

# Thermal Capacity of Collector System Feeders in Wind Farms

Eduardo H. Enrique

Tom Wier

Peter N. Haub

Stantec Consulting Ltd.







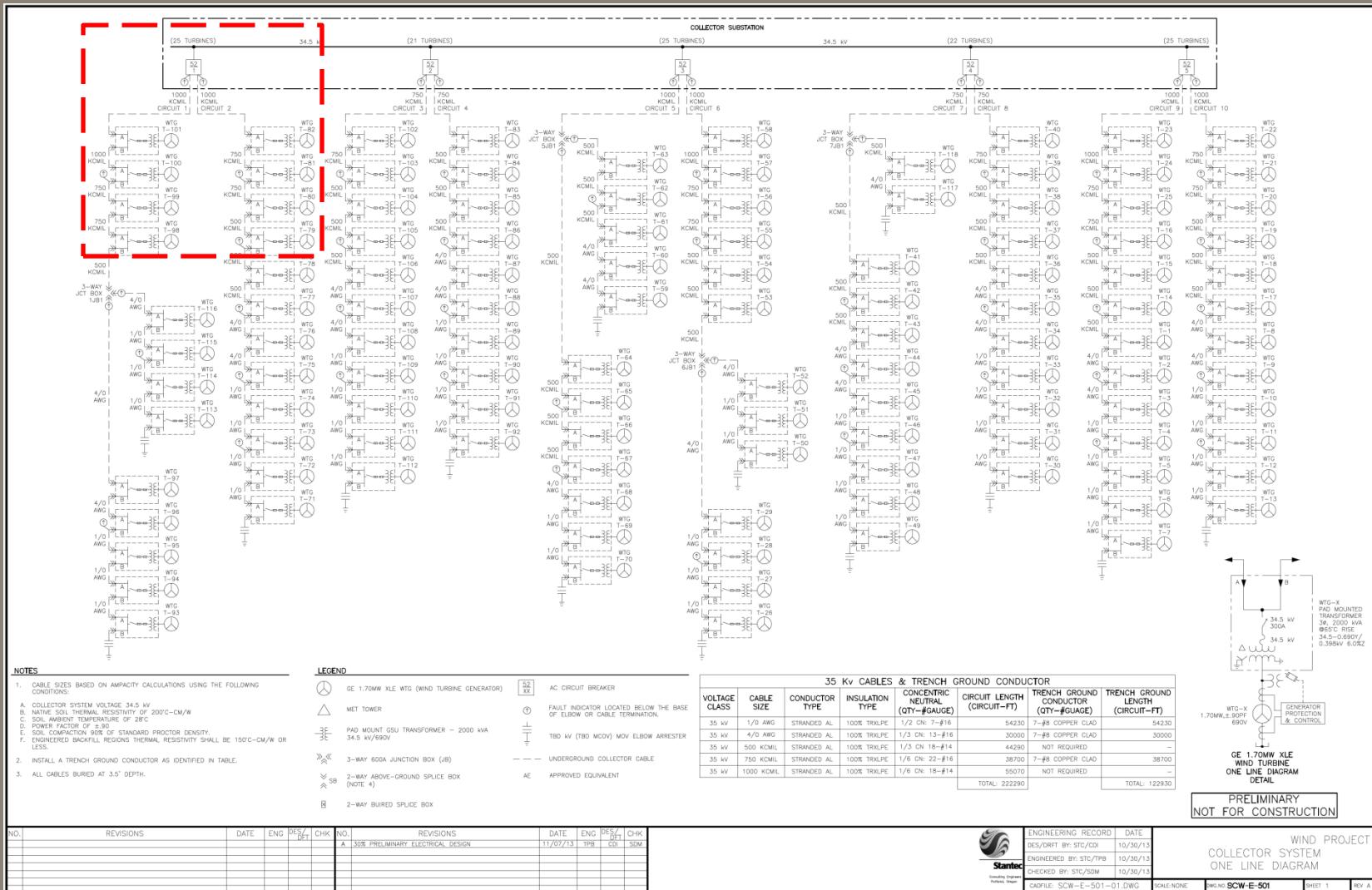
# Agenda

- 1 Thermal limitations of feeders**
- 2 Buried in conduit vs direct buried cables**
- 3 Multi-feeder trench**
- 4 Summary**

