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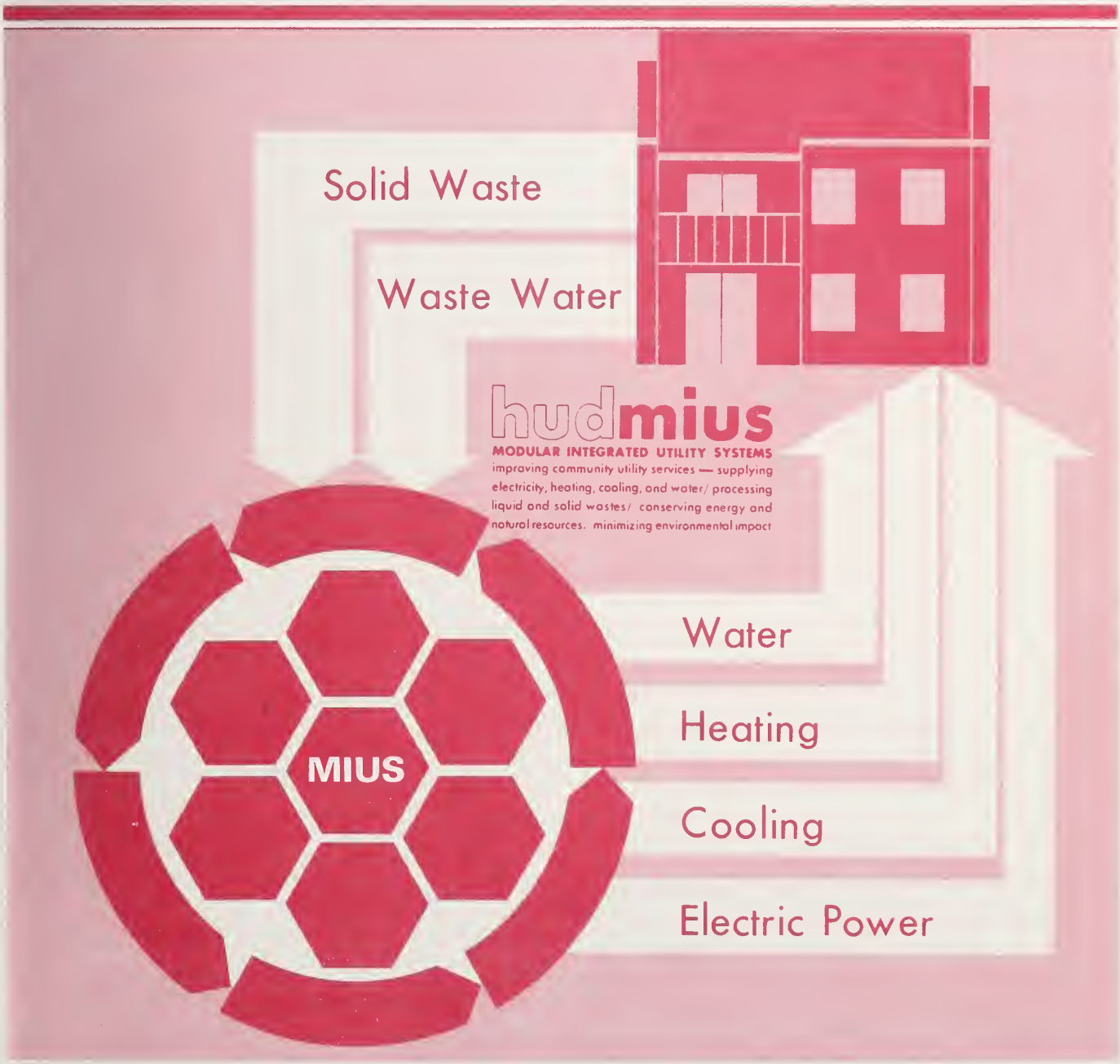
Department of Housing and Urban Development
Office of Policy Development and Research

NBS Special Publication 489 Supplement 1

Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program, Supplement 1



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[1]Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Washington, DC 20234.
[2]Some divisions within the center are located at Boulder, CO 80303.

Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program, Supplement 1

M. H. Nimmo and B. Reznek, Editors

Building Equipment Division
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National Bureau of Standards
Washington, DC 20234

Prepared for
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Department of Housing and Urban Development
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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

NATIONAL BUREAU OF STANDARDS
Ernest Ambler, Director

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FOREWORD

The Department of Housing and Urban Development (HUD) sponsored the Modular Integrated Utility System (MIUS) Program that was to develop and demonstrate the advantages of integrating systems that provide utility services - electric power, heating and cooling, potable water, liquid waste treatment, and solid waste management. The objective of the MIUS concept: furnish utility services consistent with a reduced use of critical natural resources, protection of the environment, and minimization of costs.

Under HUD's direction, several agencies participated in the HUD-MIUS Program. They included the Department of Energy, the Department of Defense, the Environmental Protection Agency, the Department of Health, Education and Welfare, the National Aeronautics and Space Administration, and the National Bureau of Standards. The National Academy of Engineering provided an independent assessment of the original Program. Drafts of most of the technical documents abstracted in this publication were reviewed by the agencies participating in the HUD-MIUS Program.

The HUD-MIUS Program and its related activities began at HUD in 1970. NBS SP 489 provided a catalog (titles, abstracts, bibliographic data) of materials published through August 1976. HUD and the National Bureau of Standards continued their collection and dissemination of information in support of the Program. This publication complements SP 489. It serves those who are interested in MIUS technology with information on reports issued subsequent to the publication of NBS SP 489.

Ernest Ambler, Director
National Bureau of Standards

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*Note: These "Reports" page numbers continue from those in NBS SP-489, in order to maintain continuity of pagination.

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 (now part of DoE)

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

AIChE - American Institute of Chemical Engineering; 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

DoE - Department of Energy; 20 Massachusetts Avenue, N.W., Washington, D.C. 20545

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 (now part of DoE)

ESOP - Energy Systems Optimization Program (Computer Software)

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; IUS 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); NASA

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 (Computer Program)

NO_x - Nitrogen Oxides

NTIS - National Technical Information Service (U.S. Dept. of Commerce)

ORNL - Oak Ridge National Laboratory (Operated by Union Carbide Corp. for AEC and its successors ERDA and DoE); 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

T.A. - Technology Assessment; T.E. - Total Energy

TES - Thermal Energy Storage

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

SI UNITS

In view of the presently accepted practice of industry in the United States, common U. S. units of measurement have been used in portions of this report. In recognition of the United States as a signatory to the General Conference of Weights and Measures, which gave official status to the metric SI system of units in 1960, appropriate conversion factors have been provided in the table below. The reader interested in making further use of the coherent system of SI units is referred to: NBS SP330, 1981 Edition, "The International System of Units," or E380-72, ASTM Metric Practice Guide (American National Standard 2210.1).

Metric Conversion Factors

Length	1 inch (in) = 25.4 millimeters (mm) 1 foot (ft) = 0.3048 meter (m)
Area	1 ft^2 = 0.092903 m^2
Volume	1 ft^3 = 0.028317 m^3
Temperature	F = 9/5 C + 32
Temperature Interval	1 F = 5/9 C or K
Mass	1 pound (lb) = 0.453592 kilogram (kg)
Mass Per Unit Volume	1 lb/ft^3 = 16.0185 kg/m^3
Energy	1 Btu = 1.05506 kilojoules (kJ)
	1 kWh = 3413 Btu
Specific Heat	1 Btu/[(lb) (°F)] = 4.1868 kJ/[(kg) (K)]

Abstracted Reports and Articles
of the HUD Modular Integrated
Utility Systems (MIUS) Program
Supplement 1

M. H. Nimmo and B. Reznek, Editors

ABSTRACT

This document provides an additional listing of reports and articles relating to the HUD-MIUS Program. Reports published and selected since the issuance of NBS SP-489 are listed. Also included, for the sake of completeness, are some earlier reports which had not been included in the original NBS SP-489. Both NBS SP-489 and this document are required for full coverage. The entry for each report contains an abstract and other pertinent information, including procurement sources and procedures. Reports are grouped by four general subject categories: Program/Concept Description; Systems Analysis; Technology Evaluation; and Hardware Evaluation & Demonstration. The reports are further classified into three publication/availability categories: government publications (Published Reports); non-government publications and articles (Outside Publications); and "informal" reports and data (Open-File Reports). An overall subject index has been included which covers both NBS SP-489 and this document.

Key Words: Abstracted reports and articles; coal-fired MIUS; comparison studies; concept background of MIUS; conservation of energy; energy analysis; HUD/MIUS Program; HVAC systems; performance analysis; solid waste; total energy; utility systems.

1. INTRODUCTION

This is an addendum to a previously issued 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 informal reports which should be accessible in the files of agencies that participated 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 news items in periodical publications are generally excluded, as are reports which were not a direct part of the 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 were subjected to certain "quality control" procedures. HUD 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 were submitted to all participating agencies for review. Comments were received and assembled by NBS into a CTR for resolution by the group preparing the report. Any unresolved comments were included separately in the Foreword to the final published report, along with a brief statement describing the CTR process.

Almost all Published Reports of the HUD-MIUS Program were subjected to the CTR process. In a few instances, 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 could be completed. Documents prepared during the early stages of the HUD-MIUS Program (i.e., 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 entries, 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 report sections 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 below:

Program/Concept Description. 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. Provide data and evaluations of MIUS systems, and 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 and types of buildings are often presented.

Technology Evaluation. Generally focuses 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 & Demonstration. Primarily 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, Tennessee; systems and components at JSC, Houston, Texas. Reports provide overall goals, test plans, schedules and progress as well as actual research results and evaluations.

Several documents could be classified into more than one subject category; this is particularly true of those reports dealing with Hardware Evaluation & Demonstration, since some of these reports are technology evaluation and/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 classify documents into subject category by the major thrust of the document, with an eye towards the likely interests of various potential users of this document.

The reports and articles in this list have also been grouped into three major classifications corresponding to availability, as 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 of these publications have completed either the HUD-MIUS CTR process and/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 or coauthored by others (often largely based on technical data and material supplied by HUD-MIUS participants). These have been 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 HUD-MIUS (formal) 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 generally of limited interest outside the Program. Often they provide detailed data and calculations which are (also) summarized in formal published reports. They may also be of an incomplete/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, as such.

1.3 Format for Report Listing

One numbered page is (generally) devoted to each report. The following information is provided on these pages (with * items discussed below):

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

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

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

Responsible Organization(s): indicates the HUD-MIUS participating agency which sponsored a report prepared mainly by others under contract. This item is left blank for other than outside consultant/contractor report or (as appropriate) for reports in the "open" literature.

Procurement Source; Accession No.: indicates the procurement source and accession number for obtaining reports. Detailed information is provided in the Availability and Procurement Notes. For "Open-File" Reports, this item is always entitled: Reference Source & Accession No., so as to properly indicate that physical procurement is often not possible although the reports are available for review and reference on a "need-to-know" basis.

1.4 Availability and Procurement Notes

Published Reports are available from either the GPO or from NTIS, as indicated under Procurement Source. 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 by draft on an American bank.

The letter symbol, publication number, full title of the publication, SD catalog number, and SD stock number are mandatory 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 frequent 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 about 4 x 6 inches. Orders for publications should be made out to:

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
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; 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) 487-4660 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 processed, with probable 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, an order will be sent by first class mail within 24 hours. Or, you can pick up an order at the Washington Information Center & Bookstore or at the NTIS Springfield Operations Center for a $6.00 per item charge. Orders may also be placed by telephone or TELEX. The order desk number is (703) 487-4650 and the TELEX number is 89-9405.

