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

Senior Design Team 18 - May 2024

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BLACK & VEATCH

STATE

Eli

Agenda

- Safety Moment
- Updated AutoCAD Drawings
- One line Fuses
- Voltage Drop for Faculty Mentor
- Feedback and Updates

Proper Ergonomics - Baylor

- As engineers, often find ourselves spending long periods of time at our desks
- Important to maintain good posture to reduce risk of injury and problems later down the line
- Standing Desks can be great addition to workspace
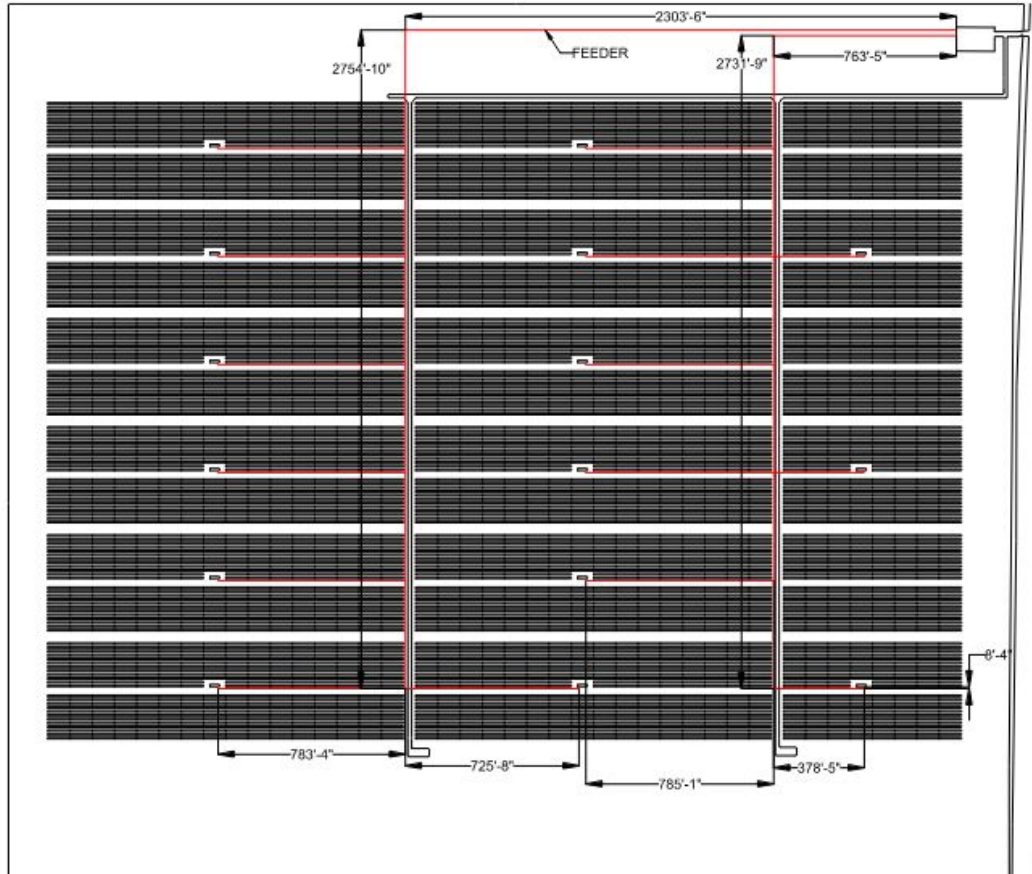 - Many physical benefits while being able to stay productive at desk

