Date: **February 10, 2014**

Marianne Dunst
Crown Castle
3530 Toringdon Way
Charlotte, NC 28277

AW Solutions Inc
300 Crown Oak Centre Drive
Longwood, FL 32750
(407) 260-0231

Subject: Structural Analysis Report

Carrier Designation:	***Sirius XM Radio Inc* Co-Locate**	
	Carrier Site Number:	HAR040S
	Carrier Site Name:	HAR040S
Crown Castle Designation:	**Crown Castle BU Number:**	806359
	Crown Castle Site Name:	NHV 104 943122
	Crown Castle JDE Job Number:	257917
	Crown Castle Work Order Number:	707434
	Crown Castle Application Number:	213469 Rev. 1
Engineering Firm Designation:	**AW Solutions Inc Project Number:**	806359
Site Data:	**423 ORONOQUE ROAD, MILFORD, New Haven County, CT**	
	Latitude *41° 14' 16.23"*, Longitude *-73° 5' 10"*	
	100 Foot - Monopole Tower	

Dear Marianne Dunst,

AW Solutions Inc is pleased to submit this **"Structural Analysis Report"** to determine the structural integrity of the above mentioned tower. This analysis has been performed in accordance with the Crown Castle Structural 'Statement of Work' and the terms of Crown Castle Purchase Order Number 614711, in accordance with application 213469, revision 1.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the tower stress level for the structure and foundation, under the following load case, to be:

LC7: Existing + Reserved + Proposed Equipment **Sufficient Capacity**
Note: See Table I and Table II for the proposed and existing/reserved loading, respectively.

The analysis has been performed in accordance with the TIA/EIA-222-F standard and 2005 CT State Building Code based upon a wind speed of 85 mph fastest mile.

All modifications and equipment proposed in this report shall be installed in accordance with the attached drawings for the determined available structural capacity to be effective.

We at *AW Solutions Inc* appreciate the opportunity of providing our continuing professional services to you and Crown Castle. If you have any questions or need further assistance on this or any other projects please give us a call.

Structural analysis prepared by: Robert Kitsteiner, E.I.

Respectfully submitted by:

STATE OF CONNECTICUT ★ EMMANUEL POULIN ★ No. 22947 LICENSED PROFESSIONAL ENGINEER

Emmanuel Poulin, P.E.
VP of Engineering

2/10/14

tnxTower Report - version 6.1.3.1

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1) INTRODUCTION

This tower is a 100 ft Monopole tower designed by VALMONT in August of 1986. The tower was originally designed for a wind speed of 0 mph per EIA-222-C. The tower was modified in July of 2008. Those modifications are considered in this report.

2) ANALYSIS CRITERIA

The structural analysis was performed for this tower in accordance with the requirements of TIA/EIA-222-F Structural Standards for Steel Antenna Towers and Antenna Supporting Structures using a fastest mile wind speed of 85 mph with no ice, 37.6 mph with 0.75 inch ice thickness and 50 mph under service loads.

Table 1 - Proposed Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
90.0	90.0	1	til-tek	TA-2335-DAB-L-095 w/ Mount Pipe	1	7/8	1
		1	tower mounts	Side Arm Mount [SO 102-1]			
50.0	50.0	1	til-tek	TA-2324-LHCP	1	1/2	1
		1	tower mounts	Side Arm Mount [SO 102-1]			
45.0	45.0	1	prodelin	1111	2	19/64	1
		2	tower mounts	Side Arm Mount [SO 102-1]			
		1	trimble	57860-30			

Notes:
1) Proposed Equipment

Table 2 - Existing and Reserved Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
98.0	105.0	6	decibel	DB846F65ZAXY w/ Mount Pipe	12 1	7/8 1/2	1
	103.0	1	gps	GPS_A			
	101.0	3	antel	BXA-171063-8BF-2 w/ Mount Pipe	-	-	2
		3	decibel	932DG90T2E-M w/ Mount Pipe			3
		6	rfs celwave	FD9R6004/2C-3L			2
		3	swedcom	SWCP 2x5514 w/ Mount Pipe			
	98.0	1	tower mounts	Platform Mount [LP 602-1]			1
83.0	83.0	3	ericsson	KRY 112 144/1	12	1-5/8	1
		3	rfs celwave	APX16DWV-16DWVS-E-A20 w/ Mount Pipe			
		1	tower mounts	Platform Mount [LP 602-1]			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
73.0	73.0	3	rfs celwave	APXV18-206517S-C w/ Mount Pipe	6	1-5/8	1
		1	tower mounts	Pipe Mount [PM 601-3]			

Notes:
1) Existing Equipment
2) Reserved Equipment
3) Equipment To Be Removed

Table 3 - Design Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
100	100	3	RFS / Celwave	PD 10017	-	-
83	83	3	RFS / Celwave	PD 1132D	-	-
80	80	2	Generic	6' Diameter MW	-	-

3) ANALYSIS PROCEDURE

Table 4 - Documents Provided

Document	Remarks	Reference	Source
4-GEOTECHNICAL REPORTS	FDH	1256016	CCISITES
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	FDH	1256012	CCISITES
4-TOWER MANUFACTURER DRAWINGS	Valmont	1245431	CCISITES
4-TOWER REINFORCEMENT DESIGN/DRAWINGS/DATA	PJF	2280914	CCISITES

3.1) Analysis Method

tnxTower (version 6.1.3.1), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

1) Tower and structures were built in accordance with the manufacturer's specifications.
2) The tower and structures have been maintained in accordance with the manufacturer's specification.
3) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
4) When applicable, transmission cables are considered as structural components for calculating wind loads as allowed by TIA/EIA-222-F.

This analysis may be affected if any assumptions are not valid or have been made in error. AW Solutions Inc should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 5 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
L1	100 - 46.8333	Pole	TP33.26x23.43x0.313	1	-8.67	1676.22	42.1	Pass
L2	46.8333 - 0	Pole	TP41.3x31.6787x0.375	2	-18.48	2569.04	61.6	Pass
							Summary	
						Pole (L2)	61.6	Pass
						Rating =	61.6	Pass

Table 6 - Tower Component Stresses vs. Capacity – LC7

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	76.9	Pass
1	Base Plate	0	35.4	Pass
1	Base Foundation	0	32.5	Pass

Structure Rating (max from all components) =	76.9%

Notes:
1) See additional documentation in “Appendix C – Additional Calculations” for calculations supporting the % capacity consumed.

