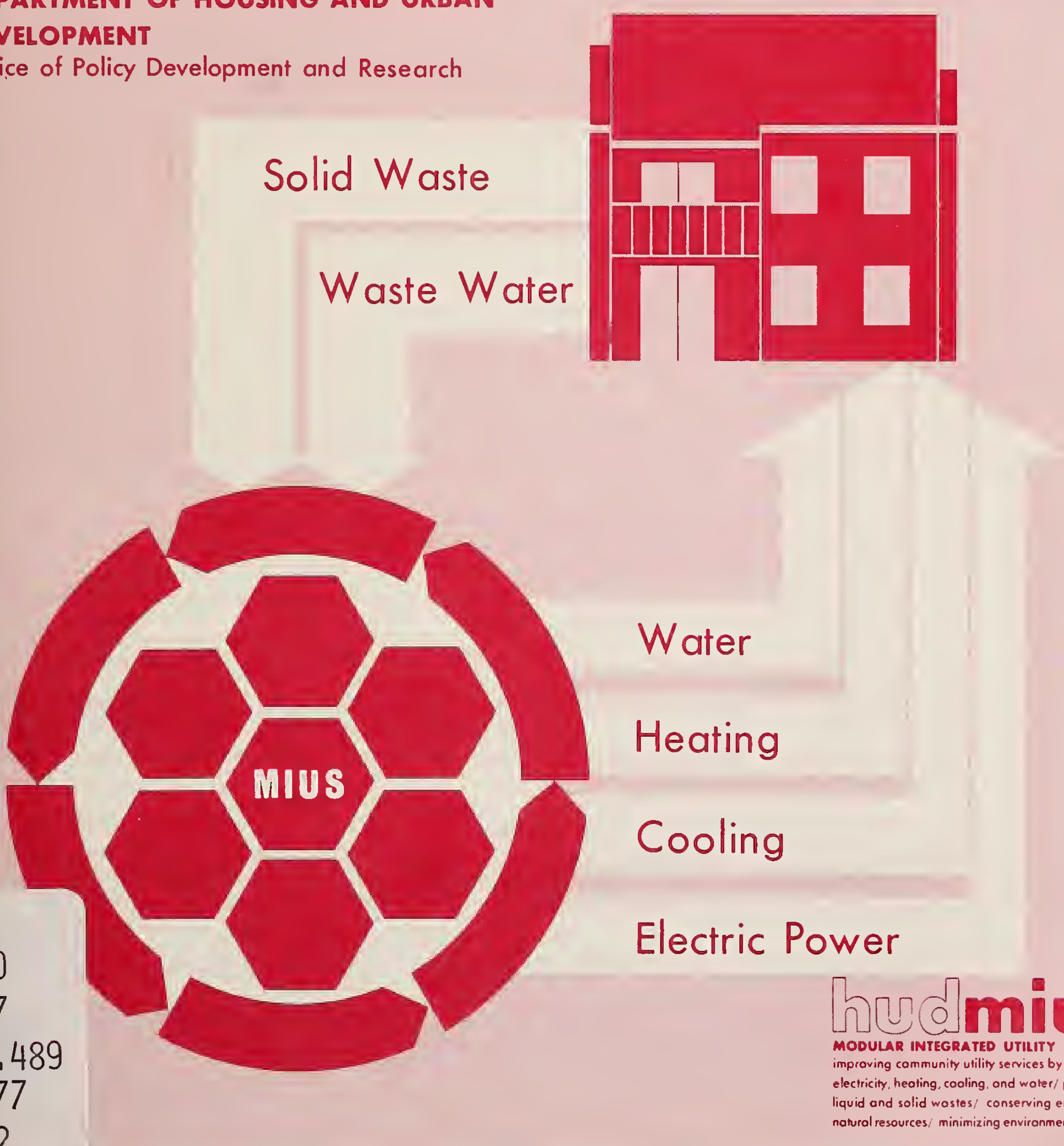
Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program

NBS SPECIAL PUBLICATION 489

ERCE
National Bureau of Standards
prepared for
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Office of Policy Development and Research



hudmius
MODULAR INTEGRATED UTILITY SYSTEMS
improving community utility services by supplying electricity, heating, cooling, and water/ processing liquid and solid wastes/ conserving energy and natural resources/ minimizing environmental impact

NATIONAL BUREAU OF STANDARDS

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Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Standards — Office of International Relations.

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

[2] Located at Boulder, Colorado 80302.

Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program

J.D. Ryan and B. Reznek, Editors

Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
Washington, D.C. 20234

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FORWORD

The Department of Housing and Urban Development (HUD) is conducting the Modular Integrated Utility System (MIUS) Program to develop and demonstrate the advantages of integrating community systems for providing utility services. The utility services include electric power, heating and cooling, potable water, liquid waste treatment and solid waste management. The objective of the MIUS concept is to provide the desired utility services consistent with reduced use of critical natural resources, protection of the environment and minimization of cost.

Under HUD direction, several agencies are participating in the HUD-MIUS Program including the Energy Research and Development Administration, Department of Defense, Environmental Protection Agency, Department of Health, Education and Welfare, National Aeronautics and Space Administration, and National Bureau of Standards. The National Academy of Engineering has provided an independent assessment of the Program. Drafts of technical documents are reviewed by the agencies participating in the HUD-MIUS Program. The draft of this publication received such a review and all comments were resolved with HUD.

The HUD-MIUS Program and its related activities has been underway at HUD since 1970. This publication provides a means to access the large amount of material prepared to date by this effort. HUD and the National Bureau of Standards will continue their collection and dissemination of information in support of the continuing Program, now moving into the demonstration and implementation phases. This publication will be updated in the future to insure that those concerned with MIUS technology are able to keep abreast of available reports.

Ernest Ambler, *Acting Director*
National Bureau of Standards

CONTENTS

LIST OF ACRONYMS

AAAS - American Association for the Advancement of Science; 1515 Massachusetts Ave., N.W., Washington, D.C. 20005

ACES - Annual Cycle Energy System

AEC - Atomic Energy Commission (also see ERDA)

AIAA - American Institute of Aeronautics and Astronautics; 1290 Avenue of the Americas, New York, N.Y. 10019

AIChE - American Institute of Chemical Engineerings; United Engineering Center, 345 East 47th Street, New York, N.Y. 10017

ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers; United Engineering Center, 345 East 47th Street, New York, N.Y. 10017

ASME - American Society of Mechanical Engineers; United Engineering Center; 345 East 47th Street, New York, N.Y. 10017

CBD - Central Business District

COSMIC - Computer Software Management Information Center, Barrow Hall University of Georgia, Athens, Ga. 30601

DSC - Decision Sciences Corporation

"E-CUBE" - "Energy-Equipment-Economics" (Computer Program)

EIS - Environmental Impact Statement

EPA - Environmental Protection Agency; 401 M Street, S.W., Washington, D.C. 20460

ERDA - Energy Research and Development Administration (also see AEC); 20 Massachusetts Avenue, N.W., Washington, D.C. 20545

ESOP - Energy Systems Optimization Program (for computer)

FAQS - Federal Air Quality Standards

GPO - (U.S.) Government Printing Office

HEW - (U.S. Department of) Health, Education and Welfare; 330 Independence Avenue, S.W., Washington, D.C. 20201

HUD - (U.S. Department of) Housing (and) Urban Development; 451 7th St. S.W., Washington, D.C. 20410

HVAC - Heating, Ventilating (and) Air Conditioning

IDHA - International District Heating Association

IECEC - Intersociety Energy Conversion Engineering Conference

IEEE - Institute of Electrical and Electronic Engineers; United Engineering Center, 345 East 47th St., New York, N.Y. 10017

IUS - Integrated Utility System

IUSB - Integrated Utility Systems Board (of NAE)

JSC - (Lyndon B.) Johnson Space Center (of NASA); also see NASA and USPO

LHV - Lower Heating Value (of a fuel)

MIST - MIUS Integration and Subsystems Test (laboratory)

MIUS - Modular Integrated Utility Systems

NAE - National Academy (of) Engineering

NAS - National Academy (of) Science

NASA - National Aeronautics and Space Administration (also see JSC and USPO); 600 Independence Avenue, Washington, D.C. 20546

NBS - National Bureau of Standards (U.S. Department of Commerce); Washington, D.C. 20234

NBSLD - NBS's Load Determination (Program for Computer)

NOx - Nitrogen Oxides

NTIS - National Technical Information Service

ORNL - Oak Ridge National Laboratory (Operated by Union Carbide Corp. for AEC and its successor ERDA); P.O. Box "X"; Oak Ridge, Tenn. 37830

OSHA - Occupational Safety and Health Administration; 200 Constitution Avenue, N.W., Washington, D.C. 20210

SINDA - Systems Improved Numerical Differencing Analyzer

SMSA - Standard Metropolitan Statistical Area

SRR - Systems Requirements Review

T.A. - Technology Assessment

T.E. - Total Energy

TES - Thermal Energy Storage

USPO - Urban Systems Project Office (also see NASA and JSC)

Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program

J.D.Ryan and B.Reznek

ABSTRACT

This document provides a complete listing of reports and articles relating to the HUD-MIUS Program. Reports from 1970 through August, 1976 are included. The entry for each report contains an abstract and other pertinent information, including procurement sources and procedures. Reports are presented by 4 general subject categories: Program and Concept Description, Systems Analysis, Technology Evaluation, and Hardware Evaluation and Demonstration. The reports are further classified into 3 publication/availability categories: government publications (Published Reports), non-government publications and articles (Outside Publications) and unpublished reports and data (Open-File Reports).

Key words: Abstracted reports and articles; HUD Modular Integrated Utility Systems (MIUS) program; total energy; utility systems.

1. INTRODUCTION

This is a list of abstracted reports and articles of the HUD-MIUS Program and its HUD-sponsored related activities in the area of T.E. Systems. This list includes all formal publications and selected unpublished reports which are accessible in the files of agencies participating in the MIUS Program. Significant articles and reports concerning MIUS which were published outside the Program are also included. Agency press releases, newspaper articles and new items in periodical publications are generally excluded, as are reports which are not a direct part of HUD-MIUS Program.

1.1 Quality Control of HUD-MIUS Reports

In order to merit recognition as a formal HUD-MIUS Program publication through use of the HUD-MIUS logo on the cover, documents are subjected to certain quality control procedures. HUD has established the Coordinated Technical Review (CTR) process to serve as the formal mechanism for quality control of HUD-MIUS documentation. During the preparation of formal reports, draft reports are submitted to all participating agencies for review. Comments are received and assembled by NBS into a CTR for resolution by the group preparing the report. Unresolved comments are included separately in the foreword to the final published report, along with a brief statement describing the CTR process.

Almost all formal published documents of the HUD-MIUS Program have completed the CTR process. In a few instances, in which reports were of a very detailed nature, comments were provided by peer groups outside the HUD-MIUS Program as an informal alternative to the CTR process. In a few other cases, the need for timely publication meant that the CTR process was curtailed before the document revision process was completed. Documents prepared before the existence of the HUD-MIUS Program (prior to mid-1972) were published without a formal multi-agency review process although normal intra-agency review procedures were usually followed.

1.2 Classification of Reports

To facilitate accessing the report entries, the reports and articles are classified by subject matter into four categories representing the type of effort or program phase under which the report was prepared. Separate sections of this list are devoted to each of the categories and within each of these four sections, the abstracts are listed in reverse chronological order. The categories are defined and explained as follows:

Program & Concept Description - these reports provide background on the goals and objectives of the HUD-MIUS Program including program structure, approach, schedules and relationships with other federal agency programs. Also provided are the technical rationale, estimated impacts and implementation considerations.

Systems Analysis - these reports provide data and evaluations of MIUS systems, subsystems or components usually in terms of the economic, environmental or energy conservation aspects of a MIUS serving community utility loads for a typical year. Trade-offs and systems' effects of various equipment configurations, climates, loads, types of buildings are often presented.

Technology Evaluation - these reports generally focus on a particular subsystem or component which could be part of a MIUS. Surveys of equipment availability with performance data and costs are included in this category along with more generic studies and surveys of control systems, computer methods and performance specifications. These reports provide basic data and methodologies for Systems Analysis work.

Hardware Evaluation and Demonstration - these reports deal with one of three projects: the NBS-conducted HUD-MIUS Total Energy full-scale Demonstration in Jersey City, N.J.; the ORNL-conducted coal-fired MIUS laboratory and pilot plant research in Oak Ridge, TN; and the NASA-conducted MIST test-bed research on MIUS subsystems & components at JSC, Houston, TX. Reports provide overall goals, test plans, schedules and progress as well as actual research and evaluations.

Several documents could be classified into more than one subject category. This is particularly true of reports dealing with Hardware Evaluation & Demonstration, since some of these reports are technology evaluation or systems analysis studies conducted prior to obtaining actual research results. Such reports are kept in the Hardware Evaluation & Demonstration category. Overall, care has been exercised to properly classify documents into subject category by the major thrust of the document with an eye towards the various users of this list & how their interests are likely to channel.

The reports and articles in this list also have been classified into three major classifications corresponding to availability. The classifications are described below:

Published Reports (P): publications and reports made available through established government document sources. The reports include those prepared by Federal agency staff personnel and those prepared by others under contract. Most publications in this classification have completed either the HUD-MIUS CTR process or an outside technical review.

Outside Publication (PO): reports and articles published by non-government organizations. Articles include those by agency staff personnel and those authored by others (often largely based on interviews and material supplied by HUD-MIUS participants). These reports and articles are published in technical periodicals, research journals, professional society transactions and other non-government sources. Most items in this classification have not been subjected to the technical review process.

Open-File Reports (OF): unpublished reports that are being made available, for reference only, at certain agency offices/libraries. These reports are of limited interest outside the Program. In many cases they provide detailed data and calculations which are summarized in formal published reports. These OF's may also be of an incomplete or informal nature, unreviewed and not intended for formal publication and widespread outside distribution. Most of these items have not been subjected to a technical review process.

1.3 Format for Report Listing

One numbered page is generally devoted to each report. The following information is provided:

Title
*Author(s)
Date of Issuance
*Document Prepared By
*Responsible Organization(s)
*Procurement Source; Accession No.
Other Identification
Total Pages
Total References Cited
Classification of Document
Abstract

* items are explained on the following pages

Author(s): indicates authorship as stated on the report. Where no entry is made, no author is cited in the report.

Document Prepared By: indicates the organizational affiliation of the author or the organization which prepared the report in the case of anonymous authorship.

Responsible Organization: indicates the HUD-MIUS participating agency which sponsored a report prepared mainly by others under contract. This item is left blank for all reports other than outside consultant/contractor reports.

Procurement Source; Accession Number: indicates the procurement source and accession number for obtaining reports. Detailed information is provided in Availability and Procurement Notes. For Open-File Reports, this item is entitled: Reference Source; Accession Number to properly indicate that physical procurement is often not possible, but the reports are available for review and reference.

1.4 Availability and Procurement Notes

Published Reports are available from either the GPO or from NTIS, as indicated under the Procurement Source item. The number following the source acronym is the one to be used in ordering the report from the indicated source.

Those reports indicated as being available from GPO are available only while still in print. Once they are out of print, they may be obtained from NTIS. Orders for GPO publications should be made out to:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Remittances for publications should be by coupon, postal money order, express money order or check. Postage stamps will not be accepted. Publications cannot be mailed before remittances are received. Foreign remittances should be made either by international money order or draft on an American bank.

The letter symbol, publication number, full title of the publication, SD catalog number, and SD stock number MUST be given when ordering. The Superintendent of Documents allows a discount of 25 percent on orders of 100 or more copies of one publication. Persons who make requent purchases from the Superintendent of Documents may find a deposit account convenient. Deposits of $25 or more are accepted, against which orders may be placed without making individual remittances or first obtaining quotations. Order blanks are furnished for this purpose. After the order has been processed, the order itself is returned, showing the publications supplied, explanations regarding those not sent, the amount of charge, and the balance on deposit.

No charge is made for postage on documents sent to points in the United States and its possessions. In computing foreign postage, add one-fourth of the price of the publication to cover the cost of shipping and handling charges.

Those reports indicated as being available from NTIS can be obtained in either a paper copy (PC) or microfiche (MF) form. The size of the microfiche film sheet is 105. x 148.75 mm (about 4 x 6 inches). Orders for publications should be made out to:

National Technical Information Service
U.S. Department of Commerce
Springfield, VA 22161

Orders for publications purchased from NTIS can be prepaid or billed later. Please note that if an order is not accompanied by payment, an additional $5.00 ship and bill charge will be added. Orders can also be charged to American Express Card accounts, please provide card expiration date, account number and authorized signature. Detailed information concerning NTIS can be obtained directly from NTIS. It is advisable to call (703) 557-4660 to establish prices prior to ordering.

Normal delivery time takes three to five weeks. It is vital that items be ordered by number or the order will be manually filled, insuring delay. You can opt for airmail delivery for a $1.00 charge per item. For fastest service, call the NTIS Rush Handling Service, (703) 557-4700. For a $10.00 charge per item, and order will be airmailed within 48 hours. Or, you can pick up an order at the Washington Information Center & Bookstore or at the NTIS Springfield Operations Center within 24 hours for a $6.00 per item charge. Orders may also be placed by telephone or TELEX. The order desk number is (703) 557-4650 and the TELEX number is 89-9405.

Outside Publication Reports and articles may be obtained from the publishing organization, subject to availability. Articles which are unavailable can often be purchased at a nominal price through library lending/duplication services or from the Library of Congress Photoduplication Service; information about this latter source may be obtained from:

Photoduplication Service
Library of Congress
Washington, D.C. 20540

Open-File Reports are available for reference only, during regular office hours, at certain HUD-MIUS participating agency offices and/or libraries. These reports may not be removed from these locations. The individual researcher may be able to make copies of a limited amount of this material depending on circumstances. The National Bureau of Standards maintains a complete file of all HUD-MIUS Program Open File reports. Other agencies participating in the program maintain a reference file of the reports for which they were responsible. This is indicated in the Reference Source items. To obtain access to the reports please contact the following, as indicated below. For any (OF) Reports in this list:

C.W.Phillips
Center for Building Technology
National Bureau of Standards
Gaithersburg, Maryland (location)
Washington, D.C. 20234 (mail)

For those (OF) Reports for which NASA-JSC is indicated as the Reference Source:

H.E.Benson
Systems Evaluation Office
National Aeronautics & Space Administration
Johnson Space Center
Clear Lake City, Texas (location)
Houston, Texas 77058 (mail)

For those (OF) Reports for which HUD is indicated as the Reference Source:

Jerome H. Rothenberg
Division of Energy, Building Technology and Standards Research
Department of Housing and Urban Development
451 7th St. S.W., Rm. 8158
Washington, D.C. 20410

For those (OF) Reports for which ORNL is indicated as the Reference Source:

W.R.Mixon
Oak Ridge National Laboratory
P.O. Box X
Bldg. 3550
Oak Ridge, Tennessee 37830

2. PROGRAM/CONCEPT DESCRIPTION REPORTS

TITLE: Recycling Energy through Modular Integrated Utility Systems

AUTHOR(S): J. Rothenberg

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION: "HUD Challenge", Volume VII, No. 6, June 1976; pages 8&9

TOTAL PAGES: 2 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (P)

ABSTRACT

This article by the HUD-MIUS Program Manager concisely reviews the "historical" background, goals and on-going projects that are associated with the MIUS programs.

It states that MIUS goals are intended to provide for:

a) options in the provision of utility services for urban/suburban development;

b) more efficient utilization of energy and other resource;

c) reducing the total cost of utilities;

d) improving the quality of the environment.

TITLE: Integrating Community Utilities

AUTHOR(S): J.R. Schaefgen

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-256898

OTHER IDENTIFICATION: Proceedings of the Third National Conferences on Complete Water Reuse; Cincinnati, Ohio; June 27-30, 1976; LCC #76-21203

TOTAL PAGES: 19 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper broadly describes the roles played by separate conventional utility services in the generation of electricity, wastewater and potable water treatment and solid waste disposal. The application of MIUS concepts in the integration of these same utilities is explained.

MIUS performance requirements, as compared to those of "conventional" utilities, are stated to include conservation of fuel and other natural resources, reduction of environmental degradation, decreasing the total public costs, satisfactory reliability, capability for keeping-up with community development and greater flexibility during intensive land development projects.

It is pointed out that the greater benefits of a MIUS result from the strong integration of the electrical and thermal subsystems. Several studies are briefly summarized to illustrate the integratiion principles.

The water treatment aspects of MIUS are stated to include the potential for water conservation through water reuse. Wastewater that has received advance treatment can be reused for such end purposes as lawn-watering, fire-fighting, MIUS and industrial process applications and recreational facilities.

An active project in its initial states is described, which is intended to demonstrate MIUS benefits to prospective users of MIUS installations.

TITLE: A New Look at Modular Integrated Utility Systems (MIUS)

AUTHOR(S): W.R. Mixon

DATE OF ISSUANCE: 3rd. Quarter, 1975

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "District Heating" Magazine

OTHER IDENTIFICATION: Vol. 61, No. 1, pp. 8-11; Keynote Address at IDHA 66th. Annual Conference in Skytop, Penn. on June 23, 1975

TOTAL PAGES: 4 TOTAL REFERENCES CITED: 3 CLASS.OF DOCUMENT: (PO)

ABSTRACT

This "keynote address" summarizes the objectives and scope of the entire MIUS program. The primary objectives are delineated, a list of the various government and private professional group participants is given and selected analytical results are presented. A series of concluding statements concisely summarizes the advantages and limitations of MIUS, with the net balance said to distinctly favor the MIUS concept.

TITLE: MIUS: Darkhorse in the Nation's Energy Future?

AUTHOR(S): M.D. Zimmerman (Editor)

DATE OF ISSUANCE: 4/17/75

DOCUMENT PREPARED BY: "Machine Design" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "M.D." Magazine

OTHER IDENTIFICATION: pp. 20-25; V. 47, #9

TOTAL PAGES: 5 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This article is a semi-technical summary of T.E. and MIUS. It covers the history and basic MIUS concepts and the roles played by the major participants in the HUD programs which are investigating MIUS feasibility. A selection of generalized data, in percentage format, is cited to illustrate the limitations and potentialities of the concepts.

TITLE: MIUS Utilities Breakthrough

AUTHOR(S): D. Koral (Editor)

DATE OF ISSUANCE: 12/74 + 1/75

DOCUMENT PREPARED BY: "Building Systems Design" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "B.S.D." Magazine

OTHER IDENTIFICATION: pp. 5-12; V. 72, #1

TOTAL PAGES: 8 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This article presents the MIUS concepts, highlights its most prominent characteristics, and outlines the potential utility of MIUS to architects, developer/builders, engineers, management personnel concerned with utilities and their regulation, and manufacturers of equipment that is likely to be used in a MIUS.

