



Proudly Serving Rural Routt County * City of Steamboat Springs * Town of Hayden * Town of Oak Creek * Town of Yampa * Routt County School

Date: 4/17/2020

Address: 29920 COUNTY ROAD 27, OAK CREEK	Property Use: AGRES
Owner: SAGE CREEK LAND RESERVES, LLC	Lot Area: 2178
Parcel ID: 945194001	Year Built: 0
Zoning: AF	Book Page:



Building

TB-20-262

To: Tyler Tholl

Design information:

Occupancy Classification: U
Character and Use: Renovations to Existing Tower
Number of Stories: NA
Type of Construction: IIB
Occupant Load: NA

**RCRBD Record Set
T.A.**

01/04/2021

Dear Tyler,

The following items below (**modified in blue**) will require additional information or a re-submittal prior to the Permit being Approved and Issued. Please feel free to contact us by phone or email with any questions or concerns.

1. Towers shall be designed and constructed in accordance with the provisions of TIA-222. Submit ~~plans and~~ structural calculations signed and sealed in accordance with State of Colorado law.
2. Include anchor bolt calculation(s) with specifications to include diameter, length and details of cage and ties as applicable. **Show the specifications for anchor bolts and foundation requirements and reinforcement on the sealed plans.**
3. Design loads including soil bearing pressure used in the design shall be stated on the plans. **Provide these items with signed and sealed tower drawings.**

(Corrections have been made and approved. Date _____ By _____)

✓ **Items noted below do not require a response or comment back during the Plan Review in order for us to approve this permit.**

Routt County Regional Building Department

136 Sixth Street, PO Box 773840 Steamboat Springs, CO 80477 PH: 970-870-5566 Fax 970-870-5489

Separate Electrical Permits must be applied for and obtained prior to any work being done within this trade.

Reviewed by: Ted Allen



STRUCTURES

**RCRBD Record Set
T.A.**

01/04/2021



May 20, 2020

Angela Fisher, PE
Union Telephone
Ph: 307-782-4045
afisher@unionwireless.com

Subject: **Structural Analysis for Existing 80' 4-leg tower (model 108-M840-80')**
Analysis Order No. 441507
Original Valmont Microflect Tower Drawing No. D-118598
Site Name: Oak Creek Coal, Routt County, CO
Site Coordinates: 40° 21' 14.8" N, 107° 04' 21.3" W

We have completed the structural analysis you requested for the above referenced lattice tower. **The results of our analysis indicate that the existing lattice tower, its baseplates, anchor bolts and foundation are structurally adequate to accommodate your proposed antenna loading. The tower is at approximately 100% capacity, for the below requested design criteria and loading.**

The design criteria and loading condition used for this analysis was as follows:

- Structural analysis per TIA-222-H
- Wind Loading Condition No. 1: 111 mph 3-sec gusted Ultimate wind speed, no ice
- Wind Loading Condition No. 2: 50 mph 3-sec gusted Ultimate wind speed, ¼" ice
- Wind Loading Condition No. 3: 60 mph 3-sec gusted wind speed, no ice (twist & sway)
- Structure Risk Category III
- Exposure C
- Topography Category 3, H = 700' = (7490' site elev. – 6790' surrounding terrain)
- Seismic Ss = 0.55, S1 = 0.099
- Antenna & line loading per attached spreadsheet inventory
- All waveguide/coax assumed stacked on one face mounted waveguide ladder

Valmont certifies that the proposed loading meets the design criteria of the ANSI/TIA-222-H, "Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures."

The structural analysis was based upon tower information obtained from Valmont Microflect Drawing No. D-118598.



As the TIA-H tower factored base reactions from this reanalysis are less than the original EIA-F tower base reactions (factored by 1.35 per TIA-H section 15.6.2), we would therefore consider the foundation to still be within acceptable limits. Further, our check of the foundation shows it to still be within acceptable limits for the base reactions from this analysis. This is provided the foundation and soil conditions match those of Valmont Microflect Drawing No. D-119403 rev.A.

If there are any questions concerning the structural analysis, please feel free to contact me directly at 503-589-6698.

Sincerely,

A handwritten signature in blue ink, appearing to read "Chris Blaumer".

Christopher W. Blaumer, PE
Design Engineer

Enc. Reanalysis calculations



This engineering study is based on the theoretical capacity of the structure. It is not a condition assessment of the tower.

This report is being provided by Valmont Microflect without the benefit of an inspection by our personnel and is based on information supplied by the customer to us. Valmont Microflect has made no independent determination, nor is required to, of the accuracy of the information provided. Therefore, unless specifically informed to the contrary by the customer in writing, we assume the following:

1. The subsoil characteristics exist as stated on the tower drawing or stated elsewhere in this report;
2. The tower is erected and maintained in accordance with the manufacturer's plans and specifications and is plumb;
3. There is no damage, natural or manmade, to the structure, either gradual or sudden;
4. All connections are properly installed;
5. The information concerning the components, existing and proposed, is accurate; and
6. There are no modifications to the tower itself, except as may be disclosed elsewhere in this report.

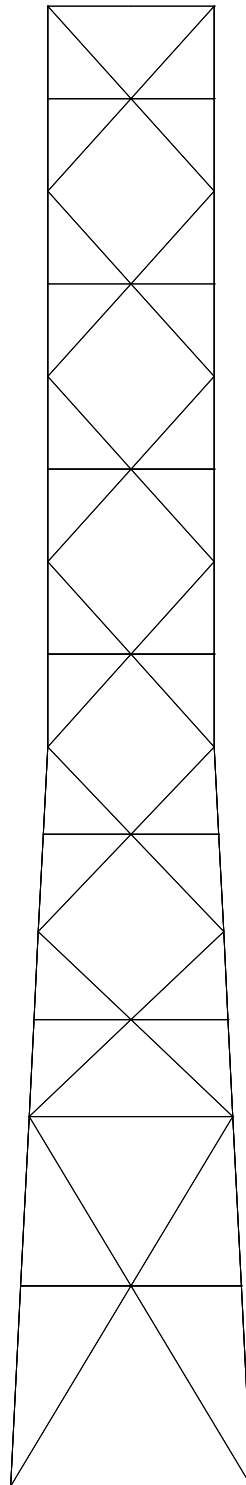
This report is valid for only the design criteria listed (Ex. Code, wind, antenna and line loading lists, etc.). If any of this information is not correct this study should not be used.

Site Name	Oak Creek Coal	Tower Type	Self Supporting Lattice	Review Date	4/6/2020
County	Routt	# Legs	4	Elevation	7490
State	Colorado	Tower Height	80	Latitude	40°21'14.8"N
TIA 222 Version	Rev H	Tower:	108-M840-80	Longitude	107°4'21.3"W
Class	III	Valmont S.O.:	D-118598		

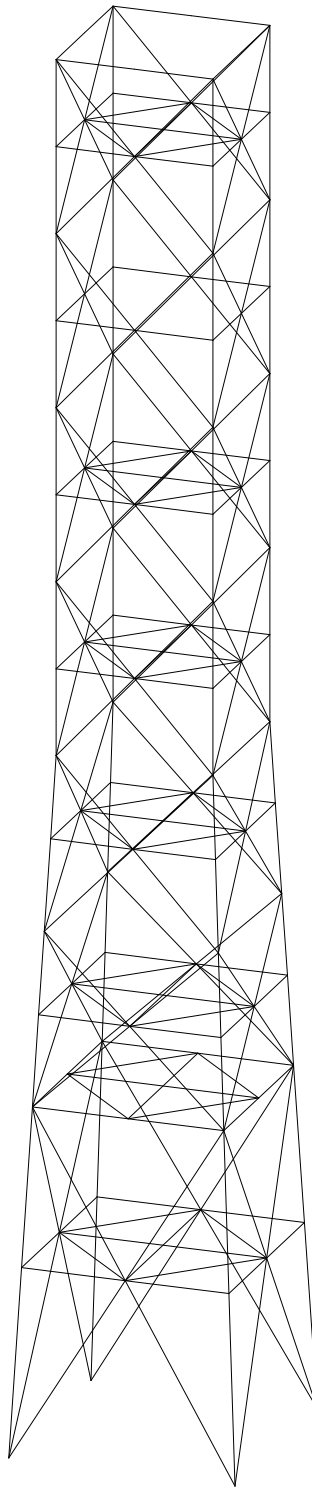
Loading:

Owner	Category	Height	Manufacturer	Model	Azimuth	Quantity	Location	Purpose
Union	Coax	0-80	Andrew	AVA7-50	NA	2	Existing	X Sector
Union	Sector Frame	80	Valmont	VFA12-HD 12' Frames	40	1	FUTURE	NA
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	40	2	FUTURE	A Sector
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	40	2	FUTURE	A Sector
Union	RRU	80	Huawei	Union RRUs: UMTS/LTE	40	9	FUTURE	A Sector
Union	BOX	80	Raycap	RCKD6140PF48	40	2	FUTURE	A Sector
Union	Interference Mitigation	80	Ubiquam	UBiFiX: 13" x 6" x 5")	40	3	FUTURE	A Sector
Union	FTTA	0-80	TBD	7/8" Power/Fiber Cable	NA	1	FUTURE	A Sector
Union	FTTA	0-80	TBD	1-5/8" Power/Fiber Cable	NA	2	FUTURE	A Sector
Union	Coax	0-80	Andrew	AVA7-50	NA	2	Existing	Y Sector
Union	Sector Frame	80	Valmont	VFA12-HD 12' Frames	135	1	FUTURE	NA
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	135	2	FUTURE	B Sector
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	135	2	FUTURE	B Sector
Union	RRU	80	Huawei	Union RRUs: UMTS/LTE	135	9	FUTURE	B Sector
Union	BOX	80	Raycap	RCKD6140PF48	135	2	FUTURE	B Sector
Union	Interference Mitigation	80	Ubiquam	UBiFiX: 13" x 6" x 5")	135	3	FUTURE	B Sector
Union	FTTA	0-80	TBD	7/8" Power/Fiber Cable	NA	1	FUTURE	B Sector
Union	FTTA	0-80	TBD	1-5/8" Power/Fiber Cable	NA	2	FUTURE	B Sector
Union	Coax	0-80	Andrew	AVA7-50	NA	2	Existing	Z Sector
Union	Sector Frame	80	Valmont	VFA12-HD 12' Frames	300	1	FUTURE	NA
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	300	2	FUTURE	G Sector
Union	Panel Antenna	80	KMW	EPBQ-654L8H8-L2	300	2	FUTURE	G Sector
Union	RRU	80	Huawei	Union RRUs: UMTS/LTE	300	9	FUTURE	G Sector
Union	BOX	80	Raycap	RCKD6140PF48	300	2	FUTURE	G Sector
Union	Interference Mitigation	80	Ubiquam	UBiFiX: 13" x 6" x 5")	300	3	FUTURE	G Sector
Union	FTTA	0-80	TBD	7/8" Power/Fiber Cable	NA	1	FUTURE	G Sector
Union	FTTA	0-80	TBD	1-5/8" Power/Fiber Cable	NA	2	FUTURE	G Sector
Union	MW Dish	25	Andrew	HPX8-65	314.7	1	Existing	Hayden
Union	Waveguide	0-25	Andrew	EW63	NA	2	Existing	Hayden
Union	MW Dish	25	Andrew	USX6	13.492	1	FUTURE	North Clark
Union	Waveguide	0-25	Andrew	EW63	NA	2	FUTURE	North Clark
ATT/FN	Sector Frame	60	Valmont	VFA10-HD FRAMES	40	1	NEW	NA
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	40	1	NEW	A Sector
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	40	1	NEW	A Sector
ATT/FN	DUAL CLAMP MOUNT	60	Rosenberger	D218RRUDSM	40	1	NEW	A Sector
ATT/FN	RRH	60	Nokia	3JR80236AAAA	40	1	NEW	A Sector
ATT/FN	RRH	60	Nokia	3JR80235AAAA	40	1	NEW	A Sector
ATT/FN	Sector Frame	60	Valmont	VFA10-HD FRAMES	135	1	NEW	NA
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	135	1	NEW	B Sector
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	135	1	NEW	B Sector
ATT/FN	DUAL CLAMP MOUNT	60	Rosenberger	D218RRUDSM	135	1	NEW	B Sector
ATT/FN	RRH	60	Nokia	3JR80236AAAA	135	1	NEW	B Sector
ATT/FN	RRH	60	Nokia	3JR80235AAAA	135	1	NEW	B Sector
ATT/FN	Sector Frame	60	Valmont	VFA10-HD FRAMES	300	1	NEW	NA
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	300	1	NEW	G Sector
ATT/FN	Panel Antenna	60	CommScope	NNH4-65C-R6-V3	300	1	NEW	G Sector
ATT/FN	DUAL CLAMP MOUNT	60	Rosenberger	D218RRUDSM	300	1	NEW	G Sector

ATT/FN	RRH	60	Nokia	3JR80236AAAA	300	1	NEW	G Sector
ATT/FN	RRH	60	Nokia	3JR80235AAAA	300	1	NEW	G Sector
ATT/FN	Power Ttrunk	0-60	TBD	WR-VG86ST-BRD	NA	3	NEW	All Secctors
ATT/FN	Fiber Feed	0-60	TBD	FB-L98B-235-75000	NA	1	NEW	All Secctors
ATT/FN	Grounding	0-60	TBD	#2 Insulated Cable	NA	1	NEW	All Secctors
Union	Interference Mitigation	55	Ubiquam	UBiFiX: (13" x 6" x 5")	40	3	NEW	A Sector
Union	Interference Mitigation	55	Ubiquam	UBiFiX: (13" x 6" x 5")	135	3	NEW	B Sector
Union	Interference Mitigation	55	Ubiquam	UBiFiX: (13" x 6" x 5")	300	3	NEW	G Sector
Peabody Energy	Dish	20	Mimosa	B5 - 18" Diameter	74	1	LEASED	Colocator
Peabody Energy	Waveguide	0-20	Unknown	CAT5 - .25" Diameter	NA	2	LEASED	Colocator
Peabody Energy	Dish	20	Mimosa	B5 - 18" Diameter	102	1	LEASED	Colocator
Peabody Energy	Waveguide	0-20	Unknown	CAT5 - .25" Diameter	NA	2	LEASED	Colocator



Customer: Union Telephone
Site: Oak Creek Coal, Routt County, CO
Tower Model no.: 108-M840-80
File no.: C:\Users\CWB1\Desktop\SS_TOWER\TowerFiles\441507_1.twr
Date: 05/20/20



Customer: Union Telephone
Site: Oak Creek Coal, Routt County, CO
Tower Model no.: 108-M840-80
File no.: C:\Users\CWB1\Desktop\SS_TOWER\TowerFiles\441507_1.twr
Date: 05/20/20

File Name when printed: 441507_1.twr

SS_TOWER: Version 5.7.0

Titles:

Union Telephone, Oak Creek Coal, Routt County, CO
108-M840-80' reanalysis

Tower Description = 108-M840-80
Gross Tower Weight (kips) = 9.535
Specification = TIA222H
Number of Legs = 4

Parent Modules from which this tower was built:

C:\Program Files (x86)\SS_TOWER\MODFiles\8dv4s_20.mod
 C:\Program Files (x86)\SS_TOWER\MODFiles\8dv4s_20.mod
 C:\Program Files (x86)\SS_TOWER\MODFiles\8et4s_20.mod
 C:\Program Files (x86)\SS_TOWER\MODFiles\8ft4s_20.mod

ANSI/TIA-222-H Design Criteria

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Structural Category = Class III
Exposure = C
Topographic Factor = 3
Height of Crest = H = 700
Tower Elev. above sea level = zs = 7490

