34.5/115 kV Solar Power Plant & Substation Senior Design Project

Senior Design Team 18 - May 2024

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BLACK & VEATCH

Agenda

- Safety Moment
- Calculation Documents
- AutoCAD Update
- ETAP
- Feedback

Safety Moment - Forklift Safety

Forklift operators and individuals working in proximity to these operations face various hazards like collisions, falls, tip-overs, and being struck. To mitigate these risks, adhere to the following precautions:

Forklift Operations

- Operate the vehicle strictly in accordance with the manufacturer's guidelines.
- Always utilize a seatbelt if the forklift is equipped with one.
- Avoid surpassing the rated load capacity and ensure stability and balance.
- Refrain from raising or lowering the load while in motion.
- Maintain a safe distance from platform and ramp edges.
- Remain vigilant of other vehicles within the operational area.
- Ensure clear visibility of the work zone and verify adequate clearance when raising, loading, and maneuvering the forklift.
- Utilize proper footing and handholds, if provided, when entering the lift.
- Employ horns at cross aisles and obstructed areas.
- Exercise caution around pedestrians and adhere to designated speed limits.
- Prohibit giving rides or using the forks to lift individuals.

Reference: Occupational Safety and Health Administration (OSHA)

Safety Training

- Only permit trained and certified personnel to operate a forklift.
- Ensure operators receive training specific to the types of trucks in use.

Forklift Maintenance

- Withdraw from service any forklift identified as being in an unsafe operational state.
- Maintain forklifts in a clean condition, devoid of excess oil and grease.
- Conduct repairs and maintenance as per the manufacturer's recommendations.

Source Link Image Link

Calculations - BOM

Solar Component

Component Type	SKU/Model Number	Quantity	Price	Datasheet Link	Total Price	Pricing Link
PV Panels	ZXM7-SHDB144-550/M	143250	$270.00	Link	$38,677,500.00	Link
Combiner Boxes	BHSZ-16-1-1500V	360	$1,921.00	Link	$691,560.00	Link
Inverters	PVS980-MWS-4000kVA-K-34.5-Dry	15	$200,000.00	Link	$3,000,000.00	Page 31
2" Conduit	2 in. x 10 ft. Sch. 40 PVC Conduit	1331	$25.90		$34,472.90	Link
3" Conduit	3 in. x 10 ft. PVC Schedule 40 Conduit	798	$60.78		$48,502.44	Link
600 MCM		21128.92	$15.65		$330,667.60	Link
10 AWG		1395	$0.38		$530.10	Link
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
				Total Solar Farm Cost	$42,783,233.04	

