GPD GROUP, INC.

STRUCTURAL ANALYSIS REPORT

140′ Self-Support Tower

6985 Homesteader Lane
Hayden, CO 81639

SBA Site Name: Hayden 2, CO
SBA Site Number: CO09874-A

Union Telephone Company Site Name: Hayden

GPD Project Number: 2016778.09874.04

Analysis Results

Tower Components	59.4%	Sufficient
Foundation	43.6%	Sufficient

December 16, 2015

Respectfully submitted by:

12/16/2015
Christopher J. Scheks P.E.
Colorado #: 49793

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APPENDICES

Executive Summary

The purpose of this analysis is to verify whether the existing self-support tower is structurally capable of carrying the proposed antenna and coax loads as specified by Union Telephone Company to SBA. This report was commissioned by Ms. Aubree Holmes of SBA.

The existing structure and its foundations have been analyzed per the following requirements:

Governing Code(s)	TIA-222-G, 2012 IBC & ASCE 7-10
Wind Speed*	89 Nominal MPH 3-Second Gust
Wind Speed w/ Ice	Not Applicable
Radial Ice Thickness	0″
Risk Category	II
Exposure Category	C
Topographic Category	1

*Wind Speed in nominal form is equivalent to a 115 MPH Ultimate 3-Second Gust.

Per TIA-222-G Section 2.6.4 ice may be ignored for structures located in regions where the design ice thickness is less than or equal to 0.25 inches (6mm).

Conclusions & Recommendations

The designs of the tower and its foundation are sufficient for the proposed loading in accordance with the above loading criteria and will not require modification.

Tower Description

The existing 140′ self-support tower is located in Hayden, CO. The tower was originally designed by Valmont Microflect in June of 2005. The original design load for the tower was for a 100 MPH basic wind speed with 1/2" of radial ice per EIA/TIA-222-F. The tower was originally designed to hold the following loading:

Original Design Loading:

Mounting Level (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	# of Feed Lines	Coax Size (in)
150	2		10′ whips on stand-offs		
90-135	1		LPX-8C FM antenna with radome		
	1		SHPX-8AC FM antenna with radome		
85	1		6′ Dia. Std w / Rad		
80	1		2′ panel		
75	2		6′ panels on stand-offs		
65	1		2′ panel		
50	2		10′ whips on stand-offs		
45	1		6′ Dia. Std w/ Rad		
35	1		6′ Dia. Grid		
30	2		4′ Dia. Std w/ Rad		
	1		4′ Dia. Std		
25	1		4′ Dia. Std w/ Rad		

Documents Provided:

Document Type	Remarks	Source
Original Tower Design	Valmont Microflect S.O. #: 18286-05 , dated: 06/30/05	SBA
Geotechnical Report	North West Colorado Consultants Inc. Job #: 99-4132, dated: 09/15/99	SBA
TIA Inspection Report	FDH Job #: 07-0106T, dated: 01/22/07	SBA
Previous Analysis	FDH Project #: 08-07194E S1, dated: 08/04/08	SBA
Site Summary	SBA Site ID#: CO09874-A, dated: 12/08/15	SBA

Tower Materials:

Structural Components	Material Strength
Legs	ASTM A500 (46 KSI Yield Strength)
Bracing Members	ASTM A500,A36 (46,36 KSI Yield Strength)
Member Bolts	A325X
Anchor Rods	ASTM F1554 (55 KSI Yield Strength)

Tower Loading

The following data shows the major loading that the tower supports. All existing, leased, and the proposed loading information was provided by SBA or taken from the previous structural analysis.

Existing/Leased Loading

Carrier	Mounting Level (ft)	Center Line Elevation (ft)	# of Antennas	Antenna Manufact.	Antenna/Mount Model	# of Coax	Coax Size (in)	Note
Unknown	113	113	1		6-Bay FM	1	2	
			1		2' Standoff			
			1		6-Bay FM	1	1-5/8	
			1		2.5' Standoff			
	88	88	1	Gabriel	116682 Dish	1	EW90	
			1		Pipe Mount			
	84	84	1	Radiowave	SEC-2501-60-178	1	1/4	
			1	Alvarion	AU-RE-HP-34 TMA			
			1		Pipe Mount			
	77	77	2	Decibel	DB982H120E-M	2	1-1/4	
			1		10.5' Sector Mount			
	70	70	1	Radiowaves	SEC-25W-60-178	1	1/4	
			1	Alvarion	AU-RE-HP-34 TMA			
			1		Pipe Mount			
Union Telephone Company	57	57	2	Antel	LPD-7905/8	2	7/8	
			1		13' Sector Mount			
	56	56	2	Antel	LPD-7905/8	2	7/8	
			1		13' Sector Mount			
	55	55	1	Andrew	Omni	1	7/8	
	53	53	2	Antel	LPD-7905/8	2	7/8	
			1	Andrew	Omni	1	7/8	
			1		15.5' Sector Mount			
Unknown	53	53	1	Canopy	245614 Yagi	1	1/2	
	47.5	47.5	1		20" x 30" Yagi	1	7/8	
			1		Pipe Mount			
	47	47	1	Gabriel	116682 Dish	1	EW61	
			1		Pipe Mount			
	39.5	39.5	1	Radiowaves	SP4-24 Dish	1	1/2	
			1		Pipe Mount			
	38.5	38.5	1		20" x 30" Yagi	1	7/8	
			1		Pipe Mount			
	35.5	35.5	1	Andrew	141163 Dish	1	1/2	
			1		Pipe Mount			
	34	34	1	Radiowaves	SP4-5.8NS Dish	1	1/2	
			1		Pipe Mount			
	32.5	32.5	1	Radiowaves	100170-4	1	1/2	
			1		Pipe Mount			
Union Telephone Company	28	28	1	Radiowaves	SPR-5 8NS	1	1-1/4	
			1		Pipe Mount			
	22.5	22.5	1	Andrew	HP6-107	1	EW90	
			1		Pipe Mount			
Unknown	15.5	15.5	1	Scala	HDCA-5EB Yagi	1	1/2	
Union Telephone Company	13	13	1	Andrew	HPX8-65-P6A	1	EW63	
			1		Pipe Mount			

