



Solar Power Plant and Substation Design Project

IOWA STATE UNIVERSITY and BLACK AND VEATCH

*John Jennison, Aayush Shah, Adilene Prieto, Kyle Neal, Logan Miller,
Matthew Schindler, Shadoe Rusk*

A photograph of the Iowa State University campus, featuring a large domed building on the left and a large tree in the foreground. The entire image is overlaid with a semi-transparent red filter. Two horizontal white lines are present: one above the text and one below it.

IOWA STATE UNIVERSITY

Electrical and Computer Engineering

Safety Moment

Fatigue:

- Extreme tiredness resulting from mental or physical exertion or illness.

Importance:

- One of the biggest safety concerns out in the field in any specialization
- Easily Preventable
- $\frac{2}{3}$ of the working class is affected by workplace fatigue

Causes:

- Lack of Sleep
- Excessive Lifting and Moving
- Long Shifts/Night Shifts

Solutions:

- Quality and Quantity of Sleep
- Appropriate length of work
- Appropriate Lifestyle and Diet



New Technology

Yara Birkeland

- First fully electric, autonomous cargo ship
- Yara International, Norwegian company
- Yara Marine Technologies
- First voyage 2021, Herøya to Brevik

Ship Specifications

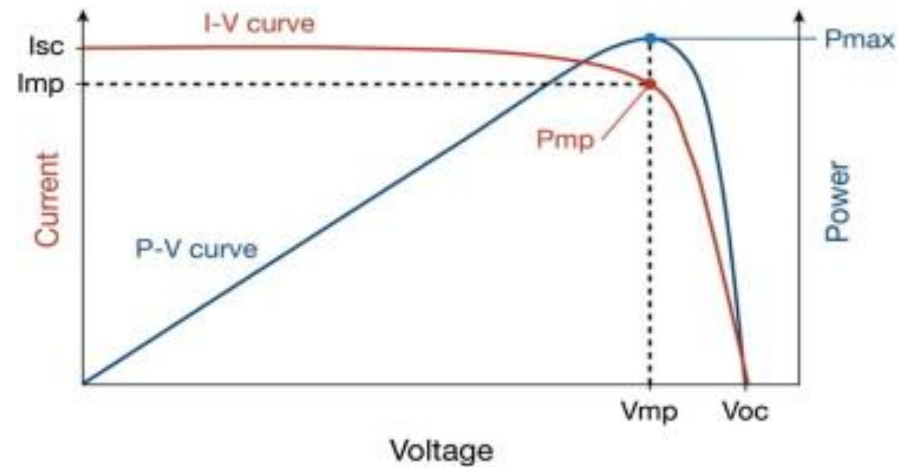
- 7 MWh battery capacity
- Two 900kW Azipull pods
- Two 700 kW tunnel thrusters
- Top speed 13 knots (~15 mph)
- Cargo Capacity is sixty 40' shipping containers



Utility Grade Solar Panels

First Solar Series 6

P _{MAX}	(W)	420
Efficiency	%	17
V _{MAX}	(V)	180.4
I _{MAX}	(A)	2.33
V _{OC}	(V)	218.5
I _{SC}	(A)	2.54

