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115/34.5kV Solar Plant & Substation Senior Design Project

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| Senior Design Team 41

| 04/14/2025

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AGENDA

- Safety Moment
- New Technology
- AutoCAD Updates
- ETAP
- BOM
- Discuss the Rest of the Semester

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SAFETY MOMENT

LOTO

What Is the Meaning of LOTO?

LOTO stands for **Lockout/Tagout**. It's a safety process used to **turn off machines and keep them off** while maintenance or repairs are being done.

According to OSHA, LOTO procedures **prevent an estimated 50,000 injuries and 120 fatalities each year**.

Why is LOTO important?

- It **prevents accidents** by stopping machines from starting unexpectedly.
- It **keeps workers safe** during maintenance.
- It **saves time** by helping teams work safely and efficiently.
- It **clearly shows** when a machine is being worked on, so others don't turn it on.

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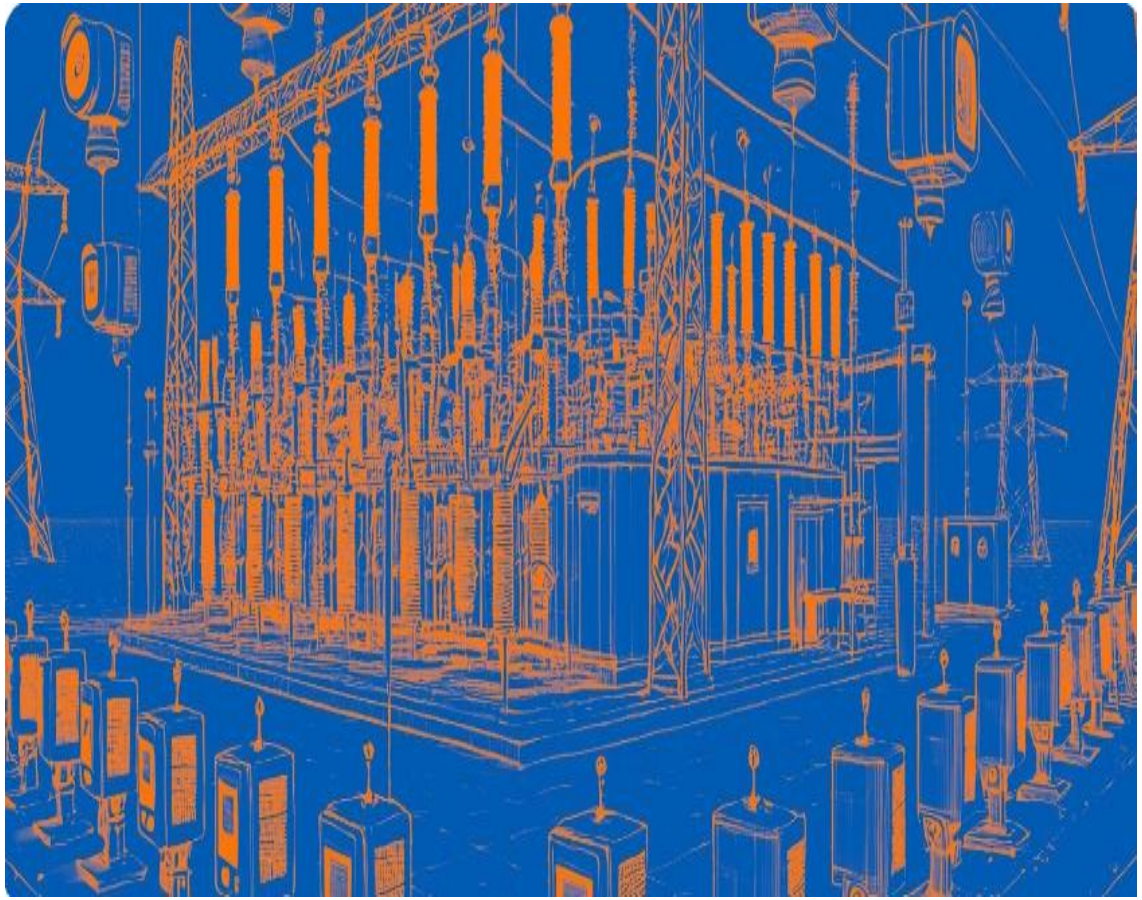
NEW TECHNOLOGY

IoT Substation Monitoring

1. **Definition:**
   A system that uses smart sensors, communication networks, and data analytics to monitor substation equipment in real time, enabling automated maintenance and improved operational efficiency.

https://www.iotforall.com/empowering-the-grid-iot-substation-monitoring



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IoT Substation Monitoring

2. Key Components:

- Sensor Networks: Monitor voltage, current, temperature, etc.
- Communication Infrastructure: Transmits data using protocols like MQTT.
- Edge Computing: Processes data locally for faster decisions.
- Cloud Platforms: Stores and visualizes data remotely.
- Predictive Analytics: Detects issues before failures occur.