Misc Component

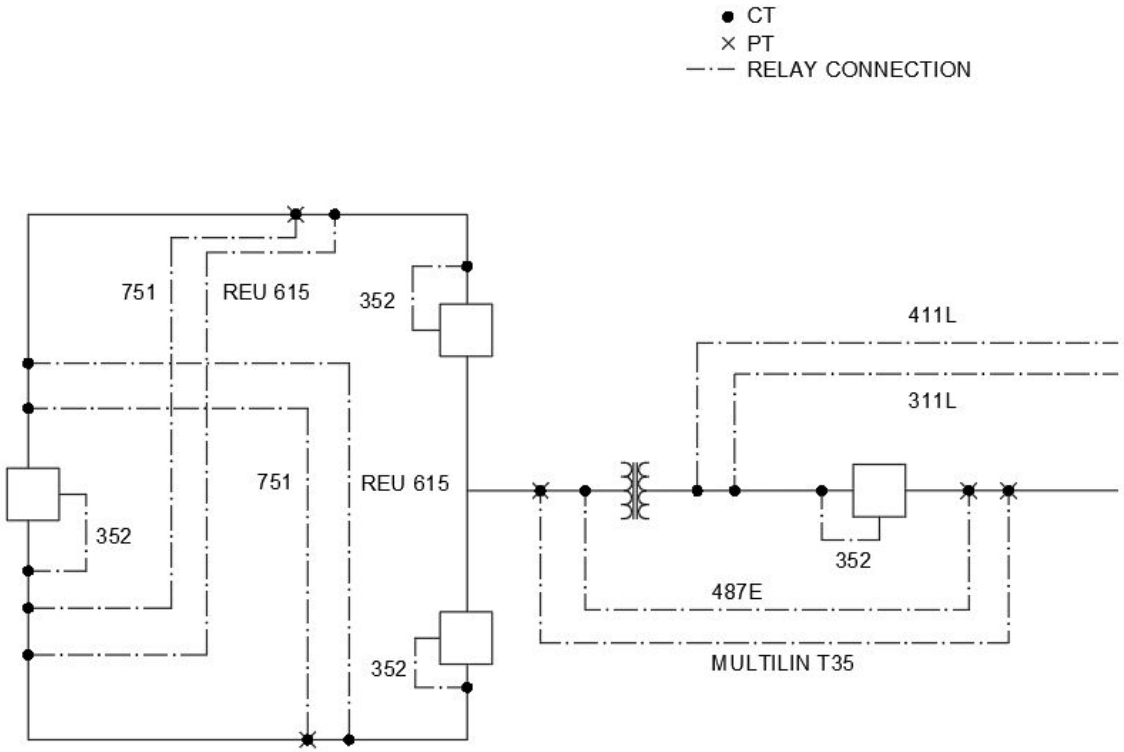
Component Type	SKU/Model Number	Quantity	Price	Datasheet/Website Link	Total Price	Pricing Link
Bus Bars					$0.00	
Fence (50' Segment)		340	$633.00		$215,220.00	Link
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
				Total Misc Cost	$215,220.00	

Substation Component

Component Type	SKU/Model Number	Quantity	Price	Datasheet/Website Link	Total Price	Pricing Link
SEL-411L	0411L1X6X1C7CDXH5C424XX	1	$11,170.00	Link	$11,170.00	Link
SEL-311L	0311L03C0325XXXX	1	$6,920.00	Link	$6,920.00	Link
SEL-487E	0487E3X611XXC5X5H675XXX	1	$8,860.00	Link	$8,860.00	Link
GE Multilin T35	T35J03AKHF8MH6DM8RP6EU67WXX	1	$4,500.00	Link	$4,500.00	Link
SEL-751	751301ACA3A70851F00	2	$1,270.00	Link	$2,540.00	Link
ABB REU615	2rca025340a0001b	2	$750.00	Link	$1,500.00	Link
SEL-352	035211425H2X4XX	4	$4,690.00	Link	$18,760.00	Link
CB1	OHB 36.25.25	3	$35,000.00	Link	$105,000.00	Circuit Breaker (35 kV)
CB2	SPS2-123-40-2	1	$95,500.00	Link	$95,500.00	Circuit Breaker (115kV)
DS1	EV-H	8	$7,000.00	Link	$56,000.00	Discon. Switch (34.5 kV)
DS2	65742-A	2	$20,000.00	Link	$40,000.00	Discon. Switch (138 kV)
LA1	PEXLIM Q36-XN36 (H)	6	$500.00	Link	$3,000.00	Surge Arrestor (34.5kV)
LA2	AZES013G115144	3	$2,000.00	Link	$6,000.00	Surge Arrestor (138kV)
T1 (Power XFMR)	SF-9000000/15	1	$2,000,000.00	Link	$2,000,000.00	Page 7
T2 (Station Power)	MT-PML-R50-1P-GMA-50KVA-SZ-LT-DF-Z6-BB-CS-2BZ-M1	1	$18,641.04	Link	$18,641.04	Link
CT1	G953000DA	24		Link	$0.00	
CT2	OSKF123	6	$15,000.00	Link	$90,000.00	Current XFMR (138kV)
PT1	G840520TA	3	$2,000.00	Link	$6,000.00	Volt XFMR (34.5kV)
PT2	Unavailable	1	$7,000.00	Link	$7,000.00	Cap Volt XFMR (138kV)
Battery MTS	GF224NR	1	$842.73	Link	$842.73	Link
Battery Backup	3CA-5M	20	$1,152.75	Link	$23,055.00	Link
				Total Substation Cost	$2,505,288.77	