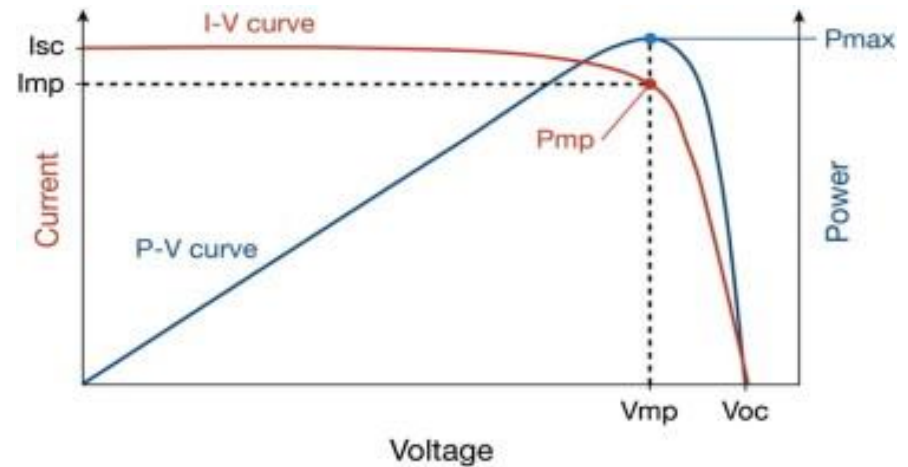


- 30 Year performance warranty
- HQ in Tempe Az

Utility Grade Solar Panels

Jinko Tiger Pro 54 HC

P _{MAX}	(W)	410
Efficiency	%	21
V _{MAX}	(V)	30.62
I _{MAX}	(A)	13.39
V _{OC}	(V)	37.14
I _{SC}	(A)	13.95



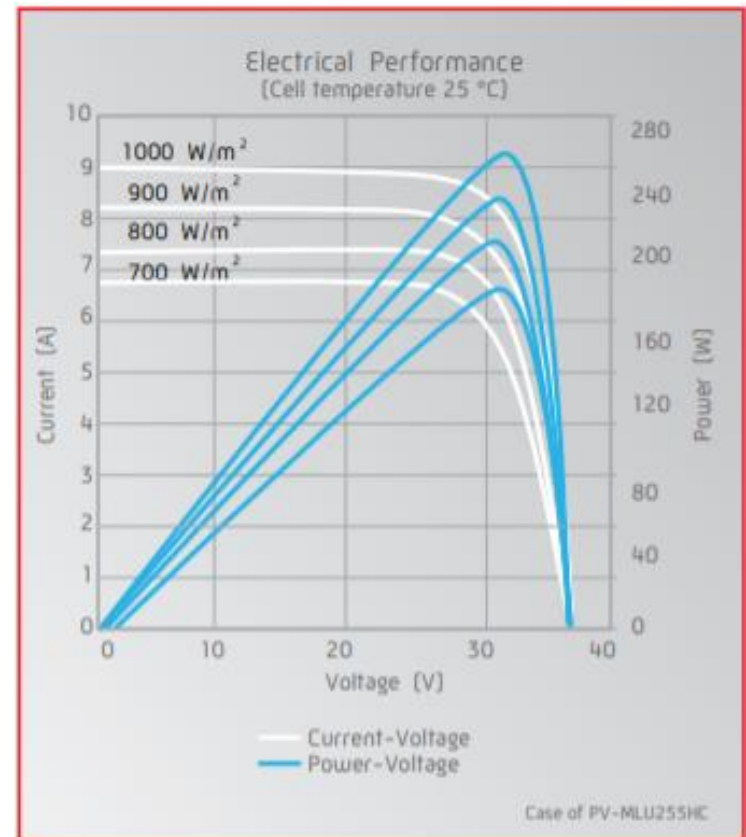
- 25 Year performance warranty
- HQ in Shanghai China