3. Benefits:

- Real-Time Monitoring: Instant visibility of system status.
- Predictive Maintenance: Prevents failures, reduces downtime.
- Efficient Resource Use: Smarter maintenance and upgrades.
- Improved Safety: Fewer manual checks in dangerous areas.
- Cost Savings: Lower repair and energy costs.
- Fast Fault Response: Quick alerts and remote action.

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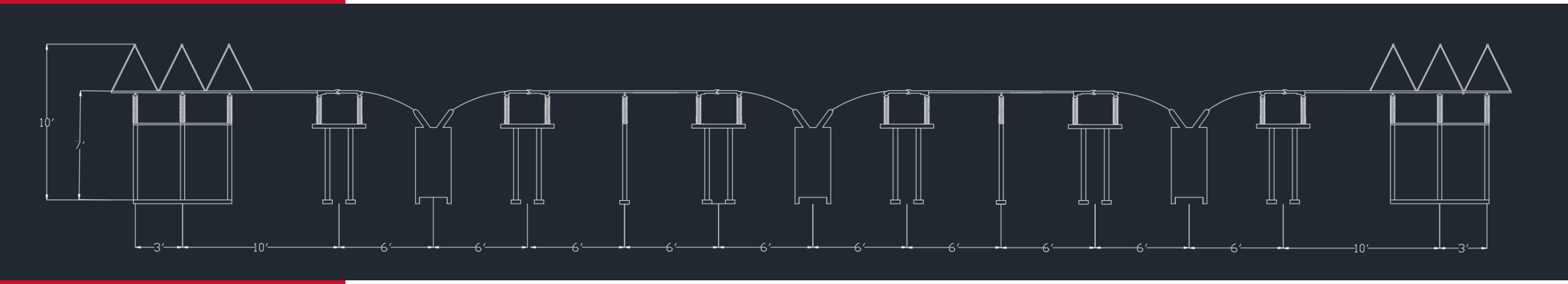
AutoCAD

Section C



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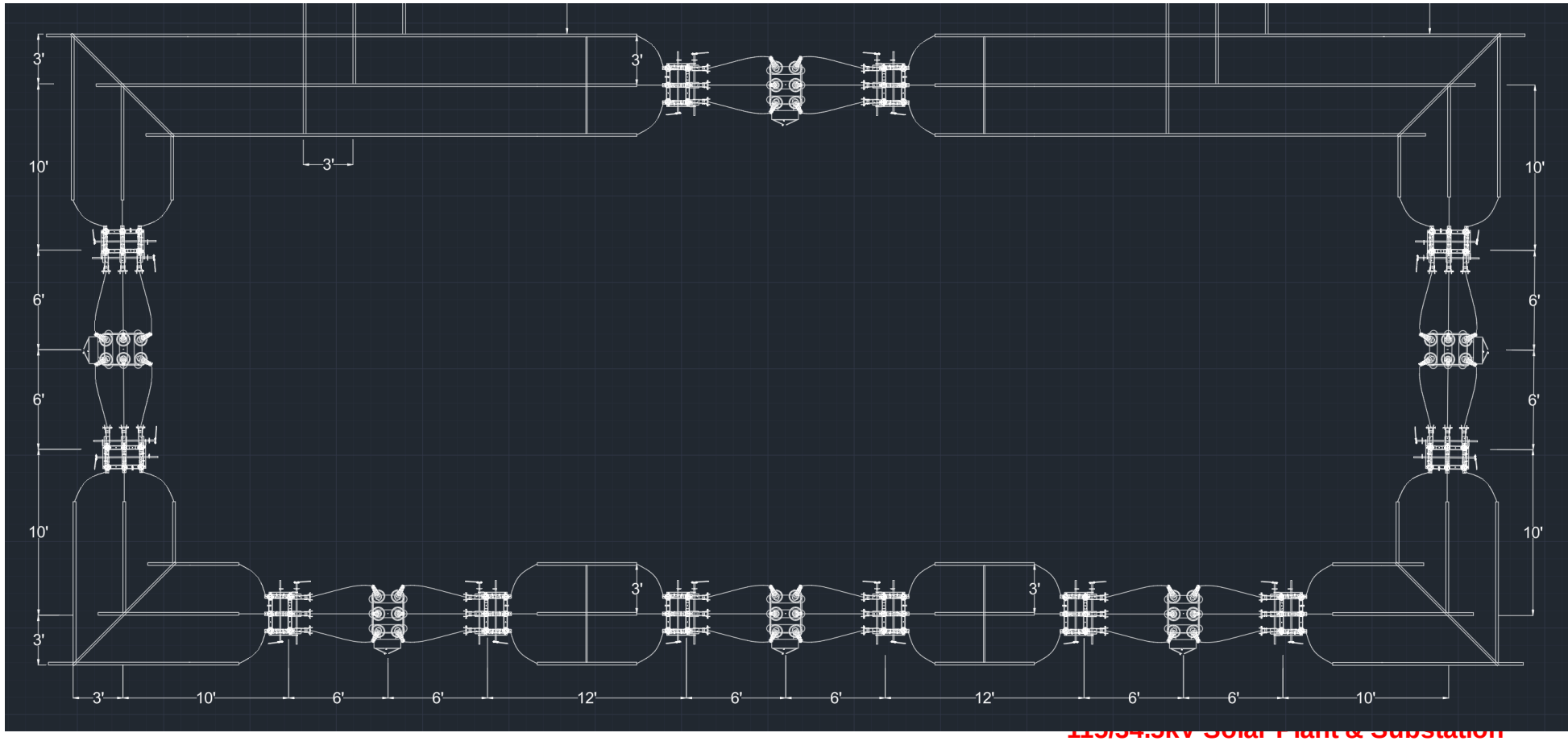
AutoCAD

