NORTHERN ARIZONA UNIVERSITY

Memorandum

To: Sarah Oman

From: F2 - SRP - Carl Aaker, Ahmad Abuouf, Wyatt Bain, Tatum Begay, Alonzo Bizahaloni, Brandon Dunn, Taylor McCormack, William Senseman

Date: March 20, 2018

Re: Hardware Review #2

Up to this point we have finished more than 90% of our project (solar air heater). The only task left before we are 100% complete is the attaching of the solar air heater to our box. This will be done by connecting the duct work and the wires, for the fans already attached to the air heater, from our air heater panel to our box. Below in Figures 1-4 is the progress so far:

Figure 1: Inside View of the Box

Figure 1 shows the inside view of our box. The sheets of PCM are held by metal rods between sheets of insulation, also in that section is the fan for output to the house. On the right side we have our inlet fan with our battery, Arduino, circuit board, and connecting wires. In the insulations are holes where the duct work will carry the hot air into the section holding the PCM.

Figure 2: Inside View of Closed Thermal Box

Figure 2 shows the inside view with the insulation lid to keep the heat inside the PCM section.

Figure 3: Top View of Solar Thermal Panel

Figure 4: Bottom View of Solar Thermal Panel

Figure 3 and 4 shows the top and bottom view of the solar thermal panel, with the two collars and fans attached.

Carl Aaker - From hardware review 1 to hardware review 2, I was in charge of editing the final proposal report from last semester using the revisions that were set in place from the graders. This included editing the table of contents and renaming the project design considerations in order to make the table of contents more organized. I also reformatted the tables in order to make them on one page and reduced the size of the filler in the tables. I analyzed the volume of the air that would be flowing inside of the box in order to determine the amount of air will be flowing from the box into the hogan throughout the night when the fans circulate the hot air.

Ahmad Abuouf - As far as this project is concerned, a lot was done. Every member greatly contributed to the making of this project. Each and every one of us was assigned duties to perform in this project. In the past one month, I had four duties to perform this project. I helped with paying for the materials of our project from the hardware. I was also in charge of updating all the information concerning the project in our website to be readily

available for everyone to access it. I also did the photographing of the completed project, the pictures herein in the reviews were taken and compiled by me. Moreover, helped with manufacturing our project.

Wyatt Bain - From hardware review 1 to 2, a lot has been done. First off, I have been working with William and Tatum to get the fan and the circuits working and install them onto the air heater. As a group that has been accomplished. As well as working on the electrical components, i have also been working on the construction of the air heater itself. William, Taylor, and I have been cutting inlet and outlet holes within the insulation, cutting and installing rebar, and attaching the fans to the box. Lastly, I helped with the midpoint presentation and the midpoint report.For the rest of the semester, I will continue on helping with constructing our prototype and working on team assignments that are required for the class.

Tatum Begay - During the period of Hardware Review 1 to Hardware Review 2, I was in charged of the website and keeping it up to date. I coded the gallery and added pictures to it. I fixed the homepage of the website to include a picture of our design and to add SolarthermiX and Green Rhino as our sponsors. The about me page was fixed to make the team descriptions in third person. Nevertheless, I helped Wyatt with the fan circuit and code. After we got those to run, I worked with William and Wyatt to combined those two circuits. I also helped with developing and editing the midpoint presentation as well as the midpoint report.

Alonzo Bizahaloni - I have been determining a way of how the thermal box should be set up which will be decided by the homeowner. Alarick has agreed to aid my calculations how much the thermal box would sink into the sand whether if it is wet or dry. Also, looking at the height of each hogan or home while back on the Navajo reservation during spring break. Looking at the height of the hogans which will be determine by height of the hogans on the reservation.

Brandon Dunn - During the period from hardware review 1 to 2, I completed a lot of work. I was in charge of implementing the EnergyPlus software. This included finding all information about used materials in the construction of the box from r-value, specific heat capacity and conductivity to the enthalpy curve of the pcm material used. This information then had to be implemented in the software and debugged. I managed to implement a Navajo Hogan as well as most of the box implementation from pcm to solar air heater. While more work needs to be completed to connect the air nodes in the system so that all portions work and the Hogan is heated, I believe with the remaining time and some aid even this can be accomplished. I also aided in the construction of the box including; the cutting of holes for the inlet and outlet of the box, the attachment of our collars and fans for the duct work on the box and solar thermal panel and the cutting of the styrofoam insulation walls for the inside box. I also aided in obtaining many materials needed for the construction of the box

including insulating spray foam, rebar and foam insulation walls. I also aided a lot with the midpoint presentation and midpoint report.

Taylor McCormack - From hardware review 1 to hardware review 2 a lot was done. Over the past month I was in charge of getting the rest of our materials ordered, and picked up. I helped with the manufacturing of our box: assisted in cutting our sheets of insulation, cutting the holes for the inlet and outlet of the box, the cutting of the rebar for the PCM, the installation of our insulation in the box and the holes drilled into them for ducting, the attachment of our collars and fans for the duct work on the box and the solar thermal panel. I contacted Amir Roth the manager of the EnergyPlus program to get assistance in how to operate the software. An analytical analysis was done to see if the coil heating system was efficient. Helped with the midpoint presentation and now working the midpoint report.

William Senseman - Between hardware review 1 and 2, I accomplished a lot of manufacturing on the Green Rhino box. I personally, cut all the holes from intake and outtake holes on the Green Rhino box to the inlet holes through the Thermasheath insulation box inside the Green Rhino box. Then, I applied Great Stuff Gap Filler to the Thermasheath box airtight minus ventilation holes for air to circulate through. I also cut the rebar and put it in the box with Wyatt's help. I also designed the Photoresistor circuit and code for the fans to run off of based on light sensitivity. My circuit and code was then taken and place in one circuit with the fans circuit and code so they run in parallel with each other based on how much light is present. I attached the fans and circuits along with Wyatt's help inside the box all we have to do is hook them up to the battery. I also helped work on the midpoint presentation and report.

Action Items:

1. Attach the solar thermal panel to our box: Taylor McCormack, William Senseman
2. Set up the box and house for testing procedures: Taylor McCormack, Wyatt Bain
3. Acquire temperature measurement devices: Taylor McCormack
4. Talk with Professor Sagnik Mazumdar about using LabVIEW and Thermocouples: Taylor McCormack, Alonzo Bizahaloni
5. Testing of the box and recording of the data: Taylor McCormack, Alonzo Bizahaloni, Tatum Begay
6. Simulate Box and PCM efficiency on EnergyPlus: Brandon Dunn, William Senseman
7. Cut and place ventilation duct: William Senseman, Wyatt Bain
8. Update Website: Tatum Begay, William Senseman
9. Attach Arduino and wires to the fans: Tatum Begay, Wyatt Bain
10. Acquire and install various sensors for our box. Ahmad Abuouf, Carl Aaker
11. Ensure the efficient working of our box. Ahmad Abuouf, Carl Aaker