

Project: Sunrise Powerline Project
Location:
Contract:
Engineer:
Filename: SunrisePowerlink

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Study Case: RWB 12-Way

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Study: Uniform Temperature Ampacity

Electrical Transient Analyzer Program

Underground Cable Raceway Systems

Ampacity Optimization Analysis - Uniform Ampacity

Method: Neher-McGrath

<u>U/G System ID</u>	<u>Number of Cable Raceways</u>	<u>Number of Ext. Heat Sources</u>
RWB 12-Way DB	2	0

<u>Type</u>	<u>Soil</u>		<u>Temperature Limits</u>	
	<u>RHO</u> °C-cm/Watt	<u>Ambient Temperature</u> °C	<u>Alarm</u> °C	<u>Warning</u> °C
Clay Dry	90.0	35.0	90.0	88.0

Multiplying Factors (MF)

Application MF: Not Considered
Individual Projection MF: Not Considered
Global Projection MF: 100 %

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Underground Cable Raceway Systems (RW20)

Duct Bank Raceway Data:

ID	Reference Distance		Dimension		Fill		Number of Conduits	Number of Cables	Average Distance Center-to-Center inch
	Horizontal inch	Vertical inch	Height inch	Width inch	Type	RHO °C-cm/Watt			
RW20	51.00	6.40	71.60	78.00	Light Aggregate	60.0	12	2	13.59

Conduit Data:

ID	Reference Distance		Type	Size inch	Thickness inch	OD inch	RHO °C-cm/Watt	Thermal R Ohm-ft	Fill %
	Horizontal inch	Vertical inch							
Cond121	7.00	36.60	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond122	50.30	36.60	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond123	7.00	51.20	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond124	50.10	50.60	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond125	7.00	64.30	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond126	50.10	64.00	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond127	28.80	36.80	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond128	28.60	50.90	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond129	28.40	64.00	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond130	71.00	36.60	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond131	71.00	50.80	PVC_40	8	0.280	8.000	600.0	0.226	42.32
Cond132	71.00	64.30	PVC_40	8	0.280	8.000	600.0	0.226	42.32

* Warning - Industry representatives recommend avoiding a jam ratio of 2.8 to 3.2.
 # Alarm - Cable jamming may occur when jam ratio is in between 2.74 and 2.8.

Cable Data:

ID	Size	Rated kV	Current Amp	Projection Load		Conductor				Insulation		
				Factor %	Factor %	No.	Type	Per Phase	Construction	Type	Thickness mil	Thermal R Ohm-ft
Cable21	3500	230.000	0.00	100	100	1/C	CU	2	CmpSgm-NC-NT	XLPE	950.0	1.090
Cable22	3500	230.000	0.00	100	100	1/C	CU	2	CmpSgm-NC-NT	XLPE	950.0	1.090

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ID	Shielding				Jacket		Rdc @ 25°C μOhm/ft	Outside Diameter inch
	Status	Type	End Connection	Thickness mil	Sheath/Armor Type	Type		
Cable21	None		Open			NONE	1.37	4.84
Cable22	None		Open			NONE	1.37	4.84

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Analysis Results (RW20)

No.	Cable ID	Conduit/Location ID	Conductor per Cable	Energized Conductor per Cable	Rdc @ Final Temp. $\mu\text{Ohm/ft}$	Dielectric Losses Watt/ft	Yc	Ys	Conductor Losses Watt/ft	Current Amp	Temp. $^{\circ}\text{C}$
1	Cable21-1A	Cond123	1	1	1.69	2.973	0.490	0.000	3.251	1137.69	84.75
2	Cable21-1B	Cond128	1	1	1.71	2.973	0.481	0.000	3.283	1137.69	90.03
3	Cable21-1C	Cond127	1	1	1.68	2.973	0.491	0.000	3.247	1137.69	84.17
4	Cable21-2A	Cond125	1	1	1.69	2.973	0.490	0.000	3.251	1137.69	84.83
5	Cable21-2B	Cond129	1	1	1.71	2.973	0.481	0.000	3.282	1137.69	89.75
6	Cable21-2C	Cond121	1	1	1.66	2.973	0.500	0.000	3.218	1137.69	79.39
7	Cable22-1A	Cond122	1	1	1.68	2.973	0.491	0.000	3.247	1137.59	84.12
8	Cable22-1B	Cond132	1	1	1.69	2.973	0.490	0.000	3.252	1137.59	84.96
9	Cable22-1C	Cond130	1	1	1.66	2.973	0.500	0.000	3.219	1137.59	79.68
10	Cable22-2A	Cond131	1	1	1.69	2.973	0.490	0.000	3.251	1137.59	84.91
11	Cable22-2B	Cond126	1	1	1.71	2.973	0.481	0.000	3.281	1137.59	89.77
12	Cable22-2C	Cond124	1	1	1.71	2.973	0.481	0.000	3.283	1137.59	90.03

