

EE 491 – sdmay19-26

115kV / 34.5kV SOLAR POWER PLANT/SUBSTATION DESIGN PROJECT

Week 8 Report

Monday (10/22/2018) – Sunday (10/28/2018)

Client: Black & Veatch

Advisor: Venkataramana Ajjarapu

Team Email: sdmay19-26@iastate.edu

Team Members:

Katayi Katanga – Communication Leader

Nur Shuazlan – Meeting Scribe

Yao Cheah – Website Manager #1

Ahmed Sobi – Team Leader/Layout Designer #1

Chufu Zhou – Website Manager #2/Layout Designer #2

Tam Nguyen – Report Manager

Weekly Summary:

In this week, we had a meeting with the client, and we talked about array wiring diagram, conductor sizing and type, voltage drop calculations, collector AutoCAD and parameters calculation, and feeder drawing. Then, we kept the same groups to finalize the drawings for the solar power plant, collector, and feeder. Also, we started choosing conductors based on the client's demand.

Summary of Client/Advisor Meeting:

- Chufu did safety moment about earthquake and how to take precaution.
- First, we talked about Array Wiring Diagram and Conductor Sizing and types. Katayi discussed the array wiring diagram based on the AutoCAD drawings, showing the wiring and how every CB is connected with one underground conductor that takes the current to inverter. The diagram also shows the wiring of each rack to the combiner boxes. However the below tables and values are under revision as it was pointed out on the meeting the table was used for the conductor sizing was wrong. Students should have picked the size based on the current and safety factor not the voltage.
- Then, we talked about Voltage Drop Calculations. This week draft of the voltage drop calculation was continuation of last week draft as we were trying to gain more understanding and get the right calculation. However as was discussed in the meeting the below calculation will be improved next week based on picking the optimal conductor sizing. Next week the students will change the length and voltage drop calculation of the cables because there are 2 inputs going to one CB instead of 8 inputs.
- Lastly, we talked about Collector & Feeder AutoCAD and Calculations. Students continued last week approach in order to gain more understanding of collector system and feeder. This week we took a crack at the calculation to figure out the transformer rating, inverter rating, and the current coming out of each collector. After the meeting the student understood that

they were using the wrong transformer rating which is AUX XFMR, instead we will be using the step-up XFMR parameters to get the output current. Overall we have 3 feeders attached to 34.5 KV bus. And each feeder will have 4 collector attached to it. And each collector will join and collect 3 inverter skid output. Input to 34.5 kV bus.

Past Week Accomplishments:

Katayi and Nur:-

- Continued to work on DC Voltage drop and conductor sizing

CBs 1-10, 13-22					
Conductors	Isc(A)	IMP(A)	Type	Material	AWG
String (Harness)	9.44	14.75	free air	Copper	12
Rack to CB (Jumper)	18.88	118	free air	Copper	2/0
CB to Inverter	75.52	236	Underground	Copper	400 kcmil

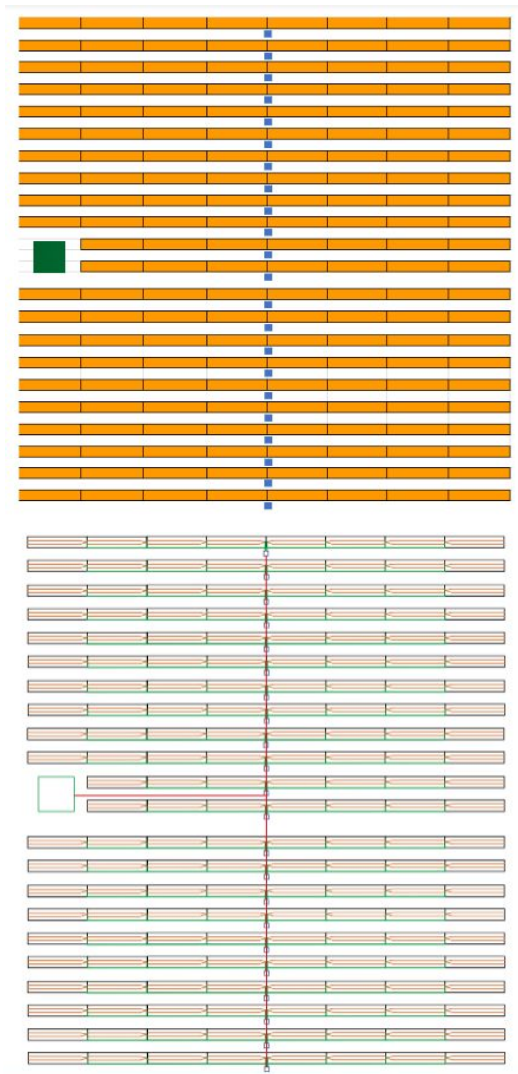
CBs 11 and 12					
Conductors	Isc(A)	IMP(A)	Type	Material	AWG
String (Harness)	9.44	14.75	Free Air	Copper	12
Rack to CB (Jumper)	18.88	118	Free Air	Copper	2/0 *
CB to Inverter (Feeder)	66.08	206.5	Underground	Copper	300 kcmil

