Renewable Energy Systems Training (REST) Laboratory Development and Workforce Training

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This proposed project will significantly contribute to the renewable energy workforce training by providing functional knowledge and understanding of solar PV systems integration, installation, startup, commissioning, protection, and troubleshooting. In this proposed project, the REST laboratory will be developed with state-of-the-art equipment to offer new solar PV installation courses for the engineering technology and college students.

The course topics and lectures include:

- **Lecture 1 -** Solar energy systems, DC/AC PV systems, solar thermal systems, active and passive water heating, space heating/cooling, and solar PV/thermal industries.
- **Lecture 2 -** Solar irradiance characteristics/measurement/calculation, peak sun, sun path characteristics (global positioning, solar time, and sun path diagrams).
- **Lecture 3 -** Solar panel orientation, site measurements, and insolation data.
- **Lecture 4 -** Perform array site planning: assessment and permitting, analysis, component location identification, and layout drawing.
- **Lecture 5 -** Perform maximum circuit voltage and current calculation, and wire selection and sizing; Select and install grounding and surge protection systems.
- **Lecture 6 -** Draw 1- and 3-line PV circuit diagram, assemble a PV array and mounting system, install conductors, and label components based on safety rules; Perform pre-startup PV system checkout and initial startup, and tie an interactive PV system into the grid.
- **Lecture 7 -** Connect and operate a PV module, and measure the open circuit voltage, short circuit current, and operating point; Calculate PV output given changes in solar irradiance and ambient temperature, determine PV module efficiency and interpret its specifications, and describe the types of PV module materials.
- **Lecture 8 -** Calculate the theoretical power output of a PV array, and connect it given a wiring diagram; Measure the open-circuit voltage of a solar battery, calculate its discharge rate, interpret its specifications, and connect it given a schematic.
- **Lecture 9 -** Interpret the battery charging characteristics, connect a charge controller and adjust its settings, and operate a charge-controlled DC PV system; Connect, operate, and troubleshoot a stand-alone AC PV system, and an interactive PV system to be tied to the grid with/without battery backup.
- **Lecture 10 -** Manually operate a solar collector in a solar thermal system based on safety rules; Interpret the specifications of the solar thermal components, and connect and operate a circulator pump and a heat exchanger.
- **Lecture 11 -** Connect and operate a digital differential controller; Program, operate, and troubleshoot a drainback solar thermal system.
- **Lecture 12 -** Program, operate, and troubleshoot a pressurized solar thermal system.