# 1 Thermal limitations of feeders

# 1

# Thermal limitations of feeders



NO.	REVISIONS	DATE	ENG	DES	DET	CHK	NO.	REVISIONS	DATE	ENG	DES	DET	CHK
	A	11/07/13	TPB	STC	CD	SUM							

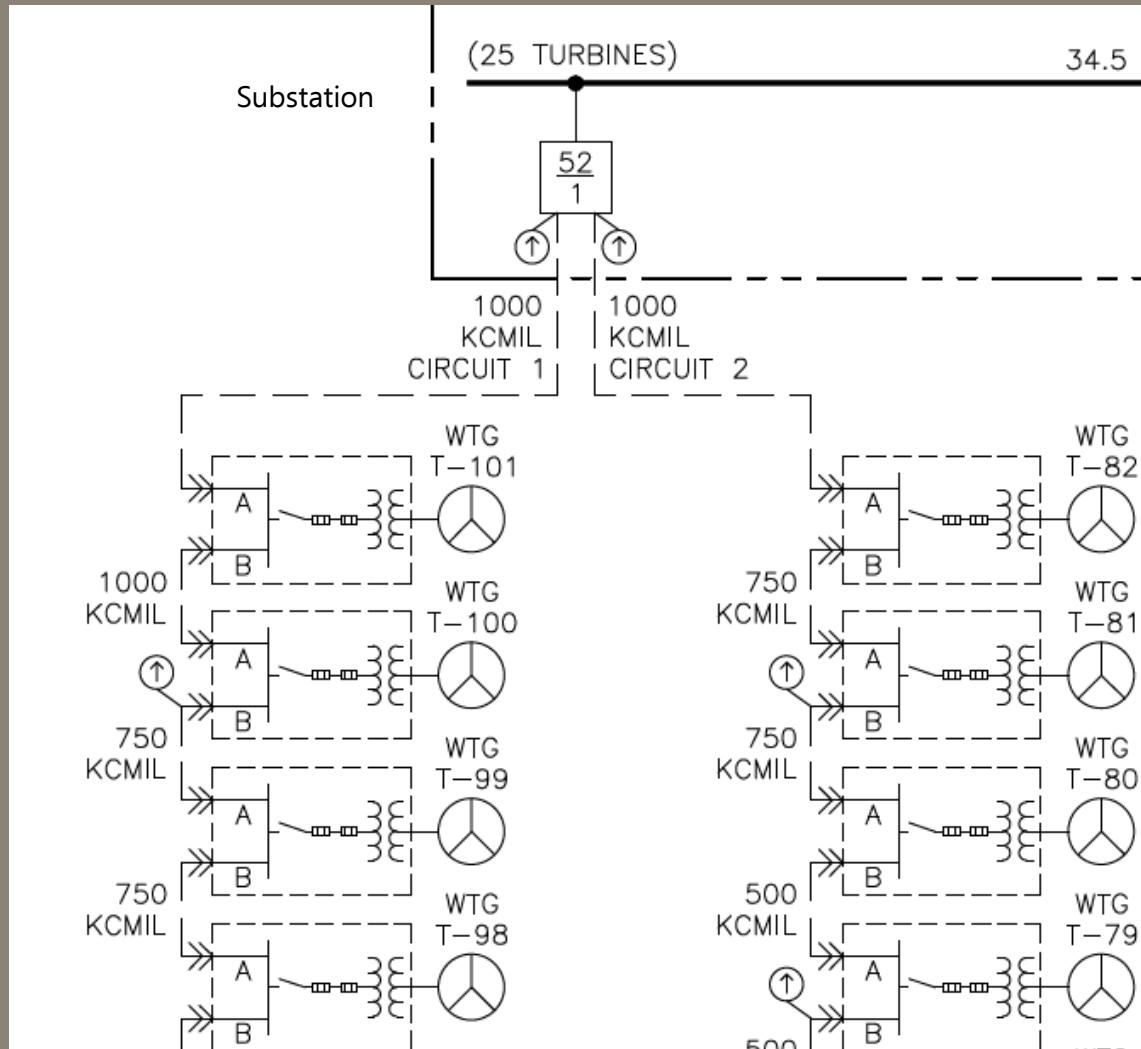


Engineering  
Consulting  
Planning Design  
Construction

ENGINEERING RECORD DATE  
DES/DET BY STC/CD 10/30/13  
ENGINEERED BY STC/TPB 10/30/13  
CHECKED BY STC/SDM 10/30/13  
CADD/CODE: SCW-E-501-01.DWG  
SAFECODE: SCW-E-501  
SHEET: 1  
REV: A

