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SOLAR MODELS DATA BASE

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NOTICE

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Abstract

The Solar Energy Information Data Bank (SEIDB) of the Solar Energy Research Institute (SERI) has undertaken the identification and classification of models and simulations used in solar energy applications. At the present time, there is no central resource for descriptions of the variety of programs which are available. By Spring of 1980, the SEIDB will have more than 170 descriptions of solar models and simulations stored in a computer and searchable online.

This Models Data Base contains descriptions of models with wind, active solar heating and cooling, photovoltaics, solar thermal, biomass, passive solar, and ocean systems applications and technologies. The functions of the models range from optimizing the size of solar collectors to monitoring the response of an OTEC plant platform to ocean waves.

The individual models described in the data base represent varying stages of development and levels of users. Models available for single runs to the general public are described, as are models which require sophisticated programming and which are used for complex research applications.

Each record in the data base describes one solar model in three sections: background information, technical descriptions, and computer information. The background file lists the developer, access information, user level, contact names and addresses, literature references, and validation tests. The technical file contains six text fields describing in detail the model problem, analytical method, limitations, user inputs, data files, and results of the run. The computer file outlines the model's operating requirements including language, machine, core, operating system, and run time.

Users may access the information in the data base in several ways. The model name is indexed for the user who wishes to retrieve information on specific model. Technology indexes have been assigned each model for the user who wishes to see, for example, all photovoltaic or passive solar models. A user who wishes to learn about all economic models or models that provide design analysis may access the data base by numerous keywords or purpose codes. Besides descriptive indexes of the models, the user may find all models available for a single run in California or all models available for architectural applications.

Introduction

In the expanding areas of energy technology, there are major demands for information and data being made not only by the technical community, but by governmental agencies and legislative bodies, architects, manufacturers, the financial community, builders, and homeowners. A specific information need of many of these groups is for the identification ofmodels and simulations used in solar energy applications. To meet this need, the Solar Energy Research Institute (SERI), with its Solar Energy Information Data Bank (SEIDB)*, has developed a Solar Models Data Base with the goal of identifying and classifying data on models and simulations with solar applications and making this information readily available to the solar community.

Need for the Models Data Base

As in other fields, models and simulations have gained wide use and respect within the solar community during recent years and, therefore, the number of models has grown significantly. Currently, numerous models exist that analyze a variety of solar energy aspects and applications. Many of these models were developed by universities for standards and testing applications. Private industries and utilities have developed

*This research, information and data center, specified by Congress in the Solar Energy Research Development and Demonstration Act of 1974, (PL 93 473), provides a centralized and comprehensive resource directed toward furnishing valid information and data in usable forms, to meet the varied requirements of the diverse solar audience. The Solar Energy Information Data Bank includes the development of online accessible data bases of solar related information, a computer network to utilize the data bases, an information dissemination program, a solar energy information center with a collection of over 25,000 publications, and an Inquiry-Referral service.

models to test their own products or systems, and to project future needs. The Federal government has made a significant investment in model development for research and development efforts. With the myriad of useful models and simulations being developed, information about these models needs to be available to the modeling and solar communities. Government sponsored models are generally documented but these reports may not be widely advertised or distributed. Other significant models may be buried in the thesis library of a university or are being developed by a private company only for their own use. The research and development efforts in the field of solar models and simulations will be most effective when the results of the efforts are widely known. The Solar Models Data Base Program is designed to provide broad dissemination of this information.

The Solar Models Data Base serves two major needs of the solar community. First, by utilizing the data base, or corollary publications, model users can find the model or simulation that best answers their modeling needs. Secondly, model developers may access the resources to discover other modeling activity in specific areas and, thereby, avoid duplicative effort.

Model users, including builders, architects, designers, analysts, engineers and others, are continually looking for new, efficient, more precise models. A researcher developing a collector sizing model may not know that a federal grant is funding a similar project. A state may need to project gasohol demand for the next decade and not realize that another state has begun research in that area. A builder's pricing model may not account for a new Federal tax credit which a more recent model would calculate into the system price. By utilizing the data base, all these people would enhance their use and development of solar models.

Contents of the Models Data Base

The models and simulations contained in the data base are categorized by the following technologies:

Active Solar Heating/Cooling, Bioconversion, Chemical Conversion, Hybrid Systems, Low-Head Hydro, Energy General, Passive Solar Heating/Cooling, Photovoltaic (Solar Cells), Process Heat, Satellite Solar Power, Ocean Systems, Solar General, Energy Storage, Solar Thermal Power, Wind Energy Conversion. If any aspect of a model pertains to one or more of these applications or technologies, the model is eligible for inclusion in the data base. In addition, the model may simulate a variety of circumstances surrounding a solar technology. Life cycle cost analysis, collector sizing, thermal mass sizing, and cost/benefit analysis are common model applications that can be found in the data base. Alcohol fuel demand, blade performance of a wind machine and evaluation of wave stress on an OTEC plant platform are more unique applications that can also be found in the data base.

Because of the variety of applications and technologies in the data base, the complexity of the models varies also. Models run on TI-59 programmable calculators such as TEANET are included, as are models such as SIM (Solar Insolation Model) which requires a ten seconds run per location per year on a Cyber 74. A beginning user of models may wish to see descriptions of other programmable calculator models whereas a researcher may use the data base to locate other complex photovoltaic models. Search strategies for the data base allow both users to find what they need. The contents of the data base are designed to supply all information necessary to determine if a specific model will serve an individual user's needs and if he/she can obtain and run the model. For the computer scientist, specific computer hardware requirements are listed. For the elementary user, the level of knowledge needed to run the model is described. For scientists and researchers, detailed descriptions of the purpose, analytic approach, inputs and outputs of the models are included.

Formating of the Models Data Base

A record in the Models Data Base contains three main sections; the name of the model functions as the main locator.

Section I

Model Name or Acronym	Validation Tests
Developer	Availability
Commercial Contacts	Costs
Level of User Knowledge	Sponsor
Documentation	Years of Releases
Literature References	Current User Types

Section II

Purpose of Program	Problem Definition
Inputs	Outputs
Analytic Approach	Limitations
Comparable Models	Degree of Solar Emphasis

Section III

Computer Language	Operating Systems
Type of Computer	Machine
Core Required	Run Time

The following is a sample record from the data base. F-CHART was chosen because of its familiarity to users. SERI will not attempt to validate any models included in the data base and inclusion in the data base does not denote endorsement.

Example of Information on F-Chart to be Included in The Solar Models Data Base

Model Name	:	F-CHART
Model Developer	:	University of Wisconsin
Year of Original Release	:	1976
Year of Current Release	:	1979
Program Sponsor	:	Solar Heating and Cooling Systems Development Branch, Office of Conservation and Solar Application, Department of Energy
Developer	:	University of Wisconsin, Madison, Wisconsin
Contact	:	Accounting Branch Solar Energy Research Institute 1617 Cole Boulevard Golden, CO 80401
Purpose of Contact	:	To Purchase/Order
Contact	:	Design Tool Manager Market Development Branch Solar Energy Research Institute 1617 Cole Boulevard Golden, CO 80401 (303) 231-1261
Purpose of Contact	:	For More Information
Accessibility & Cost	:	For Purpose Magnetic Tape . . . $100.00 Card Deck . . . . . $150.00 Overseas Shipping . $200.00
Documentation	:	User's Manual
Literature References		1. Klein, S. A., Bechman, W. A., and Duffie, J. A., "A Design Procedure for Solar Heating Systems," Solar Energy, 18, 113, (1976). 2. Klein, S. A., Bechman, W. A., and Duffie, J. A., "A Design Procedure for Solar Air Heating Systems," accepted for publication in Solar Energy, (1977). 3. Bechman, W. A., Klein, S. A. and Duffie, J. A., Solar Heating Design by the F-CHART Method, Wiley-Interscience, New York, (1977). 4. Hughes, P. J., et al., "F-CHART Version 3.0 Users Manual," Report 49-3 of the Engineering Experiment Station, University of Wisconsin-Madison, June (1979). 5. R. T. Ruegg, "Solar Heating and Cooling in Buildings: Methods of Economic Evaluation," NBSIR 75-712, U.S. Department of Commerce, National Bureau of Standards.
User Type	:	Architects, Utility Company, Researcher, Home Owner, Engineer, Contractor/Builder, Designers, Educators
Level of User Knowledge	:	Beginner

Program Description

Purpose of Program		Design Method, Building Energy Analysis
Problem Definition	:	F-CHART, which models liquid or air solar water heating or combined solar water and space heating systems (solar cooling or heat pump systems cannot be modeled) is capable of estimating the thermal performance and lifecycle economics to assist in the design of the system.
Analytic Approach	:	The F-CHART design method is based on standard solar heating system configurations using either liquid or air as the heat transfer medium. This method treats collector area as the main design variable but is capable of considering secondary design variable such as storage unit capacity. The F-CHARTS are the result of correlating hundreds of detailed simulations of solar heating systems.
Inputs-Data Files	:	The meteorological data required to use the F-CHART method are the long-term monthly average of daily total solar radiation on a horizontal surface or on the collector plane, the long-term monthly average ambient temperature, and the long-term monthly

average heating degree days (65°F base).

Inputs-User : The solar energy system data needed for the F-CHART includes the collector parameters, the effectiveness of heat exchangers between collector and tank and between the tank and building (for liquid-based systems), the storage capacity per unit area of collector, and the orientation of the collector.

The building heating load is incorporated either by specifying the monthly load (calculated by any standard technique) or by specifying the building overall loss coefficient (energy-per-degree-day concept), which is the design heating load divided by the design temperature difference. In addition, a service hot water load can be added to the heating load. Given these numbers, the fraction of monthly total loads and the fraction of the annual loads to be carried by solar energy can readily be determined for any collector area.