The paper contains a description of a HUD-implemented T.E. plant at Jersey City, N.J. which includes a cost summary, a listing of major equipment and their suppliers, and flow plus schematic diagrams of its automatic vacuum-collection system.

A concise summary is provided for the major subsystems applicable for "near-term" MIUS installations.

TITLE: Modular Integrated Utility Systems

AUTHOR(S):

DATE OF ISSUANCE: 1974

DOCUMENT PREPARED BY: HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: GPO;2300-00268

OTHER IDENTIFICATION: HUD-PDR-29-14

TOTAL PAGES: 21 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (P)

ABSTRACT

This brochure presents the MIUS concept, highlighting its most prominent characteristics, and outlines the potential utility of MIUS to architects, developers, builders, manufacturers, engineer, and management personnel concerned with utilities and their regulation.

TITLE: Total Energy Systems

AUTHOR(S):

DATE OF ISSUANCE: 12/74

DOCUMENT PREPARED BY: HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: GPO; 023-000-00284-1

OTHER IDENTIFICATION: HUD-381-PDR

TOTAL PAGES: 17 TOTAL REFERENCES CITED: 2 CLASS. OF DOCUMENT: (P)

ABSTRACT

This booklet describes the total energy concept and its potential use to housing developers, local government officials and others concerned with efficient use of energy resources. The role of HUD in demonstrating and evaluating Total Energy through a demonstration facility in New Jersey is decribed. The MIUS concept is introduced as a further development of the T.E. concept.

TITLE: Evaluating Integrated Utility Systems

AUTHOR(S):

DATE OF ISSUANCE: 9/74 (Reprinted, with corrections, 12/75)

DOCUMENT PREPARED BY: IUSB of NRC

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-238765

OTHER IDENTIFICATION: HUD-PDR-77(2); HUD Contract H-1875

TOTAL PAGES: 122 TOTAL REFERENCES CITED: 59 CLASS. OF DOCUMENT: (P)

ABSTRACT

[NOTE: This report derives from a study approved by the Executive Committee of the National Academy of Engineering (NAE). Members of the study committee who conducted the project and prepared the report were selected for recognized competence and with due consideration for the balance of disciplines concerned].

Four major areas were surveyed by NAE's Integrated Utility Systems Board (IUSB) in preparing this report. These areas were: A) a determination of the technical feasibility of complete systems, components and subsystems; B) an evaluation of alternative concepts with regard to costs, environmental impact, energy savings and other criteria; C) the identification of potential institutional constraints/incentives which might impede or encourage implementation; D) a formulation of effective plans and strategies for conducting demonstrations. A detailed list of the Board's "Findings and Recommendations" is included as part of the Report.

An evaluation of IUS is included which covers the HUD-MIUS Program, MIUS benefits and limitations, the various institutional parameters that play a part, and proposed MIUS "demonstrations". Additionally there is a summary of MIUS Technology which deals with energy systems, solid-waste management and liquid-waste treatment.

TITLE: Energy Systems for Development

AUTHOR(S): J.A. Orlando; D.R. Limaye

DATE OF ISSUANCE: 4/74

DOCUMENT PREPARED BY: Authors/Mathematica, Inc. (Philadelphia, Pa.)

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Instrument Society of America

OTHER IDENTIFICATION: Part 2 of Proceedings of Pittsburgh Conference on Modeling & Simulation; University of Pittsburgh; April 24-26, 1974; pp. 673-678

TOTAL PAGES: 6 TOTAL REFERENCES CITED: 4 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Historically the United States has been a nation of continued development and growth. Recently, because of increased concern for the environmental impact of development and overall economic downturns, that growth has been essentially arrested. One major problem, even at a slowed development pace, is that of providing adequate utility services at maximum efficiency and minimal impact.

This paper discusses one solution to the above problem; the MIUS concept. This is a concept being advanced by HUD which includes T.E. Systems with onsite water and waste processing systems. The integration of all utility needs into a single on-site system permits "waste" from one subsystem to be used in a second subsystem. For example, excess heat from the power generation subsystem is used for building heating and cooling; solid wastes are used as a fuel for heating and cooling or for sewage sludge incineration. In addition to increased efficiency, MIUS minimizes environmental impact by confining, treating and utilizing "wastes" at the source.

The paper describes the nature of a MIUS system, reports on analytic investigations of its economics and describes some of the institutional problems which offer impedements to its widespread use.

TITLE: HUD Energy Conservation Research

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 3/74

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Institute of Gas Technology (Chicago, Illinois); Session VII, paper no. 5

OTHER IDENTIFICATION: Proceedings of the Third Conferences on Natural Gas Research and Technology; Dallas, Texas; March 6-8, 1974

TOTAL PAGES: 7 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper describes major HUD research programs underway and planned, which aim at anticipating new energy demands and developing alternative strategies for meeting them. The research focuses on:

1) Identifying present residential energy consumption patterns and possible conservation measures;

2) Demonstration and evaluation of the energy-saving MIUS concept and its potential role in community development;

3) Demonstration at a Jersey City multi-family residential complex of a major element of MIUS, namely a T.E. system;

4) Demonstration of the potential for large-scale recycling of solid wastes to generate steam and electricity for residential use;

5) Demonstration of the potential of solar energy utilization, as an alternative source of energy for housing.

A brief outline is included of the current projects, intended to implement the research program, along with their governmental, utility and, private-sector research participants.

TITLE: Modular Integrated Utility Systems Program

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 12/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASHRAE

OTHER IDENTIFICATION: ASHRAE Journal; pp. 43-46

TOTAL PAGES: 4 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper gives a brief background report of the energy supply situation in the U.S., particularly for electricity, and its relationship to the demand for utilities services. It then describes alternative approaches to the current techniques for suppling utilities and relates them to HUD's MIUS Program.

The major research/development phases of the Program are summarized. The paper also briefly discusses MIUS's probable market area, potential for savings of energy and money, program goals, feasibility demonstrations and other significant parameters such as environmental impact.

TITLE: The Modular Integrated Utility System - A New Approach to the Supply of Utility Services

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: AIAA

OTHER IDENTIFICATION: 8th IECEC Proceedings; pp. 648-652; #739147

TOTAL PAGES: 5 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper provides a generalized overview of the MIUS Program. The Program, sponsored and directed by HUD, is intended to effect widespread application of the MIUS concept via a limited number of demonstrations. The MIUS is described as a combined processing plant that generates electricity, utilizes residential and recycled energy for heating, air conditioning and hot water, treats water, and processes solid and liquid wastes. The MIUS Program in its predemonstration Phase I is being carried out for HUD by numerous Government agencies: AEC, through the Oak Ridge National Laboratory; Environmental Protection Agency; Department of Commerce, through the National Bureau of Standards; the National Aeronautics and Space Administration.

MIUS is primarily concerned with near-term solutions to the problems caused by increasing costs, depletion of resources, environmental effects and increasingly overloaded centralized utility systems. The document states that MIUS appears to have the potential to provide major improvements in all utility services as contrasted to concepts which satisfy only one or two major objectives.

TITLE: Integrated Utilities for Remote Alaskan Villages

AUTHOR(S): D.R.Wright

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: Author/EPA

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: AIAA

OTHER IDENTIFICATION: 8th IECEC Proceedings; pp. 643-647; #739146

TOTAL PAGES: 2 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The report points out that widespread pollution and disease, brought on primarily by the use of polluted water in Alaska's rural villages, has resulted in a weakened and disease-inflicted people, with a life span about half that of the population in the "lower" 48 states. The EPA, through Public Law 92-500, has implemented three projects to demonstrate methods to provide central community facilities for safe water and the elimination or control of pollution. The facilities include provisions for safe community water-supply systems, toilets, bathing and laundry facilities, sewage disposal facilities and solid waste disposal. This paper discusses and includes data on the final design, initial operation of the facilities at two of the projects, capital and operation/maintenance costs and social-political aspects.

Incorporation of the MIUS concept into future utility services for Alaskan Villages, as related to the Alaska Village Demonstration Project (AVDP) central community facilities, is also discussed.

TITLE: The Design of Modular Integrated Utility Systems

AUTHOR(S): E.L. Hays; et al

DATE OF ISSUANCE: 7/73

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE: ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION: Presented at the 8th IECEC, Philadelphia, Pa, 8/13-16, 1973. Not printed in the Proceedings.

TOTAL PAGES: 24 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This paper briefly describes an effort to determine the potential value of the MIUS approach by preparing conceptual designs capable of meeting the utility requirements of specific building types. The effort compared these various designs with conventional utility systems and evaluated potential resource savings. In these conceptual designs, the minimization of energy consumption was the optimization criteria. The result of this effort was a set of feasible MIUS designs for a variety of facility types. These designs were carried out only in sufficient detail to permit the assessment of potential energy savings on an annual basis.

The procedure and results of the effort are shown through an illustrative example of the analysis for one of the building types, a garden apartment.

TITLE: Statement of Alan R. Siegel before Subcommittees of U.S. House of Representatives

AUTHOR(S): A.R. Siegel

DATE OF ISSUANCE: 6/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION: Subcommittee on Space Science & Applications and Subcommittee on Energy

TOTAL PAGES: 12 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The Statement dealt with the subject of energy and briefly presented the highlights of the MIUS Program, which HUD believes to be an extremely timely and significant research activity.

Background information is provided related to the utilities needs of housing and the effects of cost increases and energy shortages on such needs. The goals of HUD's Utilities Research Program are summarized, along with "guidelines" for executing research and demonstration efforts in these areas. The three major phases of the multiagency MIUS Program are described.

MIUS objectives are listed as: a) conservation of natural resources; b) reduction of primary energy requirements; c) minimization of environmental impact by a MIUS; d) providing utility services in phase with community growth; e) utilization of land not presently developable because "conventional" utility services are either nonexistent or are under local restrictive edicts; f) providing a transportable system for emergencies.

It is stated that the MIUS Program is concerned with "near-term" solutions to the problems caused by: spiraling costs, depletion of natural resources, environmental constraints, deteriorating underground infrastructures and increasingly overloaded centralized utility systems. Additionally, MIUS appears to have the potential to attain simultaneously a large number of major improvements in the delivery of utility services, in contrast to most projects which satisfy only one or two major objectives.

TITLE: Statement of Alan R. Siegel before Subcommittees of U.S. House of Representatives

AUTHOR(S): A.R. Siegel

DATE OF ISSUANCE: 6/19/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION: Subcommittee on Energy and Subcommittee on Conservation and Natural Resources

TOTAL PAGES: 8 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The Statement briefly presents the highlights of research activities in the Department of Housing and Urban Development (HUD) as they relate to energy conservation.

Background material is given relating to municipal utilities, the existing "bleak" energy picture and the need for new approaches in supplying answers to the problems arising from energy shortages. HUD's goals in its Utilities Research Program are described, along with the guidelines to be used in carrying out the research and demonstration efforts that form part of the Program.

Major programs were reviewed for the benefit of the Committee. These were: Residential Energy Consumption, Urban Use of Powerplant Waste Heat, T.E., MIUS and "long-range" efforts that can directly or indirectly affect the use of energy.

TITLE: Energy Utilization and Conservation Research Program of the Department of Housing and Urban Development

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 6/1/73

DOCUMENT PREPARED: Author/HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION:

TOTAL PAGES; 50 TOTAL REFERENCES CITED: 12 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The report outlines the goals and objectives of HUD's Energy Research Programs as of June 1973. The major areas covered were those for: Total Energy (T.E.), Residential Energy Consumption and Modular Integrated Utility Systems (MIUS).

It is pointed-out that HUD's research efforts are mainly oriented towards more efficiency in energy use rather than on procedures for increasing energy production.

The major HUD research programs are focused on evaluating the following alternatives for residential energy supply and demand:

a) optimization (i.e., minimization) of residential energy consumption;
b) evaluation of the role in community development of small-scale energy systems;
c) community utilization of waste heat from central station powerplants;
d) investigation of the potential for recycling solid and liquid wastes into energy;
e) assessment of integrated utility systems (IUS);
f) energy supply strategies;
g) utility installation practices.

TITLE: Response to Questions from Subcommittee of U.S. House of Representatives

AUTHOR(S):

DATE OF ISSUANCE: 6/19/73

DOCUMENT PREPARED BY: HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION: Subcommittee on Energy and Subcommittee on Conservation and Natural Resources

TOTAL PAGES: 47 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This document lists HUD's response to certain questions from the House of Representatives' Subcommittees on Energy and on Conservation and National Resources. These questions and answers dealt with how HUD's activities relate to the development of T.E. systems for multiple dwelling units and for commercial/industrial buildings.

The report summarizes HUD's efforts in the T.E. area, which include: the evaluation of existing plants, sponsorship of Operation "BREAKTHROUGH" and an examination of whether developers would be justified in investing money for feasibility studies of T.E. systems.

HUD's MIUS Program is described in detail. The description includes: a) the guidelines and design criteria to be followed; b) a list of objectives to be pursued; c) a look at the major phases of the multi-agency program schedule; d) roles to be played by the various participating groups from the Federal Government and private sectors.

TITLE: The Modular Integrated Utility System Program

AUTHOR(S): G.S.Leighton

DATE OF ISSUANCE: 5/3/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION: Presented at ASHRAE Spring Conference (1973); Vol. 79, Part II, Page 7 (Abstract Only)

TOTAL PAGES: 86 TOTAL REFERNCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This informal document presents an overall review of the early design and demonstration concepts intended to integrate the supply of all energy and waste disposal services for a community's needs. Possible methods of energy conservation, through the use of the residual heat from electric power generation for supplying heating and cooling, are discussed along with the reuse of water and heat-generation from solid waste disposal plants. The technologies required for integrated systems to service communities ranging up to 1000 families are considered part of the MIUS project.

Data is given on electrical, gas, water and solid-waste utility growth and their attendant problems.

The HUD Programs dealing with T.E. are discussed, with particular emphasis on major research programs which focus on evaluating alternatives for residential energy supply. Operation "BREAKTHROUGH" (and its demonstration site at Jersey City, N.J.) is reviewed. The T.E. system associated with this site is explained in detail.

The paper contains a brief review of an economic evaluation of T.E. Its objective is the preparation of guideline criteria for the determination, by private and public sectors of the U.S. economy, of the applicability of T.E. systems to residential developments.

The potential markets for MIUS are summarized. The impacts of MIUS, extrapolated to about 1986, are listed and concisely described. The MIUS Program Plan is outlined in detail. The generic MIUS Integration and Subsystem Test (MIST) concept is discussed.

TITLE: NASA Studying Urban Utility Designs

AUTHOR(S): E.J. Bulban

DATE OF ISSUANCE: 4/9/73

DOCUMENT PREPARED BY: "Aviation Week & Space Technology" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "A.W.S.T." Magazine

OTHER IDENTIFICATION: pp. 56-57

TOTAL PAGES: 2 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper presents a brief summary of the MIUS program at NASA's JSC. It states that "space technology and systems integration techniques are being applied to the design of urban utilities services for the future".

TITLE: Washington Wants Products that Conserve Energy

AUTHOR(S): G.S. Leighton + Editorial Staff of A.&R. B.

DATE OF ISSUANCE: 3/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "Air Conditioning & Refrigeration Business" Magazine

OTHER IDENTIFICATION: pp. 61-63 + 69

TOTAL PAGES: 4 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper presents a first-hand look at governmental research on residential energy conservation and on the evaluation of improvements in the efficiency of heating/cooling equipment. It states that HUD and its research contractor, Hittman Associates, was in process of completing a report that pinpoints every major use and waste of residential energy along with recommendations for cutting-down on such waste. HUD's intent is to use data from studies of this type to promote changes in Building Standards so that they would cover energy-conserving building techniques plus equipment improvements. A preliminary listing of such recommendations is included in the paper, along with a summary of savings within a "characteristic" house.

TITLE: Engineered Comunities: Modular Integrated Utilities - Panacea for the Energy Crisis?

AUTHOR(S): D.R. Heinly (Editor)

DATE OF ISSUANCE: 2/73

DOCUMENT PREPARED BY: "Actual Specifying Engineer" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "A.S.E." Magazine

OTHER IDENTIFICATION: pp. 89-90

TOTAL PAGES: 2 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper is a brief description of various aspects of MIUS and T.E. It covers "modularized" utility systems proposed for certain Alaskan villages, the Jersey City T.E. Demonstration Plant, generalized MIUS concepts, and the three phases (planning/technology, project demonstration and commercialization) of the MIUS Program.

TITLE: HUD Takes Total Energy Concept One Step Beyond: Evolution of an Idea

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 1/73

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "Air Conditioning & Refrigeration Business" Magazine

OTHER IDENTIFICATION: pp. 81-84; Vol. 30, No. 1

TOTAL PAGES: 4 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper describes a HUD research program devoted to developing a single, combined-package plant for supplying a full range of "conventional" building utilities. This (MIUS) program also embodies the treatment of water and liquid-waste, the processing of solid-wastes, and clarifies the use of residual and recycled energy to do a large part of the job.

The report summarizes (1971) residential operating costs and provides general background statistics for the solid-waste problem as of 1970. Various major phases of the planned MIUS research/development/demonstration program are described.

TITLE: Modular Integrated Utility System (MIUS) Program Description

AUTHOR(S):

DATE OF ISSUANCE: 12/72

DOCUMENT PREPARED BY: HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION:

TOTAL PAGES: 20 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The report states that the combined pressures of rapid population growth and the mobility of the U.S. population indicate a need for large-scale community development such as; new communities , additions to existing ones, and large-scale redevelopment. To make such developments livable certain utilities are required, namely; electricity, environmental conditioning (heating and/or air conditioning), water and waste treatment, and disposal. The distribution networks to dispense these services must also be provided.

The overall objectives of the MIUS Program are stated as: 1) the provision of improved utility services with resultant advantages in total cost, decreased environmental impact, and increased efficiency in the utilization of natural resources; 2) installing such services at a pace equal to the rate of growth of the new development; 3) allowing for releasing land for development that is not now being serviced by conventional utility systems.

TITLE: Total Energy Systems: A Review of Recent NBS Activities

AUTHOR(S): J.E.Snell; P.R.Achenbach

DATE OF ISSUANCE: 6/72

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Drexel University

OTHER IDENTIFICATION: Proceedings of Effective Energy Utilization Symposium, Philadelphia, Pa., 6/8-9, 1972, Pages 201-233

TOTAL PAGES: 33 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper (briefly) reviews and reports on the status of several NBS activities in the area of T.E. systems, as they relate to the theme of the Symposium.

A recent review of the state of the art in such systems applications indicated the need for good, concise operating and performance data to serve as a basis for more effective utilization of this concept for saving energy. HUD requested NBS to assist in the development of a T.E. system on the BREAKTHROUGH housing site at Jersey City, N.J. and to conduct a full-scale field study with appropriate instrumentation to obtain engineering, cost and maintenance data.

In a related effort, NBS, AEC, EPA and NASA are supporting HUD in a new effort entitled the MIUS program. The premise of this 3-phase effort is to demonstrate the potential energy, resource and cost economies of combining energy-generating facilities and waste disposal facilities on a modular-basis so as to keep pace with changing patterns and rates of urban growth.

TITLE: Urban Energy Utilization and Conservation

AUTHOR(S): G.S. Leighton

DATE OF ISSUANCE: 6/72

DOCUMENT PREPARED BY: Author/HUD

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Institute of Gas Technology (Chicago, Illinois); Session II, paper no. 2

OTHER IDENTIFICATION: Proceedings of the Second Conference on Natural Gas Research and Technology; Atlanta, Georgia, June 5-7, 1972

TOTAL PAGES: 13 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (PO)

ABSTRACT

HUD's responsibility for improving the present and future well being of existing, and yet-to-be-built urban areas, requires that strict attention be paid to energy sources and their efficient use. The objective of HUD's research, which presently covers the spectrum from an analysis of individual dwelling unit energy utilization through MIUS, is not presently directed towards the development of component technology. The objective is to assure that the quantities and types of energy that are required to satisfy current and future population needs are available. This, it is believed, can be accomplished by the evaluation of existing and developing technologies and by working to affect institutional change.

The paper summarize HUD's efforts in the general areas of T.E. and MIUS. Descriptions of T.E. demonstration projects are included along with a description of the three primary elements of the MIUS program, namely: planning and technology assessment; demonstrations; commercialization.

TITLE: Total Energy and Pneumatic Waste Collection Demonstrations

AUTHOR(S):

DATE OF ISSUANCE: 5/72

DOCUMENT PREPARED BY: HUD

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD

OTHER IDENTIFICATION:

TOTAL PAGES: 21 TOTAL REFERENCES CITED: 4 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This booklet describes two innovative technologies being investigated by HUD: 1) the use of a Total Energy (T.E.) plant to provide electricity, heat and air-conditioning to a residential complex; 2) an automatic pneumatic waste-collection system. Operation "BREAKTHROUGH" (HUD's major research/development/demonstration effort for improving every phase of planning/production/delivery of housing) afforded an opportunity to carry out demonstrations of the two technologies. Both were to be used at the Jersey City, N.J. prototype site.

In its discussion of T.E. in residential complexes, the report covers: a) the basic concepts of T.E. and its practical uses; b) the nature of a representative T.E. plant; c) HUD's energy programs; d) a description of the Jersey City site and its T.E. plant.

In discussing community waste collection, the following areas were covered: a) comparison of "old" and "new" collection procedures; b) HUD's Waste Systems Study; c) pneumatically-powered trash collection procedures; d) future possible approaches for pneumatic collection setups.

TITLE: Environmental Control in Manned Spacecraft - Its Potential Contribution to Pollution Control

AUTHOR(S): E.L. Hays (NASA-JSC) and H.N. Myrick (University of Houston)

DATE OF ISSUANCE: 10/71

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: AIAA; Paper No. 71-1012

OTHER IDENTIFICATION: Presented at AIAA 8th Annual Meeting and Technology Display, Washington, D.C., 10/25-28, 1971

TOTAL PAGES: 28 TOTAL REFERENCES CITED: 14 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The purpose of this paper is to consider the application of the concept of planned resource utilization, as practiced in the manned spacecraft programs, to a living community on earth. Basically, integrated water and waste management, thermal environmental control, toxic environmental control, personal and occupational safety, power generation, and waste heat rejection systems in the spacecraft have provided a very habitable environment that includes use, then extensive reuse, of natural and available secondary resources.