Number of Load Cases = 8

LC	Wind Vel. MPH	Base El. ft.	Ice t in.	Ice Den. lbs/ft^3	Wind Dir. degrees
1	111	0	0	56	0
2	111	0	0	56	0
3	50	0	.25	56	0
4	111	0	0	56	45
5	111	0	0	56	45
6	50	0	.25	56	45
7	Seismic Download (Ss: .55, S1: .099, Site Class: D)				
8	Seismic Uplift (Ss: .55, S1: .099, Site Class: D)				

LINEAR APPURTENANCE LOAD DATA

Elevations		Area		Wt.	Area		Wt.	Distr
ft.	ft.	Norm ft ² /ft	Tang ft ² /ft	Ice = 0 lbs/ft	Norm ft ² /ft	Tang ft ² /ft	Ice = 0.25 lbs/ft	
1- 0.00	79.90	0.67	0.58	8.93	1.03	0.88	13.79	L1=1,L2=0,L3=0,L4=0
1- 0.00	80.00	3.91	1.38	34.90	4.06	1.67	81.00	L1=0.5,L2=0.5,L3=0,L4

WIND AREA APPURTENANCE LOAD DATA

El.	Jt.	Jt.	EPA-N Ice = 0	EPA-P	Wt.	EPA-N Ice = 0.25	EPA-P	Wt.	Mount Location	# of Sectors	Mount Desc
ft.			ft ²	ft ²	kips	ft ²	ft ²	kips			
1- 79.9	254	274	13.2	9.2	0.66	16.35	11.9	0.73	L1	3	
1- 79.9	255	275	13.2	9.2	0.66	16.35	11.9	0.73	L2	3	
1- 79.9	256	276	13.2	9.2	0.66	16.35	11.9	0.73	L3	3	
4- 79.9	254	274	12.9	10.78	0.11	13.16	10.51	0.16	L1	3	2 x 96
4- 79.9	255	275	12.9	10.78	0.11	13.16	10.51	0.16	L2	3	2 x 96
4- 79.9	256	276	12.9	10.78	0.11	13.16	10.51	0.16	L3	3	2 x 96
9- 79.9	254	274	2.7	1.65	0.06	2.8	1.73	0.07	L1	3	
9- 79.9	255	275	2.7	1.65	0.06	2.8	1.73	0.07	L2	3	
9- 79.9	256	276	2.7	1.65	0.06	2.8	1.73	0.07	L3	3	
2- 79.9	254	274	2.73	1.01	0.02	2.82	1.07	0.02	L1	3	
2- 79.9	255	275	2.73	1.01	0.02	2.82	1.07	0.02	L2	3	
2- 79.9	256	276	2.73	1.01	0.02	2.82	1.07	0.02	L3	3	
3- 79.9	254	274	1.2	0.6	0.02	1.26	0.65	0.03	L1	3	
3- 79.9	255	275	1.2	0.6	0.02	1.26	0.65	0.03	L2	3	
3- 79.9	256	276	1.2	0.6	0.02	1.26	0.65	0.03	L3	3	
1- 60	194	214	12.1	9.2	0.63	15.2	11.9	0.7	L1	3	
1- 60	195	215	12.1	9.2	0.63	15.2	11.9	0.7	L2	3	
1- 60	196	216	12.1	9.2	0.63	15.2	11.9	0.7	L3	3	
2- 60	194	214	18.52	9.78	0.12	18.8	9.48	0.17	L1	3	2 x 96
2- 60	195	215	18.52	9.78	0.12	18.8	9.48	0.17	L2	3	2 x 96
2- 60	196	216	18.52	9.78	0.12	18.8	9.48	0.17	L3	3	2 x 96
2- 60	194	214	2.7	1.65	0.06	2.8	1.73	0.07	L1	3	
2- 60	195	215	2.7	1.65	0.06	2.8	1.73	0.07	L2	3	
2- 60	196	216	2.7	1.65	0.06	2.8	1.73	0.07	L3	3	
3- 55	174	194	2.17	1.59	0.03	2.26	1.32	0.04	L1	3	2 x 60
3- 55	175	195	2.17	1.59	0.03	2.26	1.32	0.04	L2	3	2 x 60
3- 55	176	196	2.17	1.59	0.03	2.26	1.32	0.04	L3	3	2 x 60
1- 25	36	56	51.76	51.76	0.48	52.34	51.32	0.61	L3	1	4 x 48
1- 25	34	54	29.77	29.77	0.32	30.22	29.19	0.4	L1	1	4 x 48
1- 20	34	54	4.64	4.64	0.06	4.82	3.79	0.08	L1	1	4 x 48
1- 20	35	55	4.64	4.64	0.06	4.82	3.79	0.08	L2	1	4 x 48

POINT LOAD DATA

LC	Elevation ft.	Jt.	Jt.	Fx	Fy	Fz	Mx	My	Mz
				-----	kips	-----	-----	kip*ft	-----

SEISMIC LOAD DATA

SEISMIC DESIGN VALUES

Ss: 0.55

S1: 0.10

Fa: 1.36

Fv: 2.40

Freq: 6.83 (Calculated)

Panel ID	Elevation		Tower Wt Kips	Appurt Wt. Kips	Lateral Force Kips
	Bottom ft.	Top ft.			
1	0.0	10.8	1.77	0.47	0.07
2	10.8	19.9	1.53	0.40	0.16
3	19.9	25.2	0.78	1.07	0.19
4	25.2	29.9	0.53	0.21	0.10
5	29.9	35.2	0.75	0.23	0.16
6	35.2	39.9	0.51	0.21	0.13
7	39.9	44.9	0.53	0.22	0.15
8	44.9	49.9	0.36	0.22	0.13
9	49.9	54.9	0.53	0.22	0.17
10	54.9	59.9	0.36	0.29	0.15
11	59.9	64.9	0.47	2.60	0.58
12	64.9	69.9	0.36	0.22	0.12
13	69.9	74.9	0.53	0.22	0.16
14	74.9	79.9	0.54	2.78	0.60

APPLIED LOADS BY ELEVATION**Load Case 1**

El.	Load on Members			Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz		Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips		kips	kips	kips	kips	kips
0.00	-0.538	0.000	-0.840		0.000	0.000	0.000	0.508	-0.284
10.81	-0.989	0.000	-1.995		0.000	0.000	0.000	0.931	-0.525
19.95	-0.744	0.000	-1.468		-0.536	0.000	-0.171	0.682	-0.378
25.17	-0.489	0.000	-0.907		-3.647	0.000	-0.926	0.501	-0.262
29.92	-0.487	0.000	-0.654		0.000	0.000	0.000	0.518	-0.263
35.17	-0.486	0.000	-0.864		0.000	0.000	0.000	0.529	-0.262
39.90	-0.450	0.000	-0.522		0.000	0.000	0.000	0.525	-0.256
44.90	-0.435	0.000	-0.634		0.000	0.000	0.000	0.549	-0.263
49.90	-0.440	0.000	-0.435		0.000	0.000	0.000	0.556	-0.263
54.90	-0.444	0.000	-0.634		-0.712	0.000	-0.261	0.562	-0.263
59.90	-0.448	0.000	-0.435		-4.561	0.000	-3.426	0.568	-0.263
64.90	-0.451	0.000	-0.559		-0.093	0.000	-0.070	0.572	-0.263
69.90	-0.455	0.000	-0.435		0.000	0.000	0.000	0.576	-0.263
74.90	-0.550	0.000	-0.634		0.000	0.000	0.000	0.580	-0.263
79.90	-0.281	0.000	-0.428		-10.167	0.000	-6.115	0.291	-0.131

Load Case 2

El.	Load on Members			Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz		Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips		kips	kips	kips	kips	kips
0.00	-0.538	0.000	-0.630		0.000	0.000	0.000	0.508	-0.213
10.81	-0.989	0.000	-1.496		0.000	0.000	0.000	0.931	-0.393
19.95	-0.744	0.000	-1.101		-0.536	0.000	-0.140	0.682	-0.283
25.17	-0.489	0.000	-0.680		-3.647	0.000	-0.705	0.501	-0.197
29.92	-0.487	0.000	-0.490		0.000	0.000	0.000	0.518	-0.197
35.17	-0.486	0.000	-0.648		0.000	0.000	0.000	0.529	-0.197
39.90	-0.450	0.000	-0.391		0.000	0.000	0.000	0.525	-0.192
44.90	-0.435	0.000	-0.475		0.000	0.000	0.000	0.549	-0.197
49.90	-0.440	0.000	-0.326		0.000	0.000	0.000	0.556	-0.197
54.90	-0.444	0.000	-0.475		-0.712	0.000	-0.202	0.562	-0.197
59.90	-0.448	0.000	-0.326		-4.561	0.000	-2.581	0.568	-0.197
64.90	-0.451	0.000	-0.419		-0.093	0.000	-0.053	0.572	-0.197
69.90	-0.455	0.000	-0.326		0.000	0.000	0.000	0.576	-0.197
74.90	-0.550	0.000	-0.475		0.000	0.000	0.000	0.580	-0.197
79.90	-0.281	0.000	-0.321		-10.167	0.000	-4.598	0.291	-0.099

Load Case 3

El.	Load on Members			Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz		Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips		kips	kips	kips	kips	kips
0.00	-0.139	0.000	-1.110		0.000	0.000	0.000	0.115	-0.512
10.81	-0.253	0.000	-2.951		0.000	0.000	0.000	0.210	-0.946
19.95	-0.184	0.000	-2.293		-0.112	0.000	-0.195	0.154	-0.681
25.17	-0.120	0.000	-1.516		-0.749	0.000	-0.979	0.113	-0.473
29.92	-0.120	0.000	-0.939		0.000	0.000	0.000	0.117	-0.474
35.17	-0.120	0.000	-1.451		0.000	0.000	0.000	0.119	-0.473
39.90	-0.112	0.000	-0.775		0.000	0.000	0.000	0.118	-0.461
44.90	-0.109	0.000	-1.151		0.000	0.000	0.000	0.124	-0.474
49.90	-0.111	0.000	-0.673		0.000	0.000	0.000	0.125	-0.474

Load Case 3

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
54.90	-0.112	0.000	-1.160	-0.142	0.000	-0.289	0.127	-0.474
59.90	-0.113	0.000	-0.677	-0.990	0.000	-3.425	0.128	-0.474
64.90	-0.114	0.000	-0.964	-0.020	0.000	-0.070	0.129	-0.474
69.90	-0.114	0.000	-0.680	0.000	0.000	0.000	0.130	-0.474
74.90	-0.132	0.000	-1.172	0.000	0.000	0.000	0.131	-0.474
79.90	-0.067	0.000	-0.733	-2.166	0.000	-6.154	0.066	-0.237

Load Case 4

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
0.00	-0.419	-0.419	-0.840	0.000	0.000	0.000	0.508	-0.284
10.81	-0.774	-0.774	-1.995	0.000	0.000	0.000	0.931	-0.525
19.95	-0.585	-0.585	-1.468	-0.379	-0.379	-0.171	0.682	-0.378
25.17	-0.384	-0.384	-0.907	-2.579	-2.579	-0.926	0.501	-0.262
29.92	-0.384	-0.384	-0.654	0.000	0.000	0.000	0.518	-0.263
35.17	-0.384	-0.384	-0.864	0.000	0.000	0.000	0.529	-0.262
39.90	-0.353	-0.353	-0.522	0.000	0.000	0.000	0.525	-0.256
44.90	-0.339	-0.339	-0.634	0.000	0.000	0.000	0.549	-0.263
49.90	-0.344	-0.344	-0.435	0.000	0.000	0.000	0.556	-0.263
54.90	-0.346	-0.346	-0.634	-0.503	-0.503	-0.261	0.562	-0.263
59.90	-0.350	-0.350	-0.435	-3.225	-3.225	-3.426	0.568	-0.263
64.90	-0.352	-0.352	-0.559	-0.066	-0.066	-0.070	0.572	-0.263
69.90	-0.355	-0.355	-0.435	0.000	0.000	0.000	0.576	-0.263
74.90	-0.433	-0.433	-0.634	0.000	0.000	0.000	0.580	-0.263
79.90	-0.222	-0.222	-0.428	-7.189	-7.189	-6.115	0.291	-0.131

Load Case 5

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
0.00	-0.419	-0.419	-0.630	0.000	0.000	0.000	0.508	-0.213
10.81	-0.774	-0.774	-1.496	0.000	0.000	0.000	0.931	-0.393
19.95	-0.585	-0.585	-1.101	-0.379	-0.379	-0.140	0.682	-0.283
25.17	-0.384	-0.384	-0.680	-2.579	-2.579	-0.705	0.501	-0.197
29.92	-0.384	-0.384	-0.490	0.000	0.000	0.000	0.518	-0.197
35.17	-0.384	-0.384	-0.648	0.000	0.000	0.000	0.529	-0.197
39.90	-0.353	-0.353	-0.391	0.000	0.000	0.000	0.525	-0.192
44.90	-0.339	-0.339	-0.475	0.000	0.000	0.000	0.549	-0.197
49.90	-0.344	-0.344	-0.326	0.000	0.000	0.000	0.556	-0.197
54.90	-0.346	-0.346	-0.475	-0.503	-0.503	-0.202	0.562	-0.197
59.90	-0.350	-0.350	-0.326	-3.225	-3.225	-2.581	0.568	-0.197
64.90	-0.352	-0.352	-0.419	-0.066	-0.066	-0.053	0.572	-0.197
69.90	-0.355	-0.355	-0.326	0.000	0.000	0.000	0.576	-0.197
74.90	-0.433	-0.433	-0.475	0.000	0.000	0.000	0.580	-0.197
79.90	-0.222	-0.222	-0.321	-7.189	-7.189	-4.598	0.291	-0.099

Load Case 6

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
0.00	-0.112	-0.112	-1.110	0.000	0.000	0.000	0.115	-0.512
10.81	-0.205	-0.205	-2.951	0.000	0.000	0.000	0.210	-0.946

Load Case 6

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
19.95	-0.151	-0.151	-2.293	-0.079	-0.079	-0.195	0.154	-0.681
25.17	-0.098	-0.098	-1.516	-0.530	-0.530	-0.979	0.113	-0.473
29.92	-0.099	-0.099	-0.939	0.000	0.000	0.000	0.117	-0.474
35.17	-0.099	-0.099	-1.451	0.000	0.000	0.000	0.119	-0.473
39.90	-0.092	-0.092	-0.775	0.000	0.000	0.000	0.118	-0.461
44.90	-0.090	-0.090	-1.151	0.000	0.000	0.000	0.124	-0.474
49.90	-0.091	-0.091	-0.673	0.000	0.000	0.000	0.125	-0.474
54.90	-0.092	-0.092	-1.160	-0.100	-0.100	-0.289	0.127	-0.474
59.90	-0.093	-0.093	-0.677	-0.700	-0.700	-3.425	0.128	-0.474
64.90	-0.093	-0.093	-0.964	-0.014	-0.014	-0.070	0.129	-0.474
69.90	-0.094	-0.094	-0.680	0.000	0.000	0.000	0.130	-0.474
74.90	-0.110	-0.110	-1.172	0.000	0.000	0.000	0.131	-0.474
79.90	-0.056	-0.056	-0.733	-1.532	-1.532	-6.154	0.066	-0.237