Utility Grade Solar Panels

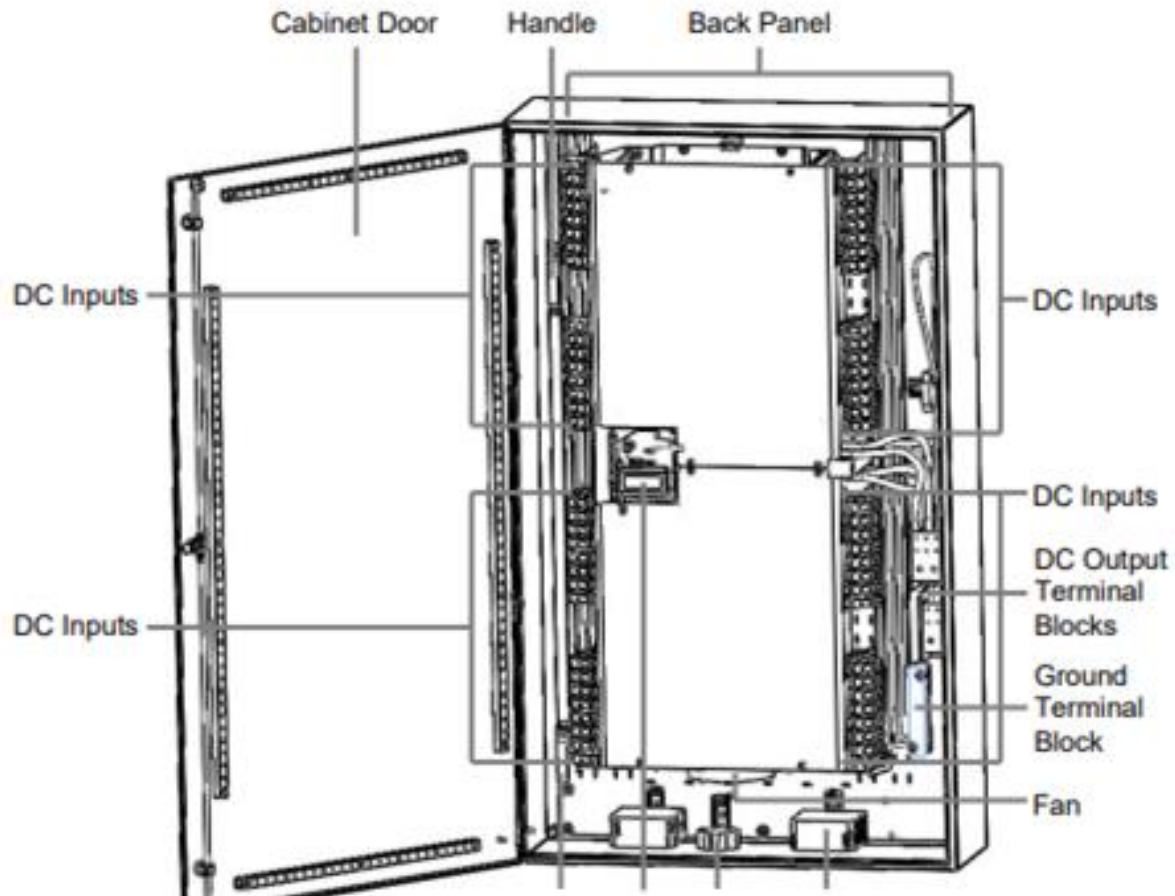
Mitsubishi Electric Photovoltaic Module - MLU Series

Pmax	255 W
Efficiency	15.4%
Vmax	31.2 V
Imax	8.18 A
VOC	37.8 V
ISC	8.89 A

- 25-year power output warranty
- HQ Tokyo, Japan



Combiner Boxes



https://www.solaredge.com/sites/default/files/solaredge_combiner_box_installation_guide.pdf

Combiner Boxes

Solaredge Combiner Boxes

- Maximum Input Voltage - 600 VDC
- Ground Fault/Lightning/Surge Protection
- Voltage Leak detection (String Monitoring)
- Fused
- Variable string input
 - 16 String
 - 9.6 ADC max input current
 - 192 ADC max (1) output current
 - 36 & 64 String
 - 6.4 ADC max input current
 - 288 ADC(36 string) max (1) output current
 - 512 ADC(64 string) max (2) output current

Innovative Solar Inc.

- Maximum Input Voltage - 1500 VDC
- Surge Protection /Arc Fault(optional) Protection
- Fused
- Variable string input (6 - 32)
 - 13.3 ADC max input current
 - 400 ADC max output current

KACO DC-Combiner Boxes

- Maximum Input Voltage - 1500 VDC
- Surge Protection/String Monitoring Capability
- Fused
- Variable String Input (up to 24)
 - 30 ADC max input current
 - 500 ADC max output current

Inverters

Schneider PV Skid:

- Components
 - DC recombiner
 - Transformer
 - Auxiliary Power Supply
 - Inverter
 - Monitoring and control cabinet
- Reasons to use:
 - Flexible in terms of Apparent Power configurations
 - Easy to install/ maintain
 - Reliability
 - High investment returns

https://solar.schneider-electric.com/wp-content/uploads/2015/07/br20160822_pv-skid-brochure.pdf