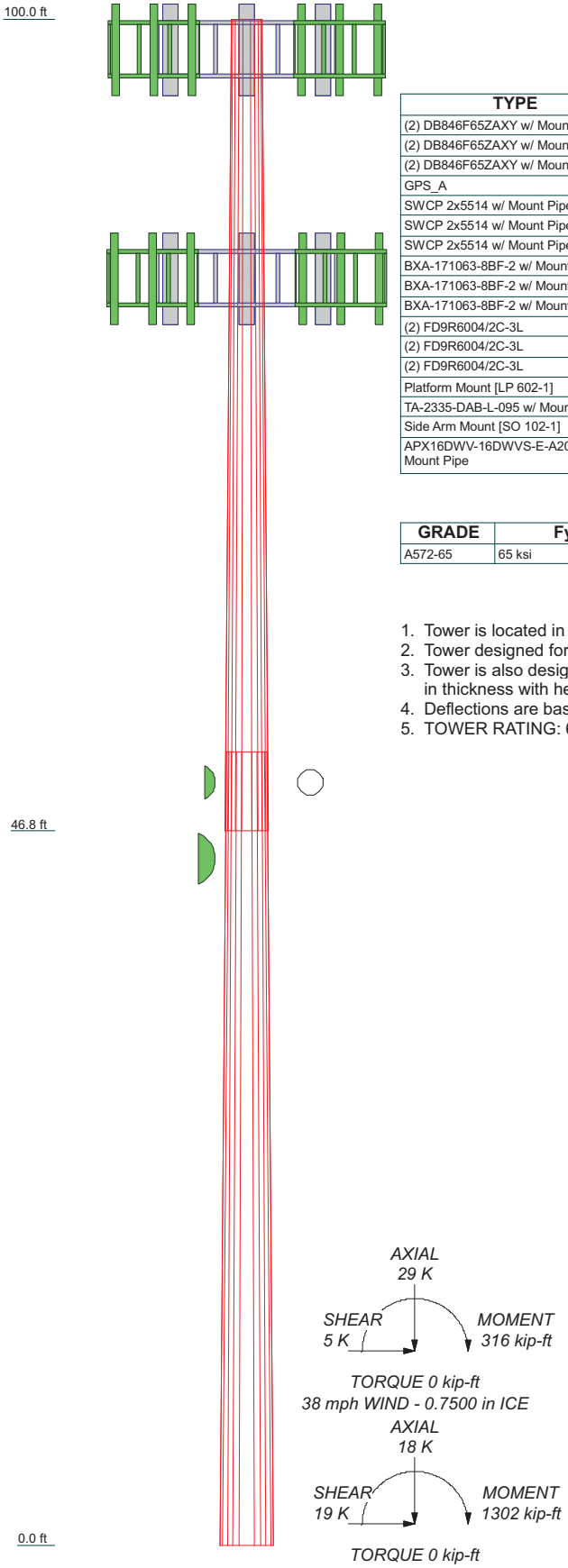
4.1) Recommendations

The tower and its foundation have sufficient capacity to carry the existing, reserved, and proposed loads. No modifications are required at this time.

APPENDIX A

TNXTOWER OUTPUT

Section	1	2
Length (ft)	53.17	52.00
Number of Sides	12	12
Thickness (in)	0.3130	0.3750
Socket Length (ft)	5.17	
Top Dia (in)	23.4300	31.6787
Bot Dia (in)	33.2600	41.3000
Grade	A572-65	
Weight (K)	5.1	7.7
		12.8



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
(2) DB846F65ZAXY w/ Mount Pipe	98	KRY 112 144/1	83
(2) DB846F65ZAXY w/ Mount Pipe	98	KRY 112 144/1	83
(2) DB846F65ZAXY w/ Mount Pipe	98	KRY 112 144/1	83
GPS_A	98	APX16DWV-16DWVS-E-A20 w/ Mount Pipe	83
SWCP 2x5514 w/ Mount Pipe	98	APX16DWV-16DWVS-E-A20 w/ Mount Pipe	83
SWCP 2x5514 w/ Mount Pipe	98	Platform Mount [LP 602-1]	83
SWCP 2x5514 w/ Mount Pipe	98	APXV18-206517S-C w/ Mount Pipe	73
BXA-171063-8BF-2 w/ Mount Pipe	98	APXV18-206517S-C w/ Mount Pipe	73
BXA-171063-8BF-2 w/ Mount Pipe	98	APXV18-206517S-C w/ Mount Pipe	73
BXA-171063-8BF-2 w/ Mount Pipe	98	Pipe Mount [PM 601-3]	73
(2) FD9R6004/2C-3L	98	Side Arm Mount [SO 102-1]	50
(2) FD9R6004/2C-3L	98	TA-2324-LHCP	50
(2) FD9R6004/2C-3L	98	Side Arm Mount [SO 102-1]	45
Platform Mount [LP 602-1]	98	Side Arm Mount [SO 102-1]	45
TA-2335-DAB-L-095 w/ Mount Pipe	90	57860-30	45
Side Arm Mount [SO 102-1]	90	1111	45
APX16DWV-16DWVS-E-A20 w/ Mount Pipe	83		

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 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: 61.6%

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Job: ***BU 806359***			
Project: ***WO 707434***			
Client: Crown Castle	Drawn by: Robert.Kitsteiner	App'd:	
Code: TIA/EIA-222-F	Date: 02/10/14	Scale: NTS	
Path: R:\Central_Data\CROWN CASTLE\CRC - STRUCTURAL\BU806359 - WO707434\ENGINEERING\BU806359 - WO707434.eri		Dwg No. E-1	

Tower Input Data

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

2) Tower is located in New Haven County, Connecticut.
3) Basic wind speed of 85 mph.
4) Nominal ice thickness of 0.7500 in.
5) Ice thickness is considered to increase with height.
6) Ice density of 56 pcf.
7) A wind speed of 38 mph is used in combination with ice.
8) Temperature drop of 50 °F.
9) Deflections calculated using a wind speed of 50 mph.
10) A non-linear (P-delta) analysis was used.
11) Pressures are calculated at each section.
12) Stress ratio used in pole design is 1.333.
13) Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

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

Distribute Leg Loads As Uniform
Assume Legs Pinned
√ Assume Rigid Index Plate
√ Use Clear Spans For Wind Area
Use Clear Spans For KL/r
Retension Guys To Initial Tension
√ Bypass Mast Stability Checks
√ Use Azimuth Dish Coefficients
√ Project Wind Area of Appurt.
Autocalc Torque Arm Areas
SR Members Have Cut Ends
Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing
Use TIA-222-G Tension Splice
Capacity Exemption

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

Poles

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

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	100.00-46.83	53.17	5.17	12	23.4300	33.2600	0.3130	1.2520	A572-65 (65 ksi)
L2	46.83-0.00	52.00		12	31.6787	41.3000	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	24.2565	23.2987	1589.2074	8.2759	12.1367	130.9419	3220.1650	11.4669	5.4404	17.381
	34.4333	33.2060	4600.8046	11.7950	17.2287	267.0434	9322.4774	16.3430	8.0748	25.798
L2	33.7859	37.7993	4727.8260	11.2067	16.4096	288.1137	9579.8572	18.6036	7.4849	19.96
	42.7569	49.4169	10564.2618	14.6511	21.3934	493.8094	21406.0585	24.3215	10.0634	26.836

