Solar Charging Station

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Progress Check
Document

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1.0 Introduction

The Institute for Sustainable Energy Solutions (ISES) at NAU is a premier research division that works on renewable energy. ISES has in its possession multiple solar photovoltaic modules that can be designed to power small electronics such as cell phones and laptops. Our goal is to design a solar charging station capable of providing enough power to charge small electronic devices. More specifically, we will be looking into the control systems and display systems create a grid connected charging station. The client of this project is Dr. Tom Acker, Professor of Mechanical Engineering at Northern Arizona University. He is a reviewer of ASME Journal of Solar Energy and the director of ISES. His research field includes renewable energy systems, thermal-fluid systems analysis.

This report will be mainly focused on design modifications and individual tasks. After we talked to Dan Hanselman who works for Arizona Wind & Sun, we recognized that we made some mistakes in our previous design. To ensure our system can work correctly, we reselect the inverter and monitor. Also, we assign each team member different tasks to make sure our project can be completed effectively.

2.0 Previous design

For our previous system our team decided to go with the 1000W inverter based on the calculated maximum output. The panel were set of three arrays of two panels each because that way is some of the panels are shaded the system would still work. The display for the system were provided by Green Energy Options (GEO) which had some of the basic information displayed. Next the changes to previous design will be discussed with the reasoning behind each change.

3.0 Design Changes

Hanselman recommended to calculate the inverter size based off the maximum watt output for the panels. Each panel is rated for a 300W output, thus using 6 panels the total wattage equals 1800W. The inverter size must be greater than the total wattage of the system so a 2000W inverter was selected. In particular, a Sunny Boy 2000HF-US (Figure 1) was chosen due to the efficiency of the inverter and the competitive pricing. A graphic display on the inverter face records how much power was produced by the solar panels.

Figure 1: *Sunny Boy*

Figure 2: *Sunny Beam Monitor*

The display was changed from the GEO Chorus PV to the Sunny Beam Monitor (figure 2). Compatibility with the Sunny Boy inverter was the driving force behind the change. The Sunny Beam provides versatility in monitor placement and display outputs by interacting with the inverter via Bluetooth. In addition, the Sunny Beam provides a $75 savings from the GEO Chorus PV system.

The original design consisted of three arrays of two panels each. This set-up was selected because it allowed the system to operate regardless of partial shading. The new inverter requires an input voltage between 175V – 480V thus all the panels must be wired in series to fall within the designated voltage range.

4.0 Budget

Table (1) shows the updated budget analysis. The changes to the budget include the costs of the inverter, the display, outlet and the total. Because the inverter was changed from a 1000W inverter to a 2000W grid tie specific inverter, the cost was raised by a significant amount (about $1100). The display cost actually decreased by a small amount with the change that was made to that particular component. The total cost increased mostly because of the inverter. Finally, the cost of the outlets changed because there switched from USB and appliance specific power sources to general plugs. The updated budget is double the amount of the previous budget, because of the changes that were mentioned previously.

Table 1: *Budget Analysis for the ISES Solar Charging Station*

Item	**Cost ($)**
Sunny Boy 2000HF-US Inverter	1385
SMA Sunny Beam Monitor	236.93
Square D Disconnect Switch 30A 240V AC	60
Midnite Solar MNPV3-Circuit Combiner/ DC Disconnect	75
#12 AWG Two Conductor Stranded Wire 50ft	45
Outlets	19.49
Total	1821.42

5.0 Project Plan

In our last meeting with Dr. Acker he suggested talking with Hanselman before continuing with the project and applying to the Green Fund. Hanselman is a solar specialist for Northern Arizona Wind and Sun, so he is an expert on the project being developed. We are sending our final design to Hanselman for approval before sending in the application to the Green Fund, but once that has been completed we can move ahead with the rest of the planned semester.

As seen in the gantt chart in appendix A, we will next be ordering our parts and testing the equipment and solar panels. As the testing is the main part of project, that will take the most extensive amount of time. Once we have confirmed that all the part work as intended, the group will assemble all the components and begin working on the final poster and operation manual for the UGRADS. This last few items will last until the end of the semester, were we plan on handing off the project to a new capstone group. This group will build the structure for our assembly and implement it in the business building patio.

Table (2) shows the distribution of tasks that are being undertaken by the individual team members. Because the solar panels need to be tested in order to determine how much power they are actually producing and whether or not they actually work. The task of testing the solar panels will be overseen by two team members because of the number of panels that will be tested. Another task will be to submit an application to and then correspond with the Green Fund of Northern Arizona University. This task is to be overseen by a single team member in order to simplify the process. A third task is to order the parts. This will be overseen by two team members in order to guarantee that all of the proper system components are acquired. The inverter that will be obtained will be tested as its own piece of the system. This is because most of the system processes are performed within the inverter and it is necessary to have a working inverter incorporated within the system. This will be overseen by a single team member because it is only a single component of the system. The final task is to test the entire system. This is to guarantee that the system is fully functional, and performing in the way that it is designed to. This will be overseen by a single team member in order to simplify the organization of the recordings that will be taken in order to complete the analysis of the system.