Load Case 7

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
0.00	-0.034	0.000	-0.840	0.000	0.000	0.000	0.000	-0.284
10.81	-0.114	0.000	-1.995	0.000	0.000	0.000	0.000	-0.525
19.95	-0.174	0.000	-1.468	0.000	0.000	-0.195	0.000	-0.378
25.17	-0.144	0.000	-0.907	0.000	0.000	-1.138	0.000	-0.262
29.92	-0.128	0.000	-0.654	0.000	0.000	0.000	0.000	-0.263
35.17	-0.142	0.000	-0.864	0.000	0.000	0.000	0.000	-0.262
39.90	-0.139	0.000	-0.522	0.000	0.000	0.000	0.000	-0.256
44.90	-0.137	0.000	-0.634	0.000	0.000	0.000	0.000	-0.263
49.90	-0.150	0.000	-0.435	0.000	0.000	0.000	0.000	-0.263
54.90	-0.164	0.000	-0.634	0.000	0.000	-0.314	0.000	-0.263
59.90	-0.368	0.000	-0.435	0.000	0.000	-4.073	0.000	-0.263
64.90	-0.352	0.000	-0.559	0.000	0.000	-0.083	0.000	-0.263
69.90	-0.142	0.000	-0.435	0.000	0.000	0.000	0.000	-0.263
74.90	-0.383	0.000	-0.634	0.000	0.000	0.000	0.000	-0.263
79.90	-0.301	0.000	-0.428	0.000	0.000	-7.346	0.000	-0.131

Load Case 8

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
0.00	0.034	0.000	-0.630	0.000	0.000	0.000	0.000	-0.213
10.81	0.114	0.000	-1.496	0.000	0.000	0.000	0.000	-0.393
19.95	0.174	0.000	-1.101	0.000	0.000	-0.158	0.000	-0.283
25.17	0.144	0.000	-0.680	0.000	0.000	-0.864	0.000	-0.197
29.92	0.128	0.000	-0.490	0.000	0.000	0.000	0.000	-0.197
35.17	0.142	0.000	-0.648	0.000	0.000	0.000	0.000	-0.197
39.90	0.139	0.000	-0.391	0.000	0.000	0.000	0.000	-0.192
44.90	0.137	0.000	-0.475	0.000	0.000	0.000	0.000	-0.197
49.90	0.150	0.000	-0.326	0.000	0.000	0.000	0.000	-0.197
54.90	0.164	0.000	-0.475	0.000	0.000	-0.242	0.000	-0.197
59.90	0.368	0.000	-0.326	0.000	0.000	-3.066	0.000	-0.197
64.90	0.352	0.000	-0.419	0.000	0.000	-0.063	0.000	-0.197
69.90	0.142	0.000	-0.326	0.000	0.000	0.000	0.000	-0.197
74.90	0.383	0.000	-0.475	0.000	0.000	0.000	0.000	-0.197

Load Case 8

El.	Load on Members		Tower DL	Discrete Loads			Accessories Loads	
	Fx	Fy	Fz	Fx	Fy	Fz	Fxy	Fz
ft.	kips	kips	kips	kips	kips	kips	kips	kips
79.90	0.301	0.000	-0.321	0.000	0.000	-5.521	0.000	-0.099

60 MPH Maximum Twist & Sway: 0.05444 degrees

111 Maximum Twist and Corresponding Sway

El.	Maximum Twist	Sway	LC
79.90	0.11625	0.29811	1
74.90	0.10212	0.29587	1
69.90	0.09316	0.29533	2
64.90	0.08319	0.28512	2
59.90	0.07746	0.29398	2
54.90	0.06216	0.27097	2
49.90	0.05516	0.27224	1
44.90	0.03697	0.23141	1
39.90	0.02552	0.19957	2
35.17	0.02047	0.14922	1
29.92	0.03701	0.14449	1
25.17	0.01349	0.09314	1
19.95	0.01360	0.09272	1
10.81	0.00469	0.02199	1

111 Maximum Sway and Corresponding Twist

El.	Maximum Sway	Twist	LC
79.90	0.29811	0.11625	1
74.90	0.29587	0.10212	1
69.90	0.29660	0.09314	1
64.90	0.28623	0.08319	1
59.90	0.29509	0.07742	1
54.90	0.27182	0.06216	1
49.90	0.27224	0.05516	1
44.90	0.23141	0.03697	1
39.90	0.20011	0.02547	1
35.17	0.14922	0.02047	1
29.92	0.14449	0.03701	1
25.17	0.09379	0.00772	5
19.95	0.09342	0.01257	5
10.81	0.02280	0.00370	4

JOINT DEFLECTIONS

Maximum X deflection = -3.3304 in. at joint 275 for Load Case 8
Maximum Y deflection = -2.2629 in. at joint 277 for Load Case 8
Maximum Z deflection = -0.7220 in. at joint 30 for Load Case 8

SUMMARY OF MEMBER FORCES and ALLOWABLE LOADS

Member Description	Global		Member		LC	Length	KL/r	Over	
	Sj	Ej	Forces					FcA	Capacity
DVG401 2 L's 2.000 X 2.000 X 0.188	276	273	6.28	2		99	121.78	21.22	3.38
Fy= 36 Area= 1.43 Spc= 0.375	275	272	-0.48	1		r= 0.977		L from DB-	YES
DVT301 Angle 1.750 X 1.750 X 0.125	250	252	0	4		108	311.41	0.98	99.99
Fy= 36 Area= 0.42	251	253	0	4		r= 0.347		L from DB-	NO
DVI301 Angle 1.750 X 1.750 X 0.125	251	252	3.12	4		60	172	4.02	1.28
Fy= 36 Area= 0.42	250	251	-3.12	4		r= 0.347		L from DB-	NO

SUMMARY OF MEMBER FORCES and ALLOWABLE LOADS

Member Description	Global		Member Forces	LC	Length	KL/r	Over	
	Sj	Ej					FcA	Capacity
DVG301 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	251	255	0.38	1	49.5	100.57	16.05	34.17
	254	251	-0.47	1	r= 0.865		L from DB-	YES
DVD201 Pipe 1.90 X 0.145 Fy= 46 Area= 0.8	276	253	5.93	1	74	118.86	12.78	1.35
	253	277	-9.5	2	r= 0.623		L from DB-	YES
DVG101 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	211	215	0.36	1	99	139.16	9.84	22.32
	214	211	-0.44	1	r= 0.865		L from DB-	YES
DVD101 Pipe 1.90 X 0.145 Fy= 46 Area= 0.8	213	197	7.93	2	74	118.86	12.78	1.61
	211	195	-4.51	4	r= 0.623		L from DB-	YES
DVL101 Pipe 4.50 X 0.237 Fy= 46 Area= 3.17	214	234	9.7	5	60	39.75	118.16	6.11
	196	216	-19.33	4	r= 1.51		L from DB-	YES
DVT302 Angle 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.42	170	172	0	1	108	311.41	0.98	99.99
	171	173	0	1	r= 0.347		L from DB-	NO
DVI302 Angle 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.42	171	172	0.45	5	76.37	220.2	1.97	4.36
	170	171	-0.45	5	r= 0.347		L from DB-	NO
DVG302 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	176	173	0.82	1	49.5	100.57	16.05	19.51
	174	171	-0.43	1	r= 0.865		L from DB-	YES
DVD202 Pipe 1.90 X 0.145 Fy= 46 Area= 0.8	173	157	11.75	2	74	118.86	12.78	1.09
	156	173	-8.65	2	r= 0.623		L from DB-	YES
DVT102 Angle 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.42	130	132	0	4	108	311.41	0.98	99.99
	131	133	0	4	r= 0.347		L from DB-	NO
DVI102 Angle 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.42	132	133	0.19	1	76.37	220.2	1.97	10.32
	133	130	-0.19	1	r= 0.347		L from DB-	NO
DVG102 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	131	135	0.34	1	49.5	100.57	16.05	37.96
	134	131	-0.42	1	r= 0.865		L from DB-	YES
DVD102 Pipe 1.90 X 0.145 Fy= 46 Area= 0.8	133	117	9.14	2	74	118.86	12.78	1.04
	116	133	-12.32	1	r= 0.623		L from DB-	YES
DVL102 Pipe 4.50 X 0.237 Fy= 46 Area= 3.17	134	154	40.02	5	60	39.75	118.16	2.53
	116	136	-46.74	4	r= 1.51		L from DB-	YES
ETT303 Angle 2.000 X 2.000 X 0.125 Fy= 36 Area= 0.48	90	92	0	0	113.68	285.97	1.34	99.99
	91	93	0	6	r= 0.398		L from DB-	NO
ETI303 Angle 2.000 X 2.000 X 0.125 Fy= 36 Area= 0.48	92	93	0.21	2	80.39	202.21	2.68	12.4
	93	90	-0.22	1	r= 0.398		L from DB-	NO
ETG303 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	91	95	0.34	2	52.31	104.72	15.35	35.24
	94	91	-0.44	1	r= 0.865		L from DB-	YES
ETD303 Pipe 2.88 X 0.203 Fy= 46 Area= 1.7	93	77	9	2	80.2	84.65	43.56	4.84
	76	93	-6.54	1	r= 0.947		L from DB-	YES
ETT103 Angle 2.000 X 2.000 X 0.125 Fy= 36 Area= 0.48	50	52	0	0	125.71	316.23	1.09	99.99
	51	53	-0.01	3	r= 0.398		L from DB-	NO
ETI103 Angle 2.000 X 2.000 X 0.125 Fy= 36 Area= 0.48	52	53	0.1	1	88.89	223.61	2.19	21.01
	53	50	-0.1	1	r= 0.398		L from DB-	NO
ETG103 2 L's 1.750 X 1.750 X 0.125 Fy= 36 Area= 0.84 Spc= 0.375	56	53	2.41	2	56.38	111.05	14.28	5.93
	54	51	-1.77	1	r= 0.865		L from DB-	YES

SUMMARY OF MEMBER FORCES and ALLOWABLE LOADS

Member Description	Global		Member Forces	LC	Length	KL/r	Over	
	Sj	Ej					FcA	Capacity
ETD103 Pipe 2.88 X 0.203	53	37	7.52	2	83	87.61	42.1	4.28
Fy= 46 Area= 1.7	36	53	-9.83	2	r= 0.947	L from DB-	YES	
ETL103 Pipe 4.50 X 0.237	54	74	69.72	5	57.1	37.83	119.35	1.54
Fy= 46 Area= 3.17	36	56	-77.61	4	r= 1.51	L from DB-	YES	
FTT204 Angle 3.000 X 3.000 X 0.188	30	32	0.01	3	132	221.36	5.03	99.99
Fy= 36 Area= 1.09	30	32	0	0	r= 0.596	L from DB-	NO	
FTI204 Angle 3.000 X 3.000 X 0.188	30	31	0.14	1	93.34	156.52	10.05	71.68
Fy= 36 Area= 1.09	31	32	-0.13	1	r= 0.596	L from DB-	NO	
FTG204 2 L's 2.000 X 2.000 X 0.125	35	32	8.71	1	60.44	109.63	16.67	1.91
Fy= 36 Area= 0.97 Spc= 0.5	30	34	-7.74	2	r= 1.013	L from DB-	YES	
FTT104 Angle 3.000 X 3.000 X 0.188	11	13	0	0	143	239.81	4.28	99.99
Fy= 36 Area= 1.09	11	13	-0.01	6	r= 0.596	L from DB-	NO	
FTI104 Angle 3.000 X 3.000 X 0.188	12	13	0.16	1	101.12	169.57	8.56	50.46
Fy= 36 Area= 1.09	13	10	-0.17	1	r= 0.596	L from DB-	NO	
FTG104 2 L's 2.000 X 2.000 X 0.125	11	15	0.63	2	65.94	105.29	17.51	21.71
Fy= 36 Area= 0.97 Spc= 0.5	14	11	-0.81	1	r= 0.626	L from DB-	YES	
FTD104 Pipe 3.50 X 0.216	1	11	19.34	5	140	120.32	34.78	1.57
Fy= 46 Area= 2.23	12	3	-22.14	4	r= 1.164	L from DB-	YES	
FTL104 Pipe 5.56 X 0.258	14	34	68.05	5	130	69.24	128.94	1.73
Fy= 46 Area= 4.3	3	16	-74.76	4	r= 1.878	L from DB-	YES	

MAXIMUM REACTIONS (KIPS)

Tower Height (ft.) = 79.90
 Tower Height + Base El. (ft.) = 79.90
 Base Dimension (ft.) = 13.00

Maximum resultant of X and Y reaction forces

Joint	X Y resultant	Corresponding Z	Load Case
1	19.877	-98.988	5
2	16.354	81.268	1
3	21.843	110.349	4
4	13.480	-68.989	2

Maximum Z reaction force

Joint	Z force	Corresponding X Y resultant	Load Case
1	12.036	2.359	8
2	81.268	16.354	1
3	110.349	21.843	4
4	9.727	2.109	8

Minimum Z reaction force

Joint	Z force	Corresponding X Y resultant	Load Case
1	-98.988	19.877	5
2	1.007	0.272	8
3	-1.111	0.128	8
4	-68.989	13.480	2

Maximum Overturning Moment at Base = 1911.32 kip-ft. for LC 5

Corresponding Shear at Base = 36.69 kips

Corresponding Torque at Base = 322.04 kip-in.

Corresponding Weight at Base = 20.03 kips

Corresponding Maximum Uplift = 98.97 kips

Corresponding Maximum Download = 108.98 kips

REACTIONS BY LOAD CASE (kips)

Tower Height (ft.) = 79.90
 Tower Height + Base El. (ft.) = 79.90
 Base Dimension (ft.) = 13.00

Reactions of LOAD CASE 1

Joint	X	Y	XY	Z
1	7.298	11.240	13.401	-65.226
2	9.644	-13.208	16.354	81.268
3	10.109	11.798	15.537	78.374
4	8.801	-9.829	13.193	-67.804

Maximum Overturning Moment at Base = 1902.70 kip*ft.
 Corresponding Shear at Base = 35.85 kips
 Corresponding Torque at Base = -373.55 kip*in.
 Corresponding Weight at Base = 26.61 kips

Reactions of LOAD CASE 2

Joint	X	Y	XY	Z
1	7.596	11.458	13.747	-67.116
2	9.345	-12.945	15.965	79.188
3	9.927	11.536	15.219	76.942
4	8.985	-10.050	13.480	-68.989

Maximum Overturning Moment at Base = 1899.72 kip*ft.
 Corresponding Shear at Base = 35.85 kips
 Corresponding Torque at Base = -373.55 kip*in.
 Corresponding Weight at Base = 20.03 kips

Reactions of LOAD CASE 3

Joint	X	Y	XY	Z
1	0.235	1.397	1.417	-5.186
2	3.589	-4.101	5.449	27.695
3	3.086	3.812	4.905	23.728
4	1.099	-1.108	1.561	-9.304

Maximum Overturning Moment at Base = 431.65 kip*ft.
 Corresponding Shear at Base = 8.01 kips
 Corresponding Torque at Base = -73.26 kip*in.
 Corresponding Weight at Base = 36.93 kips

Reactions of LOAD CASE 4

Joint	X	Y	XY	Z
1	14.117	13.466	19.510	-97.098
2	0.057	-2.246	2.247	8.492
3	14.785	16.078	21.843	110.349
4	-3.018	-1.356	3.308	4.870

Maximum Overturning Moment at Base = 1907.22 kip*ft.
 Corresponding Shear at Base = 36.69 kips
 Corresponding Torque at Base = 322.04 kip*in.
 Corresponding Weight at Base = 26.61 kips

Reactions of LOAD CASE 5

Joint	X	Y	XY	Z
1	14.415	13.685	19.877	-98.988
2	-0.243	-1.983	1.997	6.411
3	14.603	15.816	21.527	108.918
4	-2.833	-1.577	3.243	3.685

Maximum Overturning Moment at Base	=	1911.32 kip*ft.
Corresponding Shear at Base	=	36.69 kips
Corresponding Torque at Base	=	322.04 kip*in.
Corresponding Weight at Base	=	20.03 kips

Reactions of LOAD CASE 6

Joint	X	Y	XY	Z
1	1.756	1.971	2.640	-12.517
2	1.447	-1.686	2.222	11.611
3	4.173	4.797	6.358	31.078
4	-1.497	0.798	1.696	6.761

Maximum Overturning Moment at Base	=	403.22 kip*ft.
Corresponding Shear at Base	=	8.32 kips
Corresponding Torque at Base	=	67.66 kip*in.
Corresponding Weight at Base	=	36.93 kips

Reactions of LOAD CASE 7

Joint	X	Y	XY	Z
1	-0.586	-0.019	0.587	2.272
2	2.034	-2.096	2.921	15.069
3	1.520	2.088	2.583	12.252
4	-0.088	0.026	0.092	-0.798

Maximum Overturning Moment at Base	=	172.31 kip*ft.
Corresponding Shear at Base	=	2.88 kips
Corresponding Torque at Base	=	0.00 kip*in.
Corresponding Weight at Base	=	28.80 kips

Reactions of LOAD CASE 8

Joint	X	Y	XY	Z
1	-1.703	-1.633	2.359	12.036
2	0.269	0.043	0.272	1.007
3	-0.118	-0.049	0.128	-1.111
4	-1.328	1.639	2.109	9.727

Maximum Overturning Moment at Base	=	145.02 kip*ft.
Corresponding Shear at Base	=	2.88 kips
Corresponding Torque at Base	=	0.00 kip*in.
Corresponding Weight at Base	=	21.66 kips

This technique assumes elastic material properties and is based upon the following formulations:

$\{P\} = [K] \{X\}$
 where $\{P\}$ = applied nodal loads
 $[K]$ = structural stiffness matrix
 $\{X\}$ = nodal displacements

Microflect's implementation of this technique allows for three-dimensional frames with nodal loads. Truss members may be input by specifying beam member end moment releases. Supports and/or support settlements may be input by specifying nodal displacements.