3. SYSTEMS ANALYSIS REPORTS

TITLE: MIUS Systems Analysis-The Effects of Thermal Energy Storage and Solid Waste Incineration Options on MIUS Cost and Fuel Consumption

AUTHOR(S): C.L. Segaser; W.R. Mixon

DATE OF ISSUANCE: 7/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-26

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72; ERDA-40-333-72

TOTAL PAGES: 59 TOTAL REFERENCES CITED: 23 CLASS. OF DOCUMENT: (P)

ABSTRACT

Water is the preferred thermal energy conveyance fluid between a MIUS district heating and cooling plant and the consumer. Water was also chosen as the thermal energy storage medium for MIUS in preference to one of the available latent-heat of phase-change materials because of its abundance, cheapness and unique thermal properties.

This Memorandum presents the results of a parametric system analysis (which uses the ORNL 1973 MIUS hourly comparative energy computer program) to evaluate the effects on fuel consumption in a representative MIUS model due to the application of a sensible heat thermal energy storage (TES) device using water as the TES material. An economic evaluation is included for several cases, with and without solid waste incineration and heat recovery, over a range of storage capacity and fuel cost.

The analysis indicates that a significant saving in fuel consumption can accrue from the storage of excess waste heat for subsequent use during periods when the available heat from the engine-generators is inadequate to satisfy the demand. If one also utilizes the heat energy available from the incineration of solid wastes, a fuel savings of up to 5%/year can result. However, the breakeven cost of the fuel assumed to be natural gas, should be at least $2.25 per thousand cu ft, in order to economically justify the installation.

The economic analysis was also used to compare costs of various options of solid waste incineration for the pertinent MIUS and consumer models. These options included combinations of cases with and without heat recovery, thermal storage and supplemental fuel consumption. The incremental fuel cost, or credit, for each option was based on the difference in total fuel consumption from that of a MIUS model without incineration.

TITLE: MIUS Systems Analysis: Comparison of MIUS and Conventional Utility Systems for an Existing Development

AUTHOR(S): E.C.Hise; et al

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-20

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72; ERDA 40-333-7

TOTAL PAGES: 170 TOTAL REFERENCES CITED: 66 CLASS. OF DOCUMENT: (P)

ABSTRACT

The Walden Development (in Schaumburg, Ill.) contains an occupied complex of apartments, townhouses and commercial space served by conventional utilities. The Live Model is the same complex as "served" by an analytically substituted, unoptimized, total-energy system having district heating/cooling, solid-waste incineration and liquid waste treatment. The conventionally-served Walden Development and the Live Model are compared in this report.

The electrical and space heating and cooling loads were calculated for the complex. The equivalent fuel consumption and cost of the utility equipment to satisfy these loads were estimated for both utility systems. Several sensitivity analyses are also presented, covering variations of indoor design temperature and of utility system characteristics.

The Live Model study indicates a savings of about 17% of the fuel now required by Walden. The increased owning and operating costs of Live-Model energy-type utilities are found to be small relative to the total owning and operating costs for the Walden development and relative to the degree of refinement of design/cost estimates. Incineration of solid waste would be more expensive but with little change in fuel consumption. On-site, biological, liquid waste treatment would cost about the same as the conventional biological system; physical-chemical treatment would be more expensive but would yield a higher quality effluent.

Environmental effects of the Live Model are discussed and compared to those from the conventional utilities. It is estimated that the Live Model does not change local air quality markedly from that estimated for Walden and that the air quality would be well within the Federal Air Quality Standards (FAQS).

TITLE: MIUS Community Conceptual Design Study

AUTHOR(S): T.E. Redding, et al

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; NASA TM X-58174

OTHER IDENTIFICATION: JSC-10650

TOTAL PAGES: 565 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (P)

ABSTRACT

This design study was performed to determine the feasibility, practicality and applicability of the MIUS concept to a "satelittle" new-community development with a population of approximately 100,000. Two MIUS design options [a 29-MIUS unit (option I) and an 8-MIUS unit (option II) facilities] were considered. Each results in considerable resource savings when compared to those for a conventional utility system. The results of economic analyses indicated that the total cash outlay and operations and maintenance costs for these two options were considerably less than for a conventional system. Computer analyses performed in support of this study provided corroborative data for the study group. An environmental impact assessment was performed to determine whether the MIUS meets or will meet necessary environmental standards. The MIUS can provide improved efficiency in the conservation of natural resources, while not adversely affecting the physical environment.

Electrical power, HVAC, solid-waste and water systems criteria are conceptually discussed. Pyrolysis of solid-waste, vacuum collection of wastewater, use of heat in wastewater treatment and water saving/reuse techniques are covered.

TITLE: MIUS Systems Analysis: Initial Comparisons of Modular-Sized Integrated Utility Systems and Conventional Systems

AUTHOR(S): G. Samuels; et al

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS;ORNL/HUD/MIUS-6

OTHER IDENTIFICATION:

TOTAL PAGES: 260 TOTAL REFERENCES CITED: 30 CLASS. OF DOCUMENT: (P)

ABSTRACT

This memorandum presents the results of a preliminary study of the comparative economics, fuel requirements and environmental impacts of MIUS and conventional energy systems. No final conclusions were reached since the results were only intended to help determine the requirements for additional modeling and analyses of utility system performance and costs.

The primary analytical effort was placed on determining the cost and energy requirements associated with several methods for supplying electricity, space heating, domestic hot water and air conditioning services to garden and high-rise apartments.

The study was also limited to a site having the climate of Philadelphia, Pennsylvania. A total of 11 cases (or models) were examined with all of them being evaluated on the basis of present marginal costs and fuel energy requirements. Two of the models were also studied for environmental impact. The evaluations and comparisons are preliminary and approximate being based on "country-wide average" present marginal cost figures and a single, fairly average, United States climate.

No attempt has been made in these preliminary analyses to compare system costs on the basis of present or projected market prices for electricity or fossil fuels supplied to various types of customer. The calculations also made no allowances for possible reductions in cost that might be derived from the mass production of standardized MIUS units nor for possible reduced costs of electricity that may eventually occur due to the use of improved planning procedures similar to those used in large electric utility company systems.

TITLE: Initial Comparisons of Modular-Sized Integrated Utility Systems and Conventional Systems for Several Building Types

AUTHOR(S): H.E. Benson; L.G. Monford, Jr.

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N76-24082

OTHER IDENTIFICATION: JSC-09076; NASA TM X-58140

TOTAL PAGES: 89 TOTAL REFERENCES CITED: CLASS.OF DOCUMENT: (P)

ABSTRACT

This report reviews the results of six MIUS conceptual design studies applied to a: garden-apartment complex, high-rise office building, high-rise apartment building, shopping center, high school and hospital. The main purpose of the studies was to determine the performance of a MIUS and to compare this performance to that of a conventional utility system. The basic studies incorporated Houston, Texas weather data. In addition, the size and location of the garden apartment's design were varied to examine their effects on performance.

The studies showed that a MIUS design could be expected to save from ∿18 to 36% of "conventional" energy needs. The heating and air-conditioning systems were such that heating was supplied in large part from waste heat recovered from solid waste incineration and power generation. Trash removal from the site was estimated to be 80%. Water saving was estimated to be as much as 50% through reusing treated waste water in cooling towers.

In parallel with the design study, new construction was surveyed to determine where MIUS systems could be applied for the largest market potential. This indicated that the largest percentage of new construction is for single-family dwellings. Apartments represent a significant portion of new construction (∿15%) and constitute the second largest dollar value.

Finally, the environmental effects of the design were established. The basic environmental impact of a MIUS was that local thermal emissions and air pollution will be increased but total thermal and air pollution in the city will be reduced.

TITLE: MIUS System Analysis: Effects of Unfavorable Meteorological Conditions and Building Configurations on Air Quality

AUTHOR(S): L. Breitstein; R.E. Gant

DATE OF ISSUANCE: 2/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-29

OTHER IDENTIFICATION: Addendum II of ORNL/HUD/MIUS-6; ERDA 40-333-72; Contract No. W-7405-eng-26

TOTAL PAGES: 77 TOTAL REFERENCES CITED: 18 CLASS OF DOCUMENT: (P)

ABSTRACT

This analytical study compares the highest ground-level concentrations of atmospheric pollutants that would result from the exhaust gases of the thermal electric subsystems of both a hypothetical reference MIUS and a conventional utility system model. Both systems are assumed to serve a large complex of garden-type apartments, under a variety of meterological conditions, with emphasis being given to those conditions which were most likely to induce poor air quality. Estimates are included for the possible effects of aerodynamic downwash of exhaust gases and of building configurations on air quality with an apartment complex served by MIUS. Calculated concentrations of pollutants have been compared to the appropriate air quality standards established by EPA.

[NOTE: This memorandum is an addendum to a more general document, "Initial Comparisons of Modular-Sized Integrated Utility Systems and Conventional Systems," ORNL/HUD/MIUS-6.]

TITLE: Economic Objectives of Utility Companies and Developers in Evaluating a MIUS

AUTHOR(S): B.J.Bartter

DATE OF ISSUANCE: 11/75

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB 246864

OTHER IDENTIFICATION: NBSIR 75-721

TOTAL PAGES: 31 TOTAL REFERENCES CITED: 7 CLASS. OF DOCUMENT: (P)

ABSTRACT

This report provides information on the economic decision-making process for implementation of a MIUS by utility companies, developers and a combination of these two groups.

The scope of this study is relatively narrow. For example, neither technological nor legal barriers are discussed although both could be important in the adoption and implementation of a MIUS. Its purpose is to provide a perspective of the economic interests of potential participants such as utility companies and developers.

Five participants and three roles are identified namely; the private utility company, public utility company, private speculative developer, private nonspeculative developer and the governmental developer. Roles they might play include "owner/operator" and "ultimate consumer".

Information was obtained related to participants economic analysis of utility investment alternatives. This data was synthesized into economic criteria which are perceived by each participant to be most important in evaluating alternative utility investments. From the analysis of these economic criteria, and without references to any legal barriers, the possible combinations of participants and roles in the implementation of a MIUS are specified. These combinations are ranked according to the degree of likelihood that each method will actually be employed.

TITLE: Final Environmental Statement - Application of Modular Integrated Utility Systems Technology
AUTHOR(S): T.H. Row; et al

DATE OF ISSUANCE: 10/75

DOCUMENT PREPARED BY: ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; HUD-PDR-EIS-75-1F

OTHER IDENTIFICATION:

TOTAL PAGES: 236 TOTAL REFERENCES CITED: 146 CLASS. OF DOCUMENT: (P)

ABSTRACT

This "Environmental Statement" was prepared by HUD in accordance with the National Environmental Policy Act of 1969 (NEPA) and in support of HUD's proposal to proceed with a MIUS demonstration. The statement is a generic environmental assessment of the consequences of applying MIUS technology.

The document assesses the environmental impact from installation and operation of the MIUS in a generic sense. Local consequences are evaluated through use of a hypothetical housing development, with assumed typical climatic conditions, and a reference MIUS model which has been designed to provide complete utility services. The effects of the use of alternative MIUS components, subsystems and processes were also examined. Results of the analysis of the single hypothetical application were then extended to provide an evaluation of nationwide utilization of the MIUS concept subject to constraints of the projected market. This document is of a generic nature. Environmental statements for actual MIUS installations, at specific sites, will be completed as required.

TITLE: Effects on Air Quality from MIUS and Conventional Thermal-Electric Systems
AUTHOR(S): J.O. Kolb

DATE OF ISSUANCE: 8/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: IEEE; 75CHO 983-7 TAB

OTHER IDENTIFICATION: Record of the 10th IECEC; pp. 269-277; #759043

TOTAL PAGES: 9 TOTAL REFERENCES CITED: 7 CLASS.OF DOCUMENT: (PO)

ABSTRACT

The objective of this study was to evaluate the effects of local air quality from combustion emissions of the thermal/electric subsystem of a MIUS, and compare this with several conventional utility system models. The consumer model used in this study is a garden-apartment complex housing ∿2500 people.

The MIUS thermal/electric subsystem provides district space heating/cooling, domestic hot water and all electrical requirements. MIUS prime-movers considered were diesel engines or spark-ignition gas engines. Emissions and their effects on air quality were evaluated both with and without incineration of solid wastes from the MIUS's residential consumers.

Conventional utility electricity was assumed to be provided by a mix of new coal and nuclear-fueled central generating plants projected for the near future. The analysis of these conventional utilities covered several building service models with the following equipment: district space heating/cooling and domestic hot water; space heating and hot water from building boilers; space cooling from individual apartment air conditioners; an all-electric model, with individual apartment heat-pumps.

The major conclusions of this study are concerned with: a) emissions quantities, b) distribution of pollutants and c) effects on air quality, as they are related to Federal Air Quality Standards (FAQS).

TITLE: Guide to the Preparation of a Site-Specific Environmental Statement for a Modular Integrated Utility System Demonstration

AUTHOR(S): W.R. Mixon; et al

DATE OF ISSUANCE: 7/8/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: ORNL

OTHER IDENTIFICATION:

TOTAL PAGES: 65 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This document gives general guidance for the preparation of an environmental statement related to the specific site and design of the first MIUS demonstration. The outline does not address every item of concern that may arise as a result of particular site problems. It was written, using the experience gained in the ORNL "Environmental Statements Project", to set forth suggested areas for analysis. It notes that the first step in performing the environmental analysis of any site will be to tailor the outline to the individual nature of the system and its location, once their special characteristics have been determined. This ORNL guide was intended to serve as an instructive outline for the authors contributing to the Statement, as well as an outline of the planned approach to the site-specific Statement task for review and comment by other Program agencies.

TITLE: Data Requirements for Evaluating the Environmental, Socio-economic, and Community Impacts of the MIUS Total Utilities System

AUTHOR(S):

DATE OF ISSUANCE: 5/12/75

DOCUMENT PREPARED BY: Booz-Allen & Hamilton, Inc.

RESPONSIBLE ORGANIZATION(S): NBS

REFERENCE SOURCE; ACCESSION NO.: NBS

OTHER IDENTIFICATION: EPA Contract No. 68-01-2942

TOTAL PAGES: 94 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This report is intended to serve as a basis for assessing the technical, economic and institutional feasibility of the MIUS concept in a broader range of applications.

The report defines the data that should be provided to the government by the developer of a prototype MIUS under the HUD/MIUS demonstration program. Data requirements are developed for several potential impact areas including: Occupational, Environmental, Reliability, Community, Land development, Single-point management, Economic, Comparison of MIUS with conventional utilities and Institutional impact areas.

Evaluating the performance of the prototype MIUS will require the collection of a substantial amount of data in the various potential impact areas. Much of this data will have to be provided by the developer who will construct and operate the prototype. In order to ensure that such data will be available, it will be necessary to specify (e.g., as part of the developer's contract with HUD) the desired information. Such information would include details as to the access to the plant and its related development.

TITLE: Social Cost Considerations and Legal Constraints in Implementing Modular Integrated Utility Systems

AUTHOR(S): N.W.Lede; et al

DATE OF ISSUANCE: 12/74

DOCUMENT PREPARED BY: Authors/Texas Southern Univ., (Houston, Texas)

RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N75-15503

OTHER IDENTIFICATION: NASA-CR-140894. Contract No. NGR-44-016-016

TOTAL PAGES: 243 TOTAL REFERENCES CITED: 390 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Social costs associated with the design, demonstration and implementation of MIUS are considered; these factors include the social climate of communities, leadership patterns, conflicts and cleavages, specific developmental values, MIUS utility goal assessment and the suitability of certain alternative options for use in a program of implementation.

General considerations are discussed in the field of socio-technological planning. These include guidelines for understanding the conflicts and population diversity, some relevant goal choices and ideas useful to planners of the MIUS facility.

TITLE: Application of the Integrated Utilities Concept to Community-Size Developments

AUTHOR(S): T.E. Redding (USPO)

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME

OTHER IDENTIFICATION: Record of the 9th IECEC; pp. 493-498; #749016

TOTAL PAGES: 6 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

As a part of a conceptual design study, NASA has investigated the application of MIUS concept to a large new Community Model. The complete community consists of a central business district with a number of surrounding villages. Two different MIUS installation options are defined which differ in the number, type and location of their MIUS installations and, to some extent, in their utility details. Each MIUS installation included multiple diesel-engine/generator units with heat recovery, solid-waste incinerators with heat recovery, optimized space heating/cooling installations, combined biological and physical/chemical wastewater treatment; also supervisory plus local control systems. Each MIUS design option was evaluated relative to a conventional utilities system approach. It was concluded that compared to the conventional system: MIUS energy savings would be ∿38%, water savings ∿17%, effluent reduction ∿17% and solid-waste load reduction ∿80%.

TITLE: Economic Guidelines for Total Energy Systems

AUTHOR(S): J.L. Oplinger; et al

DATE OF ISSUANCE: 6/74

DOCUMENT PREPARED BY: Author/DSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASHRAE

OTHER IDENTIFICATION: ASHRAE Transactions; V. 80, Part 2; pp. 212-223

TOTAL PAGES: 12 TOTAL REFERENCES CITED: 12 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Even though T.E. has potentially valuable resource conservation and environmental impact characteristics, it must also be justified economically. In most cases residential project developers do not seriously consider T.E. because of the technical complexities of such economic evaluation. Recognizing this situation HUD called for a study with the overall objective being "preparation of guide criteria for the determination, by the private and public sectors of the economy of the applicability of T.E. systems for residential development".

The paper emphasizes that the primary purpose of the analysis was not to replace project-specific feasibility studies but rather to identify those situations in which a full technical and economic study would be apparently justified.

The paper defines the bounding parameters of the analysis e.g., size of projects to which T.E. systems are to be applied. It also points out that the basic purpose of the study was to provide easily usable guidelines for evaluating T.E. system opportunities over a wide range of conditions. Additional discussions are concerned with maintenance costs, waste-heat utilization, project density effects, commercial space considerations and distribution system facets.

TITLE: Housing Data for Modular Integrated Utility Systems (MIUS) Economic Analysis

AUTHOR(S): D.R. Glenn; et al

DATE OF ISSUANCE: 5/74 (Vol. I) 12/73 (Vol. II)

DOCUMENT PREPARED BY: Authors/Decision Sciences Corp.

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-242392 (Vol. I)
PB-242393 (Vol. II)

OTHER IDENTIFICATION: HUD-DSC-3; HUD Contract No. H-1776

TOTAL PAGES: 963 TOTAL REFERENCES CITED: 10 CLASS. OF DOCUMENT: (P)

ABSTRACT

The purpose of this study was to establish a "baseline" definition of the multi-family housing construction industry. Particular emphasis is placed on data bases for the existing market, and on the incremental growth patterns during the period 1968-1973 (roughly), when this type of housing experienced its greatest advance. The increase was from 40% to almost 54% of total new housing.

The report is presented in three volumes. Volume I consists of three sections, in addition to the Executive Summary, Section I. Section II presents a detailed analysis of the various physical and marketing aspects influencing the multi-family housing industry. Included are summaries of the findings from extensive data collection and analysis efforts, ranging from national coverage down to the Standard Metropolitan Statistical Area (SMSA) level. Each major multi-family dweling category is reviewed to determine its relation to other housing, and to factors impacting the selection of design approaches including their marketing and physical constraints. Section III documents the in-depth study conducted in Atlanta and Philadelphia. These two cities were used to determine the common and extraordinary setups of the multi-family housing industry as represented by the largest builder/developer organizations operating in each of these areas. Topics included in this investigation were site selection criteria, construction phasing/scheduling, historical background and anticipated future trends.

Volume II contains selected SMSA data which has been compiled into two groupings, by census region and climatic (temperature) zones.

TITLE: Housing Data for Modular Integrated Utility System (MIUS) Economic Analysis, Vol. III

AUTHOR(S): D.R. Glenn; et al

DATE OF ISSUANCE: 5/74

DOCUMENT PREPARED BY: Authors/Decision Sciences Corp.

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: HUD; HUD-DSC-3

OTHER IDENTIFICATION: Volumes I and II available from NTIS.

TOTAL PAGES: TOTAL REFERENCES CITED: CLASS OF DOCUMENT: (OF)

ABSTRACT

Volume III has two sections. The first presents the detailed statistics of selected SMSA's which were, in turn, used to compile statistics in the Volume II groupings. The second contains the SMSA project profile data sheets for the metropolitan areas having multifamily construction activity; the data covers a spectrum of dwelling types. Each of number of living units and dwelling types (e.g. low or high rise; 3 and 4 living units). Most of the data analysis is presented in statistical form so as to facilitate its application to marketing studies, design calculations for heating/cooling loads, land requirements, cost trade-offs and the related requirements for other data.

TITLE: Public Utility Regulation: Potential and Problems for Modular Integrated Utility System (MIUS) Ownership

AUTHOR(S): R.J. King

DATE OF ISSUANCE: 1973

DOCUMENT PREPARED BY: L.B.J. School of Public Affairs; University of Texas at Austin

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: L.B.J. School/NASA-JSC

OTHER IDENTIFICATION: EZ/JC-74-148

TOTAL PAGES: 80 TOTAL REFERENCES CITED: 17 CLASS. OF DOCUMENT: (OF)

ABSTRACT

Anyone wishing to provide the many services incorporated into a MIUS will be confronted with many governmental regulations and requirements. The degree of such regulation depends on the character of MIUS and its customers, the method of operation and owner(s). The following basic questions are addressed by this report: What is meant by a public business and what requirements are public businesses obliged to fulfill? How much regulation can be avoided or when is it unavoidable? Who can best own and/or operate a MIUS and under what conditions of regulation?

Part I covers the general history of the regulation of businesses affecting the public. It attempts to define certain legal or constitutional regulation limits so that, in the future, they can be applied to cases which are as yet unforeseen.

Part II is divided into three sections dealing with regulation at the Federal, state and local levels which will directly affect MIUS ownership. Primarily it concentrates on particular problems which are only imposed under specific circumstances which may be controlled. It is the goal of this report to recommend what type or class of owner can best own and/or operate a MIUS under the various circumstances considered.

Basically this report is concerned with two classes of owner/operators, namely private developers and public utilities. Private developers are defined as private individuals or corporations whose major business is other than the provision of the MIUS type services usually furnished by public corporations. The report outlines the possible levels of regulation which may be imposed on private developers as certain features are added to his MIUS services and will suggest ways to avoid "public" classification and the resulting regulation.

[NOTE: This report was sponsored by the University of Houston at the request of the Director of Administration and Program Support at NASA's JSC.]

