LNX-8513DS-VTM w/ Mount Pipe	140
(1) Low Profile Platform MNT	193	LNX-8513DS-VTM w/ Mount Pipe	140
APXVTM14-C-I20 w/ Mount Pipe	193	APL866513 w/ Mount Pipe	140
APXVTM14-C-I20 w/ Mount Pipe	193	APL866513 w/ Mount Pipe	140
APXVTM14-C-I20 w/ Mount Pipe	193	(2) HBXX-6517DS-A2M w/ Mount Pipe	140
TD-RRH8x20-25	193	(2) HBXX-6517DS-A2M w/ Mount Pipe	140
TD-RRH8x20-25	193	(2) HBXX-6517DS-A2M w/ Mount Pipe	140
TD-RRH8x20-25	193	RRH 2X60-2100 W/SOLAR	140
AIR 21 B2A/B4P w/Mount Pipe	165	RRH 2X60-2100 W/SOLAR	140
AIR 21 B2A/B4P w/Mount Pipe	165	RRH 2X60-2100 W/SOLAR	140
AIR 21 B2A/B4P w/Mount Pipe	165	LNX-6514DS-AIM w/ Mount Pipe	140
AIR 21 B4A/B2P w/Mount Pipe	165	LNX-6514DS-AIM w/ Mount Pipe	140
AIR 21 B4A/B2P w/Mount Pipe	165	LNX-6514DS-AIM w/ Mount Pipe	140
AIR 21 B4A/B2P w/Mount Pipe	165	RRH 2x40-700 W/SOLAR	140
KRY 112 144/1	165	RRH 2x40-700 W/SOLAR	140
KRY 112 144/1	165	RRH 2x40-700 W/SOLAR	140
KRY 112 144/1	165	DB-T1-6Z-8AB-0Z	140
(1) Low Profile Platform MNT	165	(2) 742 351 w/Mount Pipe	130
(2) 7700.00 w/Mount Pipe	150	(2) 742 351 w/Mount Pipe	130
(2) 7700.00 w/Mount Pipe	150	(2) 742 351 w/Mount Pipe	130
(2) 7700.00 w/Mount Pipe	150	(1) Low Profile Platform MNT	130
P65-17-XLH-RR w/Mount Pipe	150	GPS	30
P65-17-XLH-RR w/Mount Pipe	150	(1) Standoff MNT	30
AM-X-CD-14-65-00T w/ Mount Pipe	150		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in New London 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 38 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 99%

FDH Engineering, Inc.
6521 Meridien Drive, Suite 107
Raleigh, North Carolina 27616
Phone: 9197551012
FAX: 9197551031
Tower Analysis

Job: Stonington East, CT00595-S-05			
Project: 15BGXI1400			
Client: SBA Network Services, Inc.	Drawn by: Tyler Ferguson	App'd:	
Code: TIA/EIA-222-F	Date: 03/20/15	Scale: N	
Path:		Dwg No.	

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 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	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	196 - 154.75	Pole	Max Tension	2	0.00	-0.00	-0.00
			Max. Compression	14	-9.33	0.04	-0.02
			Max. Mx	11	-4.23	265.33	0.08
			Max. My	8	-4.23	-0.03	-265.39
			Max. Vy	5	11.59	-265.29	-0.04
			Max. Vx	2	-11.59	0.09	265.36
			Max. Torque	13			0.04
L2	154.75 - 118.75	Pole	Max Tension	1	0.00	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	14	-27.18	0.20	0.80
			Max. Mx	11	-14.44	979.68	1.34
			Max. My	2	-14.43	1.18	980.93
			Max. Vy	5	29.32	-979.60	-0.99
			Max. Vx	2	-29.34	1.18	980.93
			Max. Torque	10			-2.05
L3	118.75 - 74.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-39.68	-0.06	0.37
			Max. Mx	5	-25.03	-2396.29	-2.40
			Max. My	2	-25.03	2.50	2398.20
			Max. Vy	5	36.66	-2396.29	-2.40
			Max. Vx	2	-36.68	2.50	2398.20
			Max. Torque	11			-1.99
L4	74.5 - 35.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-54.58	-0.34	-0.11
			Max. Mx	5	-38.09	-3915.80	-3.70
			Max. My	2	-38.08	3.63	3918.18
			Max. Vy	11	-43.15	3915.62	3.75
			Max. Vx	8	43.16	-3.81	-3918.10
			Max. Torque	11			-1.74
L5	35.5 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-74.80	-0.19	-0.89
			Max. Mx	11	-56.20	5917.25	5.10
			Max. My	8	-56.20	-5.26	-5920.94
			Max. Vy	11	-49.84	5917.25	5.10
			Max. Vx	8	49.87	-5.26	-5920.94
			Max. Torque	11			-1.51