# 1

## Thermal limitations of feeders

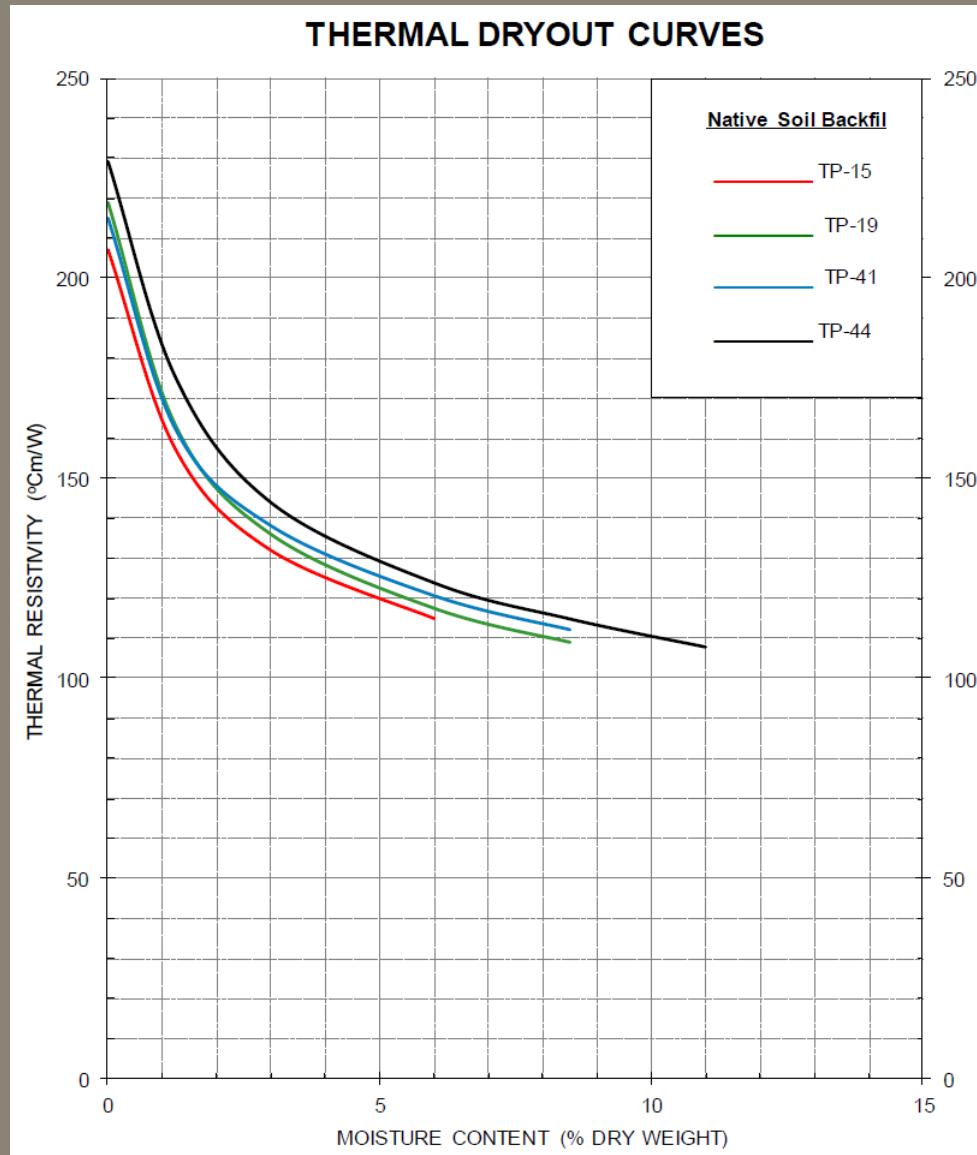


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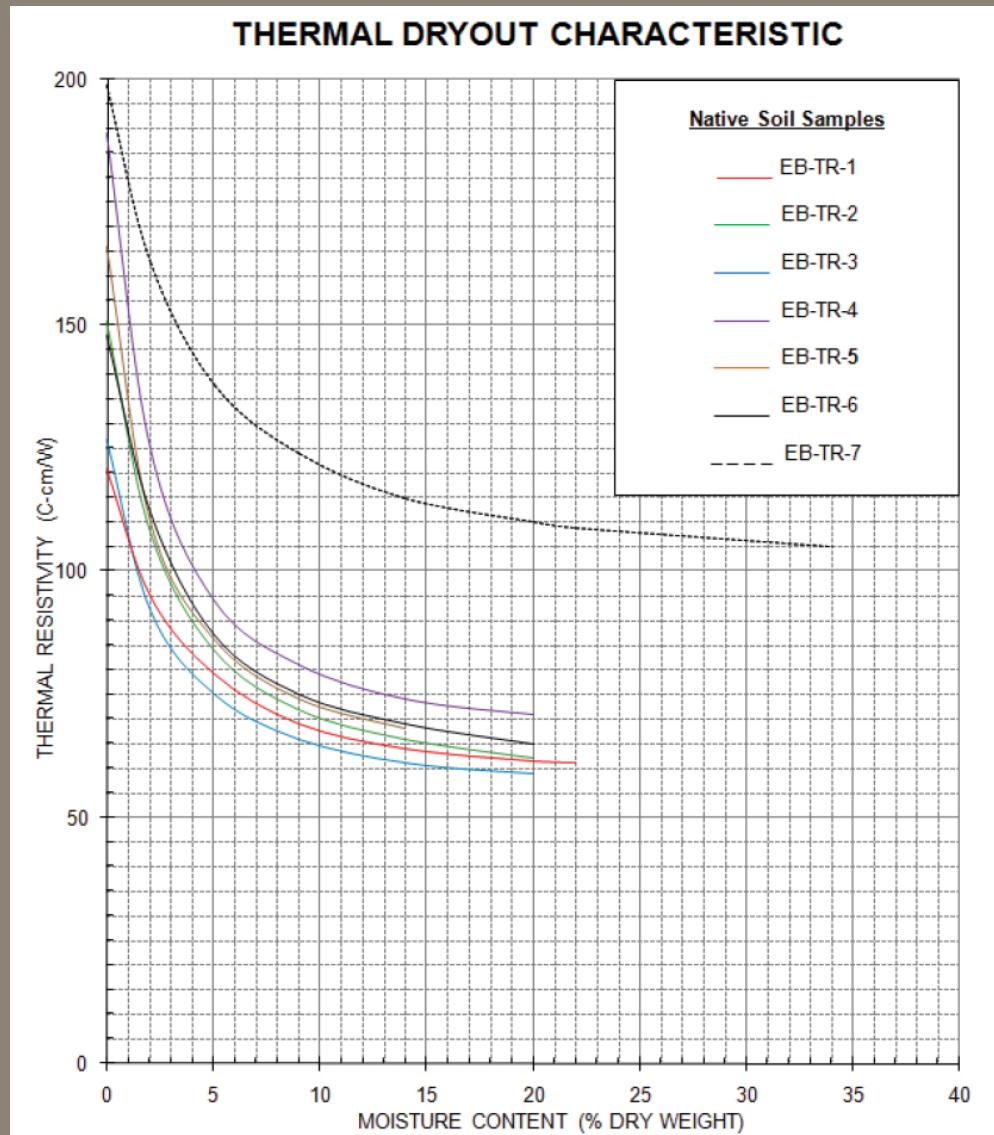
# 1

