

SOLAR HEATING AND COOLING
TECHNICAL DATA AND SYSTEMS ANALYSIS

Center for Environmental and Energy Studies



The University
Of Alabama
In Huntsville

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SOLAR HEATING AND COOLING
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PROGRESS REPORT

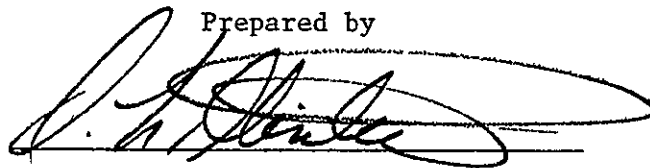
CONTRACT NAS8-31293

Submitted to

National Aeronautics & Space Administration
Marshall Space Flight Center, Alabama

(Summary for Period September 1975 - June 1976)

Prepared by

A handwritten signature in black ink, appearing to read 'D. L. Christensen', is written over a horizontal line. The signature is stylized and somewhat cursive.

D. L. Christensen
Principal Investigator

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE
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HUNTSVILLE, ALABAMA

JUNE 1976

ABSTRACT

The research activities described herein were accomplished by The University of Alabama in Huntsville as Task I under Contract NAS8-31293 for the Marshall Space Flight Center (MSFC), National Aeronautics and Space Administration (NASA).

These research activities were applied to Task I of the contract during the period, September 1975 - June 1976, and consisted of continuing the acquisition and processing of selected parametric data for inclusion in a computerized Data Base using the Marshall Information Retrieval and Data System (MIRADS) developed by NASA-MSFC. This Data Base provides extensive technical and socioeconomic information related to solar energy heating and cooling on a national scale. A broadly based research approach has been used to assist in the support of program management and the application of a cost-effective program for solar energy development and demonstration.

ACKNOWLEDGEMENTS

This report has been prepared by a solar energy research team of the Center for Environmental and Energy Studies (CEES), The University of Alabama in Huntsville, as a summary of progress under NASA Contract NAS8-31923. David L. Christensen, Research Associate, is the Principal Investigator of the overall research study. Ronald Rubery is the UAH Task Team Leader for the efforts described in this report. Other major contributors to the project and to this report are:

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The University of Alabama in Huntsville also wishes to acknowledge the assistance and valuable contributions made by numerous other individuals of NASA-MSFC and to express thanks for the cooperation of various government agencies, industries, universities, technical societies, and other professional organizations.

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I. INTRODUCTION AND BACKGROUND

Since the initial award of NASA Contract NAS8-31293 to The University of Alabama in Huntsville in October 1974 for the performance of "Solar Heating and Cooling Technical Data and Systems Analysis", the basic research activities (as outlined in the September 1975 Progress Report)¹ have developed into an extensive data research and collection activity. Basic UAH research efforts have primarily concentrated on the areas of architectural design, materials characteristics, climatic conditions, economics, and heating and cooling systems and emphasize the collection, processing, and submission of data to expand the computerized data base required for systems analysis support of the MSFC systems development role in the National Solar Heating and Cooling Demonstration Program.

The MSFC Data Base has an extensive capability to be expanded to include data for any type of energy consideration and is intended to permit rapid retrieval of technical and socioeconomic data in formats that are accessible by remote terminals through interactive operations. This comprehensive computerized National Solar Energy Base which MSFC is developing for the Energy Research and Development Administration (ERDA) incorporates vast statistical data on such diverse items as weather trends, population, equipment test data, facility description parameters, operational data from national solar heating and cooling demonstration sites, utility rates, construction and urbanization trends, and prices and price indices.

Supporting the data research and gathering requirements for this Data Base has been the focal point of UAH contract activities on NAS8-31293 since May 1, 1975. The total contract value for this period of October 1974 through June 1976, has been \$156,444. Of this total, some \$79,000 has been used for development of the Data Base under Task I.

This report covers the extension and expansion of the scope of work for Task I for the period of performance from September 1, 1975 through June 30, 1976. Separate Progress Reports describe the UAH activities for other tasks performed on NAS8-31293. These other tasks include documentation of solar energy activities which provides management and educational materials related to national solar energy heating and cooling programs, surveys and catalogs of solar radiation measuring equipment, and evaluations of nationwide locations for solar radiation data stations. Close liaison and consultation with solar energy experts and professional organizations involved with solar energy activities have likewise been accomplished under this contract.

¹Progress Report Contract NAS8-31293 "Solar Heating and Cooling Technical Data and Systems Analysis" by D. L. Christensen (Summary for period October 1974 - August 1975)

II. CURRENT CONTRACT ACTIVITIES

Data describing climatic conditions; architectural details of homes, office buildings and manufacturing buildings; heating and cooling systems and components including cost and performance parameters; and energy availability and related costs are required for conducting system analyses of solar heating and cooling applications. This type of data is necessary as primary input parameters for computer programs which allow analyses of application and site requirements, performance criteria, research and development needs, and economic comparisons related to solar heating and cooling systems to determine their marketability.

The following work statements, covering a period of performance from September 1, 1975 through June 30, 1976, were added to NASA Contract NAS8-31293 by amendments and this work is now being performed by The University of Alabama in Huntsville:

1. Continue the gathering of solar radiation and surface weather data from the National Weather Service (NWS); continue the effort of collecting climatological data and maintain the MSFC/UAH awareness and participation in climatological data gathering projects for solar analysis use; provide updates as they become available, to the initial list of solar radiation data sources.
2. Continue to seek authoritative and centralized sources of representative building associations who can provide blueprints and catalogs; maintain the search, collection and sorting of useful books, documents, publications, etc. necessary to the task (i.e. listing recognized associations involved with building materials); continue to evaluate and provide new source documents containing the physical properties and costs of materials.
3. Continue the compilation of source lists of government documents available throughout the various government depository systems to be utilized within the program; continue the effort being provided to maintain the bibliography card file for the Statistical Abstract source material; continue the Statistical Abstract evaluation as directed by the MSFC Technical Monitor; continue to update and complete, as necessary, the computerized data format sheets and submit them to the MSFC Technical Monitor.
4. Continue to search for additional information involving the characteristics and performance of heating and cooling equipment and provide the information to the Technical Monitor as it becomes available; maintain continuous updates to the source lists of heating and cooling manufacturers. This information will continue to be forwarded to the Technical Monitor as it becomes available through the contract period of performance;

utilize the results of the Program Opportunity Announcement of ERDA and other data to develop a cataloging of standardized descriptions and data on solar systems and components; continue the collection and cataloging of available data through the use of the ARI Index of Manufacturers.

Detailed formats previously developed through the combined efforts of MSFC and UAH personnel are being used to insure flexibility and effectiveness in the final analyses. Each of the task areas (climate, equipment, architecture, economics) are discussed in detail in the following sections of this report, and activities to date are included. All responsible task team members have been completing these format sheets with as much data as is available within the designated data categories.

CLIMATIC DATA - SUB-TASK 1

SUB-TASK OBJECTIVES

To collect atmospheric, solar radiation and environmental data and organize it for use in simulations and evaluations of solar energy in various forms.

APPROACH

Review available sources and determine the availability and present format of atmospheric observational data. Determine specific locations and regions of primary interest and establish priorities.

ACTIVITIES AND PROGRESS

Telephone conversations with Mr. Vince Haggerty of the National Climatic Center (NCC), Asheville, North Carolina, determined that weather data tapes are now available for about \$60 to \$75 per reel. One reel contains 10 years of hourly surface records for any years before 1965 and 3-hourly records for years subsequent to 1965. The surface weather data must be re-formatted for the MSFC computer programs as it is better to select only that surface data which matches the solar radiation data of present interest.

As the result of a sample survey to locate new sources of solar radiation and hourly surface data, a draft copy of a preliminary solar radiation source document was initiated, primarily due to the amount of interest generated through the survey efforts. The draft copy of the "Initial Report on the Availability of Solar Radiation Data" document describes the need for solar radiation data having stricter controls on maintenance of equipment and recording procedures. As it takes several years before the new data reaches sufficient quantity to apply to solar energy projects, it is desirable to locate these alternate sources of solar radiation data as soon as possible.

The preliminary report was prepared with the cooperation of the National Weather Service and other organizations and provides locations which have recorded and collected solar radiation data, which may be applicable to present and planned solar energy projects. The data itself has not been collected nor evaluated. An address list of organizations who participated in this survey is included in the preliminary report.

The following electronic tape data were acquired by UAH during the report period:

1. Five reels of daily solar radiation, BCD, 800 BPI, format 280. This completes the entire availability of solar radiation data collected for the periods under analyses.
2. Three reels of surface weather data and seven reels of solar radiation data were delivered to the Technical Monitor during this period that were originally ordered prior to this report period.

3. Sixty-four reels of hourly surface data in format 1440, BCD, even parity, 7 track, 800 BPI; encompassing 27 different weather stations.

As a further aid to support the MSFC climatological studies, CEES collected various sets of documents from the NCC at Asheville, North Carolina, including:

1. "Monthly Norms of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-70".
2. "Monthly Averages of Temperature and Precipitation for State Climatic Divisions 1941-70".

The climatological normals and averages presented in these documents are based on records for the 30-year period 1941-70, inclusive. Data are assembled by individual states.