NOTE: * Input racks 1 to 3 have a wire size of 1 AWG

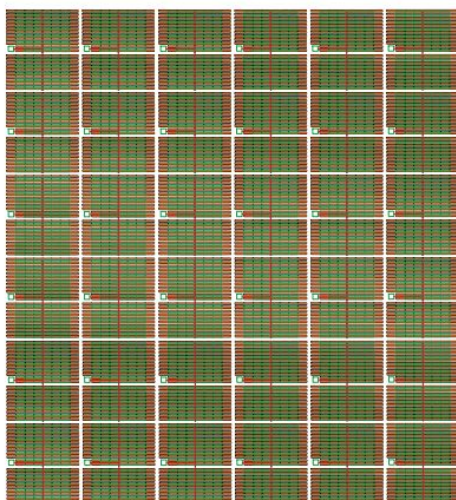
Voltage drop for circuit per cent
0.83%
0.82%
0.80%
0.79%
0.78%
0.76%
0.75%
0.74%
0.72%
0.71%
0.69%
0.71%
0.73%
0.74%
0.76%
0.77%
0.78%
0.80%
0.81%
0.82%
0.84%
0.85%
0.77%

Average of worst-case DCB voltage drop:	0.77%
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- also updated the layout of a single array and created the wiring diagram on AutoCAD



	Wire Harness
	Jumper
	Feeder wire



Ahmed and Chufu:

- collector calculation

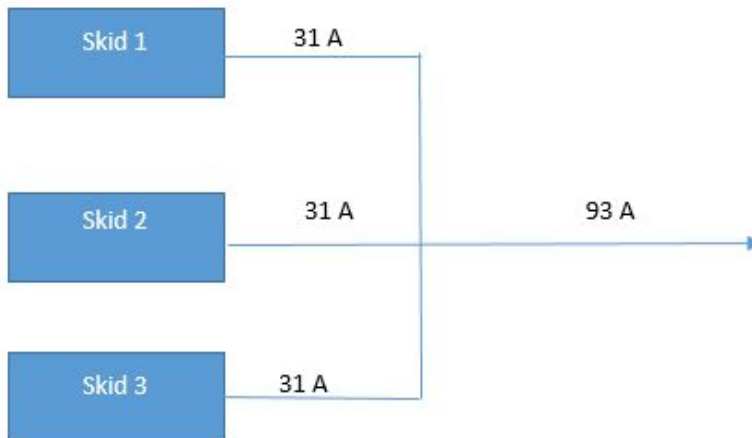
Transformer rating:

Max current of the inverter = 3000 A
Rated output voltage = 357 V
Transformer rating = $(3000 \times 357 \times 1.732) = 1854 \text{ KVA}$
Eaton 1666 KVA inverter output is 1831 KVA