Outputs : There are two options in the use of the program. First, the collector area can be specified and the annual (and monthly, if desired) thermal performance is returned. If cost data are supplied, an economic assessment can also be returned. The second option is to request the program to find the economic optimum collector area. The program uses a numerical technique to optimize the collector area and returns the same information as the first option but for the optimum area. The economic optimum collector area is found by calculating the estimated value of future costs for both the solar system and the conventional system (including, if desired, the effects of escalating fuel prices, property and income taxes, tax rebates, interest, depreciation, insurance, and maintenance). The optimum collector area minimizes the sum of the present value of future cost plus the initial costs of the solar system above the costs of a conventional heating system.

Limitations : Two basis uncertainties are associated with F-CHART. First, a system must be well engineered and constructed to perform the way in which F-CHART estimates. Second, there are uncertainties in the meteorological data. Some data are long-term averages of careful measurements and will not change much; other data are subject to change.

Solar Emphasis : Primary

Computer Information

Used On :

Language : FORTRAN

Machine	Operating System	Core Required	or Run Time
Cyber CDC or	Scope II Version 501	23000_{10} 54000_{8}	characters characters

Searching the Models Data Base

Two subject keyword schemes exist for indexing individual models. A searcher may use one or more of the fifteen technologies previously described, or, utilizing a controlled vocabulary list, the searcher may use broader subject keywords to locate a model. A searcher may locate models in several other ways: by purpose of model (such as life cycle cost, component analysis, load program), user type (such as architect, economist, homeowner), accessibility to model (such as purchase, single run service, lease), or contact person or company for the model (name and address of developer, marketer, or sponsor). The following are examples of common questions answered by the data base:

Are there any models that deal with wind systems in the data base?

Which models are especially useful to utility companies? Who can I contact to use the model?

What models run in FORTRAN?

Which models give life cycle costs for solar heating and cooling applications? Is there a model called SOLTES? Describe it in detail.

Solar Model Information Sources

Several publications describing solar models currently exist. The Technology Commercialization Division of SERI, in cooperation with the Systems Analysis Branch and the Information Systems Division, has published a brochure detailing several models with solar heating and cooling applications entitled "Analysis Methods for Solar Heating and Cooling Applications: Active and Passive Systems" (SERI/SP-35-232R, January 1980). This new brochure complements earlier publications on "Analysis Methods for Wind Applications" (SERI/SP-35-231) and "Analysis Methods for Photovoltaic Applications" (SERI/SP-35-230).

To inform the modeling community about the Solar Models Data Base and to encourage designers of new models to submit information on their programs, the Information Systems Division of SERI has published Solar Models Data Base Candidates (SERI/SP-451-563). This brochure lists more than 170 models and simulations that are being considered for entry into the computerized Solar Models Data Base. In the Spring of 1980, SERI will publish an up-to-date, detailed pamphlet describing solar models with a wide range of solar technologies and applications. The Solar Models Data Base will be fully operational in March 1980 and will be available for online searches.

If a user has a special question that cannot be answered in the publications from the data base, he/she may access its online capabilities. SERI's Solar Energy Information Center, the National Solar Heating and Cooling Information Center, the four Solar Energy Regional Offices, and the Department of Energy in Washington, D.C. have direct access to the system. A user may write or call any of the offices listed below to outline their information needs.

Mid-American Solar Energy Complex
8140 26th Avenue, South
Bloomington, Minnesota 55420
(612)854-0400
SEIDB Contact: Ms. Joyce Mortison
Chief Librarian: Ms. Agnes Brown

Southern Solar Energy Center
61 Perimeter Park
Atlanta, Georgia 30341
(404)458-8765
SEIDB Contact: Mr. George Meier
Chief Librarian: Ms. Pam McElhaney

National Solar Heating and Cooling Information Center
1911 Arch Street
Philadelphia, Pennsylvania 19103
(215)448-1535
SEIDB Contact: Ms. Marcia Ballen
Chief Librarian: Ms. Gloria Fultz

Northeast Solar Energy Center
70 Memorial Drive
Cambridge, Massachusetts 02142
(617)661-3500
SEIDB Contact: Dr. David Chan
Chief Librarian: Ms. Eileen Baker

Western SUN
921 S.W. Washington Street
Suite #160
Portland, Oregon 97205
(503)241-1222
Chief Librarian: Mr. Jay Tappan

Beginning Spring of 1980, SERI will be hosting a series of SEIDB training sessions. The training session participant will receive training in the INQUIRE data base management language and will learn particulars of the SEIDB data bases.

Besides maintaining descriptions of solar models and simulations, SERI has an On-line Models Library that contains the full model in executable forms. Currently SERI is maintaining three models - F-CHART, SOLCOST, and RSVP. For additional information on the On-line Models Library or the Solar Energy Information Data Bank ((SEIDB) and training opportunities for its use, please contact the following persons at the Solar Energy Research Institute (SERI), 1617 Cole Boulevard, Golden, Colorado 80401:

Network Coordinator - Training
Rafael Ubico (303)231-1032

Data Base Development Branch Chief
Howard Shirley (303)231-1204

On-line Models Library Manager
Nancy Birkenheuer (303)231-1464

Solar Models Data Base Analyst
Kate Kramer (303)231-1227