ARCHITECTURAL DATA - SUB-TASK 2

SUB-TASK OBJECTIVES

Acquire architectural data sufficient to describe typical buildings, including residential, commercial, public and manufacturing facilities.

APPROACH

Since completion of the formats for describing architectural data for any building, research efforts have concentrated on locating suppliers of residential and commercial blueprints, such as known architects affiliated with the AIA and motel/hotel corporations willing to loan blueprints, for analyses and adaptability to solar heating and cooling systems. This effort has expanded into contacting such agencies as HUD and professional associations to acquire various data such as minimum housing standards, standardized building cost data (i.e. labor rates, materials cost, etc.).

ACTIVITIES AND PROGRESS

A supplier of blueprints for "standard" home construction has been utilized to assist in the home construction analyses. This firm has, as one of its functions, the capability of providing blueprints of typical homes that could be considered compatible for conversion to a solar heating and cooling system. Twelve different home designs have been acquired from the Homes for Living Corporation of New York, N. Y. These plans were useful except for the lack of schematics depicting the duct work for the heating and cooling system; however, through the assistance of the ASHRAE Manual J document for heating and cooling load calculations it is possible to design appropriate systems for the various home plans. Its utilization should produce a workable heating and cooling layout system for each of the 12 blueprints.

To assist the activity of identifying various standard construction costs and related construction parameters, the aid of the Robert Snow Means Construction Company which annually publishes the book, Construction Cost Data, was acquired.

The Department of Housing and Urban Development furnished several volumes of data related to minimum standards for the construction industry. The specific volumes being utilized are: HUD - Minimum Property Standards, (1973 editions), for care-type housing, one family, and two family dwellings. HUD is presently in the process of developing minimum standards that would be applicable to the application of solar heating and cooling systems to specific structures.

To assist in the problem of collecting specific construction data representative of a Standard Metropolitan Statistical Area (SMSA), formal communications were established with key city personnel for each SMSA, such as the City Building Permit Officer. These sources, along with the various professional and trade associations (see Attachment A) have proven very instrumental in the collection of the various site construction and other related architectural information.

In conjunction with the establishment of a file on trade and professional associations, a listing of related organizations has been developed. This listing has been approved by the Technical Monitor and is being retained on active file. It is being compiled into one master listing along with related classifications being investigated under the UAH research efforts.

In addition to the various home site blueprints, the UAH has been very successful in soliciting commercial blueprints of motel construction from Holiday Inns of America as well as Days Inns Incorporated. Analysis of these blueprints should aid in determining the feasibility of applying solar energy heating and cooling systems to structures of this type.

THERMAL LOADS DATA - SUB-TASK 3

SUB-TASK OBJECTIVES

Collect the thermal properties of various categories of materials to allow thermal analyses of residential or commercial buildings and associated equipment.

ACTIVITIES AND PROGRESS

Various references on building materials were collected. However, due to the variation of sources, no single reference has all the information necessary to meet data entry requirements. Small portions of the required data may be found in each reference. Also, most of the existing physical property data are given in a range of values since the intended usage of the various materials is quite diversified.

Due to the variation of properties cited in the materials source files and references, two alternative approaches were suggested: Collect all building materials nomenclature and cost data from "The Building Construction Cost Data, 1976", and similar sources and use them for a "baseline materials source list". Then combine the individual properties of each material from other references and add these to the nomenclature and cost data list. Once this total listing has been developed, it will only be necessary to update and improve the baseline materials data base as new sources of better information are acquired.

An alternative suggestion was to obtain the names of existing building material suppliers from the "National Association of Building Manufacturers" or similar organizations and mail directly to these organizations a material survey type questionnaire requesting their assistance for entering data. Once this data has been collected, it would be necessary to organize the information under major categories, reorganize and edit as needed, and load this data into the computer.

HEATING AND COOLING EQUIPMENT - SUB-TASK 4

SUB-TASK OBJECTIVES

Continue in the acquisition of data on conventional and solar heating and cooling systems, subsystems, and components sufficient for performance evaluation.

APPROACH

Continue to survey manufacturers' literature and handbooks, ASHRAE data books, manufacturer computer programs, and governmental and industrial studies and surveys for pertinent data. Develop composite listing of sources and contacts for gathering additional data.

ACTIVITIES AND PROGRESS

Conventional Equipment

The Air Conditioning and Refrigeration Institute (ARI) Index to Manufacturers, a representation of sixty-one firms supplying HVAC equipment on the U.S. market, is presently being utilized in the research efforts.

All of the firms in the report were contacted by telephone or by formal letter requesting specific data on product line and related prices. In addition, the Thomas Register and the 1975 Plant Engineering Directory and Specifications Catalogue were utilized to obtain data on additional manufacturers which market HVAC equipment.

Over 140 data packages on conventional heating and cooling manufacturers have been submitted.

Contacts have been made with the U. S. Department of Commerce in Washington, D. C. as well as affiliated offices in Birmingham, Alabama, resulting in the receipt of the 1973 and 1974 statistical reports on sales of Air Conditioning and Refrigeration Equipment and warm air furnaces. This data was useful in determining priorities of work based on the significance of equipment sales.

Solar Equipment

The equipment research team assembled data sources for solar collector manufacturers and supplies of components (coatings, plating, paint, glaze absorbers, storage, etc.). This list is continuously refined and purged of errors and duplications.

The files now contain approximately 120 manufacturers of solar collectors. Technical data on about one-half of these are available and have been transferred to the Technical Monitor for review. The flow of data has been on a constant basis and as it becomes available, it is incorporated into the files. Attachment B represents additional information concerning manufacturers, experimenters and sales outlets for solar energy collectors that was gathered and organized during the contract period. This information is continuously reviewed and submitted on data format input sheets.

CONCLUSION

As new information is received on conventional and solar heating and cooling manufacturers and their products, it has been processed and entered into the data base.

Efforts have also been made to establish a more reliable standard for solar collector data points from which to state efficiency, output, etc. It is anticipated that at some point, such data will be standardized to aid in making comparisons between the various subsystems.

Product information related to solar heating and cooling systems, subsystems, and components has been inventoried, catalogued, and delivered in three volumes to the MSFC Technical Monitor. Also, some 167 systems installations have been identified to date, ranging from residential to heavy commercial and process applications. Many of these are privately funded programs but could provide data of interest to the National Demonstration Program (such as solar radiation data taken at new sites).

A major effort was completed to purge and re-enter all known vendors involved with the manufacture or study of solar and conventional heating and cooling equipment, including a total update of the manufacturers' survey. The task team is also purging the Standard Change Integration Tracking (SCIT) listings (used by the Solar Heating and Cooling Team of NASA-MSFC) and incorporating only selected manufacturers from it into the Manufacturers Survey. This documentation effort should be representative of all available vendors involved with the research, development, manufacturing, and sales aspects of conventional as well as solar heating and cooling equipment.

ECONOMIC DATA - SUB-TASK 5

SUB-TASK OBJECTIVES

Continuation of efforts as outlined in the September 1975 report but with more emphasis on the acquisition of detailed data within the specific geographic and economic areas that will enhance the analyses of economic influences affecting the overall solar heating and cooling technical data and system analyses.

APPROACH

Investigate and acquire new sources and data to be utilized in the overall project.

ACTIVITIES AND PROGRESS

Most of the activity within the Economics section has been devoted to completing the large number of format sheets developed for related subjects, such as economics, fuel rates, construction costs, etc. However, as deemed necessary by the MSFC Technical Monitor, this section has investigated new areas of interest. As a result, the activities and progress achieved under Economics has been divided into the following activities: economics as related to the statistical abstracts, energy, REremote CONsole (RECON), data insurance, library research, and bibliography.

Economics

A large number of data format sheets (some 2,500) based on the Statistical Abstract of the United States were completed and delivered to the Technical Monitor. The areas covered by these sheets include:

1. Population
2. Vital Statistics
3. Education
4. Geography and Environment
5. Finances and Employment
6. Labor Force, Employment and Earnings
7. Income, Expenditures and Wealth
8. Prices
9. Transportation and Agriculture
10. Mining and Mineral Products
11. Distribution and Services
12. Energy
13. Construction and Housing

Some sheets in the following areas have been completed for all of the Statistical Abstracts (1950-1975):

1. Prices
2. Mining and Mineral Products
3. Distribution and Services
4. Energy
5. Construction and Housing

The two most recent abstracts, 1974 and 1975, have been completed in their entirety as related to the format data sheets.

Data sheets have also been provided that are based on Federal Power Commission News Release Bulletins and three Census Bureau series that deal with manufacturers.

Energy

Format sheets for recording data related to energy were also provided in support of the data recording activity.

In order to obtain samples of various energy company rates, demand schedules, etc., data was collected by soliciting selected energy supplying companies within the ten (10) selected SMSA's. The task team obtained considerable assistance from the Federal Power Commission (FPC) in this effort. The FPC publishes documents on each state that identifies consolidated energy company rates as related to the various counties within each state. Due to the completeness of these publications, the design and entry of data into the format sheets was simplified.

Some 1,406 packets of electrical energy format sheets have been completed. This completes this particular effort and includes all the states except Alaska and Hawaii.