The resulting computer output consists of nodal displacements, member end forces and moments, and support reactions.

Ref. 1: MATRIX METHODS OF STRUCTURAL ANALYSIS, 2nd Edition, Chu-Kia Wang, International Textbook Co., Scranton, Pennsylvania, 1970

LOAD CALCULATIONS FOR CRITICAL MEMBERS

[illegible]

DWG. NO. B-123.45	SHEET 1 OF 1	STRESS ANALYSIS UNION WIRELESS SITE: OAK CREEK COAL, CO		<table><tr><th>REV</th><th>DESCRIPTION</th><th>DATE</th><th>BY/CK</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table>	REV	DESCRIPTION	DATE	BY/CK																
		REV	DESCRIPTION		DATE	BY/CK																		
valmont MICROFLECT		BY	CWB																					
		CK	MF																					
		DATE	20MAY20																					
		S.O.	441507-1																					
3575 25TH STREET SE, SALEM, OR 97302 MAIN: (503)363-9267 FAX: (503)316-2040																								

441507 - anchor bolt & baseplate design check per TIA-H:

tower height = 80 ft
tower base width = 13 ft
number of legs = 4
unfactored tower weight = 22.3 k

TIA-H tower factored base reactions:

total OTM = 1911 ft-k
total tower shear = 36.7 k
max shear per leg = 21.84 k
max uplift per leg = 98.9429 k
max download per leg = 110.6504 k

Least Leg Factor of Safety (LLFS) = 1.00
LLFS factored total OTM = 1911 ft-k
LLFS factored total tower shear = 36.7 k
LLFS factored max shear per leg = Vu = 21.84 k
LLFS factored max uplift per leg = Pt = 98.9429 k
LLFS factored max download per leg = Pc = 110.6504 k

anchor bolt design per TIA-H, Section 4.9.9:

Fy = 55 ksi
Fu = 75 ksi
ab quantity = Nb = 4
ab diameter = 1.5 in
ab circle diameter = 12 in
gross bolt area Ag = 1.767146 in²
effective ab dia = ab dia - (.9743/nthrd) = 1.337617 in
tensile bolt area An = 1.41 in²
effective Zbolt = 0.398881 in³
nthrd = 6 per in

ab ϕ (in)	tensile Abolt (in ²)	edge distance (in)	nthrd (per in)
0.5	0.142	0.75	13
0.625	0.226	0.875	11
0.75	0.334	1	10
0.875	0.462	1.125	9
1	0.606	1.25	8
1.125	0.763	1.5	7
1.25	0.969	1.625	7
1.375	1.16	1.71875	6
1.5	1.41	1.875	6
1.75	1.9	2.1875	5
2	2.5	2.5	4.5
2.25	3.25	2.8125	4.5
2.5	4	3.125	4

grout below baseplate: yes

check anchor bolt capacities:

ab group tension capacity = $\phi_t R_{nt} N_b = 0.75 (F_u A_n) N_b = 317.25$ k >= max uplift per leg, OK
ab group compression capacity = $\phi_c R_{nc} N_b = 1.0 (F_y A_n) N_b = 310.2$ k >= max download per leg, OK
ab group shear capacity = $\phi_v R_{nv} N_b = 0.75 (0.5 F_u A_g) N_b = 198.8039$ k >= max shear per leg, OK
ab group shear capacity = $\phi_c R_{nv} N_b = 1.0 (0.6 F_y A_n / 2) N_b = 93.06$ k >= max shear per leg, OK

check anchor bolt combined interaction:

lar = 1.5 in, lar <= 1(d)
Mu = 0.65 * lar * Vu / Nb = 5.3235 in-k

check when lar <= 1(d) or if grout below baseplate "yes" & lar <= 3 in:

$(P_t / (\phi_t R_{nt} N_b))^2 + (V_u / (\phi_v R_{nv} N_b))^2 = 0.109336$ <= 1.0, OK
 $P_c / (\phi_c R_{nc} N_b) + (V_u / (\phi_c R_{nv} N_b))^2 = 0.411785$ <= 1.0, OK

baseplate design per 'Formulas for Stress and Strain', 5th Edition, ROARK & YOUNG

Fy = 36 ksi
diameter of base leg = 5.5625 in
bolt edge distance = 1.875 in
baseplate diameter = 15.75 in
baseplate area = 170.5269 in²
Qu = 3060 psi
Pr = 0.3
Qarea = 36.16026 in²
A = 4.386972
B = 2.78125
Ro = 2.78125
C8 = 0.790675
C9 = 0.254158
L17 = 0.053303
Mrb = 4.958845
req'd baseplate thickness for download = Tdown_r = 0.782434 in (per Roark & Young eq.2L)

A = 6
C5 = 0.392565
L6 = 0.087214
W = -5.66193
Mrb = 7.547297
req'd baseplate thickness for uplift = Tup_r = 0.96528 in (per Roark & Young eq.1F)
baseplate thickness = 2 in >= req'd thickness, OK
baseplate diameter = 15.75 in

SLAB FDN DESIGN CHECK PER TIA-H:

Project: 441507
Input:
legs 4
otm_t 1911 k-ft
sh_t 36.70 k
sh_l 21.84 k
wt 20.03 k
f_w 13.00 ft
b 26.00 ft
t 48.00 in
net_p_a 3.00 ksf
s_f 1.00

Date: 05/20/20

Run by: CWB

3 or 4 leg tower
total tower overturning moment
total tower shear
max. leg shear
total tower weight (0.9D)
tower face width at base.
slab width (rigid square slab only)
slab thickness
ultimate soil bearing pressure
allowable stress increase factor (rebar)

d_f 3.50 ft.

depth from final grade to bottom of footing

dens_c 0.150 kcf

density of concrete

dens_s 0.100 kcf

density of soil

f_c 3,000 psi

concrete compres. strength

f_y 60,000 psi

rebar yield strength

Output Summary:

s_r 2.43
net_p 1.31 ksf
vol_c 100 cu.yd.
slab two-way shear:
slab beam shear:
max eccen. 3.96 ft

OK (overturning F.S. OK)
OK (net soil bearing pressure is OK)
Total volume of concrete.
(punching shear ok)
(beam shear ok)
<= 0.45*slab width, OK

customer: Union Telephone

site: Oak Creek Coal, CO

tower: 108-M840-80

Factored tower OTM from tower analysis prog.

Factored tower total base shear from tower analysis prog.

Factored tower max leg shear from tower analysis prog.

Lowest Factored Weight from analysis

Between leg centroids

Square slab with tower c.g. = slab c.g.

No stress increase allowed for TIA-H

Distance from bottom of pad to grade.

Stability ratio must be greater than 1.0

Compare net press to design strength

(no overage included)

Check at edge of slab(3-leg) or corner(4-leg.)

Check cantilevered section over full slab width.

Check $e \leq 0.45 \times \text{slab width}$ per TIA-H 9.4.1

PROJECT INDEX

APPLICANT:
UNION TELEPHONE COMPANY
850 N HIGHWAY 414
PO BOX 160
MOUNTAIN VIEW, WY 82939

SITE ACQUISITION:
CONTACT: TYLER THOLL
PHONE: (307) 782-4804
EMAIL: ttholl@unionwireless.com

ENGINEER/DESIGNER:
CONTACT: NICHOLAS CONSTANTINE
PHONE: (303) 566-9918
EMAIL: nconstantine@tepgroup.net

CONSTRUCTION MANAGER:
CONTACT: JUSTIN HAWS
PHONE: (307) 747-7054
EMAIL: jhaws@unionwireless.com

SURVEYOR: _____
PLANS NOT VERIFIED BY A LICENSED SURVEYOR.

PROPERTY OWNER:
PEABODY COAL
701 MARKET St. SUITE 731
St. LOUIS, MISSOURI 63101

CONTACT: MIKE BERDINE
PHONE: (970) 870-2782

POWER COMPANY:
YAMPA VALLEY ELECTRIC ASSOCIATION
3715 EAST US HWY 40
P.O. BOX 217
CRAIG, CO 81626

CONTACT:
PHONE: (970) 824-6593

TELEPHONE COMPANY:
UNION TELEPHONE COMPANY
PO BOX 160
850 NORTH HIGHWAY 414
MOUNTAIN VIEW, WY 82939

PHONE: (307) 782-6131

DRAWING INDEX

[illegible]

OAK CREEK COAL

COMMUNICATION SITE

29920 COUNTY ROAD 27
OAK CREEK, ROUTT COUNTY, COLORADO 80467

80' SELF-SUPPORTING LATTICE TOWER

FIRSTNET OVERLAY - TOWER WORK

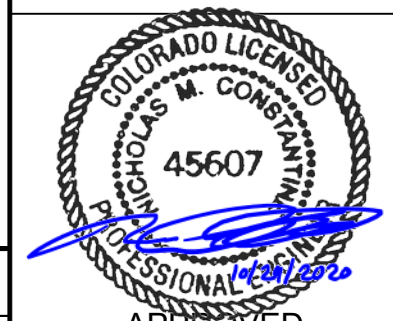


850 N. HIGHWAY 414
PO BOX 160
MOUNTAIN VIEW, WY 82939

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CURRENT REV	DATE
H	03/25/2020

DESIGNER: **MATTHEW FISHER**

REVIEWER:
NICHOLAS CONSTANTINE

APPROVED
FOR
CONSTRUCTION

28 OCTOBER 2020

AT&T SITE ID: COL04473A

FA CODE: 15084278

PROJECT NAME:

OAK CREEK COAL

PROJECT ADDRESS:

29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE:

FIRSTNET TITLE SHEET

SHEET NUMBER:

T1

SITE DESCRIPTION		VICINITY MAP	DRIVING DIRECTIONS
1	LEGAL DESCRIPTION: SE $\frac{1}{4}$ OF SE $\frac{1}{4}$ SECTION 30 T5N R86W 6THPM		HEADING EAST OUT OF THE TOWN OF HAYDEN, COLORADO TOWARD STEAMBOAT SPRINGS, CLOCK 4.5 MILES TO THE JUNCTION WITH COUNTY ROAD NO. 27. TURN RIGHT ON COUNTY ROAD NO.27 AND CLOCK 12.1 MILES ALONG THE COUNTY ROAD NO. 27. TURN LEFT ON A DIRT ROAD HEADING NORTHEASTERLY AND CLOCK 0.3 MILES TO A TWO-TRACK ROAD ON THE RIGHT. TURN RIGHT AND FOLLOW THE TWO TRACK ABOUT A MILE TO THE TOP OF TWENTYMILE RIDGE. THE COMMUNICATION SITE IS LOCATED ABOUT 150 FEET NORTHEAST OF THE EXISTING POLE ANTENNA MOUNT AND BUILDING BELONGING TO PEABODY COAL COMPANY. CONTACT PERSON FOR PEABODY COAL IS MIKE BERDINE (MINE MANAGER) AT 970-870-2782 OR RICK STILLION, (ELECTRICAL SUPERVISOR) AT 970-870-2788.
2	GEOGRAPHIC COORDINATES (NAD83): 40°21'14.8"N 107°4'21.3"W		
3	ELEVATION: 7490' AMSL		
4	ASR: N/A		
5	PROJECT NOTES: SEE SCOPE OF WORK DOCUMENT FOR DETAILED SCOPE OF WORK.		

DRAWINGS ISSUED BY:

MATTHEW FISHER

TITLE:

PROJECT ENGINEER

DATE:

28 OCTOBER 2020

LEGEND

LEASE AREA AND 6' CHAIN LINK FENCE WITH BARBED WIRE

HIDDEN LINE

CONCRETE FOUNDATION

UTC

COMPANY IDENTIFIER

P

PROPANE LABEL

NO SMOKING SIGN

N
(•)

RF NOTICE SIGN

C
(•)

RF CAUTION SIGN

NEW EQUIPMENT

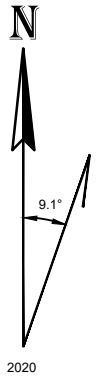
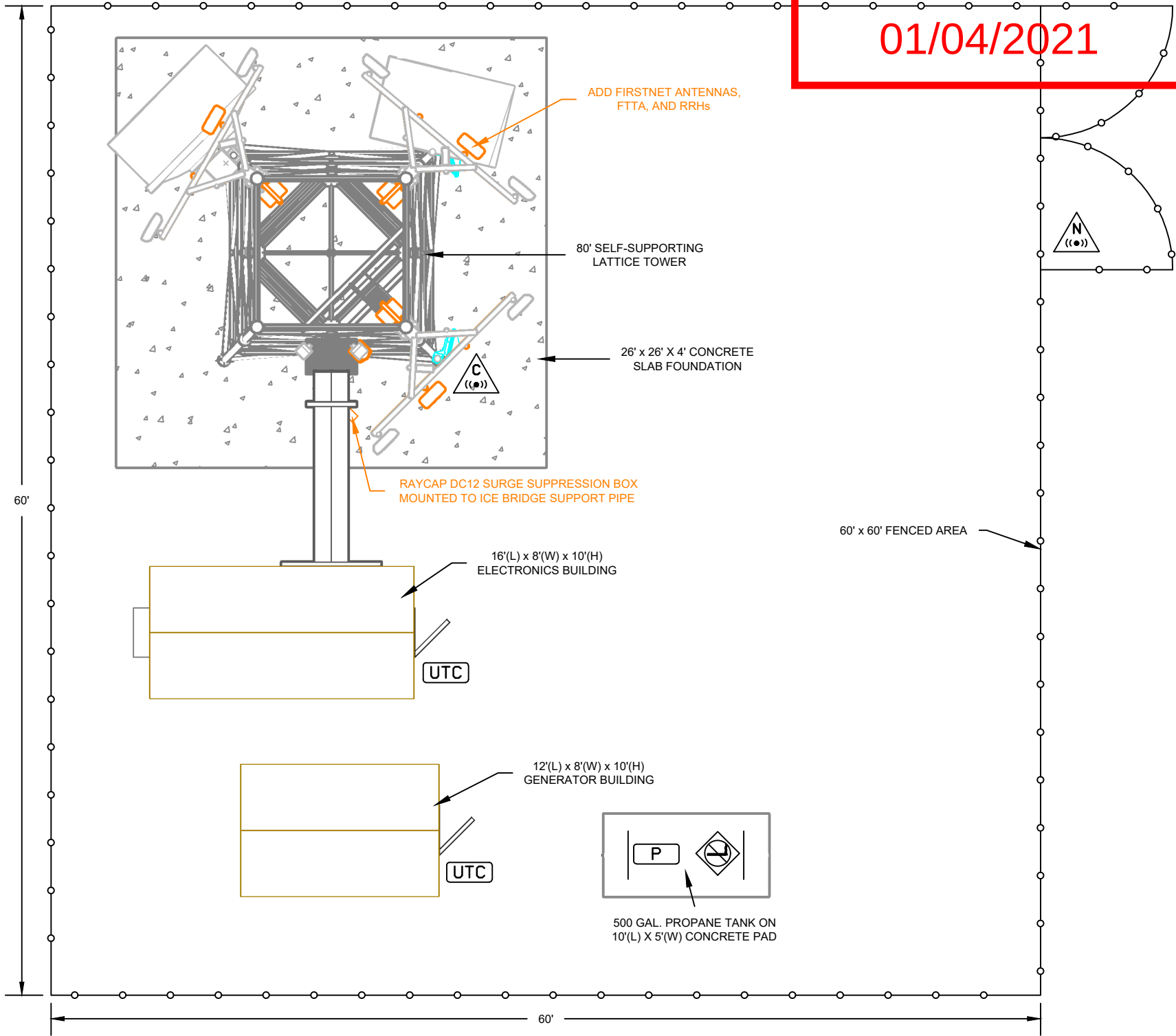
RETIRE EQUIPMENT

COLO EQUIPMENT

RCRBD Record Set

T.A.