Sun Wize PV Skid:

- Components same as Schneider
- Reasons to use:
 - Battery rating options, 500Ah to 610 Ah
 - 280 W, 450 W, and 750 W

[SunWize Mobile Solutions | Skid Structures](#)

ABB PV Skid:

- Components same as Schneider
- Reasons to use:
 - Contains Central inverter, helps with larger scale projects
 - Efficient and cost effective
 - 2500 W and 5000W varieties

[SSU central inverter data sheet rev A 1YNE182002.pdf \(abb.com\)](#)

Location: New Mexico vs Iowa

Category	Iowa	New Mexico
Irradiance	4 kWh/m ² /day	6.48 kWh/m ² /day
Land for sale	~82 thousand acres	78 million acres
Price per acre of land	\$7,600/acre	\$1200/acre



\$245,000

380 acres - McIntosh, New Mexico (Sandoval County)

Just minutes west of McIntosh, only 15 minutes south of I-40, we have 2 parcels totaling 725 acre ra...

Project Management Tools

Work Plan

- Outlines project goals and objectives
- Breaks down project into its components

Work Plan

Item No	Description	Responsible/ Preparer
Project Initiation		
1	Prepare work plan	
2	Assemble project team	
3	Prepare schedule	
4	Prepare communication plan	
5	Set up project accounting	
6	Set up tracking mechanisms	
7	Additional tasks	
<i>Deliverable: Project Management Plan</i>		
Initial Data Gathering		
8	Collect community data, (demographics, government structure, etc.)	
9	Identify Stakeholders (water committee, Water District, other agencies)	
10	Research applicable design criteria, (water quality regulations, required water quality per capita, building codes)	
11	Research other wells & similar projects in the area	
12	Cultural Data	
13	Travel Planning	
14	Additional data	
<i>Deliverable: Pre-trip Plan</i>		

Work Plan

Project Construction Work Breakdown		
Item No	Description	Responsible/ Preparer
Construction		
1	Site clearing and grading	
2	Drill borehole	
3	Develop well	
4	Well draw down test	
5	Water quality tests	
6	Construction site security (fencing, well head enclosure, etc.)	
7	Install tank support structure	
8	Install tank	
9	Dig trenches and install transmission and distribution lines	
10	Construct water taps	
11	Install connections, valves, & miscellaneous fittings	
12	Install pump	
13	Install 250 WT solar collectors	
14	Pump testing and flow rate measurement	
15	Final inspection and punchlist	
16	Certify construction complete	

Project Management Tools

Project Schedule

- Project Activities and Tasks
- Resources
- Start and end dates

Project Schedule

Item No	Description	Start Date	End Date	Predecessor (Item No)	Duration (calendar days)
Notice to Proceed/Approval		6/1/2020	6/2/2020		1
Project Initiation					
1	Prepare work plan	6/2/2020	6/9/2020	NTP	7
2	Assemble project team	6/2/2020	6/23/2020	NTP	21
3	Prepare schedule	6/9/2020	6/11/2020	1	2
4	Prepare communication plan	6/23/2020	6/25/2020	2	2
5	Set up project accounting	6/11/2020	6/18/2020	3	7
6	Set up tracking mechanisms	6/18/2020	6/21/2020	5	3
7	Additional tasks	6/21/2020	6/29/2020	5	8
Deliverable: Project Management Plan		Due Date	6/30/2020	7	1
Initial Data Gathering					
8	Collect community data, (demographics, government structure, etc.)	6/30/2020	7/20/2020	Due Date	20
9	Identify Stakeholders (water committee, Water District, other agencies)	6/30/2020	7/13/2020	Due Date	13
10	Research applicable design criteria, (water quality regulations, required water quality per capita, building codes)	7/13/2020	7/20/2020	9	7
11	Research other wells & similar projects in the area	7/13/2020	7/20/2020	9	7
12	Cultural Data	7/13/2020	7/20/2020	9	7
13	Travel planning	6/29/2020	7/29/2020	Due Date	30
14	Additional data	7/29/2020	8/6/2020	13	8
Deliverable: Pre-trip Plan		Submit Date	8/7/2020	14	1
Onsite Data Gathering					

Project Management Tools

Gantt Chart

A traditional way for engineers to present project scheduling is to use Gantt charts.