Key Plan



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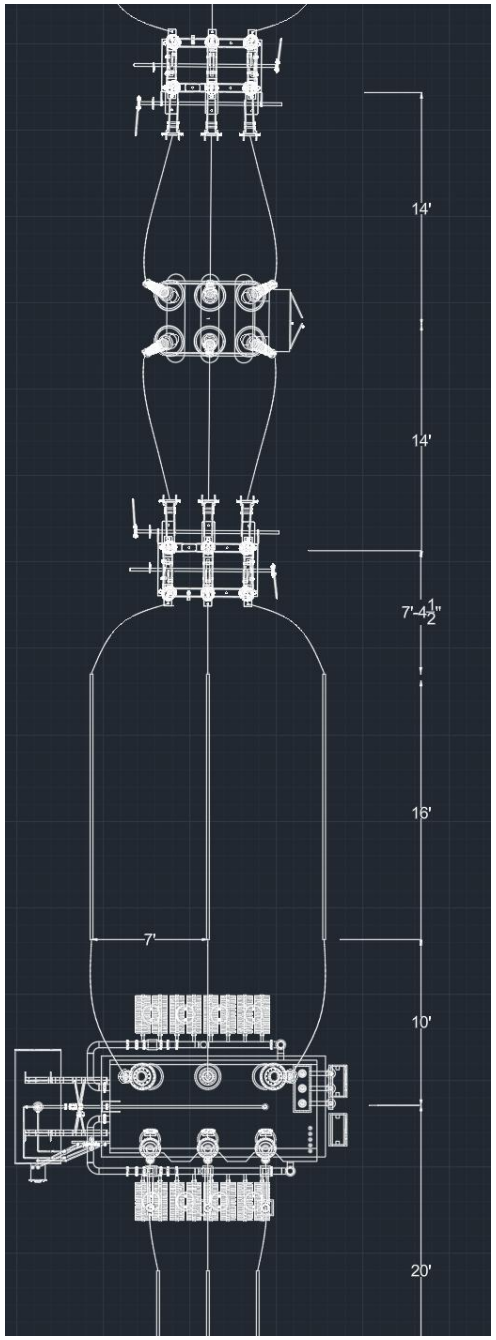
AutoCAD

