2 Project Plan

2.1 Project Management/Tracking Procedures

Which of agile, waterfall or waterfall+agile project management style are you adopting? Justify it with respect to the project goals.

We have a waterfall+agile project management style. This is because we have regular interactions with the group and the client that are strictly planned out each week. These meetings occur every Tuesday, Wednesday, and Thursday. There is a lot of planning required because we plan each week how we are going to create the models, layout, calculations, and presentations. We are also working in a linear way as we complete one aspect of the project each week, slowly working towards the final solar field and substation design.

What will your group use to track progress throughout the course of this and the next semester. This could include Git, Github, Trello, Slack or any other tools helpful in project management.

We use our meeting agenda and meeting minutes each week to track our progress throughout the course. We have what has already been done and what needs to be accomplished each week on these minutes and agendas. We also keep a list of questions on the agenda to confirm any questions we have with the client and keep track of what is being done.

2.2 Task Decomposition

In order to solve the problem at hand, it helps to decompose it into multiple tasks and subtasks and to understand interdependence among tasks. This step might be useful even if you adopt agile methodology. If you are agile, you can also provide a linear progression of completed requirements aligned with your sprints for the entire project.

- Create a high-level model to help you see the finished product better.
- Farm layout should take accessibility and space requirements into account.
- According to part ratings, cost, and power efficiency, create component attachments.
- Analysis of economic efficiency
- Calculations of voltage drop
- Analysis of trench fill

For our project we will be taking two semesters to design a solar farm and substation. In the first semester, we'll concentrate mostly on developing the solar panel design layout. To do this, we must first choose an appropriate place for our plant, which will depend on several design variables that we must examine. We then have to use an array parameter tool that our customer had given us, which enabled us to select the appropriate components for our design. We will then use AutoCAD and Bluebeam to design the arrangement. Calculating our system's voltage drop was also considered one of the design criteria we have to complete this semester.

Next semester we will start to design the 60 MW substation for our solar farm which will require us to also take a larger scale look at our overall design.

2.3 Project Proposed Milestones, Metrics, and Evaluation Criteria

What are some key milestones in your proposed project? It may be helpful to develop these milestones for each task and subtask from 2.2. How do you measure progress on a given task? These metrics, preferably quantifiable, should be developed for each task. The milestones should be stated in terms of these metrics: Machine learning algorithm XYZ will classify with 80% accuracy; the pattern recognition logic on FPGA will recognize a pattern every 1 ms (at 1K patterns/sec throughput). ML accuracy target might go up to 90% from 80%.

In an agile development process, these milestones can be refined with successive iterations/sprints (perhaps a subset of your requirements applicable to those sprint).

<u>Solar Field Design</u>

- Plant must have a DC input of 80 MW with an AC output of 60 MW
- The location chosen will maximize sunlight and have enough space to fit the 60MW solar plant and the substation that must go along with it.
- The voltage drop throughout the solar field will be < 5%.
- Complete each stage of the engineering design document (in CAD)
    - Create a title block/cover page
    - Solar plant layout details
    - Racking details
    - Electrical details
    - Wire schedule
    - Code calculations page
    - Cutsheet page
- The panel, converter, and inverter combination chosen must have an inverter loading ratio of < 1.3.

<u>Substation Design</u>

- The substation must be able to go from 115kV to 34.5 kV
- More specific details for this part of the project will be provided next semester

2.4 Project Timeline/Schedule

• A realistic, well-planned schedule is an essential component of every well-planned project
• Most scheduling errors occur as the result of either not properly identifying all of the necessary activities (tasks and/or subtasks) or not properly estimating the amount of effort required to correctly complete the activity
• A detailed schedule is needed as a part of the plan:
– Start with a Gantt chart showing the tasks (that you developed in 2.2) and associated subtasks versus the proposed project calendar (including both 491 and 492 semesters). The Gantt chart shall be referenced and summarized in the text.