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 100.00-46.83				1	1	1		
L2 46.83-0.00				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
LDF4-50A(1/2")	C	No	Inside Pole	98.00 - 0.00	1	No Ice	0.00	0.15
						1/2" Ice	0.00	0.15
						1" Ice	0.00	0.15
						2" Ice	0.00	0.15
						4" Ice	0.00	0.15
LDF5-50A(7/8")	C	No	Inside Pole	98.00 - 0.00	12	No Ice	0.00	0.33
						1/2" Ice	0.00	0.33
						1" Ice	0.00	0.33
						2" Ice	0.00	0.33
						4" Ice	0.00	0.33
LDF7-50A(1-5/8")	C	No	Inside Pole	83.00 - 0.00	12	No Ice	0.00	0.82
						1/2" Ice	0.00	0.82
						1" Ice	0.00	0.82
						2" Ice	0.00	0.82
						4" Ice	0.00	0.82
*								
CR 50 1873(1-5/8")	A	No	CaAa (Out Of Face)	73.00 - 0.00	1	No Ice	0.20	0.83
						1/2" Ice	0.30	2.34
						1" Ice	0.40	4.47
						2" Ice	0.60	10.55
						4" Ice	1.00	30.05
CR 50 1873(1-5/8")	A	No	CaAa (Out Of Face)	73.00 - 0.00	5	No Ice	0.00	0.83
						1/2" Ice	0.00	2.34
						1" Ice	0.00	4.47
						2" Ice	0.00	10.55
						4" Ice	0.00	30.05
*								
AVA5-50(7/8")	C	No	CaAa (Out Of Face)	90.00 - 0.00	1	No Ice	0.11	0.30
						1/2" Ice	0.21	1.28
						1" Ice	0.31	2.87
						2" Ice	0.51	7.88
						4" Ice	0.91	25.23
LDF4-50A(1/2")	C	No	CaAa (Out Of Face)	50.00 - 0.00	1	No Ice	0.00	0.15
						1/2" Ice	0.00	0.84
						1" Ice	0.00	2.14
						2" Ice	0.00	6.58
						4" Ice	0.00	22.78
7916A(19/64")	C	No	CaAa (Out Of Face)	45.00 - 0.00	2	No Ice	0.00	0.15
						1/2" Ice	0.00	0.84
						1" Ice	0.00	33.59
						2" Ice	0.00	37.62
						4" Ice	0.00	53.00
*								
Step Pegs (5/8" SR) 7-in w/30" step	C	No	CaAa (Out Of Face)	100.00 - 0.00	1	No Ice	0.03	0.49
						1/2" Ice	0.13	0.97
						1" Ice	0.23	1.46
						2" Ice	0.43	2.42
						4" Ice	0.83	4.36

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	100.00-46.83	A	0.000	0.000	0.000	5.181	0.13
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	6.299	0.61
L2	46.83-0.00	A	0.000	0.000	0.000	9.273	0.23
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	6.519	0.71

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	100.00-46.83	A	0.824	0.000	0.000	0.000	9.495	0.58
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	22.182	0.74
L2	46.83-0.00	A	0.750	0.000	0.000	0.000	16.995	1.05
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	21.963	2.89

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	100.00-46.83	-0.1445	-0.0623	-0.4208	0.0205
L2	46.83-0.00	-0.1630	-0.1736	-0.4634	-0.1465

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Level 98 Verizon*									
(2) DB846F65ZAXY w/ Mount Pipe	A	From Leg	4.00 0.00 7.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	7.27 7.88 8.48 9.72 12.33	7.82 9.01 9.91 11.81 15.98	0.05 0.11 0.19 0.37 0.87
(2) DB846F65ZAXY w/ Mount Pipe	B	From Leg	4.00 0.00 7.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	7.27 7.88 8.48 9.72 12.33	7.82 9.01 9.91 11.81 15.98	0.05 0.11 0.19 0.37 0.87
(2) DB846F65ZAXY w/ Mount Pipe	C	From Leg	4.00 0.00 7.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.27 7.88 8.48 9.72 12.33	7.82 9.01 9.91 11.81 15.98	0.05 0.11 0.19 0.37 0.87

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
						4" Ice			
GPS_A	A	From Leg	4.00	0.0000	98.00	No Ice	0.30	0.30	0.00
			0.00			1/2"	0.37	0.37	0.00
			5.00			Ice	0.46	0.46	0.01
						1" Ice	0.65	0.65	0.02
						2" Ice	1.15	1.15	0.08
						4" Ice			
*									
SWCP 2x5514 w/ Mount Pipe	A	From Leg	4.00	0.0000	98.00	No Ice	7.25	6.97	0.04
			0.00			1/2"	7.75	7.75	0.10
			3.00			Ice	8.25	8.50	0.17
						1" Ice	9.29	10.06	0.34
						2" Ice	11.48	13.40	0.79
						4" Ice			
SWCP 2x5514 w/ Mount Pipe	B	From Leg	4.00	0.0000	98.00	No Ice	7.25	6.97	0.04
			0.00			1/2"	7.75	7.75	0.10
			3.00			Ice	8.25	8.50	0.17
						1" Ice	9.29	10.06	0.34
						2" Ice	11.48	13.40	0.79
						4" Ice			
SWCP 2x5514 w/ Mount Pipe	C	From Leg	4.00	0.0000	98.00	No Ice	7.25	6.97	0.04
			0.00			1/2"	7.75	7.75	0.10
			3.00			Ice	8.25	8.50	0.17
						1" Ice	9.29	10.06	0.34
						2" Ice	11.48	13.40	0.79
						4" Ice			
BXA-171063-8BF-2 w/ Mount Pipe	A	From Leg	4.00	0.0000	98.00	No Ice	3.18	3.35	0.03
			0.00			1/2"	3.56	3.97	0.06
			3.00			Ice	3.96	4.60	0.10
						1" Ice	4.85	5.89	0.19
						2" Ice	6.77	8.89	0.49
						4" Ice			
BXA-171063-8BF-2 w/ Mount Pipe	B	From Leg	4.00	0.0000	98.00	No Ice	3.18	3.35	0.03
			0.00			1/2"	3.56	3.97	0.06
			3.00			Ice	3.96	4.60	0.10
						1" Ice	4.85	5.89	0.19
						2" Ice	6.77	8.89	0.49
						4" Ice			
BXA-171063-8BF-2 w/ Mount Pipe	C	From Leg	4.00	0.0000	98.00	No Ice	3.18	3.35	0.03
			0.00			1/2"	3.56	3.97	0.06
			3.00			Ice	3.96	4.60	0.10
						1" Ice	4.85	5.89	0.19
						2" Ice	6.77	8.89	0.49
						4" Ice			
(2) FD9R6004/2C-3L	A	From Leg	4.00	0.0000	98.00	No Ice	0.37	0.08	0.00
			0.00			1/2"	0.45	0.14	0.01
			3.00			Ice	0.54	0.20	0.01
						1" Ice	0.75	0.34	0.02
						2" Ice	1.28	0.74	0.06
						4" Ice			
(2) FD9R6004/2C-3L	B	From Leg	4.00	0.0000	98.00	No Ice	0.37	0.08	0.00
			0.00			1/2"	0.45	0.14	0.01
			3.00			Ice	0.54	0.20	0.01
						1" Ice	0.75	0.34	0.02
						2" Ice	1.28	0.74	0.06
						4" Ice			
(2) FD9R6004/2C-3L	C	From Leg	4.00	0.0000	98.00	No Ice	0.37	0.08	0.00
			0.00			1/2"	0.45	0.14	0.01
			3.00			Ice	0.54	0.20	0.01
						1" Ice	0.75	0.34	0.02
						2" Ice	1.28	0.74	0.06
						4" Ice			
*									
*									
TA-2335-DAB-L-095 w/	B	From Leg	4.00	0.0000	90.00	No Ice	7.98	3.87	0.05

