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Department of Electrical and Computer Engineering

115/34.5kV Solar Plant & Substation

Client: Black & Veach: Adam Schroeder, Elymus Schaffer, Utsavee Desai
Faculty Advisor: Venkataramana Ajjarapu

BLACK & VEATCH

Andrew M Chizek, David W Ntako, Ben Palkovic, Mohamed A Sam, Sergio Sanchez Gomez & Dallas R Wittenburg

| Senior Design Team 41

| 12/10/2024

PROJECT OVERVIEW

- Fully design a 60 MW solar plant and its corresponding 115/34.5 kV substation through site and component selection, modeling, and calculations to ensure our design meets all requirements
- Provide reliable, renewable energy transmission and distribution to the users of our plant

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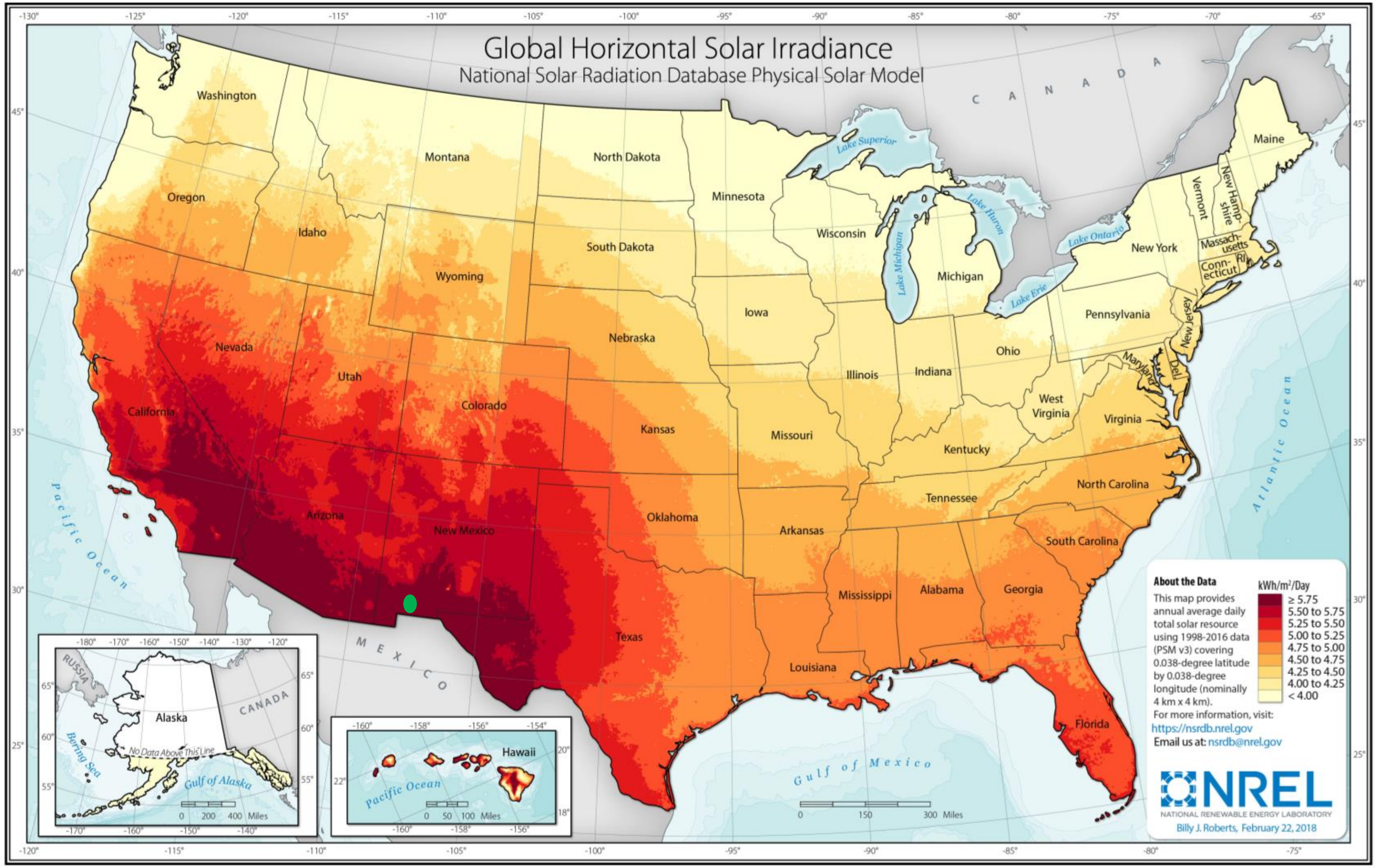
LOCATION

- Deming, New Mexico
- Advantages:
- Land pricing
- Solar Irradiance
- Our land plot is located near transmission lines that our substation can connect to



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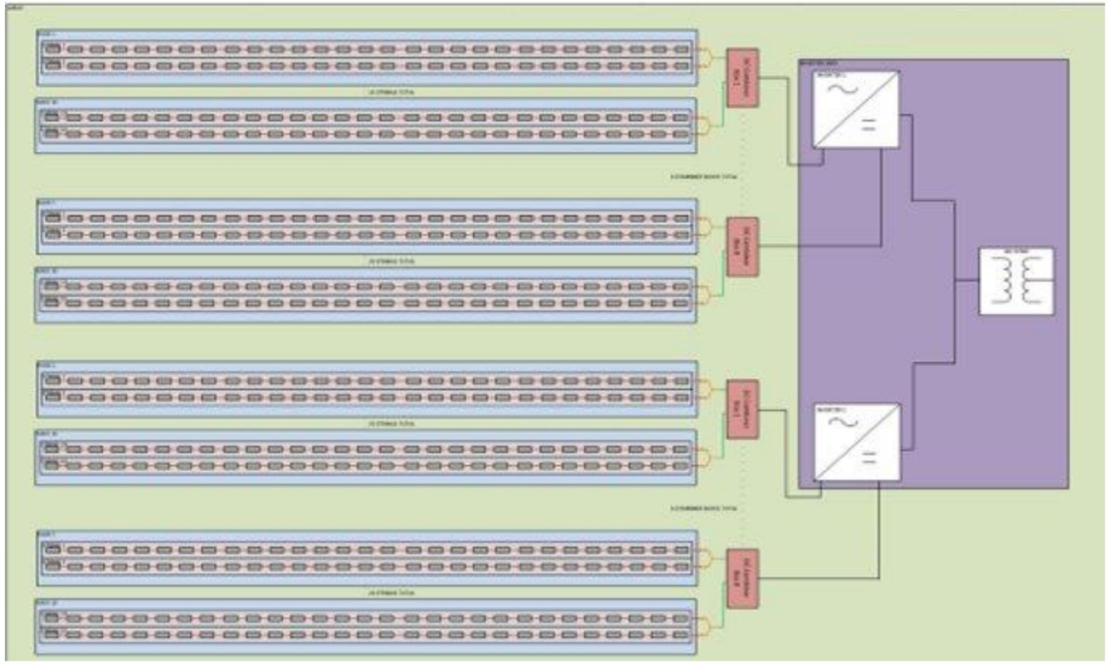
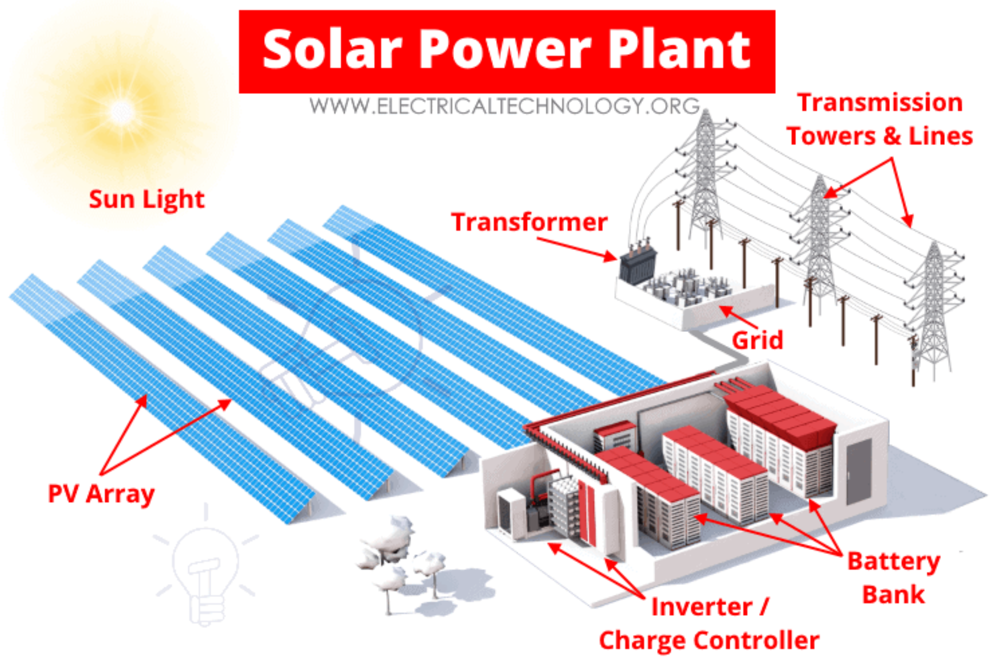
OVERVIEW OF A 60 MW SOLAR PLANT