TITLE: Economic Analysis of MIUS and Conventional Utility Systems in Minneapolis, Washington, D.C., Houston, and New York City

AUTHOR(S): W.C. Rochelle; R.D. Stallings

DATE OF ISSUANCE: 10/73

DOCUMENT PREPARED BY: Lockheed Electronic Co., Inc.; Aerospace Systems Div.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC/L.E. Co., Inc.; TM 3070

OTHER IDENTIFICATION: LES-ASD 1197; Project No. 3375; Contract No. NASA 9-12200

TOTAL PAGES: 84 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This report covers an economic analysis used to determine the costs for constructing and operating a MIUS intended to provide utility services for five sizes of garden-level apartment complexes. For each system, four locations were considered, namely; Minneapolis, Washington, D.C., Houston and New York City. For comparison purposes, the cost of providing utility services by conventional means was also determined.

Included in the study were the effects of varying the prime-mover size and their number, fuel/electricity/solid-waste disposal/water/sewage-rates, and city cost indexes. The data generated were used in determining yearly cash flow, and in performing a profitability analysis for each complex size and each location.

The results indicate a savings in the yearly cost of utilities (O.&M., interest, depreciation and income taxes) for a MIUS - over a conventional system for New York City and Washington having complex sizes greater than about 180 and 480 units, respectively. For Houston and Minneapolis, it does not appear possible to have a savings for the garden-level apartment complexes.

TITLE: Preliminary Environmental Statement on the Use of MIUS in a Model New Community

AUTHOR(S):

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION:

TOTAL PAGES: 110 TOTAL REFERENCES CITED: 23 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This document serves as a Preliminary Environmental Impact Statement dealing with a model of a new community and a set of models of MIUS(s) which support this community. The impact of the community on the existing environment and infrastructure are evaluated together with the environmental effects of supporting the community with a MIUS. [NOTE: For this design study, the community is assumed located in the Washington, D. C. area.]

The major areas discussed are:

(1) Project Summary and Description
(2) Regional Growth Trends
(3) MIUS Locations, Descriptions and Phasing
(4) Ecological Information; Inventory and Synthesis
(5) Design Concept and Land Use
(6) Management of Environmental Impacts
(7) Societal Factors Bearing on the Project
(8) Fiscal Impact
(9) Environmental Effects Requiring Research
(10) Probable Adverse Environmental Effects Which Cannot Be Avoided
(11) Alternatives to Proposed Actions
(12) The Relationship Between Short-Term Uses of the Environmental and the Maintenance of Long-Run Productivity
(13) Irreversible and Irretrievable Commitment of Resources, as a Result of the Proposed Action

TITLE: MIUS Garden Apartment Size and Location: Parametric Study

AUTHOR(S): W.C. Rochelle et al (L.E. Co., Inc.); A.E. Brandli et al (USPO)

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: NASA-JSC/Lockheed Electronics Co., Inc.

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: L.E. Co., Inc./NASA-JSC

OTHER IDENTIFICATION: NASA-MIUS Program Working Paper JSC 08098; 73-EZ3-001

TOTAL PAGES: 164 TOTAL REFERENCES CITED: 4 CLASS. OF DOCUMENT: (OF)

ABSTRACT

Results are given for a MIUS parametric analyses of garden-level apartments. Five sites in the United States were considered, encompassing a wide range of climatological data and geographical locations, namely, Houston, Washington, D.C., Denver, Seattle and Minneapolis. Four sizes of apartment complexes (300, 648, 1720 and 3000 units) were investigated, assuming the use of diesel engines or gas turbines or steam-power plants as prime movers. The best MIUS for each complex was found to be composed of: 1) a boiler for its heat source, 2) a diesel prime-mover plus generator for electrical energy, 3) an incinerator for waste burning and 4) a "floating ratio" of absorption/compression air conditioning. The study indicated annual energy savings, for the best MIUS, of nearly 30% over the conventional (commercial) power source.

Another finding was that the Northern climates were better for construction of a MIUS. There was no clear indication as to which size complex would be preferable since such preference is largely dictated by the overall efficiency of the off-the-shelf diesel prime movers which are compatible with each complex size.

The remainder of this report presents details of the MIUS concept, the method of analysis used (including a short description of the ESOP Program), study criteria and a discussion of results. Appendices are included which primarily deal with the detailed results of energy and cost savings, seasonal information and input data.

TITLE: Heating and Air Conditioning Loads on Community Buildings

AUTHOR(S):

DATE OF ISSUANCE: 8/21/73

DOCUMENT PREPARED BY: Lockheed Electronics Co., Inc.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC AMD/069

OTHER IDENTIFICATION: 820812201

TOTAL PAGES: 77 TOTAL REFERENCES CITED: 1 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The heating and air conditioning load (on 16 buildings in a planned community which was located in the Washington, D.C. area) have been plotted by the CALCOMP Potter, based on calculations obtained by using the loads portion of the ESOP. The building types included: 1) single residences, 2) elementary school, 3) townhouse, 4) garden-level apartment complex, 5) 10-story high-rise apartment complex, 6) mid-school, 7) high school, 8) high-rise office building, 9) recreation area, 10) local shopping center, 11) hospital, 12) regional mall, 13) 20-story high-rise apartment complex, 14) college, 15) low-rise inn and 16) high-rise inn. The loads shown for single family residences are the total loads for 713 residences.

Heating and cooling loads were plotted for each building for a 24-hour period for the following seasonal cases: 1) winter-mean temperature; 2) winter-2σ low temperature and no cloud cover; 3) winter-2σ low temperature and full cloud cover; 4) spring-mean temperature; 5) summer-mean temperature, 6) summer-2σ high temperature and no cloud cover; 7) fall-mean temperature. The mean temperature cases correspond to the following percentages of cloud cover: 1) winter-58%, spring-55%, summer-51% and fall-47%. In addition to the load plots, input ESOP data are included for each case.

TITLE: Economic Evaluation of Total Energy; Guidelines

AUTHOR(S):

DATE OF ISSUANCE: 7/73

DOCUMENT PREPARED BY: Decision Sciences Corp.

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB 228 683

OTHER IDENTIFICATION: HUD-DSC-2; HUD Contract No. H-1776

TOTAL PAGES: 53 TOTAL REFERENCES CITED: 6 CLASS. OF DOCUMENT: (P)

ABSTRACT

The report describes a computer simulation approach leading to the development of a set of graphs which greatly simplifies the evaluation of T.E. systems for residential projects. The information required to carry out this type of evaluation is readily available in the early stages of project planning. The required input information is simply:

1) Geographic Region.
2) Project Size; e.g., the number of dwelling units.
3) Gas Cost; e.g., in cents per thousand cubic feet (¢/MCF).
4) Oil Cost; e.g., in cents per gallon (¢/gal.).
5) Purchased Electricity Cost; e.g., in cents per kilowatt hour (¢/KWH).

The basic evaluation procedure is a simple five-step process. It has been developed so that people with little technical training will be able to use the previous information to quickly obtain a preliminary project estimate of T.E. economic feasibility. Based on the preliminary indication of T.E. feasibility, a decision can then be made as to whether a full-scale engineering feasibility study should be undertaken. A number of secondary factors which may influence the results for a particular project are also discussed. These secondary factors can be used to correct the initial results determined via the five-step evaluation procedure.

TITLE: Economic Evaluation of Total Energy; Technical Report

AUTHOR(S):

DATE OF ISSUANCE: 7/12/73

DOCUMENT PREPARED BY: Decision Sciences Corp.

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB 228 893

OTHER IDENTIFICATION: HUD-DSC-1; HUD Contract No. H-1776

TOTAL PAGES: 481 TOTAL REFERENCES CITED: 33 CLASS. OF DOCUMENT: (P)

ABSTRACT

The purpose of this report is to discuss the analysis methodology used to develop Total Energy (T.E.) economic evaluation guidelines. Such guidelines are intended to enable a user to obtain a preliminary estimate of T.E. feasibility prior to a full-scale engineering feasibility study. These guidelines are separately published as HUD-DSC-2. The discussion of this methodology in the present report includes an identification of the critical assumptions and a summary of intermediate results which are not included in HUD-DSC-2.

The report is organized into seven major sections. Section I, "Introduction", covers the general overview and background of the document. Section II, "Information Base and Assumptions", serves as a central source of the data required for economic evaluation of T.E. systems. The design methodology for both conventional and total energy systems is presented in Section III, "Energy System Design Methodology and Results", along with a description of the many energy systems which were synthesized and evaluated during the study.

Computer simulation analysis was used in the study to evaluate energy system designs and determine energy demand and consumption levels. The computer simulation analysis process is decribed and simulation results are presented in Section IV, "Energy System Performance Evaluation".

"Economic Evaluation Methodology and Results" are presented in Section V. Capital cost and operating cost information is presented. Final results show the internal rate of return as a function of energy costs, climate and project size.

TITLE: MIUS Performance Study for 300, 648, 1720, and 3000 Unit Garden-Level Apartment Complexes

AUTHOR(S): W.C. Rochelle; et al

DATE OF ISSUANCE: 5/73

DOCUMENT PREPARED BY: Lockheed Electronics Co., Inc.; Aerospace Systems Div.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: L.E. Co., Inc.; TR 3003

OTHER IDENTIFICATION: LEC 0315; Project No. 3377; Contract No. NAS 9-12200

TOTAL PAGES: 168 TOTAL REFERENCES CITED: 11 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The report contains the results of a MIUS parametric analysis for garden-level apartments. Five U.S.A. sites (with unique climatological data and geographical locations) were studied, namely: Houston; Washington, D. C.; Denver; Seattle; Minneapolis. Apartment complexes with 300, 648, 1720 and 3000 units were investigated in which diesel engines, gas turbines and steam-power plants were each assumed to be the prime movers.

Within the scope of this study, which essentially considered only energy consumption, the following conclusions were reached:

1) For maximum energy savings, MIUS construction is more favorable in a cold climate than in either a warm or mild climate;

2) Energy savings per apartment are relatively independent of apartment complex size;

3) Energy savings are primarily dependent on the overall efficiency (i.e., electrical efficiency plus waste-heat recovered) of the prime mover and secondarily on climate;

4) For the MIUS configurations which were evaluated, the diesel prime movers appear to have lowest energy consumption.

It was concluded that the best MIUS for each complex would be composed of: 1) a boiler for heat source, 2) a diesel prime mover for electrical energy, 3) an incinerator for waste burning and 4) a floating ratio of absorption/compression air conditioning. The best MIUS was found to have annual energy savings of $\sim$ 30% over the conventional/commercial power source.

TITLE: Economic Techniques for Evaluation of Alternative Utility Service Systems: An approach for the comparison of a MIUS to a conventional utility service system

AUTHOR(S): M.H. Grannatt, 3rd

DATE OF ISSUANCE: 5/25/73

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NBS

OTHER IDENTIFICATION: "Working Paper"

TOTAL PAGES: 28 TOTAL REFERENCES CITED: 1 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This paper focuses on three issues: 1) the data necessary to conduct an analysis; 2) the proper techniques to employ that will assure correct/consistent analyses which are sensitive to the viewpoints of various "decision-makers" such as utilities companies, consumers, developers, etc.; 3) recommendations for additional economic analysis that should help to isolate problem areas, prior to their becoming unresolved or difficult to handle.

[NOTE: This "working paper" was written for submission to the IUSB's Task Force on Economic Feasibility and is based in part on the output from workshops on Economic Techniques held at HUD and NBS, in May 1973. The paper's recommendations represent the opinions of economists in NBS's Building Economics Section but such opinions are not necessarily those of others attending the conferences.]

TITLE: The Effect of Stage Construction in the Cost of District Heat to the Hypothetical Reference City Described in ORNL-HUD-14

AUTHOR(S): H.P. Payne

DATE OF ISSUANCE: 1/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: ORNL; ORNL-HUD-MIUS-10

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72 (Research)

TOTAL PAGES: 12 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This memorandum estimates heating costs for a spectrum of assumptions which cover the initial size and growth pattern of the hypothetical reference city (of ∿ 400,000 people) described in a report, ORNL-HUD-14, entitled "Use of Steam Electric Power Plants to Provide Thermal Energy to Urban Areas." Simultaneous completion of the dual-purpose power plant and the large city were assumed for purposes of cost estimates in said report.

The results of these estimates indicate that if as little as 20% of the city were completed at the same time as the dual-purpose plant, and that if the city grew to full size over a period of 10 to 20 years, then the price of district heat would not be greatly increased over that for a city whose completion coincided with that of the dual-purpose plant. For smaller initial city sizes, such as might be served by MIUS, the cost of starting with a large dual-purpose plant is shown to be much higher than that for the original simultaneous completion assumption.

TITLE: Total Energy Systems, Urban Energy Systems, Residential Energy Consumption: Federal Council on Science and Technology
AUTHOR(S):

DATE OF ISSUANCE: 10/72

DOCUMENT PREPARED BY: F.C. on S.&T. Committee on Energy Research and Development Goals Subpanel
RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-221-374

OTHER IDENTIFICATION: Contains reprints of NBS Report 10402 & NBS Special Publication 361, Vol. 1, pp. 419-430; these are abstracted separately in this list.
TOTAL PAGES: 353 TOTAL REFERENCES CITED: 76 CLASS OF DOCUMENT: (P)

ABSTRACT

This print is the product of a technology evaluation effort by three subpanels of the FCST Committee on Energy Research & Development. These subpanels, led by HUD, investigated Total Energy Systems, Urban Energy Systems and Residential Energy Consumption.

The report is largely made up of the three detailed subpanel reports. The subpanel report on Total Energy Systems, chaired by NBS, contains Task Submittals by individual subpanel participants. These include a Task Submittal from NBS dealing with Total Energy, refrigeration technology, insulated heat distribution, energy storage, R&D needs, and evaluation of Total Energy. Other Task Submittals deal with technical problems (Gamze, Korobkin and Caloger), socio-legal problems (Edison Electric Institute), market potential (ORNL), research and development required (Surndstrand Corp.).

The subpanel reports on Urban Energy Systems (ORNL) and Residential Energy Consumption (Hittman Associates) are included along with supplementary reports from the American Gas Association, Electric Energy Association and NBS.

TITLE: NASA Report on Housing Development - A Study for the President's Domestic Council, Volume 1 of 2

AUTHOR(S):

DATE OF ISSUANCE: 9/16/71

DOCUMENT PREPARED BY: NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION:

TOTAL PAGES: 37 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The National Aeronautics and Space Administration (NASA) aerospace team has extensive capabilities in systems engineering, environmental control, water supply, waste management, materials, structures, habitability, and electrical power generation and distribution, which are directly applicable to many present-day housing problems. It is felt that these talents can enhance the Department of Housing and Urban Development (HUD) activity. Accordingly, a program is proposed in which aerospace management techniques, systems engineering, and aerospace hardware technology will be applied to the design of housing. The goal of the program is to assist HUD in the development of improved housing systems aimed at natural resource conservation, pollution reduction, and enhanced fire and personal safety. This report also illustrates how this space technology and experience could be applied to develop new housing concepts which have the potential to decrease the domestic use of water and electrical power, to decrease domestic gaseous pollution, to reduce the burden on central sewage (wastewater) treatment plants, and thus to minimally impact the community utilities and the national ecology.

TITLE: NASA Report on Housing Development - A Study for the President's Domestic Council, Volume 2 of 2

AUTHOR(S):

DATE OF ISSUANCE: 9/16/71

DOCUMENT PREPARED BY: NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION:

TOTAL PAGES: 81 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (OF)

ABSTRACT

To delineate the manner in which NASA might contribute to the solution of national problems of natural resource conservation, pollution abatement, and household safety as related to housing, a design for an apartment complex has been developed as an illustrative example with these specific problems considered. The example apartment complex contains approximately 500 apartment units and would be intended for construction in an area in which a substantial increase in the public utility requirements would have a serious impact on the surrounding urban environment

This volume presents one example of a design approach for providing housing for 500 families in a manner which would minimize the impact on the environment and the demand for natural resources, yet increase the safety and durability aspects of the household. It is shown in the example that "integrated" water conservation and reprocessing concepts can reduce the volume of municipal water required for household use by 94 percent and yet not impose a hardship of restricted use on the residents. Also shown is that local waste incineration and electrical power generation will yield advantages. A preliminary economic assessment of this integrated utility system shows that, although the initial installation costs are increased by approximately $600,000 and the annual maintenance costs are also greater, the annual operating savings (compared with present-day costs) to the consumer make the integrated concept economically practical.

TITLE: Thermal Effects of Various Air-Conditioning Methods Used in Conjunction with an Electric Power Production and District Heating Facility

AUTHOR(S): M.E.Lackey

DATE OF ISSUANCE: 2/71

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCES; ACCESSION NO.: NTIS; ORNL-HUD-13

TOTAL PAGES: 47 TOTAL REFERENCES CITED: 4 CLASS. OF DOCUMENT: (P)

ABSTRACT

This study was conducted for HUD to determine the effects on thermal energy requirements, waste heat utilization, and waste heat disposal of an energy plant that, in addition to its other functions, is designed to supply energy for air conditioning.

Three steam cycles that encompass the range of cycles used with fossil-fired plants presently in commercial operation were considered as energy sources. The steam cycles considered are typical of the best large fossil-fueled plants in operation, advanced nuclear reactors under development (such as the liquid-metal fast breeder, advanced gas-cooled reactors, and molten-salt thermal breeder), and the light-water reactors presently in operation.

Two locations of the refrigeration equipment relative to the reactor site were used to determine the effects on the reactor site waste heat disposal requirements. One of the locations considered was at the reactor site with chilled water exported to the remote consumption sites. The other location considered was at the many consumption sites; this required that the energy for the operation of the refrigeration equipment be exported from the reactor site in the form of steam or hot water in a district heating system.

Calculations were made of the energy required for air conditioning and the waste heat disposal impacts of the various energy source and refrigeration cycle combinations.

TITLE: Use of Steam Electric Power Plants to Provide Thermal Energy to Urban Areas

AUTHOR(S): A.J.Miller; et al

DATE OF ISSUANCE: 1/71

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-14

TOTAL PAGES: 222 TOTAL REFERENCES CITED: 75 CLASS. OF DOCUMENT: (P)

ABSTRACT

The purpose of this study for the Department of Housing and Urban Development was to determine the feasibility of providing thermal energy, as well as electricity, to urban areas from steam-electric power plants. The economic feasibility is based simply on electricity and heat costs; no cost credits were taken for reductions in environmental pollution. The considerations of resource conservation and environmental improvement were principal elements in this study.

Heat-electric systems, their efficiencies, and heat rejection characteristics were examined first. The consumption of heat in several applications is then discussed in some depth. Information is presented on the siting, reliability and costs of nuclear stations and on the design and cost of hot-water piping systems. Finally, all this information is integrated in a highly conceptual "new city" with light-water reactors in an "energy center" supplying heat and electricity for the city needs.

An analysis was made of a 1980 reference city of 389,000 people with a climate similar to that of Philadelphia. Variations in this base case were examined with respect to city size, distance from energy center and climate.

This study has shown that with coordinated planning of energy centers and new cities, it would be feasible to provide thermal energy from steam-electric power plants to urban areas. With nuclear plants the siting with respect to nearby populations could be in accordance with present-day practice.

4. TECHNOLOGY EVALUATION REPORTS

TITLE: MIUS Wastewater Technology Evaluation

AUTHOR(S): J.C.Poradek

DATE OF ISSUANCE: 5/76

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; NASA TM X-58130

OTHER IDENTIFICATION: JSC-09304

TOTAL PAGES: 125 TOTAL REFERENCES CITED: 281 CLASS. OF DOCUMENT: (P)

ABSTRACT

The key to process selection in the wastewater treatment area is the general requirement for operation in close proximity to densely populated areas, and the integration of wastewater treatment with other MIUS subsystems. Such integration lends itself to some form of reuse of the treated wastewater, to compact systems with reduced manpower requirements and to use of waste outputs of other processes within the MIUS.

The paper is intended to be an evaluation of the present state-of-the art for wastewater treatment, as applicable to a MIUS. The opinions presented herein are those of NASA's USPO and are based on an 18 month review of various processes, which are examined with respect to several MIUS applications including: garden and high-rise apartment buildings, shopping centers, hospitals, office buildings and a community mixture.

This document attempts to determine the worth of the various processes and process groupings with respect to MIUS applications, rather than to survey such processes and then allow the reader (who has perhaps only a limited understanding of the integration or the interconnected aspects of MIUS) to make this own evaluation. With this in mind, the authors state that: new technology will (probably) change the present document's conclusions, some processes may be slighted and others perhaps overemphasized and that each decision can be reexamined. Nevertheless, they feel that the information presented is worthwhile.

TITLE: MIUS Technology Evaluation: Thermal Energy Conveyance

AUTHOR(S): J.T. Meador

DATE OF ISSUANCE: 5/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.; NTIS; ORNL/HUD/MIUS-22

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72 (Research); ERDA 40-333-72

TOTAL PAGES: 95 TOTAL REFERENCES CITED: 39 CLASS. OF DOCUMENT: (P)

ABSTRACT

Thermal energy produced by MIUS can be distributed at moderate temperatures, with low-pressure steam or water most adaptable as energy transfer media. This report discusses the types, cost and performance of several types of conduits for thermal energy conveyance. Conduits, applicable to MIUS water conveyance of thermal energy, are evaluated from data on characteristics and economic factors related to district heating and cooling systems for housing developments.

Types of conduit that are most prevalent, both in older systems that are still in operation and in more recent installations, are illustrated and discussed. Information on long-term performance is included, where available, from inspection reports onvarious existing systems.

Materials of construction are considered according to the demands of the three major requirements of a conduit. These requirements are: (1) conveyance of the heat transfer media, (2) insulation from thermal losses and (3) encasement to protect the pipe and insulation from both external loads and the underground environment.

Illustrative analyses are presented that include most of the design parameters involved in thermal conveyance so as to put in perspective the most important features of such systems. Prefabricated conduits made of mild steel with corrosion resistant coatings, or those made of fiberglass reinforced epoxy, seem most likely to meet the requirements of a MIUS for "low-temperature" hot water service. Conduits made of asbestos-cement, or a thermoplastic such as polyvinyl chloride, are considered adequate and less expensive for chilled-water service.

TITLE: MIUS Technology Evaluation: Preliminary Subsystem Recommendations for Near Term Concepts

AUTHOR(S): G. Samuels; W.J. Boegly, Jr.