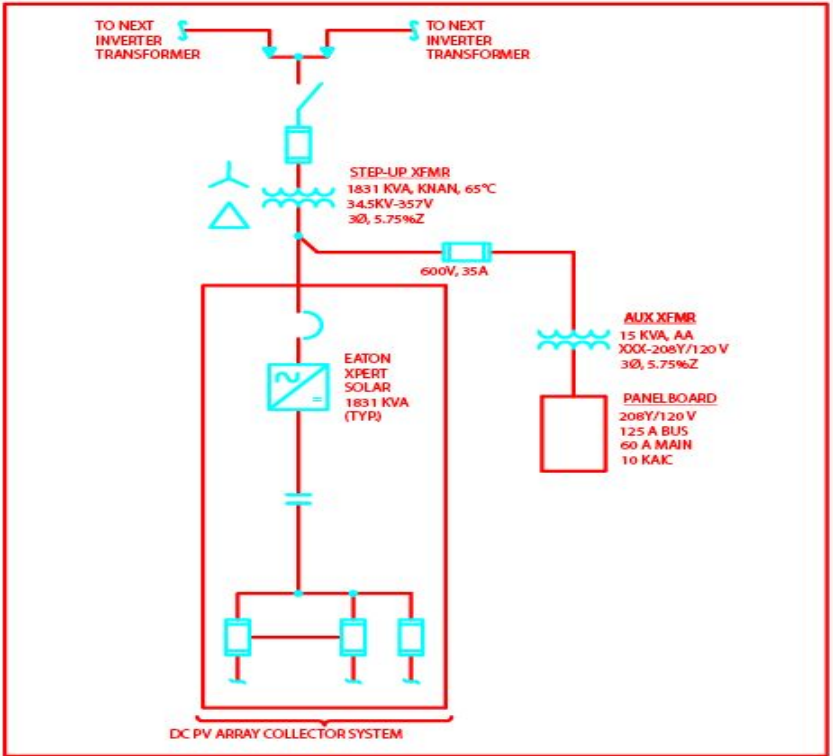
Based on the transformer parameters:
1831 KVA KNAN, 65 celsius
34.5 KV - 357 V
3 phase, 5.75 %

Single inverter skid output current:

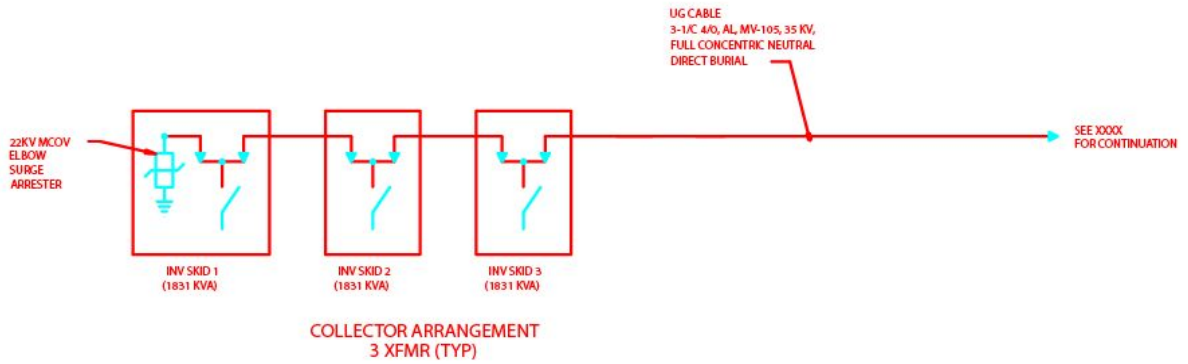
$$I = 1831 \text{ KVA} / (34.5 \text{ KV} \times 1.732) = 30.64 \text{ A}$$



- collector finale collector drawing and arrangement



1831 KVA INVERTER TRANSFORMER DETAIL



COLLECTOR ARRANGEMENT
3 XFMR (TYP)

Tam and YJ: -

- Feeder calculation:

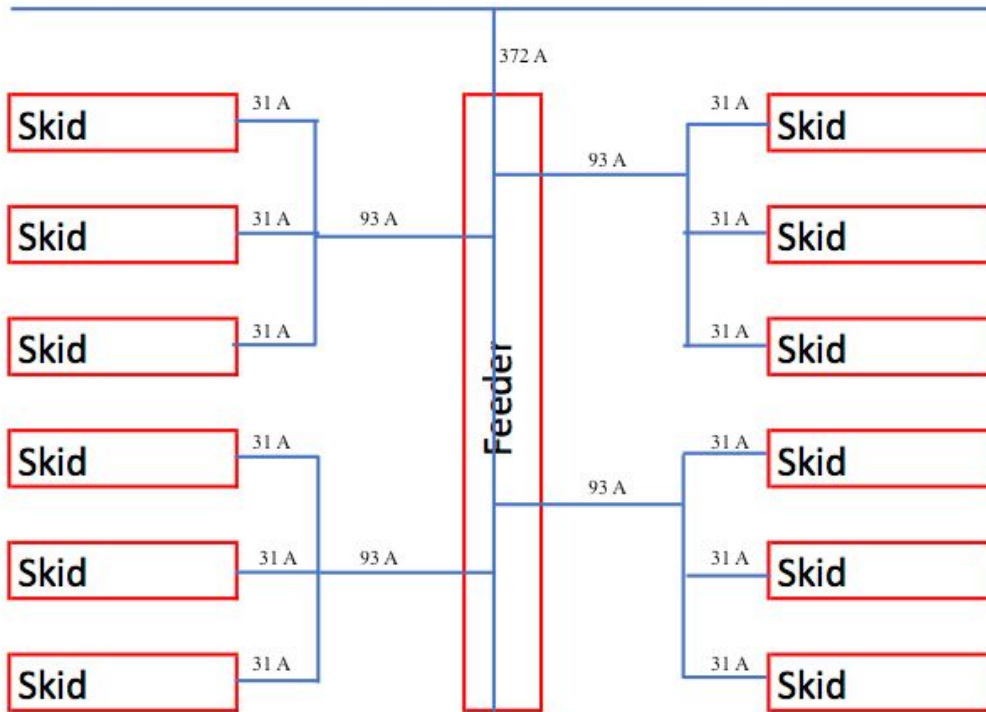
Current go into the feeder:

$$I_{\text{feeder}} = 93 \times 4 = 372 \text{ A}$$

Choosing conductor: Add 10%

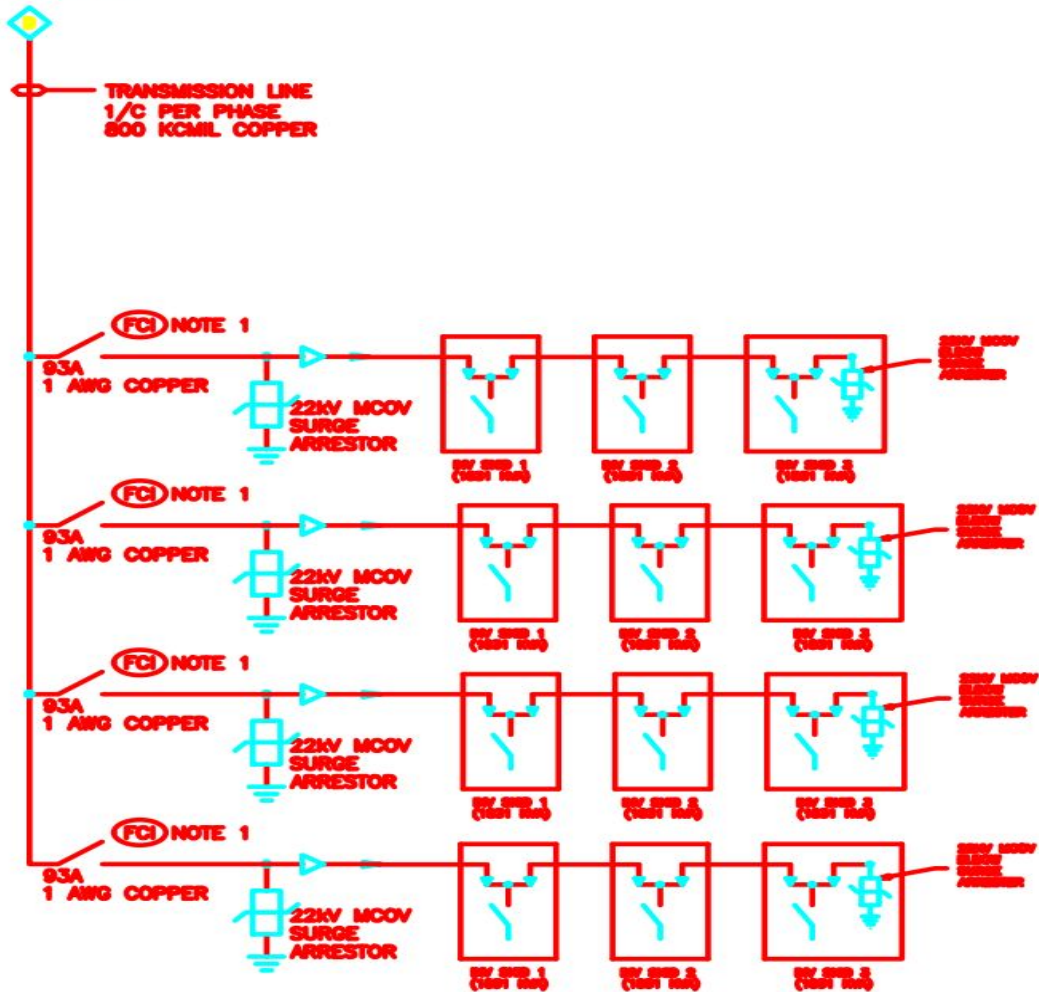
$$I_{\text{real feeder}} = 372 \times 1.1 = 409.2 \text{ A}$$