- Within a string, solar panels are connected in series to combine their voltages to achieve our desired string voltage.
- Strings are connected in parallel within racks, which are then fed to a combiner box.
- The combiner box combines the strings and directs it to an inverter.
- The inverter converts the electricity from DC to AC and includes skids to step up the voltage to 34.5kV.
- The electricity is transmitted to the feeder and carried to the substation.



OVERVIEW OF SUBSTATION – 115/34.5 kV

- Step-up transformer increases voltage from 34.5kV to 115kV
- The higher voltage allows integration into the local electrical grid.
- Electricity is distributed to end users, including homes and businesses.



REQUIREMENTS

- **Functional**
  - Solar Farm needs to provide power 24/7 without announced announcements
  - Solar Panel needs to work to properly produce clean energy
  - Solar Farm needs to be cost effective and help to save money
- **Aesthetic**
  - Farm needs to be in calculated rows to maximize the panel efficiency and space. Panel efficiency corresponds to power output.
- **Safety**
  - The solar farm construction and operation must adhere to all applicable safety code
- **Environmental**
  - Solar Panels need to be sustainable and help reduce carbon emissions

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COMPONENTS

1. PV Module

ELECTRICAL DATA | NMOT*

	Nominal Max. Power (Pmax)	Opt. Operating Voltage (Vmp)	Opt. Operating Current (Imp)	Open Circuit Voltage (Voc)	Short Circuit Current (Isc)
CS7N-685TB-AG	518 W	37.2 V	13.91 A	44.8 V	14.79 A
CS7N-690TB-AG	522 W	37.4 V	13.94 A	45.0 V	14.83 A
CS7N-695TB-AG	526 W	37.6 V	13.97 A	45.2 V	14.87 A
CS7N-700TB-AG	529 W	37.8 V	14.00 A	45.4 V	14.91 A
CS7N-705TB-AG	533 W	38.0 V	14.03 A	45.5 V	14.95 A
CS7N-710TB-AG	537 W	38.2 V	14.06 A	45.7 V	14.99 A
CS7N-715TB-AG	541 W	38.4 V	14.09 A	45.9 V	15.03 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m^2, spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

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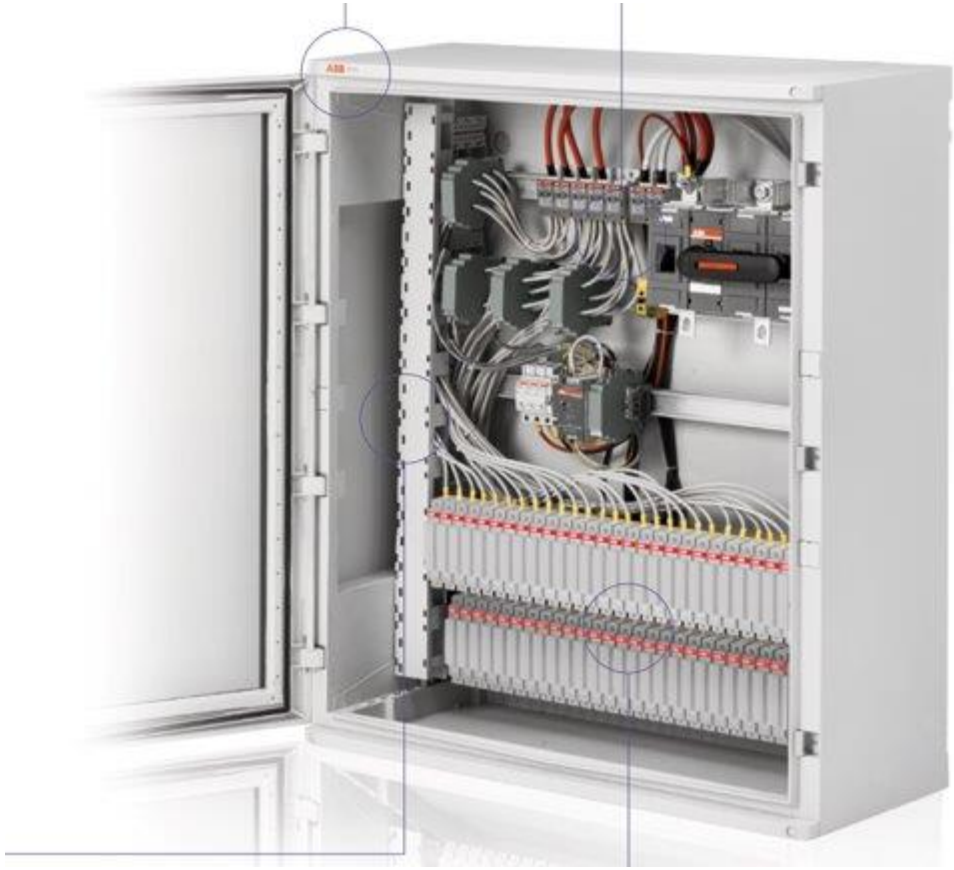
COMPONENTS

2. Combiner Box

- NEMA 4 outdoor-rated enclosure.
- High current ratings.
- Utility-scale.
- High protection standards.



COMPONENTS

3. **Inverter**

- High efficiency.
- Large power capacity.
- Low total harmonic distortion.
- Versatility and scalability.

