

EE 491 – sdmay19-26

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

Week 3 Report

Monday (9/17/2018) – Sunday (9/23/2018)

Client: Black & Veatch

Advisor: Venkataramana Ajjarapu

Team Email: sdmay19-26@iastate.edu

Team Members:

Katayi Katanga – Team/Communication Leader

Nur Shuazlan – Meeting Scribe

Yao Cheah – Website Manager #1

Ahmed Sobi – Layout Designer #1

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

Tam Nguyen – Report Manager

Weekly Summary:

This week, we had a meeting with our client and advisor. In this meeting, we went through our plan for this and next semester, and we showed them what we understood about the project to make sure we were on the right path. After we had the client/advisor meeting, we started creating a Gantt chart and schedule for our plan, rough draft of our solar power plant design, and justification about location and equipment we will use.

Summary of Client/Advisor Meeting:

We went through team member roles, project deliverables as well as the plans for the two semesters. Team should try to keep up with the plans for the two semesters. Each team member is responsible to finish his/her own task on time based on the roles assigned.

We presented our findings on the tasks being assigned last week.

Items discussed are as below:

- Location of Solar Power Plant/Substation

- Solar Power Plant/Substation Specifications

- Single Line Diagram

- Inverter Load Ratio

- Inverter: Eaton 1666kW

- Panel: Hanwha 325W

- Fixed Rack System

Despite the fact that the model of inverter and solar panel was given, students should be doing researches on other power inverter and solar panel products available out there to justify the reasons we chose the inverter Eaton 1666kW and solar panel Hanwha 325W. Aspects such as

price, stability, model parameters and company's reliability, etc. should be considered. Student team should also present a rough draft of the solar power plant layout in the next client meeting.

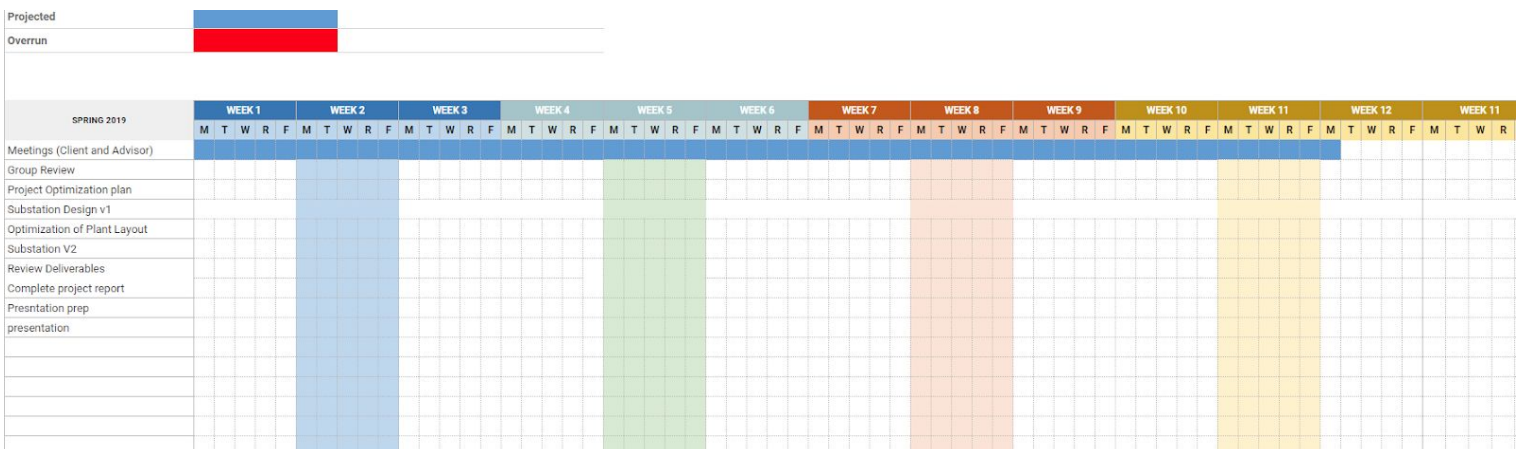
Past Week Accomplishments:

Katayi:-

- Learned how to use the array parameter tool
- Found the datasheet of the combiner box that will be used, the combiner box is Ingecon SunString Box 500A, 1500 VDC
- Calculated the tentative costs of the solar power plant components and the total cost of the power plant
 - 237,312 panels: \$48,411,648
 - 252 combiner boxes: \$322,701
 - 46 inverters: \$19,877,462.50 (estimated using the price of smaller inverters)
 - 243.8 acres of land: \$2,925,600
 - total cost: \$71,537,411.50
- Updated group calendars
- Created the Fall 2018 tentative Gantt Chart

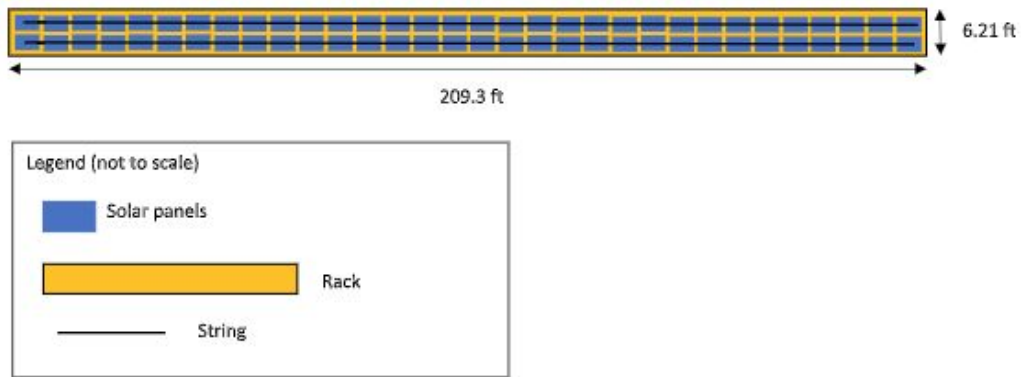


- Created the Spring 2019 tentative Gantt Chart

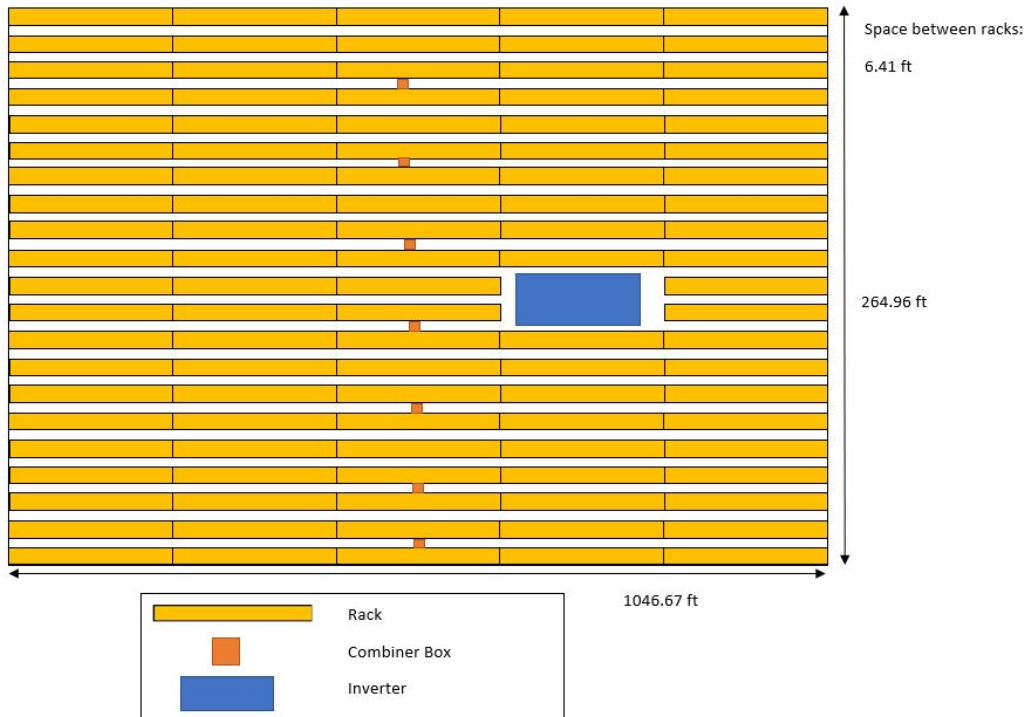


Nur:-

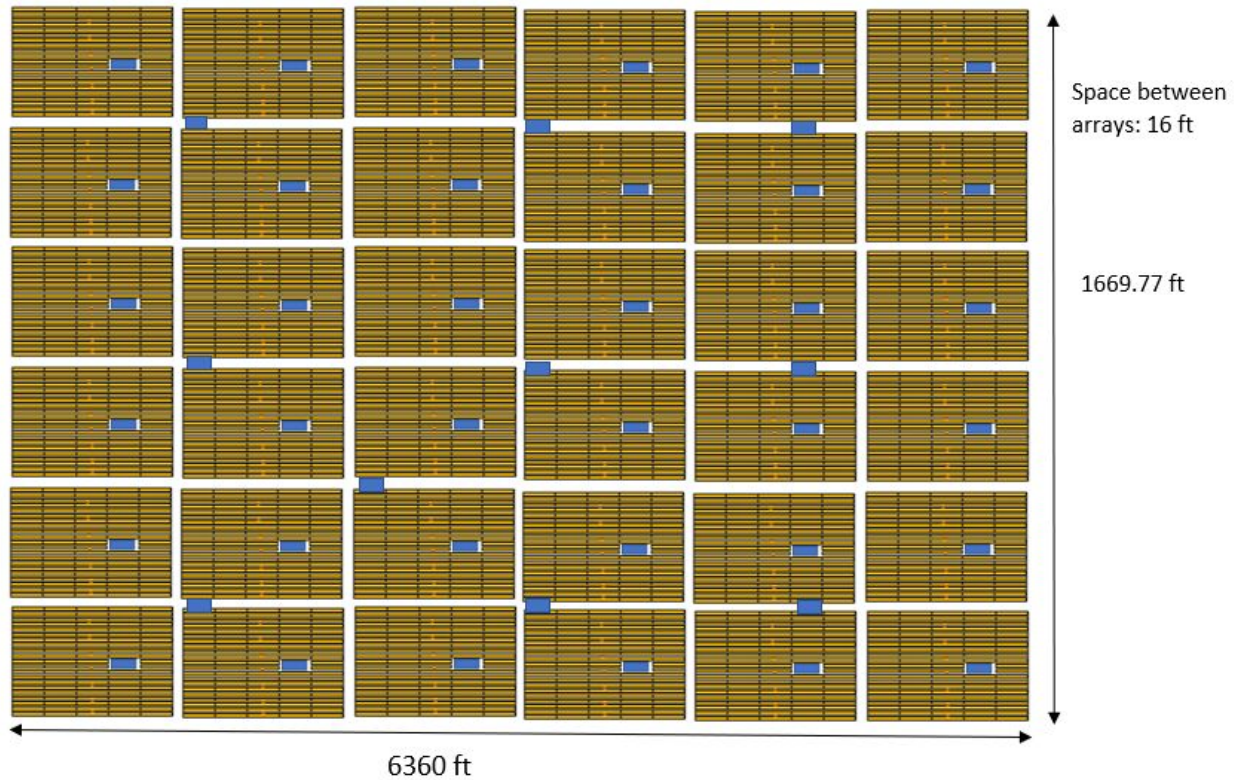
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- Created the layout of a single rack



- Created the layout of a single array



- Created the layout of a single array



YJ:-

Differences between monocrystalline and polycrystalline material solar panels