DATE OF ISSUANCE: 5/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-17

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72 (Research); ERDA 40-333-72

TOTAL PAGES: 54 TOTAL REFERENCES CITED: 18 CLASS. OF DOCUMENT: (P)

ABSTRACT

Various considerations, based on a series of technology evaluations and model analyses, are discussed and used to select suitable subsystems as candidates for near-term MIUS application. These subsystems are to provide dwelling units plus associated commercial facilities with electricity, space heating and cooling, domestic hot water, potable water, fire-protection water and liquid/solid waste disposal.

Internal-combustion piston engines (gas, diesel or dual fuel) are recommended for the prime movers, with a final selection dependent on the availability and dependability of fuel supplies. The best choice for the heat-recovery system will probably be a 240°F to 250°F system suitable only for single-stage absorption chillers. Heat rejection from the system may be by cooling tower or to a pond. A pond, in addition to serving as the heat rejection system, may be used as a source of water for fire protection, to store storm water and possibly to serve as a solar energy collector and water supply for a water source heat-pump system.

The final selection of the various utility subsystems of a MIUS installation will depend on climate, population density and size, consumer mix or demand, local geology, and local resources such as water, natural gas and land.

TITLE: MIUS Technology Evaluation: Water Supply and Treatment

AUTHOR(S): A.L. Compere; et al

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-21

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72 (Research); ERDA 40-333-72

TOTAL PAGES; 139 TOTAL REFERENCES CITED: 118 CLASS. OF DOCUMENT: (P)

ABSTRACT

Water treatment is one of the services which may be performed within a MIUS, assumed to serve from 100 to 3000 dwelling units and their associated facilities. The relatively small size and self-contained MIUS creates special situations with respect to the application of innovative water treatment and distribution technologies. This report evaluates current and future technology on the basis of its suitability for application as part of a MIUS development with emphasis on the present state of the art.

The conventional technology evaluated in this report is, for the most part, appropriate to the treatment of the surface water supplies; in fact, the small pre-engineered plants described are designed primarily for surface water treatment. Although commercially available pre-engineered plants would be suitable for treatment of many surface water supplies, separate evaluation should be made of the degree of treatment necessary for each MIUS.

In some situations, separate components (rather than a complete pre-engineered plant) may be most appropriate when designing a MIUS supply. A MIUS potable water treatment system might include disinfection, coagulation and flocculation, solids separation and filtration. These separate processes are discussed and evaluated.

Overall water supply systems considerations are also discussed. Among the points discussed are water source quality, treatment plant complexity, personnel skill levels, economies of scale, water transmission costs, fire protection water supply, and economic evaluation considerations.

TITLE: Total Energy Systems for Buildings (Citations from the Engineering Index Data Base)

AUTHOR(S): A.S.Hundermann

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Author/NTIS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE: ACCESSION NO.: NTIS; PS-76/0275

OTHER IDENTIFICATION:

TOTAL PAGES: 148 TOTAL REFERENCES CITED: 55 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Technology for total energy systems as applied to residential complexes and industrial plants is discussed. These systems employ a primary source of energy, such as oil, natural gas, or solar heat to provide comprehensive energy requirements in the form of light, heating, cooling, air conditioning, drying, process heat, and power for an industrial plant or for a commercial or public building. Included are schemes for electricity generation, waste-heat recovery, and direct power drive of mechanical equipment coupled to a prime mover. Modular Integrated Utility Systems (MIUS) are covered, including studies on gas turbines for use in MIUS systems. Computerized simulation studies are also discussed. (Contains 55 abstracts.)

TITLE: Total Energy Systems for Buildings (Citations from the NTIS Data Base)

AUTHOR(S): A.S.Hundermann

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Author/NTIS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PS-76/0274

OTHER IDENTIFICATION: Update of NTIS PS-75/215 COM-74-11138 and COM-73-11582, See also page 77 of this listing.

TOTAL PAGES: 137 TOTAL REFERENCES CITED: 46 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Technology and economics associated with total energy systems are discussed. These systems employ a primary source of energy, such as oil, natural gas, or solar heat to provide comprehensive energy requirements in the form of light, heating, cooling, air conditioning, drying, process heat, and power for an industrial plant or for a commercial or public building. Included are schemes for electricity generation, waste heat recovery, and direct power drive of mechanical equipment coupled to a prime mover. Abstracts primarily pertain to Modular Integrated Utility Systems (MIUS) technology as applied to residential complexes; a few abstracts deal with MIUS technology for military facilities and commercial buildings. Topic areas cover social costs, energy conservation potential, and the use of solar energy in total energy systems. (Contains 46 abstracts)

TITLE: Investigation of Storage System Designs and Techniques for Optimizing Energy Conservation and Integrated Utility Systems: 3 Volumes

AUTHOR(S):

DATE OF ISSUANCE: 3/10/76

DOCUMENT PREPARED BY: Battelle Columbus Laboratories (BCL)

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC; NASA 9-14628

OTHER IDENTIFICATION: T-1139,3; Contract No. NASA 9-14628

TOTAL PAGES: 387 TOTAL REFERENCES CITED: 315 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This is a three volume set comprising the final report on the entitled study. The research program was sponsored by the USPO. The volumes are entitled: I-Executive Summary; II-Application of Energy Storage to IUS; III-Assessment of Technical and Cost Characteristics of Candidate IUS Energy Storage Devices.

The potential for further improving performance and reducing the cost of IUS installations through the use of energy storage devices was examined and the results are summarized in this report. Candidate energy storage concepts in the general areas of thermal, inertial, superconducing magnetic, electrochemical, chemical and compressed air storage were assessed. The storage of thermal energy as the sensible heat of water was selected as the primary candidate or near-term application to IUS.

Volume II includes: 1) descriptions of the two (no-storage) IUS baselines utilitized in the study; 2) discussions of the chosen assessment critieria and selection framework; 3) a summary of the rationale for selecting water storage for near-term application to IUS; 4) discussion of the integration aspects of water storage systems; 5) an assessment of IUS, with water storage, in alternative climates.

Volume III contains monographs which discuss each of the energy storage categories assessed in the study. It summaries the basic theory of operation of each of the categories and contains a broad list of references which serve as a guide to the information currently available.

TITLE: MIUS Technology Evaluation: Comparison of Trenching Costs for Separate and Common Trenching

AUTHOR(S): J.T.Meador

DATE OF ISSUANCE: 2/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-15

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 81 TOTAL REFERENCES CITED: 10 CLASS.OF DOCUMENT: (P)

ABSTRACT

Estimates are reported for the combined costs associated with excavating, backfilling and compacting several classes of soil in utility trenches. These costs include estimates for the earth moving equipment and for operating labor. Published cost rates are applied to applicable trench sections in order to estimate total earthwork costs. The derived trenching cost data are then used to estimate the possibility of savings in cost through application of common trenching methods to several configurations of one section of mains, sized to meet the demands of a large garden apartment complex served by a MIUS. [Note: The assumed trench cross sections comply with Occupational Safety and Health Administration (OSHA) Standards.]

The results indicate that earthwork costs could be reduced by about one-third through use of a common trench with moderately compact spacing between utilities rather than by providing separate trenches for each type of utility. Closer spacing would lead to lower accessibility for maintenance, whose costs are not included in this study. Potential savings were small or negligible in installations having large spacing between utility service mains to provide ready accessibility for maintenance.

TITLE: MIUS Technology Evaluation: Compression Refrigeration Systems for Air Conditioning

AUTHOR(S): C.J. Claffey; C.L. Segaser

DATE OF ISSUANCE: 2/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-19

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 43 TOTAL REFERENCES CITED: 19 CLASS. OF DOCUMENT: (P)

ABSTRACT

This evaluation describes the current status, performance and costs of the types of compression refrigeration equipment considered suitable for use in MIUS to provide residential space cooling.

The technology of compression-type refrigeration for air conditioning systems is well established. Its widespread application in warmer climates attests to its general acceptance is a reliable means of providing comfort air conditioning. The existence of the many competing manufacturers assures a wide selection of machines to suit any air conditioning application. With the exception of some "room-size" air conditioners, compression machines operate in an efficient manner .. significant percent of the small-capacity machines are also notably efficient.

The report summarizes the fundamental refrigeration cycle and the various types of mechanical refrigeration compressors and their driving prime movers. The selection of refrigerant fluid is covered. Efficiencies, performance values and energy flow are discussed. Capital, operating and maintenance costs are given. Manufacturers of compression-type air conditioning equipment and their products are listed.

TITLE: Energy Conservation in the Single Family House (Task Report)

AUTHOR(S):

DATE OF ISSUANCE: 1/76

DOCUMENT PREPARED BY: Clovis Heimsath Associates, Inc.(Houston, Tx.)

REFERENCE SOURCE; ACCESSION NO.: NASA JSC

PROCUREMENT SOURCE; ACCESSION NO.: NASA JSC

OTHER IDENTIFICATION: Contract No. NAS 9-14643

TOTAL PAGES: 56 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (OF)

[ABSTRACT]

A representative energy consumption model of a single family house was designed to analyze numerous energy conservation techniques for practical application within the near future. The baseline model was designed so that effects of construction in three climate zones could be analyzed for conservation practice cost effectiveness. For this study the effects of zoning, wall insulation changes, roof area reduction (single story to 2-story scheme), window area reduction, weather stripping, window orientation, and air lock entry vestibules were investigated. Summarization of the results indicate that very significant energy savings are possible with the single family house with some of the techniques analyzed. The energy model and methodology lend themselves to a more extensive analysis using additional energy conservation materials and techniques.

TITLE: MIUS Technology Evaluation: Thermal Energy Storage Materials and Devices

AUTHOR(S): C.L. Segaser

DATE OF ISSUANCE: 11/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-23

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 65 TOTAL REFERENCES CITED: 29 CLASS.OF DOCUMENT: (P)

ABSTRACT

The generation of electricity by an on-site power plant results in a considerable amount of waste-heat energy being released from the prime-mover/coolant system and from exhaust gases. A MIUS can effectively utilize such heat for domestic space and water heating and, with less efficiency, for domestic air-conditioning by use of an absorption chiller. If the amount of waste heat that can be recovered does not quite closely match the heat demand, excess heat must be rejected either to the environment or to be stored until it is required. A heat deficiency must be made up from said storage or an auxiliary heat-source such as a boiler. This report presents an evaluation for MIUS applications of the technologies relevant to the design of thermal energy storage (TES) devices and the selection of TES media.

Several TES materials are commercially available in large quantities, are relatively inexpensive, and have properties which make them suitable for consideration in a MIUS. The techniques for TES may involve the sensible heat of water or available nonporous solids or may utilize the latent heat of fusion of one of the available phase-change materials. (PCMs).

One can conclude that water is a logical choice for thermal energy storage in a MIUS based partly on the fact that water is a low-cost material. Also, because water is the most likely thermal energy conveyance medium between a MIUS district heating and cooling plant and the point of use, the TES containment unit can be a simple large district storage tank that does not require an intermediate heat exchanger.

TITLE: Wastewater Recycling and Water Conservation

AUTHOR(S): D.L. Brown; et al

DATE OF ISSUANCE: 11/75

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: National Sanitation Foundation, NSF Building, Ann Arbor, Michigan 48105;

OTHER IDENTIFICATION: Paper presented at 2nd National Conference on Individual Onsite Wastewater Systems

TOTAL PAGES: 9 TOTAL REFERENCES CITED: 3 CLASS.OF DOCUMENT: (PO)

ABSTRACT

The paper describes an alternative to the "traditional" approaches of supplying utility services to communities, including sewage treatment and disposal. This alternative has been developed by HUD under its MIUS Program. The MIUS program is formulating a limited-size, integrated concept for providing utility services to a community designed to conserve energy and natural resources. This paper summarizes the integrated concepts that have been identified for the wastewater treatment subsystem of a MIUS. These include waste-heat utilization, wastewater recycling and methane gas generation.

TITLE: Integrated Waste Management Systems - On site MIUS Application

AUTHOR(S): J.H. Rothenberg (HUD); W.R.Mixon; W.J.Boegly, Jr. (ORNL)

DATE OF ISSUANCE: 11/75

DOCUMENT PREPARED BY: Authors/HUD/ORNL

RESPONSIBLE ORGAIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Authors/AIChE

OTHER IDENTIFICATION: Paper presented at Institute's 68th Annual Meeting; Los Angeles, Calif.; 11/16-11/20, 1975

TOTAL PAGES: 22 TOTAL REFERENCES CITED: 12 CLASS. OF DOCUMENT: (OF)

ABSTRACT

A series of evaluation studies on the major components and subsystems of utility technologies applicable to MIUS has been completed as a part of the Program. Some of the more important general conclusions from these studies are discussed and each of the major utility subsystems of MIUS are examined with respect to their potential for integration with other subsystems and as to the advantages resulting from such integration.

The paper summarizes the following major areas of investigation: Electric-Thermal Subsystem; Solid-Waste Subsystem; Liquid-Waste Collection and Disposal; Potable-Water Treatment; Common Trenching for utilities; and Common Advantages of subsystem integration.

Results of the evaluations indicate that MIUS can meet many of the program objectives while providing services at about the same cost as alternative conventional utilities. Although MIUS is not proposed as a direct competitor (or even as a complete substitute) for conventional utilities, there are believed to be a significant number of applications for which MIUS would be of public benefit. It is expected that municipalities and utility companies, as well as private developers, would consider this option.

TITLE: The Annual Cycle Energy System

AUTHOR(S): H.C. Fisher

DATE OF ISSUANCE: 8/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: IEEE; 75CHO 983-7 TAB

OTHER IDENTIFICATION: Record of 10th IECEC; pp. 251-259; #759041

TOTAL PAGES: 9 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The Annual Cycle Energy System (ACES) is a residential and commercial space heating, air-conditioning and potable water heating system. The energy transfer utilizes an electrically driven heat-pump, which obtains its heat from water stored "in situ" in an underground insulated tank. The basis for the system is that water frozen during the winter heating season can be stored as ice and can provide air-conditioning in the summer.

The resulting annual COP (Coefficient of Performance) of the heat-pump can be as high as 5, since both heating and cooling outputs of the heat-pump are used; this concept relies on a heat balance around the structure on an annual basis. In 80% of the USA, the heating and cooling requirements are in (or can be brought into) balance for a well-insulated building.

Topics discussed in this paper include: 1) an analysis of the ice-freezing process, wherein calculations are compared to experimental test results; 2) the results of analysis on the heat leak into the ice storage tank; 3) the effect of latitude on the heat balance in the buildings as related to the size of storage tank, insulation of storage tank, supplemental solar panels and cost of operation; 4) a discussion of alternative ACES applications.

Cost calculations (based on a 9%, 20-year mortgage and associated costs and credits) are shown which indicate that the system breaks even when compared with ones using electric resistance heating and individual air conditioners, with electricity at about 2.5 to 3.5 cent/kWhr.

TITLE: Technology Survey of Electrical Power Generation and Distribution for MIUS Application
AUTHOR(S): W.L. Gill; T.E. Redding

DATE OF ISSUANCE: 7/75

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N75-31573

OTHER IDENTIFICATION: JSC-08661; NASA TM X-58127

TOTAL PAGES: 64 TOTAL REFERENCES CITED: 25 CLASS. OF DOCUMENT: (P)

ABSTRACT

This report describes likely electrical generation power systems for the MIUS program, divided into two classes: conventional and experimental. Conventional power systems include the use of Rankine, Brayton, and binary cycles, reciprocating internal combustion engines and electric generators. Heat-recovery apparatus associated with such conventional power systems and their supporting equipment are also discussed. Experimental power systems include: electrochemical setups, nuclear energy sources, thermionics, thermoelectricity, solar energy, magnetohydrodynamics plus hydroelectric, tidal, geothermal and wind power. Power distribution aspects are briefly discussed.

Steam and organic Rankine cycle systems, open-and closed-cycle gas turbines, diesel and natural gas engine/generators and fuel cells currently appear to be the most universally applicable power sources for MIUS.

Energy storage devices may be applicable for MIUS plants. These include: batteries, hydrogen/oxygen generators (i.e., water electrolysis) and heat storage devices.

TITLE: Feasibility Study of Solar Energy Utilization in Modular Integrated Utility Systems (Final Report)

AUTHOR(S):

DATE OF ISSUANCE: 6/30/75

DOCUMENT PREPARED BY: Arthur D. Little, Inc.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N-75-28518

OTHER IDENTIFICATION: A.D.L. Inc.; Report No. 78036/Contract No. NAS 9-14524

TOTAL PAGES: 186 TOTAL REFERENCES CITED: 2 CLASS. OF DOCUMENT: (P)

ABSTRACT

The study evaluated applications of solar energy in MIUS. The primary intent was to examine the potential performance of solar energy systems as elements of the major MIUS subsystems. Detailed interaction studies, and design iterations of the entire MIUS incorporating the solar thermal energy system, were excluded. The four major MIUS subsystems examined for solar energy applications were wastewater and solid-waste management, power generation,and HVAC.

A "Village Complex" MIUS, located in the Washington, D.C. area, was selected for use as a baseline system since extensive background information for it had been generated in past studies performed by the USPO. Load and performance requirements were determined for the major subsystems and their elements. Preliminary solar thermal-energy concepts were defined and described.

In considering non-technical issues such as public acceptance, architectural integration and institutional constraints, attention was directed to characteristics of solar energy peculiar to implementation in the MIUS. Two key issues were identifed: 1) economic competitiveness and 2) allocation of land usage. Recommendations are given for continued activities, with emphasis on situations that are specific to the needs and applications of MIUS.

TITLE: Study of Fuel Cell Powerplants with Heat Recovery (Final Report)

AUTHOR(S): J.M, King; et al

DATE OF ISSUANCE: 4/24/75

DOCUMENT PREPARED BY: Power Utility Div. of United Aircraft Corp.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: P.U.Div.; FCR-002/NASA-JSC

OTHER IDENTIFICATION: NASA Contract NAS 9-14220

TOTAL PAGES: 109 TOTAL REFERENCES CITED: 1 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The report shows that heat can be recovered from fuel cell powerplants by simply replacing the air-cooled heat exchangers in current designs with units which transfer the heat to an integrated utility system (IUS). A study of energy availability for a 40 KW powerplant showed that the total usable energy, at rated power, represents 84% of the fuel's lower heating value: 38% as electric energy, 24 as heat at temperatures suitable for absorption air conditioning and 22 as usable heat at lower temperatures. Total usable energy increases to 96% of the fuel's lower heating value for powerplants with ratings in the megawatt class. The effects of design variables on heat availability were shown to be small.

Additionally, design requirements were established for the heat recovery exchangers. Among other things, the characteristics of two candidate fuel cell coolants after exposure to fuel cell operating conditions were measured. The tests also disclosed that these coolants are acceptable for use in fuel cell powerplants.

A test program was defined to assess fouling and other characteristics of fuel cell heat exchangers, as needed to confirm heat exchanger designs for heat recovery. [NOTE: This report was prepared for NASA's JSC/USPO by the Power Utility Division of United Aircraft Corporation.]

TITLE: Annual Cycle Energy System (ACES) for Residential and Commercial Buildings

AUTHOR(S): H.C. Fischer

DATE OF ISSUANCE: 4/18/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: Author/ORNL

OTHER IDENTIFICATION: Workshop on Solar Energy Storage Subsystems for the Heating and Cooling of Buildings; Univ. of Va. April 18, 1975

TOTAL PAGES: 17 TOTAL REFERENCES CITED: 2 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The paper describes the Annual Cycle Energy System (ACES) as consisting of a residential and commercial, heating and air-conditioning system also providing for domestic hot-water. The energy transfer system utilizes a heat pump, which obtains its heat from water stored in an underground insulated tank. The water frozen in the tank during the winter heating season is used to provide air-conditioning in the summer.

The resulting annual COP of the heat-pump can be as high as 5 to 6, since both heating and cooling outputs of the heat-pump are used. This concept relies on a heat balance around the structure on an annual basis. The paper points out that in ∿ 80% of the USA, the heating and cooling requirements are in, or can be brought into, balance for a well-insulated building.

Topics discussed in this paper include: 1) an analysis of the ice-freezing process; 2) the results of analysis on the heat leak into the ice storage tank; 3) the effect of latitude on the heat in the building; 4) a discussion of alternative ACES applications.

Cost estimate calculations based on a 9%, 20-year mortgage and associated costs and credits are shown which indicate that the system breaks even when compared with ones using electric resistance heating and individual air conditioners, with electricity at about 2¢/kWhr.

TITLE: Technology Survey of Computer Software as Applicable to the MIUS Project

AUTHOR(S): B.E. Fulbright

DATE OF ISSUANCE: 3/75

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N75-21159

OTHER IDENTIFICATION: JSC-09213; NASA TM X-58159

TOTAL PAGES: 15 TOTAL REFERENCES CITED: 29 CLASS OF DOCUMENT: (P)

ABSTRACT

Computer simulations are necessary for MIUS development, design, demonstration and operation. Several existing programs that could be used, or modified slightly, for MIUS use are examined in this report.

This TM represents a first look at existing computer software that could be applied to a MIUS simulation. The report is not intended as a comprehensive list but as a survey of the available types of programs either from governmental or private sources. Included are brief descriptions of several programs and subprograms together with the areas of simulation to which they might be applicable. This survey has been conducted to familiarize cognizant personnel with such programs.

TITLE: SINDA Systems Simulator Computer Program for MIST Test Laboratory (4 Volumes)

AUTHOR(S): W.C. Rochelle; et al

DATE OF ISSUANCE: 3/75

DOCUMENT PREPARED BY: Lockheed Electronics Co., Inc; Aerospace Systems Div.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC/L.E. Co., Inc.; TM 5007

OTHER IDENTIFICATION: LEC 5521; Project Nos. 3375 & 3377

TOTAL PAGES: 854 TOTAL REFERENCES CITED: 18 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This document provides a program description of the SINDA systems simulator computer model as applied to the MIUS Integration and Subsystems Test (MIST) Laboratory. The document consists of: Vol. I - Engineering Description of Model; Vol. II - Programmer's Manual; Vol. III - User's Manual; Vol. IV - Test Case Analysis Report.

Vol. I contains a general technical description, including MIST equipment performance data used in the model and MIST sensor/SINDA nodal correspondence and modes of operation of the model. The basic details of the SINDA model are described, including piping and nodal network, equipment flow-rate and flow-rate and temperature logic, mixing valve control logic, loads logics and pressure prediction technique. This volume provides the model without the details of programming logic, user's input or program results.

Vol. II has the program listings for the SINDA/MIST model and other information of special interests to a programmer. This material includes a basic description of the SINDA Program, including general program logic differences between steady-state and transient models and flow chart. The program's network solution techniques are discussed, for both steady-state and transient models and the model's subroutines are presented.