ARRAY PARAMETER TOOL

String Size

Location Dependent	Min Temp	4.44	C
Datasheet (STC)	Voc	47.9	V
Datasheet (STC)	Ref temp	25	C
Datasheet	Temp Coeff of Voc	-0.0029	/C
	Temp delta	-20.56	
	temp correction	1.06	
	VOc corrected	50.756	
Confirm possible with Panel	string voltage	1500	V
	String size	29.5532	
Designer Choice: 600	string size	29	
	Actual String Voltage	1471.9	

Electrical Rack Size

Designer Choice		Landscape	
Datasheet	Module width	7.82	ft
Datasheet	module height	4.27	ft
Designer Choice	Rack width	29	modules
Designer			

Solar Plant Size

Access Road w/ Space for CB	50	ft
Height		ft
Width		ft
Area of Plant	483236	ft^2
	166.35	acres

CB capacity

Datasheet (STC)	mod/string Isc	18.49	A
NEC sectic	multiplier	1.25	
	nom Isc	23.1125	
Irr.	multiplier	1.25	
	max Isc	28.8906	A
	allowed current	320	A
	s this disconnect A?		
	strings per CB	11.0763	
	Round down:	11	
	racks per CB	5.5	

Array Design

Designer Choice	Racks per row	5	
Designer Choice	rows per Array	26	
Designer Choice	Racks removed	0	
	Total Racks/Array	130	
	Total modules	7540	
Datasheet (STC)	module capacity	700	W
	dc capacity	5278	kW
Designer Choice	inverter capacity	4095	kW
			MVA
Provided: Industry standard	ILR	1.28889	

Array Size

Designer Choice	tilt	30	
	table height proj	7.39586	ft
Designer Choice	row space	9	ft
	pitch	16.3959	ft
	Space for Inverter Maintenance		ft
	Array height	426.292	ft
	Array width	1133.9	ft
	Ground Coverage Ratio	0.52086	

Solar Plant

Solar Plant		
Arrays in Plant	15	
Panels in Plant	113,100	
Inverters in Plant	15	
CBs in Plant	390	
DC Plant Output	77.33	MW
AC Plant Output	60	MW

VOLTAGE DROP CALCULATIONS:

DCB	Strings per Rack	IMP for String	String Length	String wire size	String Conductor resistance	String resistance	Voltage Drop of String	IMP for Jumper	Jumper Length	Jumper wire size	Jumper resistance	Jumper resistance	Voltage Drop of Jumper	Voltage Drop of String	Voltage Drop of Jumper
DCB#-##	per rack	Amp	feet	AWG	Ohm/kft	Ohm	Volts	Amp	feet	AWG	Ohm/kft	Ohm	Volts	percent	percent
DCB1-01	2	14	226.87	10	1.2400	0.5448151	7.8769264	28	569	8	0.7640	0.8409313	24.344096	0.525128427	1.622939733
DCB1-02	2	14	226.87	10	1.2400	0.5448151	7.8769264	28	342	8	0.7640	0.5061071	14.632128	0.525128427	0.9754752
DCB1-03	2	14	226.87	10	1.2400	0.5448151	7.8769264	28	115	8	0.7640	0.1703152	4.92016	0.525128427	0.328010667
DCB1-04	2	14	226.87	10	1.2400	0.5448151	7.8769264	28	342	8	0.7640	0.5061071	14.632128	0.525128427	0.9754752
DCB1-05	2	14	226.87	10	1.2400	0.5448151	7.8769264	28	569	8	0.7640	0.8409313	24.344096	0.525128427	1.622939733
Combiner Name		from Array Parameter	panels in string * panel width	IMP x 1.25 AWG size above that	Table 8 NEC						Table 8 NEC				

$$V_d = \frac{I \times 2 \times d}{1000\, ft/kft} \times \left(\frac{\Omega}{kft} \right)$$

Where:

V_d = voltage drop

d = route length of dc cable in feet (2 x adjusts for total circuit wire length)

I = dc current in amperes (commonly I_{mp})

Ω/kft = ohms/thousand feet (resistance)

$$\text{Voltage drop (in percentage)} = \frac{V_d}{V_{MAX}} \times 100$$

DCB	No. of Rack Inputs	IMP for DCB circuit	Feeder length	Feeder wire size	Feeder resistance	Feeder resistance			Voltage drop for feeder	Voltage drop for feeder	Voltage drop for circuit	VMP for circuit			Voltage drop for circuit
DCB#-##	#	Amp	feet	kcmil	Ohm/kft	Ohm			Volt	per cent	Volt	Volt			per cent
DCB1	5	140.00	780	600	0.0214	0.0323			4.67376	0.48%	42.31033333	1500.00			2.82%
DCB2	5	140.00	764	600	0.0214	0.0316			4.577888	0.47%	42.278376	1500.00			2.82%
DCB3	5	140.00	748	600	0.0214	0.0310			4.482016	0.46%	42.24641867	1500.00			2.82%
DCB4	5	140.00	732	600	0.0214	0.0303			4.386144	0.45%	42.21446133	1500.00			2.81%
DCB5	5	140.00	716	600	0.0214	0.0296			4.290272	0.44%	42.182504	1500.00			2.81%
DCB6	5	140.00	700	600	0.0214	0.0290			4.1944	0.43%	42.15054667	1500.00			2.81%
DCB7	5	140.00	684	600	0.0214	0.0284			4.098528	0.42%	42.11858933	1500.00			2.81%
DCB8	5	140.00	668	600	0.0214	0.0277			4.002656	0.41%	42.086632	1500.00			2.81%
DCB9	5	140.00	652	600	0.0214	0.0270			3.906784	0.40%	42.05467467	1500.00			2.80%
DCB10	5	140.00	636	600	0.0214	0.0263			3.810912	0.39%	42.02271733	1500.00			2.80%
DCB11	5	140.00	620	600	0.0214	0.0256			3.71504	0.38%	41.99076	1500.00			2.80%
DCB12	5	140.00	604	600	0.0214	0.0251			3.619168	0.37%	41.95880267	1500.00			2.80%
DCB13	5	140.00	588	600	0.0214	0.0244			3.523296	0.36%	41.92684533	1500.00			2.80%
DCB14	5	140.00	588	600	0.0214	0.0244			3.523296	0.36%	41.92684533	1500.00			2.80%
DCB15	5	140.00	604	600	0.0214	0.0251			3.619168	0.37%	41.95880267	1500.00			2.80%
DCB16	5	140.00	620	600	0.0214	0.0256			3.71504	0.38%	41.99076	1500.00			2.80%
DCB17	5	140.00	636	600	0.0214	0.0263			3.810912	0.39%	42.02271733	1500.00			2.80%
DCB18	5	140.00	652	600	0.0214	0.0270			3.906784	0.40%	42.05467467	1500.00			2.80%
DCB19	5	140.00	668	600	0.0214	0.0277			4.002656	0.41%	42.086632	1500.00			2.81%
DCB20	5	140.00	684	600	0.0214	0.0284			4.098528	0.05%	42.11858933	1500.00			2.81%
DCB21	5	140.00	700	600	0.0214	0.0290			4.1944	0.05%	42.15054667	1500.00			2.81%
DCB22	5	140.00	716	600	0.0214	0.0296			4.290272	0.06%	42.182504	1500.00			2.81%
DCB23	5	140.00	732	600	0.0214	0.0303			4.386144	0.06%	42.182504	1500.00			2.81%
DCB24	5	140.00	748	600	0.0214	0.0309			4.482016	0.06%	42.182504	1500.00			2.81%
DCB25	5	140.00	764	600	0.0214	0.0327			4.577888	0.06%	42.182504	1500.00			2.81%
DCB26	5	140.00	780	600	0.0214	0.0334			4.67376	0.06%	42.182504	1500.00			2.81%
		sum total of combiner box current		IMP x 1.25AWG size abc Table 8 NEC								Voltage your strings	Average of worst-case DCB voltage drop:		2.81%