Outside Publication reports and articles may generally be obtained from the publishing organization, subject to availability. Articles which are otherwise 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 cannot (in general) be removed from these locations but the researcher may be allowed to make copies of a limited amount of this material, depending on circumstances. The National Bureau of Standards maintains a complete file of all such reports as have been abstracted herein, as well as those in NBS SP-489. Other agencies participating in the program probably 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 contact:

Chief, Building Equipment Division
Center for Building Technology
National Bureau of Standards
Gaithersburg, Md. (physical location)
Washington, D.C. 20234 (mail location)

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

Chief, Systems Design Office, Mail Code EW4
National Aeronautics & Space Administration
Johnson Space Center
Clear Lake City, Tex. (physical location)
Houston, Tex. 77058 (mail location)

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

Chief, Utilities Research
Building Technology Division
Office of Policy Development and Research
Department of Housing and Urban Development
451 7th St., S.W., Room 8158
Washington, D.C. 20410

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

Manager, X-10 Site Groups
Efficiency and Renewables Section
Energy Division
Oak Ridge National Laboratory
P.O. Box X
Bldg. 4500N, Room 167
Oak Ridge, Tenn. 37830

2. PROGRAM/CONCEPT DESCRIPTION REPORTS

TITLE: Status Report: Rational Use of Energy Program

AUTHOR(S): ERDA

DATE OF ISSUANCE: 6/76

DOCUMENT PREPARED BY: Committee on the Challenges of Modern Society (CCMS) North Atlantic Treaty Organization
RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; ERDA-76/132]

OTHER IDENTIFICATION: ERDA-76/132

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

ABSTRACT:
This report was prepared as an account of work sponsored in part by the U.S. Government, through its treaty arrangements with the North Atlantic Treaty Organization (NATO), Committee on Challenges of Modern Society (CCMS). The report's MIUS statement is found on page 18 and is summarized below.

The overall objective of the MIUS study group (of CCMS) is to develop a methodology for comparing the technological and economic efficiencies of integrated utility systems for communities. The initial MIUS project meetings took place via a series of visits and discussions in Nov. and Dec., 1974 to determine the project's direction and scope. An organizing meeting was held in April 1975. The 20 representatives from seven countries attending the meeting expressed substantial interest in exchanging information on improved methods for providing efficient, integrated utilities services.

The Netherlands Central National Council for Applied Scientific Research hosted the MIUS working session in Apeldoorn on Dec. 9-10, 1975. At this meeting, an international glossary of MIUS terms in English, French and German was reviewed and approved and two working committees on Data Format and Measurement Technology were established to develop a uniform methodology and format for information exchange. The MIUS study group's next meeting was held on May 9-10, 1976 in France.

The USA has focused its efforts in this project on preparing the standard reporting "short form" and the glossary of terms. The United States' HUD-MIUS program is proceeding as planned. Currently, the Jersey City Total Energy Demonstration is in an operational data-gathering and evaluation phase. The design study for a MIUS demonstration on a 900-unit equivalent residential site is under way. ERDA (now DoE) has contracted for a feasibility analysis of a grid-connected system and has undertaken a major thrust to develop and commercialize various integrated systems concepts.

TITLE: Application of Modular Integrated Utility Systems (MIUS) Concept as a Strategy for Urban Rehabilitation and Development

AUTHOR(S): R.E. Gant

DATE OF ISSUANCE: September 1980

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Contact ORNL (Refer to ORNL/HUD/MIUS-53)

OTHER IDENTIFICATION: ORNL/HUD/MIUS-53; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 DOE 40-333-72

TOTAL PAGES: 66 TOTAL REFERENCES CITED: 31 CLASS OF DOCUMENTS: (P)

ABSTRACT: The primary objective of this investigation was to define the existing physical and environmental status of the USA's major metropolitan areas and to assess the potential role of the MIUS concept as a housing strategy for implementing redevelopment/rehabilitation in such areas. Analyses of data from the 100 largest metropolitan areas indicated that in many cities the combination of inadequate utility services (i.e., those having deteriorating, aging and/or undersized infrastructures) and unacceptable environmental quality may severely restrict their redevelopment/rehabilitation alternatives.

Results of air quality investigations indicate that almost all areas were not in compliance with the national primary air quality standards. Also acceptable disposal sites and proven management alternatives for municipal solid waste are decreasing, with the result that some urban areas are developing their own resource-recovery strategies.

Among other things, this document reports on the number and capacity of landfills in each state. It examines the adequacy of current water treatment practices, as based on the detection of halogenated organics in municipal drinking water supplies; water quality data from 38 metropolitan areas is presented. Migration patterns have also been assessed so as to determine the population dynamics of metropolitan areas and as an indication of future utility requirements and housing patterns.

A case study of Philadelphia was used to characterize the potential role of MIUS in this community, since housing patterns and planned redevelopment efforts and a proposed metropolitan district-heating system made the MIUS concept an attractive alternative for the city's strategy planning.

The results of this investigation indicate that many cities would benefit from using the MIUS concept in their rehabilitation and redevelopment efforts. As urban areas encounter increasingly stringent environmental regulations, deteriorating physical facilities and uncertain energy supplies, the MIUS concept becomes an attractive strategy for meeting the present and future needs of cities.

TITLE: MIUS Feasibility - Five Exploratory Studies

AUTHOR(S): D.J. Mitchell

DATE OF ISSUANCE: 1/1980

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Contact NBS (Refer to NBSIR 79-1787)

OTHER IDENTIFICATION: NBSIR 79-1787

TOTAL PAGES: 157 TOTAL REFERENCES CITED: 4 CLASS OF DOCUMENTS: (P)

ABSTRACT: This publication is one of a series, developed under the HUD-MIUS Program, which describes the collaborative efforts of NBS, NASA and their contractors in the comparative analysis of a MIUS and conventional utilities, for separate housing projects. These efforts consisted of three separate tasks, namely: Comparative Environmental Analysis; Comparative Energy Anslysis; Utility System Design and Cost Analysis.

These studies highlight the comparisons between the estimated energy use of the housing projects in question, when serviced by a MIUS and by existing utility technology. The utilities studied were: electricity, HVAC, domestic hot water, potable water, wastewater treatment and solid-waste disposal. NASA and NBS undertook separate energy and cost analyses which looked into the impact on each utility service and the total effect on all utilities. This report details the methods used to design and evaluate the MIUS and conventional utility systems, for each of the 5 projects.

The "planned" projects ranged in size from 344 to 1628 dwelling units and were made up of varying mixes of: mobile homes; single-family attached and detached residences; and multi-family, low and high rise buildings. One of the projects (1264 dwelling units) included a "village center" of 20,000 sq. ft.

The Comparative Environmental Analysis Task covered the following parameters: Ecology; Physical/Chemical; Aesthetics; Social. The Comparative Energy Analysis Task utilized the developer's site and conceptual (building) plans, plus (preliminary) engineering reports, to formulate inputs for the site load calculations. A detailed analysis was used to generate the site loads (as they were related to both occupancy and weather) under both "average" and "design" conditions. These loads were, in turn, used as an input for the Utility System Design and Cost Analysis Task, which calculated the comparative energy consumption, vis-à-vis MIUS and conventional utility schemes.

Costs were developed using site or regional variations (as available) for fuel, labor, purchased utility services and taxes.

TITLE: Guidelines for Evaluation of a MIUS Demonstration

AUTHOR(S): R.A. Grot; et al

DATE OF ISSUANCE: 12/78

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 291-441]

OTHER IDENTIFICATION: NBSIR 78-1563

TOTAL PAGES: 43 TOTAL REFERENCES CITED: 14 CLASS OF DOCUMENT: (P)

ABSTRACT:
HUD's Office of Policy Development and Research had been working to reduce the cost of utility services, in order to lessen a major constraint on the production and marketability of housing. This effort has resulted in increasing attention to the consumer side of the energy problem, especially as it relates to residential energy consumption. HUD's research efforts were directed to a more efficient utilization of energy, rather than to increased production of energy, since overall efficient use in housing and associated facilities is important. As a part of its work in energy research for community development, HUD sponsored the development of a Modular Integrated Utility System (MIUS).

The integration of (normally) separate, required utility services into an integrated utility system and the development of that system on a modular basis, in step with the development of the community, are conceptually attractive. However, the nature of the process under which a community is established and the lack of experience and expertise which a conventional developer has at his disposal led HUD to undertake a demonstration project to investigate how a MIUS would be designed, constructed and evaluated as a part of the total development of the community. The principal objectives of the MIUS demonstration were: a) to demonstrate its technical performance and public benefits; b) to demonstrate the viability of private sector ownership and operation; c) to establish a data base to further implementation of the MIUS concept.

In order to maximize the benefits from a demonstration of a MIUS, a carefully-planned evaluation should: a) assess its technical performance; b) determine the public benefits; c) show the viability of private ownership; and d) provide a data-base to support future analyses of said MIUS. This document is a guideline for the development of a detailed evaluation plan for a MIUS facility which was planned as a demonstration site at St. Charles, Maryland. Generic types of technical, institutional and economic issues are discussed. General performance measures for the total system, and for each subsystem, are identified. The classes of data required and the types of data analyses that should be employed are outlined.

TITLE: Performance Guidelines for a Modular Integrated Utility System

AUTHOR(S): D.J. Mitchell

DATE OF ISSUANCE: 11/78

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 289-783]

OTHER IDENTIFICATION: NBSIR 78-1395

TOTAL PAGES: 89 TOTAL REFERENCES CITED: 10 CLASS OF DOCUMENT: (P)

ABSTRACT:
HUD is conducting the MIUS Program devoted to the development of the technical, economic and institutional advantages of integrating the systems for providing all (or several) of the utility services for a community. The primary objective of the MIUS concept is to provide the desired utility services consistent with a reduced use of critical natural resources, plus protection of the environment and minimization of costs. The program goal is to foster implementation of the integrated utility system concept by the private or public organization that has been selected by a given community to provide its utilities.

These MIUS Performance Guidelines are an aid to the drafting of conceptual, preliminary and final designs for a specific MIUS planned for a particular geographic location.

The document identifies the constraints associated with: the electrical supply; source(s) of thermal energy; solid-waste management; potable water supply; and wastewater treatment for a residential or residential/commercial development (as provided by a local, onsite integrated entity). It also addresses the collection and distribution of these utility services to the outer wall "interface" of each user building; the utility distribution internal to a "user building" is not covered. [Note: the term user building is taken to mean any building, or site facility, served by a MIUS utility subsystem.]

This document defines the suggested (generic) performance of a MIUS serving a residential/commercial development. Performance requirements, criteria, and evaluations identify the engineering parameters and other constraints associated with the utilities to be provided by a local, integrated source. Included are performance requirements, criteria and evaluations for the environmental impact, health, safety and subjective acceptability. It is recognized that because of the many possible combinations of MIUS designs, ownership, methods for implementation and local regulations, a MIUS implementor may want to omit and/or greatly simplify many of the performance requirements, criteria and evaluations contained herein.

TITLE: International Project Catalog of Modular Integrated Utility Systems

AUTHOR(S): M.H. Nimmo; C.W. Phillips

DATE OF ISSUANCE: 7/78

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; Stock No. 003-003-01953-4]

OTHER IDENTIFICATION: NBS Special Publication 515; NATO/CCMS 73

TOTAL PAGES: 455 TOTAL REFERENCES CITED: 27 CLASS OF DOCUMENT: (P)

ABSTRACT:

The International Project Catalog was prepared for the Committee on the Challenges of Modern Society-Rational Use of Energy Pilot Study - Modular Integrated Utility Systems (CCMS-MIUS Project). The catalog is a compilation of project descriptions of more than 200 MIUS-type projects being conducted in the participating countries. Each description includes: an outline of each project, its status, the approach used, expected results, basic technical data, the principal investigator, an indication whether or not data is (or will be) available and other miscellaneous project information. The catalog is useful: in (1) identifying the various projects in progress and (2) to persons seeking further technical information on particular projects in which they are interested.