WRONG SITTING POSTURE

CORRECT SITTING POSITION

CORRECT STANDING POSITION
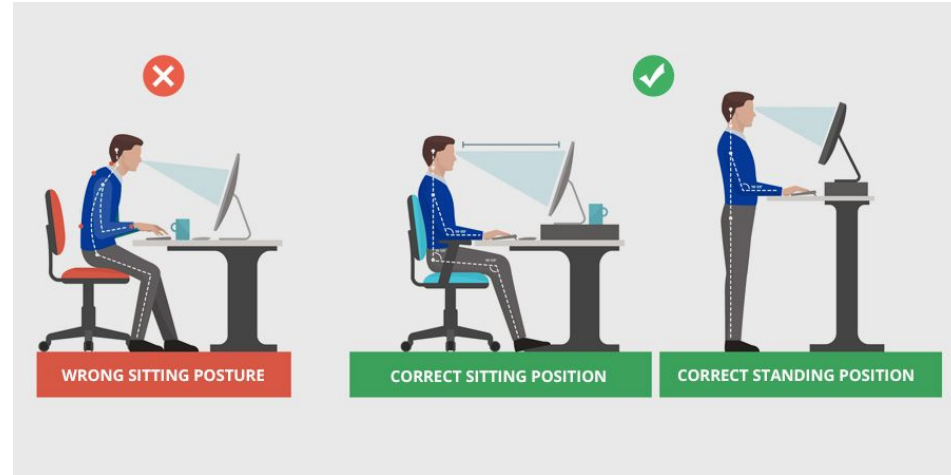
Review Set

- Baylor sent over a set on Friday
- Will incorporate changes to final sheet set

SHEET LIST TABLE	
SHEET NUMBER	**SHEET TITLE**
E100	PROJECT TITLE
S100	SITE PLAN
S101	SITE KEYPLAN
S102	SITE WIRING
PV100	SOLAR KEY PLAN
PV101	OVERALL ARRAY LAYOUT
PV102	ARRAYS 1 - 12 LAYOUT
PV103	ARRAYS 13 - 15 LAYOUT
PV104	WIRING ARRAYS 1 - 12
PV105	WIRING ARRAYS 13 - 15
PV106	SOLAR DESIGN DETAILS
PV107	AC ONE LINE
PV108	DC ONE LINE
PV109	STRING ONE LINE
PV110	PANEL DATASHEET
PV111	COMBINER BOX DATASHEET
PV112	SKID INVERTER DATASHEET

Site Feeder Plan

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PV106	SOLAR DESIGN DETAILS
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PV112	SKID INVERTER DATASHEET

Fuse Calculations

- NEC sections 240.6 and 690.9 go over PV systems and fuse ratings

- Isc worst case = 13.89 A (Nominal Isc) * 1.25 * 1.25 = 21.71 A

- Isc worst case total = 21.71 A * 16 (Number of strings) = 347.25 A

- Next highest fuse rating = 25 A for single, 350 A for total

Updated DC One-line
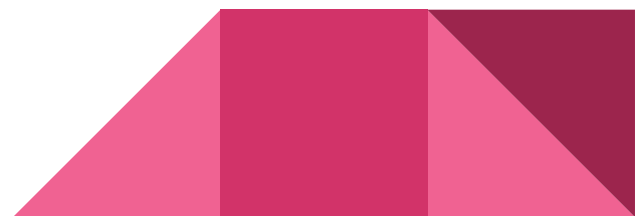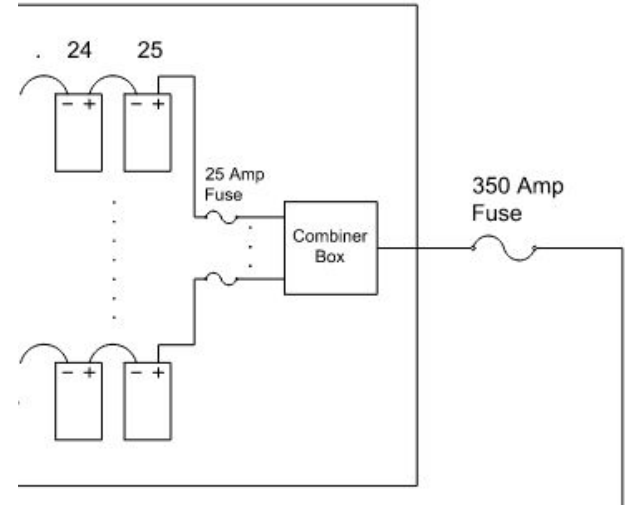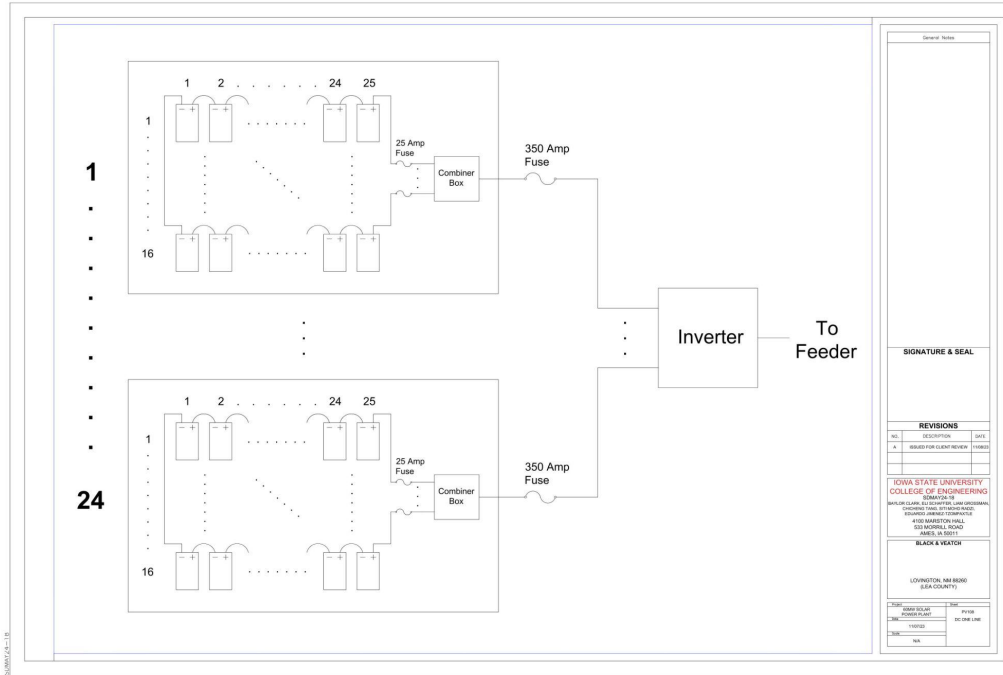
Updated Voltage Drop (Horizontal)