## Thermal limitations of feeders



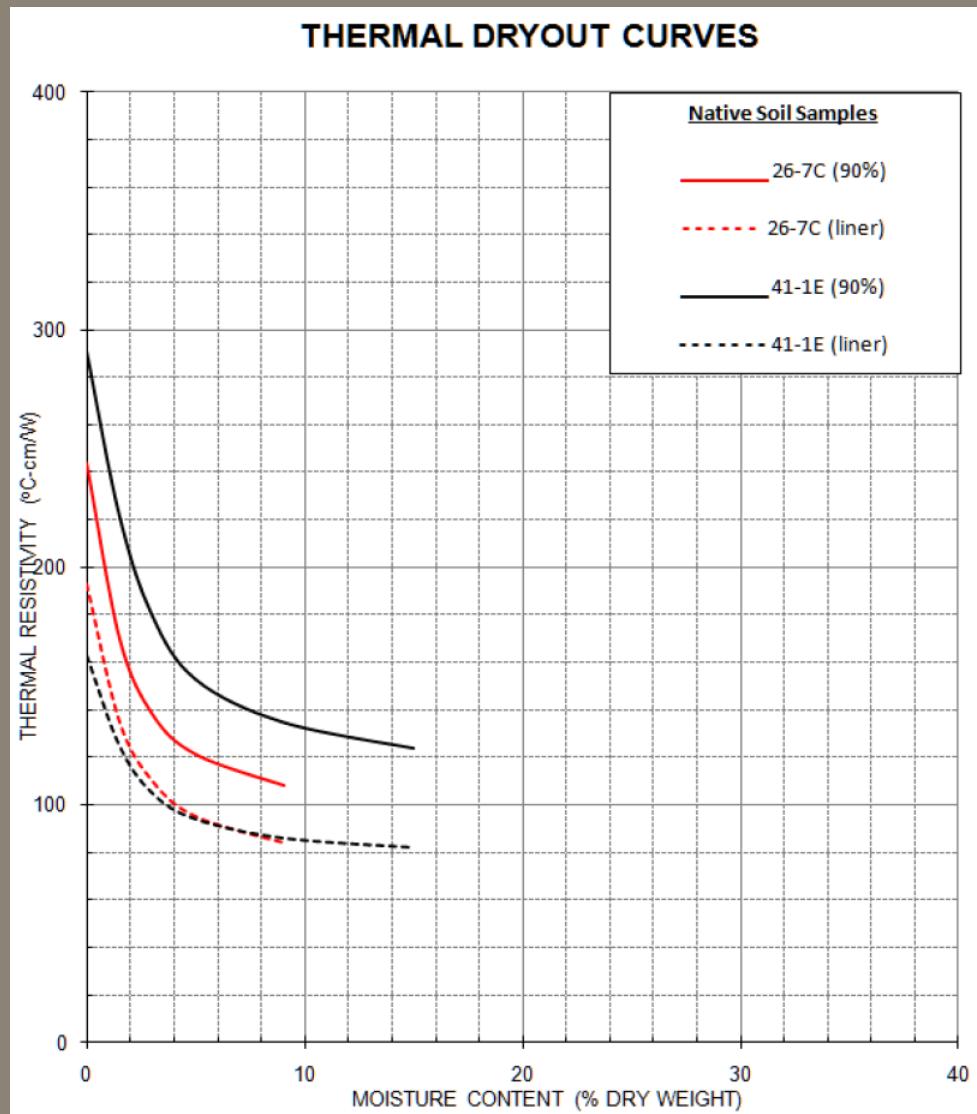
# 1

## Thermal limitations of feeders



# 1

## Thermal limitations of feeders



# 2 Conduit vs. direct buried cables

# 2 Buried in conduit vs direct buried cables

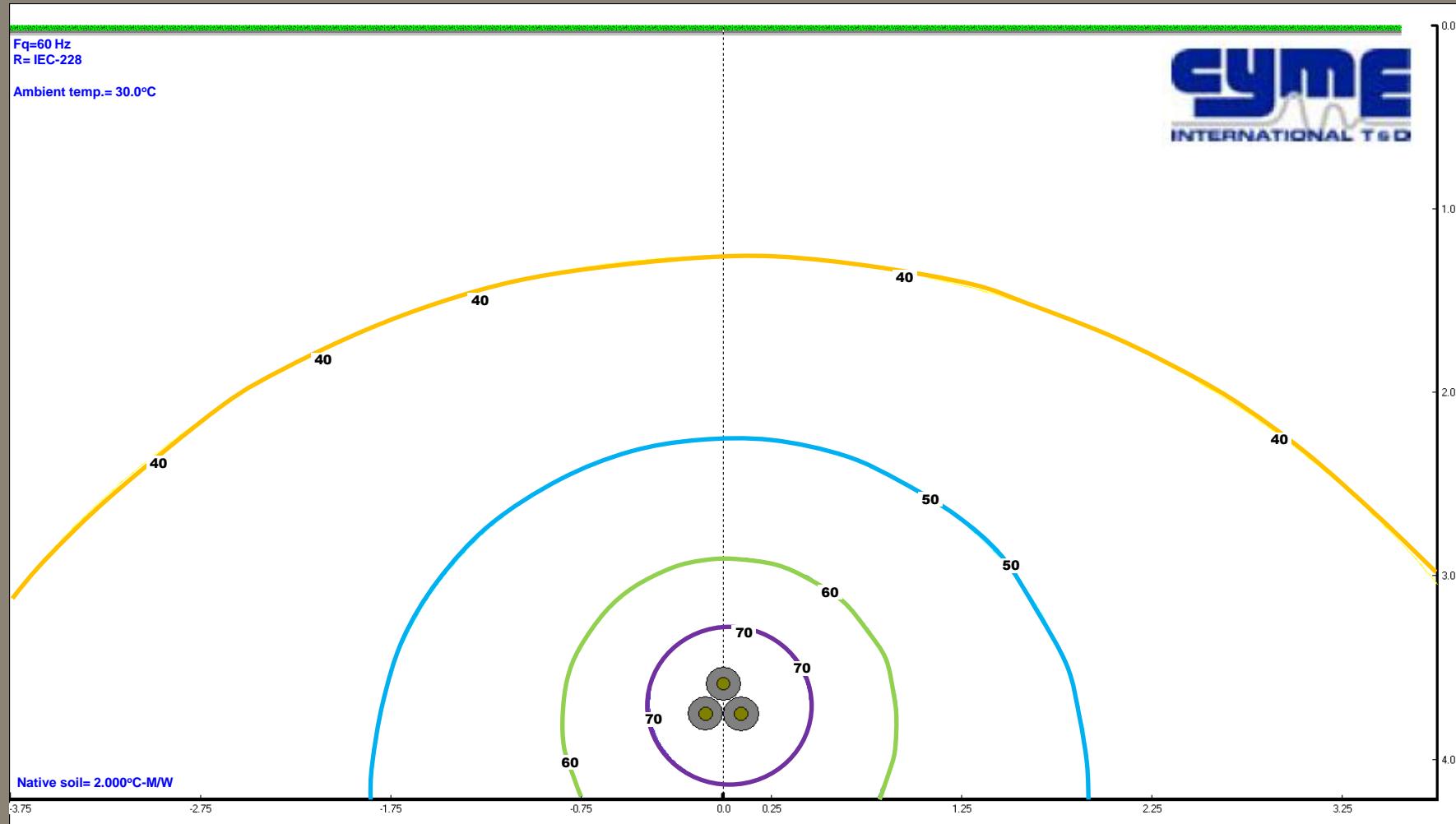
## Installation Type: Directly Buried

Parameter	Unit	Value
Ambient Soil Temperature at Installation Depth	°C	25
Thermal Resistivity of Native Soil	°C m/W	1.5
Non-Isothermal Earth surface modeling	Enabled/Disabled	Enabled
Ambient Air Temperature	°C	43
Moisture Migration (Soil Dry Out)	Enabled/Disabled	Enabled
Dry Soil Thermal Resistivity	°C m/W	3.75
Critical Temperature	°C	55

## Summary Results

Solution converged							
Cable\Cable type no	Circuit	Phase	Location		Load Factor [p.u]	Temperature [°C]	Ampacity [A]
			X[ft]	Y[ft]			
1\1	1	A	-0.075	4.295	1	105	261
2\1	1	B	0.075	4.295	1	105	261
3\1	1	C	0	4.163	1	104.6	261

