

EE 491 Weekly Report 4

Start Date: February 21

End Date: February 27

Group number: 18

Project title: Utility Scale Lithium-Ion Energy Storage Project

Client &/Advisor: Burns and McDonnell, Zhaoyu Wang

Team Members/Role:

- ❖ Oksana: Leader; responsible for keeping the team on track
- ❖ Sarah: Organizer; responsible for revising, editing, and helping keep track of all our reports.
- ❖ James: Document Report; responsible for the submission of our reports. Inverter quantity and cable sizing to batteries
- ❖ Cole: Point of Contact/Communicator; responsible for meeting and contacting the clients, faculty advisor, and the AutoCAD site layout design.

Weekly Summary:

This week, we did not have any major assignments that needed to be completed for our client, so as a group, we worked more in-depth with our battery and inverter technology. We determined that we will use the BYD MC10C-5365-U-R-4M01 battery container technology and the Siemens Gamesa Proteus PCS 4600E. We also worked more closely on our AutoCAD diagram with the sizing, spacing and making the design 3D.

Past Week Accomplishment:

As a group:

- Determined the battery and inverter technology models we will be using
- Calculated the number of batteries and Inverters
- Calculated the reactive power for our design
- We used the installation manuals for spacing the batteries and inverters in our AutoCAD site layout.

Individually

- James: I confirmed and finalized the inverter for our project. We will be using Siemens Gamesa Proteus PCS 4600E.
- Oksana: I worked on the calculations and finalized them for the meeting. I also worked with AutoCAD to continue getting more comfortable with the software.
- Cole: I downloaded civil 3D software and familiarized myself with it. I can worked on moving the site layout over, so it has a map of the surrounding area.
- Sarah: I familiarized myself with AutoCAD software and began editing our team website.

Pending Issues:

We need to verify the spacing for our site layout on AutoCAD to ensure it follows the specifications in the installation manuals.

Individual Contributions:

Name	Individual Contribution	Hours this reporting period	Previous Hours	Previous Cumulative Hours	Total Hours
Oksana Grudanov	Redo the calculations with the specified values for our technology. I also worked through the report and continued to work on AutoCAD. I was in charge of writing the client meeting notes this week and uploading them to teams.	1.0 (client meeting) 1.5 (weekly report) 0.5 (AutoCAD) 0.5 (calculations) 1.0 (weekly meeting) 0.5 (write client meeting notes and upload to teams)	5.5	10.0	20.5
Sarah Ebert	Worked on AutoCAD and updated the team website	1.0 (client meeting) 1.0 (AutoCAD) 1.0 (weekly meeting) 1.0 (team website)	4.0	14.5	20.0
Cole Dustin	Worked on AutoCAD/Civil 3D	1.0 (client meeting) 1.0 (weekly meeting) 1.5 (AutoCAD/Civil 3D)	5.5	10.0	19.5
James Mendenhall	Inverter Decision	1.0 (client meeting) 1.0 (weekly meeting) 1.0 (Inverter decision)	5	10.0	18.0

Plans for the upcoming week:

This week, our client gave us a few assignments that we will complete for next week's meeting. During our meeting on Monday, we discussed the calculations we had completed. We noticed some incorrect values used for our calculations, so we will redo those calculations to get a result that better suits our specifications. Another assignment we were given this week was to continue working on the site layout on AutoCAD and focus on the spacing, sizing, and placement of our design. We need to add a "driveway" road in our site location for the entrance to the lot and move the design to the northwest side of the plot, as that is closer to the nearest substation that we will be hooking it up to. We will need to check the installation manual for our

battery technology to verify we are spacing them correctly. We will also need to change the placement of our batteries to have them in a row of four batteries lined up sideways, as that is most common for battery storage designs. We will also add a 20x10 foot rectangle in our AutoCAD design for the fuse box, breaker, control panel, etc. Additionally, we were given a recommendation to download AutoCAD civil 3D for our design as it can help the look of our design especially having it in 3D. The last assignment we were given to be completed before the next meeting was to begin working on the rough draft of our one line diagram. We will start by drawing it out by hand and then will transfer it over to AutoCAD for the finished product. We will also continue to add to our team website as well.

Individual Assignments for the upcoming week:

Oksana: I will be helping Cole with the AutoCAD design research for our project layout. I will be looking at the instruction manuals provided by our client to help us justify the spacing for our project. We will change our design layout by having the batteries lined up in a row of four batteries and having them lined up sideways. I will look closely at the installation manuals and verify our spacing for the layout.

James: Sarah and I will create a one-line diagram rough draft this week. We will review the outlines we received from our client to determine what we will need.

Sarah: I will work with James to create a rough draft of the one-line diagram. We will review the notes provided by our client for the one-line diagrams and create a handwritten draft. I will transfer the hand-drawn rough draft to AutoCAD. I will also continue to add to our team website.

Cole: I will move the site layout from AutoCAD to Civil 3D, and correct the dimensions as discussed in this week's meeting. I will also add the equipment pad including the panel box and the switch board to the civil 3D drawing.