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
Mount Pipe			0.00			1/2"	8.43	4.43	0.10
			0.00			Ice	8.88	5.00	0.16
						1" Ice	9.83	6.21	0.30
						2" Ice	11.90	8.96	0.69
						4" Ice			
*									
*									
APX16DWV-16DWVS-E-A20 w/ Mount Pipe	A	From Leg	4.00	0.0000	83.00	No Ice	7.81	3.78	0.06
			0.00			1/2"	8.37	4.64	0.11
			0.00			Ice	8.92	5.38	0.17
						1" Ice	10.04	6.91	0.31
						2" Ice	12.41	10.16	0.72
						4" Ice			
APX16DWV-16DWVS-E-A20 w/ Mount Pipe	B	From Leg	4.00	0.0000	83.00	No Ice	7.81	3.78	0.06
			0.00			1/2"	8.37	4.64	0.11
			0.00			Ice	8.92	5.38	0.17
						1" Ice	10.04	6.91	0.31
						2" Ice	12.41	10.16	0.72
						4" Ice			
APX16DWV-16DWVS-E-A20 w/ Mount Pipe	C	From Leg	4.00	0.0000	83.00	No Ice	7.81	3.78	0.06
			0.00			1/2"	8.37	4.64	0.11
			0.00			Ice	8.92	5.38	0.17
						1" Ice	10.04	6.91	0.31
						2" Ice	12.41	10.16	0.72
						4" Ice			
KRY 112 144/1	A	From Leg	4.00	0.0000	83.00	No Ice	0.41	0.20	0.01
			0.00			1/2"	0.50	0.27	0.01
			0.00			Ice	0.59	0.35	0.02
						1" Ice	0.81	0.53	0.03
						2" Ice	1.36	1.00	0.08
						4" Ice			
KRY 112 144/1	B	From Leg	4.00	0.0000	83.00	No Ice	0.41	0.20	0.01
			0.00			1/2"	0.50	0.27	0.01
			0.00			Ice	0.59	0.35	0.02
						1" Ice	0.81	0.53	0.03
						2" Ice	1.36	1.00	0.08
						4" Ice			
KRY 112 144/1	C	From Leg	4.00	0.0000	83.00	No Ice	0.41	0.20	0.01
			0.00			1/2"	0.50	0.27	0.01
			0.00			Ice	0.59	0.35	0.02
						1" Ice	0.81	0.53	0.03
						2" Ice	1.36	1.00	0.08
						4" Ice			
*									
*									
APXV18-206517S-C w/ Mount Pipe	A	From Leg	4.00	0.0000	73.00	No Ice	5.40	4.70	0.05
			0.00			1/2"	5.96	5.86	0.10
			0.00			Ice	6.48	6.73	0.15
						1" Ice	7.55	8.51	0.28
						2" Ice	9.92	12.28	0.68
						4" Ice			
APXV18-206517S-C w/ Mount Pipe	B	From Leg	4.00	0.0000	73.00	No Ice	5.40	4.70	0.05
			0.00			1/2"	5.96	5.86	0.10
			0.00			Ice	6.48	6.73	0.15
						1" Ice	7.55	8.51	0.28
						2" Ice	9.92	12.28	0.68
						4" Ice			
APXV18-206517S-C w/ Mount Pipe	C	From Leg	4.00	0.0000	73.00	No Ice	5.40	4.70	0.05
			0.00			1/2"	5.96	5.86	0.10
			0.00			Ice	6.48	6.73	0.15
						1" Ice	7.55	8.51	0.28
						2" Ice	9.92	12.28	0.68
						4" Ice			
*									
*									

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
57860-30	A	From Leg	4.00 0.00 0.00	0.0000	45.00	No Ice	0.08	0.08	0.00
						1/2" Ice	0.12	0.12	0.00
						1" Ice	0.17	0.17	0.00
						2" Ice	0.29	0.29	0.01
						4" Ice	0.65	0.65	0.04
* *									
Platform Mount [LP 602-1]	C	None		0.0000	98.00	No Ice	32.03	32.03	1.34
						1/2" Ice	38.71	38.71	1.80
						1" Ice	45.39	45.39	2.26
						2" Ice	58.75	58.75	3.17
						4" Ice	85.47	85.47	5.00
Side Arm Mount [SO 102-1]	B	None		0.0000	90.00	No Ice	1.50	1.50	0.03
						1/2" Ice	1.74	1.75	0.04
						1" Ice	1.98	2.00	0.04
						2" Ice	2.46	2.50	0.07
						4" Ice	3.42	3.50	0.11
Platform Mount [LP 602-1]	C	None		0.0000	83.00	No Ice	32.03	32.03	1.34
						1/2" Ice	38.71	38.71	1.80
						1" Ice	45.39	45.39	2.26
						2" Ice	58.75	58.75	3.17
						4" Ice	85.47	85.47	5.00
Pipe Mount [PM 601-3]	C	None		0.0000	73.00	No Ice	4.39	4.39	0.20
						1/2" Ice	5.48	5.48	0.24
						1" Ice	6.57	6.57	0.28
						2" Ice	8.75	8.75	0.36
						4" Ice	13.11	13.11	0.53
Side Arm Mount [SO 102-1]	C	None		0.0000	50.00	No Ice	1.50	1.50	0.03
						1/2" Ice	1.74	1.75	0.04
						1" Ice	1.98	2.00	0.04
						2" Ice	2.46	2.50	0.07
						4" Ice	3.42	3.50	0.11
Side Arm Mount [SO 102-1]	A	None		0.0000	45.00	No Ice	1.50	1.50	0.03
						1/2" Ice	1.74	1.75	0.04
						1" Ice	1.98	2.00	0.04
						2" Ice	2.46	2.50	0.07
						4" Ice	3.42	3.50	0.11
Side Arm Mount [SO 102-1]	C	None		0.0000	45.00	No Ice	1.50	1.50	0.03
						1/2" Ice	1.74	1.75	0.04
						1" Ice	1.98	2.00	0.04
						2" Ice	2.46	2.50	0.07
						4" Ice	3.42	3.50	0.11