Final Proposed Loading Configuration

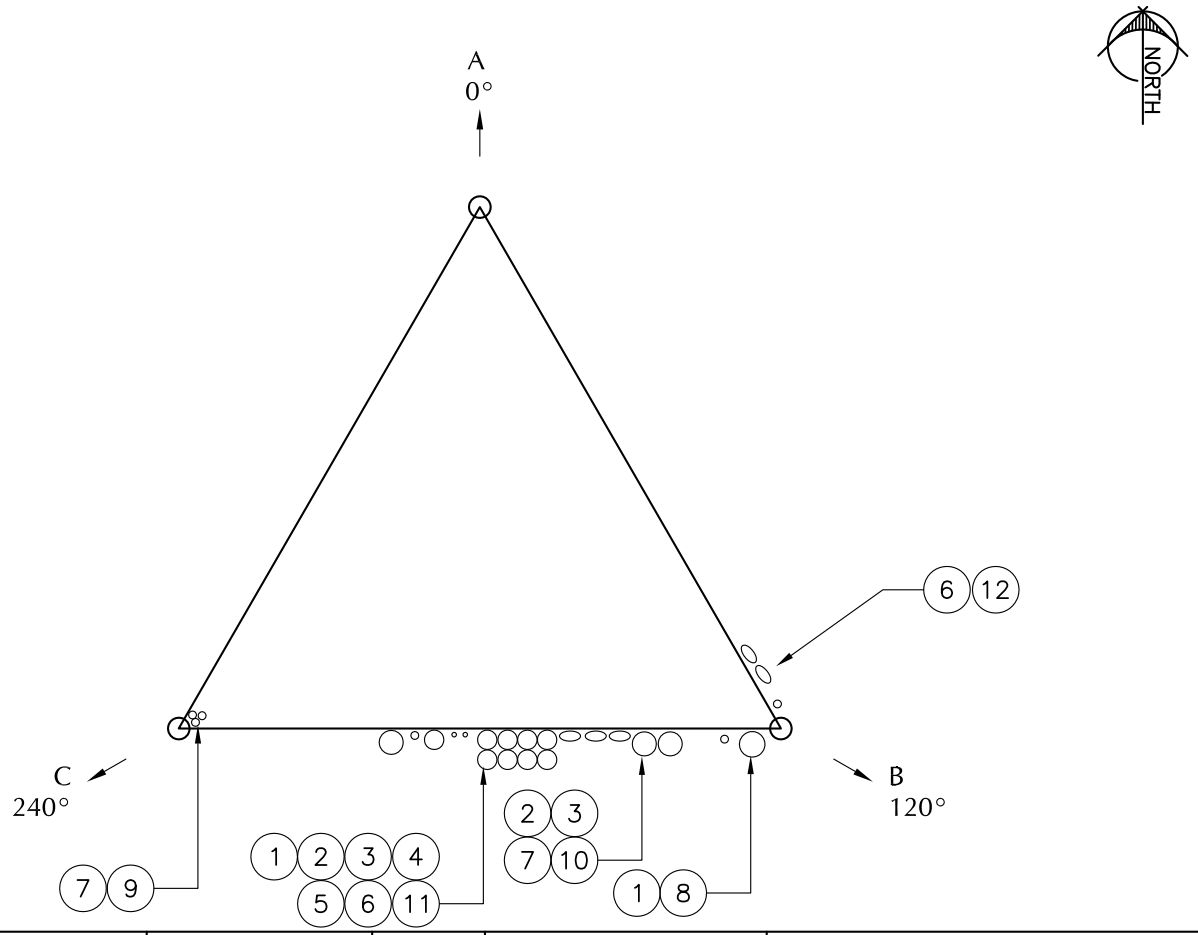
Carrier	Mounting Level (ft)	Center Line Elevation (ft)	# of Antennas	Antenna Manufact.	Antenna/Mount Model	# of Coax	Coax Size (in)	Note
Union Telephone Company	57	57	2	Kathrein	800 10634	2	7/8	1
			1		13' Sector Mount			
	56	56	2	Kathrein	800 10634	2	7/8	
			1		13' Sector Mount			
	55	55	1	Andrew	Omni	1	7/8	
	53	53	2	Kathrein	800 10634	3	7/8	
			1	Andrew	Omni			
			1		15.5' Sector Mount			
	28	28	1	Radiowaves	SPR-5 8NS			
			1		Pipe Mount			
	22.5	22.5	1	Andrew	HP6-107	1	EW90	
			1		Pipe Mount			
	13	13	1	Andrew	HPX8-65-P6A	2	EW63	
			1		Pipe Mount			

Notes:

1) This loading represents Union Telephone Company's final configuration. See next page for proposed coax layout.

