The Off-Grid Zero Emissions Building (OGZEB) Hybrid Thermal/Electrical Energy Storage System

Restated Scope and Project Plans

Team 15/23:

Corey Allen | Anthony Cappetto | Kristian Hogue | Tristian Jones | Nicholas Kraft
Lucas dos Santos | Artur Nascimento

Advisers/Coordinators:

Kamal Amin | Michael Frank | Helen Li | Juan Ordonez | Jim Zheng

Table of Contents

Work Statement

The spring semester will entail a variety of new goals and objectives. The main objective is to complete the Ice Storage System prototype, have the newly designed battery array functioning, and research the possibility of connecting the OGZEB to the power grid. Once these two systems are complete, they will undergo testing. The Ice Storage prototype will be used as a "Proof of Concept" only and will not be installed in parallel with the main AC system since it is scaled down due to cost constraints. The Ice Storage System will be tested using indoor air at room temperature. To fully test the system (both storage and melting processes), a chiller would be required in order to freeze the water within the aluminum tanks. Whether or not a chiller will be purchased is dependent on the supplied budget. If a chiller cannot be purchased than the melting process during off peak hours will be simulated by simply filling the tanks with ice water. The testing will aid in future development of a full size system.

Project Scope

By the end of the semester the thermal system prototype should be built and the new battery array should be installed. After testing, calculations for the full size system will be estimated with respect to the scaled down system. This will allow for calculations in energy and cost savings had the full size system been installed. These could be utilized to show that this type of system is a viable option for off-grid residential energy solutions.

After the battery array is properly installed, other issues will be looked into to maximize overall performance of the house. These issues include, a temperature monitoring system for the battery array, change/improvement in the battery management system, and research the possible of connecting the OGZEB to the power grid.

Major Goals and Objectives

The main objectives and subsequent work breakdown for the spring semester is as follows:

1. ***Purchase and install battery system***

2. ***Battery monitoring device***
    a. Develop prototype and purchase parts
    b. Code development
    c. Testing of prototype
    d. Creation/implantation of final product
3. ***Battery management system***
    a. Gather relevant information/data on current system
    b. Address major concerns and design flaws
    c. Produce a detailed updated manual for future teams
    d. Provide final battery management schematic for system
4. ***Power Grid Connection***
    a. List of materials and permits needed to connect the OGZEB to the Tallahassee grid
    b. Talk to Tallahassee Utility for information about economic benefits and what regulations need to be followed to complete a project of this scope
    c. Create a circuit diagram illustrating the entire electrical system
    d. List some potential problems
    e. Cost analysis and economic benefits
    f. Create a concise step by step process for next year's team

5. ***Complete construction of ice system prototype***
    a. Fin design and construction
    b. Lid modification for (air-tight) sealing and portability
    c. Fan procurement and installation
    d. Install drain
    e. Install outside insulation

6. ***Testing of both systems***
    a. Compare actual heat transfer of ice system to theoretical and scale to full size model
    b. Monitor maximum battery drainage and other pertinent data to ensure maximum battery life
    c. Calculation of cost savings and energy storage

Project Updates

1. ***Purchase and install battery system***

   The batteries have been purchased. It will be about 6 weeks before they arrive.

2. ***Battery monitoring device***

   The prototype has been developed and parts have been ordered. The beginning stages of the code developing will begin within the following weeks.

3. ***Battery management system***

   Contact with OGZEB staff has been made, waiting for reply to set appointment to analyze current management system.

4. ***Power Grid Connection***

   Some preliminary research has been completed and an appointment to speak with a Tallahassee Utility representative has been scheduled.

5. ***Complete construction of ice system prototype***

   The construction of the Ice Storage prototype is currently underway and has made significant progress. The system is a proof of concept only, so cheap materials were used in construction. Recycled plywood was used for the outer shell and the aluminum tanks were crafted out of thin aluminum sheets and sealed with adhesive caulking. The fins will be constructed out of thin aluminum and glued to the surface of the water tanks using thermally conductive glue, but before the construction of this phase, a fin pattern to maximize effectiveness has to be determined. The fan still has to be procured before cutting out a section in the shell for the fan installation. The air inlet and outlet sections cut out in the outside shell will be hinged to the outside wall and be allowed to open and close. (Open during the melting process and closed during the chilling process). Finally, to maximize the effectiveness of the system latches will be placed on the lid to make the system air tight ergo minimizing the heat gain into the system.