So we choose 800 Kcmil because it can handle 410 A.



- Feeder AutoCad drawing:

CIRCUIT_B2-12
DWG NO. XXXX



Pending Issues:

- N/A

Plans For Next Week:

Kat and Nur:

- Finalize all files about solar layout and voltage drop calculation. Make them look nice to send to the client.

Tam and YJ: -

- Finalize all files about feeder layout and calculation. Make them look nice to send to the client.
- Doing research in breaker.

Amed: -

- Finalize all files about collector layout and calculation. Make them look nice to send to the client.

Chufu: -

- Finalize all AutoCad drawings, and prepare to send them to the client.

Individual Contributions

Team Member	Individual Contributions	Hours	Cumulative Hours
Katayi Katanga	Did research on: <ul style="list-style-type: none"> - Voltage drop - NEC Created/Performed: <ul style="list-style-type: none"> - Voltage drop calculations - Conductor Sizing - Plan for wiring - Attend all meetings 	15	102
Nur Shuazlan	Did research on: <ul style="list-style-type: none"> - Voltage drop - NEC Created/Performed: <ul style="list-style-type: none"> - Voltage drop calculations - Conductor Sizing - Plan for wiring - Attend all meetings 	15	104
Yao Cheah (YJ)	Did research on: <ul style="list-style-type: none"> - Conductor for feeder Created/Performed: <ul style="list-style-type: none"> - Redesigning Website - Uploaded weekly report - Finalize feeder calculation - Attend all meetings 	20	82
Ahmed Sobi	Did research on: <ul style="list-style-type: none"> - conductor sizing for collector - output of transformer 	16	96

	<p>Created/Performed:</p> <ul style="list-style-type: none"> - finalize collector calculation - finalize collector drawing - determine the collector parameters - attended all the most of the meeting 		
Tam Nguyen	<p>Did research on:</p> <ul style="list-style-type: none"> - Conductor for feeder <p>Created/Performed:</p> <ul style="list-style-type: none"> - Weekly report - Finalize feeder calculation - Attend three meetings 	10	74.5
Chufu Zhou	<p>Did research on:</p> <ul style="list-style-type: none"> - conductor sizing for collector - output of transformer <p>Created/Performed:</p> <ul style="list-style-type: none"> - determine the collector parameters - attended all the most of the meeting 	12	71

Team Hours: 88

Cumulative Team Hours: 529.5