The catalog is the first of a three level system to report on MIUS type of projects. The second and third level reporting systems, which are expected to be improved and completed in future activities under another international organization, will provide information and guidelines for reporting progress and supplying data. The catalog consists of three parts: an Introduction; list of Projects by Country; and Project Descriptions, one for each project reported.

The Catalog has been designed to facilitate the location of projects by country and type (e.g., total energy, district heating) and to aid in the inclusion of future revisions.

TITLE: Committee on the Challenges of Modern Society, Rational Use of Energy Study, MIUS Project Final Report (Vols. I and 2)

AUTHOR(S): M.H. Nimmo; C.W. Phillips

DATE OF ISSUANCE: 6/78

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 283-428 & PB 283-429]

OTHER IDENTIFICATION: Vol. 1 (Description, Activities and Products): NBSIR 78-1468-1, NATO/CCMS No. 74-1; Vol. 2 (Minutes of Project Meetings): NBSIR 78-1468-2, NATO/CCMS No. 74-2

TOTAL PAGES: 258 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (P)

ABSTRACT:

Volume 1 of this report, by the Committee on the Challenges of Modern Society - Modular Integrated Utility Systems (MIUS) Project, includes: a description of the project; its objectives; the chronology of the project; a description of its activities and products; copies of its products (Appendices A-E). Volume 2 includes the minutes of the CCMS-MIUS Project meetings, severally identified as Appendices F-J. This report further discusses the progress of each activity and product and gives the Committee's recommendations, which call for the continuation of the project activities.

The objectives of the CCMS-MIUS Project were to identify MIUS-Type Projects in participating countries and to develop a mechanism for transferring technical data, concerning these projects, to experts in the participating countries. The Project had its first meeting in Brussels, April 10-11, 1975 and its fifth (and last) meeting in Turin, July 12-14, 1977.

The Project produced a glossary of special terms, a project summary form for the International Project Catalog (NATO/CCMS 73, NBS SP-515; July, 1978) and a list of research needs in MIUS Type of Projects. It began development of (1) a project progress/evaluation report, (2) a standard methodology for measuring the performance of MIUS Type of Projects and (3) a paper on "Incentives and Barriers". The glossary is expected to promote a greater understanding of terms unique to MIUS. The project summary form was developed to seek project descriptions for the catalog, which identify MIUS Type of Projects. The project progress/evaluation reports on progress and summarizes technical information, for purposes of evaluation and comparison. The standard methodology identifies the type of information required for measuring the performance of a MIUS Type of Project and for the collecting and reporting of data.

TITLE: Total Energy Applications for Commercial and Residential Space Conditioning and Electricity Requirements

AUTHOR(S): J.A. Orlando; N.R. Friedman

DATE OF ISSUANCE: 3/78

DOCUMENT PREPARED BY: Authors/Mathtech, Inc. (Washington, D.C.)

RESPONSIBLE ORGANIZATION(S): Mathtech, Inc.

PROCUREMENT SOURCE; ACCESSION NO.: [Government Institutes, Inc. 4377 Bethesda Ave., N.W., Washington, D.C. 20014]
OTHER IDENTIFICATION: "Proceedings of 5th Energy Technology Conference"; Washington, D.C.; Feb. 27-March 1, 1978; pages 858-864

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 4 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This paper deals with various aspects of cogeneration and its relation to Total Energy (T.E.). Cogeneration is defined as the simultaneous generation of electricity and useful thermal energy in a single facility. Generally, the thermal energy can be utilized for heating and cooling in residential, commercial, industrial and institutional applications. Ther term DEUS (Dual Energy Using System) is used synonymously with the work cogeneration.

As a basis for some of their research activities, DoE collected actual data on several operating cogeneration systems. Specifically, DoE attempted to document the decision processes leading to the implementation of a DEUS and the actual resulting operating experience. DoE reported several conclusions on the basis of their case studies. Specifically, that the economic viability and operating mode for a cogeneration system is a direct function of the relative prices of energy. Second, it was concluded that the system design must be flexible to allow for the many changes that are likely to occur to the community over the life of the DEUS. One approach is to deal in community services rather than in energy forms directly; i.e., the community planner must choose from among options for providing space heating, cooling, etc., rather than from among options for providing gas or oil or electric power.

The paper states that there are several conclusions that can be made regarding the cogeneration concept. First, under foreseeable energy prices, there is only a thin profit margin available from the use of a T.E. system. Second, operators need to have a maintenance orientation and the revenue base necessary to provide adequate maintenance. Third, the plant owner must establish a revenue schedule which prices products at their value and above their cost to produce.

TITLE: The Annual Cycle Energy System Concept and Application

AUTHOR(S): J.C. Moyers; E.C. Hise

DATE OF ISSUANCE: 10/77

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: [Pergamon Press, Inc.; Maxwell House, Fairview Park, Elmsford, N.Y. 10523]
OTHER IDENTIFICATION: "International Conference on Energy Use Management"; Tuscon, Arizona; Oct. 24-28, 1977; pages 231-238 (Vol. II)

TOTAL PAGES: 8 TOTAL REFERENCES CITED: 4 CLASS OF DOCUMENT: (PO)

ABSTRACT:

The Annual Cycle Energy System (ACES), under development at ORNL, promises to provide space heating, air conditioning and water heating at a significantly lower expenditure of energy than for conventional space conditioning and water heating systems. The ACES embodies heat pumping, thermal storage and (where climate dictates) solar assistance. In addition, the ACES presents the electric utility with a much flatter wintertime load profile than the air-to-air heat pump and permits managed operation to reduce the utility's peak air conditioning load. The concept is described in the paper, along with variations in design that permit flexibility to maximize energy conservation or to provide load management capabilities. Installations that exist (or are under construction) are described and variations are discussed that are incorporated to meet specific objectives.

The ACES system - through a combination of heat pumping, thermal storage, and solar assistance - provides an integrated approach to meeting space heating, water heating and air conditioning requirements with significantly reduced energy consumption. The concept offers flexibility in design and operation to meet alternative objectives of energy conservation and management of loads imposed on the utility. The four demonstration projects under way should provide proof of the system's capabilities and serve to indicate the latitude that is available to the designer/user.

TITLE: An Overview of Urban Energy Systems Technology Options

AUTHOR(S): T.J. Marciniak & R.E. Holtz

DATE OF ISSUANCE: 10/77

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): Argonne National Laboratory

PROCUREMENT SOURCE; ACCESSION NO.: [Pergamon Press, Inc.; Maxwell House, Fairview Park; Elmsford, N.Y. 10523]
OTHER IDENTIFICATION: "International Conference on Energy Use Management"; Tuscon, Arizona; Oct. 24-28, 1977; pages 819-825 (Volume III/IV)
TOTAL PAGES: 7 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This Article states that there are options to the conventional means of meeting the electrical space heating/cooling and miscellaneous energy needs of an urban community. Many of these optional systems are both economic and energy conserving. The use of community energy systems (whether they are District heating and cooling, Total Energy or selective energy systems) can reduce the amount of scarce fuels needed to supply the energy needs of the community. Compared to an all-electric, conventional system, upwards of 40 to 50% of scarce fuel energy can be saved mainly because of the waste-heat useage from electrical generation.

The Article points out that the main problem faced by a designer of energy systems (in an urban environment) is what kind of system to choose and what technologies to incorporate. Moreover, the use of integrated systems is contingent upon many factors, including: energy savings; capital costs; fuel costs; refuse disposal costs; system reliability and maintainability; reliability of fuel source; and certainty of the estimated energy demand in the community. Further, one must give due consideration to the institutional problems that can originate thru the establishment of an independent system in an urban environment. It is essential to consider all such factors when considering an urban energy system. [In the preceding context, the MIUS is considered to be an "integrated" system, sponsored by HUD and based mainly on current technologies.]

TITLE: The Energy Conservation Potential of Modular Integrated Utility Systems in Residential-Commercial Applications

AUTHOR(S): W.R. Mixon

DATE OF ISSUANCE: 10/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [Pergamon Press, Inc.; Maxwell House, Fairview Park; Elmsford, N.Y. 10523]

OTHER IDENTIFICATION: "International Conference on Energy Use Management"; Tuscon, Arizona; Oct. 24-28, 1977; pages 827-833 (Volume III/IV)

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 8 CLASS OF DOCUMENT: (PO)

ABSTRACT:

HUD is conducting the MIUS Program which is devoted to the development and demonstration of the technical, economic and institutional advantages of integrating the systems for providing all (or several) of the utility services for a community. The concept utilizes a relatively small, combined utility plant located on the development site and has the objective of providing utility services in a way that reduces the use of critical natural resources, protects the environment and minimizes cost.

This paper summarizes the results, related to energy conservation, from analytical comparisons of MIUS with conventional utility systems, both serving a 720-unit garden apartment complex. Based on a commercially available MIUS model, using internal combustion engines to drive electric generators and utilizing waste heat from the engines for domestic heating and cooling, MIUS was shown to be significantly more efficient in the use of input fuel energy over a wide range of climate. Energy savings with MIUS ranged from about 14%, over the use of conventional heat pumps in San Diego, to 50% over the use of electric resistance heating in Minneapolis. An overall average of comparisons with 5 conventional models in 5 climates yielded a 30% savings of fuel energy with MIUS. [The effects on energy use from using solid waste incineration with heat recovery and thermal energy storage in MIUS are also discussed]

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

AUTHOR(S): J.D. Ryan and B. Reznek, Editors

DATE OF ISSUANCE: 8/77

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; SD Catalog No. C13.10:489]

OTHER IDENTIFICATION: NBS SP-489

TOTAL PAGES: 153 TOTAL REFERENCES CITED: 132 CLASS OF DOCUMENT: (P)

ABSTRACT:

This document provides a complete listing of significant reports and articles relating to the HUD-MIUS Program from (early) 1970 through August, 1976. 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/Concept Description; Systems Analysis, Technology Evaluation; and Hardware Evaluation & Demonstration. These Abstracts are further classified into 3 publication/availability categories; namely: government publications ("Published Reports"); non-government publications and articles ("Outside Publications"); and unpublished reports and data ("Open-File Reports").

TITLE: Some Institutional Factors Affecting MIUS - A Case Study and Annotated Bibliography

AUTHOR(S): J. Elder

DATE OF ISSUANCE: 6/77

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 268-425]

OTHER IDENTIFICATION: NBSIR 76-1103

TOTAL PAGES: 64 TOTAL REFERENCES CITED: 62 CLASS OF DOCUMENT: (P)

ABSTRACT:

This report considers some of the institutional factors which could affect the development and implementation of an innovative utility project and in particular that of a MIUS. A case study of the planning and implementation stages of a major utility project was undertaken along with several studies of less complex utility projects. The case studies and literature survey indicated a number of institutional factors, along with a wide range of issues associated with these factors. Specifically, the factors which are considered fall into the following areas: utility company response; local citizen group response; environmental group response; labor interests; builder/developer role; local planning agency and (local) state and Federal agency involvement. Economic and legal/regulatory factors are not considered in any detail.

An annotated bibliography, exploring the literature on institutional response to existing or proposed utility projects and to innovation in general, is included.

In addition to the case studies and the annotated bibliography, the report contains a list of researchers currently working on related programs. Also included are a list of journals and other major references which are likely to include relevant material.

TITLE: Siting of Modular Integrated Utility Systems (MIUS)

AUTHOR(S): W.R. Mixon

DATE OF ISSUANCE: 1977

DOCUMENT PREPARED BY: Author

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: [American Nuclear Society; Transactions Volume 27; TANSAO 27 1-1028(1977) ISSN:0003-018X]
OTHER IDENTIFICATION: 1977 Winter Meeting; San Francisco, Calif.; Nov. 27 - Dec. 2, 1977; pages 698-699

TOTAL PAGES: 2 TOTAL REFERENCES CITED: 3 CLASS OF DOCUMENT: (PO)

ABSTRACT:

The paper states that the primary goals of MIUS are to meet one or more of the following objectives:
1) conserve natural resources; 2) reduce energy consumption; 3) minimize environmental impact; 4) provide utilities in phase with the demands of community development; 5) eliminate the impact of local restrictions on waste treatment which can delay housing construction; 6) reduce total cost for utility services.