Yc = Increment of AC/DC resistance ratio due to AC current skin and proximity effect

Ys = Increment of AC/DC resistance ratio due to losses of circulation and eddy current effect in shield, sheath and armor

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Summary (RW20)

No.	Cable ID	Conduit/Location ID	Size AWG/kcmil	Current Amp	Temp. °C
1	Cable21-1A	Cond123	3500	1137.69	84.75
2	Cable21-1B	Cond128	3500	1137.69	90.03 *
3	Cable21-1C	Cond127	3500	1137.69	84.17
4	Cable21-2A	Cond125	3500	1137.69	84.83
5	Cable21-2B	Cond129	3500	1137.69	89.75 #
6	Cable21-2C	Cond121	3500	1137.69	79.39
7	Cable22-1A	Cond122	3500	1137.59	84.12
8	Cable22-1B	Cond132	3500	1137.59	84.96
9	Cable22-1C	Cond130	3500	1137.59	79.68
10	Cable22-2A	Cond131	3500	1137.59	84.91
11	Cable22-2B	Cond126	3500	1137.59	89.77 #
12	Cable22-2C	Cond124	3500	1137.59	90.03 *

F Indicates fixed cable size in cable sizing calculations or fixed cable ampacity in uniform ampacity calculation
* Indicates a cable temperature exceeding its limit
Indicates a cable temperature exceeding its marginal limit

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Underground Cable Raceway Systems (RW21)

Duct Bank Raceway Data:

ID	Reference Distance		Dimension		Fill		Number of Conduits	Number of Cables	Average Distance Center-to-Center inch
	Horizontal inch	Vertical inch	Height inch	Width inch	Type	RHO °C-cm/Watt			
RW21	210.00	6.40	71.60	78.00	Light Aggregate	60.0	12	0	0.00

Conduit Data:

ID	Reference Distance		Type	Size inch	Thickness inch	OD inch	RHO °C-cm/Watt	Thermal R Ohm-ft	Fill %
	Horizontal inch	Vertical inch							
Cond133	7.00	36.60	PVC_40	8	0.280	8.000	600.0		
Cond134	50.30	36.60	PVC_40	8	0.280	8.000	600.0		
Cond135	7.00	51.20	PVC_40	8	0.280	8.000	600.0		
Cond136	50.10	50.60	PVC_40	8	0.280	8.000	600.0		
Cond137	7.00	64.30	PVC_40	8	0.280	8.000	600.0		
Cond138	50.10	64.00	PVC_40	8	0.280	8.000	600.0		
Cond139	28.80	36.80	PVC_40	8	0.280	8.000	600.0		
Cond140	28.60	50.90	PVC_40	8	0.280	8.000	600.0		
Cond141	28.40	64.00	PVC_40	8	0.280	8.000	600.0		
Cond142	71.00	36.60	PVC_40	8	0.280	8.000	600.0		
Cond143	71.00	50.80	PVC_40	8	0.280	8.000	600.0		
Cond144	71.00	64.30	PVC_40	8	0.280	8.000	600.0		

* Warning - Industry representatives recommend avoiding a jam ratio of 2.8 to 3.2.
 # Alarm - Cable jamming may occur when jam ratio is in between 2.74 and 2.8.

Cable Data:

ID	Size	Projection Load				Conductor			Insulation	
		Rated kV	Current Amp	Factor %	Factor %	No.	Type	Per Phase Construction	Type	Thickness

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ID	Shielding				Sheath/Armor Type	Jacket		Rdc @ 25°C	Outside Diameter
	Status	Type	End Connection	Thickness		Type	Thickness		

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Analysis Results ()

No.	Cable ID	Conduit/Location ID	Conductor per Cable	Energized Conductor per Cable	Rdc @ Final Temp.	Dielectric Losses	Yc	Ys	Conductor Losses	Current Amp	Temp. °C
0											

Yc = Increment of AC/DC resistance ratio due to AC current skin and proximity effect

Ys = Increment of AC/DC resistance ratio due to losses of circulation and eddy current effect in shield, sheath and armor

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Summary ()

<u>No.</u>	<u>Cable ID</u>	<u>Conduit/Location ID</u>	<u>Size</u>	<u>Current</u> <u>Amp</u>	<u>Temp.</u> <u>°C</u>
0			F	F	

- F Indicates fixed cable size in cable sizing calculations or fixed cable ampacity in uniform ampacity calculation
- * Indicates a cable temperature exceeding its limit
- # Indicates a cable temperature exceeding its marginal limit