# 2 Buried in conduit vs direct buried cables



# 2 Buried in conduit vs direct buried cables

## Installation Type: Duct Bank

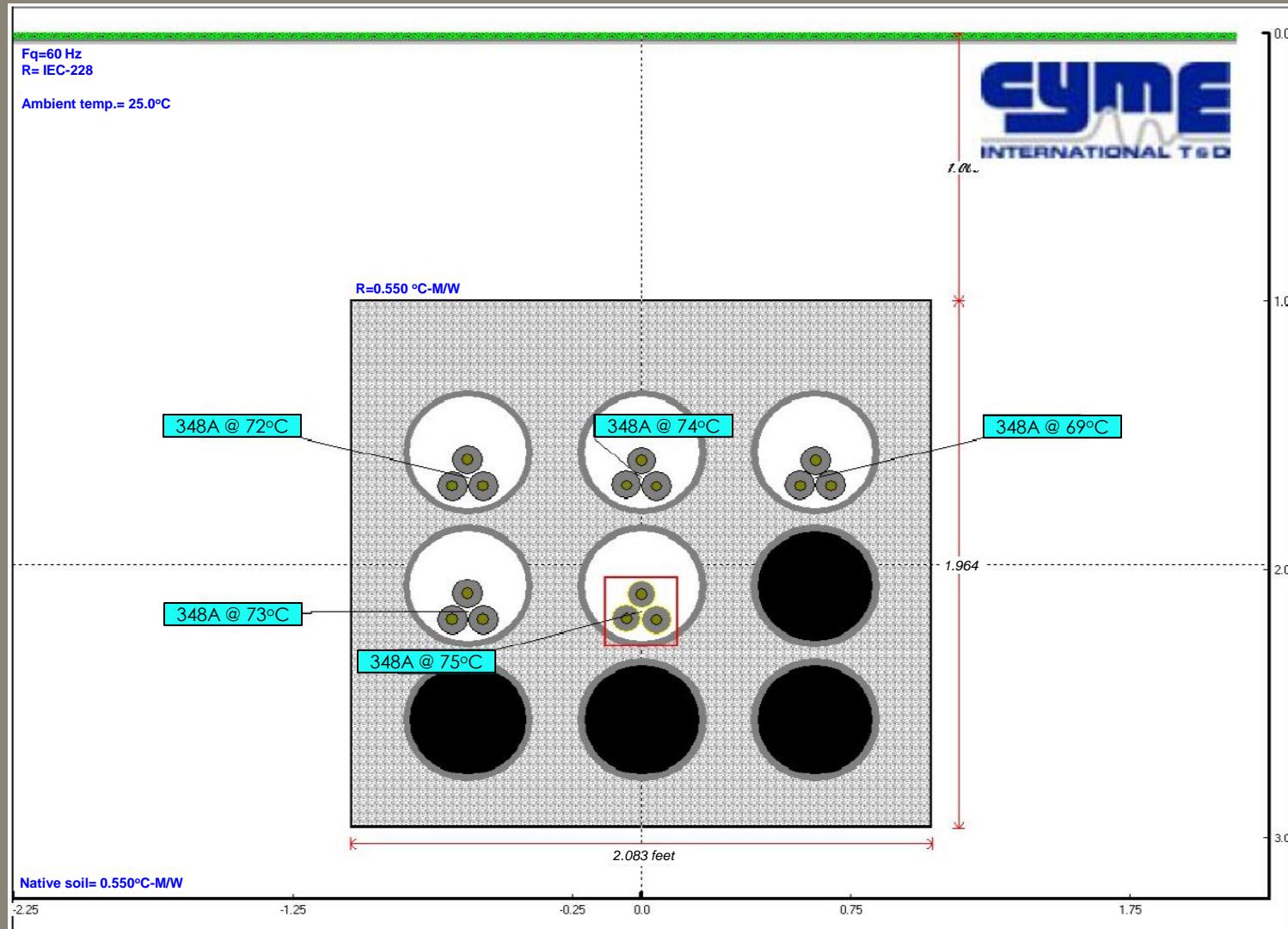
Parameter	Unit	Value
Ambient Soil Temperature at Installation Depth	°C	25
Thermal Resistivity of Native Soil	°C m/W	0.55
Duct Bank Width	ft	2.083
Duct Bank Height	ft	1.964
Duct Bank X Center	ft	0
Duct Bank Y Center	ft	1.982
Thermal Resistivity of Duct Bank	°C m/W	0.55

## Summary Results

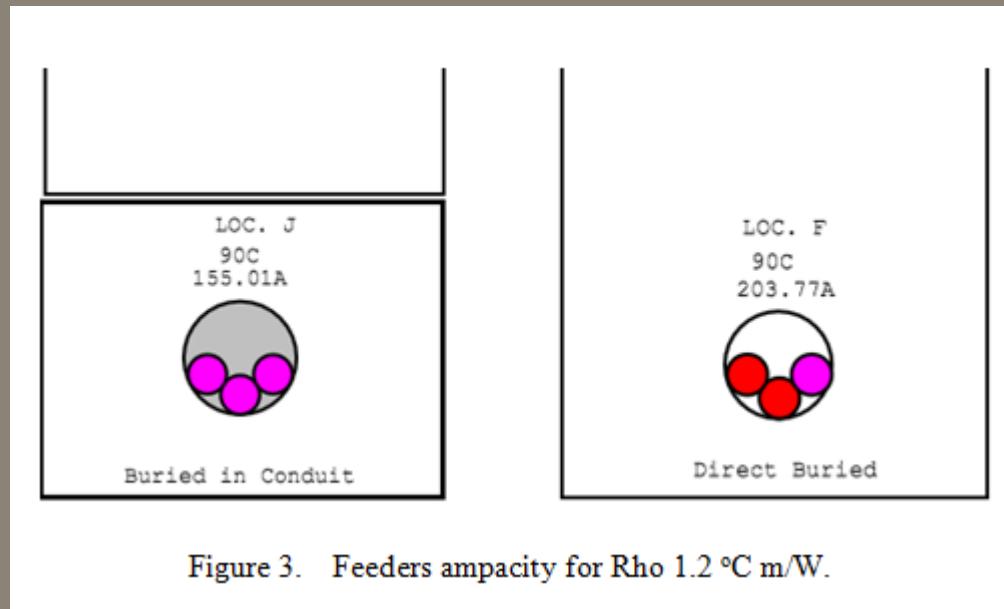
### Solution converged

Cable\Cable type no	Circuit	Phase	Location		Load Factor [p.u]	Temperature [°C]	Ampacity [A]
			X[ft]	Y[ft]			
1\1	1	A	-0.625	1.657	1	71.5	348
2\1	2	A	0	1.657	1	73.5	348
3\1	3	A	0.625	1.657	1	68.5	348
4\1	4	A	-0.625	2.157	1	73.4	348
5\1	5	A	0	2.157	1	74.9	348

