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Department of Electrical and Computer Engineering

115/34.5kV Solar Plant & Substation
Senior Design Project

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| Senior Design Team 41

| 04/28/2025

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AGENDA

- Safety Moment
- New Technology
- Section View Updates
- Grounding Grid Updates
- Conduit Plan

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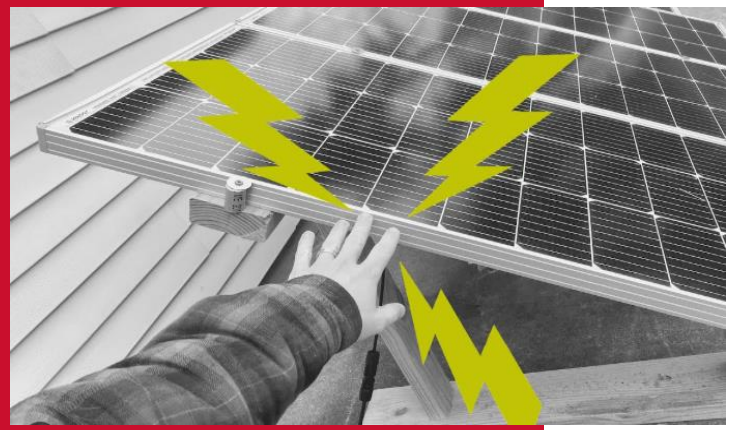
SAFETY MOMENT



DC Hazards in Solar Substations

-Solar panels can develop internal faults or arc faults from any manufacturing defects, damage, or aging

-Faulted panels may energize the metal frame that encases them, creating a risk of electric shock

-Always a risk because DC power is generated whenever there's sunlight - solar panels cannot just be fully turned off like a thermal generator

Safety Considerations

-Always treat panel frames as energized until proved safe

-Perform visual inspections for burns/melted conductors

-Use proper PPE for high-voltage DC work

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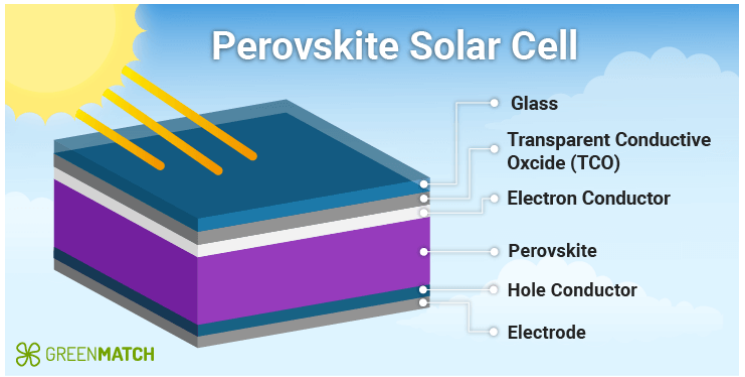
NEW TECHNOLOGY

Perovskite Solar Cells

- Perovskite is a family of semiconductor material with a very specific crystal structure
- Capable of absorbing both visible and near-infrared light
- Process of manufacturing is simpler
- LONGi Solar achieved record high 26.81% efficiency