As part of the evaluation and assessment efforts of the MIUS Program, the potential impacts from construction and operation of a hypothetical MIUS model (using commercially available technologies) were analyzed and compared to that of alternative conventional systems. The objectives were to identify and compare the beneficial and adverse effects of MIUS with respect to program goals.

Characteristics of MIUS in relationship to siting criteria are briefly summarized, namely:
a) MIUS was estimated to use from 10 to 40% less land than conventional utilities, depending on whether MIUS uses storage ponds for cooling and/or fire protection.
b) Current technology MIUS would consume about 30% less fuel energy, averaged over ranges of climate and systems used for comparison, than conventional utilities.
c) Unlike conventional utilities, MIUS does not need to be located near surface water. MIUS can reuse treated liquid waste: for cooling tower makeup, as a supply to a cooling pond, for fire protection, or for irrigation - thereby meeting cooling and other requirements without additional withdrawal.
d) While definite conclusions depend on many site-specific factors, the MIUS can generally be characterized as a relatively small on-site utility system that conserves energy while providing equal services in an environmentally acceptable manner. Pollution of water and land from MIUS operation can be significantly less than from conventional systems.

TITLE: The Modular Integrated Utility System (MIUS) as a Potential Influence on Community Development

AUTHOR(S): W.R. Mixon

DATE OF ISSUANCE: 1977

DOCUMENT PREPARED BY: Author

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: ["Water, Air and Soil Pollution" 7(1977); pages 261-269]

TOTAL PAGES: 9 TOTAL REFERENCES CITED: 8 CLASS OF DOCUMENT: (PO)

ABSTRACT:

The MIUS Program is a multiagency effort directed towards the development, demonstration, evaluation and ultimate widespread application of a new option for providing utility services to communities. HUD is conducting the MIUS Program, which is devoted to the development and demonstration of the technical, economic and institutional advantages of integrating the systems for providing all or several of the utility services for a community. Possible utility services include the provision of electric power, domestic heating and cooling, potable water, fire protection water, liquid waste treatment and solid waste management. The objective of the MIUS concept is to provide the desired utility services in a way that is consistent with a significant reduction in the use of critical natural resources, protection of the environment and minimization of cost.

A MIUS might be sized to accommodate several hundred (or a few thousand) multifamily dwelling units, nearby single-family housing and associated commercial facilities. The MIUS is modular in that it can be installed near appropriate users in phase with the actual demands of community development or redevelopment. It uses an integrated systems approach, whereby some resource requirements of one service are met by utilizing the effluent of another. For example, heat rejected from electrical generation might be used for residential space heating and the effluent from liquid waste treatment might be used for fire pretection and/or cooling-tower water.

This paper summarizes the MIUS concept and the type and extent of its potential application. Possible interactions between MIUS and the local community are identified from a comparison of the technological and physical characteristics of MIUS with those of alternative conventional utilities. Possible impacts on land use and patterns of community development are emphasized.

TITLE: Energy Conservation Potential of Modular Integrated Utility Systems (MIUS)

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

DATE OF ISSUANCE: 9/76

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: [AIChE]

OTHER IDENTIFICATION: 11th IECEC Proceedings; pp 554-558 (#769094)

TOTAL PAGES: 5 TOTAL REFERENCES CITED: 8 CLASS OF DOCUMENT: (PO)

ABSTRACT:

The MIUS program, under the direction and sponsorship of HUD, is a multi-agency effort directed towards the development, demonstration and ultimate widespread application of a new option for providing community utility services. MIUS stands for a relatively small plant located within new housing developments or communities and which could provide all their utility services: electricity, heating and cooling, solid and liquid waste treatment and potable water. As with Total Energy Systems, the MIUS concept places electrical generation near consumers in order to economically utilize waste heat for domestic heating and cooling.

This paper summarizes results related to energy conservation, as derived from analytical comparisons of MIUS with conventional utility systems with both assumed to be serving a 720-unit garden apartment complex. Based on a commercially available MIUS model using gas-fueled internal combustion engines to drive electric generators, and with waste heat from the engines being used for domestic heating and cooling, MIUS was shown to be significantly more efficient in the use of input fuel energy over a wide range of climate. Energy savings with MIUS ranged from about 14% over conventional heat pumps in San Diego to about 50% over all-electric apartments with resistance heating in Minneapolis. An overall average of comparisons, with 5 conventional models in 5 climates, amounted to a 30% savings of fuel energy with MIUS. [The effects on energy use from using solid waste incineration with heat recovery and the application of thermal energy storage in MIUS are also discussed.]

TITLE: The Modular Integrated Utility Systems (MIUS) Program

AUTHOR(S): J. H. Rothenberg

DATE OF ISSUANCE: 9/76

DOCUMENT PREPARED BY: Author

RESPONSIBLE ORGANIZATION(S): HUD

PROCUREMENT SOURCE; ACCESSION NO.: [AIChE]

OTHER IDENTIFICATION: 11th IECEC Proceedings; pp 1719-1725 (#769297)

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (PO)

ABSTRACT:

MIUS is an extension of a total energy system but, in addition to performing energy-heat recovery functions, it also processes solid and liquid wastes and purifies water. In addition to saving energy, the MIUS concept minimizes the adverse environmental impacts of utility systems. HUD has organized the MIUS program into three phases. Phase I included the evaluation of available technology, development of component and system performance specifications and detailed technical/economic/institutional feasibility studies of the concept. At present, HUD-Policy Development Research is conducting a demonstration of a total energy system in Jersey City, N.J. coupled with an "automatic" pneumatic trash collection system. A MIUS Integration and Systems Test (MIST) facility at NASA/JSC has been used for the development and verification of MIUS control systems. A coal-fueled MIUS is being developed which will enable the use of coal as a substitute for oil. Phase II of the HUD-MIUS Program, which investigated the construction and evaluation of a demonstration project in a private sector residential development, was initiated in April 1976. Phase III provides for the dissemination of the many study-phase results directly oriented to implementation of the concept.

The HUD-MIUS Program is one of the many national efforts to conserve energy and help the USA become more self-sufficient in meeting energy needs. Furthermore, the program has the added dimension of helping to solve community services needs, particularly those of wastewater and solid waste treatment. The MIUS, an alternative to large central stations, offers new capacity and improved efficiency in the provision of utility services.

TITLE: Modular Integrated Utility Systems (MIUS)

AUTHOR(S): W.R. Mixon; J.O. Kolb

DATE OF ISSUANCE: 12/75

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: [Clean Energy Research Institute; School of Engineering and Environmental Design; University of Miami]
OTHER IDENTIFICATION: "Energy Conservation: A National Forum"; Fort Lauderdale, Fla.; Dec. 1-3, 1975; Pages 432-442 of Forum Proceedings

TOTAL PAGES: 11 TOTAL REFERENCES CITED: 3 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This paper summarizes potential energy savings, air quality impacts and annualized costs resulting from application of the MIUS concept and compares them to alternative conventional utilities. Analyses are based primarily on use of currently available technology but the application of systems under development is also considered. The conclusions presented represent a current summary of results from evaluation studies of major components and subsystems applicable to MIUS, systems analyses comparing MIUS to conventional utilities serving identical consumer models and assessments of impacts from application of the MIUS concept.

To date, the series of evaluations and impact assessments that have been completed on MIUS technology lead to the following list of "general conclusions": 1) The quality and reliability of MIUS services can be at least equal to that of conventional utilities; 2) The potential to rapidly incorporate advanced technologies in MIUS is at least equal to, and perhaps better, than in conventional systems; 3) In its applicable market, MIUS would consume less energy from fuel resources than would projected alternative conventional systems; 4) MIUS dependence on gas or oil may overshadow its energy savings, but a system using coal fuel is under development; 5) The private cost of services from MIUS would be about the same as from conventional utilities; 6) Some of the environmental impacts from MIUS would be less than those from conventional utility systems and others would be greater; 7) Social, legal and institutional acceptance of MIUS could be achieved if the developer took certain steps to fully inform the public in a manner which would have promoted positive attitudes; 8) Apparently, there are no very important adverse secondary or higher order impacts caused by substitution of MIUS for conventional systems; 9) MIUS would have beneficial applications where there were building moratoriums because of inadequate utility service capacity. [MIUS could also be utilized at remote government installations or other remote sites.]

TITLE: Preliminary Considerations on Selection of a Universal MIUS Design Criteria

AUTHOR(S): C.F. Lively, Jr.

DATE OF ISSUANCE: 9/73

DOCUMENT PREPARED BY: Author/NASA-JSC; USPO

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE & ACCESSION NO.: [NASA-JSC]

OTHER IDENTIFICATION: JSC-08446; USPO Internal Note

TOTAL PAGES: 56 TOTAL REFERENCES CITED: 4 CLASS OF DOCUMENT: (OF)

ABSTRACT:

This document is a (preliminary) study of the combining of technical economic and marketing considerations needed to define one "universal" MIUS concept. The study outlines one approach which can be taken towards defining the (optimum) universal MIUS concept. The results and data are preliminary in nature and any conclusions that are drawn must also be considered preliminary and subject to verification.

A universal MIUS is defined as one having a "population" large enough to be economically produced and marketed. Associated questions relate to: 1) whether MIUS can be designed to meet the design criteria of a market segment large enough to attract a manufacturer; 2) the nature of said design criteria; and 3) the size of the associated market. This study presents one approach to these problems. The criterion used in the study was to select locations which would appear to be most economical for a MIUS and which have reasonable environmental variations; i.e., those which had the largest electrical/fuel-oil cost ratios and, hence, maximum potential cost savings.

The MIUS characteristics variation, for the design range chosen, was relatively large. It was concluded that the design of a single preengineered, manufactured product (having a large market potential) is not feasible. The universal MIUS concept would in all likelihood reduce to a preliminary MIUS design concept, with a catalog of components; i.e., the MIUS design would be somewhat different for each location and facility, with components selected from a catalog of MIUS components for each such application.

TITLE: Marketing Considerations for a Modular Integrated Utility System (an "Executive Summary")

AUTHOR(S): R.F. Stone; et al

DATE OF ISSUANCE: 8/73

DOCUMENT PREPARED BY: Abt Associates, Inc. (Cambridge, Massachusetts)

RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: [Abt Associates]

OTHER IDENTIFICATION: Contract NASA-2022; JSC EZ-3/73-295

TOTAL PAGES: 35 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This report describes a study of the market characteristics of MIUS on a national, state and municipal level; it seeks to define the distributions (by size) of various building types that may be amenable to MIUS and also to determine the number of MIUS units that could provide utility services (in four size ranges) for each building type. This new building market may be comprised of groups of buildings or individual buildings. The potential markets for MIUS are also examined from national, state and municipal viewpoints. Resource savings through MIUS-based on both building construction and municipal utility expansion forecasts - are determined.

It is concluded that individual apartment buildings, between 100 to 500 dwelling units up to between 500 to 2000 dwelling units, are potential primary markets for MIUS to attempt to capture. Stores, schools, libraries (between 80,000 and 400,000 square feet) and offices larger than 80,000 square feet should also provide excellent secondary markets. Overall, the projection is that slightly more than 25% of all building construction appear suitable, in size and specifications, as potential markets for MIUS. [In addition, it seems that municipal utility companies may be in a position to use MIUS to serve that portion of utility expansion required by all new buildings.]

3. SYSTEMS ANALYSIS REPORTS

Systems Analysis Reports

These reports provide data and evaluations of MIUS systems, subsystems or components. Information is 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.