SBA Site ID#: CO09874-A
December 15, 2015

Proposed Coax Configuration



#	CARRIER	SIZE	QTY.	ELEVATION	NOTES
1	Unknown	2", 1-5/8"	1, 1	113', 113'	
2	Unknown	EW90, 1/4"	1, 1	88', 84'	
3	Unknown	1-1/4", 1/4"	2, 1	77', 70'	
4	Union Telephone Co.	7/8", 7/8"	2, 2	57', 56'	
5	Union Telephone Co.	7/8", 7/8"	1, 3	55', 53'	
6	Unknown	1/2", 7/8"	1, 1	53', 47.5'	
7	Unknown	EW61, 1/2"	1, 1	47', 39.5'	
8	Unknown	7/8", 1/2"	1, 1	38.5', 35.5'	
9	Unknown	1/2", 1/2"	1, 1	34', 32.5'	
10	Union Telephone Co.	EW90	1	22.5'	
11	Unknown	1/2"	1	15.5'	
12	Union Telephone Co.	EW63	2	13'	(1) Proposed

Assumptions

This structural analysis is based on the theoretical capacity of the members and is not a condition assessment of the tower. This analysis is from information supplied, and therefore, its results are based on and are as accurate as that supplied data. GPD has made no independent determination, nor is it required to, of its accuracy. The following assumptions were made for this structural analysis.

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 the Existing/Reserved Loading and Proposed Loading Tables, and the specified documents.
4) All mounts, if applicable, are considered adequate to support the loading. No actual analysis of the mount(s) is performed. This analysis is limited to analyzing the tower only.
5) Mount sizes, weights, and manufacturers are best estimates based on photos provided and determined without the benefit of a site visit by GPD.
6) The existing coax layout has been based on the previous analysis and tower photos.
7) The proposed coax shall be installed as shown in this report.
8) All member connections and foundation steel reinforcing are assumed designed to meet or exceed the load carrying capacity of the connected member and surrounding soils respectively unless otherwise specified in this report.

If any of these assumptions are not valid or have been made in error, this analysis may be affected, and GPD should be allowed to review any new information to determine its effect on the structural integrity of the tower.

Tower Section Results

Capacity Summary of Structural Components

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF*P_{allow} K	% Capacity	Pass/ Fail
T1	140 - 130	Leg	P2.5 STD	2	-0.77	53.87	1.4	Pass
T2	130 - 120	Leg	P2.5 STD	20	-3.35	53.87	6.2	Pass
T3	120 - 110	Leg	P3.5 STD	38	-5.99	94.36	6.3	Pass
T4	110 - 100	Leg	P3.5 STD	50	-10.51	94.75	11.1	Pass
T5	100 - 90	Leg	P4 STD	62	-15.37	116.39	13.2	Pass
T6	90 - 80	Leg	P4 STD	74	-20.39	116.60	17.5	Pass
T7	80 - 70	Leg	P5 STD	86	-27.00	164.91	16.4	Pass
T8	70 - 60	Leg	P5 STD	98	-33.82	165.03	20.5	Pass
T9	60 - 51	Leg	P6 STD	110	-43.19	197.67	21.8	Pass
T10	51 - 40	Leg	P6 STD	122	-43.74	183.00	23.9	Pass
T11	40 - 31	Leg	P6 STD	131	-61.80	197.67	31.3	Pass
T12	31 - 20	Leg	P6 STD	143	-62.42	183.00	34.1	Pass
T13	20 - 11	Leg	P8 STD	152	-80.49	317.42	25.4	Pass
T14	11 - 0	Leg	P8 STD	164	-92.44	304.06	30.4	Pass
T1	140 - 130	Diagonal	L1 3/4x1 3/4x3/16	7	-0.31	10.21	3.1	Pass
T2	130 - 120	Diagonal	L1 3/4x1 3/4x3/16	27	-0.59	10.21	5.8	Pass
T3	120 - 110	Diagonal	P1.5 STD	40	-1.42	13.94	10.2	Pass
T4	110 - 100	Diagonal	P1.5 STD	52	-1.99	12.99	15.3	Pass
T5	100 - 90	Diagonal	P1.5 STD	64	-1.93	12.03	16.1 16.4 (b)	Pass
T6	90 - 80	Diagonal	P1.5 STD	76	-2.13	10.96	19.5	Pass
T7	80 - 70	Diagonal	P1.5 STD	88	-2.58	10.14	25.5	Pass
T8	70 - 60	Diagonal	P1.5 STD	103	-2.73	9.18	29.8	Pass
T9	60 - 51	Diagonal	P2.5 STD	114	-4.77	23.49	20.3 21.8 (b)	Pass
T10	51 - 40	Diagonal	P2.5 STD	124	-6.10	16.02	38.1	Pass
T11	40 - 31	Diagonal	P2.5 STD	135	-5.73	21.22	27.0 27.2 (b)	Pass
T12	31 - 20	Diagonal	P2.5 STD	145	-6.94	14.58	47.6	Pass
T13	20 - 11	Diagonal	P2.5 STD	156	-6.65	18.84	35.3	Pass
T14	11 - 0	Diagonal	P2.5 STD	167	-8.12	13.66	59.4	Pass
T10	51 - 40	Horizontal	2L2x2x3/16x3/8	115	-0.76	16.76	4.5	Pass
T12	31 - 20	Horizontal	2L2x2x3/16x3/8	133	-1.08	13.77	7.9	Pass
T14	11 - 0	Horizontal	2L2 1/2x2x3/16x3/8	154	-1.60	12.61	12.7	Pass
T3	120 - 110	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	46	-0.10	12.05	0.9	Pass
T4	110 - 100	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	58	-0.18	10.59	1.7	Pass
T5	100 - 90	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	70	-0.27	9.32	2.9	Pass
T6	90 - 80	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	82	-0.35	7.86	4.5	Pass
T7	80 - 70	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	95	-0.47	6.75	6.9	Pass
T8	70 - 60	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	106	-0.59	5.78	10.1	Pass
T1	140 - 130	Top Girt	L2x2x3/16	5	-0.02	8.48	0.2 0.3 (b)	Pass
T2	130 - 120	Top Girt	L1 3/4x1 3/4x3/16	22	0.02	20.12	0.1	Pass
							Summary	
						Leg (T12)	34.1	Pass
						Diagonal (T14)	59.4	Pass
						Horizontal (T14)	12.7	Pass
						Secondary Horizontal (T8)	10.1	Pass
						Top Girt (T1)	0.3	Pass
						Bolt Checks	37.1	Pass
						RATING =	**59.4**	**Pass**

Additional Capacities

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
	Anchor Rods	0	36.3	Pass
1	Tower Base Foundation	0	43.6	Pass

1) Foundation capacity determined by comparison to the original design reactions.