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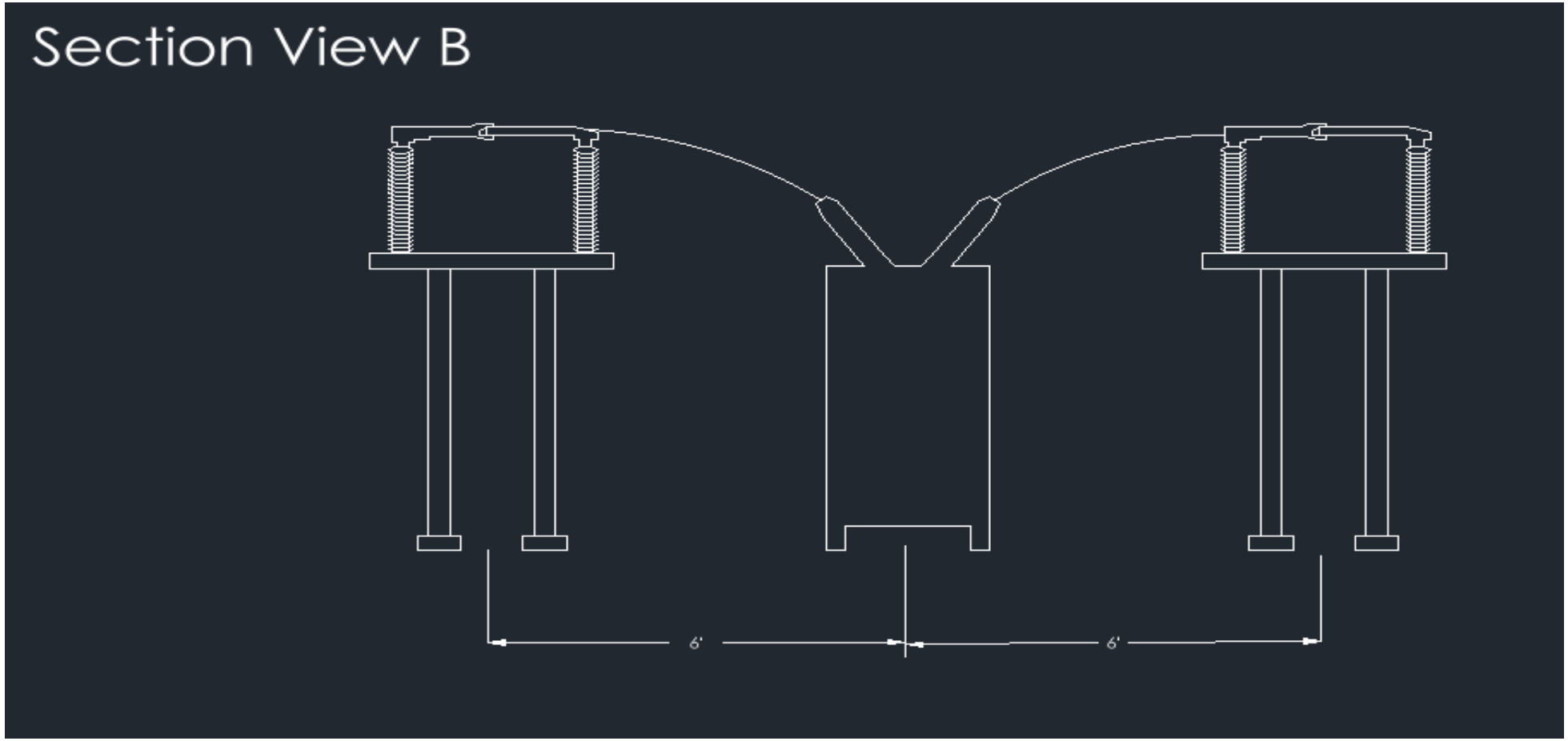
AutoCAD

Updated section B based on the comments provided and key plan



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Grounding Updates

- Updated grounding spreadsheet
- 140' x 150' fence dimensions, overall 150' x 160'

Grounding calculation (IEEE 80)

Reference https://community.ptc.com/sejnu66972/attachments/sejnu66972/PTCMathcad/175612/1/Earthing%20Exercise%20B1%20IEEE%20Std%2080%20PDF.pdf

ONLY EDIT CELLS HIGHLIGHTED YELLOW

Given parameters for grounding

Parameters	Value	Unit	Symbols		
Maximum grid current	32	kA	Ig	I	22.627417
Fault duration for conductor sizing	1	s	tc		
Shock duration	0.5	s	ts		
Surface layer thickness	0.15	m	hs		
Surface layer resistivity	3000	ohm-m	ps		
Surface layer derating factor	0.8		Cs		
Body weight	50	kg	w		
Ambient temperature	40	C	Ta		
Grounding conductor depth	0.15	m	h		
Grid reference depth	1	m	h0		

Parameters to calculate/find

Parameters	Value	Unit	Symbols	Value	Unit
Dimension of fence (x)	140	ft, m			
Dimension of fence (y)	150	ft,m			
Grid dimension (# x #)	140 x 150				
Number of parallel conductors	2.09432E-06		n		
Spacing between n parallel conductors	10	ft	D	3.048	m
grid conductor diameter	0.038333	ft	d	0.011683898	m
Total length of conductor in the horizontal grid	914.4	m	Lc		
Perimeter length of grid	188.976	m	Lp		
Area of the grid	21000	m^2	A		
Max length in the x direction	150	ft	Lx	45.72	m
Max length in the y direction	160	ft	Ly	48.768	m
Max distance between any two points on the grid	66.84785878	m	Dm		m
Total length of rod needed	20085.6	m	LR		m
Length of each rod	20	m	Lr		m
Number conductors	9.677419355		na	2.949677419	m
Number conductors	0.570976858		nb	0.174033746	m
Number conductors	3.79022E-07		nc	1.15526E-07	m
Number conductors	1		nd	0.3048	m
Number of grounding rods	1004.28		r	306.104544	m