Key Plan



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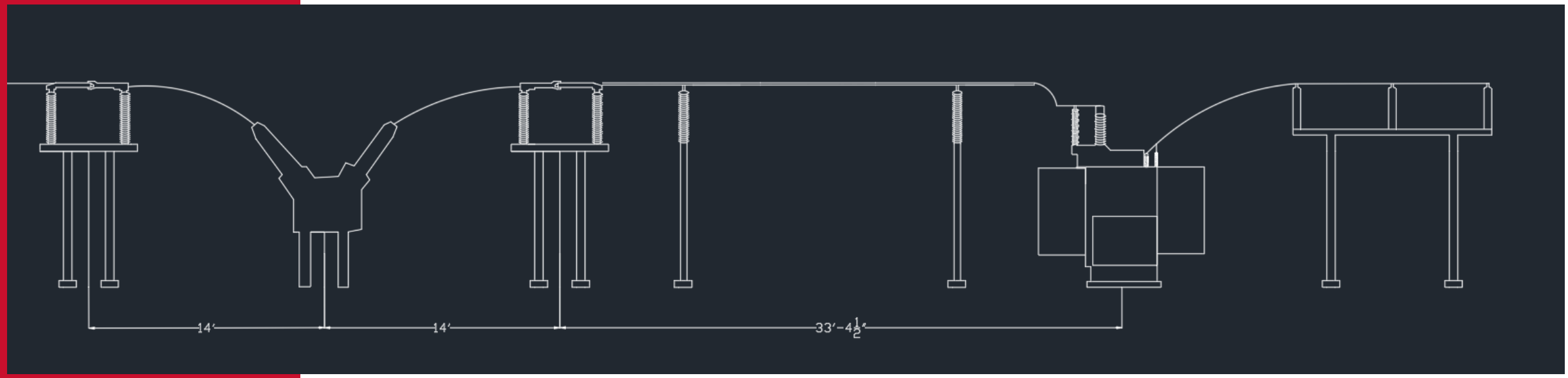
AutoCAD