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	14	74.80	-0.00	0.00
	Max. H_x	11	56.23	49.81	0.04
	Max. H_z	2	56.23	0.04	49.84
	Max. M_x	2	5920.39	0.04	49.84
	Max. M_z	5	5917.00	-49.81	-0.04
	Max. Torsion	4	1.21	-43.12	24.89
	Min. Vert	2	56.23	0.04	49.84
	Min. H_x	5	56.23	-49.81	-0.04
	Min. H_z	8	56.23	-0.04	-49.84
	Min. M_x	8	-5920.94	-0.04	-49.84
	Min. M_z	11	-5917.25	49.81	0.04
	Min. Torsion	10	-1.21	43.12	-24.89

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	56.23	0.00	0.00	0.28	0.13	0.00
Dead+Wind 0 deg - No Ice	56.23	-0.04	-49.84	-5920.39	5.51	-0.43

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead+Wind 30 deg - No Ice	56.23	24.87	-43.14	-5125.32	-2954.26	-0.95
Dead+Wind 60 deg - No Ice	56.23	43.12	-24.89	-2955.88	-5122.41	-1.21
Dead+Wind 90 deg - No Ice	56.23	49.81	0.04	5.67	-5917.00	-1.15
Dead+Wind 120 deg - No Ice	56.23	43.16	24.96	2965.76	-5127.75	-0.78
Dead+Wind 150 deg - No Ice	56.23	24.94	43.19	5131.23	-2963.56	-0.20
Dead+Wind 180 deg - No Ice	56.23	0.04	49.84	5920.94	-5.26	0.43
Dead+Wind 210 deg - No Ice	56.23	-24.87	43.14	5125.88	2954.50	0.95
Dead+Wind 240 deg - No Ice	56.23	-43.12	24.89	2956.45	5122.65	1.21
Dead+Wind 270 deg - No Ice	56.23	-49.81	-0.04	-5.10	5917.25	1.15
Dead+Wind 300 deg - No Ice	56.23	-43.16	-24.96	-2965.19	5128.01	0.78
Dead+Wind 330 deg - No Ice	56.23	-24.94	-43.19	-5130.68	2963.82	0.20
Dead+Ice+Temp	74.80	0.00	-0.00	0.89	-0.19	0.00
Dead+Wind 0 deg+Ice+Temp	74.80	-0.01	-11.59	-1428.79	0.46	-0.05
Dead+Wind 30 deg+Ice+Temp	74.80	5.79	-10.03	-1236.92	-714.64	-0.12
Dead+Wind 60 deg+Ice+Temp	74.80	10.04	-5.79	-713.38	-1238.30	-0.16
Dead+Wind 90 deg+Ice+Temp	74.80	11.59	0.01	1.54	-1430.21	-0.16
Dead+Wind 120 deg+Ice+Temp	74.80	10.04	5.80	716.28	-1238.96	-0.11
Dead+Wind 150 deg+Ice+Temp	74.80	5.80	10.04	1239.33	-715.77	-0.04
Dead+Wind 180 deg+Ice+Temp	74.80	0.01	11.59	1430.54	-0.85	0.05
Dead+Wind 210 deg+Ice+Temp	74.80	-5.79	10.03	1238.68	714.25	0.12
Dead+Wind 240 deg+Ice+Temp	74.80	-10.04	5.79	715.14	1237.91	0.16
Dead+Wind 270 deg+Ice+Temp	74.80	-11.59	-0.01	0.22	1429.82	0.16
Dead+Wind 300 deg+Ice+Temp	74.80	-10.04	-5.80	-714.52	1238.57	0.11
Dead+Wind 330 deg+Ice+Temp	74.80	-5.80	-10.04	-1237.58	715.38	0.04
Dead+Wind 0 deg - Service	56.23	-0.01	-17.24	-2051.54	1.99	-0.15
Dead+Wind 30 deg - Service	56.23	8.61	-14.93	-1775.88	-1023.64	-0.33
Dead+Wind 60 deg - Service	56.23	14.92	-8.61	-1024.11	-1774.96	-0.43
Dead+Wind 90 deg - Service	56.23	17.23	0.01	2.14	-2050.45	-0.41
Dead+Wind 120 deg - Service	56.23	14.93	8.64	1027.89	-1776.82	-0.28
Dead+Wind 150 deg - Service	56.23	8.63	14.94	1778.29	-1026.87	-0.07
Dead+Wind 180 deg - Service	56.23	0.01	17.24	2052.08	-1.74	0.15
Dead+Wind 210 deg - Service	56.23	-8.61	14.93	1776.42	1023.89	0.33
Dead+Wind 240 deg - Service	56.23	-14.92	8.61	1024.66	1775.21	0.43
Dead+Wind 270 deg - Service	56.23	-17.23	-0.01	-1.59	2050.70	0.41
Dead+Wind 300 deg - Service	56.23	-14.93	-8.64	-1027.34	1777.07	0.28
Dead+Wind 330 deg - Service	56.23	-8.63	-14.94	-1777.74	1027.13	0.07