We change AWG from 12 to 10

Voltage-Drop Calculation = <3%

Resources	NEC Table 8 Conductor Properties
	NEC AWG Chart

16 racks Combiner box (Horizontal Array)

DCB	Strings per rack	ISC for string	String length	String wire size	String conductor resistance	String resistance	Voltage drop of string(AWG #12)	Voltage drop of string
DCB#-##	per rack	Amp	feet	AWG	ohm/kft	ohm	Volts	%
DCB1-01	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-02	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-03	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-04	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-05	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-06	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-07	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-08	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-09	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-10	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-11	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-12	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-13	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-14	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-15	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-16	1	13.89	93	10	1.24	0.11532	3.204	0.214

AWG=600

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	16	222.24	161	600	0.0241	0.004	1.725	0.11	8.13	1500	0.54
DCB2	16	222.24	151	600	0.0241	0.004	1.618	0.11	8.02	1500	0.53
DCB3	16	222.24	141	600	0.0241	0.003	1.510	0.10	7.92	1500	0.53
DCB4	16	222.24	131	600	0.0241	0.003	1.403	0.09	7.81	1500	0.52
DCB5	16	222.24	121	600	0.0241	0.003	1.296	0.09	7.70	1500	0.51
DCB6	16	222.24	111	600	0.0241	0.003	1.189	0.08	7.60	1500	0.51
DCB7	16	222.24	101	600	0.0241	0.002	1.082	0.07	7.49	1500	0.50
DCB8	16	222.24	91	600	0.0241	0.002	0.975	0.06	7.38	1500	0.49
DCB9	16	222.24	81	600	0.0241	0.002	0.868	0.06	7.27	1500	0.48
DCB10	16	222.24	71	600	0.0241	0.002	0.761	0.05	7.17	1500	0.48
DCB11	16	222.24	61	600	0.0241	0.001	0.653	0.04	7.06	1500	0.47
DCB12	14	222.24	51	600	0.0241	0.001	0.546	0.04	6.95	1500	0.46
DCB13	14	222.24	41	600	0.0241	0.001	0.439	0.03	6.85	1500	0.46
DCB14	16	222.24	82	600	0.0241	0.002	0.878	0.06	7.29	1500	0.49
DCB15	16	222.24	92	600	0.0241	0.002	0.986	0.07	7.39	1500	0.49
DCB16	16	222.24	102	600	0.0241	0.002	1.093	0.07	7.50	1500	0.50
DCB17	16	222.24	112	600	0.0241	0.003	1.200	0.08	7.61	1500	0.51
DCB18	16	222.24	122	600	0.0241	0.003	1.307	0.09	7.71	1500	0.51
DCB19	16	222.24	132	600	0.0241	0.003	1.414	0.09	7.82	1500	0.52
DCB20	16	222.24	142	600	0.0241	0.003	1.521	0.10	7.93	1500	0.53
DCB21	16	222.24	152	600	0.0241	0.004	1.628	0.11	8.04	1500	0.54
DCB22	16	222.24	162	600	0.0241	0.004	1.735	0.12	8.14	1500	0.54
DCB23	16	222.24	172	600	0.0241	0.004	1.842	0.12	8.25	1500	0.55
DCB24	16	222.24	182	600	0.0241	0.004	1.950	0.13	8.36	1500	0.56
									Average of worst-case DCB Voltage drop (%)		0.51