DISCLAIMER OF WARRANTIES

GPD has not performed a site visit to the tower to verify the member sizes or antenna/coax loading. If the existing conditions are not as represented on the tower elevation contained in this report, we should be contacted immediately to evaluate the significance of the discrepancy. This is not a condition assessment of the tower or foundation. This report does not replace a full tower inspection. The tower and foundations are assumed to have been properly fabricated, erected, maintained, in good condition, twist free, and plumb.

The engineering services rendered by GPD in connection with this Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. No allowance was made for any damaged, bent, missing, loose, or rusted members (above and below ground). No allowance was made for loose bolts or cracked welds.

This analysis is limited to the designated maximum wind and seismic conditions per the governing tower standards and code. Wind forces resulting in tower vibrations near the structure's resonant frequencies were not considered in this analysis and are outside the scope of this analysis. Lateral loading from any dynamic response was not evaluated under a time-domain based fatigue analysis.

GPD does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information needed to perform a thorough analysis of every structural sub-component and connection of an existing tower. GPD provides a limited scope of service in that we cannot verify the adequacy of every weld, plate connection detail, etc. The purpose of this report is to assess the capability of adding appurtenances usually accompanied by transmission lines to the structure.

It is the owner's responsibility to determine the amount of ice accumulation in excess of the code specified amount, if any, that should be considered in the structural analysis.

The attached sketches are a schematic representation of the analyzed tower. If any material is fabricated from these sketches, the contractor shall be responsible for field verifying the existing conditions, proper fit, and clearance in the field. Any mentions of structural modifications are reasonable estimates and should not be used as a precise construction document. Precise modification drawings are obtainable from GPD, but are beyond the scope of this report.

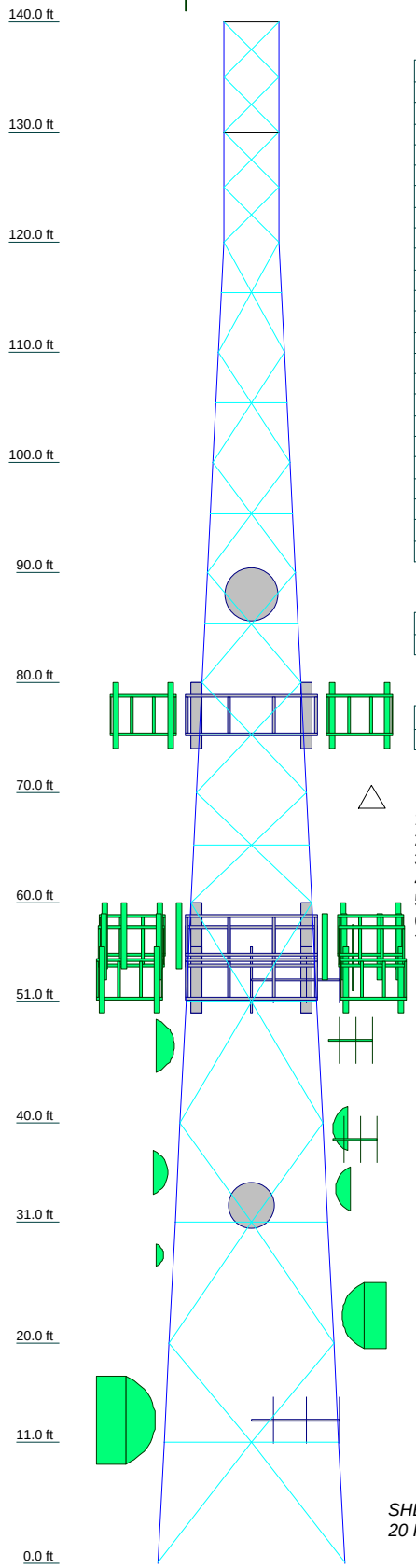
Miscellaneous items such as antenna mounts, etc., have not been designed or detailed as a part of our work. We recommend that material of adequate size and strength be purchased from a reputable tower manufacturer.

Towers are designed to carry gravity, wind, and ice loads. All members, legs, diagonals, struts, and redundant members provide structural stability to the tower with little redundancy. Absence or removal of a member can trigger catastrophic failure unless a substitute is provided before any removal. Legs carry axial loads and derive their strength from shorter unbraced lengths by the presence of redundant members and their connection to the diagonals with bolts or welds. If the bolts or welds are removed without providing any substitute to the frame, the leg is subjected to a higher unbraced length that immediately reduces its load carrying capacity. If a diagonal is also removed in addition to the connection, the unbraced length of the leg is greatly increased, jeopardizing its load carrying capacity. Failure of one leg can result in a tower collapse because there is no redundancy. Redundant members and diagonals are critical to the stability of the tower.

GPD makes no warranties, expressed and/or implied, in connection with this report and disclaims any liability arising from material, fabrication, and erection of this tower. GPD will not be responsible whatsoever for, or on account of, consequential or incidental damages sustained by any person, firm, or organization as a result of any data or conclusions contained in this report. The maximum liability of GPD pursuant to this report will be limited to the total fee received for preparation of this report.

