PROJECT SANTA CRUZ

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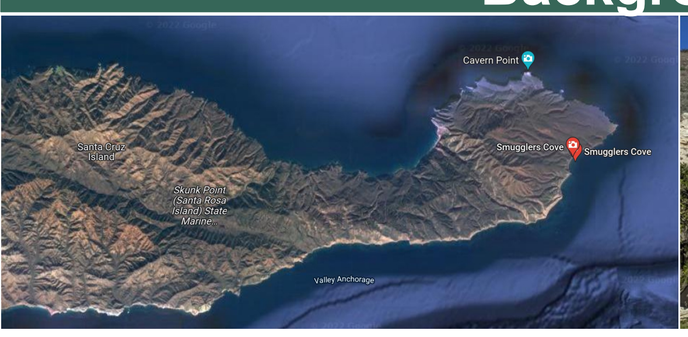
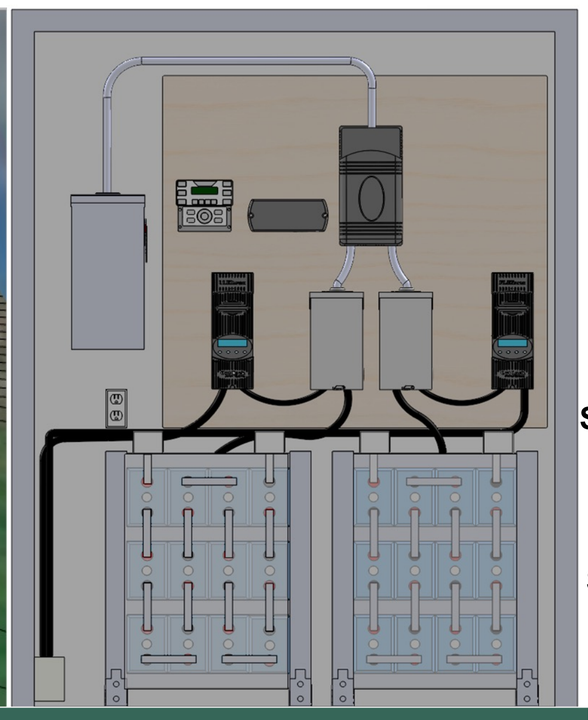
Background



An interdisciplinary engineering team of students designed, assembled and installed a photovoltaic power system for the US National Park Services on Santa Cruz Island. The system will power to a historic adobe on smugglers ranch in a remote and rugged setting.