TITLE: Second Law Analysis of the Jersey City Total Energy Plant

AUTHOR(S):

DATE OF ISSUANCE: November 1978

DOCUMENT PREPARED BY: Professional Engineering Consultants; Sherwood, Wisconsin

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: Contact NBS

OTHER IDENTIFICATION: NBS Purchase Order 809281

TOTAL PAGES: 111 TOTAL REFERENCES CITED: 9 CLASS OF DOCUMENTS: (OF)

ABSTRACT: Whereas a First-Law analysis indicates a "supposed" annual efficiency of about 60%, a Second-law analysis of the Jersey City T.E. (JCTE) Plant shows that plant to have a true annual efficiency of 22+%, compared to 20% for a conventional system.

The plant produces electricity at an efficiency of over 40%, compared to about 30%, conventionally. Site hot water (for comfort heating and domestic uses) is delivered to the buildings at an efficiency of nearly 17%. Chilled water (for comfort cooling) is produced at an efficiency of 3%. The overall efficiency with which hot and chilled water are delivered is about 12.4%, as contrasted with nearly 14% for a conventional system; since the improvement in electrical performance exceeds the decrease in thermal performance, the overall T.E. plant is more efficient.

When the engines are credited for the useful thermal energy in the exhaust gases and cooling water their efficiency is 47%, or about 12% more than when only the shaft work output is utilized. [Note: the useful energy in the exhaust is recovered at an efficiency of less than 20%.]

The engines consume about 65% of the plant fuel; the other 35% is supplied to "boilers". The efficiency of the boilers is about 18%, which is typical of current hot water boiler technology. The efficiency of the chillers is about 15%, which is typical of absorption refrigeration.

Clearly, the heart of a T.E. plant is the engine-generator-heat recovery subsystem. The First-Law viewpoint would imply that the energy output of this subsystem - in electrical and thermal form - is delivered at an efficiency of 60% by JCTE, whereas the true efficiency (at which useful energy is delivered) is about 48%. Even more remarkable is the difference between the First and Second-Law efficiency of the boilers, about 80 and 20% respectively. Also, the respective First and Second-Law efficiencies of the chillers are about 50 and 15%. The First-Law efficiency makes a T.E. plant appear to be much more efficient at producing heated water (which is used to heat site hot water and to drive the absorption-type chillers) than it actually is.

TITLE: Performance Analysis of the Jersey City Total Energy Plant (Executive Summary)

AUTHOR(S): C.W. Hurley; J.D. Ryan; C.W. Phillips

DATE OF ISSUANCE: 3/82

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Contact NBS (Refer to NBSIR 82-2483)

OTHER IDENTIFICATION: NBSIR 82-2483; HUD Utility Demonstration Series Volume Eighteen

TOTAL PAGES: 68 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENTS: (P)*

ABSTRACT: Under HUD sponsorship NBS collected and analyzed engineering, economic, environmental and reliability data from a complex located in Jersey City, N.J. The complex covers 6.35 acres and consists of four medium to high-rise apartment buildings (containing 486 units), a 46,000 sq. ft. commercial building, a school (kindergarten through third grade), swimming pool and central equipment building (CEB).

Site construction started in 1971. HUD decided to design the CEB to meet both the thermal and electrical energy demands of the site, with the necessary equipment being installed to recover waste heat from five 600kW diesel-engine/generator units. In effect the CEB became a T.E. plant.

NBS was responsible for designing and installing the instrumentation and data acquisition system (DAS), to determine fundamental engineering data from the CEB and other site buildings. The "raw data" from the DAS (starting in April 1975) was processed by a mini-computer located at NBS and specially programmed to present a broad spectrum of engineering values and profiles. This report summarizes these instrumentation/data systems and provides an outline of the significant data, that was collected, plus an abbreviated version of the plant and site.

This Report also includes the summarized results of an analysis of the quality of utility services supplied to the site consumers plus an analysis of environmental tests which were performed to show the effects of the plant on air quality, noise and cooling-tower emissions. In general, these analyses reflected favorable results from this T.E. plant.

Economic and energy analyses are reviewed as operating results and on a comparative basis with 12 alternative system designs which were considered applicable for providing the site with equivalent utility services. Systems utilizing the T.E. concept showed significant fuel savings but do not (currently) represent attractive investments compared to conventional systems, at least not with presents fuel costs. [However, analysis of the engineering data indicates that significant fuel savings can be made by relatively minor adjustments in plant procedures.]

TITLE: Performance Analysis of the Jersey City Total Energy Plant (Final Report)

AUTHOR(S): C.W. Hurley; J.D. Ryan; C.W. Phillips

DATE OF ISSUANCE: 4/82

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: Contact NBS (Refer to NBSIR 82-2474)

OTHER IDENTIFICATION: NBSIR 82-2474; HUD Utility Demonstration Series Volume Thirteen

[Note: Some of the References are cited more than once.]

TOTAL PAGES: 386 TOTAL REFERENCES CITED: 81 CLASS OF DOCUMENTS: (P)*

ABSTRACT: Under the T.E. concept, efforts are made to recover (normally) wasted heat and utilize it for space heating, domestic hot water and space cooling using absorption-type chillers. The use of such heat reduces the additional conventional energy required to meet these needs. Since T.E. requires the generation of electrical power to be near the area of the utilization of the waste heat, the application of on-site electrical generation systems is encouraged.

Under HUD sponsorship NBS collected and analyzed engineering, economic, environmental and reliability data from a complex located in Jersey City, N.J. The complex covers 6.35 acres and consists of four medium to high-rise apartment buildings, (containing 486 units), a 46,000 sq. ft. commercial building, a school (kindergarten through third grade), swimming pool and central equipment building (CEB).

Site construction started in 1971. HUD decided to design the CEB to meet both the thermal and electrical energy demands of the site, with the necessary equipment being installed to recover waste heat from five 600 kW diesel-engine/generator units. In effect the CEB became a Total Energy (T.E.) plant, utilizing absorption-type chillers; this T.E. plant has been serving the complex since Jan. 1974.

NBS was responsible for designing and installing the instrumentation and data acquisition system (DAS), to determine fundamental engineering data from the CEB and other site buildings. The "raw data" from the DAS (starting in April 1975) was processed by a mini-computer located at NBS and specially programmed to present a board spectrum of engineering values and profiles. This report describes these instrumentation/data systems and presents the significant data, plus a performance analysis of the plant and site.

Continuous, on-site, measurements were the major part of the NBS/JCTE monitoring program. Selection of the measurement parameters as well as their frequency, accuracy and duration were determined by the data requirements of the evaluation process. These monitoring efforts included: plant and site energy use studies; plant component performance; and assessment of the quality of the utility services supplied to the site tenants.

The energy study plan sought to account for: all (significant) energies supplied to the plant; that portion used by the plant for its operation; the energy supplied to each of the site buildings; distribution losses; and energy discarded from the plant as "waste heat". These data were used to calculate an overall value for plant energy effectiveness, as a function of time.

The instrumentation and data acquisition systems monitored approximately 135 plant and 90 site variables, at five-minute intervals, on a year-round basis. The system recorded on magnetic tape for shipment to NBS for processing. A Modem link (over a direct telephone line from the CEB to NBS) was also available for the transmission of real-time data, during the later part of the period covered by this report.

The accuracy of the engineering data presented in this Report is primarily dependent upon the accuracy of the measurement instrumentation. In general, the DAS instrumentation was capable of producing data at acceptable levels of accuracy for heat balance calculations, load patterns, mathematical models, etc. [Naturally, the accuracy of those values computed from more than one DAS channel depends on the combined accuracy of the indiviual pieces of instrumentation involved in presenting the data for the calculation.]

Economic and energy analyses are presented, both as operating results and on a comparative basis with 12 alternative system designs considered applicable for providing the site with equivalent utility services. Although those systems utilizing the T.E. concept showed significant fuel savings such systems do not (currently) represent attractive investments compared to conventional systems, at least not with present fuel costs. [However, the analysis of the engineering data does indicate significant savings in fuel can be made by relatively minor adjustments in plant procedures.]

This Report also includes the results of an analysis of the quality of utility services supplied to the site consumers plus an analysis of environmental tests which were performed to show the effects of the plant on air quality, noise and cooling-tower emissions. In general, these analyses reflected favorable results from this T.E. plant.

TITLE: Executive Summary: Operation Breakthrough Site Waste Management Systems and Pneumatic Trash Collection
AUTHOR(S): J.P. Overman; et al

DATE OF ISSUANCE: 11/78

DOCUMENT PREPARED BY: Hittman Associates, Inc. (Columbia, Md.)

RESPONSIBLE ORGANIZATION(S): Municipal Environmental Research Laboratory, Office of Research and Development (EPA)
PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978, 621-422/221]; [NTIS; PB 280-143]
OTHER IDENTIFICATION: HUD-PDR-199-4; HUD Utilities Demonstration Series Volume 4; Contract No. 68-03-0094

TOTAL PAGES: 36 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (P)

ABSTRACT:

The Report states that HUD's "Operation Breakthrough" (O.B.) programs demonstrate quieter, more sanitary, more convenient and more economical waste collection systems within buildings, complexes and municipalities. In the study summarized here, nine sites were analyzed and compared as to: economics; effectiveness; environmental factors; efficiency of operation; and acceptance by residents. Eight of the sites used various trash collection methods, ranging from conventional curbside pickup to centralized compaction and pickup. The ninth site (at Jersey City, N.J.) used a pneumatic trash collection (PTC) system, the first installation of its kind in a residential complex in the United States. This report summarizes the evaluation of the refuse management systems at the O.B. sites, particularly stressing the PTC system evaluation and the refuse system user acceptance surveys at eight of the sites.

A PTC system is a solid-waste management system that automatically collects all such waste generated at a site (with the exception of "bulky" waste) and compacts this refuse into sealed containers. It is designed to be a quieter, more sanitary and odorless service as well as one that is convenient for users. The system is ultimately designed to reduce operating costs, manual labor and energy requirements and thereby to provide for a more effective and efficient refuse collection service as compared to conventional systems.

TITLE: Potential Energy Savings in Commercial/Residential Communities Based on Integrated Systems Design

AUTHOR(S): R.E. Holtz; T.J. Marciniak

DATE OF ISSUANCE: 11/77

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): Argonne Laboratory

PROCUREMENT SOURCE; ACCESSION NO.: [ASME]

OTHER IDENTIFICATION: "Heat Transfer in Energy Conservation", pp 27-32; Winter Annual Meeting of ASME; Atlanta, GA, 11/27-12/2/77

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

ABSTRACT:
This paper documents a preliminary engineering analysis of alternative concepts of Integrated Community Energy Systems (ICES), as applied to a commercial/residential development designed to use conventional energy service systems. These studies have been conducted to explore the potential of ICES and the application of new technologies to meet community energy requirements. The studies were also conducted to: (1) develop ICES concepts; (2) compare these concepts with conventional energy supply systems, in terms of energy conservation and economics; and (3) identify potential problems in the development of ICES concepts. [Note: Planning information and energy load characteristics for the development had been supplied by the developer.]

Three ICES layouts have been investigated, for both a shopping center and a shopping center/commercial/residential development. These systems were conceptualized to meet the anticipated energy demands. The report shows that considerable energy savings can be obtained by employing such integrated energy systems. The prime contributor to this energy savings (in the diesel engine and fuel cell based systems) is the utilization of the waste-heat from the generation of electricity. A heat-pump centered system, which employs electricity from the grid, does not result in as large an energy savings as do the two systems which utilize waste heat; these savings are primarily due to the high COP of currently available heat pumps.

Various options to employ other energy sources to augment the primary energy source (i.e., fuel oil for diesel engines, natural gas for fuel cells and electricity for heat pumps) are also available. These options include the following: solid wastes; liquid wastes; and solar energy.