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.00	-56.23	0.00	0.00	56.23	0.00	0.000%
2	-0.04	-56.23	-49.84	0.04	56.23	49.84	0.008%
3	24.87	-56.23	-43.14	-24.87	56.23	43.14	0.000%
4	43.12	-56.23	-24.89	-43.12	56.23	24.89	0.000%
5	49.81	-56.23	0.04	-49.81	56.23	-0.04	0.008%
6	43.16	-56.23	24.96	-43.16	56.23	-24.96	0.000%
7	24.94	-56.23	43.19	-24.94	56.23	-43.19	0.000%
8	0.04	-56.23	49.84	-0.04	56.23	-49.84	0.008%
9	-24.87	-56.23	43.14	24.87	56.23	-43.14	0.000%
10	-43.12	-56.23	24.89	43.12	56.23	-24.89	0.000%
11	-49.81	-56.23	-0.04	49.81	56.23	0.04	0.008%
12	-43.16	-56.23	-24.96	43.16	56.23	24.96	0.000%
13	-24.94	-56.23	-43.19	24.94	56.23	43.19	0.000%
14	0.00	-74.80	0.00	-0.00	74.80	0.00	0.000%
15	-0.01	-74.80	-11.59	0.01	74.80	11.59	0.002%
16	5.79	-74.80	-10.04	-5.79	74.80	10.03	0.001%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
17	10.04	-74.80	-5.79	-10.04	74.80	5.79	0.001%
18	11.59	-74.80	0.01	-11.59	74.80	-0.01	0.002%
19	10.04	-74.80	5.80	-10.04	74.80	-5.80	0.001%
20	5.80	-74.80	10.04	-5.80	74.80	-10.04	0.001%
21	0.01	-74.80	11.59	-0.01	74.80	-11.59	0.002%
22	-5.79	-74.80	10.04	5.79	74.80	-10.03	0.001%
23	-10.04	-74.80	5.79	10.04	74.80	-5.79	0.001%
24	-11.59	-74.80	-0.01	11.59	74.80	0.01	0.002%
25	-10.04	-74.80	-5.80	10.04	74.80	5.80	0.002%
26	-5.80	-74.80	-10.04	5.80	74.80	10.04	0.002%
27	-0.01	-56.23	-17.25	0.01	56.23	17.24	0.004%
28	8.61	-56.23	-14.93	-8.61	56.23	14.93	0.002%
29	14.92	-56.23	-8.61	-14.92	56.23	8.61	0.002%
30	17.24	-56.23	0.01	-17.23	56.23	-0.01	0.004%
31	14.93	-56.23	8.64	-14.93	56.23	-8.64	0.002%
32	8.63	-56.23	14.94	-8.63	56.23	-14.94	0.002%
33	0.01	-56.23	17.25	-0.01	56.23	-17.24	0.004%
34	-8.61	-56.23	14.93	8.61	56.23	-14.93	0.002%
35	-14.92	-56.23	8.61	14.92	56.23	-8.61	0.002%
36	-17.24	-56.23	-0.01	17.23	56.23	0.01	0.004%
37	-14.93	-56.23	-8.64	14.93	56.23	8.64	0.002%
38	-8.63	-56.23	-14.94	8.63	56.23	14.94	0.002%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	15	0.00009875	0.00010705
3	Yes	20	0.00000001	0.00008509
4	Yes	20	0.00000001	0.00008720
5	Yes	15	0.00009876	0.00012600
6	Yes	20	0.00000001	0.00008545
7	Yes	20	0.00000001	0.00008673
8	Yes	15	0.00009875	0.00010454
9	Yes	20	0.00000001	0.00008685
10	Yes	20	0.00000001	0.00008473
11	Yes	15	0.00009876	0.00013432
12	Yes	20	0.00000001	0.00008731
13	Yes	20	0.00000001	0.00008604
14	Yes	6	0.00000001	0.00000001
15	Yes	16	0.00009870	0.00010495
16	Yes	16	0.00009851	0.00013660
17	Yes	16	0.00009851	0.00013772
18	Yes	16	0.00009868	0.00010499
19	Yes	16	0.00009850	0.00013659
20	Yes	16	0.00009850	0.00013731
21	Yes	16	0.00009868	0.00010485
22	Yes	16	0.00009850	0.00013732
23	Yes	16	0.00009850	0.00013628
24	Yes	16	0.00009869	0.00010499
25	Yes	16	0.00009851	0.00013778
26	Yes	16	0.00009851	0.00013700
27	Yes	15	0.00010564	0.00005225
28	Yes	16	0.00005139	0.00008148
29	Yes	16	0.00005139	0.00008866