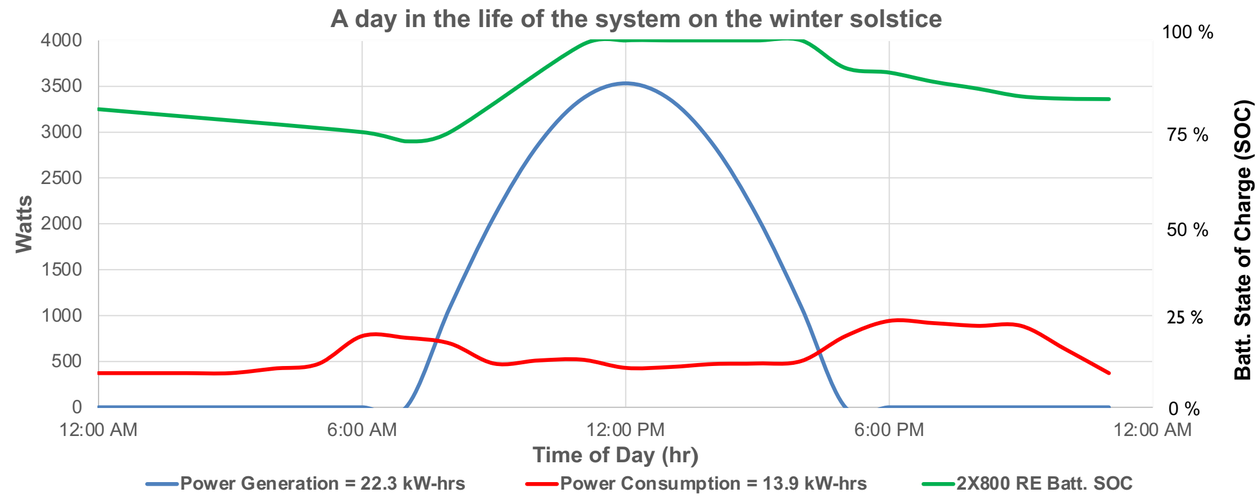


Objective

- Design and build a stand-alone photovoltaic power generation system
- Provide electrical power to a historic adobe securely and sustainably
- Develop an understanding of both system and design details

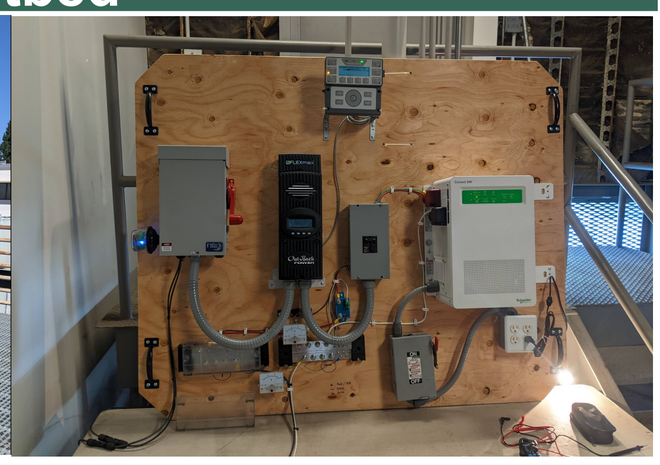
No.	Title	Requirement	Capabilities
1	Instantaneous Power	4.7 kW	5.4kW @5 sec. 3.5kW Cont.
2	Energy Delivered	13.9 kWh	22.3 kW-hr
3	Output Service	< 50 A	29.2 A Continuos
4	Circuit Protection	Resettable Circuit breakers	Complies
5	User Warning	< 70% Battery SOC	Complies
6	System Shutdown	< 50% Battery SOC	Complies
7	System Telemetry	Red/Yellow/Green Status c	Complies
8	Component Weight	< 3000 lbs	Batteries: 2300 lbs
9	Max. Comp. Size	< 6' x 3' x 3'	Complies
10	Reliability and Life	P(s) > 0.95 @ 15 Years	Designed for 15 years
11	Safety and Grounding	US Electrical Code	Complies
12	Temperature	30 F Min. - 83 F Max.	Complies
13	Structural Wind Survivability	> 100 mph	140 mph