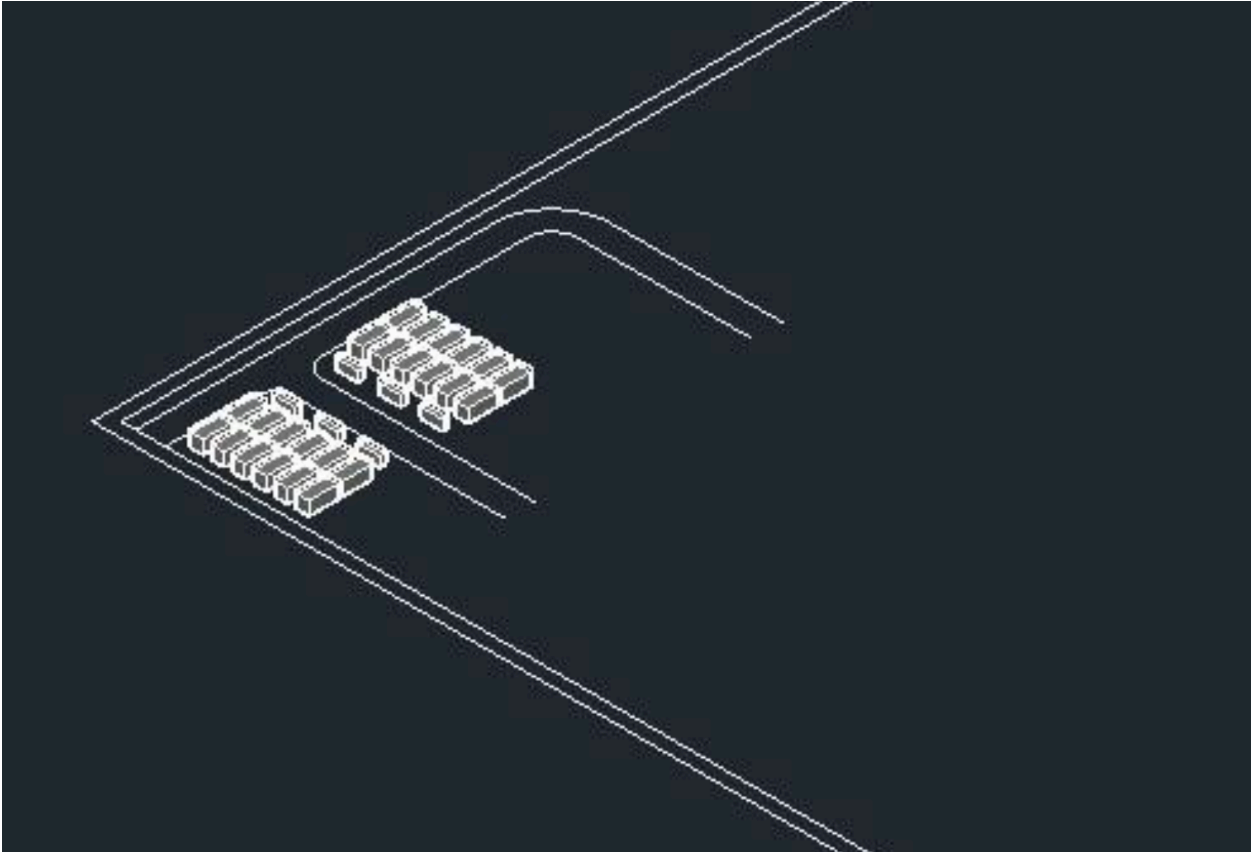
Summary of weekly advisor meeting:

We did not meet with our faculty advisor this week because he was away on a business trip. We plan to meet with him the following week to go over the stuff we learned in today's meeting and discuss our plans for the one-line diagram.

Summary of weekly client meeting:

In this week's meeting, we discussed our calculations and got some pointers on how to fix them to fit our specifications better. We also discussed the AutoCAD diagram we created and what else we needed to add. We discussed more in-depth regarding the spacing for the batteries and a slight change in our layout. We previously had them in a column of batteries and we did not have them as close together as our client wanted. We were instructed to change the layout to have four batteries lined up in a row, and have them spaced out about half an inch between each battery. We also have plans to add a few more things to our layout, such as space for the control panels, breakers, fuses, etc. Finally, we talked about our next assignment: to start working on the one line diagram.

AutoCAD site layout design:



Calculation redone:

$$S = P + jQ \quad P = 25 \text{ MW} / 100 \text{ MWh} \rightarrow 10\% \text{ BDL}$$

$$Q = S \sin(\phi) \quad \text{PF} = 0.95$$

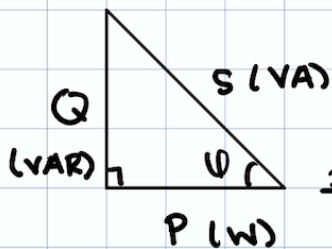
$$S = \frac{P}{\text{PF}} \quad \rightarrow \text{BYD: } 1236 \text{ kW (battery)}$$

$$\rightarrow \text{Mgen: } 4.2 \text{ MVA (inverter)}$$

\rightarrow 4 battery containers / inverter

\rightarrow we need \sim 24 battery containers

\rightarrow we will need 6 inverters total



$$\frac{25000 \text{ kW}}{1236 \text{ kW}} = 22.23 \times 1.1 = 22.25 \sim 24 \text{ battery containers}$$

\uparrow
10% BDL

\rightarrow Calculating reactive power comes from the inverter; battery produces active power

$$P = |V||I| \cos(\theta_v - \theta_i)$$

$$Q = |V||I| \sin(\theta_v - \theta_i)$$

$$S = P + jQ = \sqrt{P^2 + Q^2}$$

inverter:

$$\text{PF} = 0.95$$

$$S = 4.2 \text{ MVA}$$

$$4.6 \times 10^6 \times 6 \text{ inverters} \approx 27.6 \text{ MVA}$$

(inverter)

$$6 \text{ inverters} \times 4 \text{ hrs} = 24 \text{ batteries needed}$$

$$Q = S \sin(\phi) \quad \cos^{-1}(0.95) = 18.19^\circ$$

$$Q = (28.95) \sin(18.19)$$

$$Q = 9.037 \text{ MVAR}$$