TNX TOWER OUTPUT

Section	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
Legs		P2.5 STD		P3.5 STD		P4 STD		P5 STD		P6 STD			P8 STD	
Leg Grade	A500-46													
Diagonals	P2.5 STD				P1.5 STD									
Diagonal Grade	A500-46													
Top Girts	A	L1 3/4x1 3/4x3/16												
Horizontals	A36	L2x2x3/16												
Sec. Horizontals	N.A.													
Face Width (ft)	5		6		7		8		9		10		11		11.9		13		13.9		15		15.9		17
# Panels @ (ft)	4 @ 5				6 @ 10				1 @ 9		1 @ 11		1 @ 9		1 @ 11		1 @ 9		1 @ 11		1 @ 9		1 @ 10.9167	
Weight (K)	0.4	0.4	0.5	0.6	0.6	0.6	0.8	0.8	0.9	1.3	0.9	1.4	1.2	1.8	12.3



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 3/4"x5'	140	Pirod 15' Sector Mount	53
2' Side Mount Standoff (1)	113	20" x 30" Yagi	47.5
FM Antenna	113	Pipe Mount 12.5'x4.5"	47.5
2.5' Side Mount Standoff (1)	113	Pipe Mount 5.25'x4.5"	47
FM Antenna	113	116682	47
Pipe Mount 6'x4.5"	88	Pipe Mount 5.25'x4.5"	39.5
116682	88	SP4-24	39.5
SEC-2501-60-178	84	20" x 30" Yagi	38.5
AU-RE-HP-34 TMA	84	Pipe Mount 12.5'x4.5"	38.5
Pipe Mount 5'x2.375"	84	Pipe Mount 3'x2.375"	35.5
(2) DB982H120E-M	77	141163	35.5
10.5' Universal Sector Mount	77	Pipe Mount 5.25'x4.5"	34
SEC-25W-60-178	70	SP4-5.8NS	34
AU-RE-HP-34 TMA	70	Pipe Mount 5.25'x4.5"	32.5
Pipe Mount 5.25'x2.375"	70	100170	32.5
(2) 800 10634 w/ Mount Pipe	57	Pipe Mount 5.25'x4.5"	28
Pirod 13' Universal Sector Mount	57	SPR-5.8NS	28
(2) 800 10634 w/ Mount Pipe	56	Pipe Mount 5.25'x4.5"	22.5
Pirod 13' Universal Sector Mount	56	HP6-107	22.5
omni	55	3' Yagi	15.5
(2) 800 10634 w/ Mount Pipe	53	Pipe Mount 5.25'x4.5"	13
omni	53	HPX8-65-P6A	13
245614 Yagi	53		

SYMBOL LIST

MARK	SIZE	MARK	SIZE
A	L1 3/4x1 3/4x3/16	B	2L2 1/2x2x3/16x3/8

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A500-46	46 ksi	62 ksi	A36	36 ksi	58 ksi

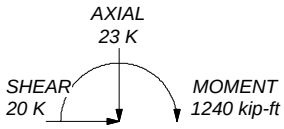
TOWER DESIGN NOTES

1. Tower is located in Routt County, Colorado.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 89 mph basic wind in accordance with the TIA-222-G Standard.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 59.4%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 92 K
SHEAR: 12 K

UPLIFT: -75 K
SHEAR: 11 K



TORQUE 13 kip-ft
REACTIONS - 89 mph WIND

GPD
520 South Main Street, Suite 2531
Akron, OH 44311
Phone: 330.572.2100
FAX: 330.572.2101

Job:	***CO10457-A Hayden 2, CO***		
Project:	***2016778.09874.04***		
Client: SBA	Drawn by: Roberto D'Angelo	App'd:	
Code: TIA-222-G	Date: 12/16/15	Scale: NTS	
Path: T:\SBA\09874\04 SA Union Telephone Co MW\tnx\CO09874-A.eri		Dwg No. E-1	

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 140.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 5.00 ft at the top and 17.00 ft at the base.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Routt County, Colorado.
Basic wind speed of 89 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Treat Feedline Bundles As Cylinder
Consider Moments - Horizontals	Assume Legs Pinned	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Diagonals	√ Assume Rigid Index Plate	√ Calculate Redundant Bracing Forces
Use Moment Magnification	√ Use Clear Spans For Wind Area	Ignore Redundant Members in FEA
√ Use Code Stress Ratios	√ Use Clear Spans For KL/r	SR Leg Bolts Resist Compression
√ Use Code Safety Factors - Guys	√ Retension Guys To Initial Tension	√ All Leg Panels Have Same Allowable
Escalate Ice	√ Bypass Mast Stability Checks	Offset Girt At Foundation
Always Use Max Kz	√ Use Azimuth Dish Coefficients	√ Consider Feedline Torque
Use Special Wind Profile	√ Project Wind Area of Appurt.	√ Include Angle Block Shear Check
√ Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Poles
Leg Bolts Are At Top Of Section	SR Members Have Cut Ends	Include Shear-Torsion Interaction
√ Secondary Horizontal Braces Leg	√ Sort Capacity Reports By Component	Always Use Sub-Critical Flow
Use Diamond Inner Bracing (4 Sided)	√ Triangulate Diamond Inner Bracing	Use Top Mounted Sockets
Add IBC .6D+W Combination	Use TIA-222-G Tension Splice Capacity Exemption	

