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Department of Electrical and Computer Engineering

BLACK & VEATCH

115/34.5kV Solar Plant & Substation Senior Design Project

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| Senior Design Team 41

| 03/24/2025

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AGENDA

- Safety Moment
- New Technology
- IEEE80 Grounding
- Three line drawing

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Safety Moment

Preventing Overhead Line Faults

- Have regular inspections and maintenance
- Keep up on vegetation clearance
- Line sag should be consistent across
- Have a backup plan to help limit the losses if a fault were to happen
- Ensure proper protection equipment is installed
  - Will help isolate only the faulted area
  - Surge arresters, circuit breakers, proper grounding, relays

| Andrew

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NEW TECHNOLOGY

High-Temperature Superconductors (HTS):

- **Overview**: HTS materials conduct electricity with zero resistance at relatively higher temperatures compared to traditional superconductors.
- **Benefits**:

1. **Reduced power losses**, leading to increased efficiency.
2. **Compact equipment design**, allowing for a smaller substation footprint.
3. **Enhanced fault current limiting**, improving grid stability.

- **Application**: Integration of HTS in transformers and cables can revolutionize substation design by minimizing energy losses and space requirements

The Role of Advanced Materials and Technologies

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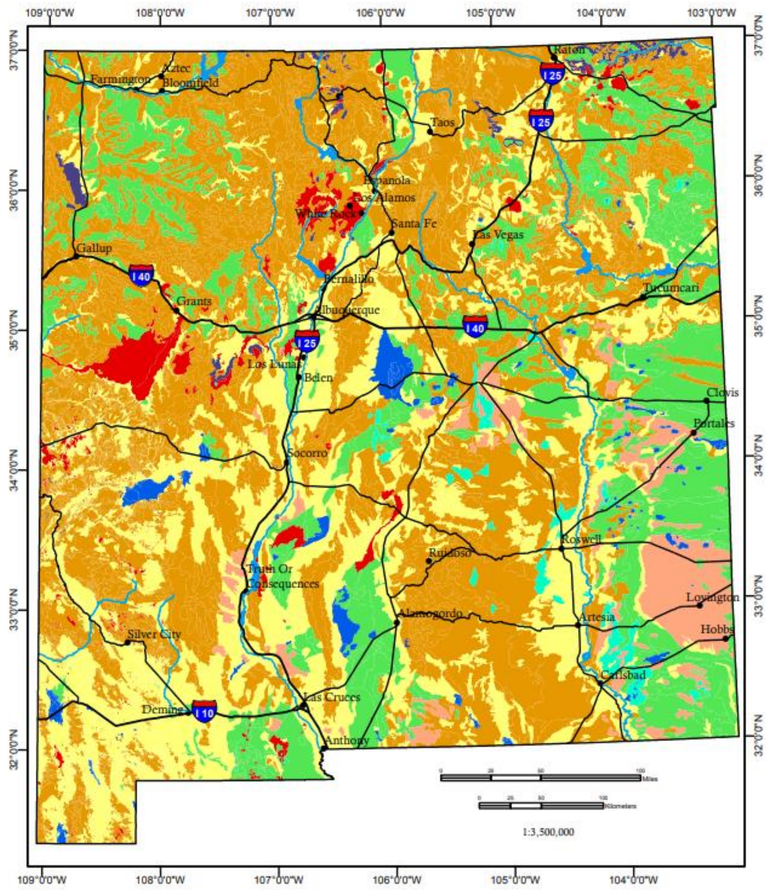
IEEE80 Grounding

- Have a good start with grounding design and analysis for the substation
- Researched soil type in SW New Mexico
- Mainly Alluvium
  - Deposit of clay, silt, sand, and gravel
  - Soil resistivity of around 100 Ohm-M



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IEEE80 Grounding

- Began a spreadsheet for grounding in accordance with IEEE 80
- Included soil resistivity data for NM

A	GENERAL DESIGN DATA			
1	Soil Resistivity, ρ	:	100	Ohm-M
2	Gravel Resistivity, ρ_s	:	2500	Ohm-M
3	Symmetrical Short Circuit Current, *Iefs*	:	13450	A
4	Duration of Earth Fault Current, *ts*	:	0.5	Sec
5	Maximum Allowable Conductor Temp.	:	700	° C
6	Design Ambient Temperature	:	40	° C
7	Thickness of Crushed Gravel h_s	:	0.102	mtr.
8	Depth of Earth Grid, *h*	:	0.5	mtr.
9	Reference depth of the Grid, *ho*		1	mtr.
	STANDARDS USED			
	IEEE Gude for Safety in AC Substation Grounding	IEEE - 80	2000	