- Monocrystalline has higher silicon purity and efficiency (19.5%, 16.77%, 19.77%)
- Monocrystalline price ranges from \$300 - \$700
- Polycrystalline utilize all silicon material in production and less purity and efficiency level
- Polycrystalline price ranges from \$200 - \$500




Reason of choosing Hanwha 325W

- More cost effective, has 16.3% efficiency
- One of the cheapest on market (About \$200+)

Suggestion on similar solar panels:

- Panel: <https://www.solaris-shop.com/gcl-gcl-p6-72-325-325w-poly-solar-panel/>
- Datasheet: <https://www.solaris-shop.com/content/GCL-P6-72%20Specifications.pdf>

GCL GCL-P6/72-325 325W POLY SOLAR PANEL



GCL POLY

RRP: ~~\$367.50~~
\$189.00
(YOU SAVE \$168.50)

SKU:
SLR-110-1107

Note:
Ships LTL Freight Only



Condition:
New

Weight:
48.94 LBS

Shipping:
Calculated at checkout

**Out of Stock. Please see manufacturer for similar products.*

- Buy 4 - 23 and get 2% off
- Buy 24 or above and get 5% off

- Price only about \$189 per panel (slightly lower than expected average)
- Good efficiency level for a monocrystalline panel (16.7%)