1	Calculation for t
	Probe Spacing (ft)
	1
	2
	3
	6
	10
	20
	30
	7

2	Calculation for M

Description	Material conductivity (%)
Copper, annealed soft-drawn	100.0

ar
0.00393

3	Calculation for T

$$E_{step50} = (1000 + 6C_s$$

4	Calculation for T

$$E_{touch50} = (1000 + 1.5C_s \times$$

5	Calculation for M

$$K_s = \frac{1}{\pi}\left[\frac{1}{2 \cdot h} + \frac{1}{D+h} + \right.$$

$$K_i = 0.644 + 0.1$$

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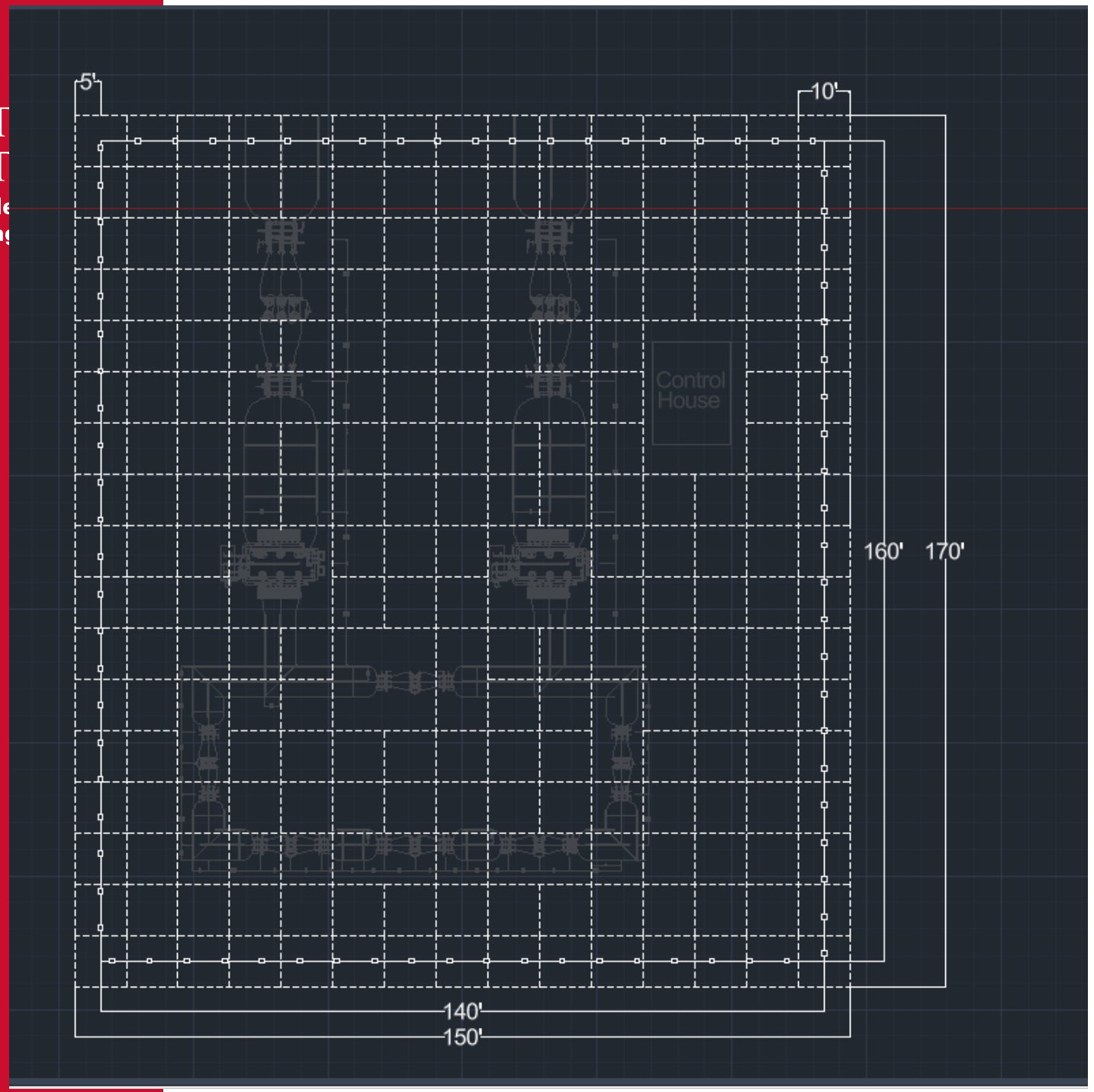

- 10' Spacing of grounding grid
- Avoided all equipment foundations

- Grounding grid to be buried 18" below surface.
- Grounding rods to be 20' in length.