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
TA-2324-LHCP	C	Paraboloid w/o	From	1.00	0.0000		50.00	2.17	No Ice	3.69	0.03

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
		Radome	Leg	0.00					1/2" Ice	3.98	0.05
				0.00					1" Ice	4.27	0.07
									2" Ice	4.84	0.11
									4" Ice	6.00	0.19
1111	C	Paraboloid w/o Radome	From Leg	1.00	-37.0000		45.00	3.33	No Ice	8.04	0.04
				0.00					1/2" Ice	8.47	0.08
				0.00					1" Ice	8.89	0.10
									2" Ice	9.74	0.17
									4" Ice	11.44	0.26

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 90 deg - No Ice
4	Dead+Wind 180 deg - No Ice
5	Dead+Ice+Temp
6	Dead+Wind 0 deg+Ice+Temp
7	Dead+Wind 90 deg+Ice+Temp
8	Dead+Wind 180 deg+Ice+Temp
9	Dead+Wind 0 deg - Service
10	Dead+Wind 90 deg - Service
11	Dead+Wind 180 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	100 - 46.8333	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-14.55	-0.47	0.26
			Max. Mx	3	-8.67	-452.88	-2.77
			Max. My	2	-8.68	2.64	449.41
			Max. Vy	3	13.07	-452.88	-2.77
			Max. Vx	2	-12.98	2.64	449.41
			Max. Torque	4			0.70
L2	46.8333 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	5	-29.18	2.86	0.04
			Max. Mx	3	-18.48	-1301.78	13.52
			Max. My	2	-18.48	-9.83	1298.30
			Max. Vy	3	19.17	-1301.78	13.52
			Max. Vx	2	-19.18	-9.83	1298.30
			Max. Torque	2			-0.59

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	6	29.18	-0.06	4.57
	Max. H_x	5	29.18	0.00	0.00
	Max. H_z	2	18.50	-0.27	19.16
	Max. M_x	2	1298.30	-0.27	19.16
	Max. M_z	3	1301.78	-19.16	0.36

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Max. Torsion	3	0.19	-19.16	0.36
	Min. Vert	1	18.50	0.00	0.00
	Min. H_x	3	18.50	-19.16	0.36
	Min. H_z	4	18.50	-0.04	-18.97
	Min. M_x	4	-1288.74	-0.04	-18.97
	Min. M_z	5	-2.86	0.00	0.00
	Min. Torsion	4	-0.18	-0.04	-18.97

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	18.50	0.00	0.00	-0.26	0.04	0.00
Dead+Wind 0 deg - No Ice	18.50	0.27	-19.16	-1298.30	-9.83	-0.02
Dead+Wind 90 deg - No Ice	18.50	19.16	-0.36	-13.52	-1301.78	-0.19
Dead+Wind 180 deg - No Ice	18.50	0.04	18.97	1288.74	-5.24	0.18
Dead+Ice+Temp	29.18	0.00	0.00	-0.04	2.86	0.00
Dead+Wind 0 deg+Ice+Temp	29.18	0.06	-4.57	-315.57	0.55	-0.04
Dead+Wind 90 deg+Ice+Temp	29.18	4.56	-0.08	-3.08	-313.26	-0.02
Dead+Wind 180 deg+Ice+Temp	29.18	0.01	4.53	313.53	1.94	0.08
Dead+Wind 0 deg - Service	18.50	0.09	-6.63	-449.54	-3.37	-0.01
Dead+Wind 90 deg - Service	18.50	6.63	-0.12	-4.85	-450.54	-0.06
Dead+Wind 180 deg - Service	18.50	0.02	6.56	445.89	-1.79	0.06

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	-18.50	0.00	0.00	18.50	0.00	0.000%
2	0.27	-18.50	-19.16	-0.27	18.50	19.16	0.000%
3	19.16	-18.50	-0.36	-19.16	18.50	0.36	0.000%
4	0.04	-18.50	18.97	-0.04	18.50	-18.97	0.000%
5	0.00	-29.18	0.00	0.00	29.18	0.00	0.000%
6	0.06	-29.18	-4.57	-0.06	29.18	4.57	0.000%
7	4.56	-29.18	-0.08	-4.56	29.18	0.08	0.000%
8	0.01	-29.18	4.53	-0.01	29.18	-4.53	0.000%
9	0.09	-18.50	-6.63	-0.09	18.50	6.63	0.000%
10	6.63	-18.50	-0.12	-6.63	18.50	0.12	0.000%
11	0.02	-18.50	6.56	-0.02	18.50	-6.56	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	0.00001979
3	Yes	4	0.00000001	0.00000701
4	Yes	4	0.00000001	0.00001809
5	Yes	4	0.00000001	0.00000001
6	Yes	4	0.00000001	0.00015221
7	Yes	4	0.00000001	0.00015208
8	Yes	4	0.00000001	0.00015150

9	Yes	4	0.00000001	0.00000001
10	Yes	4	0.00000001	0.00000001
11	Yes	4	0.00000001	0.00000001

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 46.8333	10.780	10	0.8493	0.0012
L2	52 - 0	3.281	10	0.5585	0.0001

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
98.00	(2) DB846F65ZAXY w/ Mount Pipe	10	10.423	0.8394	0.0012	41240
90.00	TA-2335-DAB-L-095 w/ Mount Pipe	10	9.004	0.7995	0.0009	20620
83.00	APX16DWV-16DWVS-E-A20 w/ Mount Pipe	10	7.792	0.7630	0.0008	12129
73.00	APXV18-206517S-C w/ Mount Pipe	10	6.149	0.7065	0.0005	7636
50.00	TA-2324-LHCP	10	3.063	0.5416	0.0001	4500
45.00	1111	10	2.565	0.4971	0.0001	4963

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 46.8333	31.127	3	2.4518	0.0037
L2	52 - 0	9.477	3	1.6133	0.0003

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
98.00	(2) DB846F65ZAXY w/ Mount Pipe	3	30.096	2.4233	0.0036	14326
90.00	TA-2335-DAB-L-095 w/ Mount Pipe	3	25.999	2.3082	0.0029	7163
83.00	APX16DWV-16DWVS-E-A20 w/ Mount Pipe	3	22.500	2.2032	0.0023	4213
73.00	APXV18-206517S-C w/ Mount Pipe	3	17.758	2.0402	0.0015	2651
50.00	TA-2324-LHCP	3	8.849	1.5646	0.0003	1561
45.00	1111	3	7.412	1.4360	0.0003	1721