Implementation of an ICES is found to be contingent upon factors such as: energy savings; life-cycle costs (i.e., initial costs, projected fuel costs and other O/M costs); system reliability and maintainability; reliability of the fuel source; and the certainty of estimated energy demand for the community. It is quite essential to consider all such factors when designing an integrated community system.

TITLE: Feasibility Analysis for the Integration of an Incinerator with Waste Heat Recovery at the HUD Jersey City Total Energy Demonstration Site.

AUTHOR(S):

DATE OF ISSUANCE: 9/77

DOCUMENT PREPARED BY: American Hydrotherm Corp. (New York, N.Y.); Contract H-2155 (Modification No. 1)

RESPONSIBLE ORGANIZATION(S): American Hydrotherm Corp.

PROCUREMENT SOURCE; ACCESSION NO.: [HUD; Office of Policy Development and Research]

OTHER IDENTIFICATION: HUD-PDR-199-6 (11/78); HUD Utilities Demonstration Series Volume Sixteen

TOTAL PAGES: 174 TOTAL REFERENCES CITED: 16 CLASS OF DOCUMENT: (P)

ABSTRACT:

The Summit Plaza Apartments Development in Jersey City, N.J. is a recently completed "Operation Breakthrough" site. One of the several innovative design concepts used at this project provided for a Total Energy (T.E.) system to supply electricity, winter heating, summer cooling and domestic hot water. [Many of the features of a T.E. plant are also components of the MIUS concept.] The retrofitting of an incinerator with waste heat recovery at this mixed-use site would further enhance its capability of improving utility services by locally processing the solid wastes generated on site, while simultaneously reducing the projects dependency on purchased (non-renewable) fossil fuel.

The Summit Plaza site was sponsored by HUD as a part of the U.S. Government's responsibility for utilities demonstrations. Its T.E. system is a fully monitored installation, with a continuing program which collects and analyzes data intended to be used to improve performance and enhance design criteria for future projects. In addition, the site is equipped with a Pneumatic Trash Collection (PTC) system which is described in detail in this report; the PTC lends itself to automation of the solid wastes handling and incineration systems. The J.C. site is particularly appropriate for a long term evaluation of an incineration system with waste heat recovery and has further validity as a demonstration of the viability of retrofitting a waste-heat recovery incinerator to an already existing project, thereby moving one step further in the MIUS concept of project self-sufficiency in all utility services.

The results of an investigation of available options for the installation of waste-heat recovery equipment, within the constraints imposed by an existing and occupied development, are summarized in this report. Since the investigation covered technically valid approaches (which were unsuitable solely because of restrictions imposed by conditions at this particular site) the report also attempts to fulfill a further function of presenting data on presently available, small or moderate-sized, factory-assembled incineration systems with waste heat recovery.

TITLE: Performance Analysis of the Jersey City Total Energy Site: Interim Report

AUTHOR(S): J. Hebrank; et al

DATE OF ISSUANCE: 7/77

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 269-517]

OTHER IDENTIFICATION: NBSIR 77-1243; HUD Utilities Demonstration Series Volume Seven

TOTAL PAGES: 175 TOTAL REFERENCES CITED: 10 CLASS OF DOCUMENT: (P)

ABSTRACT:

The Jersey City total energy plant consists of 5 diesel engine-generators with jacket and exhaust heat recovery, 2 hot-water boilers and 2 absorption chillers. The plant supplies all electrical power, hot water and chilled water (through an underground distribution system) to: 485 apartments; a 46,000 sq. ft. commercial building; a school; and an outdoor pool. The installed electrical capacity is 3000 kW, with 9.3 MBtu per hour heat recovery capacity plus a boiler capacity of 26.8 MBtu per hour and a chilling capacity of 1092 tons of refrigeration.

During the reported period (Nov. 1975 through Oct. 1976) the plant distributed a total of: 6,360,000 kWh of electrical energy; 37,400M Btu of heating; and 7,740 MBtu of chilling. The heat recovered was used to meet 39% of the site and chiller heat demands. Engine-generator gross electrical efficiency was 32.4% and gross electrical plus thermal efficiency was 61.4%. Seasonal average boiler efficiency was 81.6% and the chiller coefficient of performance was measured as 0.40. [The losses of the site distribution systems were not accounted for.]

Analysis of the plant's electrical reliability indicated that the plant supplied power to the site for 99.8% of the reported year. Outages were mostly due to malfunctions in the plant's electrical control systems.

The vast majority of the reported engineering data was collected by a data acquisition system (D.A.S.) which monitors approximately 200 transducers at the site. The raw data from the site was processed by computer at NBS. For the one year period the accuracy of the electrical, thermal and fuel data presented in this report is between 1 and 3%.

Economic data are also presented describing the capital, operating, owning and maintenance costs during the one-year period. Unit costs of electrical, heating and cooling energy commodities were determined and compared to conventionally - supplied energy unit costs.

Note: "M" = million, in above.

TITLE: Preliminary Design Study of a Baseline MIUS

AUTHOR(S): B.M. Wolfer, et al (NASA); E.H. White (Clovis Heimsath); R. Monzingo (Boeing)
DATE OF ISSUANCE: 4/77

DOCUMENT PREPARED BY: Authors/NASA-JSC/Clovis Heimsath Assoc. & The Boeing Co. (Houston, Texas)
RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N77-34050]

OTHER IDENTIFICATION: JSC-11625; NASA TM X-58193

TOTAL PAGES: 261 TOTAL REFERENCES CITED: 65 CLASS OF DOCUMENT: (P)

ABSTRACT:

A conceptual design study for a high-density, 496-unit apartment complex in a median climate (Washington, D.C.) was performed to determine whether a MIUS would be cost competitive with conventional utilities and whether implementation of the MIUS would result in using less fossil fuel. Detailed cost analyses were performed for the "baseline" MIUS complex and comparisons were made of design and operating variations for various climatic conditions. In addition, size-variation effects were investigated using 300- and 1000-unit apartment complexes for baseline comparison. [An investigation of possible environmental impacts and of State and local regulations, for Montgomery Village, Md., indicated that numerous problems would be encountered in implementing an MIUS.]

The initial plan for the baseline MIUS was based on Chicago, Ill. costs, as representative of the national median. [All historical cost data were adjusted by the appropriate Department of Labor cost index.] The costs include subcontractor (but not general contractor) profit and overhead. Costs for equipment located in the apartment buildings are excluded, as are individual dwelling metering and billing costs and administrative costs and property taxes. Both capital costs and operating and maintenance costs are considered. The maintenance costs have been largely based on 20-year average values and represent the costs required to keep equipment in good repair but do not include replacement, depreciation or amortization values.

The MIUS design presented in this report is not sufficiently detailed for implementation. The MIUS concept is such that a unique design for each application must be made with respect to: capacities; interfaces with existing systems and services; environmental interfaces and impacts; distribution and interfaces with serviced buildings; etc.

TITLE: Technology Assessment of Modular Integrated Utility Systems: Volume 1, Summary Report

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

DATE OF ISSUANCE: 12/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1977-748-189/225]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-24; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 65 TOTAL REFERENCES CITED: 2 CLASS OF DOCUMENT: (P)

ABSTRACT:

Technology Assessment is a systematic study which relates the technology to the total social framework, identifies all "impacts" and establishes cause/effect relationships to aid decision makers in balancing "good" and "bad" impacts. This assessment did not focus on technology but rather on its application effects; the basic objective was to identify and evaluate the consequences of a widespread utilization of MIUS to the year 2000. MIUS is proposed in place of conventional utility systems to serve a limited number of new residential-commercial developments. Thus, the approach was to conduct a comparative analysis of the impacts of MIUS vs alternative conventional utility systems.

This assessment is published in two volumes to best serve a wide range of interests. ORNL/HUD/MIUS-24 contains the summary section which briefly describes: the MIUS concept; assessment task; MIUS and conventional utility system technologies; potential MIUS applications and market; and expected impacts (by category). Impact categories include: resources; economic; environmental; psychological/social; national goals; and policies - both institutional and demographic. Volume 2 (published and abstracted separately as ORNL/HUD/MIUS-25) contains the detailed data and analyses in several sections, which generally correspond to the procedural method employed. Major topics include description of technologies, state-of-society assumptions, identification of impacts and impact analysis.

The MIUS concept utilizes an onsite combined "package plant" (smaller than conventional plants) to provide communities of limited size with electricity, heating/cooling water and liquid and solid waste treatment/disposal. MIUS is modular in that it can be located near appropriate users and in phase with the actual demands of community development or redevelopment. It employs an integrated systems approach, with some resource requirements of one "utility" service met by utilizing the effluent of another; e.g., heat rejected from electrical generation might be used for residential space heating and the effluent from liquid waste treatment might be used for cooling-tower water or irrigation.

TITLE: Technology Assessment of Modular Integrated Utility Systems (Vol. 2 of ORNL/HUD/MIUS-24)
AUTHOR(S): W.R. Mixon; et al

DATE OF ISSUANCE: 12/76

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1977-748-189/133]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-25; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72
*[Some references have been cited more than once]
TOTAL PAGES: 597 TOTAL REFERENCES CITED:493* CLASS OF DOCUMENT: (P)
ABSTRACT:

This assessment is published in two volumes to best serve a wide range of interests. [Section 1 (ORNL/HUD/MIUS-24) is a separate Summary Report that focuses on expected impacts by category.] ORNL/HUD/MIUS-25 contains the detailed data and analyses in several sections (2 through 6), which generally correspond to the procedural method employed. Section 2 is a short introduction to the MIUS program and concepts and the objectives, scope and approach of this assessment.

Section 3 ("Description of Technologies") describes the types of MIUS and conventional subsystems (considered most likely to exist in the years 1975 to 2000) and documents their projected costs, physical features and operating characteristics. These projections were used in discussions of the constraints related to the "State-of-Society Assumptions" (Section 4) which, in turn, were used to identify impacts (Section 5). Since this report is devoted to a comparative study of proposed MIUS vs conventional systems, all characteristics required to define MIUS must also be determined for conventional systems. Furthermore, each of the two types of utility systems encompasses extensive fields of technology, namely: electric/thermal energy generation and distribution; solid/liquid waste collection, treatment and disposal; potable and fire-protection water supply. The following topics are treated in this section: Description of MIUS Concepts; MIUS Electric Utility Technology; Conventional Electric Utilities Technology; Space Heating/Cooling for MIUS and Conventional Utilities; Potable-Water Supply/Treatment for MIUS and Conventional Utilities; Liquid-Waste Subsystems for MIUS and Conventional Utilities; Solid-Waste Subsystems for MIUS and Conventional Utilities; Consumer Thermal and Electrical Requirements; and Comparative Analysis of Selected MIUS and Conventional System Models.

The aim of Section 4 ("State-of-Society Assumptions") is to identify and discuss the societal characteristics which may accelerate, dampen or otherwise affect - or be affected by - the development and application of MIUS technology. Applicable characteristics are identified and defined and (where possible) suitable units of measurement are selected for each attribute and for the relationships between specific attributes and their effect on the application of the technology. The major topics of Section 4 are: National Goals and Policies; Current and Projected Housing Characteristics; Projected Fuel Demands and Resources; Projected Solid Waste Requirements; Projected Water Demands; Projected Liquid Waste Treatment Requirements; Institutional-Legal Factors; and Psychological and Social Factors.

Section 5 ("Identification of Impacts") is primarily devoted to clarifying the possible impacts of MIUS utilization on all sectors and interest groups of society. It consists largely of two tables which: a) categorize impacts (and, where possible, identifies the impact order and the group or biota affected) and suggests a unit for their measurement; b) lists physical and operational characteristics of MIUS with their advantages and disadvantages. Cause and effect relationships can be established by cross-checking between the tables.

Section 6 ("Impact Analysis") makes use of the technologies described and analyzed in Section 3 (and the projected state of society discussed in Section 4) to assess the impacts of utilizing the MIUS concept. Emphasis is placed on relative differences in the impacts of MIUS and non-MIUS installations. The following are treated in this section: Economic Impact on Productivity and Economic Efficiency; Economic Comparisons of Fixed and Growing Systems; Evaluation of Air Quality Levels from Hourly Load and Weather Data; Evaluation of Air Quality Levels in Selected Urban and Rural Locations; Index of Environmental Impacts; Institutional Impacts; Projected Psychological and Social Effects; Impact of MIUS on Fossil Fuel Resources; Impact of MIUS on Conventional Electric Utilities; Impact of MIUS on Projected Water Use; Impact of MIUS on Land Requirements; Impact of MIUS on Demography and Residential Characteristics; and Summary and Conclusions.

The significant substitution of MIUS for additional, conventional, utilities (or other new competing utilities) would affect some aspects of society benefically and others adversely. ORNL/HUD/MIUS-24 & -25 places the technology within the total societal framework in order to aid decision makers in the balancing of desirable and undesirable impacts.

TITLE: The Potential Benefit of an Advanced Integrated Utility System

AUTHOR(S): B.M. Wolfer

DATE OF ISSUANCE: 11/75

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1975-671-548/719]; [NTIS; N76-18671]

OTHER IDENTIFICATION: JSC-09964; NASA TM X-58170

TOTAL PAGES: 47 TOTAL REFERENCES CITED: 3 CLASS OF DOCUMENT: (P)

ABSTRACT:

This Technical Memorandum reports on a NASA/JSC investigation into the potential benefit of an advanced integrated utility system (which provides electrical power, heating/air-conditioning, solid waste disposal and water treatment) in a single integrated plant. The system incorporates MIUS-related technology, assumed to be available in 1980 with some development effort, which can serve a hypothetical apartment complex.

The investigation centered around one such integrated system. The example chosen features: a pyrolytic process for disposal of solid waste, closed-Brayton-Cycle engines plus fuel cells, solar energy collection and absorption and compression chillers. The system simultaneously treats wastewater and removes sulfur dioxide and nitrogen oxides from exhaust gases.

Calculations indicate that the system will use about 45 to 60% less energy than a current conventional system (assuming concurrent implementation of architectural energy-saving techniques in the apartment complex) and approximately 45% less water. The savings and multifuel capability of the proposed system clearly indicate the potential benefits of the advanced integrated utility concept in conserving fuel and water resources.

Three appendices are included. One describes a technique for storing thermal energy, a second discusses the uses of various fossil and synthetic fuels in the power generation options and a third lists candidate architectural energy-conserving techniques.

Although cost estimates of the advanced integrated utility system were not determined, the capital and maintenance costs of the system will be relatively high. However, these high costs should be offset by reduced operating costs attributable to the substantially reduced fuel use and to increased fuel costs; rising fuel costs will increase the cost of operating conventional systems more than for the integrated system.

TITLE: Evaluation of ORNL Report on "Technology Assessment of Modular Integrated Utility Systems"

AUTHOR(S): L.H. Mayo; et al

DATE OF ISSUANCE: 6/75

DOCUMENT PREPARED BY: "The Program of Policy Studies in Science and Technology" of the George Washington University

RESPONSIBLE ORGANIZATION(S): NBS

REFERENCE SOURCE & ACCESSION NO.: [NBS]

OTHER IDENTIFICATION: Department of Commerce Contract No. 5-35851

TOTAL PAGES: 236 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (OF)

ABSTRACT:

This report summarizes work done by George Washington University (GWU) in reviewing the Technology Assessment (T.A.) of the MIUS concept, as it was being conducted by ORNL. The report reflects upon the substantial descriptive/analytical effort involved in compiling the T.A., wherein a relatively enormous amount of technical data and analysis is produced relating to a comparative assessment of MIUS and conventional utility models.

The evaluation found that an (apparent) uncertainty on the part of the ORNL assessment group - as to the specific task objectives - resulted in a certain lack of focus as to purpose and analytical uniformity. It was concluded that the ORNL Report can be significantly strengthened, so as to make it easier to read and better understood by interested participants. Additionally, such "strengthening" will increase the T.A.'s analytical exactness and its usefulness to those public and private-sector entities and individuals who will be most concerned with the development and implementation of MIUS technology.

The GWU report contains a number of relatively concise statements concerning the principal strengths of the ORNL Report, along with recommendations for specific revisions to improve its quality and utility.

TITLE: Cost Methods and Cost Analysis Results for the Community Study MIUS Concepts

AUTHOR(S):

DATE OF ISSUANCE: 12/73

DOCUMENT PREPARED BY: The Boeing Co. (Houston, Texas)

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE & ACCESSION NO.: [NASA-JSC]

OTHER IDENTIFICATION: NASA-5 (Preliminary)

TOTAL PAGES: 295 TOTAL REFERENCES CITED: 33 CLASS OF DOCUMENT: (OF)

ABSTRACT:

This document presents cost summary results for a community application study, sponsored by the USPO. The costs for two different MIUS concepts were compared to the costs of utilities supplied from (conceptual) conventional utility systems for a community of (about) 100,000 residents. [The conceptual community had an assumed "buildup period" of 20 years, from 1975 through 1994.] The utilities investigated were: electrical power, water supply, hot water, waste water, heating, ventilation/air conditioning and solid waste disposal.

The conclusions of the study are summarized below:

A) MIUS utilities and services appear cost competitive with conventional utilities and services for large, new community applications.
B) A major MIUS cost savings is for electrical power; this results from a reduction in fuel requirements and electrical transmission facilities.
C) Another major MIUS cost saving results from reduced water supply requirements.
D) The capital and operating costs of small wastewater treatment plants are not completely offset by reduced collection costs; however intermediate-sized plants may be cost effective, mainly because of their reduced collection costs.
E) An increased capital cost, for large (central) air conditioning systems, is offset by reduced maintenance costs.
F) Solid-waste collection/handling costs are not reduced significantly by MIUS; however, recovery of energy from solid-waste appears economically desirable.

Note: Cost escalations and discounted cash-flow analyses, when compared to current (12/73) costs, do not appear to significantly affect these conclusions.

4. TECHNOLOGY EVALUATION AND DEMONSTRATION REPORTS

TITLE: Survey of User Acceptance of the Solid Waste Removal Systems at Operation Breakthrough Sites

AUTHOR(S):

DATE OF ISSUANCE: 2/76

DOCUMENT PREPARED BY: Applied Management Sciences/Hittman Associates, Inc.

RESPONSIBLE ORGANIZATION(S): National Environmental Research Center (EPA)

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 257-474]; [GPO; 1977, 231-205/6192]

OTHER IDENTIFICATION: HUD-PDR-199-1 (3/77); HUD Utilities Demonstration Series Volume 1; Contract No. 68-03-0094

TOTAL PAGES: 310 TOTAL REFERENCES CITED: CLASS OF DOCUMENT: (P)

ABSTRACT:

Note: The reader is reminded that the data, findings and recommendations contained within this report are derived from the perceptions of residents and site management personnel at "Operation Breakthrough" (O.B.) sites; the survey data are not intended to be a technical evaluation of the solid-waste management system at each O.B. site. Further, no "on-site" inspections were conducted to verify conditions as reported by the residents.

The Report presents case studies of the solid-waste disposal characteristics (and resident "attitudes" about such disposal methods) at eight O.B. sites. The data included in the report were obtained through on-site interviews of 1023 households and 8 representatives of site management. The survey was conducted during the period of January through March, 1975. Site specific recommendations were made, which were based on the conclusions drawn from site management and resident respondents.

The report includes resident and management perceptions of: the adequacy of trash storage and collection facilities and services; waste storage requirements and practices; and the suitability of the facility as regards the environment. [The data do not constitute a technical evaluation of the solid-waste management system at each facility.] The findings represent user perceptions of the effectiveness of alternative methods of trash collection, as those methods relate to different housing settings.

TITLE: Data Reduction Processes for the Jersey City Total Energy Project

AUTHOR(S): D.E. Rorrer; et al

DATE OF ISSUANCE: 5/79

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 296-482]

OTHER IDENTIFICATION: NBSIR 79-1757; HUD Utilities Demonstration Series Volume 10

TOTAL PAGES: 115 TOTAL REFERENCES CITED: 15 CLASS OF DOCUMENT: (P)

ABSTRACT:

Note: The Report assumes that the reader has a basic familiarity with computer and engineering terminology.

The Jersey City Total Energy (T.E.) system consists of a Central Equipment Building (CEB) which supplies all the electrical and thermal energy to a 6.35 acre site which has 4 medium to high-rise apartments housing 1300 people in 485 apartments plus an elementary school, swimming pool, 46,000 ft2 commercial building and parking space for the tenants. The CEB is a three-story structure which houses: five, 600 kW, diesel engine generators; two, 13.4 MBtu/hour (4.0 MW), hot water boilers; and two, 546 ton (6.6 MBtu/hour or 1.9 MW), absorption chillers.

This Report discusses the major processes used in the reduction of the data obtained from the Jersey City T.E. Site. These discussions begin with the acquisition of the "raw" engineering data and carry through to the final data presentation, in a form from which the summary performance reports of the T.E. Site are produced.

The major functions of the Jersey City T.E. data editing and conversion software program, developed by NBS, are described in some detail. Included are descriptions of: the command structure; overall data flow; data editing; data conversions; error processing; and the creation of data (output) tapes for use in further analysis. The more important subroutines which are used to handle the individual operations are also covered. The equations used in the calculation of engineering units are described, along with such derivations as are deemed appropriate.

TITLE: Design Cost and Operating Data for Alternate Energy Systems for the Summit Plaza Complex: Jersey City, N.J.

AUTHOR(S):

DATE OF ISSUANCE: 5/79

DOCUMENT PREPARED BY: H.D. Nottingham and Associates, Inc. (McLean, Va.)

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: NTIS No. to be made available

OTHER IDENTIFICATION: GCR 79-164 (NBS); HUD Utilities Demonstration Series Volume 15 (Part I of II); Contract 5-35870 (NBS)

TOTAL PAGES: 310 TOTAL REFERENCES CITED: 9 CLASS OF DOCUMENT: (P)

ABSTRACT:
The purpose of this Study is to develop basic design and operating data for comparing eleven alternate methods of supplying heating, cooling and electric power to a residential/commercial complex. The community complex studied is the Summit Plaza Development (located in Jersey City, New Jersey) which has been served since January, 1974, by a Total Energy (T.E.) plant. This development is a HUD demonstration effort, administered by NBS as regards the analysis of the performance and overall viability of the T.E. facility. Included in the scope of this study are:
1) an analysis of the installed T.E. system;
2) a conceptual design of alternate energy systems;
3) estimates of the capital, operation and maintenance costs of the existing system and each alternate system;
4) a simulation of the energy systems, operating through a typical year, to determine energy demands and consumptions.

The existing T.E. system at Summit Plaza has the following (basic) characteristics:
1) production of electric power with "on-site" diesel engine generators;
2) purchase and consumption of fuel oil as the single energy source;
3) waste heat recovery, from the diesel engines, for building heating/cooling and for the generation of domestic hot water;
4) supplemental oil-fired boilers to augment heating requirements;
5) use of absorption-type water chillers for building cooling.

The Report recommends that the relative cost effectiveness of the twelve energy systems should be compared by a life cycle analysis based on the following: a) initial construction cost; b) annual energy consumption costs; c) annual maintenance, operation and replacement costs; d) appropriate economic discount rates and cost escalation factors. The report also recommends that a "life-cycle" cost analysis (with appropriate economic discount rates and cost escalation factors) be performed so as to quantity the trade-off between the energy-efficient, high first-cost, systems and the energy-inefficient, low first-cost, systems.

TITLE: Detailed Initial Cost Data for Alternate Energy Systems for the Summit Plaza Complex: Jersey City, N.J.