WIRING MATERIALS & COMPONENTS

CBs DCB1-01 - DCB1-26

Conductors	Isc(A)	IMP(A)	Type	Conductor Material	AWG Size
String (Harness)	18.49	15	Underground	copper	10
Rack to CB (Jumper)	36.98	30	Underground	copper	8
CB to Inverter	184.9	120	Underground	copper	3/o

Property	**Copper**	**Aluminum**
Conductivity	High	Moderate
Weight	Heavy	Light
Cost	Expensive	Affordable
Strength & Durability	High	Moderate
Corrosion Resistance	Excellent	Requires treatment
Thermal Expansion	Low	High

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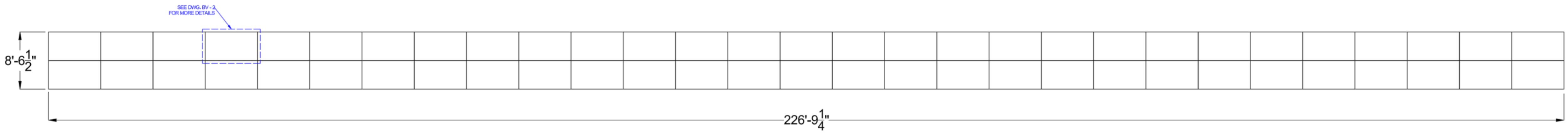
SYSTEM DESIGN – RACK LAYOUT

Factors Effecting the Rack Layout

- Open circuit voltage (Voc)
- Short circuit current (Isc)



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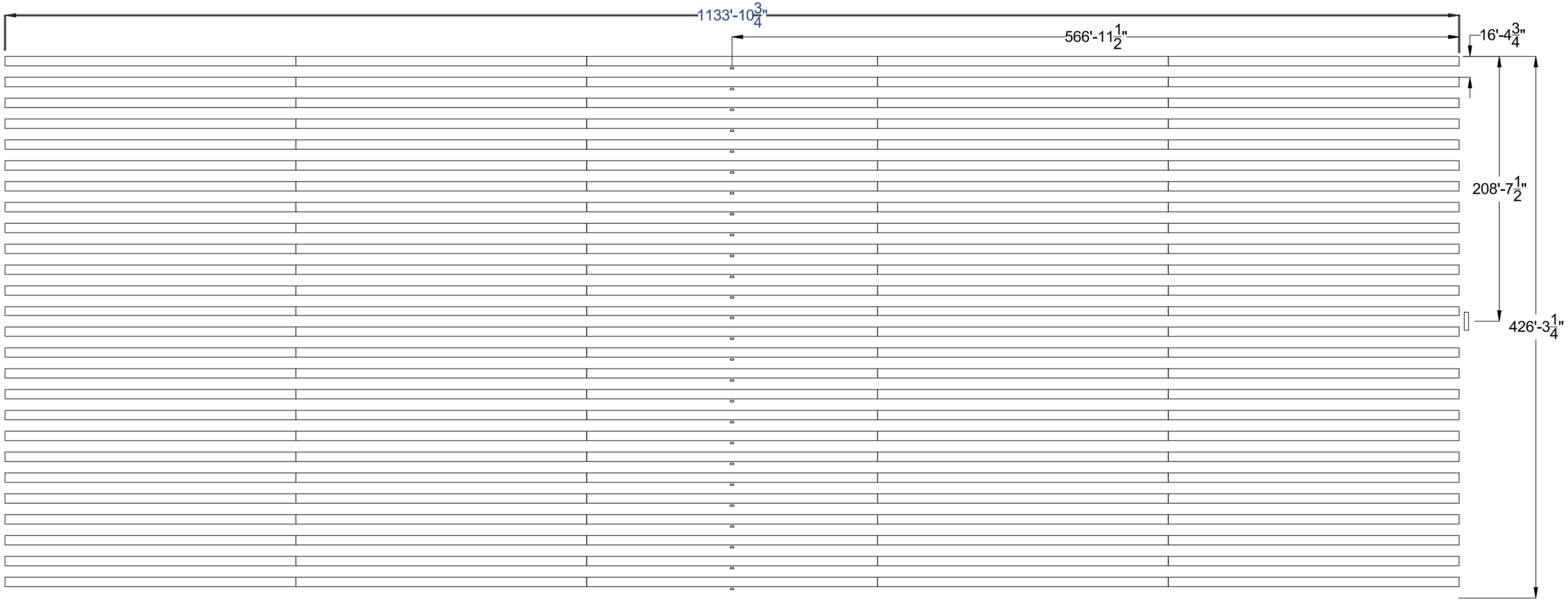
SYSTEM DESIGN – ARRAY LAYOUT



SYSTEM DESIGN – ARRAY LAYOUT

Factors Effecting the Array Layout

- Power generated by one rack
- Inverter capacity
    - Want DC capacity to be 1.3x the inverter capacity
- Ground coverage ratio
    - Effects how much shade is cast onto other panels
- Voltage drop
    - Effects placement of combiner boxes and inverter

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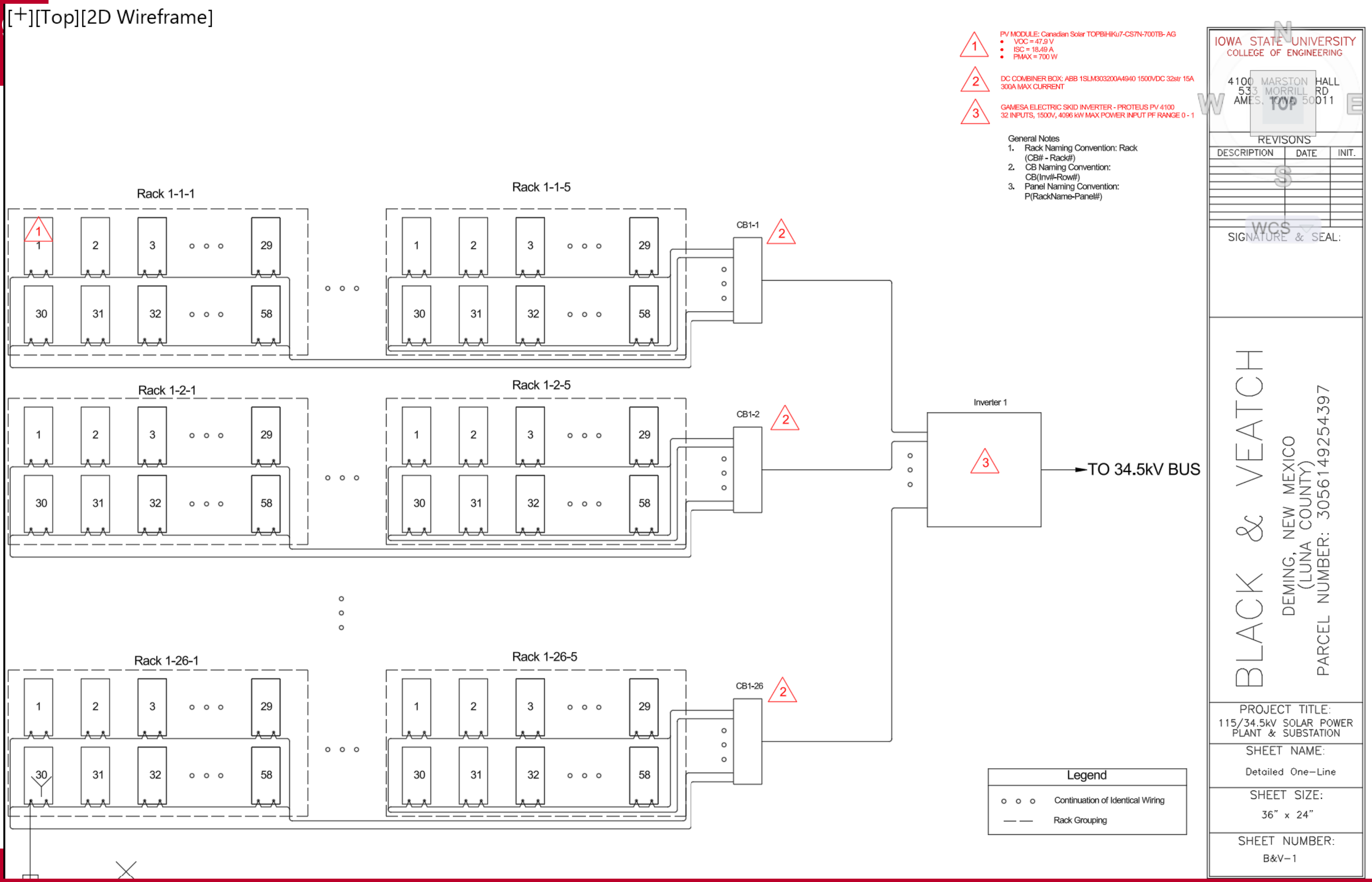
ONE LINE DIAGRAM