B SIZE OF EARTHING CONDUCTOR :

$$Amm^2 = \frac{I}{\sqrt{\left(\frac{TCAP \times 10^{-4}}{t_c \alpha_r \rho_r}\right) \ln\left(\frac{K_0 + T_m}{K_0 + T_a}\right)}}$$

Eqn.: 40 Page : 43
IEEE Std. 80 - 2000

Where

	Material Proposed	Copper-Clad Steel Wire
α_r	= Resistivity of Conductor Material	0.00378 Ohm - M
ρ_r	= Thermal co-efficient of resistivity at reference tempera	5.86
Tm	= Max. allowable temperature in °C	700 °C
Ta	= Ambient temperature in °C	40 °C
Ko	= 1/α0 or 1/αr - Tr in °C	245
Iefs	= rms current in Ka	13.45 KA
tc	= Duration of Current in s	0.5 Sec.
TCAP	= thermal capacity per unit volume from Table 1	3.85 J/(cm³°C)
Amm²	= Conductor cross section in mm²	65.89 mm²

A_{kcmil} = **130.07** kcmil

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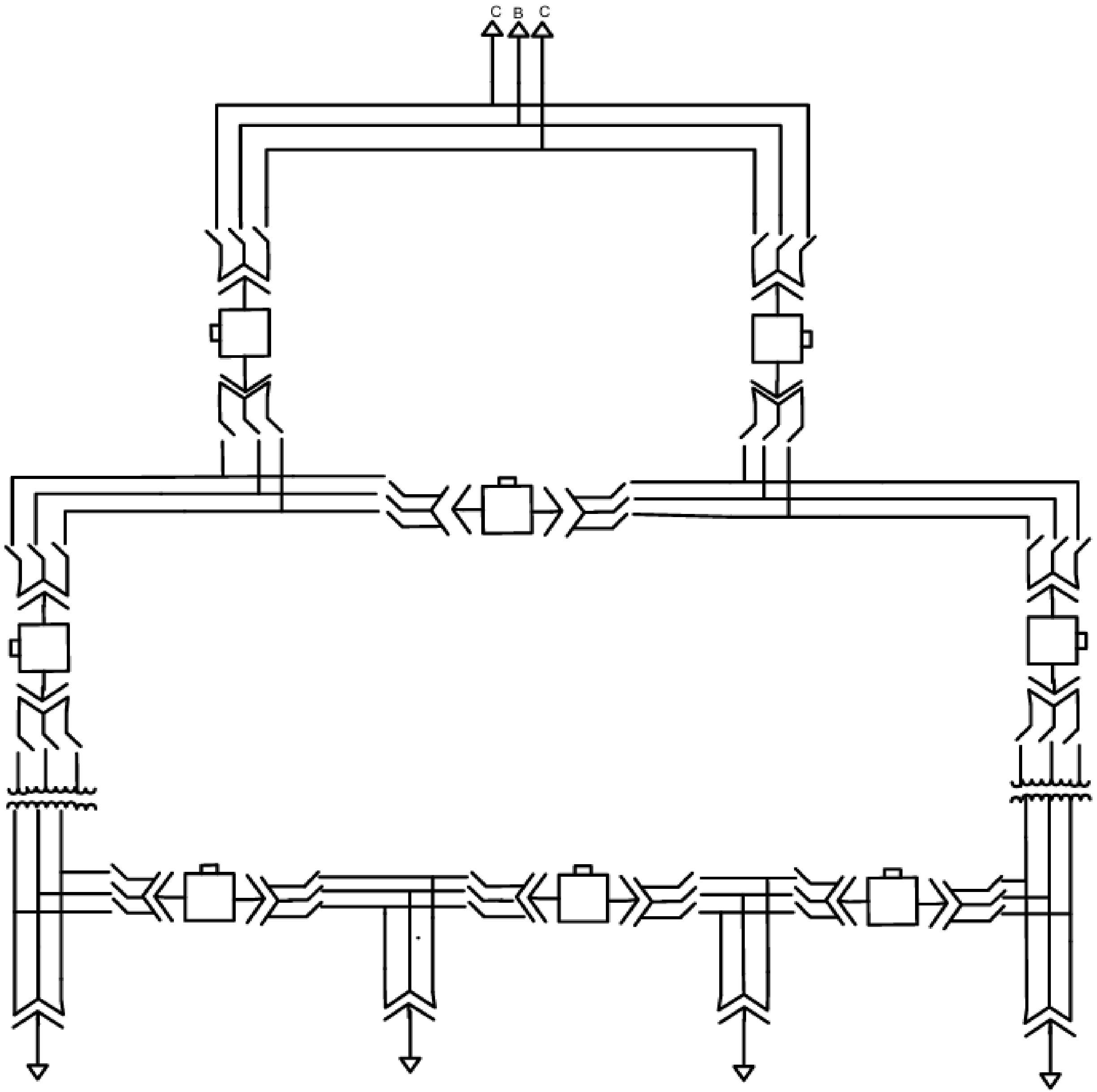
Three line drawing