30	Yes	15	0.00010564	0.00005378
31	Yes	16	0.00005139	0.00008180
32	Yes	16	0.00005139	0.00008606
33	Yes	15	0.00010564	0.00005218
34	Yes	16	0.00005139	0.00008739
35	Yes	16	0.00005139	0.00008032
36	Yes	15	0.00010564	0.00005400
37	Yes	16	0.00005139	0.00008809
38	Yes	16	0.00005139	0.00008373

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	196 - 154.75	54.292	38	2.5994	0.0024
L2	159 - 118.75	35.313	38	2.1906	0.0024
L3	124 - 74.5	20.860	38	1.6980	0.0016
L4	81 - 35.5	8.485	32	1.0092	0.0005
L5	43 - 0	2.369	32	0.4977	0.0002

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
196.00	Lightning Rod	38	54.292	2.5994	0.0024	26260
193.00	APXVSPP18-C-A20 w/Mount Pipe	38	52.691	2.5682	0.0025	26260
165.00	AIR 21 B2A/B4P w/Mount Pipe	38	38.198	2.2630	0.0025	4233
150.00	(2) 7700.00 w/Mount Pipe	38	31.210	2.0751	0.0023	3600
140.00	(1) Low Profile Platform MNT	38	26.967	1.9373	0.0020	3659
130.00	(2) 742 351 w/Mount Pipe	38	23.053	1.7903	0.0017	3720
30.00	GPS	32	1.300	0.3422	0.0001	5387

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	196 - 154.75	156.093	2	7.4808	0.0070
L2	159 - 118.75	101.610	2	6.3078	0.0070
L3	124 - 74.5	60.087	13	4.8925	0.0045
L4	81 - 35.5	24.464	7	2.9100	0.0015
L5	43 - 0	6.833	7	1.4357	0.0005