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement ft*	*Face Offset in*	*Lateral Offset (Frac FW)*	*#*	*# Per Row*	*Clear Spacing in*	*Width or Diameter in*	*Perimeter in*	*Weight plf*
Safety Line 3/8	C	No	Ar (CaAa)	140.00 - 8.00	0.0000	0	1	1	0.3750	0.3750		0.22
Feedline Ladder (Af)	B	No	Af (CaAa)	140.00 - 8.00	0.0000	0.4	1	1	3.0000	3.0000		8.40
Feedline Ladder (Af)	C	No	Af (CaAa)	140.00 - 8.00	0.0000	0	1	1	3.0000	3.0000		8.40
2" Coax	C	No	Ar (CaAa)	113.00 - 8.00	0.0000	-0.45	1	1	0.5000	2.0000		0.83
LDF7-50A	C	No	Ar (CaAa)	113.00 - 8.00	0.0000	0.15	1	1	0.5000	1.9800		0.82

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
(1-5/8 FOAM) EW90(ELLIPTICAL)	C	No	Ar (CaAa)	88.00 - 8.00	0.0000	-0.2	1	1	0.5000	1.2800		0.32
LDF1-50A (1/4 FOAM)	C	No	Ar (CaAa)	70.00 - 8.00	0.0000	0.1	2	2	0.3500	0.3500		0.06
LDF1-50A (1/4 FOAM)	C	No	Ar (CaAa)	84.00 - 70.00	0.0000	0.1	1	1	0.3500	0.3500		0.06
LDF6-50A (1-1/4 FOAM)	C	No	Ar (CaAa)	0.00 - 8.00	0.0000	-0.25	1	1	0.5000	1.5500		0.66
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	53.00 - 8.00	0.0000	-0.05	8	4	0.5000	1.0900		0.33
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	55.00 - 53.00	0.0000	-0.05	5	3	0.5000	1.0900		0.33
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	56.00 - 55.00	0.0000	-0.05	4	2	0.5000	1.0900		0.33
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	57.00 - 56.00	0.0000	-0.05	2	1	0.5000	1.0900		0.33
LDF4P-50A (1/2 FOAM)	B	No	Ar (CaAa)	53.00 - 8.00	0.0000	0.45	1	1	0.5000	0.6300		0.15
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	47.50 - 8.00	0.0000	0.25	1	1	0.5000	1.0900		0.33
EW61(ELLIPTICAL)	C	No	Ar (CaAa)	47.00 - 8.00	0.0000	-0.2	1	1	0.5000	2.0100		0.51
LDF4P-50A (1/2 FOAM)	C	No	Ar (CaAa)	32.50 - 8.00	0.0000	0.45	3	3	0.5000	0.6300		0.15
LDF4P-50A (1/2 FOAM)	C	No	Ar (CaAa)	34.00 - 32.50	0.0000	0.45	2	2	0.5000	0.6300		0.15
LDF4P-50A (1/2 FOAM)	C	No	Ar (CaAa)	39.50 - 34.00	0.0000	0.45	1	1	0.5000	0.6300		0.15
LDF5-50A (7/8 FOAM)	C	No	Ar (CaAa)	38.50 - 8.00	0.0000	0.35	1	1	0.5000	1.0900		0.33
LDF4P-50A (1/2 FOAM)	C	No	Ar (CaAa)	35.50 - 8.00	0.0000	-0.4	1	1	0.5000	0.6300		0.15
EW90(ELLIPTICAL)	C	No	Ar (CaAa)	22.50 - 8.00	0.0000	0.2	1	1	0.5000	1.2800		0.32
LDF4P-50A (1/2 FOAM)	C	No	Ar (CaAa)	15.50 - 8.00	0.0000	0.15	1	1	0.5000	0.6300		0.15
EW63(ELLIPTICAL)	B	No	Ar (CaAa)	13.00 - 8.00	0.0000	0.4	2	2	0.5000	2.0100		0.51

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Lightning Rod 3/4"x5'	C	From Leg	4.00 0.00 3.00	0.0000	140.00	No Ice	0.38	0.38	0.03
2' Side Mount Standoff (1)	C	From Leg	1.00 0.00 0.00	0.0000	113.00	No Ice	0.09	0.70	0.01
FM Antenna	C	From Leg	2.00 0.00 0.00	0.0000	113.00	No Ice	10.00	10.00	0.15

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
2.5' Side Mount Standoff (1)	B	From Leg	1.25 0.00 0.00	0.0000	113.00	No Ice	2.28	2.00	0.04
FM Antenna	B	From Leg	2.50 0.00 0.00	0.0000	113.00	No Ice	10.00	10.00	0.15
Pipe Mount 6'x4.5"	C	From Leg	0.50 0.00 0.00	0.0000	88.00	No Ice	2.25	2.25	0.07
Pipe Mount 5'x2.375"	C	From Leg	0.50 0.00 0.00	0.0000	84.00	No Ice	1.19	1.19	0.02
SEC-2501-60-178	C	From Leg	1.00 0.00 0.00	0.0000	84.00	No Ice	3.43	3.03	0.01
AU-RE-HP-34 TMA	C	From Leg	1.00 0.00 0.00	0.0000	84.00	No Ice	0.76	0.76	0.01
10.5' Universal Sector Mount	B	From Leg	2.00 0.00 0.00	0.0000	77.00	No Ice	8.83	7.05	0.27
(2) DB982H120E-M	B	From Leg	4.00 0.00 0.00	0.0000	77.00	No Ice	8.64	4.46	0.05
Pipe Mount 5.25'x2.375"	A	From Leg	0.50 0.00 0.00	0.0000	70.00	No Ice	1.25	1.25	0.02
SEC-25W-60-178	A	From Leg	1.00 0.00 0.00	0.0000	70.00	No Ice	3.43	3.03	0.01
AU-RE-HP-34 TMA	A	From Leg	1.00 0.00 0.00	0.0000	70.00	No Ice	0.76	0.76	0.01
Pirod 13' Universal Sector Mount	C	From Leg	2.00 0.00 0.00	0.0000	57.00	No Ice	8.55	10.90	0.36
(2) 800 10634 w/ Mount Pipe	C	From Leg	4.00 0.00 0.00	0.0000	57.00	No Ice	7.11	3.32	0.06
Pirod 13' Universal Sector Mount	B	From Leg	2.00 0.00 0.00	0.0000	56.00	No Ice	8.55	10.90	0.36
(2) 800 10634 w/ Mount Pipe	B	From Leg	4.00 0.00 0.00	0.0000	56.00	No Ice	7.11	3.32	0.06
omni	B	From Leg	4.00 0.00 0.00	0.0000	55.00	No Ice	0.89	0.89	0.02
Pirod 15' Sector Mount	A	From Leg	2.00 0.00 0.00	0.0000	53.00	No Ice	10.08	11.22	0.37
(2) 800 10634 w/ Mount Pipe	A	From Leg	4.00 0.00 0.00	0.0000	53.00	No Ice	7.11	3.32	0.06
omni	A	From Leg	4.00 0.00 0.00	0.0000	53.00	No Ice	0.89	0.89	0.02