Total Project Materials Cost	$45,420,766.47

AutoCAD - Updates



ST TABLE

SHEET NUMBER	SHEET TITLE
SS100	SUB DESIGN SYMBOLS
SS101	SUB ONE-LINE
SS102	SUB KEY PLAN
SS103	SUB ONE-LINE DETAILS
SS104	SUB GROUNDING INFO
SS105	SUB THREE-LINE
SS106	SUB ONE-LINE PLAN VIEW
SS107	SUB SECTION VIEW
SS108	SUB SITE ENLARGED
SS109	SUB RELAY INFO
SS110	CB1-X DATASHEET
SS111	CB2-X DATASHEET
SS112	DS1-X DATASHEET
SS113	DS2-X DATASHEET
SS114	LA1-X DATASHEET
SS115	LA2-X DATASHEET
SS116	T1 NAMEPLATE

AutoCAD - Sheet Ordering

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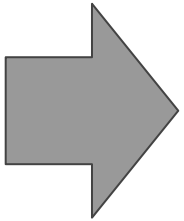

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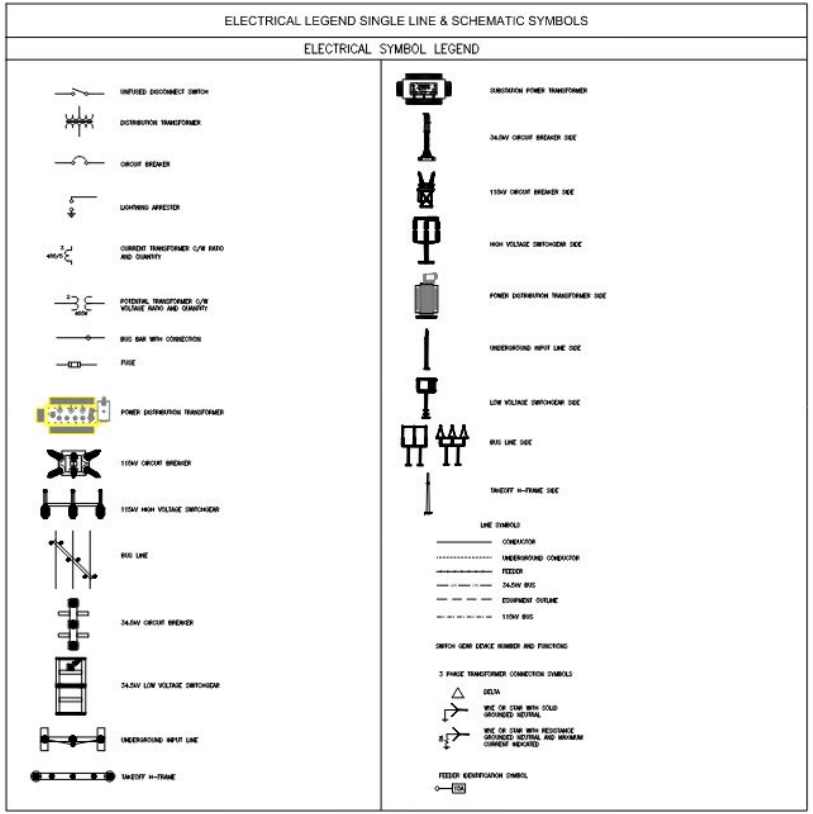