– Annotate the Gantt chart with when each project deliverable will be delivered
• Project schedule/Gantt chart can be adapted to Agile or Waterfall development model. For agile, a sprint schedule with specific technical milestones/requirements/targets will work.

SOLAR DESIGN						09/14	09/21	09/28	10/05	10/12	10/19	10/26	11/02	11/09	11/16	11/23	11/30
Task Name	***START DATE***	***END DATE***	***DURATION (WORK HOURS)***	***TEAM MEMBER***	***PERCENT COMPLETE***	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12
Research																	
Solar Panels	09/14	09/21	3	Jacob, Zach & Omer	100%												
Combiner Boxes	09/14	09/21	2	Madissen and Jenna	100%												
Inverter Skid	09/14	09/21	2	Ashton and Brooke	100%												
Bill of Materials (BOM) - Phase I	10/05	10/12	2	TBD													
Bill of Materials (BOM) - Phase II	11/2	11/9	2	TBD													
DESIGN																	
High Level Model for Visualizaton	09/14	9/21	2	TBD													
Array Parameter Tool	09/21	10/05	5	TBD													
AutoCAD Design	10/05	10/26															
Title Block/template	10/05	10/12	8	TBD													
Array layout	10/05	10/12	10	TBD													
Stringing	10/05	10/12	8	TBD													
Racking	10/12	10/19	10	TBD													
Electrical Diagram	10/12	10/26	15	TBD													
Wiring Schedule	10/12	10/26	15	TBD													
Full plant characteristics	10/19	10/26	10	TBD													
Calculations																	
Economic Estimates	10/26	11/2	10	TBD													
Voltage Drop	10/26	11/2	10	TBD													
Trench Fill	11/2	11/9	10	TBD													
Class Schedule																	
Design Document - User Needs	09/21	09/30		All/Rotate	100%												
Design Document - Project Requirements	10/03	10/07		All/Rotate	100%												
Lightning Talk	09/21	09/29		All/Rotate	100%												
Design Document - Project Plan	10/10	10/14		All/Rotate	100%												
Design Document - Module 7	10/17	10/21		All/Rotate													
Design Document - Module 8	10/24	10/28		All/Rotate													
Design Document - Module 9	10/31	11/4		All/Rotate													
Design Document Module 10	11/7	11/11		All/Rotate													
Design Document Module 11	11/14	11/18		All/Rotate													
Design Document Module 12	11/28	12/2		All/Rotate													
Weekly Reports	9/26	12/9		All/Rotate													

SUBSTATION DESIGN						1/18	1/25	02/01	2/8	2/15	2/22	3/1	3/8	3/15	3/22	3/29	4/5	4/12	4/19	4/26	5/3
Task Name	***START DATE***	***END DATE***	***DURATION (WORK DAYS)***	***TEAM MEMBER***	***PERCENT COMPLETE***	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	Spring Break	Week 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15
Equipment Selection																					
Conduit List	02/01	02/08	TBD	TBD																	
Cable List	02/01	02/08	TBD	TBD																	
Control House Materials	02/01	02/08	TBD	TBD																	
Bill of Materials	3/1	3/8	TBD	TBD																	
Layout																					
Bus Design	1/18	1/25	TBD	TBD																	
One - Line Diagram	1/25	02/01	TBD	TBD																	
Three-line Diagrams	1/25	02/01	TBD	TBD																	
Yard Equipment Layout	1/25	2/15	TBD	TBD																	
Grounding layout	2/15	2/22	TBD	TBD																	
Conduit Plan	2/8	2/15	TBD	TBD																	
Elevations	2/8	2/15	TBD	TBD																	
Protection & Control																					
Lightning Calc/Protection	2/22	03/01	TBD	TBD																	
Control House Design	3/1	3/8	TBD	TBD																	
Calculations																					
Bus Calc	02/01	02/08	TBD	TBD																	
Grounding Calc	02/01	02/08	TBD	TBD																	
AC Calc	02/01	02/08	TBD	TBD																	
DC Calc	02/01	02/08	TBD	TBD																	
Voltage Drop	02/08	2/15	TBD	TBD																	
Lightning Calc	2/15	2/22	TBD	TBD																	
Trenchfill	2/22	3/1	TBD	TBD																	
Cable Tray Fill	3/1	3/8	TBD	TBD																	
Draft Calc Report	3/8	3/29	TBD	TBD																	
Class Assignments																					
Project Document - Part 1	01/18	2/8	7 Days	All/Rotate																	
Project Document - Part 2	02/01	2/22	7 Days	All/Rotate																	
Porject Document - Part 3	02/15	3/22	7 Days	All/Rotate																	
Lightning Talk	TBD		7 Days	All/Rotate																	
Weekly Reports	1/16	5/6	7 Days	All/Rotate																	
Review and Submission																					
Review Report	3/25	4/5	TBD	All																	
Review Calculations	4/5	4/12	TBD	All																	
Review layouts	4/12	4/19	TBD	All																	
Submit	4/26	4/5	TBD	All																	
			complete																		
			future																		
	Key		break																		