Section A

- **Still updating details based on the comments left**



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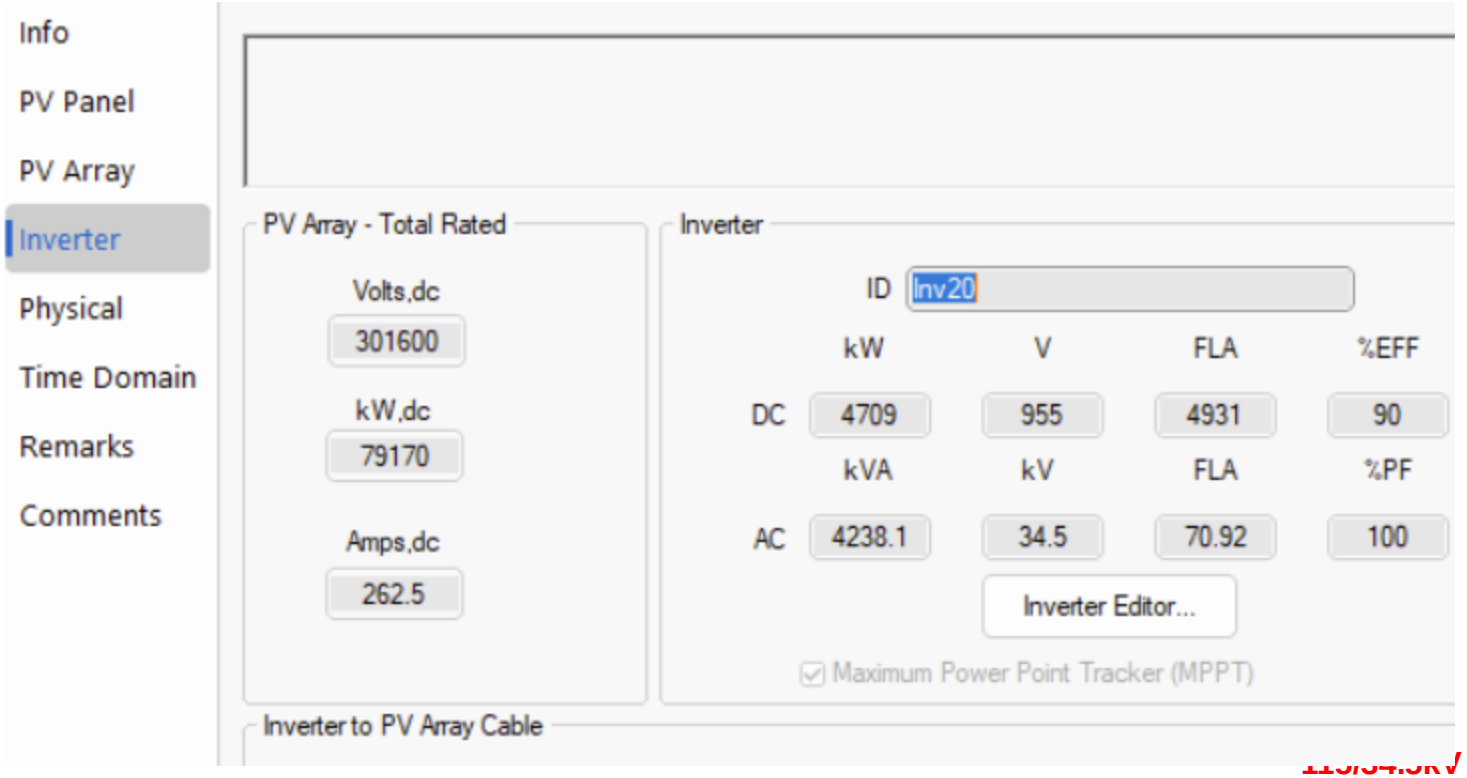
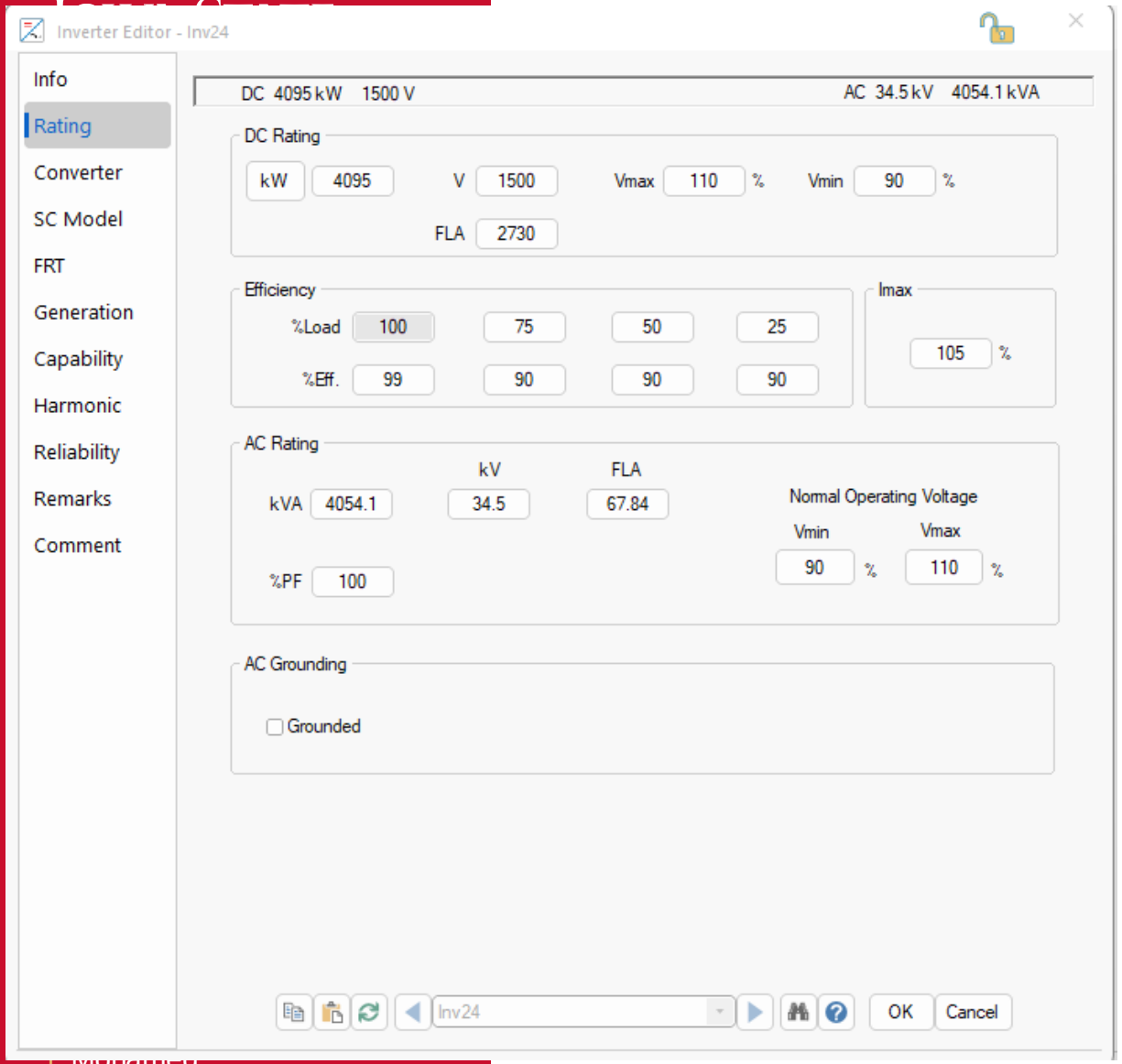
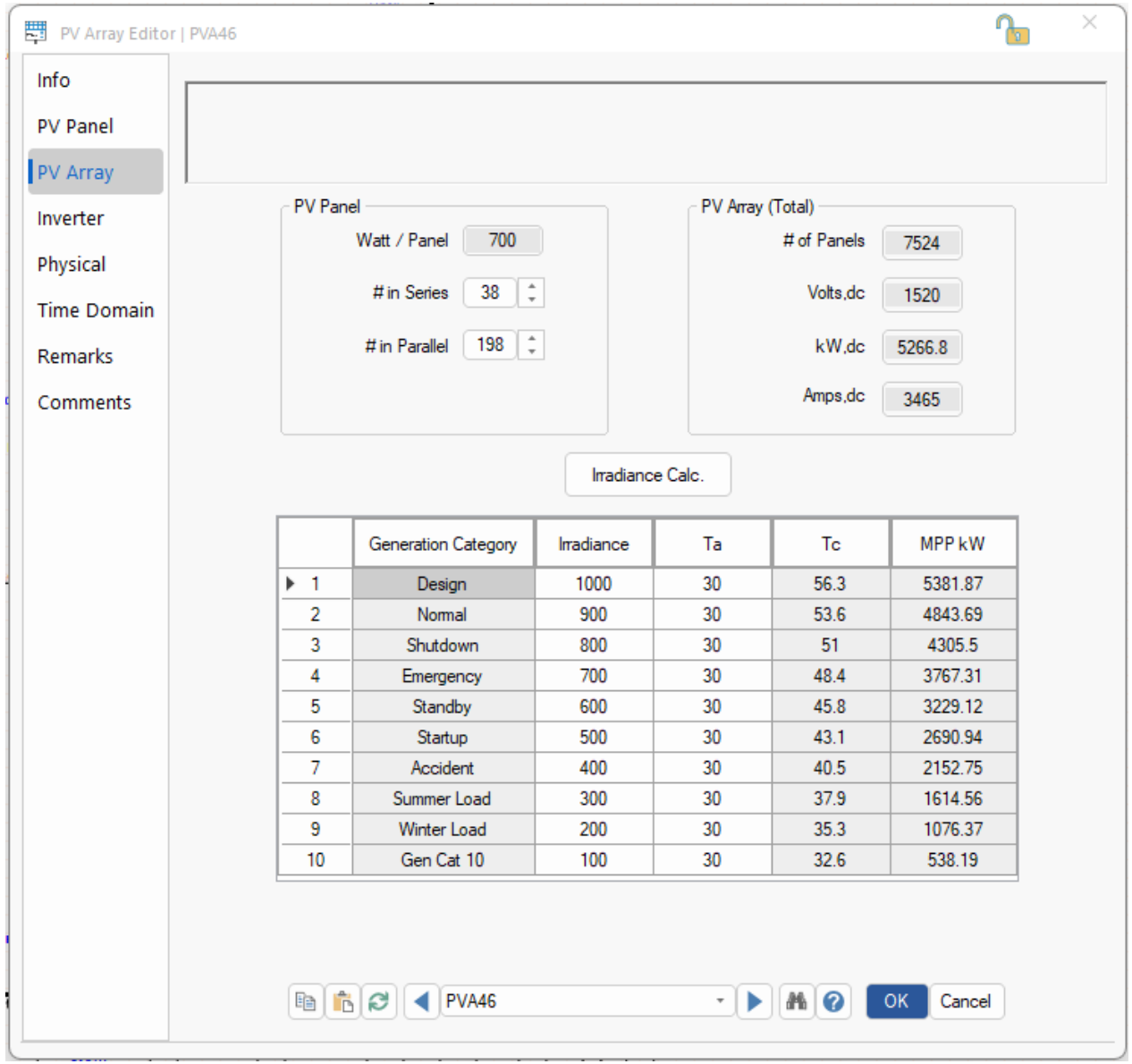
Critical Report