Due to the effort required to transfer the electrical energy data from the publications to the appropriate computer format, limited effort has been placed on searching out additional data related to the other energy sources. However, an attempt has been initiated to contact 45 different companies from the ten (10) major SMSA's requesting coal, butane, and propane cost data. Some of the requests resulted in favorable responses and this data is being held in reserve in the hope that a better and more centralized source of data can be located.

The FPC provides some assistance through their publication, Federal Power Commission News Release Bulletins. These bulletins provide fuel, cost and quality data in such areas as: coal deliveries at steam-electric plants; coal purchases for steam-electric plants; deliveries by sulfur content of coal at steam-electric plants; fuel oil deliveries at steam-electric plants and for combustion turbine and internal combustion units; fuel oil purchases for steam-electric plants; gas deliveries at steam-electric plants and for combustion turbine and internal combustion units; gas purchases for steam-electric plants.

REmote CONsole (RECON) Data Search

As an aid in the search for data related to the various disciplines necessary for overall project analyses, various UAH team members have been trained to use the MSFC RECON data search system. This system provides a means to search for data under various topics (i.e. construction, population, demography, economic development, etc.).

If a topic search results in a favorable response, the particular document listings of interest are then requested from the NASA data bank. Once UAH is in receipt of the listing, it is reviewed in more depth to determine if any of the subject matter should be pursued further. The following list represents various topics that have been investigated by the UAH task team for submittal to MSFC and as such have been requested from the data bank for further analyses:

1. Architecture
2. Buildings
3. Ceilings
4. Comprehensive Strength
5. Materials Conductivity
6. Construction Materials
7. Elastic Properties
8. Materials Flexibility
9. Floors
10. Inflatable Structures
11. Roofs
12. Shelters
13. Solar Furnaces
14. Walls

These fourteen different topical bibliographies were reviewed and summaries of the relevant articles were written by the economics task team. The articles include the following:

1. The Utilization of Solar Energy to Help Meet Our Nation's Energy Needs
2. Proceedings of the Solar Heating and Cooling for Building Workshop
3. Consumption of Energy in New York State 1972 (with estimates for 1973)
4. Domestic Solar Energy Systems for Delaware
5. Systems Analyses of Solar Energy Programs. Appendix: Research Tasks
6. Energy Conservation Handbook for Light Industries and Commercial Buildings
7. Fuel Energy and the Steel Industry, A Bibliography
8. Energy and Economic Analyses of Total Energy Systems for Residential and Commercial Buildings - Utilizing Waste Heat Recovery Techniques
9. Current Energy Shortages Oversight Series (The Major Oil Companies)
Part 2
10. Current Energy Shortages Oversight Series (The Major Oil Companies)
Part 4
11. Current Energy Shortages Oversight Series (The Major Oil Companies)
Part 3
12. Available Energy Conversion and Utilization in the U. S. ASME Paper
13. Future U. S. Demand Patterns and the Use of Hydrogen
14. The National Coal Conversion Act and The National Crude Oil Refinery Development Act.
15. Sizing of Solar Energy Storage Systems Using Local Weather Records
16. Optimization Study of Solar Absorption Air Conditioning Systems
Semiannual Progress Report
17. Solar Heating and Cooling of Buildings, Phase O. Feasibility and Planning Study
18. Solar Heating and Cooling of Buildings, Phase O, Feasibility and Planning Study, Final Report, Vol. III, Book 1, Appendix A, Task 1, Development of Requirements, Appendix B. Task 2, Systems Definition

19. Total Energy Supply and Demand, Vol. I, Ch 6--Natural Gas, Economic Analyses
20. Energy Use in the Commercial and Industrial Sectors of the U. S. Economy, 1963
21. Study of Industrial Uses of Energy Relative to Environmental Effects
22. Industrial Energy Study of the Hydraulic Cement Industry. Final Report
23. Data Base for the Industrial Energy Study of the Industrial Chemicals Group. Final Report
24. Fuel and Energy Consumption in the Coal Industries. Final Report
25. The Economic Impact of Environmental Programs. Summary Report, Nov.-Dec. 1974
26. Energy Consumption, The Chemical Industry. Final Report, Aug. 1974-Mar. 1975
27. Energy Consumption, The Primary Metals and Petroleum Industries. Final Report, Aug. 1974-Mar: 1975

An additional 33 topics were searched and found to be irrelevant.

Insurance

The economics section has also attempted to locate various data on insurance rates applicable to both homeowners and owners of businesses. A random sample of insurance books in the UAH Library revealed that the books that are available are primarily textbooks.

Contact was then made with the Insurance Information Institute in New York City. It was determined that the data in question is not available on a nation-wide basis; however, their publication, Insurance Facts, provides a list of all insurance commissioners for the various states. Contact was made with the commissioners of Georgia and Washington State. As a result, the task team acquired consumer information that is prepared for specific communities. By examination, it was determined that this is the type of information of interest and arrangements are being made to contact the other 48 commissioners in order to obtain similar publications.

Library Research

The economics section has put a great deal of effort into establishing a good working relationship with the various libraries in the area in order to assist in the data collection effort.

The UAH Library has been very helpful within its limits and has made available over 500 government documents. The categories and specific numbers of these documents are listed in Attachment C. The Alabama A&M Library also permitted the use of 32 documents. Inter-library loans have been arranged with both the Auburn University and University of Alabama, Tuscaloosa, Libraries for documents that UAH, Alabama, A&M, and the Redstone Scientific Information Center (RSIC) were unable to provide. The task team also prepared lists of the documents requested from the 10 monthly GPO catalogues, 1975, and delivered them to MSFC. These lists represent all government documents selected from the 10 different catalogues (Attachment D) and indicates the comprehensive nature of the MSFC Data Base.

The libraries have also been very helpful in allowing the task team to check out research books. A listing by subject of the various books that have been used is enclosed (Attachment E).

Working Bibliography

The Economics Section maintains an up to date card catalogue on all sources of data used throughout this project by all team members. The subject headings used for maintaining documentation control are listed below:

Accounting	Housing
Architectural	Insurance
Catalog	Materials
Concrete	Measurement
Construction	Metals
Economics	Metric System
Electricity	Solar Energy
Energy	Statistics
Energy Growth	Wind
Gas	

Other Activities

Complete proceedings from the 1975 International Solar Energy Congress and Exposition have been loaned to UAH from Wyle Laboratories of Huntsville and are being reviewed by MSFC. The volumes and related subjects are:

1. Series 10
 - A. Economic and Social Aspects
 - B. Developing Countries
 - C. General Papers
2. Series 20
 - A. Solar Radiation, Photovoltaic, Photo Chemical, Photobiological Processes
 - B. Solar Furnaces
3. Series 30
 - A. Materials Flat Plate Collectors Energy Storage
4. Series 40
 - A. Solar Heating and Cooling of Buildings
 - B. Drying and Distillation
5. Series 50
 - A. Focusing Collectors
 - B. Solar Thermal Power

In addition, efforts are being made to provide pictorial and graphic data to enhance the visual output capability of the computerized Data Base. Pictorial materials are being developed under other related tasks of this contract which can possibly be utilized.

Also, members of the UAH research team participated directly in the National Solar Energy Workshop held in Huntsville, Alabama in May, 1976. At this workshop, the computerized Data Base was demonstrated by MSFC to key energy officials of participating states and various agencies of the Federal Government. A remote terminal was installed for interactive operations during the three day workshop.

CONTRACT EXPENDITURES

Contract funding for Task I covering the period of performance
1 September through 30 June amounted to \$78,384.

ATTACHMENT A

ASSOCIATIONS AND ORGANIZATIONS

This attachment provides an organized listing of the associations and organizations that have provided specific and general data as well as those who are available to assist in providing additional research data for supporting the various tasks.

ARCHITECTURAL

1. American Institute of Architects
2. American Institute of Building Design
3. Engineers Council for Professional Development (ECPD)

CONSTRUCTION

1. American Building Contractors Association
2. American Society of Testing and Materials
3. The Association of General Contractors of Boston
4. Better Business Bureau of Boston
5. Edward G. Scharf & Son
6. Homes for Living
7. H.U.D. Alabama Area Office
8. H.U.D. Underwriting Standards - Washington, DC
9. H.U.D. Office of Mobile Home Standards - Washington, DC
10. Import Hardwood Products Associations
11. International Conference of Building Officials
12. International Masonry Institute
13. National Association of Building Manufacturers
14. National Association of Home Builders of U.S.
15. National Building Materials Distribution Association
16. National Environmental Systems Associates (NESCA)
17. National Housing Center
18. Pettey Associates
19. Robert Snow Means Construction Company
20. Underwriters' Laboratory

DISTRIBUTION & SERVICES

1. Better Business Bureau of Boston
2. Better Business Bureau of Huntsville

ENERGY

1. Federal Power Commission - Mr. Charles Moscarella
2. Federal Power Commission - Mr. William Webb
3. Gas Operations Advisory Committee - New York State
4. International Solar Energy Society
5. Tennessee Valley Authority
6. American Gas Association

EQUIPMENT

1. Air Conditioning and Refrigeration Institute
2. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
3. Association of Home Appliance Manufacturers
4. Refrigeration Engineers and Technicians Association
5. Underwriters' Laboratory

