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On-Campus Solar PV Lab: Component Selection is Only the Beginning

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Our Team & Current Mission

The solar photovoltaics (PV) team (Fig. 1) designs and installs solar panel systems in developing countries where power is either unreliable or non-existent. Recently we began construction of a Solar lab at Messiah to help pass on the experience and knowledge we have gained from previously installed international systems to future teams. Last year, all of the main components had been physically installed, but they had not been wired and programmed to be a fully working system

This poster tells of how the component selection and design of a system is really only the beginning of a fully functional installation. There is much more that goes into the final build.

Figure 1: The Solar PV Team Spring 2021

Our Partners

Past Solar partners including Living Love Ministries, Theological College of Zimbabwe, and Ekuphileni Bible Institute will be better supported by the learning made possible by the Solar Lab. We look forward to using the lab next year as we work with our new partner Tree4Hope ministry in Guatemala.

Acknowledgments

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The Solar Lab: The Purpose and Design

The Solar Lab at Messiah University has two purposes. The first of is to educate new team members about the different parts of solar PV systems. Many of the components in the Solar Lab have been used at actual Solar PV install locations. The second use of the Solar Lab is to enable experimentation with new components and modified system layouts prior to remote installation.

The preliminary design for the Solar Lab was created back in 2019 and the solar panels near Frey were installed that winter. Continued work on the project was put on hold while the Solar PV team did the design and installation of a solar water pump system in Kenya.

Fall 2019 - Spring 2020 the major system components were selected. This is the point in a typical development cycle when the team would travel to an installation site. Work which models a site installation was begun by mounting major components to our wall unit before the semester work was cut short by Covid-19 (see figure #2). During this year we continued the work normally done on site and learned that while mounting components has the appearance of a PV system being nearly done it is really only the beginning of design execution.

Figure 2: the Solar Lab Equipment Panel in spring 2020

Figure 3: the Solar Lab Equipment Panel wired in spring 2021

The Solar Lab: Installation Realities

Prior to site installations a team creates component/wire gauge selection, electrical schematics, panel layouts, and rough component locations. But details such as actual wiring paths, conduit size, and programming have always been done in country with little more than basic ideas and approximate numbers for plans. The work that was done this year to complete the Solar Lab mimicked the site team task of converting schematics and drawings into a physical system.

When the design of a solar power system is complete, it has all of the wire lengths and gauges that are needed, but not where to put them, how to bend them, and how to neatly manage the cables. Those three ideas all are difficult to plan for and include in the design especially when the team does not have detailed photos or frequent access to the installation site. While working on the installation of the solar lab at Messiah this year, the team gained valuable knowledge about the decisions that need to be made at the installation site.

Running conduit was a more time-consuming process than expected. A quick plan was drawn, the amount of conduit needed was estimated and then we jumped right into bending and assembling. Every piece was cut, and placed based on the one before it; nothing was precise. It required a different skill set than the typical design process that we have been trained to do.

The programing that was completed for the Solar Lab involved many of the components that would be bought in country during installation like inverters, batteries, charge controllers, and the system controller (Mate). The system controller programming is specific to the particular installation. It allows for variation in battery charging set points, different inverter settings, such as a grid-tie system or an off-grid replica, and can set up current limits in the charge controllers. Prior to traveling to an installation site, a team does not have access to the actual system components since they are bought in country. Thus the Mate programming that we performed during this semester is typically done as a part of the final installation.

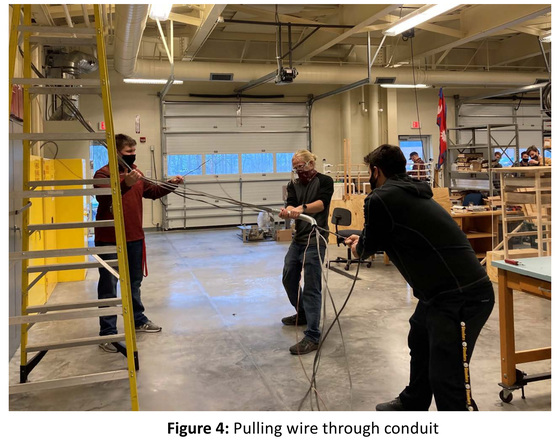

Figure 4: Pulling wire through conduit

Conclusions

The Solar PV team looks forward to verifying the operation of our completed Solar Lab and completing the training document. Both will be valuable resources for new team members as well as prototyping new client installs in the future.

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