Device ID	Type	Condition	Rating/Limit	Unit	Operating	% Operating	Phase Type
PVA_1	PV Array	Overload	70.924	Amp	1225.253	1727.6	3-Phase
PVA_2	PV Array	Overload	70.924	Amp	1225.253	1727.6	3-Phase
PVA_3	PV Array	Overload	70.924	Amp	1225.253	1727.6	3-Phase
PVA_4	PV Array	Overload	79.494	Amp	1225.253	1541.3	3-Phase
T_1	Transformer	Overload	90.000	MVA	145.620	161.8	3-Phase
T_2	Transformer	Overload	90.000	MVA	145.620	161.8	3-Phase







	Generation Category	Irradiance	Ta	Tc	MPP kW
1	Design	1000	30	56.3	5381.87
2	Normal	900	30	53.6	4843.69
3	Shutdown	800	30	51	4305.5
4	Emergency	700	30	48.4	3767.31
5	Standby	600	30	45.8	3229.12
6	Startup	500	30	43.1	2690.94
7	Accident	400	30	40.5	2152.75
8	Summer Load	300	30	37.9	1614.56
9	Winter Load	200	30	35.3	1076.37
10	Gen Cat 10	100	30	32.6	538.19

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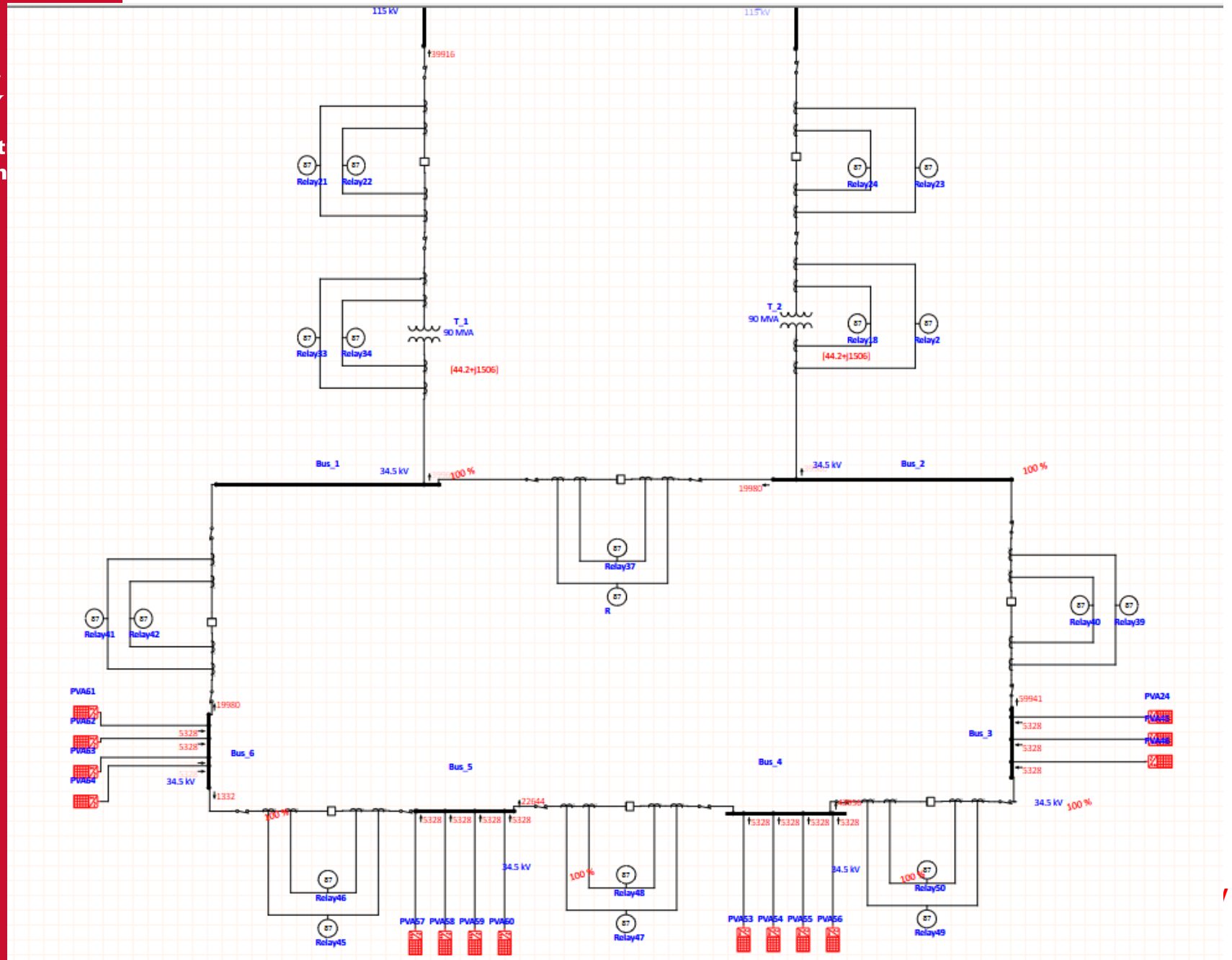

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ETAP Arc Flash

- Type of Report
- Incident Energy?
- Arc Flash Boundaries?