01/04/2021



1

COMMUNICATION SITE PLAN

SCALE: 1/8"=1'

Union

WIRELESS

850 N. HIGHWAY 414
PO BOX 160
MOUNTAIN VIEW, WY 82939

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CURRENT REV

DATE

H

03/25/2020

DESIGNER:
MATTHEW FISHER

REVIEWER:
NICHOLAS CONSTANTINE

COLORADO LICENSED

NICHOLAS M. CONSTANTINE

45607

PROFESSIONAL ENGINEER

APPROVED
FOR
CONSTRUCTION

28 OCTOBER 2020

AT&T SITE ID:
COL04473A

FA CODE:
15084278

PROJECT NAME:
OAK CREEK COAL

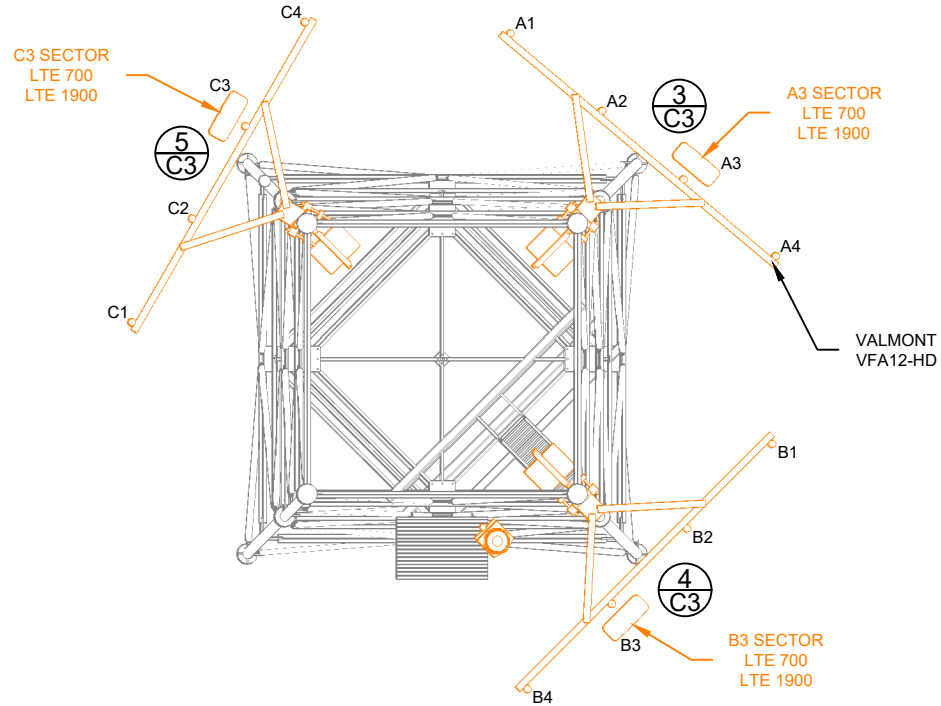
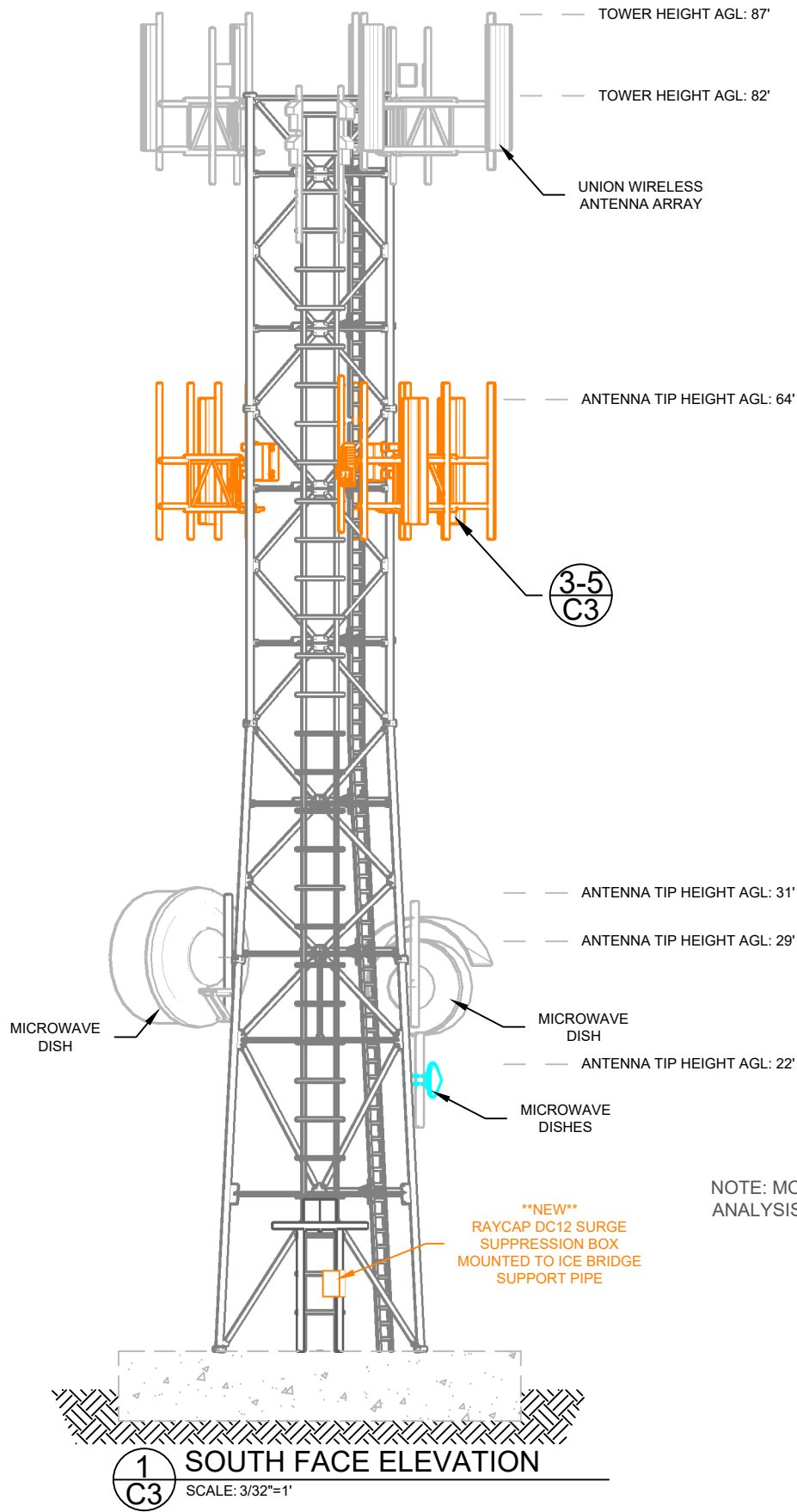
PROJECT ADDRESS:
29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE:
FIRSTNET PLAN VIEW

SHEET NUMBER:
C1

LEGEND

- NEW EQUIPMENT
- RETIRE EQUIPMENT
- COLO EQUIPMENT



2 ANTENNA DETAILS SCALE: 5/32"=1'

3 ANT FRAME DETAILS	
A3 SECTOR	ANTENNA MANUFACTURER & MODEL: 1X COMMSCOPE NNH4-65C-R6-V3 OR SIMILAR
	AZIMUTH: 31° MAG (40° TRUE)
	TIP HEIGHT ABOVE GROUND LEVEL: 64'
	TECHNOLOGY FOR 698-896 MHz PORTS: LTE 7A_1_FA/7A_2_A (4x4)
	DOWNTILT FOR 698-896 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 698-896 MHz: (4) LDF4-50A
	TECHNOLOGY FOR 1695-2360 MHz PORTS: LTE 9A_1_A (4x4)
	DOWNTILT FOR 1695-2360 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 1695-2360 MHz: (4) LDF4-50A, (4) PORTS CAPPED
4 ANT FRAME DETAILS	
B3 SECTOR	ANTENNA MANUFACTURER & MODEL: 1X COMMSCOPE NNH4-65C-R6-V3 OR SIMILAR
	AZIMUTH: 126° MAG (135° TRUE)
	TIP HEIGHT ABOVE GROUND LEVEL: 64'
	TECHNOLOGY FOR 698-896 MHz PORTS: LTE 7B_1_FA/7B_2_A (4x4)
	DOWNTILT FOR 698-896 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 698-896 MHz: (4) LDF4-50A
	TECHNOLOGY FOR 1695-2360 MHz PORTS: LTE 9B_1_A (4x4)
	DOWNTILT FOR 1695-2360 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 1695-2360 MHz: (4) LDF4-50A, (4) PORTS CAPPED
5 ANT FRAME DETAILS	
C3 SECTOR	ANTENNA MANUFACTURER & MODEL: 1X COMMSCOPE NNH4-65C-R6-V3 OR SIMILAR
	AZIMUTH: 291° MAG (300° TRUE)
	TIP HEIGHT ABOVE GROUND LEVEL: 64'
	TECHNOLOGY FOR 698-896 MHz PORTS: LTE 7C_1_FA/7C_2_A (4x4)
	DOWNTILT FOR 698-896 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 698-896 MHz: (4) LDF4-50A
	TECHNOLOGY FOR 1695-2360 MHz PORTS: LTE9C_1_A (4x4)
	DOWNTILT FOR 1695-2360 MHz: 0°MECH, RET (SEE RFDS)
	WAVEGUIDE SPECS FOR 1695-2360 MHz: (4) LDF4-50A, (4) PORTS CAPPED

RCRBD Record Set
T.A.