Updated Voltage Drop (Vertical)

We change AWG from 12 to 10

Voltage-Drop Calculation = <3%

16 racks Combiner box (Vertical Array)

DCB	Strings per rack	ISC for string	String length	String wire size	String conductor resistance	String resistance	Voltage drop of string (AWG=12)	Voltage drop of string
DCB#-##	per rack	Amp	feet	AWG	ohm/kft	ohm	Volts	%
DCB1-01	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-02	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-03	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-04	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-05	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-06	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-07	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-08	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-09	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-10	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-11	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-12	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-13	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-14	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-15	1	13.89	93	10	1.24	0.11532	3.204	0.214
DCB1-16	1	13.89	93	10	1.24	0.11532	3.204	0.214

AWG= 600, diameter = 22-32mm

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	16	222.24	607	600	0.0214	0.013	5.774	0.38	12.181	1500	0.81
DCB2	16	222.24	585	600	0.0214	0.013	5.564	0.37	11.972	1500	0.80
DCB3	16	222.24	563	600	0.0214	0.012	5.355	0.36	11.762	1500	0.78
DCB4	16	222.24	541	600	0.0214	0.012	5.146	0.34	11.553	1500	0.77
DCB5	16	222.24	519	600	0.0214	0.011	4.937	0.33	11.344	1500	0.76
DCB6	16	222.24	497	600	0.0214	0.011	4.727	0.32	11.135	1500	0.74
DCB7	16	222.24	440	600	0.0214	0.009	4.185	0.28	10.592	1500	0.71
DCB8	16	222.24	418	600	0.0214	0.009	3.976	0.27	10.383	1500	0.69
DCB9	16	222.24	396	600	0.0214	0.008	3.767	0.25	10.174	1500	0.68
DCB10	16	222.24	374	600	0.0214	0.008	3.557	0.24	9.965	1500	0.66
DCB11	16	222.24	352	600	0.0214	0.008	3.348	0.22	9.755	1500	0.65
DCB12	14	222.24	330	600	0.0214	0.007	3.139	0.21	9.546	1500	0.64
DCB13	14	222.24	258	600	0.0214	0.006	2.454	0.16	8.861	1500	0.59
DCB14	16	222.24	236	600	0.0214	0.005	2.245	0.15	8.652	1500	0.58
DCB15	16	222.24	214	600	0.0214	0.005	2.036	0.14	8.443	1500	0.56
DCB16	16	222.24	192	600	0.0214	0.004	1.826	0.12	8.233	1500	0.55
DCB17	16	222.24	170	600	0.0214	0.004	1.617	0.11	8.024	1500	0.53
DCB18	16	222.24	148	600	0.0214	0.003	1.408	0.09	7.815	1500	0.52
DCB19	16	222.24	91	600	0.0214	0.002	0.866	0.06	7.273	1500	0.48
DCB20	16	222.24	113	600	0.0214	0.002	1.075	0.07	7.482	1500	0.50
DCB21	16	222.24	135	600	0.0214	0.003	1.284	0.09	7.691	1500	0.51
DCB22	16	222.24	157	600	0.0214	0.003	1.493	0.10	7.901	1500	0.53
DCB23	16	222.24	179	600	0.0214	0.004	1.703	0.11	8.110	1500	0.54
DCB24	16	222.24	201	600	0.0214	0.004	1.912	0.13	8.319	1500	0.55
									Average of worst-case DCB Voltage drop		0.63

Feedback and Updates

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