System Design



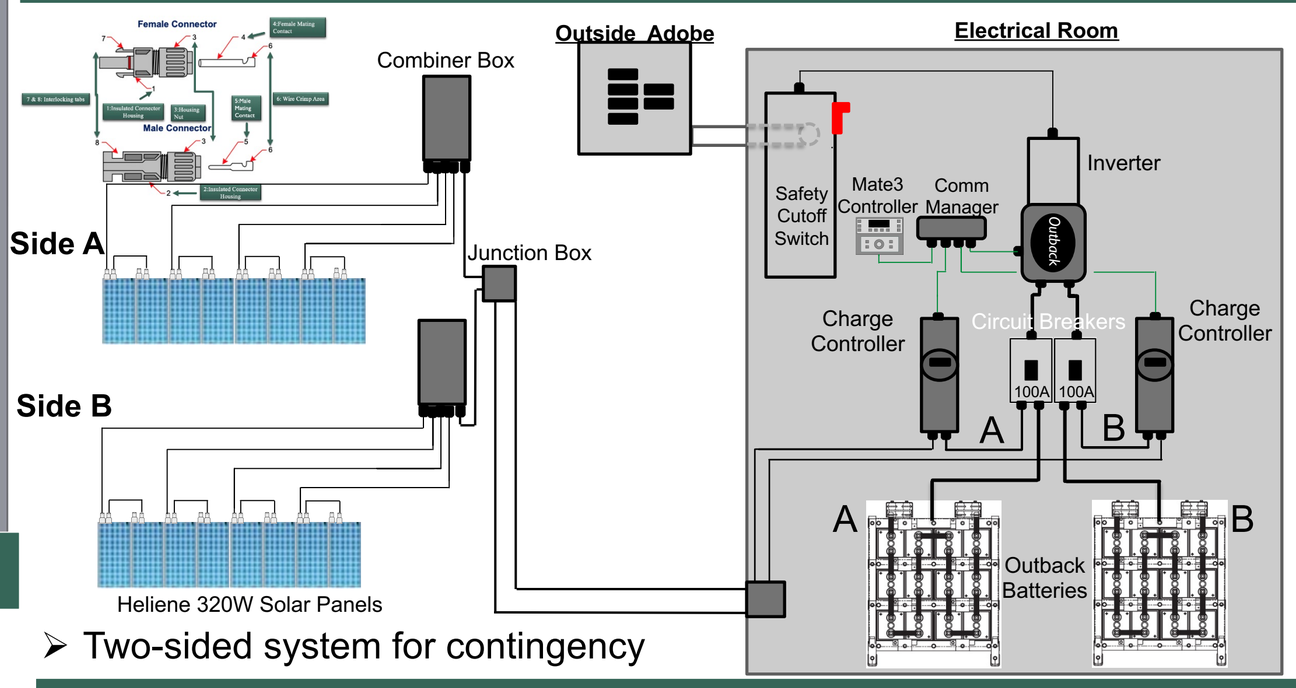
- Designed around the winter solstice this is the worst-case condition
- System contains plenty of overhead to account for solar obscuration
- Batteries offset power consumption at peak usage times
- Thermal design centered around inverter and charge cont. temperatures

Testbed



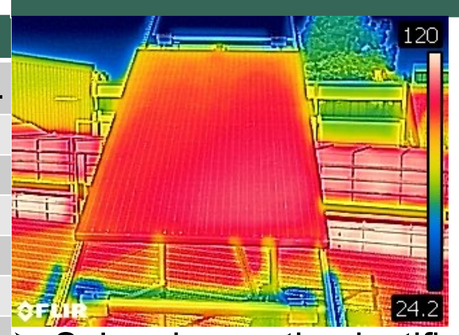
- Testbed was built to reinforce understanding of the actual system
- Similar top level system components were utilized for familiarization
- Testbed is functional and telemetry shows expected results