Ahmed:-

Miso North Star project detail

- 100 MW of solar pv capacity 440,000 solar panels
- About 800 acres of agricultural land
- Single axis tracking to maximize production
- Grid connection at the Chisago substation 115 kV

Plant solar radiation and annual AC energy production

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)
January	2.30	6,368,643
February	3.58	8,684,875
March	5.00	13,438,976
April	6.45	15,626,717
May	7.15	17,410,074
June	8.11	18,581,528
July	8.58	19,558,118
August	7.23	16,874,242
September	5.53	13,044,710
October	3.71	9,475,508
November	2.41	6,201,953
December	1.88	5,095,326
Annual	5.16	150,360,670

Justification for not building the project in the midwest

- Cheaper land but weather condition is bad for solar power (long winter, cloudy, and rainy)
- Require axis tracking to accommodate to solar radiation
- The land cost is high and the system would require expensive resources
- Lower grid capacity

Example of a location in Ames (solar radiation and AC energy)

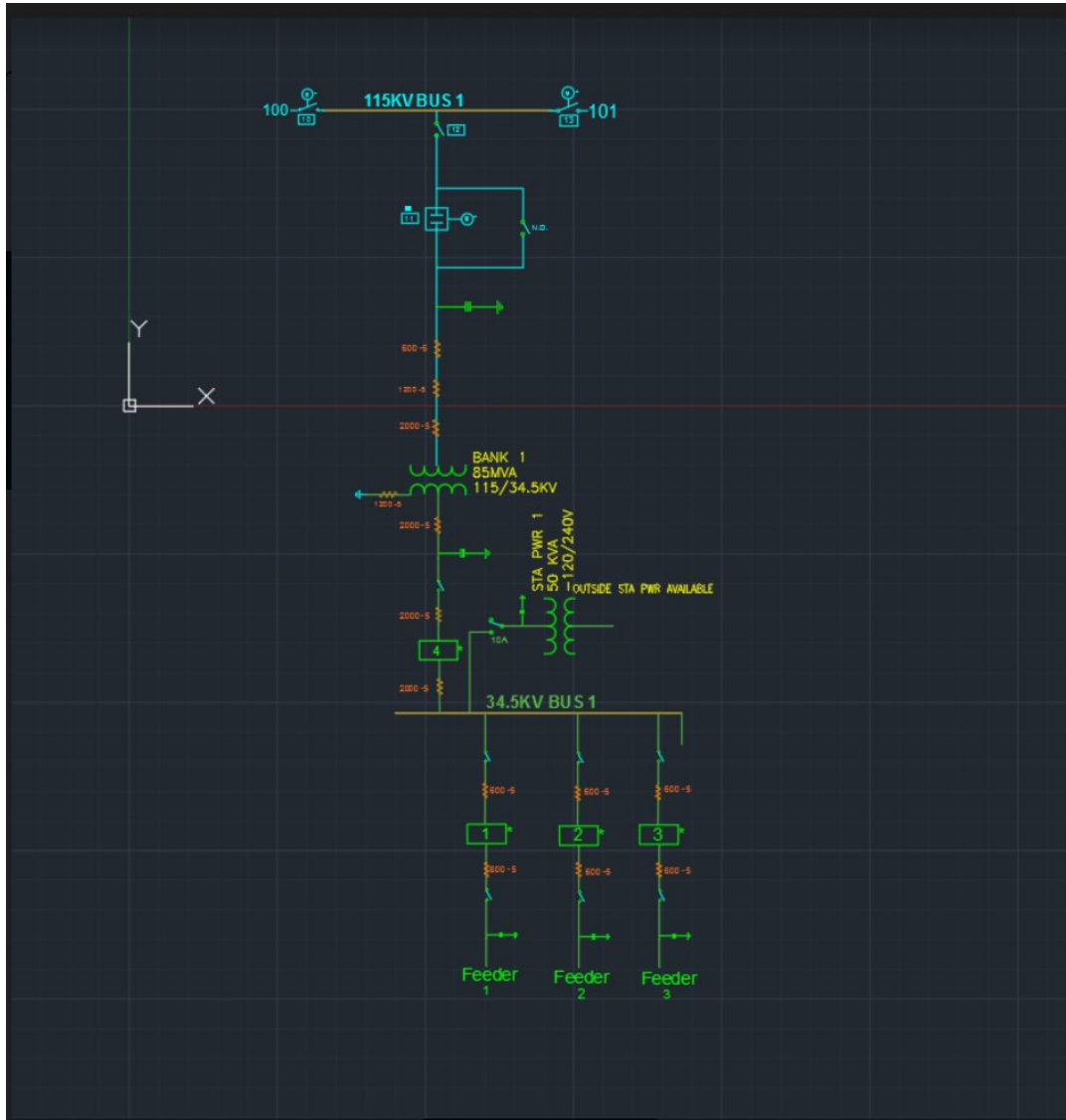
Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)
January	2.66	4,402,616
February	3.75	5,397,222
March	4.66	7,393,330
April	5.53	7,948,084
May	5.89	8,535,323
June	6.49	8,867,109
July	6.83	9,270,547
August	5.97	8,275,837
September	4.99	6,949,373
October	3.66	5,534,203
November	2.70	4,147,131
December	2.21	3,612,150
Annual	4.61	80,332,925