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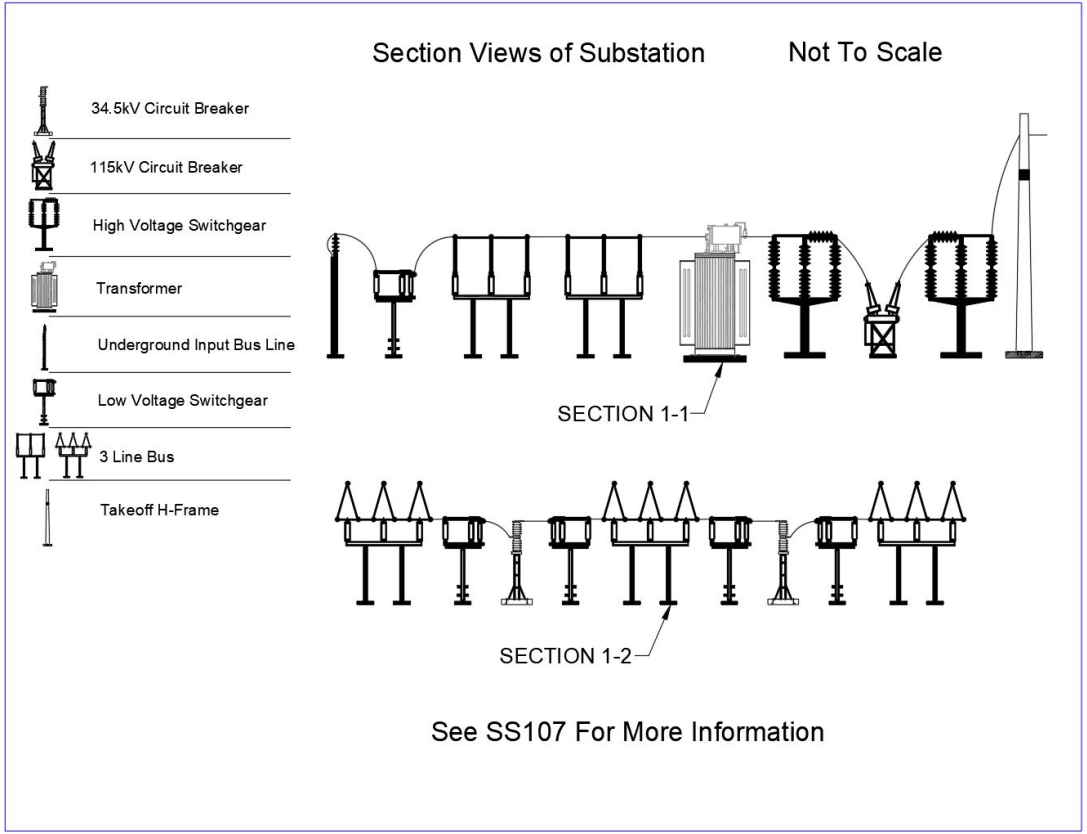

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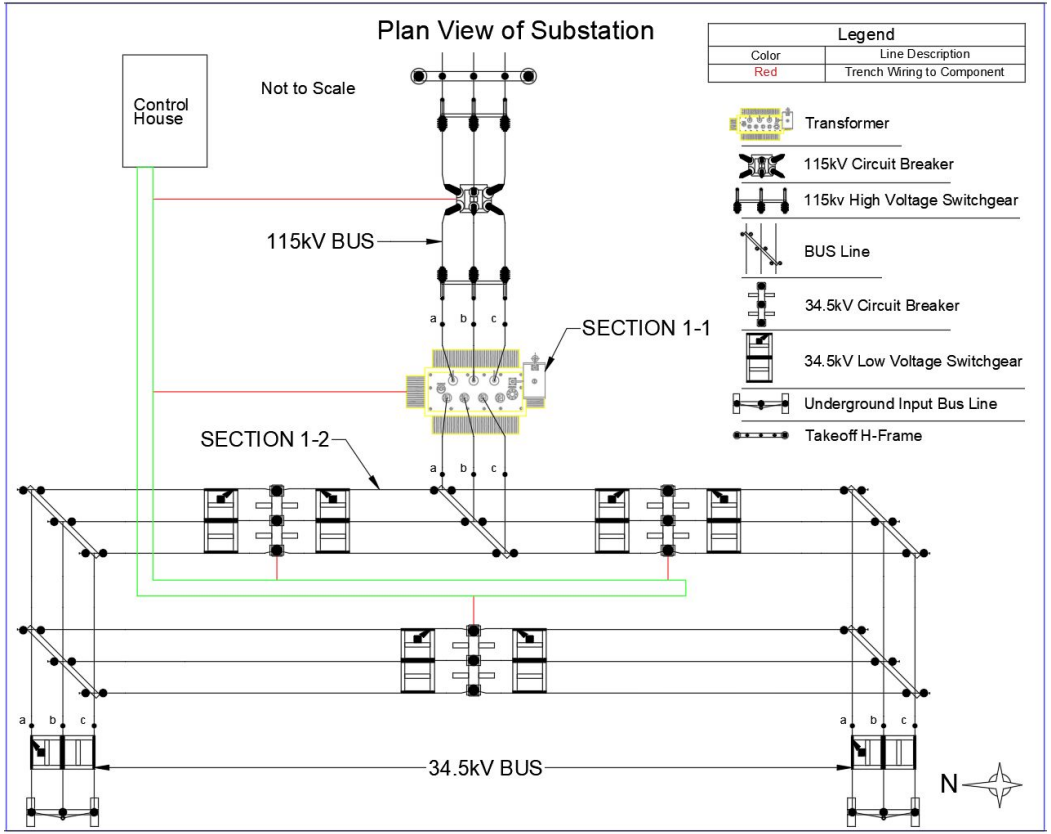