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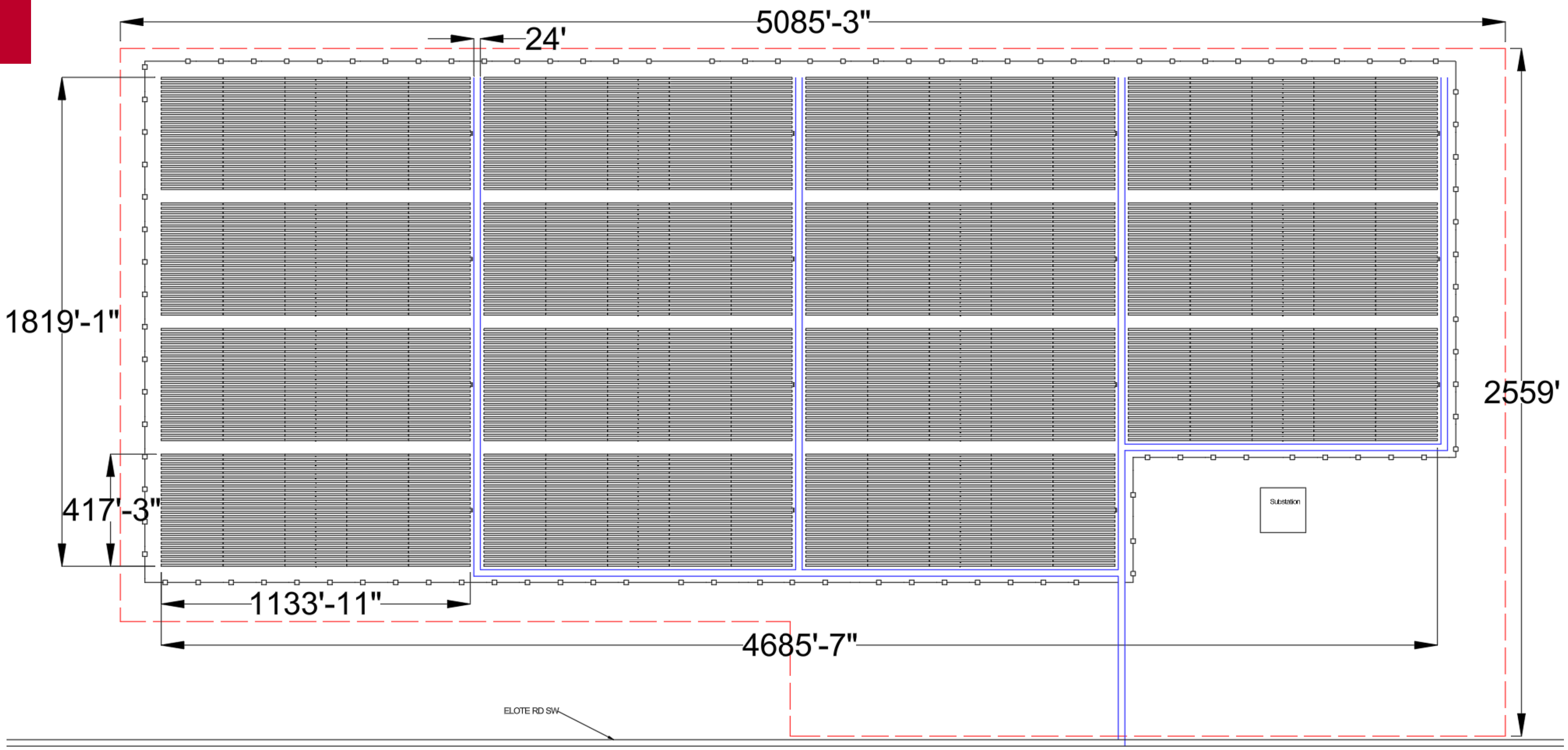
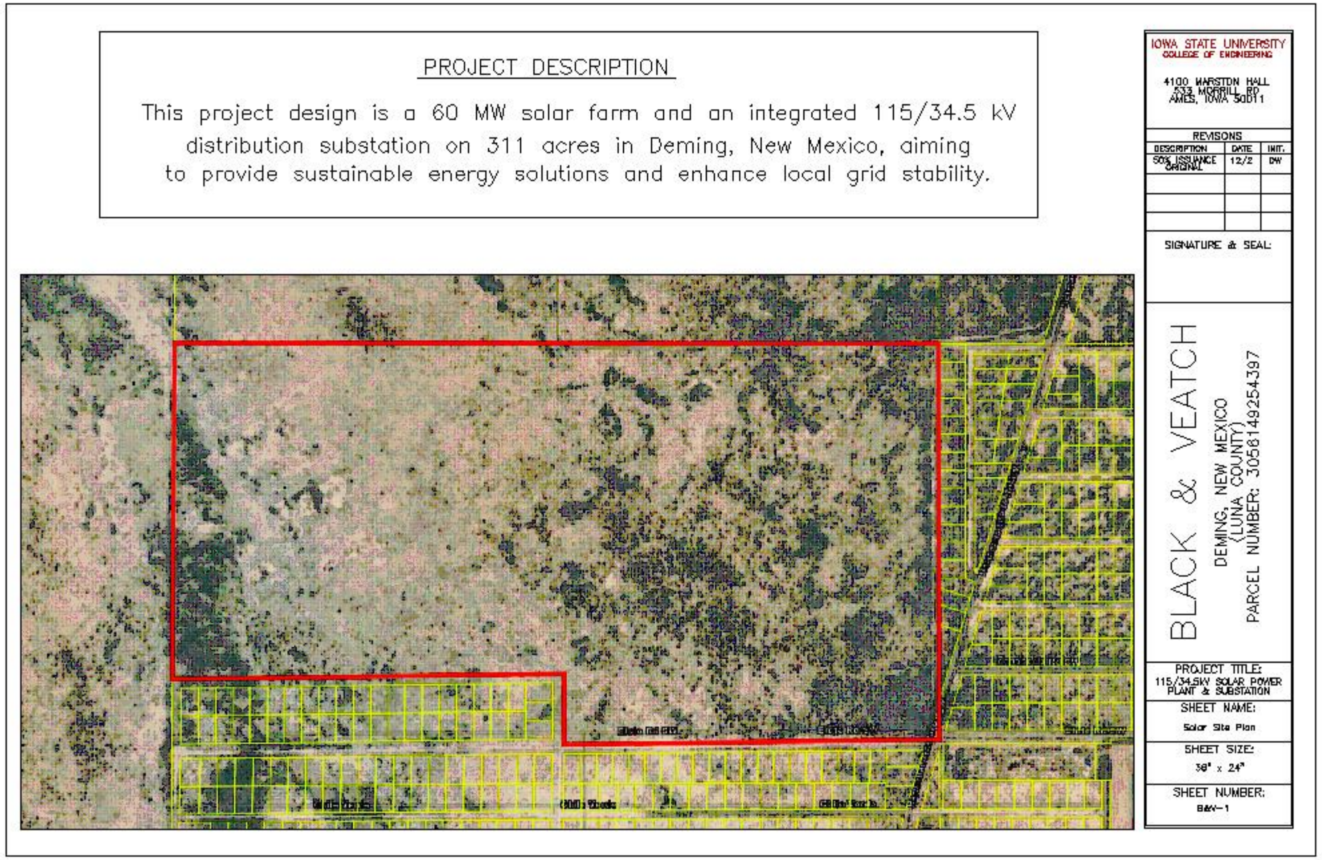
SITE PLAN