Critical Deflections and Radius of Curvature - Design Wind

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
196.00	Lightning Rod	2	156.093	7.4808	0.0070	9403
193.00	APXVSPP18-C-A20 w/Mount Pipe	2	151.498	7.3914	0.0070	9403
165.00	AIR 21 B2A/B4P w/Mount Pipe	2	109.894	6.5155	0.0072	1511
150.00	(2) 7700.00 w/Mount Pipe	13	89.830	5.9761	0.0066	1279
140.00	(1) Low Profile Platform MNT	13	77.643	5.5803	0.0059	1295
130.00	(2) 742 351 w/Mount Pipe	13	66.393	5.1579	0.0050	1313
30.00	GPS	7	3.751	0.9873	0.0003	1869

Compression Checks

Pole Design Data

Section No.	Elevation	Size	L	L_u	Kl/r	F_a	A	Actual P	Allow. P_a	Ratio $\frac{P}{P_a}$
	ft		ft	ft		ksi	in^2	K	K	
L1	196 - 154.75 (1)	TP27.76x17.39x0.1875	41.25	0.00	0.0	35.688	16.0018	-4.23	571.08	0.007
L2	154.75 - 118.75 (2)	TP36.42x26.3166x0.3125	40.25	0.00	0.0	39.000	35.0071	-14.43	1365.28	0.011
L3	118.75 - 74.5 (3)	TP46.91x34.4772x0.375	49.50	0.00	0.0	39.000	54.2197	-25.02	2114.57	0.012
L4	74.5 - 35.5 (4)	TP55.97x44.5274x0.4375	45.50	0.00	0.0	38.641	75.5743	-38.08	2920.27	0.013
L5	35.5 - 0 (5)	TP64x53.2089x0.4688	43.00	0.00	0.0	36.606	95.8925	-56.20	3510.21	0.016

Pole Bending Design Data

Section No.	Elevation	Size	Actual M_x	Actual f_{bx}	Allow. F_{bx}	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y	Actual f_{by}	Allow. F_{by}	Ratio $\frac{f_{by}}{F_{by}}$
	ft		kip-ft	ksi	ksi		kip-ft	ksi	ksi	
L1	196 - 154.75 (1)	TP27.76x17.39x0.1875	265.48	30.700	35.688	0.860	0.00	0.000	35.688	0.000
L2	154.75 - 118.75 (2)	TP36.42x26.3166x0.3125	981.88	39.615	39.000	1.016	0.00	0.000	39.000	0.000
L3	118.75 - 74.5 (3)	TP46.91x34.4772x0.375	2400.37	48.416	39.000	1.241	0.00	0.000	39.000	0.000
L4	74.5 - 35.5 (4)	TP55.97x44.5274x0.4375	3921.44	47.488	38.641	1.229	0.00	0.000	38.641	0.000
L5	35.5 - 0 (5)	TP64x53.2089x0.4688	5925.56	47.717	36.606	1.304	0.00	0.000	36.606	0.000

Pole Shear Design Data

Section No.	Elevation	Size	Actual V	Actual f_v	Allow. F_v	Ratio $\frac{f_v}{F_v}$	Actual T	Actual f_{vt}	Allow. F_{vt}	Ratio $\frac{f_{vt}}{F_{vt}}$
	ft		K	ksi	ksi		kip-ft	ksi	ksi	
L1	196 - 154.75 (1)	TP27.76x17.39x0.1875	11.60	0.725	26.000	0.057	0.04	0.002	26.000	0.000
L2	154.75 - 118.75 (2)	TP36.42x26.3166x0.3125	29.37	0.839	26.000	0.066	0.56	0.011	26.000	0.000
L3	118.75 - 74.5	TP46.91x34.4772x0.375	36.71	0.677	26.000	0.053	0.56	0.005	26.000	0.000

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	(3)									
L4	74.5 - 35.5 (4)	TP55.97x44.5274x0.4375	43.19	0.572	26.000	0.045	0.56	0.003	26.000	0.000
L5	35.5 - 0 (5)	TP64x53.2089x0.4688	49.90	0.520	26.000	0.041	0.20	0.001	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	196 - 154.75 (1)	0.007	0.860	0.000	0.057	0.000	0.868 ✔	1.333	H1-3+VT ✔
L2	154.75 - 118.75 (2)	0.011	1.016	0.000	0.066	0.000	1.027 ✔	1.333	H1-3+VT ✔
L3	118.75 - 74.5 (3)	0.012	1.241	0.000	0.053	0.000	1.254 ✔	1.333	H1-3+VT ✔
L4	74.5 - 35.5 (4)	0.013	1.229	0.000	0.045	0.000	1.242 ✔	1.333	H1-3+VT ✔
L5	35.5 - 0 (5)	0.016	1.304	0.000	0.041	0.000	1.320 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	196 - 154.75	Pole	TP27.76x17.39x0.1875	1	-4.23	761.24	65.1	Pass
L2	154.75 - 118.75	Pole	TP36.42x26.3166x0.3125	2	-14.43	1819.92	77.1	Pass
L3	118.75 - 74.5	Pole	TP46.91x34.4772x0.375	3	-25.02	2818.72	94.1	Pass
L4	74.5 - 35.5	Pole	TP55.97x44.5274x0.4375	4	-38.08	3892.72	93.2	Pass
L5	35.5 - 0	Pole	TP64x53.2089x0.4688	5	-56.20	4679.11	99.0	Pass
							Summary	
						Pole (L5)	99.0	Pass
						RATING =	**99.0**	**Pass**

Stiffened or Unstiffened, Ungrouted, Circular Base Plate - Any Rod Material

TIA Rev F

Site Data

BU#: *0*
Site Name: *Stonington East, CT00595-S*
App #: *0*
Pole Manufacturer: *Other*

Reactions		
Moment:	5926	ft-kips
Axial:	56	kips
Shear:	50	kips

Anchor Rod Data		
Qty:	24	
Diam:	2.25	in
Rod Material:	A615-J	
Strength (Fu):	100	ksi
Yield (Fy):	75	ksi
Bolt Circle:	72.76	in

Plate Data		
Diam:	78.75	in
Thick:	2.5	in
Grade:	60	ksi
Single-Rod B-eff:	8.57	in

Stiffener Data (Welding at both sides)		
Config:	0	*
Weld Type:		
Groove Depth:		<-- Disregard
Groove Angle:		<-- Disregard
Fillet H. Weld:		in
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

Pole Data		
Diam:	64	in
Thick:	0.46875	in
Grade:	65	ksi
# of Sides:	12	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Stress Increase Factor		
ASIF:	1.333	

If No stiffeners, Criteria: AISC ASD <-Only Applcable to Unstiffened Cases

Anchor Rod Results

Maximum Rod Tension:	160.5 Kips	Rigid
Allowable Tension:	195.0 Kips	Service, ASD
Anchor Rod Stress Ratio:	82.3% Pass	Fty*ASIF

Base Plate Results Flexural Check

Base Plate Stress:	50.6 ksi	Rigid
Allowable Plate Stress:	60.0 ksi	Service ASD
Base Plate Stress Ratio:	84.4% Pass	0.75*Fy*ASIF
		Y.L. Length: 34.61

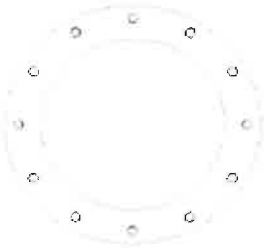
n/a

Stiffener Results

Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check: n/a



* 0 = none, 1 = every bolt, 2 = every 2 bolts, 3 = 2 per bolt

** Note: for complete joint penetration groove welds the groove depth must be exactly 1/2 the stiffener thickness for calculation purposes

(Bearing and Stability Checks) Tool for TIA Rev F or G - Application (MP, SST with unitbase)

Site Data

Site ID:
Site Name: *Stonington East, CT00595-S-05*
Project #:

Monopole Base Reaction Forces		
TIA Revision:	F	<--Pull Down
Unfactored DL Axial, PD:	56	kips
Unfactored WL Axial, PW:	0	kips
Unfactored WL Shear, V:	50	kips
Unfactored WL Moment, M:	5926	ft-kips