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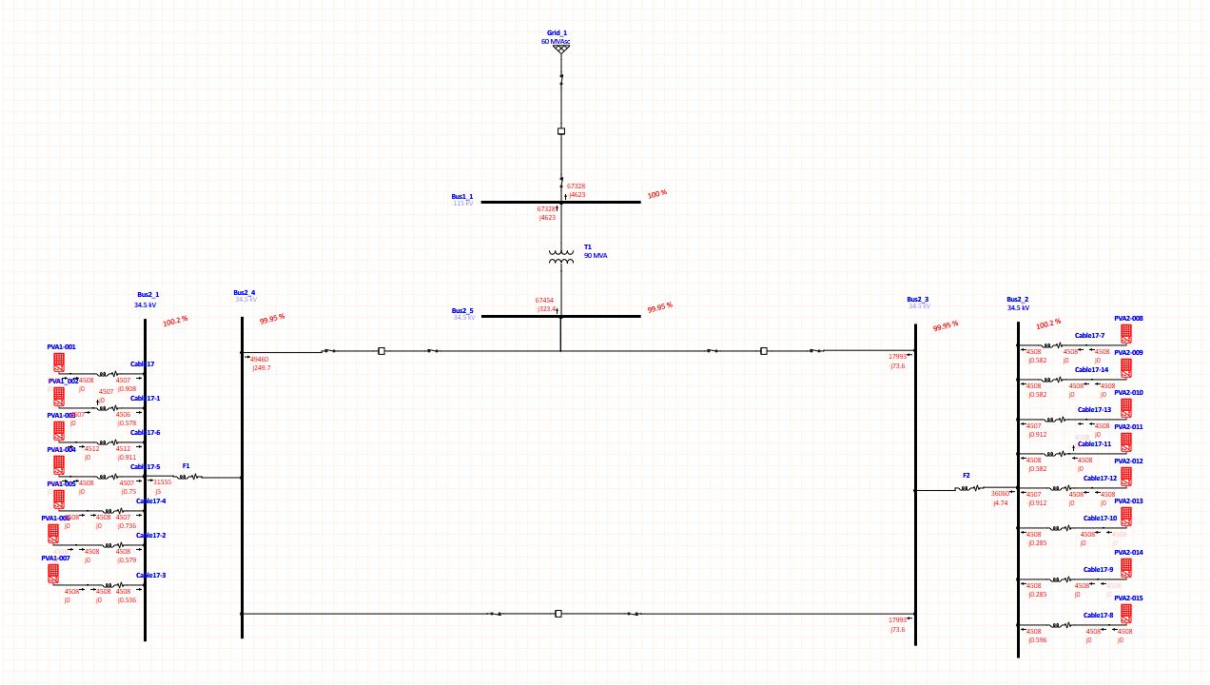
ETAP PV & Substation Power Flow Analysis