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
245614 Yagi	A	From Leg	4.00 0.00 0.00	0.0000	53.00	No Ice	0.52	0.52	0.02
Pipe Mount 12.5'x4.5"	B	From Leg	0.50 0.00 0.00	0.0000	47.50	No Ice	5.63	5.63	0.14
20" x 30" Yagi	B	From Leg	1.00 0.00 0.00	0.0000	47.50	No Ice	0.52	0.52	0.02
Pipe Mount 5.25'x4.5"	C	From Leg	0.50 0.00 0.00	0.0000	47.00	No Ice	1.88	1.88	0.06
Pipe Mount 5.25'x4.5"	A	From Leg	0.50 0.00 0.00	0.0000	39.50	No Ice	1.88	1.88	0.06
Pipe Mount 12.5'x4.5"	B	From Leg	0.50 0.00 0.00	0.0000	38.50	No Ice	5.63	5.63	0.14
20" x 30" Yagi	B	From Leg	1.00 0.00 0.00	0.0000	38.50	No Ice	0.52	0.52	0.02
Pipe Mount 3'x2.375"	C	From Leg	0.50 0.00 0.00	0.0000	35.50	No Ice	0.58	0.58	0.01
Pipe Mount 5.25'x4.5"	B	From Leg	0.50 0.00 0.00	0.0000	34.00	No Ice	1.88	1.88	0.06
Pipe Mount 5.25'x4.5"	A	From Leg	0.50 0.00 0.00	0.0000	32.50	No Ice	1.88	1.88	0.06
Pipe Mount 5.25'x4.5"	C	From Leg	0.50 0.00 0.00	0.0000	28.00	No Ice	1.88	1.88	0.06
Pipe Mount 5.25'x4.5"	B	From Leg	0.50 0.00 0.00	0.0000	22.50	No Ice	1.88	1.88	0.06
3' Yagi	B	From Leg	0.50 0.00 0.00	0.0000	15.50	No Ice	0.52	0.52	0.02
Pipe Mount 5.25'x4.5"	A	From Leg	1.00 0.00 0.00	0.0000	13.00	No Ice	1.88	1.88	0.06

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
116682	A	Paraboloid w/o	From	1.00	0.0000		88.00	4.88	No Ice	18.67	0.11

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 ft²	Weight K
		Radome	Leg	0.00 0.00							
116682	C	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		47.00	4.88	No Ice	18.67	0.11
SP4-24	B	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		39.50	4.00	No Ice	12.57	0.06
141163	C	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		35.50	4.00	No Ice	12.57	0.08
SP4-5.8NS	B	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		34.00	4.00	No Ice	12.57	0.07
100170	A	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		32.50	4.17	No Ice	13.66	0.09
SPR-5.8NS	C	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		28.00	2.00	No Ice	3.14	0.04
HP6-107	B	Paraboloid w/Shroud (HP)	From Leg	1.00 0.00 0.00	0.0000		22.50	6.00	No Ice	28.27	0.14
HPX8-65-P6A	C	Paraboloid w/Shroud (HP)	From Leg	1.00 0.00 0.00	0.0000		13.00	8.00	No Ice	50.27	0.50

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
140.00	Lightning Rod 3/4"x5'	30	1.287	0.0728	0.0207	Inf
113.00	2' Side Mount Standoff (1)	30	0.880	0.0675	0.0192	232783
88.00	116682	30	0.549	0.0540	0.0126	128759
84.00	Pipe Mount 5'x2.375"	30	0.502	0.0512	0.0121	87789
77.00	10.5' Universal Sector Mount	30	0.426	0.0468	0.0109	82164
70.00	Pipe Mount 5.25'x2.375"	30	0.356	0.0429	0.0093	187806
57.00	Pirod 13' Universal Sector Mount	30	0.239	0.0342	0.0069	72991
56.00	Pirod 13' Universal Sector Mount	30	0.231	0.0336	0.0067	72185
55.00	omni	30	0.223	0.0331	0.0066	71615
53.00	Pirod 15' Sector Mount	30	0.208	0.0320	0.0063	71453
47.50	Pipe Mount 12.5'x4.5"	30	0.169	0.0290	0.0056	90972
47.00	116682	30	0.166	0.0287	0.0055	94896
39.50	SP4-24	30	0.120	0.0242	0.0045	157014
38.50	Pipe Mount 12.5'x4.5"	30	0.114	0.0235	0.0044	138793
35.50	141163	30	0.097	0.0215	0.0041	86891
34.00	SP4-5.8NS	30	0.089	0.0204	0.0039	71253
32.50	100170	30	0.081	0.0194	0.0038	62341
28.00	SPR-5.8NS	30	0.060	0.0160	0.0032	62283
22.50	HP6-107	30	0.041	0.0120	0.0025	97149
15.50	3' Yagi	30	0.021	0.0079	0.0017	89456
13.00	HPX8-65-P6A	34	0.015	0.0067	0.0014	77340

