{ TC "'Chapter 7: Conclusions and Recommendation'" \l 1 }Chapter Seven

Conclusions And Recommendation

7.1 Conclusions{ TC "7.1 Conclusions" \l 2 }

The UW-PUMP EES version uses a simplified set of hourly weather data derived from average monthly weather data to simulate the PV pumping system. It has been shown to have a annual RMS difference of about 3% (Albuquerque) to 6.1% (Seattle) compared to the TRNSYS program, which uses the TMY weather data. Based on performance analysis of a PVPS as shown in the last chapter, it is concluded that the new simplified method, as implemented in the EES, can be used as a simulator in designing and establishing the long term performance of a PVPS over any monthly and annual period, and over a typical range of US climates.

The new algorithm developed in this project provides many advantages, such as quick determination of all operating points of a given system, great flexibility in changing the system topology and a simple interface with standard pumping system components. This can be very useful in the interest efficient analysis and developing an effective PVPS. Needless to say, all the different types of analysis and all the built-in features that EES and TRNSYS generally offer are also available.

An improvement to the PV model proposed here which would allow integration of different load models in one TRNSYS type. It is fast and has no numerical problems. The new pump model leads to an improved way to design and simulate a PVPS based on the available data from the manufacturer's catalog. Those models are proven as accurate after it was compared with the manufacturer's PVCAD program. Also as part of the simulation method, a program in the UW-PUMP EES for sizing the PV array will help users find the correct configuration of PV modules. The improved MPPT model show that an MPPT can improve the efficiency of a less effective designed PVPS in 20-30%. However there is not significant improvement for optimized direct coupled PVPS. This method can also be used in other applications. Such as changing the load from a pump to some other load such as a grid or a battery.

The EES program has been demonstrated to be a valuable tool for a PV system analysis. Many of the simulations performed via the EES would have been impractical using other PV simulation programs. The EES program was also utilized to model not only electrical characteristics of the PV system, but also temperature and radiation.

Using the weather generator can provide accurate weather data for long term simulation instead of using the detail long-term empirical weather data which is not easily found for many cites. The weather data generator also reduces the simulation time because generated weather data can be saved as a table or a curve. The flow rate of pumped water can calculated directly by using the PV and pump function regarding the radiation distribution.

7.2 Recommendation{ TC "7.2 Recommendation" \l 2 }

The new method developed in this project is still in the early stages. This method does not include an economic simulator at the current stage. Since the design of solar applications should consider the economic factors, the economic simulator is an important tool for analyzing the effectiveness of system investment. In this research, only Solar Jack provided characteristics of the pump and the MPPT products. Therefore more pump and MPPT data should be collected.

This new model has potential application for other loads. Future work would include batteries, resistors, inverter components.

No measurement data are available for this project. An important objective in future work is to obtain a set of empirical data.

The utilizability concept is a useful tool for analyzing the solar energy application. It will be interesting and desirable to find a utilizability method for analyzing and sizing the PV pumping system.