Project:	ETAP	Page:	1
Location:	24.0.1E	Date:	04-21-2025
Contract:		SN:	IASTATEPL
Engineer:	Study Case: BusFault	Revision:	Base
Filename: Oneline_1_ms		Config.:	Normal

Arc Flash Analysis
½ Cycle Calculation Method

Arc Fault Location						Correction Factors		Incident Energy						
		Enclosure												
Element ID	Connected Bus ID	ID	Type	Electrode Config.	Prefault kV	Iarc Var. (%)	Encl. CF (pu)	Ibf'' (kA)	Ia'' (kA)	Source PD Ia'' (kA)	FCT (Cycles)	Source PD ID	IE (cal/cm²)	AFB (ft)
Bus_7	Bus_7		Bus Arc Fault	VCB		0		1.325	1.325	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00
SW29	Bus_7		Source PD Line Side	VCB		0		1.325	0.000	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00
CB2_1	Bus_7		Source PD Line Side	VCB		0		1.325	0.000	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00
SW21	Bus_7		Source PD Line Side	VCB		0		1.325	0.000	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00
SW30	Bus_7		Source PD Line Side	VCB		0		1.325	0.000	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00
CB2_2	Bus_7		Source PD Line Side	VCB		0		1.325	0.000	0.000		Cannot be Determined	0.000	
												(+) Total =	0.000	0.00

BOM

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Solar Component						
Component type	**Model Number**	**Quantity**	**Price**	**Datasheet link**	**Total Price**	**Pricing link**
PV Panels	TOPBiHiKu7 CS7N-700TB-AG	113,100	$223.00	Link	$25,221,300.00	
Combiner boxes	CA1500-24-20S	360	$2,156.00	Link	$840,840.00	
Inverters	SLG-330-0279	15	$119,210.14	Link	$1,788,152.00	
Conduit					0	
Large wires (MCM)					0	

Substation Component						
Component type	**Model Number**	**Quantity**	**Price**	**Datasheet link**	**Total Price**	**Pricing link**
SEL-311C	311#01	2	$6,590.67	Link	$13,181.34	Link
SEL-311L		2	$7,130.00	Link	$14,260.00	Link
SEL-352	352#01	6	$4,782.50	Link	$28,695.00	Link
SEL-751	751#12	4	$2,000.73	Link	$8,002.92	Link
SEL-487E	487E#01	2	$10,643.19	Link	$21,286.38	Link
SEL-587	587#01	2	$2,712.64	Link	$5,425.28	Link
T (POWER XMFR)	XD 115kV/34.5 90 MVA	2				
CB1		2	$11,900.00	Link	$23,800.00	
CB2		6		Link	$0.00	
DS1		12	$8,000.00	Link	$96,000.00	Link
DS2		6		Link	$0.00	
LA1						
LA2						
PT						
CT						
Battery						

MIS Component						
Component type	**Model Number**	**Quantity**	**Price**	**Datasheet link**	**Total Price**	**Pricing link**
Fence	Solidlock® Pro 20 2096-6 12.5 ga 330' High Tensile Fixed Knot Game Fence	330	$643.00	Link	$212,190.00	Link
Bus Bar						

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End of Semester

- Lightning Protection Calcs?
- Industry Review Panel is May 9th
  - Present to BV before?

Substation Deliverables

Drawings/Documents

- Key Protection Diagram (One-line)
- Yard Equipment Layout
- Grounding Study and Calculations
- Lightning Protection Calculations
- AC & DC Battery Calculation
- ETAP Simulation and Calculations
- Additional Deliverable possibilities (depending on time):
  - Three-line Diagrams
  - AC/DC schematics
  - BOM
  - Electrical Layout Elevations
  - Lightning Calc/Protection

Documentation

- Project Design Document (Needs to be worked on throughout the project)
- Project schedule (Gantt Chart)
- Project budget
- Materials List

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THANK YOU

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| 02/03/2025