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
T1	140 - 130	Leg	P2.5 STD	2	-0.77	53.87	1.4	Pass
T2	130 - 120	Leg	P2.5 STD	20	-3.35	53.87	6.2	Pass
T3	120 - 110	Leg	P3.5 STD	38	-5.99	94.36	6.3	Pass
T4	110 - 100	Leg	P3.5 STD	50	-10.51	94.75	11.1	Pass
T5	100 - 90	Leg	P4 STD	62	-15.37	116.39	13.2	Pass
T6	90 - 80	Leg	P4 STD	74	-20.39	116.60	17.5	Pass
T7	80 - 70	Leg	P5 STD	86	-27.00	164.91	16.4	Pass
T8	70 - 60	Leg	P5 STD	98	-33.82	165.03	20.5	Pass
T9	60 - 51	Leg	P6 STD	110	-43.19	197.67	21.8	Pass
T10	51 - 40	Leg	P6 STD	122	-43.74	183.00	23.9	Pass
T11	40 - 31	Leg	P6 STD	131	-61.80	197.67	31.3	Pass
T12	31 - 20	Leg	P6 STD	143	-62.42	183.00	34.1	Pass
T13	20 - 11	Leg	P8 STD	152	-80.49	317.42	25.4	Pass
T14	11 - 0	Leg	P8 STD	164	-92.44	304.06	30.4	Pass
T1	140 - 130	Diagonal	L1 3/4x1 3/4x3/16	7	-0.31	10.21	3.1	Pass
T2	130 - 120	Diagonal	L1 3/4x1 3/4x3/16	27	-0.59	10.21	5.8	Pass
T3	120 - 110	Diagonal	P1.5 STD	40	-1.42	13.94	10.2	Pass
T4	110 - 100	Diagonal	P1.5 STD	52	-1.99	12.99	15.3	Pass
T5	100 - 90	Diagonal	P1.5 STD	64	-1.93	12.03	16.1 16.4 (b)	Pass
T6	90 - 80	Diagonal	P1.5 STD	76	-2.13	10.96	19.5	Pass
T7	80 - 70	Diagonal	P1.5 STD	88	-2.58	10.14	25.5	Pass
T8	70 - 60	Diagonal	P1.5 STD	103	-2.73	9.18	29.8	Pass
T9	60 - 51	Diagonal	P2.5 STD	114	-4.77	23.49	20.3 21.8 (b)	Pass
T10	51 - 40	Diagonal	P2.5 STD	124	-6.10	16.02	38.1	Pass
T11	40 - 31	Diagonal	P2.5 STD	135	-5.73	21.22	27.0 27.2 (b)	Pass
T12	31 - 20	Diagonal	P2.5 STD	145	-6.94	14.58	47.6	Pass
T13	20 - 11	Diagonal	P2.5 STD	156	-6.65	18.84	35.3	Pass
T14	11 - 0	Diagonal	P2.5 STD	167	-8.12	13.66	59.4	Pass
T10	51 - 40	Horizontal	2L2x2x3/16x3/8	115	-0.76	16.76	4.5	Pass
T12	31 - 20	Horizontal	2L2x2x3/16x3/8	133	-1.08	13.77	7.9	Pass
T14	11 - 0	Horizontal	2L2 1/2x2x3/16x3/8	154	-1.60	12.61	12.7	Pass
T3	120 - 110	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	46	-0.10	12.05	0.9	Pass
T4	110 - 100	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	58	-0.18	10.59	1.7	Pass
T5	100 - 90	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	70	-0.27	9.32	2.9	Pass
T6	90 - 80	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	82	-0.35	7.86	4.5	Pass
T7	80 - 70	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	95	-0.47	6.75	6.9	Pass
T8	70 - 60	Secondary Horizontal	2L1 3/4x1 3/4x1/8x3/8	106	-0.59	5.78	10.1	Pass
T1	140 - 130	Top Girt	L2x2x3/16	5	-0.02	8.48	0.2 0.3 (b)	Pass
T2	130 - 120	Top Girt	L1 3/4x1 3/4x3/16	22	0.02	20.12	0.1	Pass
						Summary		
						Leg (T12)	34.1	Pass
						Diagonal (T14)	59.4	Pass
						Horizontal (T14)	12.7	Pass
						Secondary Horizontal (T8)	10.1	Pass
						Top Girt (T1)	0.3	Pass
						Bolt Checks	37.1	Pass
						RATING =	**59.4**	**Pass**

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ADDITIONAL CALCULATIONS

Self Support Anchor Rod Analysis (Rev G)
CO09874-A Hayden 2, CO
2016778.09874.04

Anchor Rod Check per Section 4.9.9 of TIA-222-G

Number of Anchor Rods=	4	
Anchor Rod Grade=	F1554	
Diameter of Anchor Rod=	1.5	in
V_u=	14	k
P_u=	95	k
F_{ub}=	75	ksi
A_n=	1.4100	in^2
R_{nt}=	105.75	k
ϕ=	0.8	
n=	0.5	**TIA-222-G Figure 4-4 & section 4.9.9**
Interaction=	0.3635	
Percent Capacity=	36.3%	**OK**