HOUSING

1. American Building Contractors Association
2. Homes for Living
3. H.U.D. Alabama Area Office
4. H.U.D. Underwriting Standards - Washington, DC
5. H.U.D. Office of Mobile Home Standards, Washington, DC
6. National Association of Building Manufacturers
7. National Association of Home Builders of U.S.
8. National Housing Center
9. Pettey Associates
10. U.S. Dept. of Commerce Bureau of the Census

INSURANCE

1. Insurance Information Institute
2. Health, Education and Welfare - Office of Consumer Information
3. National Association of Insurance Commissioners

LIBRARY

1. Alabama A&M Library
2. Auburn University
3. MSFC Technical Library
4. Redstone Scientific Information Center (RSIC)
5. UAH Library

MATERIALS

1. American Society of Testing and Materials
2. Association of Scientific Information Dissemination Center (ASIDIC)
3. Underwriters' Laboratory

POPULATION

1. U.S. Department of Commerce

ATTACHMENT B
PRELIMINARY LISTING
OF
SOLAR ENERGY COLLECTORS
(MANUFACTURERS, EXPERIMENTERS AND SALES OUTLETS)

The following listing of manufacturers, experimenters and sales outlets for solar energy collectors was developed by The University of Alabama in Huntsville in support of NASA Contract NAS8-31293 to perform solar heating and cooling technical data and systems analysis. Material is being gathered for a computerized data base which includes climatic conditions and topographical features of various sites; economic factors from all sections of the nation, including fuel and energy costs; architectural techniques, properties of construction materials; and selected parameters for both conventional and solar energy heating and cooling equipment.

Neither the UAH, NASA, ERDA, nor any other agency of U. S. Government or the State of Alabama can assume any responsibility for the accuracy of any statement in this listing. It is provided for informational purposes only. Anyone interested in further information is expected to communicate directly with the contact designated in the listing. Telephone numbers are provided where possible.

The codings (see asterisks*) describe the status of available brochures and technical data sheets that have been gathered and provided to MSFC for entry into the computerized Technical Data Base to be used for systems analysis and development.

CODE: * Brochures on Hand
 ** Data Sheet on Hand
 *** Brochures and Data Sheet on Hand

SOLAR ENERGY COLLECTORS-MANUFACTURERS, EXPERIMENTERS AND SALES OUTLETS

1. AAI Corporation
P.O. Box 6767
Baltimore, MD 21204
Attn: I.R. Barr
(301) 666-1400
- ** 2. Alpha Designs, Inc.
1014 Vine St., Suite 2230
Kroger Building
Cincinnati, OH 45202
Attn: Miroslav Uroshevich
(513) 621-1243
- * 3. Aluminum Company of America
1501 Alcoa Building
Pittsburgh, PA 15219
Attn: William F. Lewis
(412) 553-2748
- *** 4. Ametek
One Spring Avenue
Hatfield, PA 19440
Attn: John Bowen, Manager
(215) 248-4600
- *** 5. Aquasolar, Inc.
1234 Zacchini Avenue
Sarasota, FL 33577
(813) 366-7080
- *** 6. Arizona Solar Enterprises
6719 E. Holly St.
Scottsdale, AZ 85257
Attn: Mr. Walters
(602) 945-0512
7. Beutel's Solar Heater Co.
1527 N. Miami Ave.
Miami, FL 33136
Attn: Orvar Lindstrom
(305) 371-1426
8. Brown Manufacturing Co.
P.O. Box 14546
Oklahoma City, OK 73114
Attn: Russell Brown, President
(405) 751-1323
- *** 9. Burke Rubber Company
2250 S. 10th St.
San Jose, CA 95112
Attn: Larry Schader
(408) 297-3500
- *** 10. Chamberlain
845 Larch Ave.
Elmhurst, IL 60126
(312) 279-3600
11. Coleman Solar Service
8900 NW 34th Ave.
Miami, FL 33136
Attn: Mr. Gay
(305) 233-1999
- *** 12. Corning Glass Works
Houghton Park C7
Corning, NY 14830
Attn: Jim Murry, Manager,
Special Projects
(607) 972-9000
- * 13. CSI
Solar Systems Division
12400 49th St., N
Clearwater, FL 33520
Attn: L.H. Sallen, President
(813) 577-4489
- *** 14. D & J Sheet Metal Company
10055 NW 7th Ave.
Miami, FL 33150
Attn: Jake Sticher
(305) 757-7033
- *** 15. Daystar
41 Second Ave.
Burlington, MA 01803
Attn: Clifton Smith, V. P. Marketing
(617) 272-8460

16. Dome East Corporation
325 Duffy Avenue
Hicksville, NY 11801
Attn: Jeff Thomas
(516) 938-0545
17. Dynatherm Corporation
Marble Court off Industry Lane
Cockeysville, MD 21030
Attn: A. Streb, V.P. Marketing
(301) 666-9151
18. E & K Service Company
16824 74th Avenue, NE
Bothell, WA 98011
Attn: James Ewbank
(206) 486-6660
- *** 19. Ecotechnology
234 Barbara Ave.
Solana Beach, CA 92075
Attn: Daryl Pettus
(714) 755-8361
- * 20. Edwards Engineering Corporation
101 Alexander Ave.
Pompton Plains, NJ 07444
Attn: James Campbell
(201) 835-2808
21. Emerson Electric Company
8100 W. Florissant St.
St. Louis, MO 63136
Attn: William Nusbaum, V. President
(314) 553-2000
22. Energex Corporation
5515 Industrial Road, Suite 513
Las Vegas, NV 89118
(702) 736-2994
23. Energy Conservations Systems of
Colorado Springs, Inc.
327 W. Vermijo
Colorado Springs, CO 80903
Attn: Peter O. Wood, President
(303) 475-0332
- * 24. Energy Converters, Inc.
2501 N. Orchard Knobb Ave.
Chattanooga, TN 37406
Attn: Mr. Rhodes
(404) 875-2503
25. Energy Design Associate, Inc.
3003 19th Dr., NE
Gainesville, FL 32601
Attn: Richard Rodgers
Director of Research
(904) 377-7883
- *** 26. Energy Systems, Inc.
634 Crest Drive
El Cajon, CA 92021
Attn: C.L. Caster
(714) 440-4646
- *** 27. Environmental Energies, Inc.
21243 Grand River
Detroit, MI 48219
Attn: B. O'Shea, President
(313) 533-1985
- *** 28. FAFCO, Inc.
138 Jefferson Drive
Mental Park, CA 94025
Attn: Freeman Ford
(905) 321-6311
- * 29. FESCO
Falbel Energy Systems Corporation
472 Westover Road
Stamford, CT 06902
Attn: Gerald Falbel, President
(203) 357-0626
30. Fiberglass Engineering Company
10223 Residency Road
Manassas, VA 22110
Attn: James D. Morris
(703) 361-1200
- *** 31. Fred Rice Production, Inc.
SAV Solar Heater (New Zealand)
6313 Peach Avenue
Van Nuys, CA 91411
Attn: Frederick Rice
(213) 786-3860
32. Free Heat
P.O. Box 8934
Boston, MA 02114
Attn: Edward Kunz, President
(617) 247-1769

- *** 33. Fun & Frolic, Inc.
P.O. Box 277
Madison Heights, MI 48071
Attn: Edward Konopka, President
(313) 399-1560
- ** 34. Future Systems, Inc.
12500 W. Cedar Road
Lakewood, CO 80228
Attn: Bill Thompson, Director of
Corporation Communications
(303) 989-0431
- *** 35. Garden Way Labs
P. O. Box 66
Charlotte, VT 05445
Attn: Dr. Douglas Taff, Director
(802) 425-2147
36. General Dynamics
2361 S. Jefferson Davis Highway
Suite 1112
Arlington, VA 22202
Attn: W. Ruhe
(202) 785-6500
- * 37. General Electric
P.O. Box 8661
Room 8036
Building 8
Philadelphia, PA 19101
Attn: D. L. Kirkpatrick
(215) 962-4926
38. General Industries
2238 Moffett Drive
Fort Collins, CO 80521
Attn: John Hensley, General Manager
(303) 493-1688
- *** 39. Grumman Aerospace
Energy Program Plant 25
Bethpage, NY 11714
Attn: Don Stein, Commercial Sales
(516) 575-9186
40. Halmac Company
2414 Makiki Heights Drive
Honolulu, HI 96822
Attn: L. M. Judd, Jr., President
(808) 533-6464
- * 41. Halstead Industries, Inc.
Halstead & Mitchell Div.
P.O. Box 1110
Scottsboro, AL 35768
Attn: Otto Nussbaum
(205) 259-1212
42. Helio-Dynamics, Inc.
518 S. Van Ness
Los Angeles, CA 90020
Attn: Truman Temple, President
(213) 384-9853
- * 43. Hitachi Chemical Company
America, Limited
437 Madison Avenue
New York, NY 10022
Attn: H. Aburatani, Manager
(212) 838-4804
44. Hittman Associates, Inc.
9190 Red Branch Road
Columbia, MD 21045
Attn: Dr. Curran, Sr. Staff Consultant
(301) 730-7800
- * 45. Honeywell, Inc.
Systems and Research Center
2600 Ridgeway Parkway
Minneapolis, MN 55413
Attn: Roger Schmidt, Manager
Solar Pilot Plant
(612) 378-4078
46. I.B.M.
Building 965-2
Department 725
Essex Junction, VT 05452
Attn: Dick Pratt, Staff Engineer
(802) 769-0111
- *** 47. Ilse Engineering Inc.
7177 Arrowhead Road
Duluth, MN 55811
Attn: Mr. John Ilse
(218) 729-6858
48. Illinois Institute of Technology
Institute of Gas Technology
3424 S. State Street
Chicago, IL 60616
Attn: Dr. Lavan, Associate Professor
Department of Mechanics
(312) 567-3189

- *** 49. International Environment Corporation
129 Halsted Avenue
Mamaroneck, NY 10543
Attn: Richard Rothschild, President
(914) 698-8130
50. International Solar Heating, Inc.
Route 1, Box 319A
Brandywine, MD 20614
Attn: George Gaydos
(301) 888-1267
- * 51. International Solarthermics Corporation
Box 397
Nederland, CO 80466
Attn: Bob Strickland, V. President of
Administration
(303) 258-3272
- * 52. Intertechnology Corporation
100 Main Street
Warrenton, VA 22186
Attn: Norris Beard, Director Marketing
Operation
(703) 347-7900
53. Itek Corporation
Optical Systems Division
10 Maguire Road
Lexington, MA 02173
Attn: Norm Groatlick, Engineer
(617) 276-2000
- *** 54. J & R Simmons Construction Co., Inc.
2185 Sherwood Drive
S. Daytona, FL 32019
Attn: John Simmons, Vice President
(904) 767-6367
55. Johnson Diversified, Inc.
2340 Queen Ann Street
Merrit Island, FL 32952
Attn: Stan Johnson, President
(302) 452-5545
56. Kalwall Corporation
1111 Candia Road
Manchester, NH 03105
Attn: Keith Harrison, Vice President
(603) 627-3861
- ** 57. KTA Corporation
12300 Washington Avenue
Rockville, MD 20852
Attn: Dr. W. E. Tragert
(301) 881-0047
58. McArthurs, Inc.
P. O. Box 236
Forest City, N.C. 28043
Attn: W. N. McArthurs
(704) 245-7223
59. Materials Consultants, Inc.
2150 S. Josephine Street
Denver, CO 80210
Attn: Dr. J. D. Plunkett, President
(303) 722-8258
60. Motorola, Inc.
New Venture Dev.
4039 E. Raymond Street
Phoenix, AZ 85040
Attn: Dr. I. Lesk, Manager of
Solar Program
(602) 244-5511
61. National Plastics, Inc.
Lab Sciences Division
604 Park Drive
Boca Raton, FL 33432
Attn: Joseph Cariseo, President
(305) 392-0501
62. Northeastern Solar Energy Works, Inc.
112 West 34th Street
Suite 916
New York, NY 10-01
Attn: Louis Varon, President
(212) 524-2474
- * 63. Northrup, Inc.
302 Nichols Drive
P. O. Box 452
Hutchins, TX. 75141
Attn: Harold Hammer, Vice President
of Marketing
(214) 225-4291
- * 64. Owens-Illinois
P. O. Box 1035
Toledo, OH 43666
Attn: Richard E. Ford, Marketing
Manager
(419) 243-1015
65. P. R. Distributors
1232 Zacchini Avenue
Sarasota, FL 33577
Attn: John Pickett, Owner
(813) 958-5660

- * 66. People/Space Company
259 Marlboro Street
Boston, MA 02116
Attn: Robert Shannon, Partner
(617) 261-2064
- 67. Phoenix of Colorado Springs, Inc.
P. O. Box 7246
Colorado Springs, CO 80933
Attn: Douglas Jardine, President
(303) 633-2633
- *** 68. Piper Hydro
2895 E. LaPalma
Anaheim, CA 92806
Attn: James Piper, President
(714) 630-4040
- *** 69. PPG Industries, Inc.
One Gateway Center
Pittsburgh, PA 15222
Attn: Meil M. Barker, Manager
(412) 434-3552
- 70. Powell Brothers, Inc.
5903 Firestone Blvd.
South Gate, CA 90280
Attn: Hayward Powell, Vice President
(213) 869-3307
- ** 71. R-M Products
5010 Cook Street
Denver, CO 80216
Attn: Donald P. Erickson
(303) 825-0203
- * 72. Raypak, Inc.
3111 Agoura Road
Westlake Village, CA 91359
Attn: Mr. Boniface
(213) 889-1500
- * 73. Refrigeration Research, Inc.
Solar Research Division
525 N. 5th Street
Brighton, MI 48116
Attn: Frank Rockwell, Chief Engineer
(313) 227-1151
- *** 74. Revere Copper and Brass, Inc.
Solar Energy Department
P. O. Box 151
Rome, NY 13440
Attn: William Heidrich, Manager
(315) 338-2401
- *** 75. Reynolds Metal Company
2315 Dominguez Street
Torrance, CA 90508
Attn: D. Louding, Plant Manager
(213) 328-7421
- 76. SES, Inc.
#1 Tralee
Industrial Park
Newark, DE 19711
Attn: R. O. Johnson, Marketing Mgr.
(302) 731-0990
- 77. Shelly Radiant Ceiling Company
8110 North St. Louis Avenue
Skokie, IL 60076
Attn: William Shelley, President
(312) 675-8899
- 78. Shultz Field Enterprises Solar
Utilities Company
11404 Sorrento Valley Road
Suite 112
San Diego, CA 92121
Attn: Jack Shultz, Owner
- *** 79. Skytherm Process & Engineering
2424 Wilshire Blvd.
Los Angeles, CA 90057
Attn: Harold Hay
(213) 389-2300
- *** 80. Sol-R-Tec, Inc.
The Trade Center
Hartford, VT 05047
Attn: John Devries, Vice President
(802) 295-9343
- 81. Sol-Therm Corporation
7 W. 14th Street
New York, NY 10011
Attn: I Sittenfeld
(212) 691-4623
- 82. Solar Corporation
9620 Royalton Drive
Veberly Hills, CA 90210
Attn: Hal Meier, President
(213) 276-6372

83. Solar Applications, Inc.
2200 E. Washington Street
Phoenix, AZ 85034
Attn: Robert E. Hopp, Vice President
(602) 244-1822
- * 84. Solar Development, Inc.
4180 Westroads Drive
West Palm Beach, FL 33407
(305) 842-8935
- *** 85. Solar Dynamics, Inc.
4527 E. 11th Avenue
Hialeah, FL 33013
Attn: Mr. Chester, Vice President
(305) 688-4393
86. Solar Energy Company
P.O. Box 69-B
Norland Branch
Miami, FL 33169
Attn: Mr. Balmer
(305) 233-0711
87. Solar Energy Components, Inc.
1605 Cocoa Blvd.
Cocoa, FL 32922
Attn: Walter Autry, President
(305) 632-2880
88. Solar Energy Development, Inc.
1437 Alameda Avenue
Lakewood, OH 44107
Attn: Nicholas Macron, President
(216) 221-3500
- *** 89. Solar Energy Digest
Equipment Division
P.O. Box 17776
San Diego, CA 92117
Attn: Bill Edmondson, Owner
(714) 277-2980
90. Solar Energy Products Company
121 Miller Road
Avonlake, OH 44012
Attn: Frank Rom, President
(216) 933-5000
- *** 91. Solar Energy Research Corporation
1228 15th Street
Denver, CO 80202
Attn: James Wiengard, President
(303) 573-5499
- *** 92. Solar Energy Systems
1243 South Florida Avenue
Rockledge, FL 32955
Attn: Roy C. Mealee, President
(305) 632-6251
93. Solar Equipment Corporation
P.O. Box 327
Edison, NJ 08817
Attn: John Cotsworth, President
(201) 549-3800
94. Solar Physical Corporation
1350 Hill Street
El Cajon, CA 92020
Attn: Jack Hedger, President
(714) 440-1625
- ** 95. Solar Utilities Company
11404 Sorrento Valley Road
Suite 112
San Diego, CA 92121
Attn: Jack Schultz (Owner)
(714) 452-8822
- ** 96. Solar Water Heater Company
P. O. Box 341872
Coral Gables, FL 33165
Attn: W. V. Morrow, President
(305) 221-4611
- * 97. SOLARCOA
P. O. Box 15358
Long Beach, CA 90815
Attn: Mr. A. L. Ottum
- * 98. Solaron Corp.
4850 Olive Street
Commerce City, CO 80022
(303) 289-2268
- * 99. SolarSystems, Inc.
1802 Dennis Dr.
Tyler, TX 75701
Attn: Mr. Jim Eftes, Owner
(214) 592-5343
- *100. Solarway
P.O. Box 217
Redwood Valley, CA 95470
Attn: Ben Piraino, General Manager
(707) 485-7616