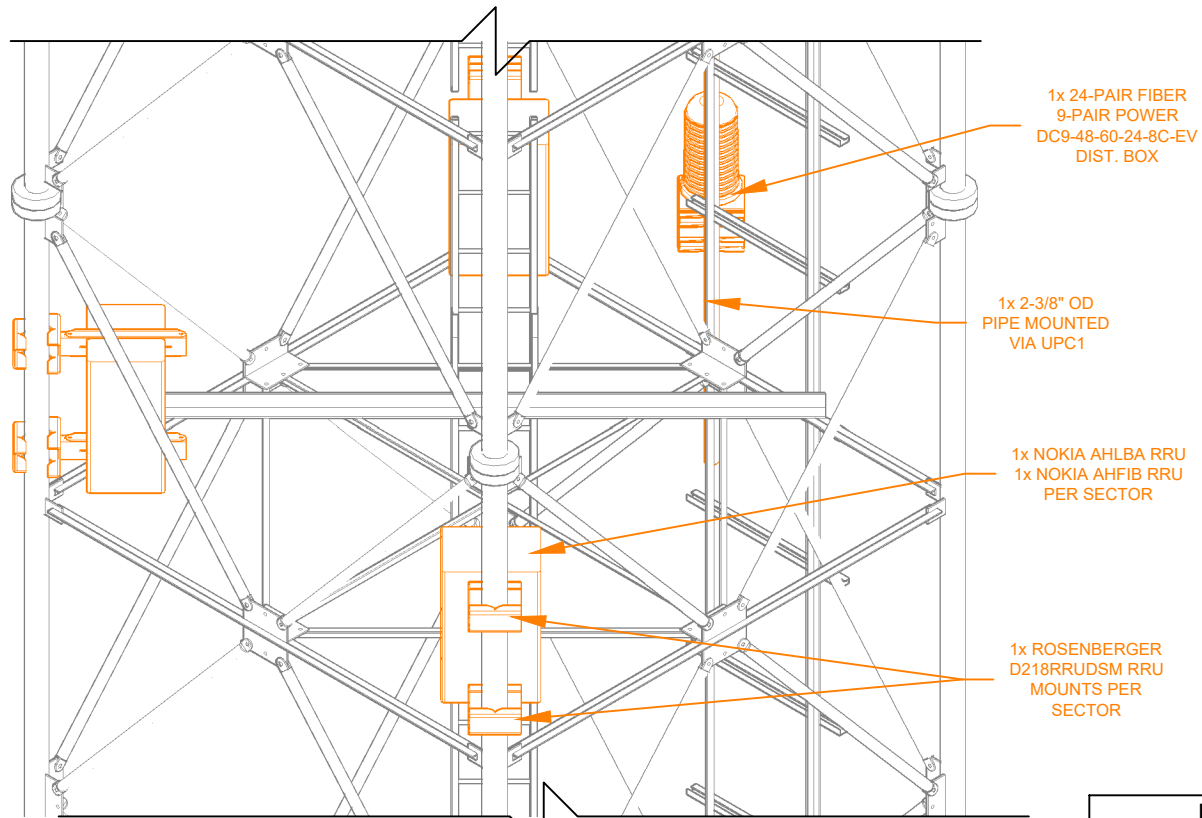
01/04/2021



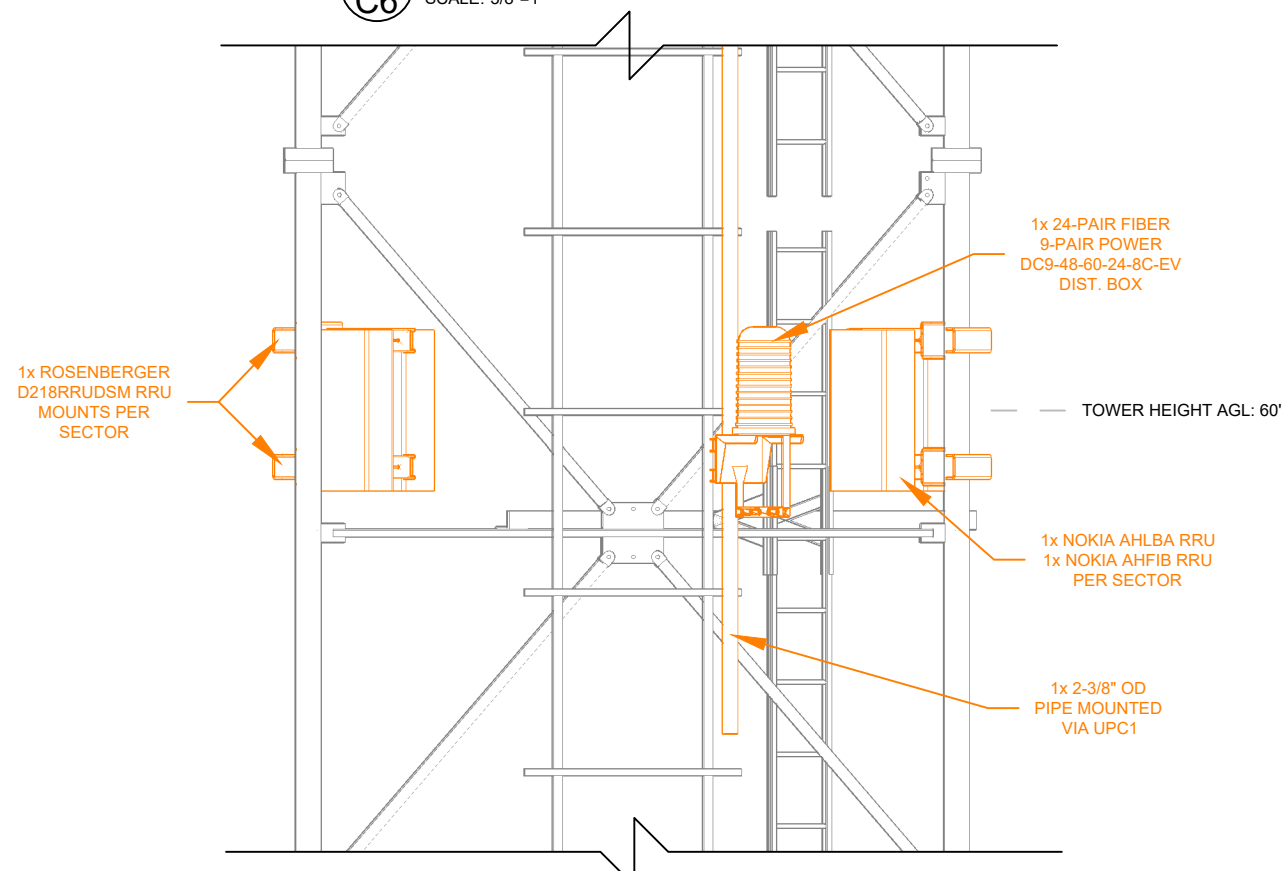
850 N. HIGHWAY 414
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MOUNTAIN VIEW, CO 82939

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CURRENT REV	DATE
H	03/25/2020
DESIGNER:	MATTHEW FISHER
REVIEWER:	NICHOLAS CONSTANTINE
APPROVED FOR CONSTRUCTION 28 OCTOBER 2020	
AT&T SITE ID:	COL04473A
FA CODE:	15084278
PROJECT NAME:	OAK CREEK COAL
PROJECT ADDRESS:	29920 COUNTY ROAD 27 OAK CREEK, CO 80467 ROUTT COUNTY
SHEET TITLE:	FIRSTNET ANTENNA DETAILS
SHEET NUMBER:	C3

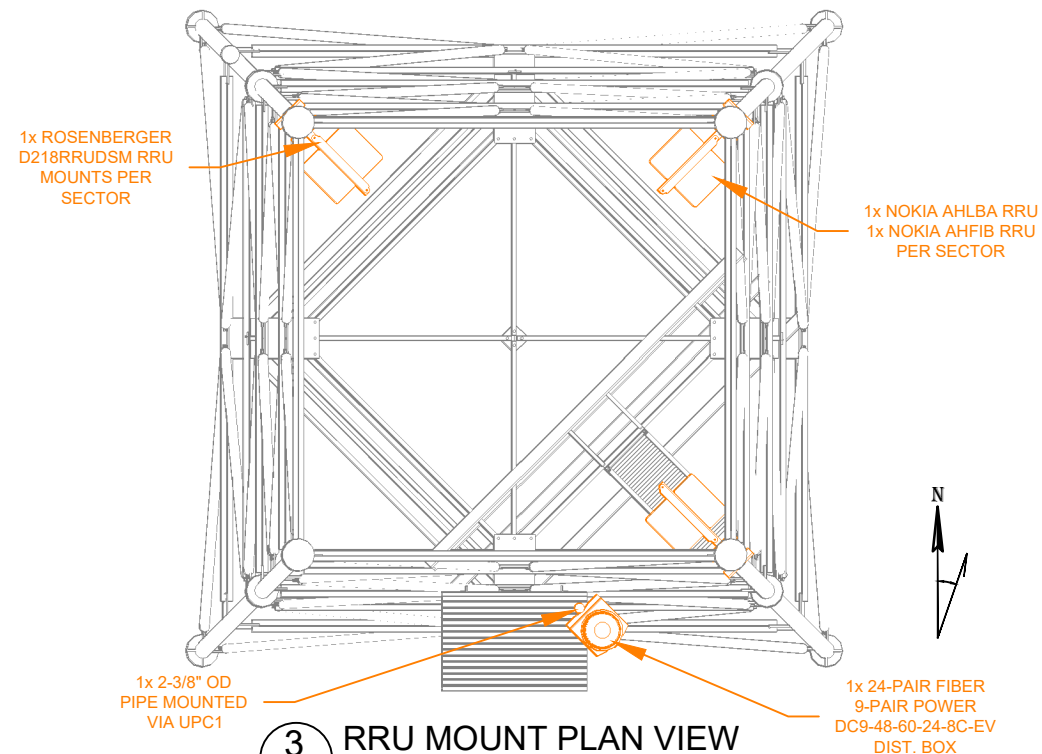


1 RRU MOUNT PERSPECTIVE
SCALE: 3/8"=1'

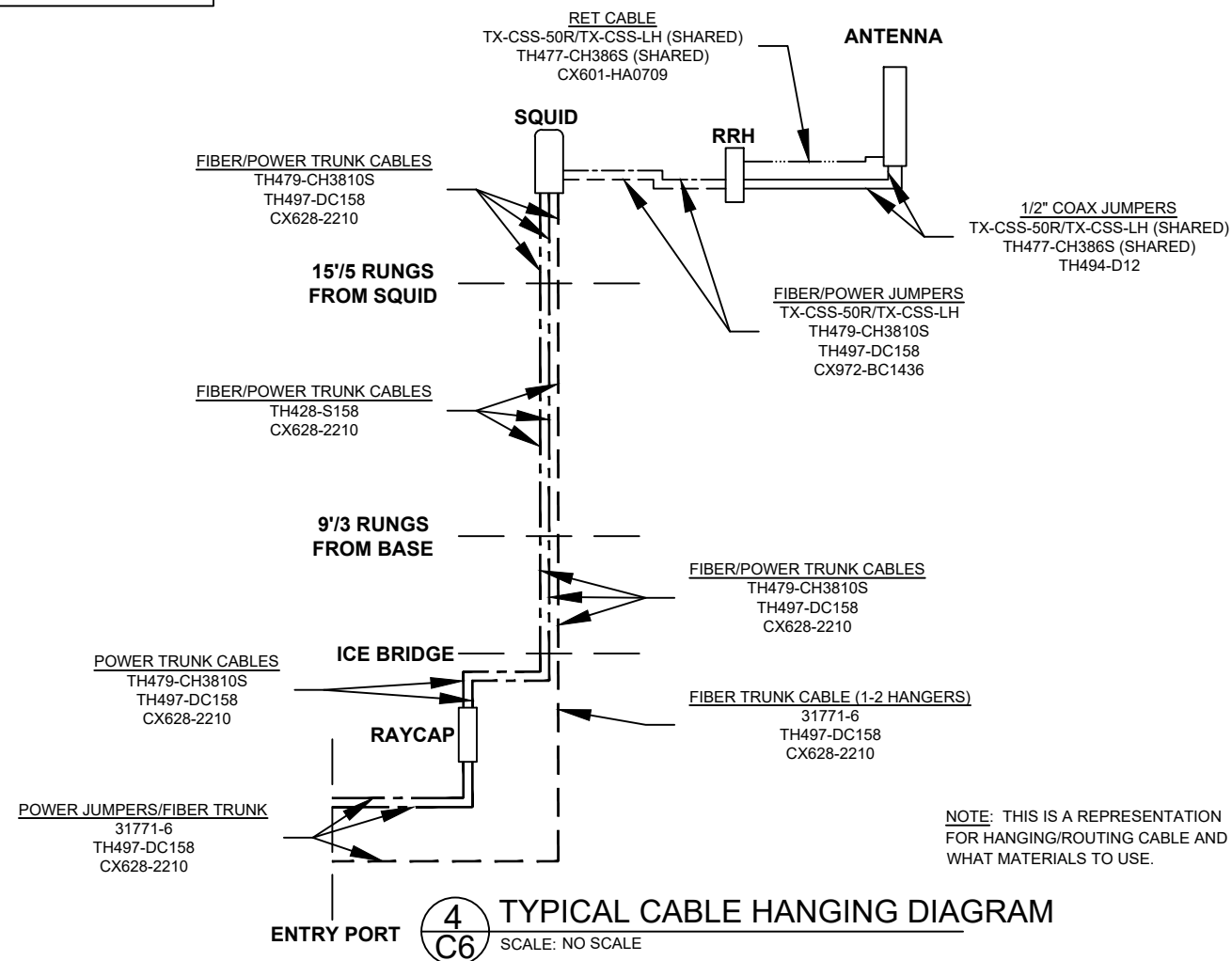


2 RRU ELEVATION VIEW
SCALE: 3/8"=1'

LEGEND
NEW/CHANGED EQUIPMENT



3 RRU MOUNT PLAN VIEW
SCALE: 1/4"=1'



4 TYPICAL CABLE HANGING DIAGRAM
SCALE: NO SCALE

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01/04/2021

CURRENT REV H DATE 03/25/2020

DESIGNER: MATTHEW FISHER

REVIEWER: NICHOLAS CONSTANTINE



APPROVED
FOR
CONSTRUCTION
28 OCTOBER 2020

AT&T SITE ID: COL04473A

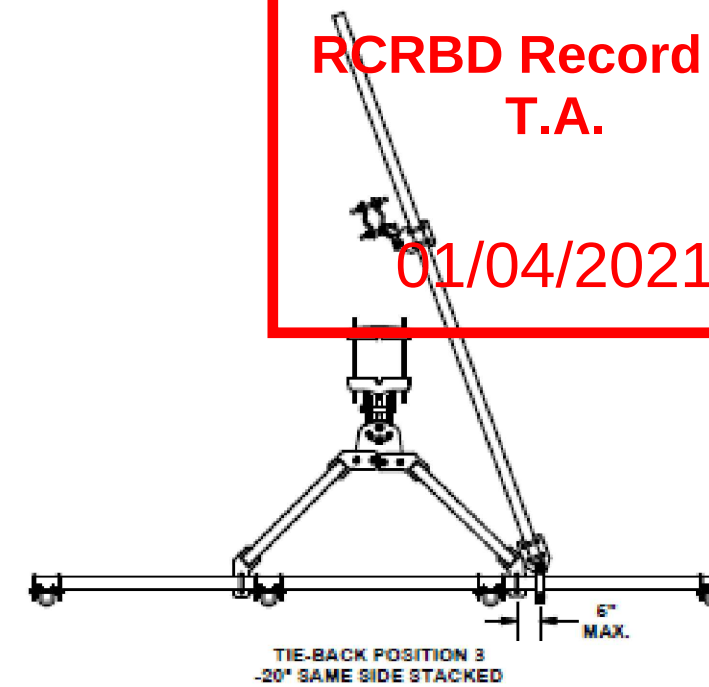
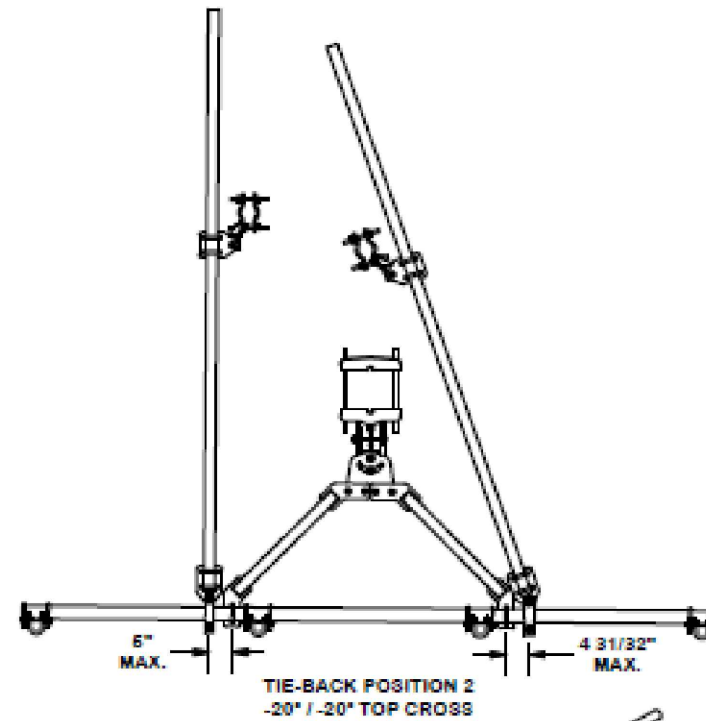
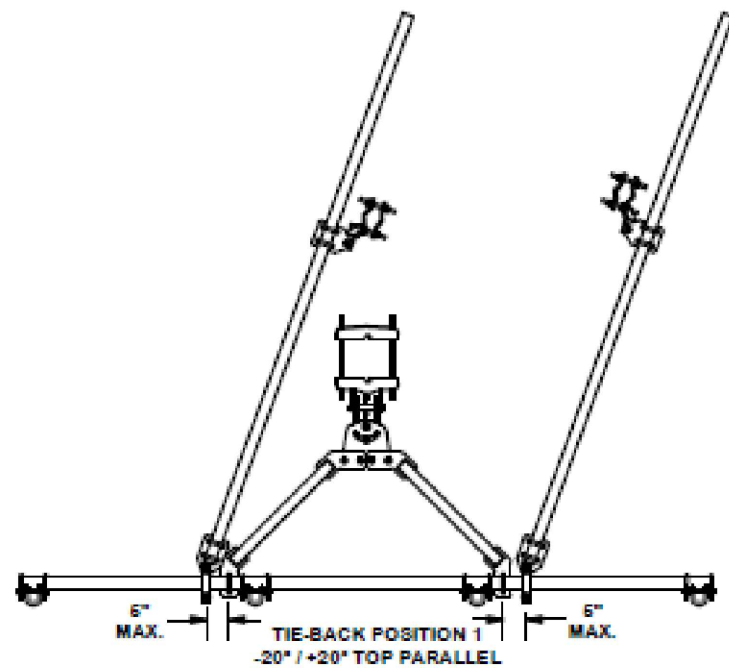
FA CODE: 15084278

PROJECT NAME:
OAK CREEK COAL

PROJECT ADDRESS:
29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

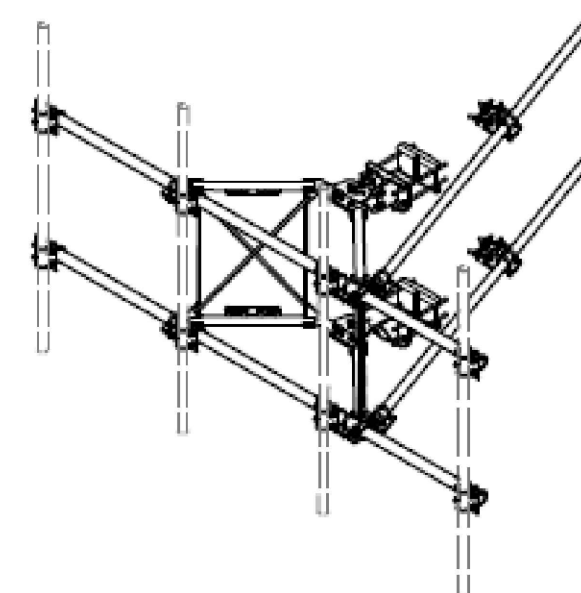
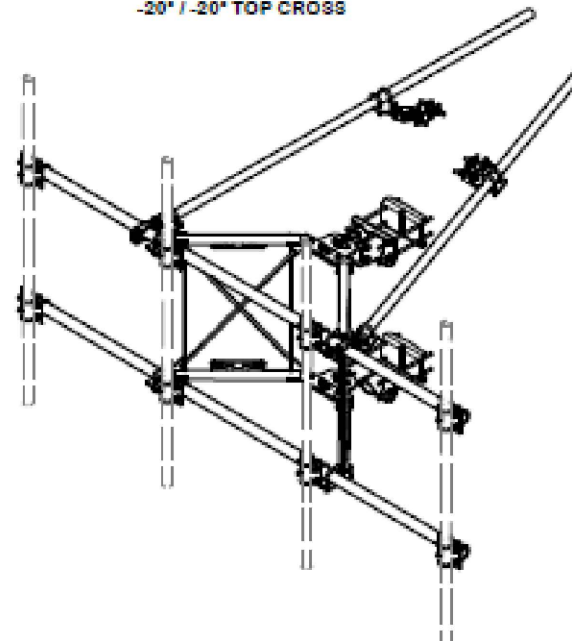
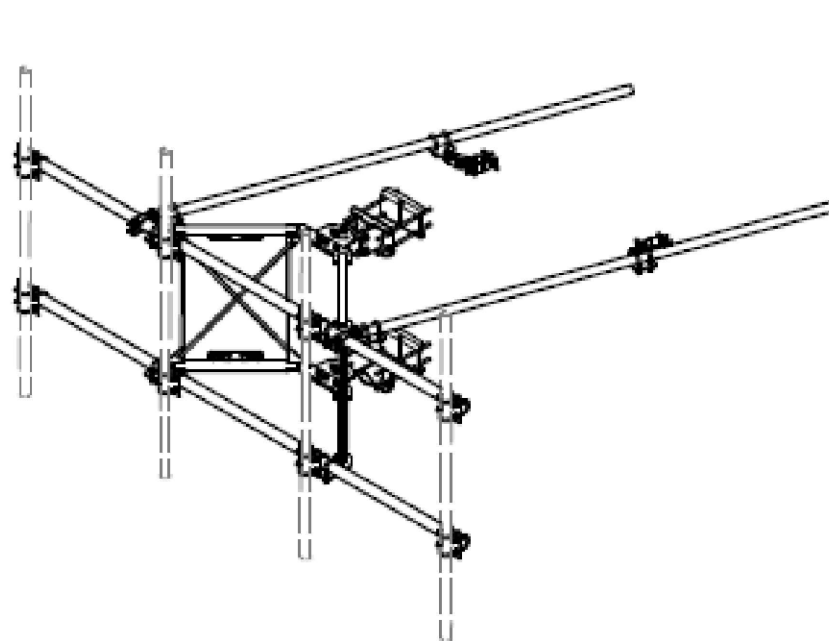
SHEET TITLE:
FN RRU MOUNTING DETAILS

SHEET NUMBER: C6



RCRBD Record Set
T.A.

01/04/2021



1
C7 SECTOR FRM - STABILIZER OPTS
SCALE: NO SCALE



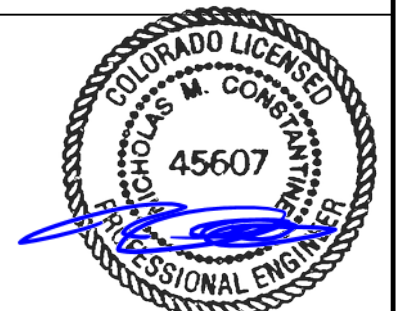
850 N. HIGHWAY 414
PO BOX 160
MOUNTAIN VIEW, WY 82939

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CURRENT REV	DATE
H	03/25/2020

DESIGNER:
MATTHEW FISHER

REVIEWER:
NICHOLAS CONSTANTINE



APPROVED
FOR
CONSTRUCTION
28 OCTOBER 2020

AT&T SITE ID:
COL04473A

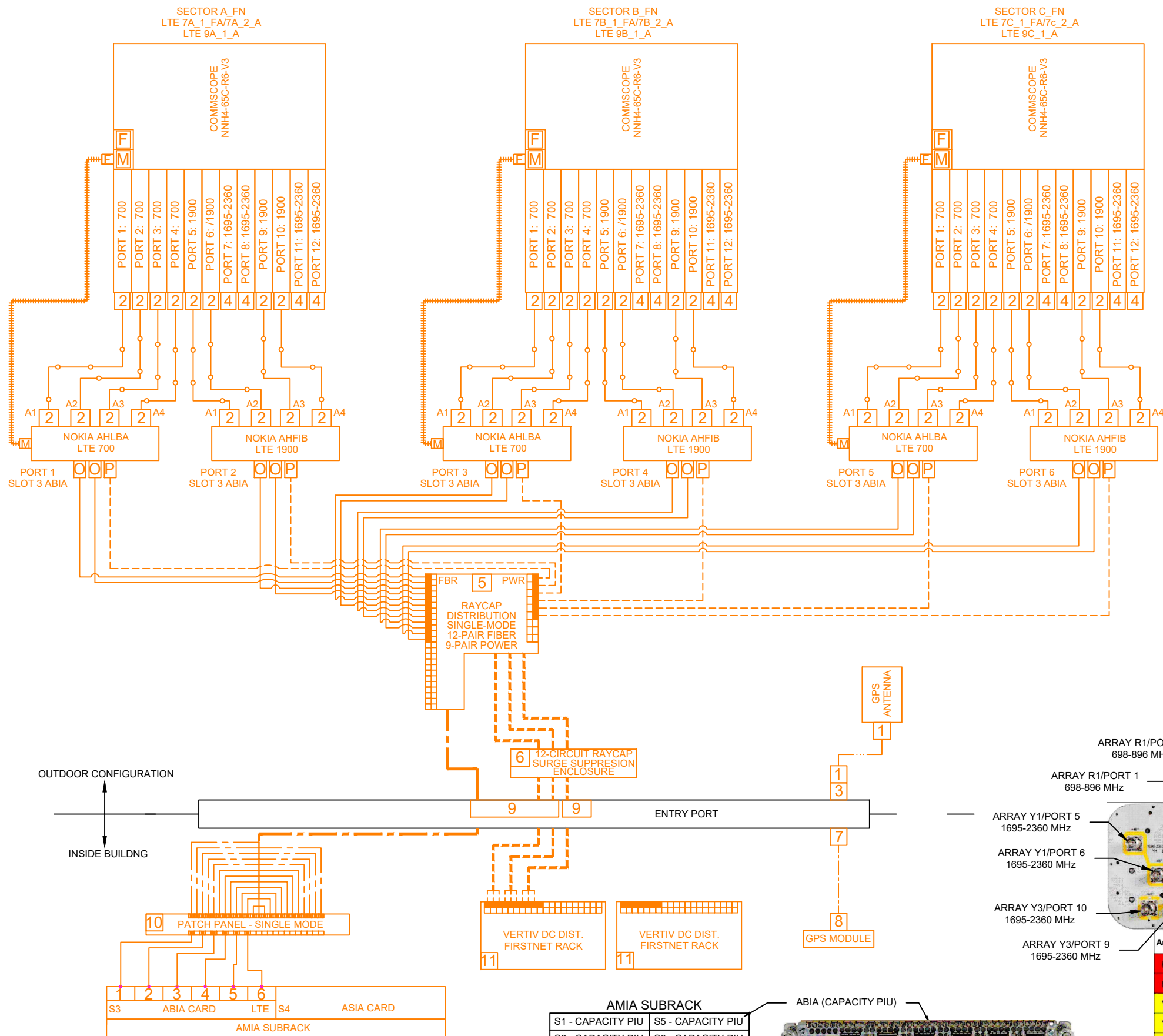
FA CODE:
15084278

PROJECT NAME:
OAK CREEK COAL

PROJECT ADDRESS:
29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE:
SECTOR FRM - STABILIZER OPTS

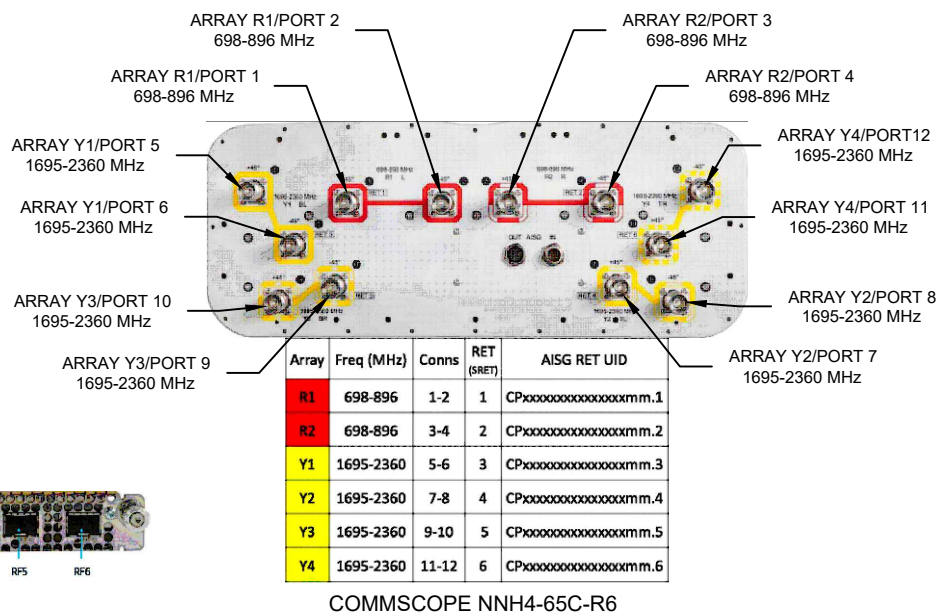
SHEET NUMBER:
C7



LEGEND

	(1) 1/2" JUMPER 4.3-10(M)-4.3-10(M) - 12'
	(1) TRUNK FIBER CABLE - 24 PAIR SM ROS FB-L98B-235-30000
	(1) TRUNK POWER CABLE - 3 PAIR 8AWG ROS WR-VG86ST-BRD
	(1) SINGLE PAIR FIBER CABLE - SM
	(1) SINGLE PAIR POWER CABLE - 8AWG
	(1) LDF4-50A
	(1) LMR-400 CABLE
	(1) RET CABLE
	NEW EQUIPMENT

1	1/2" N MALE CONNECTOR - L4TNM-PSA
2	1/2" 4.3-10 MALE CONNECTOR
3	APG-BNFFN-350
4	RL-65Z001-000N
5	DC9-48-60-24-8C-EV - TOWER TOP DIST.
6	DC12-48-60-0-25E - BOTTOM DC DIST.
7	LMR-400 N MALE CONNECTOR
8	LMR-400 SMA MALE CONNECTOR
9	CX402-EB420210 4" ENTRY BOOT
10	FB-SLODF013-024 - PATCH PANEL
11	545277 - VERTIV DC DISTRIBUTION
F	FEMALE RET CONNECTOR
M	MALE RET CONNECTOR
O	RRU OPTICAL PORT
P	RRU POWER PORT



1 R4 RAN CABLING DIAGRAM - FIRST NET
SCALE: NO SCALE



850 N. HIGHWAY 414
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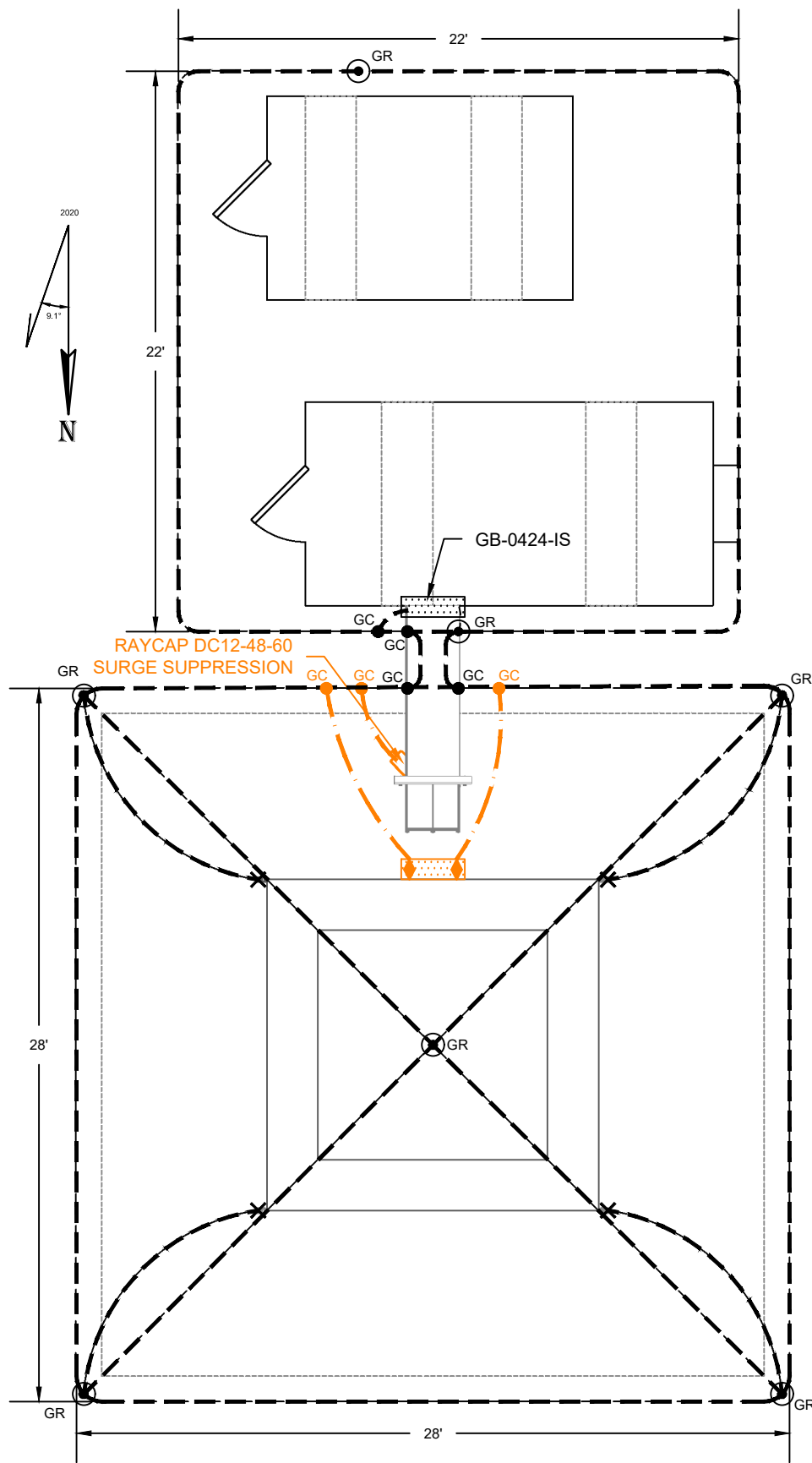
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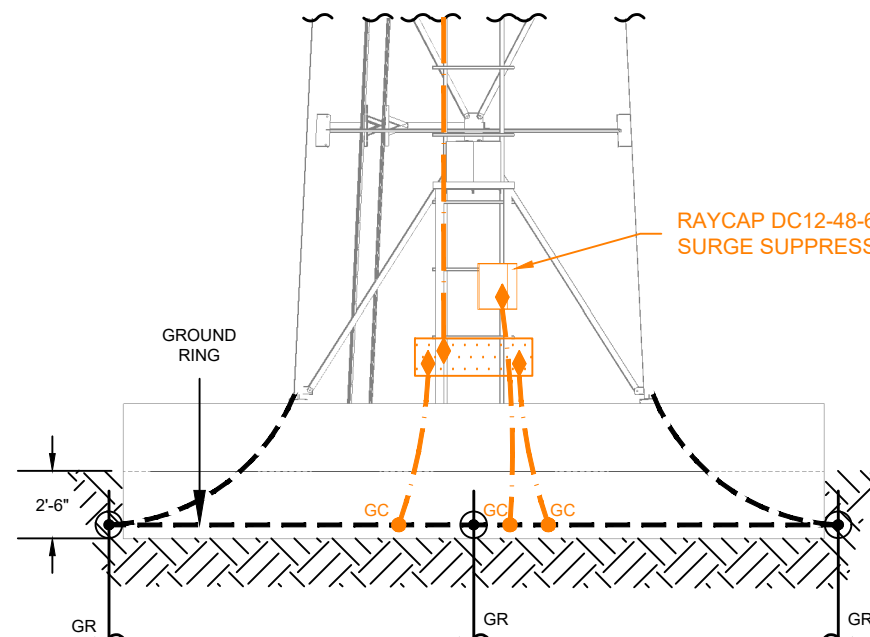
PROJECT ADDRESS:
29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE:
FIRSTNET RAN DIAGRAM

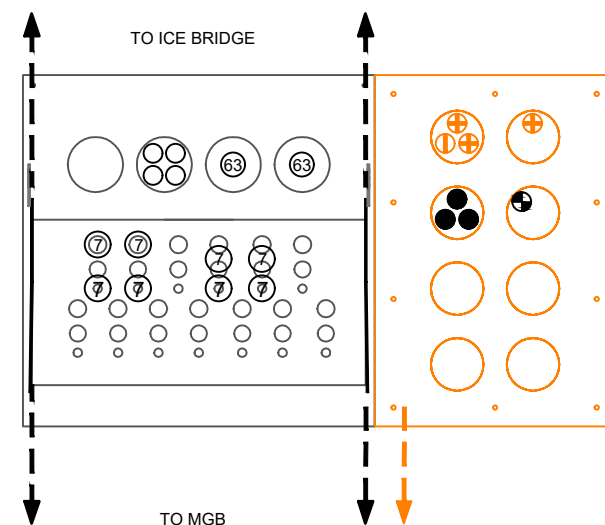
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R4



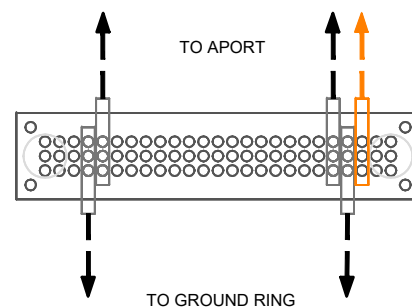
1 G1
SCALE: NO SCALE
GROUNDING DIAGRAM



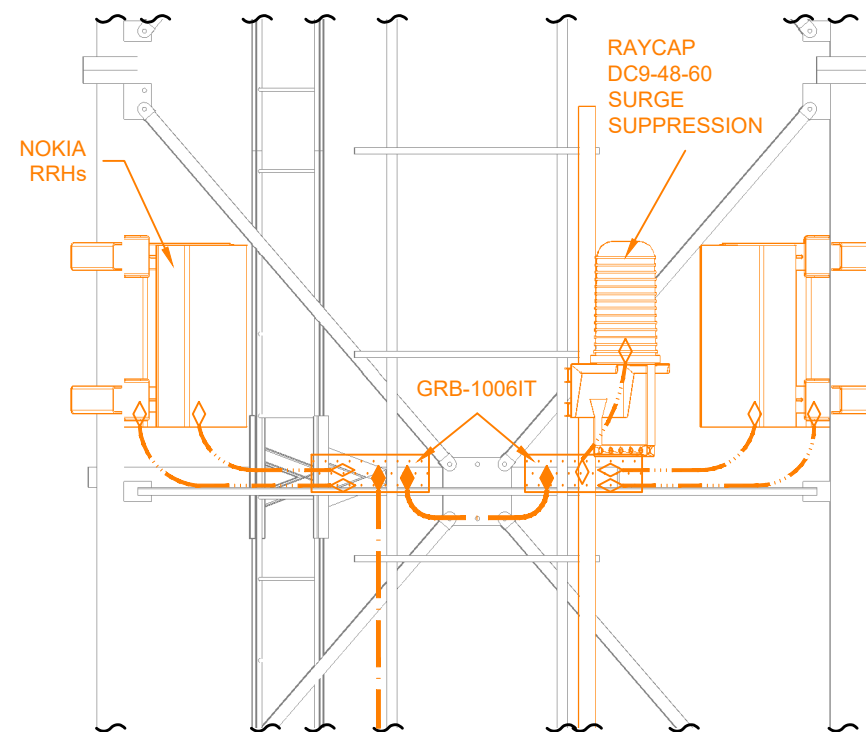
2 G1
SCALE: NO SCALE
TOWER GROUNDING ELEVATION



3 G1
SCALE: NO SCALE
A-PORT CONFIGURATION



4 G1
SCALE: NO SCALE
MAIN GROUND BUS



5 G1
SCALE: NO SCALE
TOWER GROUNDING ELEVATION

LEGEND

- GROUND ROD CONNECTION (YGHP29C26)
- GROUNDING CONNECTORS (CC 2020 OR EQUIVALENT)
- TOWER GROUND CONNECTOR (YGIBW28-550-2N)
- GROUND ROD - 8"x5/8" OD
- GROUND BAR (GB-0424-IS OR SIMILAR)
- SOLID #2 AWG TINNED COPPER WIRE - BEND RADIUS NOT TO BE LESS THAN 12"
- STRANDED #2 AWG COPPER WIRE - GREEN INSULATED
- STRANDED #6 AWG COPPER WIRE - GREEN INSULATED
- #6 AWG ONE HOLE LUG (YA6CL3BOX)
- #2 AWG LUG (YA2C2TC38)
- 1-5/8" COAXIAL CABLE - AVA7-50
- EW63 WAVEGUIDE
- 24-PAIR SINGLE MODE TRUCK FIBER CABLE
- 6-PAIR #8 AWG TRUCK POWER CABLE
- 7mm FIBER/POWER/CAT6 CABLE
- FN 24-PAIR SINGLE MODE TRUNK FIBER CABLE
- FN 3-PAIR #8 AWG TRUCK POWER CABLE
- NEW EQUIPMENT



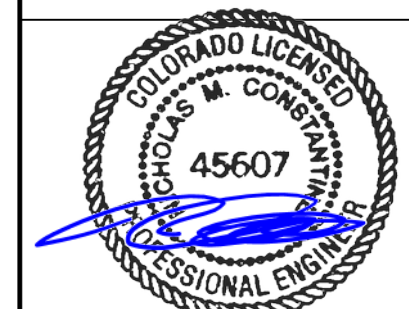
850 N. HIGHWAY 414
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FA CODE: 15084278

PROJECT NAME:

OAK CREEK COAL

PROJECT ADDRESS:

29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE:

FIRSTNET GROUNDING DIAGRAMS

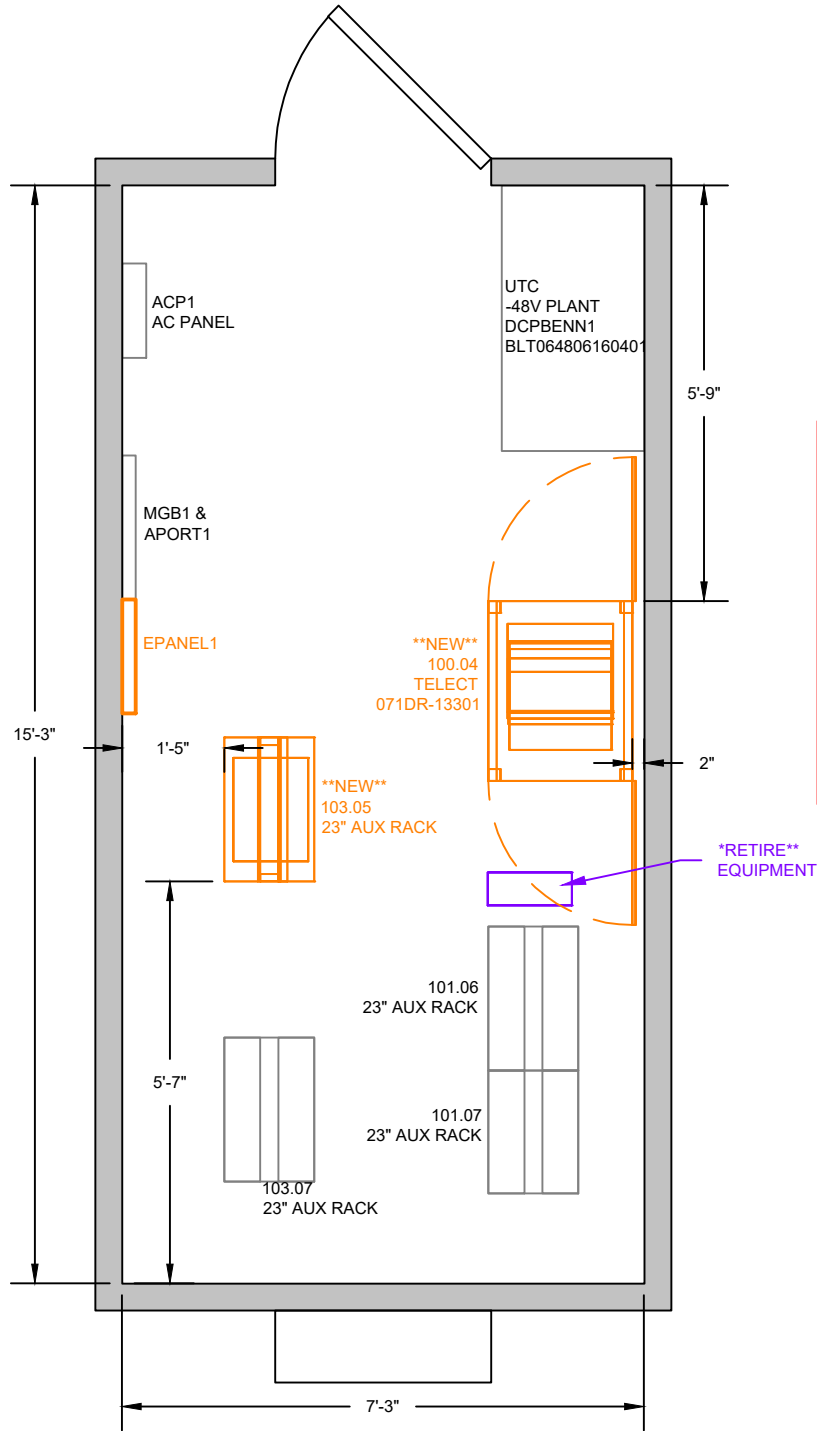
SHEET NUMBER: G1

LEGEND

NEW EQUIPMENT

RETIRE EQUIPMENT

COLO EQUIPMENT



1
A1

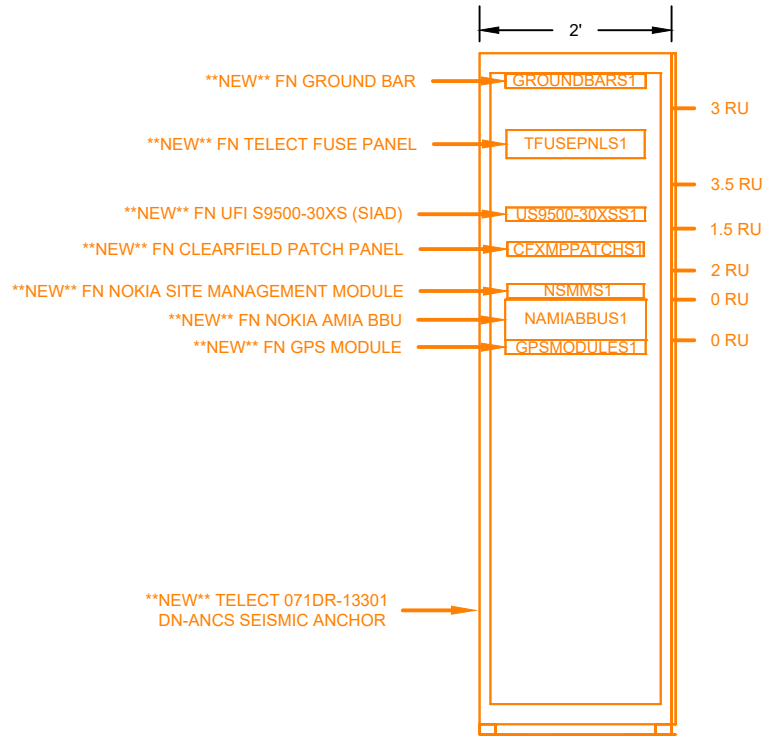
COMMUNICATION SITE FLOOR PLAN

SCALE: 3"=8'

RCRBD Record Set

T.A.

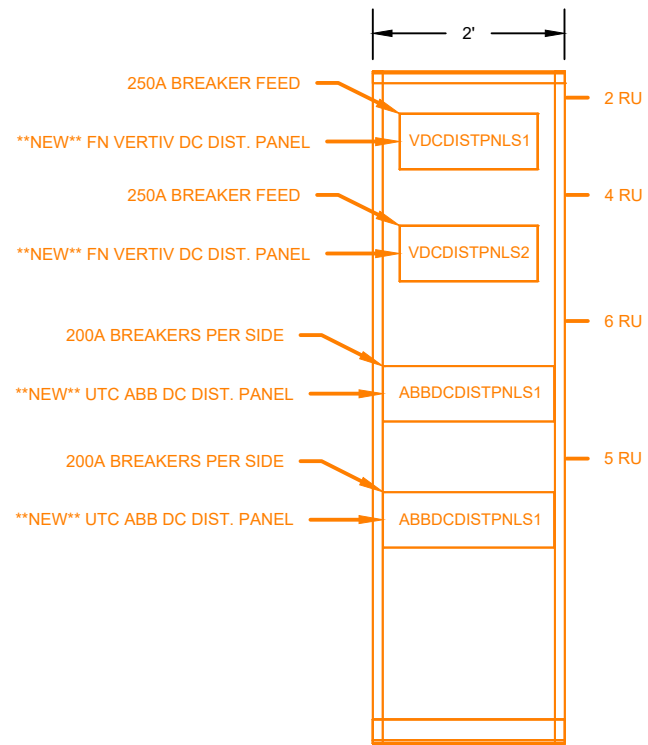
01/04/2021



2
A1

RACK ELEVATION 100.04

SCALE: 1"=2'



3
A1

RACK ELEVATION 103.05

SCALE: 1"=2'



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REVIEWER: NICHOLAS CONSTANTINE



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28 OCTOBER 2020

AT&T SITE ID: COL04473A

FA CODE: 15084278

PROJECT NAME: OAK CREEK COAL

PROJECT ADDRESS: 29920 COUNTY ROAD 27
OAK CREEK, CO 80467
ROUTT COUNTY

SHEET TITLE: FN EQUIPMENT BUILDING LAYOUT

SHEET NUMBER: A1