ETAP PV & Substation Power Flow Analysis

ID	Rating/Limit	Rated kV	MW	Mvar	Amp	% PF	% Generation
Grid_1	60 MVA	115	-67.328	4.623	338.8	-99.77	
PVA1-001	4 MW	34.5	4.508	0	75.26	100	112.4
PVA1_002	4 MW	34.5	4.507	0	75.24	100	112.4
PVA1-003	4 MW	34.5	4.512	0	75.32	100	112.5
PVA1-004	4 MW	34.5	4.508	0	75.26	100	112.4
PVA1-005	4 MW	34.5	4.508	0	75.26	100	112.4
PVA1-006	4 MW	34.5	4.508	0	75.26	100	112.4
PVA1-007	4 MW	34.5	4.508	0	75.26	100	112.4
PVA2-008	4 MW	34.5	4.508	0	75.31	100	112.5
PVA2-009	4 MW	34.5	4.508	0	75.31	100	112.5
PVA2-010	4 MW	34.5	4.508	0	75.31	100	112.5
PVA2-011	4 MW	34.5	4.508	0	75.31	100	112.5
PVA2-012	4 MW	34.5	4.508	0	75.31	100	112.5
PVA2-013	4 MW	34.5	4.508	0	75.32	100	112.5
PVA2-014	4 MW	34.5	4.508	0	75.32	100	112.5
PVA2-015	4 MW	34.5	4.508	0	75.31	100	112.5

A	B	C	D	E	F	G	H
Bus ID	Nominal kV	Voltage	MW Loading	Mvar Loading	Amp Loading		
Bus1_1	115	100	67.328	4.623	338.8	High side of xfm	
Bus2_1	34.5	100.23	31.555	0.005	526.8	PV to Feeder 1	
Bus2_2	34.5	100.16	36.06	0.0047	602.5	PV to Feeder 2	
Bus2_3	34.5	99.95	35.987	0.147	602.5	Feeder 2 to Ring bus	
Bus2_4	34.5	99.95	49.46	0.25	828.1	Feeder 1 to Ring bus	
Bus2_5	34.5	99.95	67.454	0.323	1129	Low side of xfm	

ETAP PV & Substation short circuit

ID	Nominal kV	Type	Vf (%)	Bracing Symm. kA	Bracing Asymm. kA	Bracing Peak kA	Symm. kA	Asymm. kA	Peak kA	M.F.	X/R Ratio	NACD	Standard
Bus1_1	115	Other	100				0.3508883	0.3508883	0.496231	1	0.05160001	1	IEEE C37.10
Bus2_1	34.5	Other	100				1.163947	1.163947	1.64607	1	0.1177732	1	IEEE C37.10
Bus2_2	34.5	Other	100				1.163718	1.163718	1.645745	1	0.1142611	1	IEEE C37.10
Bus2_3	34.5	Other	100				1.165014	1.165014	1.647578	1	0.1080628	1	IEEE C37.10
Bus2_4	34.5	Other	100				1.165014	1.165014	1.647578	1	0.1080628	1	IEEE C37.10
Bus2_5	34.5	Other	100				1.165014	1.165014	1.647578	1	0.1080628	1	IEEE C37.10

ID	kV	Type	CPT (Cycle)	Bus	Rated Mom. Asymm. kA	Rated Mom. Peak kA	Rated Int. Adj. kA	Rated Int. kA	Int. Adj. Symm kA
CB01_1	34.5	5 cy Sym CB	3	Bus2_4	26	43	16	16	1.165014
CB01_2	34.5	5 cy Sym CB	3	Bus2_3	26	43	16	16	1.165014
CB01_3	34.5	5 cy Sym CB	3	Bus2_3	26	43	16	16	1.165014

Questions

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Feedback and Updates

- Tasks: Updates
  - Bell: Design documents
  - Liam:
  - Eli:
  - Baylor:
  - Eduardo:
  - Chicheng: