# VALIDATION OF A TRANSIENT SIMULATION PROGRAM (TRNSYS)

BY

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RESEARCH REPORT

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ABSTRACT

Although a Transient Simulation Program (TRNSYS) has become a widely used model for simulating a solar energy system, there has not been extensive work done in validating this model with actual data. The approach used to validate this model consisted of a modular build-up of components with validation for each module.

Extreme care was taken in choosing the necessary parameters to model each component. Where parameters were not given, they were either derived or reasonable values were selected based upon general conditions prevailing in Central Florida or conditions which are generally true for certain solar hot water systems. The intent of this approach was to avoid forcing the model to fit experimental data. Such forcing can cause present results to correlate favorably, but gives no assurances for model performance in future simulations which may be made for varying conditions or completely different systems.

TRNSYS compared favorably with experimental data. The average error for an entire 8 hour simulation with 15 minute intervals was only 3.39 percent for the entire tank and collector combination. The model's major deviations were in the start-up collector outlet temperature and rapid changing in actual hot water demand which the model could not match primarily in amplitude and not phase.

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# INTRODUCTION

Although a Transient Simulation Program (TRNSYS) has become recognized and accepted as a good approach for simulating various solar energy systems, this program has not been validated using actual experimental data [1]. To evaluate the model's accuracy, actual data was used and compared to predicted values obtained from TRNSYS [2]. The United States National Bureau of Standards is currently conducting a similar effort to validate TRNSYS. This effort utilizes two approaches. One is to use TRNSYS to predict performance of several solar hot water systems. This effort will entail gathering data for approximately one year and then modeling performance. No data is presently available for this approach. The second approach involves a shorter term solution where a laboratory model is used and compared to TRNSYS. The results of this effort are available, but do not represent an actual solar hot water system.

The solar energy system selected to be modeled consisted of a forced circulation solar hot water system (depicted in Figure 1). This type of system with an auxiliary heater in the storage tank is typical of solar energy systems used in many homes today. The solar energy system investigated consisted of a solar collector, pump, and hot water storage tank with an auxiliary heater in the tank.

This investigation was performed in conjunction with the work done by Pearce [2]. Duplication of effort was avoided, but some additional system characteristics were needed to describe the solar energy system in a format compatible with TRNSYS. These additional system characteristics were either derived, or reasonable values were used which are typical for Central Florida. All assumptions will be so noted in the following text.

The text is organized such that the collector characteristics and assumptions used are first presented and following this is a similar discussion on the tank characteristics. Following these two sections is a section on the results of the simulation runs