Enter Load Factors Below:		
For P (DL)	1.2	<---- Enter Factor
For P,V, and M (WL)	1.35	<---- Enter Factor

Load Factor	Shaft Factored Loads		
1.20	1.2D+1.6W, Pu:	67.2	kips
0.90	0.9D+1.6W, Pu:	50.4	kips
1.35	Vu:	67.5	kips
	Mu:	8000.1	ft-kips

Pad & Pier Data		
Base PL Dist. Above Pier:	0	in
Pier Dist. Above Grade:	6	in
Pad Bearing Depth, D:	9	ft
Pad Thickness, T:	3.5	ft
Pad Width=Length, L:	25	ft
Pier Cross Section Shape:	Round	<--Pull Down
Enter Pier Diameter:	8	ft
Concrete Density:	150.0	pcf
Pier Cross Section Area:	50.27	ft^2
Pier Height:	6.00	ft
Soil (above pad) Height:	5.50	ft

1.2D+1.6W Load Combination, Bearing Results:

(**No Soil Wedges**) [Reaction+Conc+Soil]	1027.33	P1="1.2D+1.6W" (Kips)
Factored "1.6W" Overturning Moment (MW-Msoil), M1	8537.99	ft-kips

Orthogonal Direction:

ecc1 = M1/P1 =	8.31	ft
Orthogonal qu=	4.90	ksf
qu/ϕ*qn Ratio=	**40.87%**	**Pass**

Soil Parameters		
Unit Weight, γ:	135.0	pcf
Ultimate Bearing Capacity, qn:	16.00	ksf
Strength Reduct. factor, ϕ:	0.75	
Angle of Friction, Φ:	0.0	degrees
Undrained Shear Strength, Cu:	0.00	ksf
Allowable Bearing: ϕ*qn:	12.00	ksf
Passive Pres. Coeff., Kp	1.00	

Diagonal Direction:

ecc2 = (0.707M1)/P1 =	5.88	ft
Diagonal qu=	5.85	ksf
qu/ϕ*qn Ratio=	**48.78%**	**Pass**

Run <-- Press Upon Completing All Input

Forces/Moments due to Wind and Lateral Soil		
Minimum of (ϕ*Ultimate Pad Passive Force, Vu):	64.2	kips
Pad Force Location Above D:	1.61	ft
ϕ(Passive Pressure Moment):	103.36	ft-kips
Factored O.T. M(WL), "1.6W":	8641.4	ft-kips
Factored OT (MW-Msoil), M1	8537.99	ft-kips

Overturning Stability Check

0.9D+1.6W Load Combination, Bearing Results:

(**w/ Soil Wedges**) [Reaction+Conc+Soil]	770.49	P2="0.9D+1.6W" (Kips)
Factored "1.6W" Overturning Moment (MW-Msoil) - 0.9(M of Wedge + M of Cohesion), M2	8537.99	ft-kips

Resistance due to Foundation Gravity		
Soil Wedge Projection grade, a:	0.00	ft
Sum of Soil Wedges Wt:	0.00	kips
Soil Wedges ecc, K1:	0.00	ft
Ftg+Soil above Pad wt:	800.1	kips
Unfactored (Total ftg-soil Wt):	800.10	kips
1.2D. **No Soil Wedges.**	1027.33	kips
0.9D. **With Soil Wedges**	770.49	kips

Orthogonal ecc3 = M2/P2 =	11.08	ft
Ortho Non Bearing Length,NBL=	22.16	ft
Orthogonal qu=	10.86	ksf
Diagonal qu=	8.85	ksf

Resistance due to Cohesion (Vertical)		
ϕ*(1/2*Cu)(Total Vert. Planes)	0.00	kips
Cohesion Force Eccentricity, K2	0.00	ft

Max Reaction Moment (ft-kips) so that qu=ϕ*qn = 100% Capacity Rating

Actual M:	5926.00		
M Orthogonal:	6002.85	**98.72%**	**Pass**
M Diagonal:	6002.85	**98.72%**	**Pass**