6. ***Testing of both systems***

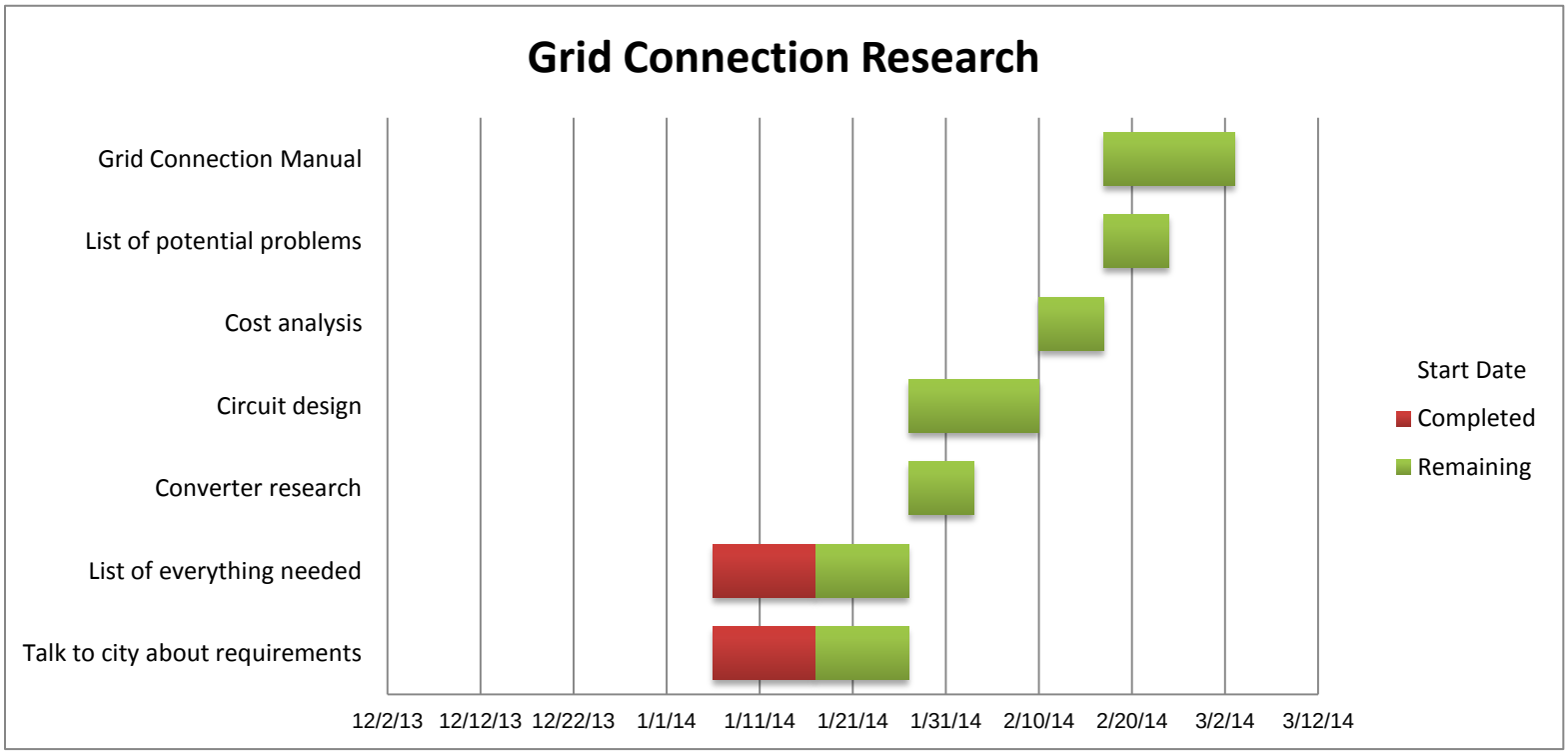
   The Ice Storage system testing is dependent on whether or not a chiller will be purchased. Because a chiller is an integral part of the full size system, it would be ideal to have it for the prototype to test both phases of the system operation. If the budget does limit the design team to testing without a chiller, only the melting phase will be simulated. The chilling phase would not be simulated in this case but would be analyzed based upon the known information of the system. Four thermometers will be installed to read the ice/water, the inlet, and the exit