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	100 - 46.8333 (1)	TP33.26x23.43x0.313	53.17	0.00	0.0	39.000	32.2432	-8.67	1257.48	0.007
L2	46.8333 - 0 (2)	TP41.3x31.6787x0.375	52.00	0.00	0.0	39.000	49.4169	-18.48	1927.26	0.010

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	100 - 46.8333 (1)	TP33.26x23.43x0.313	452.89	21.591	39.000	0.554	0.00	0.000	39.000	0.000
L2	46.8333 - 0 (2)	TP41.3x31.6787x0.375	1301.85	31.636	39.000	0.811	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	100 - 46.8333 (1)	TP33.26x23.43x0.313	13.07	0.405	26.000	0.032	0.32	0.007	26.000	0.000
L2	46.8333 - 0 (2)	TP41.3x31.6787x0.375	19.17	0.388	26.000	0.030	0.19	0.002	26.000	0.000

Pole Interaction Design Data

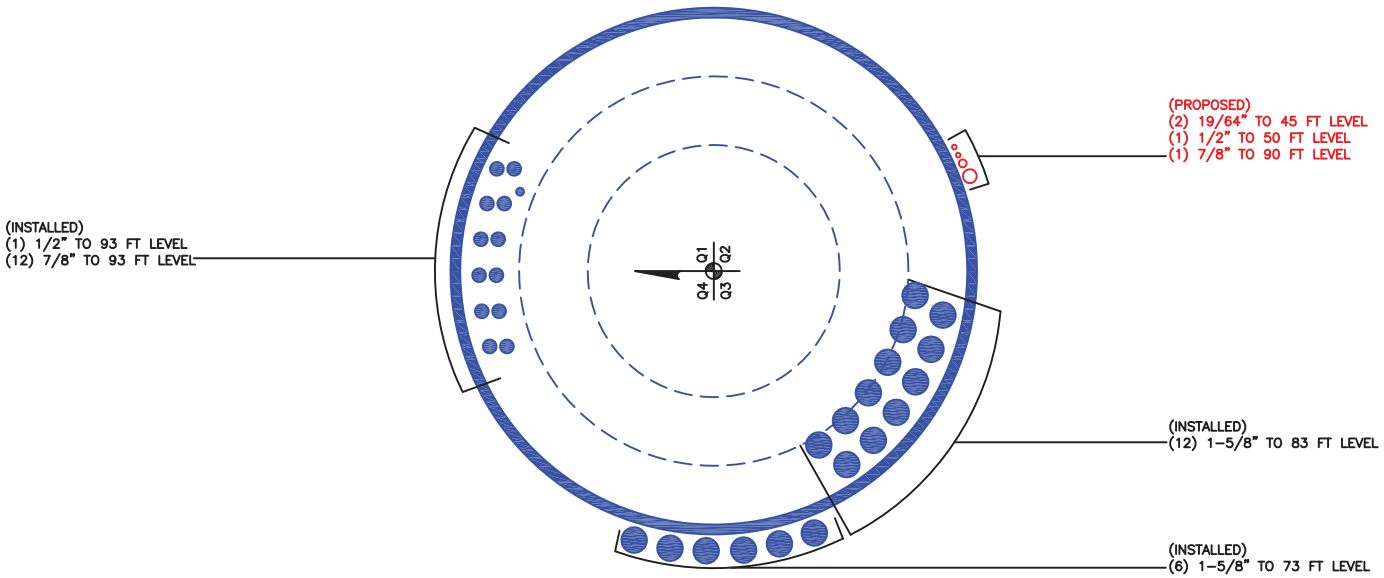
Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	100 - 46.8333 (1)	0.007	0.554	0.000	0.032	0.000	0.561 ✔	1.333	H1-3+VT ✔
L2	46.8333 - 0 (2)	0.010	0.811	0.000	0.030	0.000	0.821 ✔	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	100 - 46.8333	Pole	TP33.26x23.43x0.313	1	-8.67	1676.22	42.1	Pass
L2	46.8333 - 0	Pole	TP41.3x31.6787x0.375	2	-18.48	2569.04	61.6	Pass
							Summary	
						Pole (L2)	61.6	Pass
						RATING =	**61.6**	**Pass**

APPENDIX B

BASE LEVEL DRAWING



BUSINESS UNIT: 806359 TOWER ID: C_BASELEVEL

APPENDIX C

ADDITIONAL CALCULATIONS

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

TIA Rev F

Site Data

BU#:	*806359*
Site Name:	*NHV 104 943122*
App #:	
Pole Manufacturer:	*Other*

Reactions		
Moment:	1302	ft-kips
Axial:	18	kips
Shear:	19	kips

Anchor Rod Data		
Qty:	8	
Diam:	2.25	in
Rod Material:	A615-J	
Strength (Fu):	100	ksi
Yield (Fy):	75	ksi
Bolt Circle:	47.58	in

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

Plate Data		
Diam:	53.58	in
Thick:	2.5	in
Grade:	60	ksi
Single-Rod B-eff:	14.81	in

Base Plate Results Flexural Check

Base Plate Stress:	21.2	ksi	Rigid
Allowable Plate Stress:	60.0	ksi	Service ASD
Base Plate Stress Ratio:	35.4%	Pass	0.75*Fy*ASIF
			Y.L. Length: 23.63

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

n/a

Stiffener Results

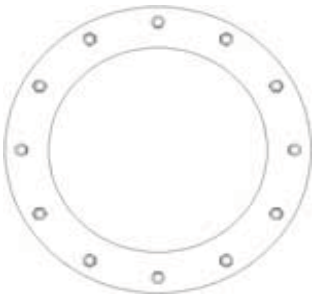
Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check:	n/a

Pole Data		
Diam:	41.3	in
Thick:	0.375	in
Grade:	65	ksi
# of Sides:	18	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Stress Increase Factor		
ASIF:	1.333	



* 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

Project: BU 806359
Site: NHV 104 943122

Designed By: RK
Date: 2/8/14
Checked by: EP

ANCHOR BOLTS ANALYSIS - 2 BOLT CIRCLES

1.0 BASE REACTIONS:

M= Moment at the base
Q= Axial load at the base
V= Shear load at the base

$M := 1302 \cdot kip \cdot ft$ (from structural analysis)

$Q := 18 \cdot kip$ (from structural analysis)

$V := 19 \cdot kip$ (from structural analysis)

2.0 BOLT PARAMETERS:

n= Number of bolts
d= Bolt diameter
D= Circle diameter
F_b= Yield strength of bolt
F_u= Ultimate strength of bolt

	(inner bolt circle)	(outer bolt circle)
	$n_1 := 8$	$n_2 := 4$
	$D_1 := 47.58 \cdot in$	$D_2 := 52.8 \cdot in$
	$F_{b1} := 75 \cdot ksi$	$F_{b2} := 150 \cdot ksi$
	$d_1 := 2.25 \cdot in$	$d_2 := 1.75 \cdot in$
	$F_{u1} := 100 \cdot ksi$	$F_{u2} := 195 \cdot ksi$