- Allows for the time required to carry out each project or management activity and task to be determined.

Gantt Chart

New Solar Water System Schedule

SIMPLE GANTT CHART by Vertex42.com

<https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html>

Community Name

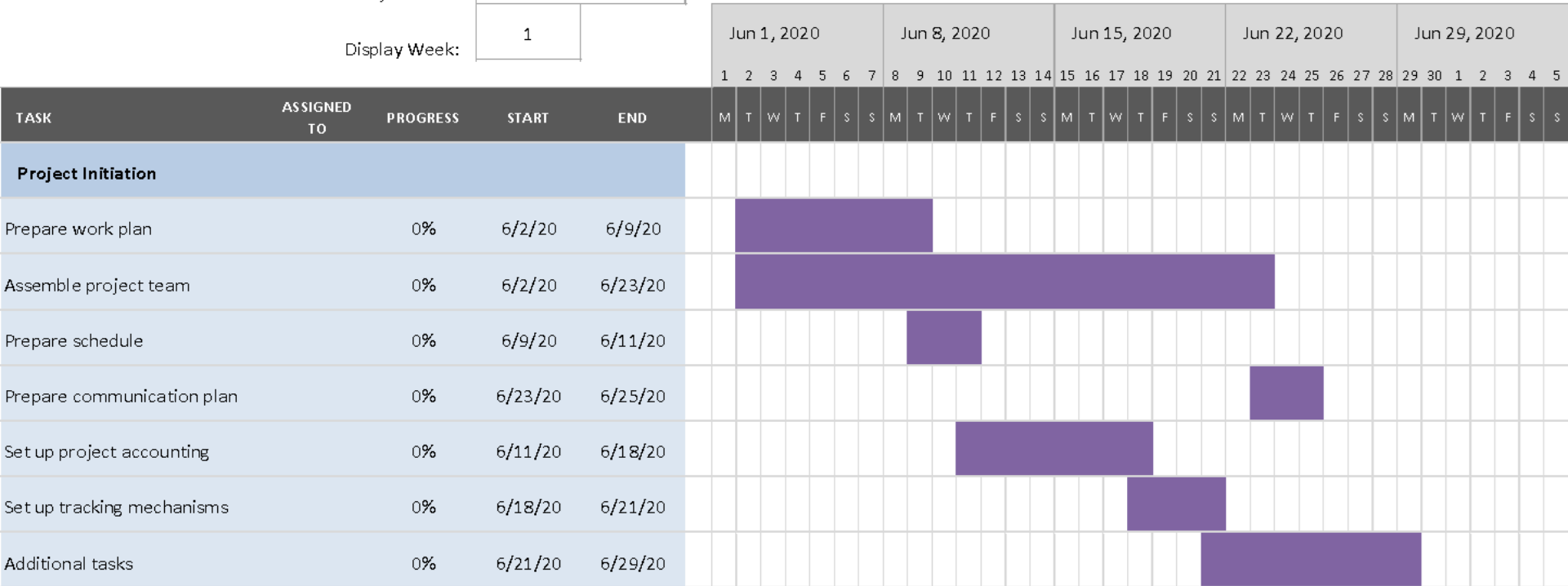
Project Lead

Project Start:

Mon, 6/1/2020

Display Week:

1



Contact Us

Aayush Shah

Power Engineering Student

ashah01@iastate.edu

620 618 0226

Matthew Schindler

Electrical Engineering Student

mattsch1@iastate.edu

815-289-2449

Kyle Neal

Power Engineering Student

kaneal@iastate.edu

224-241-9524

Adilene Prieto

Power Engineering Student

aprieto@iastate.edu

717 200 0627

Logan Miller

Electrical Engineering Student

lwm@iastate.edu

319-538-5804

John Jennison

Power Engineering Student

jennison@iastate.edu

210 250 6175

Shadoe Rusk

Power Engineering Student

shadoer@iastate.edu

641-831-0789