| Mohamed

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Relaying

- Added PTs for relays
  - Trying to figure out a good way to show connections

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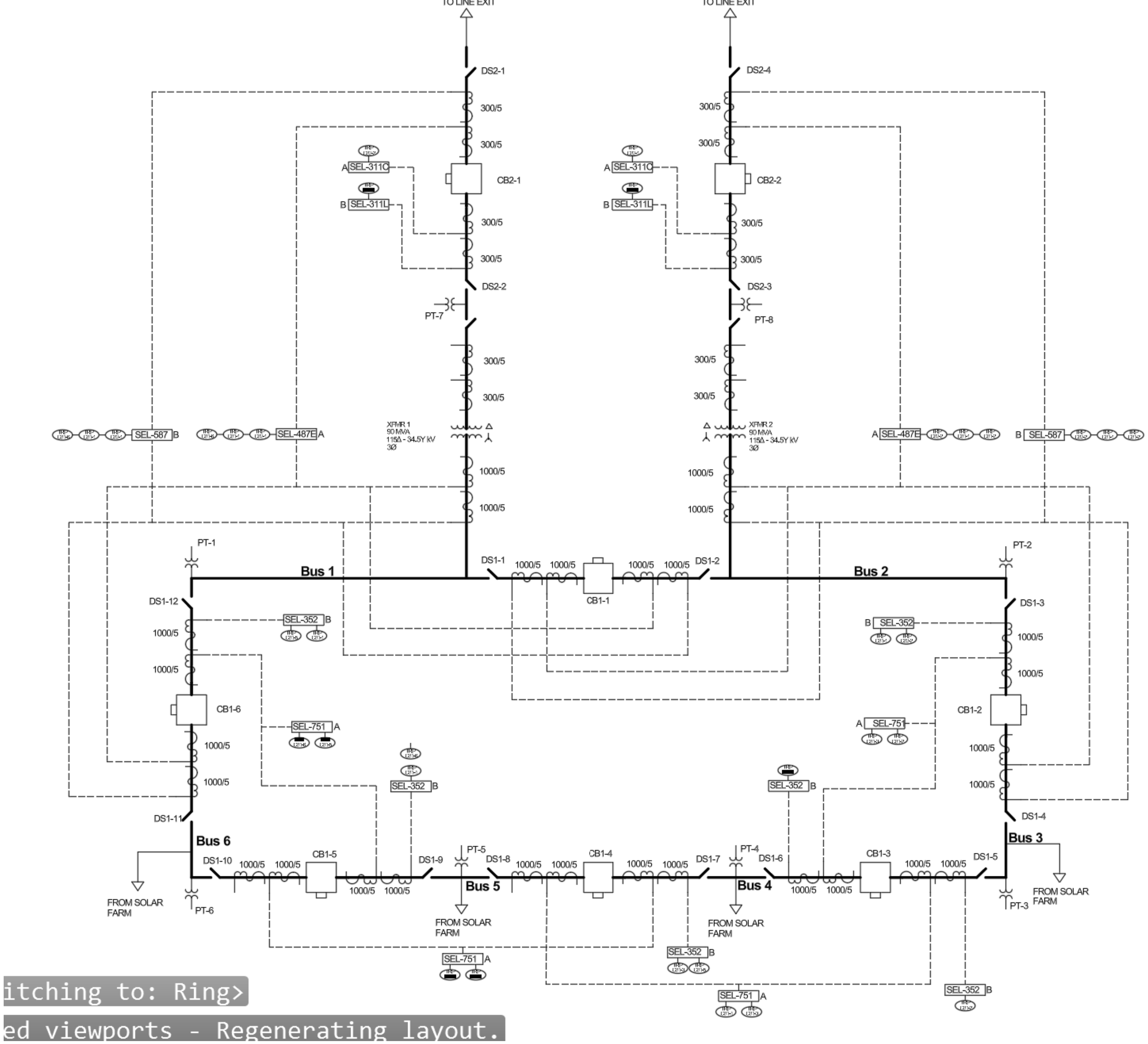

| Ben

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THANK YOU