3.0 VERIFY STRESS IN BOLTS:

θ= Angle between bolts
r= Distance from centroid of pole to extreme bolt
I_b= Inertia of one bolt
a= Area of one bolt
y= Distance from bolt to center
I_x= moment of inertia of bolt system
Q.e= Axial load on existing bolts
M.e= Moment on existing bolts
Q.n.= Axial load on new bolts
M.n= Moment on new bolts

$TPI_1 := 11$ $\qquad$ $TPI_2 := 1$

$$\theta_1 := \frac{360deg}{n_1} \qquad i := 1 .. n_1 \qquad \phi_1(i) := i \cdot \theta_1 \qquad \theta_2 := \frac{360deg}{n_2} \qquad j := 1 .. n_2 \qquad \phi_2(j) := j \cdot \theta_2$$

$$a_1 := \frac{\pi}{4} \cdot \left(d_1 - \frac{0.9743in}{TPI_1}\right)^2 = 3.669 \cdot in^2 \qquad y_1(i) := \frac{D_1 \cdot \cos(\phi_1(i))}{2} \qquad a_2 := \frac{\pi}{4} \cdot \left(d_2 - \frac{0.9743in}{TPI_2}\right)^2 = 0.473 \cdot in^2 \qquad y_2(j) := \frac{D_2 \cdot \cos(\phi_2(j))}{2}$$

$$Ix_1(i) := a_1 \cdot y_1(i)^2 \qquad Ix_2(j) := a_2 \cdot y_2(j)^2$$

$$Ix := \sum_{i=1}^{n_1} Ix_1(i) + \sum_{j=1}^{n_2} Ix_2(j) \qquad Ix = 8965 \cdot in^4$$

$$M_e := M \cdot \frac{\left(\sum_{i=1}^{n_1} Ix_1(i)\right)}{Ix} = 1206 \cdot kip \cdot ft \qquad Q_e := Q \cdot \frac{n_1 \cdot a_1}{n_1 \cdot a_1 + n_2 \cdot a_2} = 17 \cdot kip$$

$$M_n := M \cdot \frac{\left(\sum_{j=1}^{n_2} Ix_2(j)\right)}{Ix} = 96 \cdot kip \cdot ft \qquad Q_n := Q \cdot \frac{n_2 \cdot a_2}{n_1 \cdot a_1 + n_2 \cdot a_2} = 1 \cdot kip$$

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

TIA Rev F

Site Data

BU#:	*806359*
Site Name:	*NHV 104 943122*
App #:	
Pole Manufacturer:	*Other*

Reactions		
Moment:	1206	ft-kips
Axial:	17	kips
Shear:	19	kips

Anchor Rod Data		
Qty:	8	
Diam:	2.25	in
Rod Material:	A615-J	
Strength (Fu):	100	ksi
Yield (Fy):	75	ksi
Bolt Circle:	47.58	in

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

Anchor Rod Results

Maximum Rod Tension:	150.0	Kips	Rigid
Allowable Tension:	195.0	Kips	Service, ASD
Anchor Rod Stress Ratio:	76.9%	**Pass**	Fty*ASIF

Plate Data		
Diam:	53.58	in
Thick:	2.5	in
Grade:	60	ksi
Single-Rod B-eff:	14.81	in

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

n/a

Stiffener Results

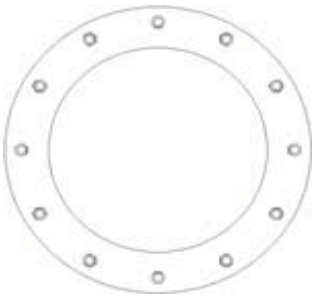
Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check:	n/a

Pole Data		
Diam:	41.3	in
Thick:	0.375	in
Grade:	65	ksi
# of Sides:	18	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Stress Increase Factor		
ASIF:	1.333	



* 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

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

TIA Rev F

Site Data

BU#:	*806359*
Site Name:	*NHV 104 943122*
App #:	
Pole Manufacturer:	*Other*

Reactions		
Moment:	96	ft-kips
Axial:	1	kips
Shear:	0	kips

Anchor Rod Data		
Qty:	4	
Diam:	1.75	in
Rod Material:	A615-J	
Strength (Fu):	195	ksi
Yield (Fy):	150	ksi
Bolt Circle:	52.8	in

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

Anchor Rod Results

Maximum Rod Tension:	21.6	Kips	Non-Rigid
Allowable Tension:	227.9	Kips	Service, ASD
Anchor Rod Stress Ratio:	9.5%	**Pass**	Fty*ASIF

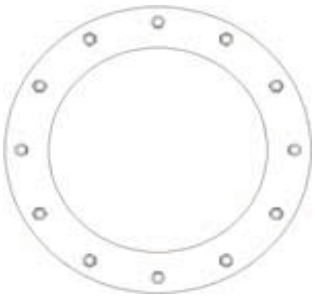
Plate Data		
Diam:		in
Thick:		in
Grade:		ksi
Single-Rod B-eff:		in

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

n/a

Pole Data		
Diam:	41.3	in
Thick:	0.375	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	



* 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

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AW Solutions Inc

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Project Title: BU 806359
Project Notes: WO 707434

Calculation Method: Full 8CD

******* I N P U T D A T A

Pier Properties

Diameter (ft)	Distance of Top of Pier above Ground (ft)	Concrete Strength (ksi)	Steel Yield Strength (ksi)
7.80	1.30	3.00	60.00

Soil Properties

Layer	Type	Thickness (ft)	Depth at Top of Layer (ft)	Density (lbs/ft^3)	CU (psf)	KP	PHI (deg)
1	Clay	4.00	0.00	105.0			
2	Sand	2.00	4.00	105.0		2.882	29.00
3	Sand	2.30	6.00	135.0		4.599	40.00
4	Clay	18.70	8.30	180.0	20000.0		

Design (Factored) Loads at Top of Pier

Moment (ft-k)	Axial Load (kips)	Shear Load (kips)	Additional Safety Factor Against Soil Failure	
1302.0	18.0	19.00	9.00	====> 2.0 / 9.0 = 22.2%

******* R E S U L T S

Calculated Pier Properties

Length (ft)	Weight (kips)	End Bearing Pressure (psf)
16.300	116.831	376.7

Ultimate Resisting Forces Along Pier

Type	Distance of Top of Layer to Top of Pier (ft)	Thickness (ft)	Density (lbs/ft^3)	CU (psf)	KP	Force (kips)	Arm (ft)
Clay	1.30	4.00	105.0			0.00	3.30
Sand	5.30	2.00	105.0		2.882	70.81	6.37
Sand	7.30	2.30	135.0		4.599	194.36	8.53
Clay	9.60	3.31	180.0	20000.0		4134.19	11.26
Clay	12.91	3.39	180.0	20000.0		-4227.40	14.61