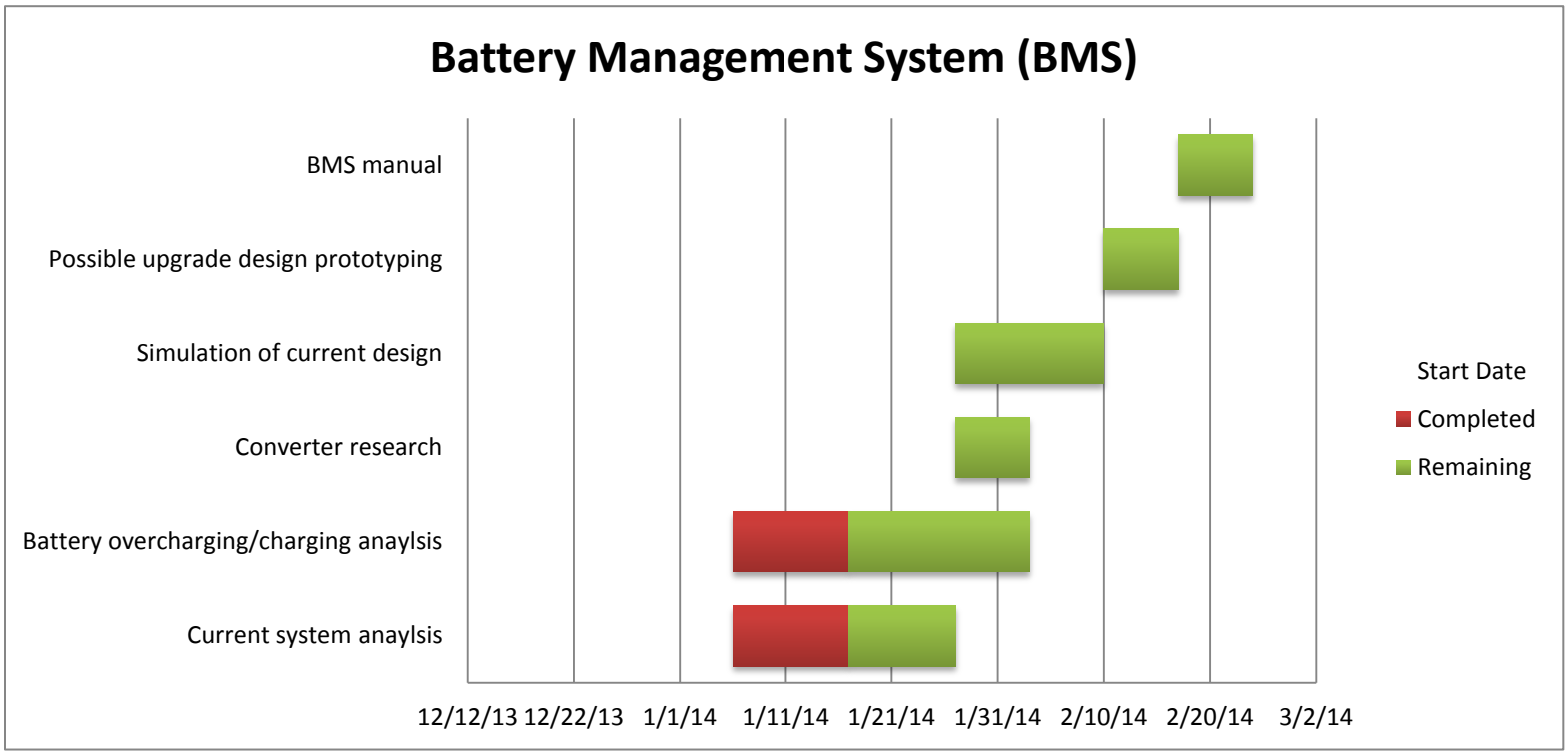
temperatures of the system. These temperatures will be used as data points to measure the heat transfer within the system.