# 2 Buried in conduit vs direct buried cables



# 2 Buried in conduit vs direct buried cables



# 2

## Buried in conduit vs direct buried cables

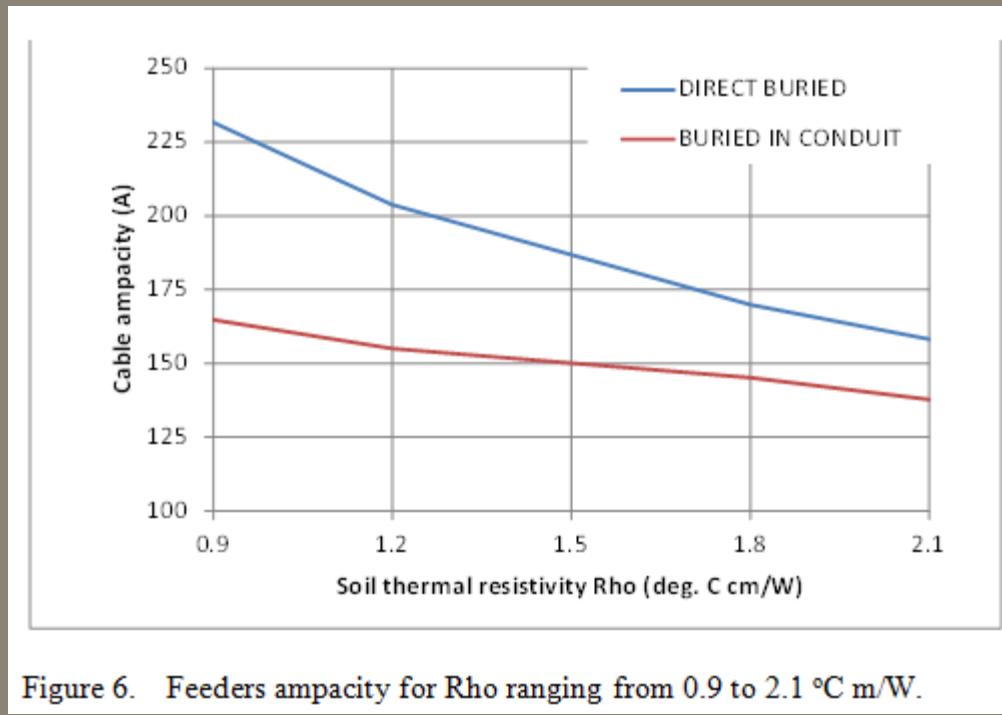


Figure 6. Feeders ampacity for Rho ranging from 0.9 to 2.1 °C m/W.