PROJECT PLAN



- Project site in Deming, New Mexico
- 311 acres
- Array design fits the plot dimensions

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BILL OF MATERIALS

	A	B	C	D	E	F	G
1	60 MW Solar Farm Components						
2	Component Type	SKU/Model Number	Quantity	Price	Datasheet	Total Quantity Price	Pricing
3	Canadian Solar PV Modules	TOPBiHiKu7 CS7N-700TB-AG	113,100	$223	Link	$25,221,300	Link
4	DC Combiner Boxes	CA1500-24-20S	390	$2,156.00	Link	$840,840	Link
5	Inverters	SLG-330-0279	15	$119,210.14	Link	$1,788,152	Link
6	600 kcmil					$0	
7	Land		311 Acres			$217,700	Link
8	Fencing					$0	
9	Labor		6+ Months @ $24/hr., 50 Workers			$0	Link
10						$0	
11						$0	
12						$0	
13						$0	
14						$0	
15						$0	
16						$0	
17						$0	
18					Total Cost	$28,067,992	

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FALL GANTT CHART

Project: 115/34.5 kV Solar Power Plant & Substation
Company Name: Black & Veatch
Project manag: Adam Schroeder, Eli Schaffer, Utsavee Desai

GANTT CHART

Week 1 9/12/2024 | Week 2 9/12/2024 | Week 3 9/19/2024 | Week 4 10/3/2024 | Week 5 10/10/2024 | Week 6 10/17/2024 | Week 7 10/24/2024 | Week 8 10/31/2024 | Week 9 11/7/2024 | Week 10 11/14/2024 | Week 11 11/21/2024 | Week 12 11/28/2024 | Week 13 12/5/2024 | Week 14 12/12/2024 | Week 15 12/19/2024

	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	TASK COMPLETE
	SOLAR PLANT					
1	**Documentation**					
	Weekly Agenda	All	9/12/2024	12/20/2024	99	☐
	Meeting Minutes	All	9/12/2024	12/20/2024	99	☐
	Weekly Report	All	9/12/2024	12/20/2024	99	☐
	Presentation Slides	All	9/12/2024	12/20/2024	99	☐
	Project Design Document	All	9/12/2024	12/20/2024	99	☐
	Final Report	All	9/12/2024	12/20/2024	99	☐
	Final Presentation	All	9/19/2024	12/20/2024	92	☐
2	**Research**					
	Utility-Grade Solar Panels	Sergio	9/12/2024	9/19/2024	7	☑
	Combiner Boxes	Mohamed	9/12/2024	9/19/2024	7	☑
	Utility-Grade Solar Inverters (skids)	Andrew	9/12/2024	9/19/2024	7	☑
	Safety Moment	Ben	9/12/2024	9/19/2024	7	☑
	Substation Design Overview	Sergio	9/12/2024	9/19/2024	7	☑
	Land Comparison	David	9/12/2024	9/19/2024	7	☑
3	**Component Selection**					
	Solar Component	David	9/19/2024	9/26/2024	7	☑
	Substation Component	All	9/19/2024	9/26/2024	7	☑
	Solar Farm and Substation Location	Sergio	9/19/2024	9/26/2024	7	☑
	Cost Estimation	All	9/19/2024	9/26/2024	7	☑
	Cost Analysis	Dallas	10/3/2024	12/20/2024	78	☑
4	**Array Parameter Calculations (Array parameter tool)**					
	String Size	All	9/19/2024	10/18/2024	30	☐
	Electrical Rack Size	All	9/19/2024	10/18/2024	30	☐
	CB Capacity	All	9/19/2024	10/18/2024	30	☐
	Array Design	Ben	9/19/2024	11/1/2024	53	☐
	Array Size	Ben	9/19/2024	11/1/2024	53	☐
	Total Equipment	David	9/19/2024	11/1/2024	43	☐
	Total Cost and Budget	Andrew	10/10/2024	11/1/2024	22	☐
	Total Power (AC & DC)	All	10/10/2024	10/18/2024	8	☐
	Voltage Drop Calculation	All	10/10/2024	11/1/2024	22	☐
5	**Solar Farm Design & AutoCAD Drawings**					
	Solar Panel Model	Dallas	10/10/2024	11/1/2024	22	☐
	Array	Ben	10/10/2024	11/1/2024	22	☐
	Rack	Ben	10/10/2024	11/1/2024	22	☐
	Solar Layout	Ben & Dallas	10/10/2024	11/1/2024	22	☐
	One Line Diagram	Ben	10/10/2024	11/1/2024	22	☐
	Mounting Structure	Dallas & Sergio	11/2/2024	11/15/2024	13	☐
	Site Plan w/ Measurements	Ben	11/2/2024	11/15/2024	13	☐
	Solar Panel Side View	Dallas & Sergio	11/2/2024	11/15/2024	13	☐
6	**Simulation**					
	Requirements	All				☐
	Simulation	All				☐
7	**Presentation**					
	Presentation	All				☐

1	**Documentation**		
	Weekly Agenda	All	9/12/2024
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	Weekly Report	All	9/12/2024
	Presentation Slides	All	9/12/2024
	Project Design Document	All	9/12/2024
	Final Report	All	9/12/2024
	Final Presentation	All	9/19/2024
2	**Research**		
	Utility-Grade Solar Panels	Sergio	9/12/2024
	Combiner Boxes	Mohamed	9/12/2024
	Utility-Grade Solar Inverters (skids)	Andrew	9/12/2024
	Safety Moment	Ben	9/12/2024
	Substation Design Overview	Sergio	9/12/2024
	Land Comparison	David	9/12/2024
3	**Component Selection**		
	Solar Component	David	9/19/2024
	Substation Component	All	9/19/2024
	Solar Farm and Substation Location	Sergio	9/19/2024
	Cost Estimation	All	9/19/2024
	Cost Analysis	Dallas	10/3/2024