Volume III presents the details of the SINDA/MIST computer program from the user's standpoint. Input data requirements, deck setup and output data features are described in detail. Core storage limitations are also discussed. A description of the input is presented, along with a discussion of all output.

The purpose of Volume IV was three-fold: (1) to illustrate the use of the model; (2) to show the types of output data; (3) to correlate results from the steady-state and transient features.

TITLE: Production of Gaseous Fuel by Pyrolysis of Municipal Solid Waste; Final Report

AUTHOR(S): T.H.Crane; et al

DATE OF ISSUANCE: 3/20/75

DOCUMENT PREPARED BY: Authors/Barber Colman Co.

RESPONSIBLE ORGANIZATION(S): NASA--JSC

PROCUREMENT SOURCE; ACCESSION NO.: B.C. Co./NASA-JSC

OTHER IDENTIFICATION: Contract No. NAS 9-14305; EZ/75-37

TOTAL PAGES: 66 TOTAL REFERENCES CITED: 10 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This report covers work done for JSC's USPO by the Resource Recovery Systems Division of the Barber-Colman Company. It evaluates the quantity and quality of fuel gas produced by an already-constructed solid waste pyrolysis system.

Pilot-plant tests were conducted on a simulated solid waste consisting typically of a mixture of 50% shredded newspaper, 5% wood waste, 3% polyethylene plastics, 10% crushed glass, 8% steel turnings and 24% water. All tests were conducted at 1400°F in a lead-bath pyrolyzer.

About 80% of the feed's organic content was converted to gaseous products: benzene, toluene and a medium-quality 500 Btu/cu. ft. fuel gas; 8% remained a partially pyrolyzed char and tars and 12% as water. The gaseous products contain over 90% of the energy inherent in the incoming waste. Less than 50% of the energy available in the products must be used as fuel to sustain the system. Actual system efficiency ranges from ∿50 to 70%, depending on the efficiency of utilization of the sensible heat of the flue gas from the pyrolyzer's radiant heaters.

Over 40% of the carbon in the feed is converted to benzene and toluene. In ten tests, benzene production exceeded 10% of the weight charged to the pyrolyzer; this represents a potential credit of ∿ $25 or more per ton of solid waste.

TITLE: ESOP (Energy Systems Optimization Program); Its Description and Comparative Analysis

AUTHOR(S): B.E. Fulbright (NASA-JSC); S.L. Ferden and R.D. Stallings (Lockheed Electronics Co.)

DATE OF ISSUANCE: 1/75

DOCUMENT PREPARED BY: Authors/NASA-JSC/L.E. Co.

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION: 1975 ASHRAE Transactions, Part 1, p. 25, (Abstract only). Presented at the ASHRAE (Atlantic City, N.J.) meeting of 1/75.

TOTAL PAGES: 11 TOTAL REFERENCES CITED: 24 CLASS. OF DOCUMENT: (OF)

ABSTRACT

Energy and cost savings can be realized by integrating various utility services (i.e., space heating and cooling, electrical power generation, solid waste disposal, potable water preparation and wastewater treatment) into a single unit which provides buildings or groups of buildings with these services. This paper presents a description of a computer program developed to support analyses of such an integration plus the results of the efforts of verification of this program. ESOP was developed to support MIUS. The program predicts energy requirements, equipment sizes and life-cycle costs of alternate methods of providing these utility requirements.

The references are intended to provide general background information to the interested reader and are not directly keyed to the text.

TITLE: Heat Value of Sludge

AUTHOR(S):

DATE OF ISSUANCE: 1974

DOCUMENT PREPARED BY: EPA

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NBS

OTHER IDENTIFICATION: Technical Brief

TOTAL PAGES: 6 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This Technical Brief first reviews the current wastewater sludge disposal procedures and then discusses the useful heat potentialities of such sludges.

It states that the heat-value of sludge depends on the amount of combustible elements such as carbon, hydrogen and sulfur present in the sludge. [NOTE: The combustible elements are chemically combined in the organic sludge as grease, carbohydrates and protein.] The combustible portion of sewage sludge has a BTU content about equal to that of lignite coal. However, when inert chemicals are used in the pretreatment steps, the weight of the sludge increases by about 10% and the heat content of the sludge is reduced accordingly.

TITLE: MIUS Technology Evaluation: Collection, Treatment and Disposal of Liquid Wastes

AUTHOR(S): W.J. Boegly, Jr.; et al

DATE OF ISSUANCE: 12/74

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-16

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 160 TOTAL REFERENCES CITED: 190 CLASS. OF DOCUMENT: (P)

ABSTRACT

The relatively small size, self-contained MIUS creates special situations for liquid waste collection and treatment technologies. This report evaluates current and future technology on the basis of its suitability for application to a MIUS but the emphasis is on the present state of the art. Technology evaluation is a continuing process for the MIUS program; this report summarizes the work done, as of July 1973.

Introductory material is presented on the quantities and composition of sewage that might be generated in housing complexes along with a discussion of water-saving devices. Pressure and vacuum sewers, as possible alternatives to the current use of gravity-flow sewerage systems, are discussed.

Individual unit processes that might be used in wastewater treatment and disposal are described and discussed along with flow sheets for systems producing effluents of various qualities and at various costs plus related information on electrical and thermal requirements. An analysis of commercially available, small, sewage treatment plants using the various unit processes is included. Costs of the plants are given, and a method is outlined for estimating the relative economy of on-site processing as compared with transporting the sewage to an existing treatment plant. Finally, possible schemes are discussed for the reuse of treated liquid waste effluents from MIUS on-site plants.

New wastewater systems have been developed that provide effluents of high enough quality to be reused for fire protection, irrigation, cooling, recreational purposes, etc. Direct recycling of effluents for use as potable water is feasible but needs further study.

TITLE: Pyrolysis System Evaluation Study (Final Report)

AUTHOR(S):

DATE OF ISSUANCE: 12/74

DOCUMENT PREPARED BY: Hamilton Standard Div. of United Aircraft Corp.

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION: Contract No. NAS 9-14305; EZ/75-356

TOTAL PAGES: 589 TOTAL REFERENCES CITED: 40 CLASS. OF DOCUMENT: (OF)

ABSTRACT

Hamilton Standard, a Contractor for NASA's research and technology effort for the USPO, conducted an evaluation of two different pyrolysis concepts intended to recover energy from solid waste in order to determine their merits for inclusion as part of an Integrated Utility System (IUS). The two concepts were (1) a Lead Bath Furnace Pyrolysis System being designed and tested by Barber Colman Company and (2) a Slagging Vertical Shaft-Partial Air Oxidation Pyrolysis System demonstrated by the Urban Research and Development Corporation (URDC). Fuel gases which can be used to offset primary fuel consumption are produced from both IUS solid waste and sewage sludge in addition to sanitary disposal of the waste. However, the reported results clearly indicate that the URDC concept is a better pyrolysis system for development and integration into an IUS.

The study evaluated the thermal integration of each concept, as well as the economic impact on the IUS resulting from such integration.

The major portion of this final report summarizes the pertinent results of the study and the general logic behind said results. Detailed technical and economic discussions supporting the study summary are organized by topic and are presented in the Appendices. The Appendices also include consultant comments and some supporting test information. [NOTE: In the conduct of the study, Hamilton Standard employed the services of Arthur D. Little as chemical process consultants, and URDC, for certain preliminary design information concerning the URDC concept.]

TITLE: Energy Systems Optimization Program (ESOP) User's Guide
(3 Volumes)

AUTHOR(S): R.D. Stallings; et al

DATE OF ISSUANCE: 11/74 (Vols. I & II); 1/75 (Vol. III)

DOCUMENT PREPARED BY: Lockheed Electronics Co., Inc.; Aerospace Systems Div.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: COSMIC

OTHER IDENTIFICATION: LEC 5041; Project No. 3375

TOTAL PAGES: 505 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (PO)

ABSTRACT

This report documents the preliminary system design program used at NASA for design and analysis of MIUS. This program is referred to as the ESOP (Energy Systems Optimization Program).

This document is presented in three volumes, with contents as follows:

Volume I - Discussions of the energy analysis performed by ESOP, program input data and output data, along with samples of output data and input listing;

Volume II - A complete computer listing of all subroutines of the energy analysis program plus a flow chart of the analysis computations;

Volume III - A discussion of the Economic Analysis (ECOBAS) and Financial Analysis (FINANS) programs, plus a program input guide, sample input, sample output and a program listing.

ESOP was written for the purpose of calculating facility load requirements and then evaluating the yearly operational characteristics of a MIUS design to satisfy said loads. Based on average hourly/daily/monthly/seasonal/yearly loads, the energy analysis will predict the fuel requirements for a MIUS as well as for a conventional-type commercial system which will also satisfy these loads. The ECOBAS will determine the capital and yearly operational and maintenance costs and the FINANS will perform a financial analysis.

The general analytical componenets of the energy analysis are summarized, namely; waste disposal, heating/cooling loads, energy requirements, power generation, conventional utility systems and wastewater treatment.

TITLE: Technology Evaluation of Heating, Ventilation, and Air Conditioning for MIUS Application

AUTHOR(S): W.L. Gill; et al

DATE OF ISSUANCE: 11/74

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N75-10135

OTHER IDENTIFICATION: JSC-08571; NASA TM X-58128

TOTAL PAGES: 51 TOTAL REFERENCES CITED: 20 CLASS. OF DOCUMENT: (P)

ABSTRACT

This report describes likely heating, ventilation and air-conditioning systems plus major components associated with their support. The various types of air-conditioning machinery that are available for use in MIUS are enumerated. Advantages and disadvantages peculiar to MIUS are considered.

Heating boilers are briefly reviewed because they will be used only to augment recovered heat from MIUS prime-mover systems. Building space-heating methods, including fan-coil units, electrical heating, gas, infrared and solar heating, are also discussed. The use of the heat pump to provide both heating and cooling is examined. Other items considered are heat-rejection, air-distribution and ventilation requirements and techniques, humidity control, air filtration and odor control. A brief discussion of overall system control requirements, and NASA research and development technology applicable to this area, concludes this survey of the state of the art.

A combination of compression and absorption space cooling, together with the use of recovered engine heat for space heating, appears to be the most efficient means of air conditioning a building complex served by a MIUS.

TITLE: Technical and Institutional Aspects of Common Trenching

AUTHOR(S): W.J.Boegly; et al

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-28

TOTAL PAGES: 226 TOTAL REFERENCES CITED: 84 CLASS. OF DOCUMENT: (P)

ABSTRACT

The U.S. Department of Housing and Urban Development (HUD) is responsible for the application of new technology to the solution of urban housing problems. As a part of their research effort, studies were initiated on the application of new underground utility installation practices such as the installation of multiple utilities in the same trench (usually called common trenching or joint trenching) or the use of utility tunnels. The information in this report represents the results obtained in evaluating the potential role of common trenching as an improved utility installation practice, strategies for implementation, and recommendations for future action.

Major technical considerations in the use of common trenching are reviewed. These considerations are: installation and maintenance practices, compatibility, and design of the trench itself. Although modifications of current installation practices appear necessary, none represented a deterrent to common trenching. Although it was found that the technological problems associated with common trenching of utilities were generally amenable to solution, the report's extensive study of institutional constraints in the coordination, application, and administration of these systems were found to limit their use.

The report further makes estimates of the capital cost savings from common trenching and analyzes the results of a trial demonstration of common trenching in East Tennessee. Strategies and incentives for implementation are explored and several recommendations are made.

Prinicipal conclusions and recommendations are: (1) an organization to gather, validate, and disseminate information on common trenching; (2) the formation and development of federal, state, and local coordinating committees; (3) development of better equipment for the installation of common-trenched utilities; (4) development of standards and criteria for common trenching; (5) federal incentives provided to states and local areas requiring compulsory undergrounding.

TITLE: Technology Evaluation of Control/Monitoring Systems for MIUS Application

AUTHOR(S): L.M. Pringle, Jr.

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N74-32715

OTHER IDENTIFICATION: JSC-08973;NASA TM X-58135

TOTAL PAGES: 55 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (P)

ABSTRACT

This report is a general survey of the possible systems and hardware required for control/monitoring in a MIUS. The purpose of the survey is to familiarize engineers who will undertake the design and analysis work specific to MIUS with appropriate techniques and hardware for monitoring and control of the individual processes that are applicable to MIUS; i.e., power generation, solid-waste treatment, etc.

A general description is given of the requirements for a MIUS control/monitoring system, control/monitoring hardware including logic controls, central control stations, subsystem hardware and actuators.

Several operational control/monitoring systems were visited during the survey and are described herein. The results of the initial survey show that only one major hardware development is required, namely, the automati monitoring of waste and water treatment processes. Computer modeling of MIUS subsystems is a needed software development.

In keeping with the use of articles of commerce in the development of the MIUS design, the survey has shown that a wide range of capabilities exists that will provide the MIUS with a control/monitoring system using mainly "off-the-shelf hardware". Baseline systems have been selected.

This report should be considered as a first look at control/monitoring system technology. It is not intended to be the final engineering/economic assessment of such technology. It is anticipated that the HUD/MIUS project will continue an in-depth study of this field.

TITLE: Integrated Waste Management Systems

AUTHOR(S): P.M.Tobin; C.E.Meyers

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Authors/EPA

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME; Paper No. 74-ENAs-47

OTHER IDENTIFICATION: Presented at ASME Meeting 7/29-8/1, 1974; Seattle, Washington

TOTAL PAGES: 12 TOTAL REFERENCES CITED: 19 CLASS. OF DOCUMENT: (PO)

ABSTRACT

This report reviews past work on Alaska Village Demonstration Projects, siting of public and private utilities and new solid waste collection techniques. MIUS (under joint sponsorship with HUD) and other new concepts are discussed including the use of solid waste as a supplement fuel source, recovery of methane from organic material and pyrolysis of organic wastes. Finally, reports are presented on several communities which plan to use the integrated waste management systems approach. To date the approach of examining pollution control, through the total waste management concept, appears to be practical and has received enthusiastic acceptance.

TITLE: Application of a Numerical Differencing Analyzer Computer Program to a Modular Integrated Utility System

AUTHOR(S): A.A. Brandli (USPO); C.F. Donham (The Boeing Co.)

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Authors/NASA-JSC/The Boeing Co.

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME;

OTHER IDENTIFICATION: Record of 9th IECEC; pp. 547-552; #749059

TOTAL PAGES: 6 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper describes the adaption of SINDA, a numerical differencing analyzer computer program, to the thermal analysis of a MIUS model. The MIUS model evaluated was one which would support a 648-unit garden complex.

SINDA (Systems Improved Numerical Differencing Analyzer) is a general purpose systems analyzer which lends itself well to any system which can be represented as a lumped-parameter nodal network governed by diffusion equations, generally referred to as a resistor/capacitor network

The objective in developing this program was to have the means to thermally analyze the response of a MIUS to varying externally impressed loads and to provide a wide range of operational flexibilities in order to give the capability of accurately determining the use of energy throughout the system. The SINDA model in this paper was specifically for a garden apartment in Houston, Texas but, with minor modifications in the program input, its range of applicability can be altered and considerably expanded to include a variety of other building complex types and geographic locations.

In order to implement the chosen model the MIUS was represented as several major networks. Each network was inputed independently but was then connected to other networks as needed to integrate the total MIUS. The networks which are simulated in this model are: a) Prime-Mover Waste Heat Unit; b) Air-Conditioning Condenser Cooling Water; c) Air-Conditioning Chilled Water.

TITLE: The Energy Systems Optimization Computer Program (ESOP) for Modular Integrated Utility Systems (MIUS) Analysis

AUTHOR(S): S.L. Ferden; et al

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Authors/Lockheed Electronics Co.

RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: ASME ;

OTHER IDENTIFICATION: Record of 9th IECEC; pp. 541-546 #749058

TOTAL PAGES: 6 TOTAL REFERENCES CITED: 21 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The report states that significant energy and cost savings can be obtained by integrating the various utility services such as space-heating/cooling, electrical power generation, solid-waste disposal, potable water and wastewater treatment into a single unit which services buildings or groups of buildings. A computer program is described which has been developed jointly by Lockheed Electronics Co. (LEC) and the USPO of NASA/JSC. The computer program is entitled the Energy Systems Optimization Program (ESOP).

The ESOP program predicts the loads, energy requirements, equipment sizes and life-cycle costs of alternative methods of meeting these utility requirements. The program has been used extensively for performing energy analyses of MIUS, which is a concept sponsored by HUD.

This paper presents a general description of ESOP, including the utility requirements determined by the program for a single building or a group of buildings. Alternative methods of meeting said requirements are discussed along with the energy analysis. A description is included of an economic data base for evaluating capital costs and operating and maintenance (O&M) costs for MIUS and conventional systems. A financial analysis routine for determining the yearly cash flow, rate of return, yield, payback and net present-value of the systems is discussed.

TITLE: General Survey of Solid-Waste Management

AUTHOR(S): T.G.Reese; R.C.Wadle

DATE OF ISSUANCE: 5/74

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; N74-24523

OTHER IDENTIFICATION: JSC-08696; TM X-58133

TOTAL PAGES: 27 TOTAL REFERENCES CITED: 21 CLASS. OF DOCUMENT: (P)

ABSTRACT

The purpose of this report is qualitatively describe the technology of modern solid-waste management systems. This technology description is written to relate various solid-waste management systems to MIUS. When comparing the system concepts to determine the optimum system for a MIUS, consideration will be given to the economics of operation including capital costs, efficiency, maintenance, reliability and needed development effort.

Likely solid-waste collection, transportation and disposal systems are described. The various types of solid waste processing equipment available for use in a MIUS are presented. Automated collection systems are discussed and the advantages and disadvantages of the various systems are enumerated. Reclamation and recycling of solid wastes are discussed, with emphasis on the processes used to separate solid waste into its various fractions. The advantages and disadvantages of various types of incinerators are covered. Pyrolysis, which provides for the recovery in the form of gas, oil and char, is considered.

The characteristics and special considerations for MIUS solid-waste system components are described.

In conducting this technology survey several government and prviate organizations were contacted and visited. The discussions with these agencies and firms provided relevant information concerning the solid-waste management systems in use today and the applicability of these systems to MIUS. A list of these contacts is given.

TITLE: MIUS Technology Evaluation: Prime Movers

AUTHOR(S): G. Samuels; J.T. Meador

DATE OF ISSUANCE: 4/74

DOCUMENT PREPARED BY:

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-MIUS-11

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 66 TOTAL REFERENCES CITED: 55 CLASS.OF DOCUMENT: (P)

ABSTRACT

Prime movers suitable for driving electric generators, whose exhaust heat can be used to heat and cool relatively small communities served by a MIUS, are evaluated from the standpoints of performance and economics.

Present ecomonic and technologic considerations limit the logical selection of prime movers in the 150-kW to 1000-kW range to gas and steam turbines, spark-ignition gas engines, and compression-ignition diesel and dual-fuel engines. Small steam turbines are of some interest in applications in which the ratio of heat to electrical usage is rather large (∿15 to 20). Small gas turbine units, having relatively low electrical efficiency (∿20%) and high excess air requirements are primarily of interest for applications in which heat usage is four to five times that for electricity. Internal-combustion piston engine units are the most efficient of the available prime movers, having good electrical (∿30%) and overall thermal efficiencies (∿80%)*.

Two other types of prime movers, which may become available for use in MIUS applications are also discussed: the Stirling engine and the organic Rankine cycle system using a turbine-generator.

Fuel economy data, maintenance and equipment costs are included for gas turbine-generator units for various internal-combustion engine-generator units.

* Overall thermal efficiency = (electrical output + heat-recovery rate) ÷ fuel-heat input.

TITLE: Impact of Environmental Protection Agency Solid Waste Management Programs on MIUS Demonstration Project

AUTHOR(S):

DATE OF ISSUANCE: 3/7/74

DOCUMENT PREPARED BY: EPA

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: EPA

OTHER IDENTIFICATION:

TOTAL PAGES: 5 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This is an informal report which summarizes the specific Federal regulations related to solid wastes, viz: "Clean Air Act", "Water Pollution Control Act" and "Solid Waste Disposal Act." It points out that although solid-waste was not covered by direct Federal standards, as of March 1974, Federal programs encourage local governments and private corporations to adopt environmentally acceptable methods for handling and disposing of such wastes, including recovery of useful materials therefrom. The report also contains a group of questions submitted to EPA, with its answers, relative to MIUS solid-waste.

TITLE: MIUS Technology Evaluation: Lithium Bromide-Water Absorption Refrigeration

AUTHOR(S): H.R. Payne

DATE OF ISSUANCE: 2/74

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-MIUS-7

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 32 TOTAL REFERENCES CITED: 14 CLASS. OF DOCUMENT: (P)

ABSTRACT

Absorption refrigeration air conditioning, which can utilize the heat recovered from engines and from the incineration of solid waste, can be included in a MIUS. This report reviews the suitability of lithium bromide plus water for such an application.

The types and sizes of manfactured units and their availability are discussed. Single-effect lithium bromide plus water absorption systems are available from domestic manufacturers, and double-effect systems probably will be manufactured in the near future. Capital, operation and maintenance costs are given for such single-effect systems.

With waste heat available from electric power generation, a total energy system will use less fuel over a wide range of conditions than a comparable conventional system supplying electric power and using compressive refrigeration. Fuel consumption comparisons are made between total energy and conventional systems providing the same service.

TITLE: MIUS Technology Evaluation: Solid Waste Collection and Disposal

AUTHOR(S): W.J. Boegly, Jr.; et al

DATE OF ISSUANCE: 9/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-MIUS-9

OTHER IDENTIFICATION: Contract No. W-7405-eng-26

TOTAL PAGES: 88 TOTAL REFERENCES CITED: 90 CLASS. OF DOCUMENT: (P)

ABSTRACT

The report briefly examines residential-municipal waste generation and follows with a more in-depth discussion of the various types of equipment and materials handling methods used in solid waste collection. Included are both collection within buildings and between-building transfers. Equipment and methods are discussed in general terms of availability, operating characteristics, relative economic, performance data etc.

Solid waste disposal is discussed at length with emphasis on heat recovery incineration. The various types of incinerators are presented in terms of current status/availability, capital and O&M costs, combustion & heat recovery efficiency, etc. Operation in discussed in terms of refuse charging, ash removal, auxiliary firing, air pollution abatement equipment.

System economic comparisons are made for various sizes of incinerators, with & without waste heat recovery compared to saintary landfills with various haul distances.

TITLE: Technology Evaluation for MIUS

AUTHOR(S): A.J. Miller; et al

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; CONF-730811-4

OTHER IDENTIFICATION: 8th IECEC Proceedings; pp. 653-659; #739149

TOTAL PAGES: 7 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper presents a summary of the results to date of an evalution of utility technologies with respect to use in MIUS. The MIUS may be sized to accommodate perhaps 100 to 3000 multifamily dwelling units plus nearby single-family housing and associated commercial facilities.

TITLE: Electrical Grid Tie-In Summary Report

AUTHOR(S):

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION: JSC EZ2-73-153

TOTAL PAGES: 15 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This is a study to determine MIUS to conventional utility electrical interconnections, options and mutual benefits. Several possible configurations were identified and a list of advantages/disadvantages to MIUS and conventional utility companies was compiled. [NOTE: Although the method of interconnection may be relatively independent of the facility type being served, for energy and cost analysis purposes a base-line MIUS system (648 unit garden apartment) with known operating characteristics was used.]

Computations were made for annual energy savings, "delta" capital cost, installation costs and capacity for each of six options. The paper presents a summary of the results and assists in the identification of similarities with other on-going studies related to interconnecting MIUS plants to serve a community.

TITLE: Community MIUS System Specification

AUTHOR(S):

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: NASA-JSC

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: NASA-JSC

OTHER IDENTIFICATION: NASA-JSC/USPO-0001-001

TOTAL PAGES; 46 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The MIUS community system specification, discussed in this document, is to be used to establish overall system requirements and the interfaces with city-wide services for the separate neighborhood, village center and central business district MIUS installations. The city is to be a new planned community of ∿ 100,000 population.

This specfication is the primary requirements document for a group of MIUS units serving a new community. It covers: 1) the basic MIUS units; 2) the facilities required to house, control, service and maintain the system; and 3) cabling/piping/ducting peculiar to the system up to and including switches, relays, valves and other interface components needed to connect MIUS to city-wide services. [NOTE: The city-wide services associated with MIUS are also included.]

Although the specification does not lock into a fixed hardware configuration, a baseline system is described consisting of 29 MIUS units. Utilities provided by the baseline MIUS units consist of electrical power generation, HVAC, solid-waste incineration, and sewage treatment subsystems. The city-wide systems included in the baseline are a fuel storage/distribution system, a conventional potable water system, and an electrical distribution grid which interfaces with all MIUS installations. Anything within the dwelling units and the storm sewerage system is excluded.

In summary, the purpose of this document is to define the requirements for a group of MIUS installations intended to serve a community, as defined in the NASA Community Conception Design Study. This document is considered representative and will be used as a basis for a product specification for a MIUS equipment designer.

TITLE: Status of Comparative Analysis (Hourly) of Loads and MIUS Energy Requirements

AUTHOR(S): J.V. Wilson

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: ORNL

OTHER IDENTIFICATION: AEC-5

TOTAL PAGES: 20 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (OF)

ABSTRACT

The main purpose of this memorandum is to describe the progress made in developing an ORNL computer program (1973 MIUS "Fotran IV" Program) which calculates MIUS energy requirements from hourly data on: use of electricity, availability of directly recoverable heat, availability of heat from solid waste, use of hot water and the needs for space heating and cooling as based on hourly Weather Bureau data. Additionally, the report includes the status of steps to make operational at ORNL two other computer programs developed elsewhere so that the results from all three programs might be compared.

TITLE: A Method for Computing the Cost of Hot Water Conveyance

AUTHOR(S): M.E. Lackey

DATE OF ISSUANCE: 1/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: ORNL; ORNL-HUD-MIUS-8

OTHER IDENTIIFICATION: HUD Interagency Agreement No. IAA-H-40-72 (Research)

TOTAL PAGES: 11 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This memorandum describes a preliminary look at methods whereby estimates of thermal energy conveyance costs for a MIUS might be systematized and computerized. It also furnishes some preliminary data on the influence of distribution and transmission distances upon the capital costs of a district hot-water heating system. Calculation procedures are illustrated through use of a simple system having uniform loads equally spaced along a constant-size distribution header.

TITLE: Technology and Economics of Utility Tunnels and Common Trenching

AUTHOR(S): W.J. Boegly, Jr.; W.L. Griffith

DATE OF ISSUANCE: 9/72

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Authors/ORNL/IECEC

OTHER IDENTIFICATION: Record of the 7th IECEC; pp. 1230-1235; #729184

TOTAL PAGES: 6 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper states that expansion of conventional underground utility systems plus the possibility of installing additional utilities (such as central heating/cooling, solid-waste collection and pneumatic mail-delivery) will produce increased "competition" for available urban installation space. Such competition is now a problem of increasing seriousness for utility companies operating in the dense areas of our larger cities. In suburban areas the problem is not as acute but, with increased emphasis on the underground placement of all utilities, it is seen that improved installation practices will be required e.g., the use of utility tunnels or the common installation of multiple utilities in the same trench.

Such utility tunnels, if properly designed, offer the potential for installation and maintenance of underground utilities without further excavation but they are more costly than conventional methods. Also, there are problems in compatibility between utilities, safety, financing and coordination. A design study for a utility tunnel system in White Plains, New York was used to illustrate the application of this concept. Cost differences between conventional buried utilities and utilities installed in tunnels were also presented.

Common or joint trenching presents many of the same problems as the utility tunnel. Its main advantage appears to be the reduction in the amount of excavation required plus its potential for a minimum disruption of the surface. Safety and coordination problems, however, have also restricted the use of common trenching. Current practices and research into the deterrents to common trenching are described along with suggested modified practices and anticipated economic gains.

TITLE: Urban Utilization of Extracted Heat and Waste Heat from Central Station Power Plants

AUTHOR(S): S.E. Beall, Jr.; A.J. Miller

DATE OF ISSUANCE: 9/72

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Authors/ORNL/IECEC

OTHER IDENTIFICATION: Record of 7th IECEC; pp. 1223-1229; #729183

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper presents an analysis by ORNL of the feasibility of providing thermal energy and electricity to urban areas from central station steam-electric power plants. Consideration is given to the use of the thermal energy for applications such as industrial processes, building space-heating, air conditioning, sewage treatment, agriculture and aquaculture.

The analysis indicated that, compared to conventional systems, the use of such dual-purpose plants significantly reduces the consumption of fuel and lessens the environmental impact of providing energy. Areas of multifamily dwellings and other multistoried buildings could be served in new cities, or renewed old cities, at costs comparable to those for more conventional separate systems. However, it would require more planning of facilities and coordination of diverse organizations than is now normally employed. The diversity of costs and dislocations associated with retrofitting existing cities would cause each such city to be a separate analysis case.

TITLE: Total Energy Applications - Industrial, Urban, Agricultural

AUTHOR(S): S.E.Beall, Jr.

DATE OF ISSUANCE: 6/72

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; CONF-730211-1

OTHER IDENTIFICATION: Presented at a Symposium on "Effective Energy Utilization", at Drexel University; Philadelphia, Penn. 6/8-6/9

TOTAL PAGES: 31 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Improved energy utilization (recycling energy intensive products, better insulation, more efficient air conditioning, etc.) and combined uses of heat and electricity were studied. Applications for the heat that remains after electricity is generated provide possibilities for significant savings. Heat from a dual-purpose plant costs less than heat generated in a separate burning of fuel because less is consumed and because capital investment and operating charges are shared by the two functions; also there is less air pollution and less waste discharged to the environment.

The beneficial use of waste heat was explored, with emphasis on study of the large steam-electric generating systems. The smaller total energy systems, with emphasis on heat recovery and use, are also being evaluated.

Different ways of making heat available in an electrical-generating system are shown. The penalty in electrical capacity that results from back-pressuring is illustrated. It is shown how steam at different temperatures can be removed from various stages of a turbine, making available a range of temperatures varying from perhaps 75° at the condenser to several hundred degrees F, if high-pressure steam is extracted.

TITLE: Comparison of the Thermal Efficiencies of a Closed-Cycle and an Open-Cycle Gas Turbine Power Plant Used in a District Heating System

AUTHOR(S): M.E. Lackey

DATE OF ISSUANCE: 2/17/72

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE; ACCESSION NO.: ORNL

OTHER IDENTIFICATION: ORNL-CF-72-2-21

TOTAL PAGES: 13 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

The use of total energy systems has been proposed for small housing developments as a means of reducing the central conversion systems. Two power conversion systems readily adaptable to small systems are the open-cycle and the closed-cycle regenerative gas turbine power plants coupled to a district heating system. A study of the overall thermal efficiency of these cycles has been made to determine if one has a fuel advantage over the other when operating under similar conditions. It was concluded that factors other than fuel advantage must be studied before the most desirable system could be selected to suit the needs of a specific application.

TITLE: The Use of Heat as Well as Electricity from Electricity Generating Stations

AUTHOR(S): S.E.Beall, Jr.; A.J. Miller

DATE OF ISSUANCE: 12/71

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ORNL

OTHER IDENTIFICATION: Symposium on the Energy Crisis; Phila., Penn. 12/29/71; Annual Meeting of AAAS

TOTAL PAGES: 19 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (OF)

ABSTRACT

This report examines means by which fuel consumption and energy wastage might be reduced. One such means is to make use of the heat as well as the electricity from electrical generating plants; less fuel will then be burned to heat buildings, energize industrial processes etc. Much of this heat could be supplied to urban areas and industries by extracting steam from future nearby power plants. Generating electricity would be somewhat less efficient but the efficiency of energy utilization would be markedly increased.

An examination by ORNL of the use of heat-electric systems to provide thermal energy to urban areas has led to the conclusion that areas of multi-family dwellings (and other multistory buildings) in new cities, or renewed old cities, could be served at costs comparable to those incurred with the more conventional separate systems. However, it would require more planning of facilities and coordination of diverse organizations than has normally been employed in connection with the development of a new city or large urban area redevelopment.

Since new communities tend to grow in "modules" of several hundred (up to a few thousand) dwelling units, ORNL is evaluating the concept of energy system modules in which prime-movers such as gas turbines and fossil fueled engines would be used to supply energy in the form of electricity, heat and air conditioning. The heat intensive of portions of the system would make use of exhaust and coolant heat from the generation of electricity by the prime-mover. Expansion of the energy system modules and eventual use of the infrastructure with large central systems are among the possible modes of urban growth that bear examination.

TITLE: System Requirements for Underground Utility Installations

AUTHOR(S): W.J.Boegly; et al

DATE OF ISSUANCE: 2/71

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL-HUD-19

TOTAL PAGES: 103 TOTAL REFERENCES CITED: 47 CLASS. OF DOCUMENT: (P)

ABSTRACT

As a part of an effort to assess the state of the art of new tunneling technology and to determine the applicability of tunneling methods to utility installation, system requirements for the installation of underground utilities have been developed. The characteristics of typical utility systems are described and analyzed to determine areas where certain methods of installation may provide advantages over other alternatives.

The report reviews current practices, in the areas of utilities' installation and excavation. Both trenching and tunneling techniques as a means of providing the installation space are assessed. Emphasis is placed on tunneling as a potential means for reducing surface excavation and the attendant traffic interference and noise associated with trenching. Estimates are made of future underground utility installation and the potential benefits of advanced utility installation systems.

The report concludes that if several utilities are to be directly buried in the same right-of-way, the joint or common use of the same trench appears to offer advantages. Conduit systems capable of containing both cables and pipes also offer a potential for minimizing the excavation necessary for installation and maintenance.

TITLE: Uses of Waste Heat

AUTHOR(S): S.E. Beall, Jr.

DATE OF ISSUANCE: 7/24/70

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SORUCE; ACCESSION NO.: ASME; ASME Paper 70-WA/Ener-5

OTHER IDENTIFICATION: Energetics Division of ASME; ASME Winter Meeting; New York, N.Y.; 11/29-12/3, 1970

TOTAL PAGES: 8 TOTAL REFERENCES CITED: 8 CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper discusses a variety of possible applications for the warm water (or "waste heat") being discharged in enormous quantities from steam-electric power stations. It summarizes the results of HUD-ORNL studies on heating/cooling cities, recycling of sewage and waste waters, and heating/cooling of enclosed environmental structures for the cultivation of plants, poultry and animals. The current U.S. work in open-field irrigation and soil heating with warm water, and in aquaculture, are reviewed. The paper concludes that the combination of several such uses could consume, or otherwise dispose of, all heat from a large power station, rendering a conventional cooling installation unnecessary.

TITLE: Solid Waste Management Practices: An Annotated Bibliography and Permuted - Title and Key Word Index

AUTHOR(S): W.J.Boegly; et al

DATE OF ISSUANCE: 2/70

DOCUMENT REPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE: ACCESSION NO.: NTIS; ORNL-HUD-12

TOTAL PAGES: 375 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (P)

ABSTRACT

In 1968 the U.S. Department of Housing and Urban Development (HUD) initiated a study at the Oak Ridge National Laboratory to review the problems associated with solid waste collection and disposal in high-density urban areas and to suggest areas where advanced technology could be applied. As a part of this effort, a review of the literature on solid waste practices was performed.

This Bibliography represents a compendium of abstracts of about 2200 articles published between 1958 and the beginning of 1970. Many of the abstracts included were taken directly from Chemical Abstracts and Engineering Index with permission of the publishers, and from other bibliographies of solid waste literature, such as those prepared by the U.S. Public Health Service and their research contractors. However, many of the articles had not been abstracted in published works, and abstracts were prepared for inclusion in this Bibliography.

In general, this Bibliography covers references pertaining to municipal refuse collection and disposal practices. No attempt was made to cover in detail the literature on agricultural or industrial solid wastes; however, some articles on these subjects have been included. Articles prior to 1958 and many foreign articles are not included. Also, in the references are extensive bibliographies on incineration and composting; the majority of these articles are not included.

The document consists of a bibliography section, author index and key word index. The references in the bibliography section are grouped into 11 major fields and into several minor fields under each major heading. Bibliographic information includes the title, supplemented by descriptors, authors, reference, abstract and source of abstract.

5. HARDWARE EVALUATION AND DEMONSTRATION REPORTS

TITLE: An Expandable Total Energy Data Editor

AUTHOR(S): R.H.F. Jackson

DATE OF ISSUANCE: 8/76

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-256-295

OTHER IDENTIFICATION: NBSIR 75-735

TOTAL PAGES: 138 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (P)

ABSTRACT

This report documents the Total Energy Data Editor as of (early) 1975. The "Editor" is a computer program developed to process the data to be collected by the ongoing T.E. Project at NBS. Consisting of a mix of FORTRAN and RAYTHEON machine-language subroutines, the Editor is a powerful, interactive program written to be run on a Raytheon 704 minicomputer with two tape drives and a disk pack. Since this document is also meant as a user's manual, it includes: a dictionary of commands, complete discussions and listings of individual subroutines and an explanation of the workings of the program. Also included in this document is the editor design philosophy, an explanation of the editing process, a description of instructions to the editor, a description of typical edit and error messages.

The design concept that was paramount in developing the Editor was flexibility through simplicity. This was required because, by the nature of the project for which it was developed, many of the data problems to be handled could not be identified in advance. Those which were "classical" problems in data collection could be anticipated and allowed for in the program design but many others would only be discovered once the data collection, editing and analysis processes had begun and these problems would then require resolution in a "real-time" mode.

TITLE: Fluidized Bed Gas Turbine Experimental Unit for MIUS Applications: Quartely Progress Report for Period 4/1/75-6/30/75

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS: ORNL/HUD/MIUS-31

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72, ERDA 40-333-72; ERDA Contract No. E (49-18)-1742

TOTAL PAGES: 24 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (P)

ABSTRACT

A program for developing a coal-fueled MIUS at ORNL is being jointly sponsored by HUD's Office of Policy Development and Research and ERDA's Office of Fossil Energy (formerly Office of Coal Research of the Interior Department). Phase I of this program, "Concept Preliminary Evaluation", entailed the evaluation of various ways in which coal and coal-derived fuels might be employed in MIUS systems. Following approval of the Phase I study, ORNL was authorized to proceed with Phase II, the development of a firm conceptual design and cost estimate for the construction of a system for test and evaluation.

In this quarter, the Phase II design work was at a modest pace pending formal transfer of funds to ORNL for the latter portion of the Phase II effort. Detailed analyses for the fluidized bed furnace design chosen have proceeded together with negotiations with vendors for system components. Cold flow tests have been performed on a small clear plastic model of the fluidized bed furnace and the results indicate that it should be possible to turn the furnace down to about 1/3 of full power. System layout studies for several possible locations for the test facility are continuing. Bench testing of the first component for a coal feed system has been initiated.

TITLE: Fluidized Bed Gas Turbine Experimental Unit for MIUS Applications: Quarterly Progress Report for Period 1/1/75-3/31/75

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ERDA; ORNL/HUD/MIUS-30

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72, ERDA 40-333-72; ERDA Contract No. E (49-18)-1742

TOTAL PAGES: 18 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (P)

ABSTRACT

A program for developing a coal-fueled MIUS at ORNL is being jointly sponsored by HUD's Office of Policy Development and Research and ERDA's Office of Fossil Energy (formerly Office of Coal Research of the Interior Department). Phase I of this program, "Concept Preliminary Evaluation", entailed the evaluation of various ways in which coal and coal-derived fuels might be employed in MIUS systems; this work was completed at the end of July, 1974. ORNL was authorized, in January 1975, to proceed with Phase II, covering the development of a firm conceptual design and cost estimate for the construction of a system for test and evaluation.

Phase II efforts have initially centered on: a detailed analysis of elements of the fluidized bed furnace and heater assembly; negotiations with vendors leading to the selection of a turbine-generator unit, the heat exchangers required and the coal feed equipment; coal flow and bench tests of key components; system layout installation, instrumentation and control studies. During this quarter, a fourth layout for the furnace was evolved to give the most favorable design developed to date and the first to meet all of the design conditions envisioned. An analytical solution suitable for handling fluidized bed pulsation problems has been developed, procurement of components for bench tests has been initiated and contractual arrangements with the Air-Research Division of Garrett Corporation have been nearly completed calling for them to analyze several different ways of adapting their engines to the fluidized bed furnace application.

TITLE: Use of Coal and Coal-Derived Fuels in Total Energy Systems for MIUS Applications; Volume I, Summary Report

AUTHOR(S): A.P. Frass, et al

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-27

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72, ERDA 40-333-72; ERDA Contract No. E (49-18)-1742

TOTAL PAGES: 47 TOTAL REFERENCES CITED: 9 CLASS. OF DOCUMENT: (P)

ABSTRACT

A program for developing a coal-fueled MIUS is being jointly sponsored by HUD and ERDA, Fossil Energy (formely Office of Coal Research of the Interior Department). The objectives of Phase I of the program, "Concept Preliminary Evaluation," were the investigation and evaluation of various ways in which coal and coal-derived fuels might be employed in MIUS systems. The results of this Phase I evaluation are presented in this report of the work. The principal conclusions of the study are:

1. MIUS systems based on small, on-site coal gasification or liquefaction plants would have much higher capital and operating costs than systems in which coal is burned directly.

2. A fluidized bed combustion system, in which coal is burned in a bed of limestone, appears to be the most attractive set-up for direct utilization of coal. Such a system would include the possibility of reducing the sulfur emissions in the stack gas along with the ability to burn any type of coal, lignite or solid waste.

3. A closed cycle gas turbine, coupled to a fluidized bed coal combustion unit, appears to be the most promising system for using coal for MIUS applications. Analyses indicate that this system will convert ∿30% of the energy in the fuel to electricity and ∿50% into heat that can be used for domestic hot water and for building heating and cooling.

TITLE: Use of Coal and Coal-Derived Fuels in Total Energy Systems for MIUS Applications: Volume II

AUTHOR(S): A.P. Fraas, et al

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; ORNL/HUD/MIUS-28

OTHER IDENTIFICATION: HUD Interagency Agreement No. IAA-H-40-72, ERDA 40-333-72; ERDA Contract No. E (49-18)-1742

TOTAL PAGES: 360 TOTAL REFERENCES CITED: 144 CLASS. OF DOCUMENT: (P)

ABSTRACT

A program for developing a coal-fueled MIUS is being jointly sponsored by HUD and ERDA, Fossil Energy (formerly Office of Coal Research of the Interior Department). The objectives of Phase I of the program, "Concept Preliminary Evaluation," were the investigation and evaluation of various ways in which coal and coal-derived fuels might be employed in MIUS systems. The results of this Phase I evaluation are presented in this report. Volume I is a summary of the results and Volume II is a complete report of the work.

The report is detailed developed the summary material presented in Volume I. The report beguns with an examination of the availability- and costs of the coal & coal-derived fuels. A technical background comparisons is presented of the various types of coal combustion systems with particular emphasis on sulfur removal and particulate emission control.

MIUS requirements are developed and used as a basis of comparing the performance and cost of typical power units using different fuels. Both off-the-shelf and advanced concepts are examined and compared. Detailed system performance and cost analysis are performed for the chosen fluidized bed combustion gas turbine system. A conceptual design is executed and specific problem areas are addressed: hot corrosion, isntrumentation & control, etc.

TITLE: An Engineering Economy Study of a Commercial Coal Fueled MIUS Concept

AUTHOR(S):

DATE OF ISSUANCE: 1975

DOCUMENT PREPARED BY: Gilbert Associates, Inc. (Reading, Penn.)

RESPONSIBLE ORGANIZATION(S): ERDA

REFERENCE SOURCE; ACCESSION NO.: ERDA; FE-1742-1

OTHER IDENTIFICATION: ERDA Contract No. E(49-18)-1742

TOTAL PAGES: 271 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (OF)

ABSTRACT

This study provides a working basis for evaluation and direction for future studies of a MIUS fueled by coal. It also presents a base case conceptual design for future comparative purposes. Finally, it includes a comprehensive analysis technique which incorporates a complete conceptual design, a detailed cost estimate and a comprehensive economic analysis of the estimated cost compared with the cost of conventionally supplied electricity.

NASA, utilizing ESOP, had previously characterized typical electrical, heating, air conditioning and potable hot water demands. Based on these demands a complete conceptual design was prepared. This effort produced system descriptions and plant layout drawings.