- *** 101. Solergy, Inc.
150 Green Street
San Francisco, CA 94111
Attn: Ronald Smith, President
(415) 398-6813
- ** 102. Southwestern Systems, Inc.
P. O. Box 5508
Yuma, AZ 85364
Attn: William S. Mitchell
(602) 782-9174
103. Stampco, Inc.
4549 St. Augustine Road
Building #13
Jacksonville, FL 32207
Attn: R. C. Decker
(904) 737-6144
- ** 104. Steelcraft Corporation
Environmental Design Division
P. O. Box 12408
Memphis, TN 38112
Attn: Gary Ford, Vice President
(901) 452-5200
- * 105. Stolle Corporation
1501 Michigan Street
Sidney, OH 45365
Attn: E. G. Beck, Vice President
(513) 492-1111
- *** 106. Suhay Enterprises
2112 W. Oak
Burbank, CA 91506
Attn: Frank L. Suhay
(213) 846-6245
- * 107. Sun Stove
Solar Energy Equipment
Division of Sun Unlimited Research
Corporation
P. O. Box 941
Sheboygan, WI 53081
(414) 452-8194
- *** 108. Sun Systems, Inc.
P. O. Box 155
Eureka, IL 61530
Attn: Dr. Y. B. Safdari, President
(309) 467-3632
- * 109. The Sundu Company
3319 Keys Lane
Anaheim, CA 92804
(714) 828-2873
- *** 110. Sunearth, Inc.
Box 99
Milford Square, PA 18935
Attn: Howard S. Katz, President
(215) 536-8555
- *** 111. Sunsav, Inc.
250 Canal Street
Lawrence, MA 01840
Attn: Peter Ottmar, President
(617) 686-8040
- *** 112. Sunsource
9570 West Pico Blvd.
Los Angeles, CA 90035
Attn: Edward London, General Mgr.
(213) 271-7248
- *** 113. Sunwater Company
1112 Pioneer Way
El Cajon, CA 92020
Attn: Ed Smith, President
(714) 440-3151
- * 114. Sunworks, Inc.
669 Boston Post Road
Guilford, CT 06437
Attn: Everett M. Barber, President
(203) 453-6191
115. T. D. Bross Line Construction Company
42 E. Dudley Town Road
Bloomfield, CT 06002
Attn: Mr. Theodore Bross, President
(203) 243-1781
116. Thomason Solar Homes, Inc.
6802 Walker Mill Road, SE
Washington, DC 20027
Attn: H. Thomason
(301) 336-0009
117. Wallace Company
Gainesville, GA. 30501
Attn: Joe Pendergrass
(404) 534-5971
- * 118. Ying Manufacturing Corporation
1940 W. 144th Street
Gardena, CA 90249
Attn: Mr. Yu, Vice President
(213) 770-1756

ATTACHMENT C

GOVERNMENT DOCUMENTS

This attachment provides a numerical accounting by subject of all government documents that have been utilized by the Economics Section.

<u>SUBJECT</u>	<u>NUMBER OF DOCUMENTS</u>
Population	20
Education	3
Geography and Environment	9
Finances and Employment	8
Labor Force, Employment and Earnings	12
Income Expenditures and Wealth	10
Prices	4
Energy	142
Transportation and Agriculture	3
Mining and Minerals	22
Construction and Housing	45
Distribution and Services	12
Metropolitan Area	267
Governments	10
Catalogues	4

ATTACHMENT D

GOVERNMENT DOCUMENTS LIST

This attachment provides a selected listing of those government documents that have been designated by the MSFC Technical Monitor as possible sources of valuable data for all related research areas. The basic sources were provided by the UAH research team from selected bibliographies and listings of government documents.

MONTHLY CATALOG - UNITED STATES GOVERNMENT PUBLICATIONS, JANUARY 1975

<u>Publishing Agency</u> <u>Library Call No.</u>	<u>Document Title</u>	<u>Publishing Agency</u> <u>Library Call No.</u>	<u>Document Title</u>
Census Bureau			
C 56.253/3 972/32 C 56.253/3 972/45 C 56.253/3 972/51	Census of Selected Service Industries, 1972. Area Statistics SC 72-A New Mexico. June 1974. Item 132-A-34 Utah. June 1974. Item 132-A-47 Wyoming. March 1974. Item 132-A-54	House of Representatives (continued)	
C 56.252/3 972/13 C 56.252/3 972/29	Census of Wholesale trade, 1972. Area Statistics WC 72-A Idaho. June 1974. Item 132-A-15 Nevada. June 1974. Item 132-A-31	Y 4.J 89/1 93-31	Judiciary Committee, House Outer Continental Shelf oil and gas, hearings before Subcommittee on Immigration, Citizenship, and International Law, 93d Congress. January 24-March 14, 1974. Item 1020
C 56.258 7 C 56.258 18 C 56.258 21 C 56.258 24 C 56.258 25 C 56.258 26	Census Portrait CP 73- Connecticut. January 1974. Kentucky. January 1974. Maryland. January 1974. Minnesota. January 1974. Mississippi. January 1974. Missouri. January 1974.	Y 4.Sci 2.93-2/0 Y 4.Sci 2.93-2/R * Y 4.Sci 2.93-2/42	Science and Astronautics Committee, House Energy legislation, report of Subcommittee on Energy, 93d Congress. May 1974. Energy policy and resource management, report prepared for Subcommittee on Energy. July 1974. Solar Energy research, development, and demonstration act of 1974, hearings before Subcommittee on Energy, 93d Congress. July 30-August 2, 1974. Item 1025-A
* C 56.218 P-20/266	Current Population Reports. Series P-20, Population characteristics. Households and Families, by type, March 1974. July 1974. Item 142-C	Y 4.W36-T 19/72	Ways and Means Committee, House Brief summary of major committee decisions on tax treatment of domestic and foreign oil and gas production, April 9, 1974.
* C 56.218 P-25/518	Current Population Reports. Series P-25, Population Estimates and Projections. Estimates of Population of States, by age, July 1, 1973. June 1974. Item 142-C	Senators	
* C 56.218 P-25/519	Estimates of Population of U.S., by age, sex, and race. April 1, 1960-July 1, 1973. April 1974. Item 142-C	Y 4.S22/3:C 76/13	Banking, Housing, and Urban Affairs Committee, Senate Consumer price index, hearing before Subcommittee on Production and Stabilization, 93d Congress. April 23, 1974. Item 1035
C 56.218 P-25/521	Estimates of Population of U.S. and Components of Change, 1973 with annual data from 1930. May 1974. Item 142-C	Y 4 In 8/13:B 64/3	Interior and Insular Affairs Committee, Senate Bonneville Power Administration financing, hearing before Sub- committee on Water and Power Resources, 93d Congress. June 6, 1974. Item 1040
* C 56.218 P-25/523	Estimates of Population of U.S. to May 1, 1974. June 1974 Item 142-C	Y 4.In 8/13:C 63/7/pt.1	Federal coal leasing program, hearings before Subcommittee on Minerals, Materials, and Fuels, 93d Congress, pt. 1. March 13-April 2, 1974. Item 1040
* C 56.218 P-60/93	Current Population Reports. Series P-60, Consumer Income. Money Income in 1973 of families and persons in the U.S. July 1974. Item 142-C	Environmental Protection Agency	
* C 56.218 P-60/94	Characteristics of low-income population, 1973. July 1974. Item 142-C	EP 1.2: W 28/17/973 1.67.2.IN2/3/963	Costs of construction of publicly-owned wastewater treatment works, 1973 needs survey, report to Congress. National Industrial wastewater assessment manufacturing year 1963, [by] Thomas J. Powers III, Bernard R. Sacks, James I. Holdaway. August 1967.
C 56.209.972/6	Government Finance. GF 72 Local Government finances in selected metropolitan areas and large Counties. 1971-1972. January 1974. Item 146-F	Federal Power Commission	
C 56.231 67	State and Local Government. Special Studies SS(series). Land title recording in U.S., Statistical Summary. March 1974 Item 148-A	FP 1.7/4.1 FP 1.7/4.2	Staff Report, FPC/OCE Guidelines for energy conservation for immediate implementation, small business and light industries, prepared by Office of the Chief Engineer, 2nd Edition. February 1974. Technical basis for energy conservation, prepared by Office of the Chief Engineer. April 1974.
Economic Joint Committee			
* Y 4.Ec 7.En 2/8	Energy Imports and U.S. balance of payments, hearings before Subcommittee on International Economics. 93d Congress, 1st Session, November 6-8, 1973. 1974. Item 1000	Labor Statistics Bureau, Labor Department	
House of Representatives			
I 28.37.971/v.1	House Documents, 92d Congress Minerals yearbook 1971. Metals, minerals, and fuels. 1973	L 2.3:1785-121 L 2.3:1785-122	Bulletin Employment outlook for coal mining 1974. Employment outlook for petroleum and natural gas production and processing, petroleum refining. 1974.
I 28.37.972/v.1	House Documents, 93d Congress Minerals yearbook, 1972. Metals, minerals and fuels.	Mines Bureau, Interior Department	
H R 11714	House Reports on Public Bills, 93d Congress Architectural guidelines to promote efficient energy use December 14, 1973.	I 28.18/4 972	Crude petroleum, petroleum products, and natural-gas-liquids 1972, final summary, prepared in Division of Fossil Fuels. December 21, 1973.
H R. 91-1751	Providing for printing of additional copies of house report entitled Impact of Energy and Fuel Crisis on Small Business. March 4, 1974.	I 28.37:971/v.1 * I 28.37 972/v.1 I 28.98/6 972	Minerals yearbook 1971 v. 1, Metals, Minerals, and Fuels, 1973 Minerals yearbook 1972 v. 1, Metals, Minerals, and Fuels. Item 639 Natural gas production and consumption, 1972, prepared by the Division of Fossil Fuels. September 7, 1973.
Y 4.B 22/1 O:5	Banking and Currency Committee, House Oil imports and energy security, analysis of current situation and future prospects, report of Ad Hoc Committee on Domestic and International Monetary Effect of Energy and Other Natural Resource Pricing, 93d Congress. September 1974.	I 28.18/3 972	World crude oil production annual 1972, prepared by the Division of Fossil Fuels. August 31, 1973.
Y 4.F 76/1 OIS/5	Foreign Affairs Committee, House Oil and Asian rivals, Sino-Soviet conflict, Japan and Oil crisis, hearings before Subcommittee on Asian and Pacific Affairs, 93d Congress, September 12, 1973-March 6, 1974. 1974. Item 1017	National Science Foundation	
		* NS 1.13.En 2	Energy research and technology, interim bibliography of reports, with abstracts. June 1974.

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MONTHLY CATALOG - UNITED STATES GOVERNMENT PUBLICATIONS, MARCH 1975

<u>Publishing Agency</u> <u>Library Call No.</u>	<u>Document Title</u>	<u>Publishing Agency</u> <u>Library Call No.</u>	<u>Document Title</u>
<u>Agriculture Department</u>			
A 1.34 536	Statistical Bulletin Vacant Housing, Is it adequate and in right places? by Donald Bird. Feb 1975. 1975. Item 15		
<u>Census Bureau</u>			
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A 1.107 287	Agricultural economic report Household income, how it relates to substandard housing in rural and Farmer Home Administration areas, by State and race, 1970, June 1975. Item 42-C		
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C 56.254/3-72-1-25	Census of construction industries, 1972, Industry series CC 72-1. Installation or erection of building equipment special trade contractors, N.E.C., SIC code 1796. May 1975. Item 133-D-2		
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C 56.218 P-25/602	Estimates of population of OR counties and metropolitan area, July 1, 1973 and 1974. June 1975. Item 142-C		
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	Adverse effects of coal mining on various Federal reservoir projects 16th report by Committee on Government Operations; June 26, 1974, 1974.	FP 1.2.EI 2/18	National power survey research and development for electric utility industry, report and recommendations of Technical Advisory Commit- tee on Research and Development, July 1974. Item 436
	Solar heating and cooling demonstration act of 1974. Conference report to accompany H.R. 11864, Aug 12, 1974.	FP 1.2.G 21/3/972	Underground storage of natural gas by interstate pipeline companies, calendar year 1972, winter 1972-73, Nov 1973.
	Solar energy research, development, and demonstration act of 1974. Report from Committee on Science and Astronautics to accompany H.R. 16371, Sept 10, 1974.		
	Enabling Secretary of Interior to provide for operation, maintenance and continued construction of Federal transmission system in Pacific Northwest by use of revenues of Federal Columbia River Power System and proceeds of revenue bonds, and for other purposes. Report from Committee on Interior and Insular Affairs to accompany S.3362, Sept. 25, 1974.		
	Solar energy research, development, and demonstration act of 1974. Conference report to accompany S.3234, Oct 4, 1974	<u>Health, Education, and Welfare Department:</u>	
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	Emergency housing finance act of 1974. Report of Committee on Banking, Housing, and Urban Affairs to accompany S.3511, May 16, 1974, 1974.	<u>Mines Bureau:</u>	
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	National Independent refinery development act of 1974. Report from Committee on Interior and Insular Affairs to accompany S.2743, Oct 21, 1974	<u>National Bureau of Standards:</u>	
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		Y 3.T 25-1/974	Annual report of Tennessee Valley Authority, fiscal year, 1974, v.1 Text. 1975.
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C 56.251/5.972/7	Census of retail trade, 1972. Major retail centers in standard metropolitan statistical areas RC 72-C (series) Connecticut, Feb 1975. Item 133	Y 4. In 8/4 94-18	Energy conservation and oil policy, hearings, pt. 2, before Subcommittee on Energy and Power, 94th Congress, 1st session, on title 2, 3, 4, 12, and 13 of H.R. 2633, identical bill H.R. 2650, and H.R. 2151, Mar 10-May 7, 1975. 1975. Item 1019
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94-1 H.rp	Emergency middle-income housing act of 1975. Report together with supplemental, additional individual and minority views from Committee on Banking, Currency, and Housing to accompany H.R. 4485, Mar 14, 1975. Item 1008-A	94-1 S.rp	Surface mining control and reclamation act of 1975. Conference report to accompany H.R. 25, May 2, 1975. Item 1008-A
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<u>National Bureau of Standards</u>	
C 13 53 B	Consumer information series Making most of your energy dollars in home heating and cooling. June 1975. Item 247-B
C 13.46 789-1	Technical note Emergency workshop on energy conservation in buildings, National Conference of States on Building Codes and Standards and National Bureau of Standards, Joint Emergency Workshop on Energy Conservation in Buildings, held at Department of Commerce, Washington, D. C. June 19, 1973, Item 249-A

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C 55.2 D 26	Data and information services of National Oceanic and Atmospheric Administration. Aug 1974.

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NS 1.18 23	Federal funds for research, development and other scientific activities. v.23, fiscal years 1973-75. 1975. Item 834-N

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PEX 14.2: En 2
PEX 14.2: M 42

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A 1.107:305

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Y 4.In 8/13 93-24/pt.4	Market performance and competition in petroleum industry, hearings pt.4, before Special Subcommittee on Integrated Oil Operations pursuant to S. Res. 45, National fuels and energy policy study, Dec 20, 1973, 1974. Item 1040		
		<u>House of Representatives: (continued)</u>	
Y 4.In 8/13 93-47	Solar energy research act of 1974, hearing, pursuant to S.Res.45, National fuels and energy policy study, 93d Congress, 2d session on S.3234, June 27, 1974. 1974. Item 1040		
Y 4.In 8/13 93-48	Energy materials and equipment allocation act, hearings, pursuant to S.Res.45, National fuels and energy policy study, 93d Congress 2d session, on S.3720, July 12 and 25, 1974. 1974. Item 1040		
Y 4.In 8/13 94-18/pt.1	Greater coal utilization, joint hearings, pt.1 before Committee on Interior and Insular Affairs and Public Works, Senate, pursuant to S.Res.45, National fuels and energy policy study 94th Congress, 1st session, on S.1777, June 10 and 11, 1975. 1975. Item 1040		
Also under Y 4.P 96/10:			
Y 4.In 8/13 94-18/pt.2	Greater coal utilization, joint hearings, pt.2, before Committees on Interior and Insular Affairs and Public Works, Senate, pursuant to S.Res.45, National fuels and energy policy study, 94th Congress, 1st session, on S.1777, June 12-23, 1975, 1975 Item 1040		
Also under Y 4.P 96/10			
Y 4.Sm 1/2 En 2/pt.1	Small Business, Select Committee on, Energy research and development and small business, hearings, 94th Congress, 1st session. Solar energy, How much? how much from small business? how soon why not more? why not sooner? May 13 and 14, 1975, 1975. Item 1049		
Y 4.Sm 1/2 En 2/pt. 1A	Solar energy, How much? how much from small business? how soon? why not more? why not sooner? May 13 and 14, 1975, 1975. Item 1049		
Y 4.Sm 1/2 En 2/pt. 1B	Solar energy, How much? how much from small business? how soon? why not more? why not sooner? May 13 and 14, 1975, 1975. Item 1049		
Y 4.Sm 1/2 En 2/pt. 1 D	Solar energy, How much? how much from small business? how soon? why not more? why not sooner? May 13 and 14, 1975, 1975. Item 1049		
<u>Energy Research and Development Administration:</u>			
ER 1.11 BERG/PPS-75/2	ERDA research and development report Heating oils, 1975. Aug 1975.		
ER 1.11 MTR-7067	Industry opinions on formation of Solar Energy Research Institute (SERI), Oct 1975. Item 1051-C		
<u>Federal Energy Administration:</u>			
FE 1.22.4	Conservation paper Lighting and thermal operations building energy reports case studies 1975. Item 434-A-10		
FE 1.22:8	Data base, potential for energy conservation in nine selected industries. 1st edition, 1975. Item 434-A-10		
FE 1.22:13	Data base, potential for energy conservation in nine selected industries, v.5. Aluminum, 1st edition, 1975. Item 434-A-10		
FE 1.22:18	Lighting and thermal operations, energy conservation principles applied to office lighting, 1975. Item 434-A-10		
FE 1.22 20	Guidelines for saving energy in existing buildings, building owners and operators manual ECM 1, June 16, 1975. Item 434-A-10		
FE 1.22:21	Guidelines for saving energy in existing buildings, engineers, architects and operators manual ECM 2, June 16, 1975 Item 434-A-10		
FE 1.22:25	Energy conservation potential in cement industry, 1975. Item 434-A-10		
FE 1.22:31	Pricing distortions of petroleum products, 1975. Item 434-A-10		
FE 1.2.D 26	Proceedings of National Energy Data Workshop, Oct 30-31, 1974, Purdue University, Feb 1974. Item 434-A-1		
FE 1.2.D 24/975	Proceedings of National Energy Data Workshop, Oct 30-31, 1974, Purdue University, Revised Apr 1975. Item 434-A-1		
FE 1.2 C 76	Report to Congress, energy conservation study, Dec 1974. (Published 1975. Item 434-A-1)		
FE 1.2.C 63/2	Short-term coal forecast, 1975-80, final report, Aug 1975. Item 434-A-1		
<u>Federal Power Commission:</u>			
FP 1.18.A1 14/974	Natural electric rate book, rate schedules for electric service in counties of 2,500 population or more, residential, commercial, and industrial services. AK, Aug 1974. Item 437-A-49		
FP 1.18-B 2/975	IN, June 1975. Item 437-A-12		

Publishing Agency
Library Call No.

Document Title

Federal Power Commission (continued)

	National electric rate book, rate schedules for electric service in communities of 2,500 population or more, residential, commercial and industrial services.
FP 1.18-L 93/974	LA. Sept 1974. Item 437-A-16
FP 1.18-M 58/975	MI. July 1975. Item 437-A-20
FP 1.18-N 42 1/974	NH. Aug 1974. Item 437-A-27
FP 1.18-P 38/975	PA. June 1975. Item 437-A-36
FP 1.18-Sa 8 c/974	SC. Aug 1974. Item 437-A-38
FP 1.18-Sa 8 d/974	SD. July 1974. Item 437-A-39
FP 1.18-U 1/974	UT. July 1974. Item 437-A-42
FP 1.18-W 52 v/974	WV. July 1974. Item 437-A-46
FP 1.18-W 99/974	WY. July 1974. Item 437-A-48
FP 1.2G 21/6/v.5	National gas survey v.5, Special reports by Geological Survey. 1973. Item 436

Federal Trade Commission

FT 1.2:En 2	Economic report, concentration levels and trends in energy sector of U.S. economy, staff report. Mar 1974. Item 535
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Labor Statistics Bureau

L 2.3:1865	Bulletin Handbook of labor statistics 1975, reference edition; 1975. Item 768
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National Bureau of Standards

C 13.29/2.64	Building science series Retrofitting existing housing for energy conservation, economic analysis. Dec 1974. Item 241-A
C 13.29/2.78	Pre-design analysis of energy conservation options for multi-story demonstration office building. Nov 1975. Item 241-A
C 13.46-853	State building regulatory programs for mobile homes and manufactured buildings, summary. Sept 1974. Item 249-A

Tennessee Valley Authority

Y 3.T 25/1 974/v.2	Annual report of Tennessee Valley Authority, fiscal year 1974, v.2, Appendixes. 1975.
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Transportation Department

TD 1.20/2-74-12	DOT-TSC-OST (series) Energy statistics, supplement to summary of national transportation statistics, final report. Aug 1974. Item 982-1-5
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ATTACHMENT E

BOOKS AND PAMPHLETS BY SUBJECT

This attachment provides a list of the books and pamphlets utilized by the UAH research team. Authors, publishers and sources are available upon request.

ACCOUNTING

Insurance Agency Accounting

ARCHITECTURAL

Architectural Graphic Standards
Building Products Register
Kidder-Parker Architects' and Builders' Handbook
MANUAL J Load Calculation
Stainless Steel for Architectural Use

CATALOG

Legally Available U.S. Government Information
World Wide Chamber of Commerce Directory 1975-76

CONCRETE

Movement and Distribution of Concrete

CONSTRUCTION

AIA Building Products Register
Architectural Graphic Standards
Building Construction
Building Construction Cost Data 1976
Building Construction Handbook
Building Construction-Materials and Types of Construction
Catalog of NBS Standard Reference Materials 1975-76
Construction Cost Data Book
Construction Publishing Company Publications
Construction of Structural Steel Building Frames
Creep in Engineering Structures
CRYOGENIC Fundamentals
Encyclopedia of Associations
Engineering Materials Handbook
Estimating Construction Costs
The Estimator
Handbook of Foamed Plastics
Heating Ventilating Air Conditioning Guide
HUD Minimum Property Standards. Care-Type Housing
HUD Minimum Property Standards. Manual of Acceptable Practices.
HUD Minimum Property Standards. Multifamily Housing

HUD Minimum Property Standards. One & Two Family Dwellings
Kidder-Parker Architects' and Builders' Handbook
The Laborator
Manual J Load Calculation
MARKS' Mechanical Engineers' Handbook
Material Data Book
Materials for Architecture
MSFC Program Stock Catalog
National Association of Home Builders
National Construction Estimator
Revision No. 1 "Minimum Property Standards for Care-Type Housing"
Revision No. 1 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for Care-Type Housing"
Revision No. 2 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for One and Two Family Dwellings"
Solar Energy Heating & Cooling Products, A Catalog
Steel and Timber Structures
Sweet's Industrial Construction Catalog File
Text Book of the Materials of Engineering
Thermal Insulation
Thermal Performance of Buildings
Thermal Radiation Properties Survey
Thermodynamic Properties of Refrigerants
Uniform Building Code

ECONOMICS

The Quality of Life in the U.S., 1970, Index, Rating, and Statistics
Economic Report of the President
Quality of Life Indicators in the U.S. Metropolitan Areas, 1970

ELECTRICITY

All Electric Homes in the United States
Electric Power Statistics
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
Typical Electric Bills 1974
Typical Electric Bills 1975

ENERGY

All Electric Homes in the United States
A Realistic View of U.S. Natural Gas Supply
Building for Energy Conservation, Proceedings
The Consumer Costs of Deregulation of the Field Price of Natural Gas
Electric Power Statistics
Energy Conservation, It Benefits All of Us!
Energy in Perspective
Energy in the American Economy, 1850-1975
Guidelines for Energy Conservation for Immediate Implementation;
Small and Light Industry

Measures for Reducing Energy Consumption for Homeowners and Renters
National Gas Reserves Study
New Energy Technologies for Buildings
1975 New York Gas Report
The Potential for Conversion of Oil-Fired and Gas-Fired Electric
Generating Units to Use of Coal
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
Typical Electric Bills 1974
Typical Electric Bills 1975

ENERGY

All Electric Homes in the United States
A Realistic View of U.S. Natural Gas Supply
Building for Energy Conservation, Proceedings
The Consumer Costs of Deregulation of the Field Price of Natural Gas
Electric Power Statistics
Energy Conservation, It Benefits All of Us!
Energy in Perspective
Energy in the American Economy, 1850-1975
Guidelines for Energy Conservation for Immediate Implementation; Small
and Light Industry
Measures for Reducing Energy Consumption for Homeowners and Renters
National Gas Reserves Study
New Energy Technologies for Buildings
1975 New York Gas Report
The Potential for Conversion of Oil-Fired and Gas-Fired Electric
Generating Units to Use of Coal
Statistics of Privately Owned Electric Utilities in the U.S. 1973
Statistics of Publicly Owned Electric Utilities in the U.S. F.P.C.
(A) Technical Basis for Energy Conservation
Typical Electric Bills 1975
U.S. Coal and the Electric Power Industry
Wind Power

ENERGY GROWTH

MEGASTAR, The Meaning of Energy Growth: An Assessment of Systems,
Technologies, and Requirements

GAS

The Consumer Costs of Deregulation of the Field Price of Natural Gas
National Gas Reserves Study
A Realistic View of U.S. Natural Gas Supply

GOVERNMENTS

United States Government Manual 1975/1976

HOUSING

HUD Minimum Property Standards. Care-Type Housing. HUD
HUD Minimum Property Standards. Manual of Acceptable Practices
HUD Minimum Property Standards. Multifamily Housing. HUD
HUD Minimum Property Standards. One & Two Family Dwellings. HUD
Revision No. 1 "Minimum Property Standards for Care-Type Housing". HUD
Revision No. 1 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for Care-Type Housing". HUD
Revision No. 2 "Minimum Property Standards for Multifamily Housing"
Revision No. 2 "Minimum Property Standards for One and Two Family Dwellings"

INSURANCE

Insurance Agency Accounting
Insurance Facts
Insurance Funds and Their Investment
Insurance Industry 15-16
Insurance Industry 17-17A
Insurance Industry 18-18A
Insurance Industry 18B-19
Insurance, A Practical Guide
Insurance Principles and Practices

INSURANCE - PROPERTY & LIABILITY

Property and Liability Insurance
Risks We Face, An Introduction to Property Insurance

MATERIALS

Mechanical Behavior of Materials at Elevated Temperatures
Movement and Distribution of Concrete
Properties of Materials at Low Temperature (Phase I)
Property Measurements at High Temperatures
Thermal Conductivity Measurements of Insulation Materials at Cryogenic
Temperatures

MEASUREMENT

VNR Metric Handbook

METALS

The Physical Examination of Metals

METRIC SYSTEM

VNR Metric Handbook

SOLAR ENERGY

Solar Energy Heating & Cooling Products, A Catalog
TERRASTAR. Auburn University Engineering Systems Design

STATISTICS

The Quality of Life in the U.S., 1970, Index, Rating, and Statistics
Quality of Life Indicators in the U.S. Metropolitan Areas, 1970
Statistical Abstract of the United States, 1950-1975

WIND

Wind Power