FALL GANTT CHART

4	**Array Parameter Calculations (Array parameter tool)**		
	String Size	All	9/19/2024
	Electrical Rack Size	All	9/19/2024
	CB Capacity	All	9/19/2024
	Array Design	Ben	9/19/2024
	Array Size	Ben	9/19/2024
	Total Equipment	David	9/19/2024
	Total Cost and Budget	Andrew	10/10/2024
	Total Power (AC & DC)	All	10/10/2024
	Voltage Drop Calculation	All	10/10/2024
5	**Solar Farm Design & AutoCAD Drawings**		
	Solar Panel Model	Dallas	10/10/2024
	Array	Ben	10/10/2024
	Rack	Ben	10/10/2024
	Solar Layout	Ben & Dallas	10/10/2024
	One Line Diagram	Ben	10/10/2024
	Mounting Structure	Dallas & Sergio	11/2/2024
	Site Plan w/ Measurements	Ben	11/2/2024
	Solar Panel Side View	Dallas & Sergio	11/2/2024
6	**Simulation**		
	Requirements	All	
	Simulation	All	
7	**Presentation**		
	Presentation	All	

Project: 115/34.5 kV Solar Power Plant & Substation — **Company Name** Black & Veatch

Project manag Adam Schroeder, Eli Schaffer, Utsavee Desai

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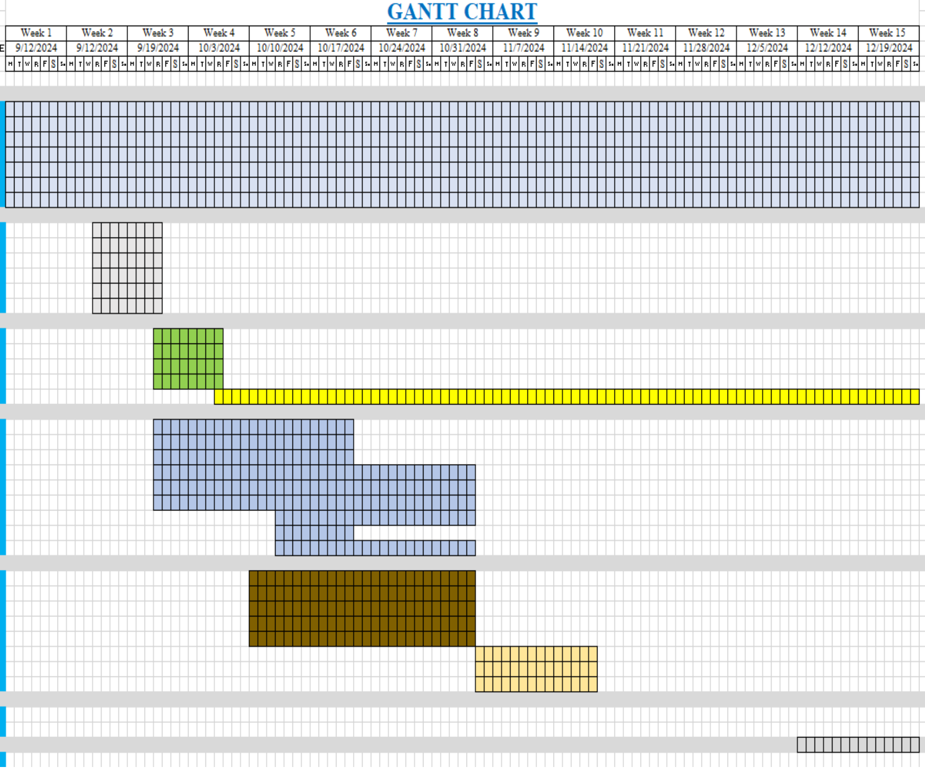
	Safety Moment	Ben	9/12/2024	9/19/2024	7	☑
	Substation Design Overview	Sergio	9/12/2024	9/19/2024	7	☑
	Land Comparison	David	9/12/2024	9/19/2024	7	☑
3	**Component Selection**					
	Solar Component	David	9/19/2024	9/26/2024	7	☑
	Substation Component	All	9/19/2024	9/26/2024	7	☑
	Solar Farm and Substation Location	Sergio	9/19/2024	9/26/2024	7	☑
	Cost Estimation	All	9/19/2024	9/26/2024	7	☑
	Cost Analysis	Dallas	10/3/2024	12/20/2024	78	☑
4	**Array Parameter Calculations (Array parameter tool)**					
	String Size	All	9/19/2024	10/18/2024	30	☐
	Electrical Rack Size	All	9/19/2024	10/18/2024	30	☐
	CB Capacity	All	9/19/2024	10/18/2024	30	☐
	Array Design	Ben	9/19/2024	11/1/2024	53	☐
	Array Size	Ben	9/19/2024	11/1/2024	53	☐
	Total Equipment	David	9/19/2024	11/1/2024	43	☐
	Total Cost and Budget	Andrew	10/10/2024	11/1/2024	22	☐
	Total Power (AC & DC)	All	10/10/2024	10/18/2024	8	☐
	Voltage Drop Calculation	All	10/10/2024	11/1/2024	22	☐
5	**Solar Farm Design & AutoCAD Drawings**					
	Solar Panel Model	Dallas	10/10/2024	11/1/2024	22	☐
	Array	Ben	10/10/2024	11/1/2024	22	☐
	Rack	Ben	10/10/2024	11/1/2024	22	☐
	Solar Layout	Ben & Dallas	10/10/2024	11/1/2024	22	☐
	One Line Diagram	Ben	10/10/2024	11/1/2024	22	☐
	Mounting Structure	Dallas & Sergio	11/2/2024	11/15/2024	13	☐
	Site Plan w/ Measurements	Ben	11/2/2024	11/15/2024	13	☐
	Solar Panel Side View	Dallas & Sergio	11/2/2024	11/15/2024	13	☐
6	**Simulation**					
	Requirements	All				☐
	Simulation	All				☐
7	**Presentation**					
	Presentation	All				☐



