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November 1979

DEC 18 1979

Systems Activities in Photovoltaics for FY79

Laxmi C. Mrig

SERI

Solar Energy Research Institute
A Division of Midwest Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

Operated for the
U.S. Department of Energy
under Contract No. EG-77-C-01-4042

SERI/PR-351-473
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PREPARED UNDER TASK NO. 3521

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FOREWORD

The work discussed in this document was prepared as part of Task 3521 and evinces activities undertaken in fiscal year 1979.

The efforts of the following people are reflected in the report: J. Watkins and M. Buhl.

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SECTION 1.0

INTRODUCTION

The Solar Energy Research Institute (SERI) is the lead center for advanced research on photovoltaic (PV) systems ranging from the investigation of advanced materials and PV devices to study on advanced balance-of-system components and subsystems.

In fiscal year 1979, the Systems Analysis Branch sought to define system requirements for thin-film PV systems. Because key personnel were transferred, the task was restructured toward these objectives: (1) initiate in-house analysis of PV systems, (2) begin the definition and specification of a PV systems laboratory, and (3) provide technical assistance to PV activities in International Division projects. The next section briefly describes the activities undertaken to support these goals.

SECTION 2.0

PV SYSTEMS ACTIVITIES DURING FY79

2.1 PV ANALYSIS CAPABILITY

Among the PV analysis codes available, the SOLCEL code, developed by Sandia Labs in Albuquerque, N. Mex., is versatile in its capabilities, well-documented, and easily accessible and thus, most suitable to be added to the SERI-leased BOR CDC6600 computer for in-house analysis of PV systems. The code, tested for built-in default values, will verify the contractor's simulation for the SOLERAS 350 kW_p system design (see Sec. 2.6) and other international projects. The revised SOLCEL, SOLCEL II, also developed by Sandia Labs, has been installed at SERI.

2.2 SIMPLIFIED PV SYSTEM DESIGN CODE DEVELOPMENT

A simplified code, developed in-house, sizes a PV system for an electrical load profile, which is the daily average based on annual electric requirements. The code sizes arrays, storage batteries, and inverters for a given AC or DC load profile and for the average insolation. The program considers the losses inherent in different components of the PV system and is written in BASIC for a HP9845 programmable calculator. This code will probably be verified in designing PV systems for UN-Pakistan projects and other small tasks for which large simulation codes like SOLCEL are expensive and the data available too approximate to justify their use.

2.3 PV APPLICATIONS CODE BROCHURE UPDATE

Analysis Methods for Photovoltaic Applications (SERI 1979) has incorporated changes suggested by users engaged in the analysis and design of PV systems and by a survey of services offered by PV systems manufacturers. The code developed by Martin-Marrietta, PST, has been added to the code list and the revised version would be widely circulated in the PV systems design community. The comments received will be analyzed for inclusion in the updates, and the information assembled for the reprint will guide future development of photovoltaic simulation models.

2.4 PV SYSTEMS MANUFACTURERS DATA BASE

Various manufacturers of PV systems and subsystems were contacted by telephone to obtain the latest information on their product lines and services. The performance and cost data, to be periodically revised, will indicate the state of the art of the PV industry and will be used in PV systems design and updates of the Solar Cost Data Bank.

2.5 SOLAR COST DATA BANK UPDATE

Since one of the major applications of PV systems in the near-term will probably be grid-connected residential electric systems, the battery storage of the residential PV systems section has been removed and other minor changes have also been made for the next update of Solar Cost Data Bank (Christmas et al. 1979).

2.6 EVALUATION OF SOLERAS 350 kW_p PROJECT PROPOSALS

One of the largest potential markets for PV applications should be village electrification for developing countries. The US-Saudi Arabia (SOLERAS) 350 kW_p PV project is the largest undertaking thus far. From the 20 proposals that were received for this project and technical support provided in evaluating the proposals, a working knowledge was gained of design options and subsystems available in this size range.

2.7 PV STANDARDS

To help assure quality for National Photovoltaic Program, SERI is managing the development of the Interim Performance Criteria (IPC) document that will provide criteria for PV systems and their components and specify methods to test system performance against these criteria.

Systems Analysis Branch personnel are also active in the development of PV standards. One member of the branch is chairman of the American Society for Testing and Materials (ASTM) Subcommittee E44.09 on Photovoltaic Electric Power Systems.

2.8 WORKSHOP ON POWER CONDITIONING FOR ALTERNATIVE ENERGY TECHNOLOGIES

This Department of Energy (DOE) workshop, co-hosted by SERI and Sandia Labs at Denver, Colo., and chaired by Systems Analysis Branch personnel, was to integrate the expertise of those working in various alternative energy areas of R&D, power conditioning manufacturers, components suppliers, program administrators, and potential users. The workshop concluded that the power quality and power conditioning costs will become increasingly important to utilities as PV systems and other alternative energy technologies increase their market penetration (Smith 1979).

2.9 PV-RELATED MEETINGS

To gain a broader exposure in the photovoltaic community, the Systems Analysis Branch participated in the following PV-related meetings:

- Critical Design Review for the Natural Bridges National Monument; 100 kW_p project sponsored by Massachusetts Institute of Technology/Lincoln Labs (MIT/LL) and Ford, Bacon, and Davis; Salt Lake City, Utah.
- Simplified Design Methods for PV Systems Design; Science Applications, Inc. (SAI) Contract with Sandia Labs/Albuquerque; Quarterly Review Meeting; Albuquerque, N. Mex.
- Utility/Customer Interface for PV systems; Westinghouse contract with Sandia Labs/Albuquerque; Quarterly Review Meeting; Albuquerque, N. Mex.
- Interim Performance Criteria (IPC) document Systems Task Group meeting at Sandia Labs/Albuquerque; Albuquerque, N. Mex.
- Photovoltaic Advanced R&D Annual Review Meeting; Denver, Colo.
- "Technical Considerations and Operational Results of Photovoltaic Pumping Systems"; a seminar by Dr. Ronald Matlin of Solar Electric International, Lexington, Mass., at SERI.

- Workshop on Power Conditioning for Alternative Energy Technologies; May 9-11, 1979; Denver Hilton Hotel; Denver, Colo.

2.10 SYSTEMS ANALYSIS OF THIN-FILM PV SYSTEMS

This task, which was scheduled for completion in FY79, was delayed until FY80 because of transfer of key personnel. Its objective is to analyze the requirements for PV systems that use thin-film devices and identify the major tradeoffs relating characteristics of thin-film PV devices to system properties including balance-of-system characteristics. The results are needed to evaluate research trends and to guide future thin-film R&D. Much of the activity in FY79 related to this task involved literature searches and familiarization with various thin-film technologies.

2.11 PV SYSTEMS LABORATORY

A brief draft report outlining the PV Systems Laboratory requirements was circulated in-house for comments. Some of the objectives of the proposed facility are these:

- To test the performance of advanced subsystems and components that constitute a PV system (array and balance-of-system);
- To optimize PV system configurations and controls for applications, particularly international and hybrid ones;
- To identify components and subsystems requiring improvements; and
- To validate system codes.

2.12 PV MAILING LIST

During the past year, SERI developed a mailing list that contains most names and addresses of people in the United States and other countries who are interested in photovoltaics. This compilation was made from lists of the PV Specialist Conference attendees, contractor review meetings, and personal contacts. Consisting of approximately 2,700 names, the master list has had one iteration of changes as a result of a recent mailing from SERI.

The computerized mailing list may be obtained as either a listing or as different mailing labels. In addition, several available sublists reflect special interests, such as thin films and silicon. This list should be periodically updated so that it can best reach the community.

SECTION 3.0

REFERENCES

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Smith, D. R. 1979. Proceedings of Workshop on Power Conditioning For Alternative Energy Technologies. Golden, CO: SERI; 9-11 May; SERI/TP-35-217.

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NREL National Renewable Energy Laboratory
02LIB094036