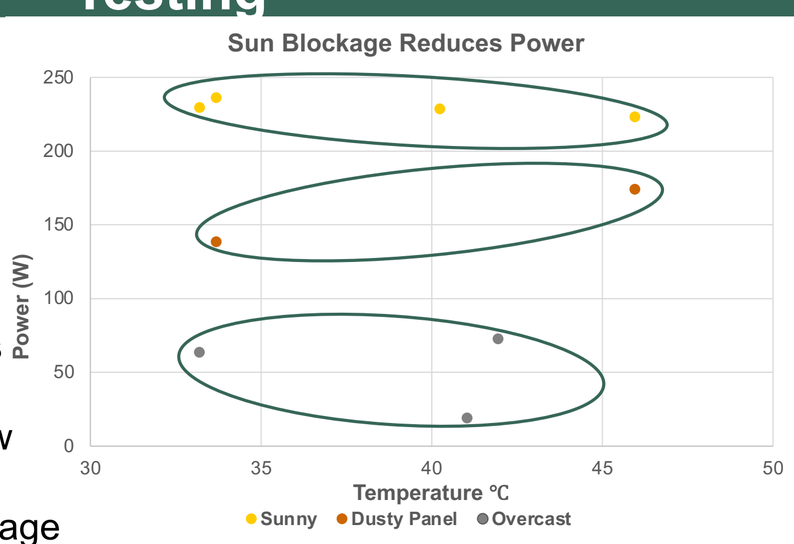
Electric Block Diagram



- Two-sided system for contingency

Testing

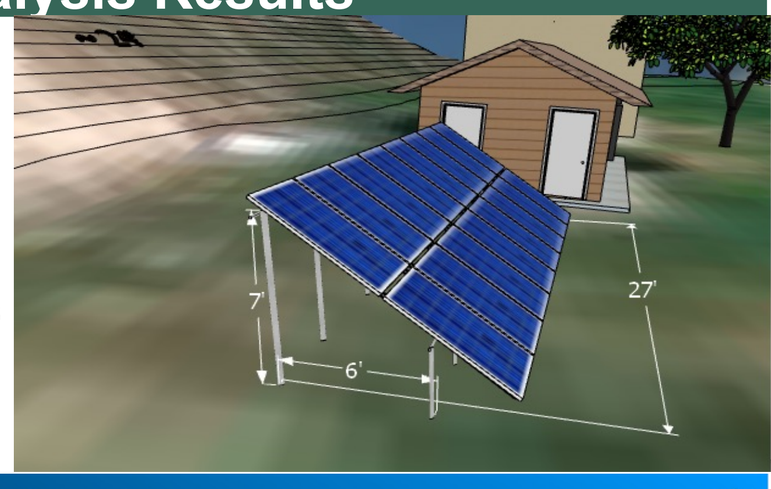




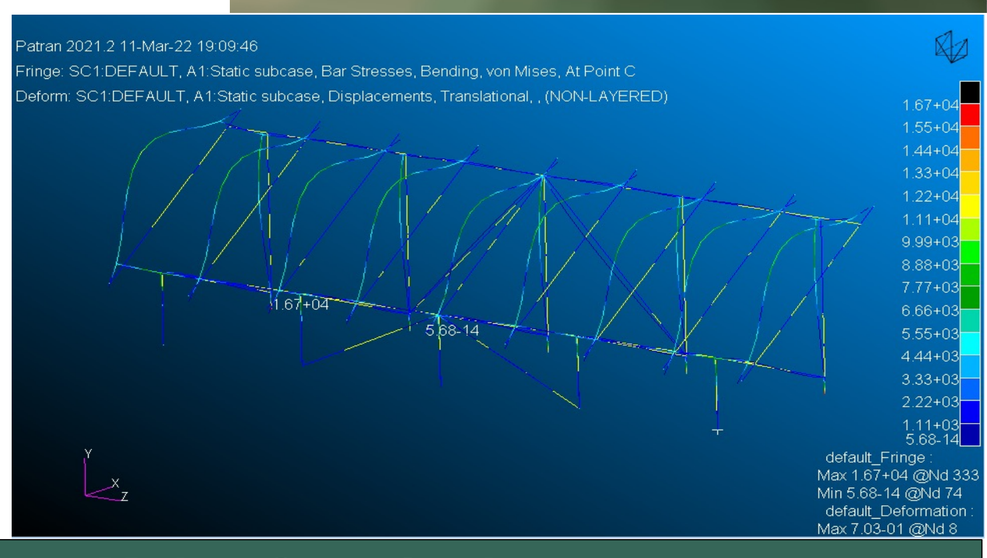
- Solar obscuration justifies System margins
- Experimental results show potential power losses
- Temperature reduces voltage

Analysis Results

- Panel structure has a low profile design
- 16 panel structure with a height of 7 ft.
- Structure is composed of galvanized and aluminum weather resistant materials



- Rails are most vulnerable to wind loads
- Results show max anchor pullout load 1175 lb



Major Conclusions

- System requirements have been met with plenty of overhead
- Proposed design can deliver 31.4 kW-hrs in summer and 22.3 kW-hrs during winter (worst case conditions)
- The team will install the photovoltaic system in situ mid summer