Upon completion of the design, a detailed budget estimate was prepared and escalated to 1985, the hypothetical MIUS installation date. Estimates of conventionally supplied electricity rates based on a typical eastern utility were also prepared. Standard accounting procedures were applied to the cost data, and an estimated yearly rate of return was established. This economy analysis, and the preparation of the conceptual design, led to certain specific conclusions which gives the following general picture of MIUS: Coal fueled MIUS facilities can be made economically viable; MIUS facilities represent relatively high initial investments and government support may be required to enhance investment appeal; MIUS can be fiscally sound and future comprehensive analysis of coal fueled MIUS economies will be justifiable by ERDA on a selective basis as the overall HUD/MIUS program develops.

TITLE: Conceptual Design of a Coal-Fired Gas Turbine for MIUS Applications

AUTHOR(S): A.P.Fraas; R.S.Holcomb

DATE OF ISSUANCE: 12/75

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; CONF-751213-2

OTHER IDENTIFICATION: Presented at the Fourth International Conferences on Fluidized Bed Combustion, McLean, Va., 12/9-12/11, 1975

TOTAL PAGES: 60 TOTAL REFERENCES CITED: 22 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Phase II of the program to develop a coal-fired gas turbine for MIUS applications was initiated in January 1975, following HUD and Office of Coal Research approval of the Phase I study which had concluded that a closed-cycle gas turbine, coupled to a fluidized bed coal combustion chamber, appears to give the most promising system for coal-fueled MIUS installations. The objective of Phase II was to evolve a firm conceptual design and cost estimate for an experimental unit designed to investigate the feasibility of the concept. This report summarizes the information presented in eleven "topical" reports, which have been prepared to present the results of the principal elements of the Phase II study.

TITLE: Bench-Scale Model Tests of a Fluidized Bed Furnace for the MIUS Coal-Fired Closed Cycle Gas Turbine

AUTHOR(S): R.S.Holcomb

DATE OF ISSUANCE: 12/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; CONF-751213-1

OTHER IDENTIFICATION: Presented at the Fourth International Conference on Fluidized Bed Combustion, McLean, Va., 12/9-12/11, 1975

TOTAL PAGES: 21 TOTAL REFERENCES CITED: 5 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Flow visualization studies were performed on a small-scale Plexiglas model of a coal-burning, fluidized-bed furnace that has been designed as a heat source for a closed-cycle gas turbine T.E. system for the HUD-MIUS Program. The test model was 10 in. square, with a tube bundle of 4 in. OD tubes by 6 rows deep. The bed material was limestone, with a mean particle size of 370 "mu" meters and a static bed height of 1 ft. The following results were obtained: a static region of bed material can be used as thermal insulation on the bed plate and around the turbine air manifolds; the minimum velocity for solids mixing at the wall was found to be 1.75 ft/sec, allowing a 3:1 turndown of the furnace; the bed pulsation frequency was observed to be 2 to 3 cycles/sec, over the operating range of air velocity.

TITLE: Flow Visualization Studies of a Fluidized Bed Furnace for a Coal-Fired Closed Cycle Gas Turbine

AUTHOR(S): R.S.Holcomb

DATE OF ISSUANCE: 12/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME; Paper No. 75-WA/Ener-4 NTIS; CONF-751106-15

OTHER IDENTIFICATION: Presented at ASME Winter Annual Meeting; 11/30-12/4, 1975

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 5 CLASS. OF DOCUMENT: (PO)

ABSTRACT

Flow visualization studies were performed on a small-scale Plexiglass model of a coal-burning, fluidized bed furnace designed as a heat source for a closed cycle gas turbine T.E. system for the HUD-MIUS Program. The test model was 10 in. square with a tube bundle of 0.25 inch O.D. tubes, 6 rows deep. The bed material was limestone with a mean particle size of 370 μm and a static bed height of 1 ft.

The following results were obtained: a static region of bed material can be used as thermal insulation for the bed plate and around the turbine air manifolds; the minimum velocity for solids mixing at the wall was 1.75 ft/sec, allowing a 3:1 turndown of the furnace: the bed pulsation frequency was 2 to 3 cycles/sec, over the operating range of air velocity.

TITLE: Design Study for a Coal-Fueled Closed Cycle Gas Turbine System for MIUS Applications

AUTHOR(S): A.P.Fraas; et al

DATE OF ISSUANCE: 8/75

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: IEEE; 75CHO 983-7 TAB

OTHER IDENTIFICATION: Record of 10th IECEC; pp. 260-268; #759042

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ABSTRACT

Work has processed at ORNL (under ERDA and HUD sponsorship) and a firm design for a pilot plant has evolved after considering a wide variety of possibilities and their relative merits in meeting the basic requirements. This paper summarizes that work.

The special requirements of the application include tight control on stack gas emissions and assurance that "dust" will be kept to a very low levels. The plant must yield a high thermal efficiency for producing electricity and heat for building heating and domestic hot water over a wide range of load conditions. The reliability must be high for semi-attended operation. Capital costs must be reasonable. Commercially-suitable equipment is to be used where practicable with a minimum of modifications. An exception to this requirement was the novel fluidized-bed coal combustion system and heater assembly.

Particular attention was given to the most important component in the system, namely the fluidized-bed furnace and heater assembly. Various current air-tuyere designs were examined, their problems noted, and one was chosen that seemed best suited to the MIUS application. A variety of coal and limestone feed systems were analyzed and two were chosen for evaluation in "bench tests" of full scale components. Several configurations for the tubes were considered along with the effects of differential thermal expansion on thermal stresses. Problems of tube vibration from both (Von Karman) vortex-shedding and bed pulsation were examined. The relation between basic fluidized-bed design parameters and the bed pulsations was evolved in the course of this work.

[NOTE: A summary of a feasibility study of the use of a fluidized-bed coal combustion system (coupled to a closed-cycle gas turbine) for MIUS applications was presented at the 1974 IECEC meeting.]

TITLE: Computer Simulation of Thermal and Fluid Systems for MIUS Integration and Subsystem Test (MIST) Laboratory.

AUTHOR(S): W.C. Rochelle; et al (Lockheed); A.E. Brandi (USPO)

DATE OF ISSUANCE: 8/75

DOCUMENT PREPARED BY: Authors/NASA-JSC/Lockheed Electronics Co.

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: IEEE; 75CHO 983-7 TAB

OTHER IDENTIFICATION: Record of 10th IECEC; pp. 461-467; #759073

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 3 CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper describes the application of the SINDA computer program to simulate the operation of the NASA/JSC MIST Laboratory. This Laboratory is designed to test the integration capability of the following subsystems of a MIUS: (1) electric power generation, (2) space heating and cooling, (3) solid waste disposal, (4) potable water supply and (5) waste water treatment. The SINDA/MIST computer model is designed to simulate the response of these subsystems to externally impressed loads. The model determines the amount of recovered waste-heat from the prime mover exhaust, water jacket and oil/aftercooler, as well as that from the incinerator. This recovered waste heat is used in the model to heat potable water for space heating and absorption air conditioning, for waste-water sterilization and to provide for thermal storage.

The report also describes the details of the thermal and fluid simulations of MIST including system configuration, modes of operation modeled, SINDA model characteristics and the results of several analyses. With appropriate modification the computer model can simulate MIST performance when using additional equipment such as "water-fired" absorption chillers, pyrolysis systems, solar-heat collectors, fuel cells, combined-cycle turbines, etc.

TITLE: Site Analysis and Field Instrumentation for an Apartment Application of a Total Energy Plant

AUTHOR(S): J.B.Coble; P.R.Achenbach

DATE OF ISSUANCE: 5/75

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; COM-75-10689

OTHER IDENTIFICATION: Presented as two papers at 7th IECEC San Diego, CA. 9/25-29/1972, (Not in IECEC proceedings); NBSIR 75-711

TOTAL PAGES: 59 TOTAL REFERENCES CITED: 16 CLASS. OF DOCUMENT: (P)

ABSTRACT

A feasibility study by NBS- sponsored by HUD -developed criteria for selecting sites for and evaluating the requirements of a total energy (T.E.) system at one or more housing sites. Six sites were selected for the feasibility study: Jersey City, N.J.; Macon, Ga.; Memphis, Tenn.; Indianapolis, Ind.; St. Louis, Mo.; Sacramento, Calif. Parameters used for making the final selection were number of dwelling units, density of dwelling units, climatic factors, energy utilization, owning/operating costs and developer's attitude.

Jersey City was chosen as the location for the installation, evaluation and field study of the T.E. system. The site covers six acres; it has four apartment buildings (containing 488 dwelling units), ∿ 50,000-sq. ft. of commercial buildings, an elementary school, swimming pool and the T.E. plant.

The buildings and the T.E. plant have been extensively instrumented to provide data on fuel utilization, system efficiencies, electrical and thermal energy generation and energy utilized and rejected. The environmental impact of the plant with respect to noise, vibration, air pollution and esthetics is under evalution. The installed system will be compared with that for several types of conventional energy systems.

TITLE: Concept Preliminary Evaluation: Small Coal Burning Gas Turbine for Modular Integrated Utility System

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 1/75

DOCUMENT PREPARED BY:

RESPONSIBLE ORGANIZATION(S): HUD + Office of Coal Research (OCR), U.S. Department of the Interior

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; PB-239109.GPO; I63.10:96/Int. 1

OTHER IDENTIFICATION: OCR Report No. 96 (Interim Report #1); OCR Contract 14-32-0001-1742; HUD Contract IAA-H-40-72 (report for May-Sept, 1974)

TOTAL PAGES: 24 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (P)

ABSTRACT

The paper summarizes a series of on-going design studies, outlines the principal possibilities for small coal-burning gas turbines, and indicates the effects of major parameters on both capital cost and thermal efficiency of MIUS plants using such turbines.

A MIUS coal-fired total energy system would supply electricity, hot water, building heat and air-conditioning 4 to 8 units of 350 to 500 kW(e) capacity would be used to provide the necessary redundancy for high reliability. To meet environmental standards for sulfur emissions, implies the use of a fluidized-bed coal combustion-chamber which also makes it possible to minimize NO_x formation.

The poor efficiency of steam turbines, in relatively small sizes, makes a gas turbine a logical candidate for the desired themodynamic cycle. Inasmuch as the air fed to the turbine will be indirectly heated by the tube bank in the bed, and thus will not contail fly ash from the the coal, turbine-bucket erosion will not be a problem.

The principal developmental problems considered in the report are those associated with the fluidized bed combustion chamber. They include corrosion of the combustion gas-side, the reliability of coal feed equipment and the extent to which the system can be operated partially unattended.

TITLE: Small Urban Energy Stations to Burn Coal

AUTHOR(S): Magazine Staff

DATE OF ISSUANCE: 1/15/75

DOCUMENT PREPARED BY: "Electrical World" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "E.W." Magazine

OTHER IDENTIFICATION: pp. 74-76 (Energy Marketing)

TOTAL PAGES: 3 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This article summarizes the ORNL's Research and Development programs related to the fluidized bed combustion of coal and other fuels as the energy source for relatively small closed-cycle gas turbines. It is planned to couple such turbines to 350 to 500 KW generators which will supply electricity to T.E. and MIUS installations.

Generalized descriptions are given for the fluidized bed and the overall system design plus the thermodynamic cycle employed and the system's estimated costs. It is stated that a major purpose of the study has been to design units capable of semiautomatic operations.

TITLE: Survey of Turbine Bucket Erosion, Deposits, and Corrosion

AUTHOR(S): A.P.Fraas

DATE OF ISSUANCE: 12/16/74

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME; Paper #75-GT-123

OTHER IDENTIFICATION: Gas Turbine Division of ASME; Gas Turbine Conference and Products Show; Houston, Texas (3/2-3/6, 1975)

TOTAL PAGES: 12 TOTAL REFERENCE CITED: 28 CLASS. OF DOCUMENT: (PO)

ABSTRACT

This paper summarizes the principal information obtained from a comprehensive survey of the literature concerned with gas turbine-bucket erosion, deposits and corrosion. Additionally, it includes personal discussions with those who have worked in these problem areas.

The primary interest in the subject has to do with the possibility of employing gas from fluidized-bed coal combustion system to drive a gas turbine, along with the realization that the ash particles (in the gas) are likely to create serious problems for an "open-cycle" system. It is concluded that the superior characteristics of the fluidized-bed system will encourage the practical development of this concept.

TITLE: HUD Conducts Evaluation of Total Energy Plant

AUTHOR(S): M. Riback

DATE OF ISSUANCE: 9/74

DOCUMENT PREPARED BY: "Diesel and Gas Turbine Progress" Magazine

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: "D.G.T.P." Magazine

OTHER IDENTIFICATION: pp. 82-24; vol. 40, no. 9

TOTAL PAGES: 3 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

This semi-technical paper summarizes HUD's program for evaluating the performance of a T.E. plant at Jersey City, N.J. which was selected from a number of innovative housing projects sponsored by HUD under its "Operation Breakthrough".

The facility is described and its relation to HUD's MIUS program is explained as mainly to be a "working laboratory" in which new techniques can be used, studied and evaluated, while-at the same time-detailed determinations of energy usage of made.

TITLE: Small Coal-Burning Gas Turbine for Modular Integrated Utility Systems

AUTHOR(S): A.P. Frass

DATE OF ISSUANCE: 8/74

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME

OTHER IDENTIFICATION: Record of 9th IECEC; pp. 499-507; #749017

TOTAL PAGES: 9 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (PO)

ABSTRACT

The increasingly difficult supply situation for gaseous and liquid fuel and for electricity introduces a new element of risk into construction and operation of large new residential/commercial complexes. One logical approach is to develop and employ a total-energy (T.E.) system that will operate on coal. To meet environmental standards, these coal systems must include provisions for keeping sulfur emissions acceptable levels. This implies the use of a fluidized bed coal combustion-chamber with crushed limestone in the bed.

This paper reviews fluidized-bed technology, summarizes thermodynamic cycle analysis, summarizes a series of design studies, outlines the principal possibilities and indicates the effects of major parameters on both capital costs and thermal efficiency.

One of the conclusions reached is that the poor efficiency of steam turbines in small sizes makes a gas turbine a logical candidate for the thermodynamic cycle. It is also stated that the fluidized bed combustion system will operate well with liquid fuel, char, low-sulfur coal or solid organic waste. It could also be used as an incinerator. A further conclusion is that ∿85% of the energy in the fuel would be available for use, about one-third as electricity and about two-thirds as heat in the form of 65°C (149°F) domestic hot water and 120°C (248°F) steam from a waste-heat boiler.

TITLE: The MIST (MIUS Integrated and Subsystems Test) Laboratory: A Testbed for the MIUS (Modular Integrated Utility System) Program

AUTHOR(S): W.S. Beckham, Jr. (USPO); F.A. Keune (Hamilton Standard Div.)

DATE OF ISSUANCE: 4/30/74

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: ASME; ASME Paper 74-ENAs-44

OTHER IDENTIFICATION: Aerospace Division of ASME; Intersociety Conference on Environmental Studies; Seattle, Washington; July 29-Aug. 1, 1974

TOTAL PAGES: 8 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (PO)

ABSTRACT

The paper states that the MIUS program being conducted by NASA/JSC (and sponsored by HUD) is intended to develop an economically feasible Integrated Utility System (IUS). The MIUS concept will integrate utility services in order to achieve resource, energy and environmental benefits. Toward this end, the NASA Urban Systems Project Office awarded a contract to the Hamilton Standard Division of United Aircraft Corporation in 1973 to design and construct a test-bed IUS, called the MIST laboratory. The facility was completed early in 1974 and has begun a long-term program to develop data for MIUS. A description of the MIST is presented and the critical design issues, which can only be verified by test, are discussed in detail; a list of MIST's major equipment is included.

TITLE: Survey of Lube Oil Analysis Techniques to be Used at the Department of Housing and Urban Development Total Energy Plant, Jersey City, New Jersey

AUTHOR(S): R.F.Burchill

DATE OF ISSUANCE: 9/73

DOCUMENT PREPARED BY: Author/Mechanical Technology, Inc. (Latham, N.Y.)

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; COM-74-10929

OTHER IDENTIFICATION: NBS-GCR 74-23; Contract #1-35937

TOTAL PAGES: 21 TOTAL REFERENCES CITED: 13 CLASS. OF DOCUMENT: (P)

ABSTRACT

Lube oil analysis can be important consideration in the preventive maintenance program of diesel-engine-generators which provide prime power in MIUS/TE applications. This report surveyed possible lube oil monitors that would scientifically "inform" plant operators when oil needed changing rather than changing the oil after a fixed amount of operating hours.

Several lube oil monitors are discussed. Filter examination is used for aircraft gas turbine oil analysis; however, in diesel engines, the presence of combustion products requires a high level of detective skill. Magnetic drain plugs are useful but a failing gear may only result in a small amount of ferrous particles, while normal wear from cylinder liners, etc. can produce relatively large amounts of ferrous particles. Other monitor systems discussed are: chip detectors, oil-particle detectors, spectroscopic oil analysis and ferrographic techniques.

The report recommends that samples of the lube oil be regularly spectroscopically analyzed for wear particles and lubricant degradation and that the engine lube oil systems be set-up so that other types of lube oil monitors can also be used, as deemed necessary.

TITLE: Mechnical and Acoustical Signature Analysis of Engine-Generator Units to be Used at HUD's T.E. Plant, Jersey City, New Jersey (Interim Report)

AUTHOR(S): R.F. Burchill

DATE OF ISSUANCE: 5/73

DOCUMENT PREPARED BY: Author/Mechanical Technology, Inc.

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: NTIS; COM-74-10934/9

OTHER IDENTIFICATION: NBS-GCR 74-22; NBS Contract No. 1-35937

TOTAL PAGES: 351 TOTAL REFERENCES CITED: CLASS. OF DOCUMENT: (P)

ABSTRACT

This report summarizes the acoustical vibration (as well as stack gas temperature and conditions of each of 5 diesel-electric sets tested in the vendor's factory. The data in this report were collected simultaneously with data on fuel, cooling water and electrical transients during the factory acceptance tests. [NOTE: The tests were required by the purchase specifications and were supervised by the NBS staff. The purchase specifications were based upon previous total energy performance specifications developed by NBS for this period.]

"Signature" analyses of each engine, over the test load range, were calculated and plotted. The analyses show existing machinery unbalance, rotating component looseness, ball and roller bearing deterioration and gear damage/wear. These analyses can be regarded as baseline data which will be compared with ones taken at future dates as the engines age. Changes will be used to predict required maintenance services.

TITLE: The Application of Total Energy Systems to Housing Developments

AUTHOR(S): P.R. Achenbach; J. B. Coble

DATE OF ISSUANCE: 2/72

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: GPO; SD Catalog No. C13.10:361, Vol. 1 (for entire volume)

OTHER IDENTIFICATION: pp. 419-430 of Symposium on "Performance Concept in Buildings; Vol. 1: Invited Papers (Philadelphia, Pa.; May 2-5, 1972)

TOTAL PAGES: 12 TOTAL REFERENCES CITED: 5 CLASS. OF DOCUMENT: (P)

ABSTRACT

A pilot invesitation of the performance of a T.E. system was undertaken by NBS in order to evaluate the potential for decreasing the fuel required to provide the utility services to an apartment complex of 500 units, and to check on noise and air pollution effects. This installation is being made at a site in Jersey City, N.J. as a part of the BREAKTHROUGH program of HUD. The selection of the site followed a feasibility study of eleven sites distributed over the United States, and the preparation of a performance specification which set forth design conditions, requirements for reliability/stability/safety of the system, as well as the environmental quality that must be attained.

The pilot total energy plant is being extensively instrumented to determine its thermal efficiency, daily/seasonal/annual load patterns, stability/reliability of the utility services, level of noise/ pollution control, maintenance/repair requirements, owning/operating costs, occupant responses to their environments and characteristics of selected innovative plant components.

TITLE: A Feasibility Study of Total Energy Systems for "Breakthrough" Housing Sites

AUTHOR(S): P.R. Achenbach; et al

DATE OF ISSUANCE: 8/12/71

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NBS; NBS Report 10402

OTHER IDENTIFICATION: NBS Project No. 4213402

TOTAL PAGES: 52 TOTAL REFERENCES CITED: 7 CLASS.OF DOCUMENT: (P)

ABSTRACT

A feasibility study of the application of total energy systems to the prototype "BREAKTHROUGH" housing sites of HUD was undertaken by the Building Research Division of NBS. These systems were investigated as alternative utility systems for future application where low reserves in conventional energy sources might exist and/or the extension of conventional utility systems might be impractical.

Originally all 11 sites in the "BREAKTHROUGH" program were considered but 5 were eliminated in an early screening because of the small number and low density of the proposed dwelling units on these sites. The 6 remaining sites (Jersey City, Memphis, Macon, St. Louis, Sacramento and Indianapolis) were studied in relation to 14 different parameters that were considered to have a bearing on their suitability for a prototype total energy system. These parameters included factors of technical administrative and economic significance.

The study resulted in recommendations for the Jersey City site as a first choice for the installation of a diesel-powered total energy system, with the Memphis site as an alternate first choice using natural gas as the fuel. The Macon site was recommended as a good choice for a split system having a typical total energy system for the more densely-occuplied part of the site and using all-electric mechanical equipment, served by the total energy system, in the less densely-occupied areas. The St. Louis site was recommended as a third choic because the developments of its two parcels of ground were similar; it thus offered an opportunity for a direct experimental comparison of a total energy system with a conventional system a few blocks away.

TITLE: A Performance Specification for a Total Energy Plant at the Jersey City "Breakthrough I" Site

AUTHOR(S):

DATE OF ISSUANCE: 12/28/70

DOCUMENT PREPARED BY: NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: NBS; NBS Report 10313

OTHER IDENTIFICATION: NBS Project NO. 4213402

TOTAL PAGES: 17 TOTAL REFERENCES CITED: CLASS.OF DOCUMENT: (P)

ABSTRACT

The report states that the contractor shall design a T.E. plant to provide all of the energy services as specified for the HUD "BREAKTHROUGH I" site at Jersey City, New Jersey. This total energy plant is described as consisting of mechanical equipment for energy generation, conversion and transfer; a building for housing the mechanical equipment; the system for distributing the utilities to the dwellings and other buildings on the site. The installation will be the subject of a field study, after acceptance, which will evaluate its performance with respect to economy, effectiveness, technical design, reliability, versatility, environmental factors and occupant acceptance. To prepare for the field study, the system must be designed to incorporate or provide for the attachment of certain instruments and transducers as specified by NBS.

Details are summarized for the following guidelines and/or requirements, namely: costs, design (including utility loads), fuel, selection of equipment, system reliability, stability of electrical service, maintenance, noise/vibration control, air pollution control, thermal environment and ventilation, aesthetics, illumination, safety, utility distribution systems, integration of service systems, provisions for future expansion and quality assurance.

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