Tam:-

- Doing research on different issues of fixed rack system: types, prices.
- Realized a problem about using rack system: should we use the rack we will buy as a standard to do our solar panel arrangement? Or we design the arrangement first, then we will design the rack later.
- Realized a problem about price and size of the inverter we will use in our solar power plant.

Chufu:-

- Learn how to use AutoCAD in Electrical version, which is originally about Mechanical Engineering
- Found the justification of Eaton 1666kW inverter
- Found the way to fix the problem about what I faced in designing thing like certain type of electrical element in circuit I cannot understand
- Personally talking to Cole who is our client about the detail about our project and concept I have for my plan in the future
- Learn how to design the layout about our project with solar panel with string and array
- The rough draft is like following figure



Pending Issues:

Ask the client about:

- The prices of the exact solar power plant components used.
- The man-hour cost.

Plans For Next Week:

Nur and Katayi:

- Use Google Earth to find the locations in Texas, doing research about solar radiation, weather, and apply parameter tool to these places.

Chufu and YJ:

- Use Google Earth to find the locations in New Mexico, doing research about solar radiation, weather, and apply parameter tool to these places.

Amed and Tam:

- Use Google Earth to find the locations in California, doing research about solar radiation, weather, and apply parameter tool to these places.

Individual Contributions

Team Member	Individual Contributions	Hours	Cumulative Hours
Katayi Katanga	<p>Did research on:</p> <ul style="list-style-type: none"> - Array parameter tool. - Found data sheets for CB. - Total cost of project and total number of components to be used. <p>Created:</p> <ul style="list-style-type: none"> - Tentative Gantt Charts. - Updated group calendars. - Attended all meetings. 	20	29.5
Nur Shuazlan	<p>Did research on:</p> <ul style="list-style-type: none"> - Array parameter tool. - Found data sheets for CB. - Total cost of project and total number of components to be used. <p>Created:</p> <ul style="list-style-type: none"> - Design drawing for the solar plant. - Attended all meetings. 	18.5	31.0
Yao Cheah (YJ)	<p>Did research on:</p> <ul style="list-style-type: none"> - Justification of using Hanwha 325W solar panel. <p>Created/Performed:</p> <ul style="list-style-type: none"> - Attended all meetings. - Uploaded meeting minutes and weekly reports on the group 	11	19.5

	website.		
Ahmed Sobi	<p>Did research on</p> <ul style="list-style-type: none"> - Location review. - MISO solar project. - Ames solar project. - Places to consider for solar power plant. - Attended all meeting except one . 	10.5	20
Tam Nguyen	<p>Did research on:</p> <ul style="list-style-type: none"> - Justification of using fixed rack system. <p>Created/Performed:</p> <ul style="list-style-type: none"> - Attends all meetings. - Created the weekly report. 	9	18.5
Chufu Zhou	<p>Did research on:</p> <ul style="list-style-type: none"> - Justification of Eaton 1666kW inverter. <p>Created:</p> <ul style="list-style-type: none"> - Attends all meetings. - Design the basic branch of our project by AutoCAD. 	8.5	18

Team Hours: 77.5

Cumulative Team Hours: 136.5