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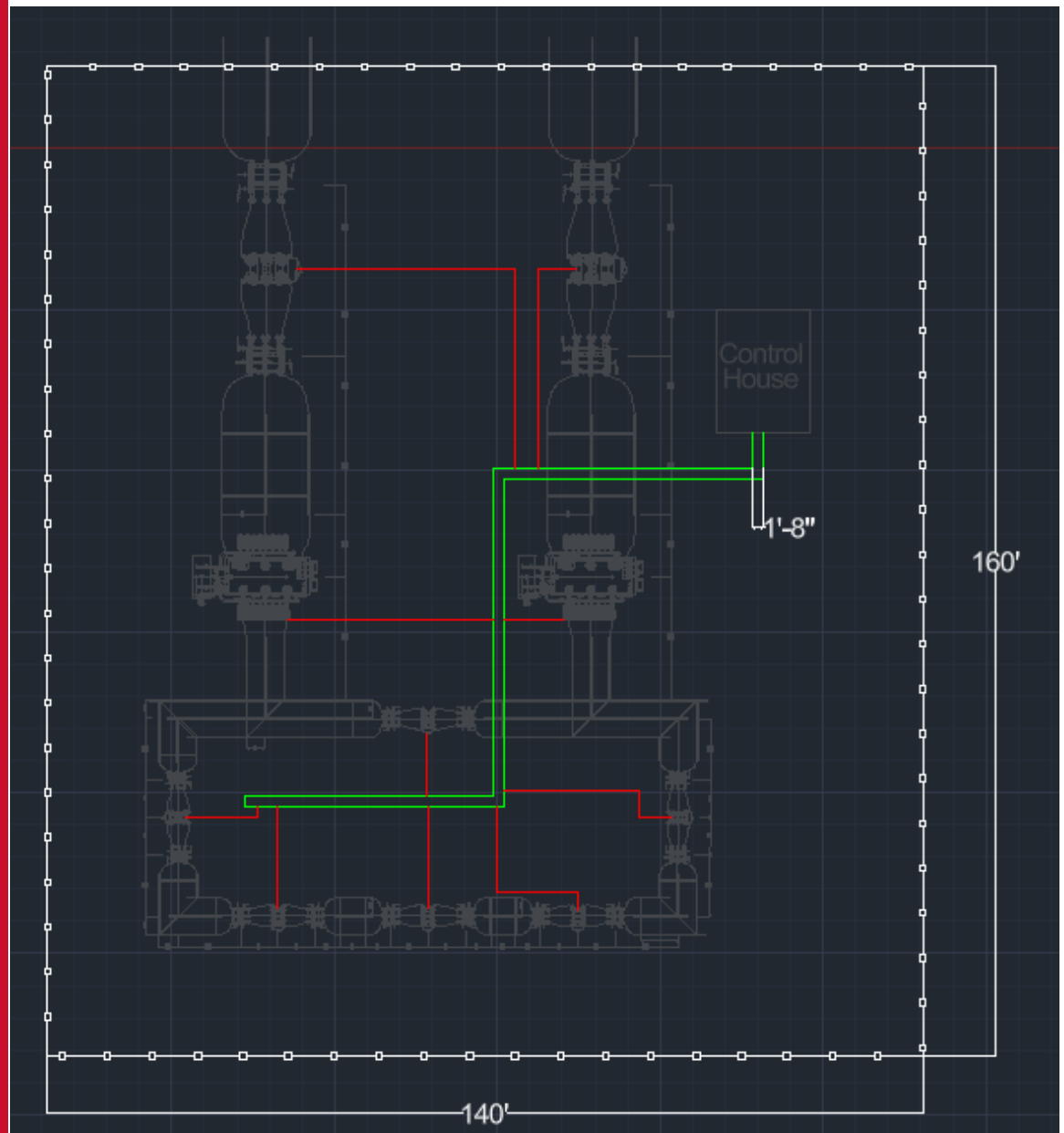
Conduit Plan



- Green - Trench
- Red – Trench wire to component
  - To all 8 Circuit Breakers
  - To both Transformers
- Past years group had a channel feeder, unsure about where to put that

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THANK YOU

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