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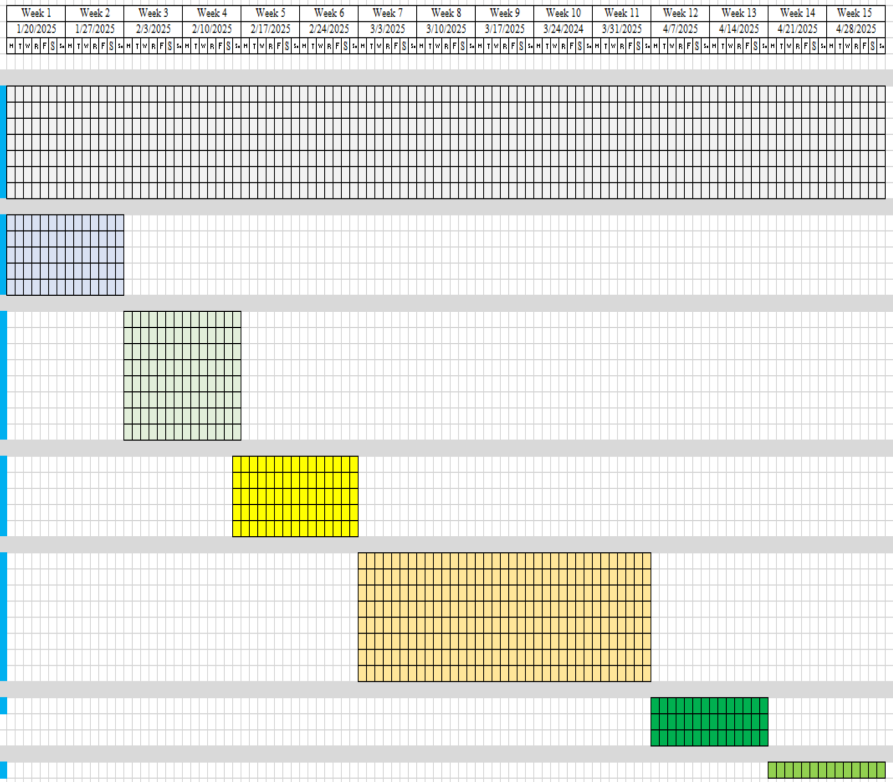
	SUBSTATION					
1	**Documentation**					
	Weekly Agenda	All	1/20/2025	5/2/2025	102	☐
	Meeting Minutes	All	1/20/2025	5/2/2025	102	☐
	Weekly Report	All	1/20/2025	5/2/2025	102	☐
	Presentation Slides	All	1/20/2025	5/2/2025	102	☐
	Project Design Document	All	1/20/2025	5/2/2025	102	☐
	Final Report	All	1/20/2025	5/2/2025	102	☐
	Final Presentation	All	1/20/2025	5/2/2025	102	☐
2	**Research**					
	Substation Components	All	1/20/2025	1/31/2025	11	☐
	Safety Moment	All	1/20/2025	1/31/2025	11	☐
	One Line	All	1/20/2025	1/31/2025	11	☐
	Bus Layouts	All	1/20/2025	1/31/2025	11	☐
	Design Standards	All	1/20/2025	1/31/2025	11	☐
3	**Component Selection**					
	Circuit Breakers	All	2/3/2025	2/14/2025	11	☐
	Transformer	All	2/3/2025	2/14/2025	11	☐
	Switches	All	2/3/2025	2/14/2025	11	☐
	Control Building	All	2/3/2025	2/14/2025	11	☐
	Cables	All	2/3/2025	2/14/2025	11	☐
	Panels	All	2/3/2025	2/14/2025	11	☐
	Relays	All	2/3/2025	2/14/2025	11	☐
	Backup Service Batteries	All	2/3/2025	2/14/2025	11	☐
4	**Calculation & Design**					
	Additional Calculations (AC, DC, lightning protection, etc.)	All	2/16/2025	2/28/2025	12	☐
	Grounding Analysis and Ground-Grid Developed With IEEE-80	All	2/16/2025	2/28/2025	12	☐
	Electrical Layout Drawings (Substation Equipment)	All	2/16/2025	2/28/2025	12	☐
	Load Flow Analysis / AC Arc Flash Study / Protection Element Analysis	All	2/16/2025	2/28/2025	12	☐
	Backup Service Battery Calculations	All	2/16/2025	2/28/2025	12	☐
5	**Substation AutoCAD Drawings**					
	One Line	All	3/3/2025	4/4/2025	32	☐
	Three Line	All	3/3/2025	4/4/2025	32	☐
	AC Schematics	All	3/3/2025	4/4/2025	32	☐
	DC Schematics	All	3/3/2025	4/4/2025	32	☐
	Wiring Diagrams	All	3/3/2025	4/4/2025	32	☐
	Conduit Layout	All	3/3/2025	4/4/2025	32	☐
	General Arrangement	All	3/3/2025	4/4/2025	32	☐
	Building/Physcial Drawings	All	3/3/2025	4/4/2025	32	☐
6	**Simulation of designed substation**					
	ETAP Simulation	All	4/7/2025	4/18/2025	11	☐
	Creation of solar/substation conceptual design-optimizing tool					
7	**Presentation**					
	Faculty Presentation	All	4/21/2025	5/2/2025	11	☐



	SUBSTATION		
1	**Documentation**		
	Weekly Agenda	All	1/20/2025
	Meeting Minutes	All	1/20/2025
	Weekly Report	All	1/20/2025
	Presentation Slides	All	1/20/2025
	Project Design Document	All	1/20/2025
	Final Report	All	1/20/2025
	Final Presentation	All	1/20/2025
2	**Research**		
	Substation Components	All	1/20/2025
	Safety Moment	All	1/20/2025
	One Line	All	1/20/2025
	Bus Layouts	All	1/20/2025
	Design Standards	All	1/20/2025
3	**Component Selection**		
	Circuit Breakers	All	2/3/2025
	Transformer	All	2/3/2025
	Switches	All	2/3/2025
	Control Building	All	2/3/2025
	Cables	All	2/3/2025
	Panels	All	2/3/2025
	Relays	All	2/3/2025
	Backup Service Batteries	All	2/3/2025

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4	**Calculation & Design**		
	Additional Calculations (AC, DC, lightning protection, etc.)	All	2/16/2025
	Grounding Analysis and Ground-Grid Developed With IEEE-80	All	2/16/2025
	Electrical Layout Drawings (Substation Equipment)	All	2/16/2025
	Load Flow Analysis / AC Arc Flash Study / Protection Element Analysis	All	2/16/2025
	Backup Service Battery Calculations	All	2/16/2025
5	**Substation AutoCAD Drawings**		
	One Line	All	3/3/2025
	Three Line	All	3/3/2025
	AC Schematics	All	3/3/2025
	DC Schematics	All	3/3/2025
	Wiring Diagrams	All	3/3/2025
	Conduit Layout	All	3/3/2025
	General Arrangement	All	3/3/2025
	Building/Physcial Drawings	All	3/3/2025
6	**Simulation of designed substation**		
	ETAP Simulation	All	4/7/2025
7	**Presentation**		
	Faculty Presentation	All	4/21/2025

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
1/20/2025	1/27/2025	2/3/2025	2/10/2025	2/17/2025	2/24/2025	3/3/2025	3/10/2025	3/17/2025	3/24/2024	3/31/2025	4/7/2025	4/14/2025	4/21/2025	4/28/2025

	SUBSTATION					
1	**Documentation**					
	Weekly Agenda	All	1/20/2025	5/2/2025	102	☐
	Meeting Minutes	All	1/20/2025	5/2/2025	102	☐
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	Final Presentation	All	1/20/2025	5/2/2025	102	☐
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	Substation Components	All	1/20/2025	1/31/2025	11	☐
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	Relays	All	2/3/2025	2/14/2025	11	☐
	Backup Service Batteries	All	2/3/2025	2/14/2025	11	☐
4	**Calculation & Design**					
	Additional Calculations (AC, DC, lightning protection, etc.)	All	2/16/2025	2/28/2025	12	☐
	Grounding Analysis and Ground-Grid Developed With IEEE-80	All	2/16/2025	2/28/2025	12	☐
	Electrical Layout Drawings (Substation Equipment)	All	2/16/2025	2/28/2025	12	☐
	Load Flow Analysis / AC Arc Flash Study / Protection Element Analysis	All	2/16/2025	2/28/2025	12	☐
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	Wiring Diagrams	All	3/3/2025	4/4/2025	32	☐
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	General Arrangement	All	3/3/2025	4/4/2025	32	☐
	Building/Physcial Drawings	All	3/3/2025	4/4/2025	32	☐
6	**Simulation of designed substation**					
	ETAP Simulation	All	4/7/2025	4/18/2025	11	☐
	Creation of solar/substation conceptual design-optimizing tool					
7	**Presentation**					
	Faculty Presentation	All	4/21/2025	5/2/2025	11	☐

TEST PLAN

ETAP
- Design
- Analysis
- Optimization

CONCLUSIONS

- Schedule Progress
- Group Member Contributions
  - Andrew: Bill of Materials, AutoCAD, Component Research
  - Ben: AutoCAD, Array Parameter Tool, PV Module Research
  - Dallas: PV Module Cost Analysis, Ground Mounting System
  - David: Solar Plant Components Selection, Voltage Drop Calculation
  - Mohamed: Voltage Drop Calculation, Combiner Box Research
  - Sergio: Gantt Chart, AutoCAD, Ground Mounting

- Plans for next semester

Q&A Session

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THANK YOU

| Senior Design Team 41

| 12/10/2024