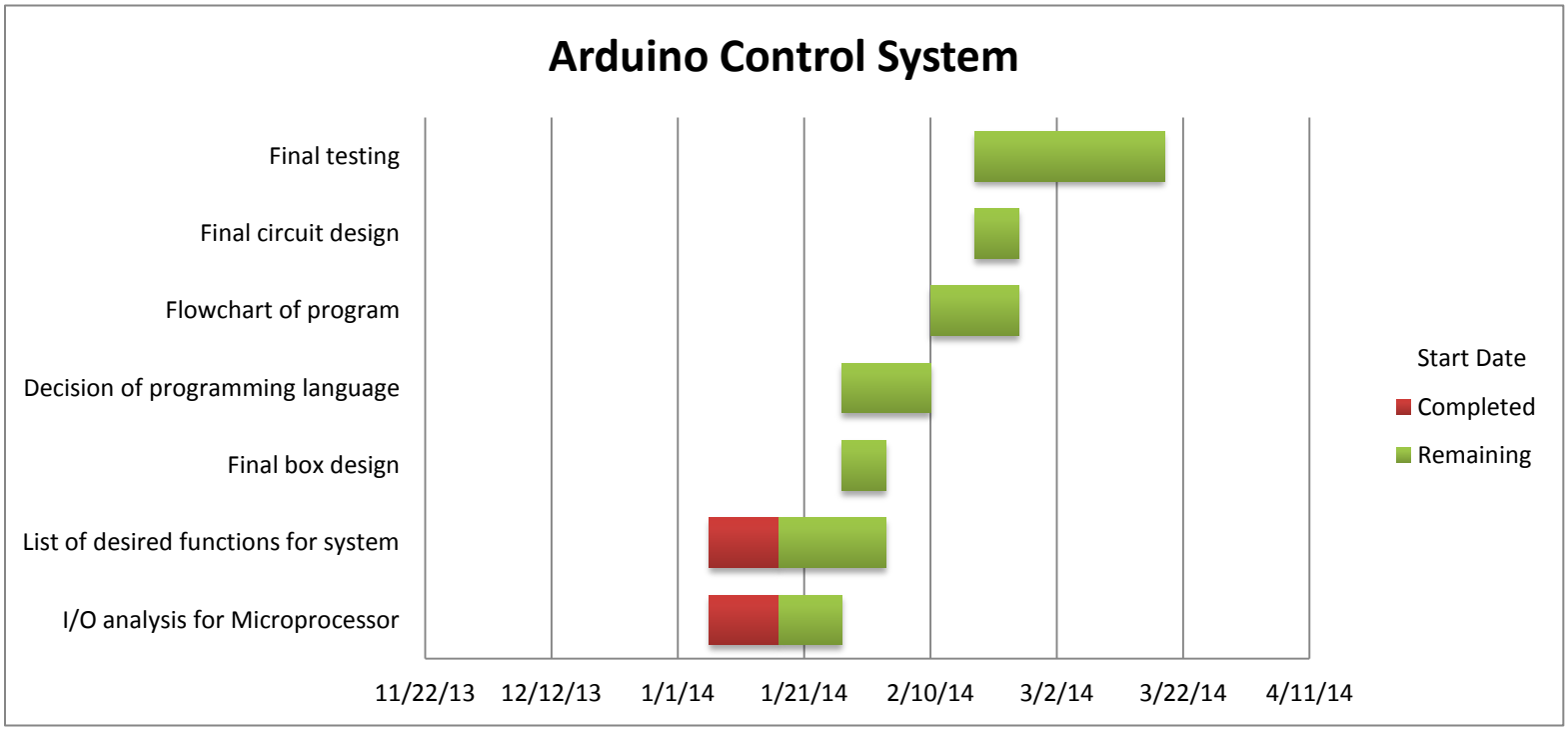
Newly Developed Issues

There are no current major issues pertaining to the completion to the project. The only issue pertaining to the testing will be whether or not there will be enough funding left to purchase a chiller. As mentioned earlier, a chiller is not an absolute need but a necessary need if the storage phase of the thermal system is to be tested.

Updated Gantt Charts




Battery Management System (BMS)
BMS manual
Possible upgrade design prototyping
Simulation of current design
Converter research
Battery overcharging/charging anaylsis
Current system anaylsis
12/12/13
12/22/13
1/1/14
1/11/14
1/21/14
1/31/14
2/10/14
2/20/14
3/2/14
Start Date
Completed
Remaining


Arduino Control System
Final testing
Final circuit design
Flowchart of program
Decision of programming language
Final box design
List of desired functions for system
I/O analysis for Microprocessor
11/22/13
12/12/13
1/1/14
1/21/14
2/10/14
3/2/14
3/22/14
4/11/14
Start Date
Completed
Remaining

Project Plan Schedule- Spring 2014

Components	January				February				March					April			
Weeks	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week13	Week 14	Week 15	Week 16	Week17
Start Dates	01/05	01/12	01/19	01/26	02/02	02/09	02/16	02/23	03/02	03/09	03/16	03/23	03/30	04/06	04/13	04/20	04/27
Restated Scope/ Plan Report																	
Design web page update																	
Midterm Presentation I																	
Design review: Progress																	
Midterm Presentation II																	
Design review: Interim																	
Operation manual																	
Design for Manufacturing/Reliability and Economics Report																	
Walk-through Presentation																	
OPEN HOUSE																	
Completed Web page																	
Final presentations																	
Final project report																	
Final Report																	
Bi-Weekly Reports			★		★							★					