# 2

## Buried in conduit vs direct buried cables

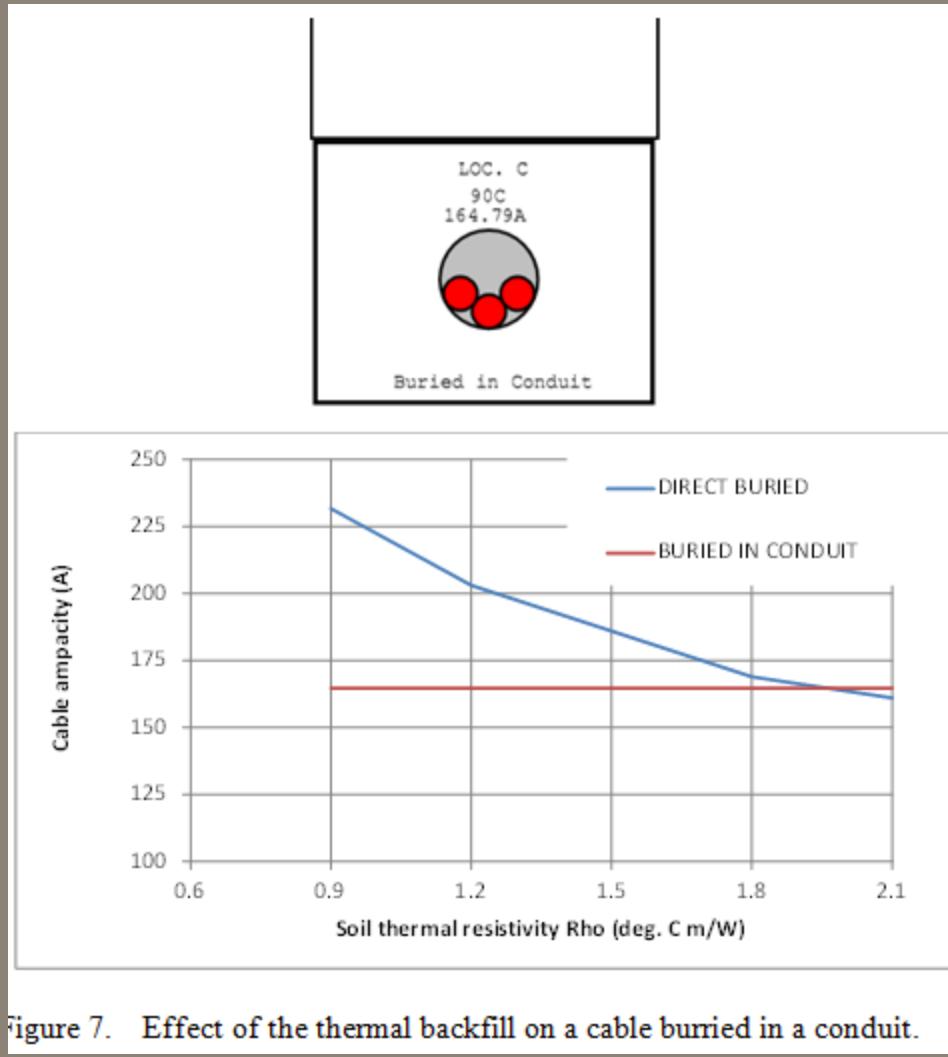


Figure 7. Effect of the thermal backfill on a cable buried in a conduit.

# 3 Multi-feeder trench

# 3 Multi-feeder trench



Figure 8. Collector feeders ampacity for cable buried in conduits and direct buried in soil with different Rho.

# 3 Multi-feeder trench

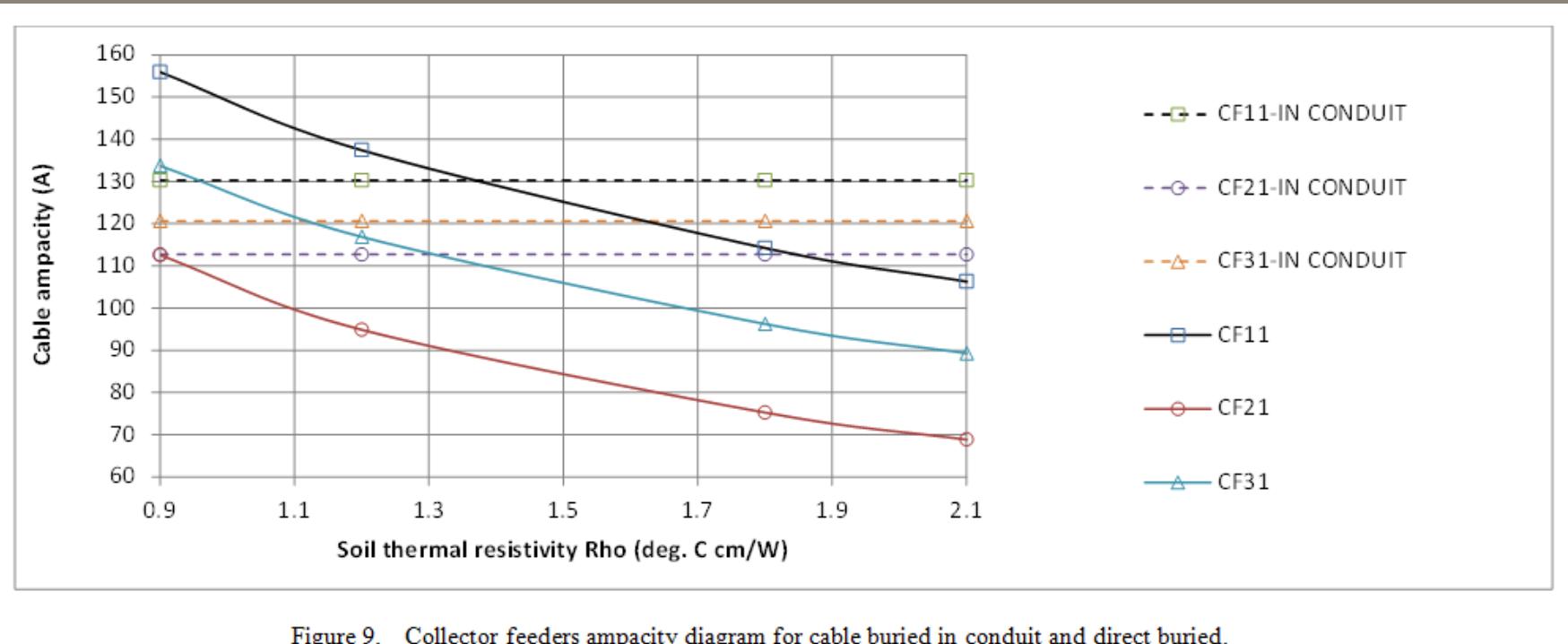


Figure 9. Collector feeders ampacity diagram for cable buried in conduit and direct buried.

# 4 Summary

1. Most wind farm sites have collector feeders buried in conduits at the substation, at road crossings or at the base of the wind turbines
2. The portion of the feeder in conduits generally exceed the 3 m or 10% rule stated by the codes
3. For the range of soil thermal resistivities found in North America, the cable buried in conduit has an ampacity lower than a direct buried cable at all locations
4. For multi-feeder trenches, the heat dissipation of all cables renders invalid the differences in ampacity mentioned above.

# Questions?

**Eduardo H. Enrique**

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