Table 2: *Task distribution among team members of the ISES Solar Charging Station*

Name	**Tasks**
Ze Chen	Testing Solar panels
Tyler Faulkner	Order parts, test system
Alexa Kearns	Green Fund, Order parts
Yaqoub Malony	Testing inverter
Thomas Penner	Testing Solar Panels

6.0 Conclusion

For the rest of the semester, the solar charging station team anticipates working closely with Dan Hanselman from Northern Arizona Wind and Sun, along with applying to the NAU Green Fund for multi semester funding. The current section of the project will begin the testing process in early February, and be completed by mid-April.

The design last semester incorporated an inverter that was designed for a battery tied system. Thus, the updated system will include a new inverter with a total wattage of 2000W. This will adequately supply the supply the needed power and extract the energy from the six solar panels that are aligned in series. Because the inverter changed, there will be a price increase from $946.65 to $1821.42. The new price also reflects a switch from USB ports to outlets. Next, Hanselman will look over the components for final approval, then an application to the Green Fund will be submitted.

References

[1] http://www.solarpanelstore.com/solar-power.sma-inverters.sma_sunnyboy.sma_hfus_2000.info.1.html?gclid=CIbL45jkpLwCFVBgfgodqHwA-w

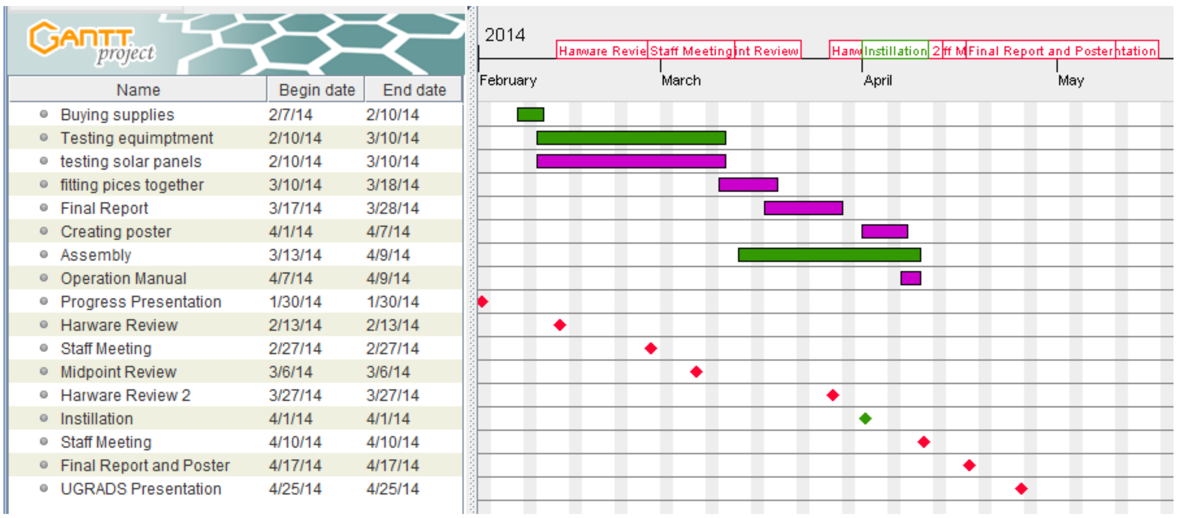
[2] http://www.solar-electric.com/sqddisw24acn1.html

[3] http://www.solar-electric.com/mnpv3.html

[4] http://www.solar-electric.com/12-2-tc.html

[5] http://www.amazon.com/50759-6-Grounded-Outlet-In-Wall-Adapter/dp/B0009HKEXM/ref=sr_1_1?ie=UTF8&qid=1391047948&sr=8-1&keywords=4+plug+outlet

Appendix A



Name	Begin date	End date
Buying supplies	2/7/14	2/10/14
Testing equimptment	2/10/14	3/10/14
testing solar panels	2/10/14	3/10/14
fitting pices together	3/10/14	3/18/14
Final Report	3/17/14	3/28/14
Creating poster	4/1/14	4/7/14
Assembly	3/13/14	4/9/14
Operation Manual	4/7/14	4/9/14
Progress Presentation	1/30/14	1/30/14
Harware Review	2/13/14	2/13/14
Staff Meeting	2/27/14	2/27/14
Midpoint Review	3/6/14	3/6/14
Harware Review 2	3/27/14	3/27/14
Instillation	4/1/14	4/1/14
Staff Meeting	4/10/14	4/10/14
Final Report and Poster	4/17/14	4/17/14
UGRADS Presentation	4/25/14	4/25/14

Figure 3: *Project plan for semester two*