Shear and Moments Along Pier

Distance below Top of Pier (ft)	Shear (with Safety Factor) (kips)	Moment (with Safety Factor) (ft-k)	Shear (without Safety Factor) (kips)	Moment (without Safety Factor) (ft-k)
0.00	172.0	13103.1	19.1	1455.9
1.63	172.0	13383.4	19.1	1487.0
3.26	172.0	13663.7	19.1	1518.2
4.89	172.0	13944.0	19.1	1549.3
6.52	132.1	14201.0	14.7	1577.9
8.15	38.3	14352.3	4.3	1594.7
9.78	-317.8	14279.2	-35.3	1586.6
11.41	-2352.1	12103.2	-261.3	1344.8
13.04	-4068.5	6631.6	-452.1	736.8
14.67	-2034.2	1657.9	-226.0	184.2
16.30	0.0	0.0	0.0	0.0

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Project Title: BU 806359
Project Notes: WO 707434

Calculation Method: Full 8CD

******* I N P U T D A T A

Pier Properties

Diameter (ft)	Distance of Top of Pier above Ground (ft)	Concrete Strength (ksi)	Steel Yield Strength (ksi)
6.30	1.30	3.00	60.00

Soil Properties

Layer	Type	Thickness (ft)	Depth at Top of Layer (ft)	Density (lbs/ft^3)	CU (psf)	KP	PHI (deg)
1	Clay	4.00	0.00	105.0			
2	Sand	2.00	4.00	105.0		2.882	29.00
3	Sand	2.30	6.00	135.0		4.599	40.00
4	Clay	18.70	8.30	180.0	20000.0		

Design (Factored) Loads at Top of Pier

Moment (ft-k)	Axial Load (kips)	Shear Load (kips)	Additional Safety Factor Against Soil Failure	
1302.0	18.0	19.00	7.00	===> 2.0 / 7.0 = 28.57%

******* R E S U L T S

Calculated Pier Properties

Length (ft)	Weight (kips)	End Bearing Pressure (psf)
16.300	76.217	577.4

Ultimate Resisting Forces Along Pier

Type	Distance of Top of Layer to Top of Pier (ft)	Thickness (ft)	Density (lbs/ft^3)	CU (psf)	KP	Force (kips)	Arm (ft)
Clay	1.30	4.00	105.0			0.00	3.30
Sand	5.30	2.00	105.0		2.882	57.19	6.37
Sand	7.30	2.30	135.0		4.599	156.99	8.53
Clay	9.60	3.31	180.0	20000.0		3336.34	11.25
Clay	12.91	3.39	180.0	20000.0		-3417.25	14.60

Shear and Moments Along Pier

Distance below Top of Pier (ft)	Shear (with Safety Factor) (kips)	Moment (with Safety Factor) (ft-k)	Shear (without Safety Factor) (kips)	Moment (without Safety Factor) (ft-k)
0.00	133.3	10655.7	19.0	1522.2
1.63	133.3	10873.0	19.0	1553.3
3.26	133.3	11090.2	19.0	1584.3
4.89	133.3	11307.5	19.0	1615.4
6.52	101.1	11506.0	14.4	1643.7
8.15	25.3	11619.0	3.6	1659.9
9.78	-262.3	11550.8	-37.5	1650.1
11.41	-1905.4	9784.1	-272.2	1397.7
13.04	-3286.1	5356.3	-469.4	765.2
14.67	-1643.0	1339.1	-234.7	191.3
16.30	0.0	0.0	0.0	0.0

Moment Capacity of Drilled Concrete Shaft (Caisson) for TIA Rev F or G

Note: Shaft assumed to have ties, not spiral, transverse reinforcing

Site Data

BU#:	*806359*
Site Name:	*NVH*
App #:	

Enter Load Factors Below:		
For M (WL)	1.3	<---- Enter Factor
For P (DL)	1.3	<---- Enter Factor

Pier Properties

Concrete:

Pier Diameter =	7.8	ft
Concrete Area =	6880.8	in^2

Reinforcement:

Clear Cover to **Tie**=	3.00	in
Horiz. **Tie** Bar Size=	6	
Vert. Cage Diameter =	7.06	ft
Vert. Cage Diameter =	84.69	in
Vertical Bar Size =	11	
Bar Diameter =	1.41	in
Bar Area =	1.56	in^2
Number of Bars =	24	
As Total=	37.44	in^2
A s/ Aconc, Rho:	0.0054	0.54%

ACI 10.5 , ACI 21.10.4, and IBC 1810.

Min As for Flexural, Tension Controlled, Shafts:

(3)*(Sqrt(f'c)/Fy:	0.0027
200 / Fy:	0.0033

Minimum Rho Check:

Actual Req'd Min. Rho:	0.33%	Flexural
Provided Rho:	0.54%	**OK**

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn.		
Pn per ACI 318 (10-2)	10242.48	kips
at Mu=(ϕ=0.65)Mn=	6985.46	ft-kips
Max Tu, (φ=0.9) Tn =	2021.76	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces

TIA Revision:	F	
Max. Service Shaft M:	1659.9	ft-kips **(* Note)**
Max. Service Shaft P:	18	kips
Max Axial Force Type:	Comp.	

(*) Note: Max Shaft Superimposed Moment does not necessarily equal to the shaft top reaction moment

Load Factor	**Shaft Factored Loads**		
1.30	Mu:	2157.87	ft-kips
1.30	Pu:	23.4	kips

Material Properties

Concrete Comp. strength, f'c =	3000	psi
Reinforcement yield strength, Fy =	60	ksi
Reinforcing Modulus of Elasticity, E =	29000	ksi
Reinforcement yield strain =	0.00207	
Limiting compressive strain =	0.003	

ACI 318 Code

Select Analysis ACI Code=	2005

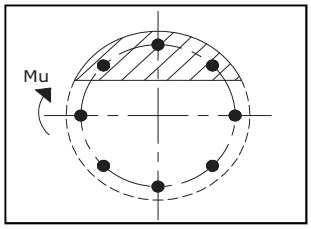
Seismic Properties

Seismic Design Category =	C
Seismic Risk =	**Moderate**

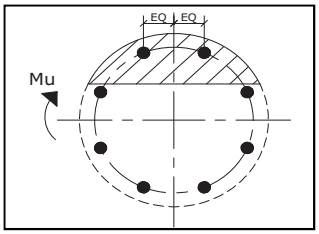
Solve (Run) <-- Press Upon Completing All Input

Results:

Governing Orientation Case: **2**



Case 1



Case 2

Dist. From Edge to Neutral Axis:	**14.31**	in
Extreme Steel Strain, ϵt:	**0.0156**	
	ϵt > 0.0050, Tension Controlled	
Reduction Factor,φ:	**0.900**	

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	23.40	kips
Drilled Shaft Moment Capacity, φMn:	**6642.35**	ft-kips
Drilled Shaft Superimposed Mu:	**2157.87**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**32.5%**