2.5 Risks And Risk Management/Mitigation

Consider for each task what risks exist (certain performance target may not be met; certain tool may not work as expected) and assign an educated guess of probability for that risk. For any risk factor with a probability exceeding 0.5, develop a risk mitigation plan. Can you eliminate that task and add another task or set of tasks that might cost more? Can you buy something off-the-shelf from the market to achieve that functionality? Can you try an alternative tool, technology, algorithm, or board?

Agile projects can associate risks and risk mitigation with each sprint.

- Misreading the datasheet - If we misread the datasheet, we will use incorrect values within the array parameter tool, therefore making our calculations for amount of arrays, inverters, etc. incorrect. This is not a high risk as we all worked on the array parameter tool together and if it is incorrect it is only an excel sheet that can be easily changed. Our work gets checked weekly by Black & Veatch as well, so this risk is extremely low

2.6 Personnel Effort Requirements

Include a detailed estimate in the form of a table accompanied by a textual reference and explanation. This estimate shall be done on a task-by-task basis and should be the projected effort in total number of person-hours required to perform the task.

Tasks	Explanation of Task	Man-hours Required
Research solar panels, combiner boxes, and inverters	Find data sheets for three different inverters, combiners, and solar panels	11 hours
Complete Array Parameter Tool	Using the different solar panels, inverters, and combiner boxes, create five spreadsheets comparing the combination of the different devices, ensuring the ILR is about 1.3.	10 hours
Research and finalize location for solar field	The irradiance, cost of land, and type of land available in Ames and in New Mexico had to be researched to determine which will be the most viable to build a solar field on. Roswell, NM was ultimately determined as the best place	4 hours
Create CAD model of solar field layout	A CAD drawing document including title block, cover page, solar plant layout details, racking details, electrical details, wire schedule, and code calculations must be designed based on the ideal combination of equipment chosen using the Array Parameter Tool. The model may need to be altered based on any calculations to ensure voltage drop is within 5%.	36 hours

Complete Calculations	Bus, grounding, AC, DC, voltage drop, lightning, trench fill, cost, and cable tray calculation must be completed using various excel sheets given to us by Black & Veatch	24 hours
Weekly Meetings	We meet as a group with our adviser Ajjarapu on Tuesdays, with Black & Veatch on Wednesdays, and then for group work time on Thursdays	3 hours each week * 8 people = 24 man-hours/week
Prepare for next semester substation design	Begin to think about how the solar field will be connected to the substation, where on the land it will go, how it will interact with the solar field and customers	5 hours per person

2.7 Other Resource Requirements

Identify the other resources aside from financial (such as parts and materials) required to complete the project.

We need AutoCAD and BlueBeam software. We also need various calculation spreadsheets provided to us by Black & Veatch to compare and contrast different potential components, estimate the voltage drop, perform a cost analysis, and other aspects of the project.