AUTHOR(S):

DATE OF ISSUANCE: 5/79

DOCUMENT PREPARED BY: H.D. Nottingham and Associates (McLean, Va.)

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: NTIS No. to be made available

OTHER IDENTIFICATION: GCR 79-165 (NBS); HUD Utilities Demonstration Series Volume 15 (Part II of II); Contract 5-35870 (NBS)

TOTAL PAGES: 139 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (P)

ABSTRACT:

Summit Plaza Complex is a residential/commercial development located in Jersey City, N.J.. It consists of four apartment buildings, a commercial/office building and a school building. The apartment buildings have 485 units and contain a total of 506,780 sq. ft.; the commercial/office building contains 49,130 sq. ft.; the school building contains 17,870 sq. ft.

The purpose of this Report is to derive detailed estimates of the construction costs of alternate energy systems which might be used for comparison with the existing Summit Plaza T.E. plant. The alternate systems included in this report were the twelve systems analyzed in a related NBS publication, GCR-164, entitled: "Design, Cost and Operating Data for Alternate Energy Systems for the Summit Plaza Complex; Jersey City, N.J.".

The alternate systems are: 1) the existing T.E. Plant; 2) the existing plant, operated such that it sells power to the local electric utility under certain conditions; 3) a T.E. plant similar to System #1, but having higher efficiency diesel-engine generators; 4) a T.E. plant, having both electric-driven and absorption-type water chillers; 5) a central heating/cooling plant, using electric-driven chillers and oil-fired boilers [Note: electricity is purchased from the local utility company for this and all subsequent systems]; 6) a central heating/cooling plant, using absorption chillers and oil-fired boilers; 7) a central heating/cooling plant, using diesel-driven centrifugal and absorption water chillers and oil-fired boilers; 8) individual heating/cooling plants for each building with each plant consisting of an electric-driven chiller and an oil-fired boiler; 9) individual heating/cooling plants for each building with each plant having an electric-driven chiller and an electric boiler; 10) incremental heating and cooling units for each space; 11) individual heat pumps for each space; 12) individual self-contained air conditioning units, with electric heat, in each space.

TITLE: Evaluation of a Conceptual Design for a Coal Fired Fluidized-Bed Combustion Furnace for a MIUS Closed Cycle Gas Turbine

AUTHOR(S): J.J. Tudor

DATE OF ISSUANCE: 1/79

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1979-748-189/371]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-36; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 37 TOTAL REFERENCES CITED: 3 CLASS OF DOCUMENT: (P)

ABSTRACT:
The evolution of a (conceptual) design for a coal-fired, fluidized-bed combustion chamber and heater, suitable for use in a MIUS application, was guided by a number of precepts which are detailed in this Report. A number of concepts were investigated. Each overall design and its components were studied and evaluated according to "criteria of merit", as also summarized in the Report. A compromise configuration was arrived at, that seemed to meet the diverse requirements reasonably well.

In evolving the design of the gas-turbine power plant (based upon a coal-fired, fluidized-bed combustion furnace) particular attention was given to the most critical component in the system, i.e., the fluidized bed furnace and heater assembly. Various layout arrangements of the economizer and recuperator (relative to the fluidized bed) were studied. Several configurations were considered for the tubes in the heat transfer "matrix" of the bed and economizer and the related effects of differential thermal expansion on thermal stresses were analyzed. The possibility of tube vibration, resulting from Karman vortex shedding or from bed pulsation, was examined. A relation between basic fluidized-bed design parameters and the expected frequency of bed pulsations was derived. Particular attention was given to the accommodation of dimensional expansion in the manifolds, piping, plenum chamber and furnace support structure so as to minimize thermal expansion stresses. Configurations were chosen that would limit the leakage of dusty air or combustion gas leakage to a sufficiently low level so that the pumping power would not be increased significantly. Also, the furnace configuration was designed to limit heat losses to the engine room to less than 1% of the system output. Various tuyere designs that have been tested by different organizations were examined, their problems noted and the one that seemed best suited to the MIUS applications was selected. Similarly, a number of coal and limestone feed systems were considered and two were chosen for evaluation in bench tests of full-scale components. The various tube and furnace configurations were also examined from the standpoint of access for inspection and maintenance.

TITLE: Instabilities in a Coal Burning Fluidized Bed

AUTHOR(S): A.S. Thompson

DATE OF ISSUANCE: 11/78

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978-748-189/299]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-38; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 40 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (P)

ABSTRACT:

An ORNL program for developing a coal-fueled MIUS is being jointly sponsored by HUD's Office of Policy Development and Research and ERDA's Fossil Energy Branch. This publication is one of a series developed under the HUD-MIUS Program to further a particular aspect of the program goals; it is one of several topical reports covering the various aspects of the conceptual design of a coal-fueled MIUS system. This particular report deals with an analytical study of the instabilities in a coal-burning fluidized bed.

The report derives equations based on a simplified flow model, for the analytical prediction of the frequency at which periodic instabilities are generated in a bed of particulate matter when the bed is fluidized by the circulation of a gas through it. The derived frequency depends on the inverse square root of the bed depth and on the expansion of the bed in its operating condition. The amount of expansion, in turn, depends on the velocity of the fluidizing gas. The results of the analysis indicate that (between the minimum and maximum flow rates at which fluidization can exist) there are two bed depths at each flow rate, for which the forces on a particule are in equilibrium; one depth corresponds to a "dense" phase, the other to a "light" phase of the particulate matter of which the bed is composed and only for flow rates below a prescribed maximum are these two phases in quasi-stable equilibrium.

The analysis of this report is based on a set of simplifying assumptions in which: (1) the motions of particles are small and transient variations in properties can be linearly related and (2) the bed materials are distributed uniformly and homogeneously. In analyzing the gas flow through the bed, it has been assumed that the local distribution of the particles in the gas can be described in terms of a regular geometric pattern. The relationships from the analysis appear to be confirmed by (reported) experiments on the behavior of fluidized beds, under both bubbling and slugging conditions.

TITLE: Preliminary Evaluation of the Electrical Service Reliability of a Small Total Energy Plant

AUTHOR(S): J.D. Ryan

DATE OF ISSUANCE: 8/78

DOCUMENT PREPARED BY: Author

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: [SAE; SAE/P-78/75]

OTHER IDENTIFICATION: 13th IECEC Proceedings; pp 2180-2185 (#789291)

TOTAL PAGES: 6 TOTAL REFERENCES CITED: 13 CLASS OF DOCUMENT: (PO)

ABSTRACT:

Electrical service reliability data were obtained from the initial four years of operation of the Summit Plaza Total Energy Plant located in Jersey City, New Jersey. This on-site, 2.3 MW, plant was designed with reserve capacity intended to assure reliable operation independent of a utility grid connection. The measured reliability of this plant was compared to the reliability of utility-supplied electricity from several data sources. Reliability performance of the TE plant was (mostly) nearly equal to that of the electric utilities. Two years of poor reliability seemed to be more representative of a "debugging" phase of plant operation. An additional 1-2 years of data collection is needed to establish the "normal" reliability levels of this plant. Suggestions for unattended operation and component improvements, to enhance the reliability of TE plants, are also presented.

TITLE: An Annotated Compilation of the Sources of Information Related to The Usage of Electricity in Non-Industrial Applications

AUTHOR(S): B. Reznek

DATE OF ISSUANCE: 7/78

DOCUMENT PREPARED BY: Author

RESPONSIBLE ORGANIZATION(S): Ben Reznek, Consultant

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 285-260]

OTHER IDENTIFICATION: NBS Publication No. GCR 78-130

TOTAL PAGES: 690 TOTAL REFERENCES CITED: 420 CLASS OF DOCUMENT: (P)

ABSTRACT:
This document provides a list of abstracts of "published" (and privately-printed") electricity usage information which is either directly, or in a significant secondary context, related to the non-industrial usage classifications. [The pertinent literature has been examined and abstracted for a period beginning about 1952 and extending thru 1977.]

Categorization of this Compilation's information sources was kept reasonably simple; however, a substantial percentage of the abstracts needed extensive cross-referencing even though their primary information context tends to center in the primary subject area listed in their Document Classification space in the forms used for abstracting. A limited number of general interest areas needed background discussion; such areas are covered by summarizing paragraphs in the INTRODUCTION of this report.

The Load Research Committee of the Association of Edison Illuminating Companies' (LRC/AEIC) "privately-printed" abstracts (which comprise one of the two primary groupings of this document) include appreciably more detail than does the usual format; these extra details are intended to assist the readers, since access to the complete references may not be feasible. The "published" references have been abstracted in such fashion that the readers can make their own determination as to whether they will want to check the entire reference

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This report was sponsored by HUD as part of the MIUS Program, since a data base for estimating "start-up" and "future" electrical usage is a necessary and important requirement for developing a MIUS. MIUS-type demonstration projects are being investigated but the relative importance of this energy concept is not yet evaluated; therefore, it was decided to expand this Compilation's information search so as to include data with potential use for all non-Industrial/non-MIUS applications. Material was introduced which dealt with the general background of Load Research, past usage experience and the various techniques for predicting future trends in electricity consumption. Thus, this Compilation can be viewed as being somewhat more than a collection of abstracts since it provides a capsulized background plus data base sources for use in conventional, T.E. and MIUS and other conceptual applications.

TITLE: Plan for Environmental Evaluation of MIUS Demonstration at St. Charles, Md.

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

DATE OF ISSUANCE: 7/78

DOCUMENT PREPARED BY: Authors/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: ORNL/HUD/MIUS-51; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72

TOTAL PAGES: 110 TOTAL REFERENCES CITED: 58 CLASS OF DOCUMENT: (P)

ABSTRACT:

This publication is one of a series developed in the MIUS Program under the direction of HUD, which is conducting the Program for the development and demonstration of the technical, economic and institutional advantages of integrating the systems used for all (or several) of the utility services for a community.

MIUS demonstration phase activities were formally initiated in April, 1976, by a grant to Interstate Land Development Co., Inc. (ILD) for the conceptual and preliminary MIUS designs to serve part of the "new town" of St. Charles, Maryland. The intent of the demonstration was to have a private sector entity design a MIUS that would be cost effective in satisfying a site-specific performance specification and that would address institutional issues as required.

This document presents a plan for environmental evaluation of the St. Charles (concept) MIUS. The proposed MIUS would be located within the community and would include diesel engines to generate electricity, solid-waste incineration and liquid-waste treatment. Heat recovered from the engines and incinerator would be used for space heating/cooling and water heating; treated liquid waste would be used for golf course irrigation.

Environmental and/or human health effects of potential significance were first identified by comparing postulated emissions from the MIUS plant with Federal, state/local regulations for pollutants having known adverse effects. A program of sampling and analysis was outlined for monitoring the critical parameters. Evaluation of the human health and environmental effects was heavily based on the collection of inferred data for which the comparison of verified predictions with air and water quality standards and criteria will determine the degree of impact. Human welfare impacts are based on a comparative study between the Smallwood Village community (which would receive its utility services from the MIUS plant) and a comparable, conventionally-served community.

The program included two sets of evaluations. The first was designed to evaluate the performance of the MIUS subsystems and to determine their emissions. The second is covered in this report and is designed to evaluate the environmental effects of MIUS emissions. Sampling for both programs may be at common points; however, the frequency of data collection and the pollutants analyzed may be different for each.

Because the design, analyses and institutional resolutions (of the preliminary design state) satisfied several demonstration objectives, HUD decided not to fund construction of the plant. Project documentation, including this evaluation plan, is intended to serve as a site-specific case study to guide private sector implementations of the concept.

TITLE: A Review of Computer Software Applicable to the MIUS Program

AUTHOR(S): W.L. Carroll; J.R. Schaefgen, Jr.

DATE OF ISSUANCE: 10/77

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 273-175]

OTHER IDENTIFICATION: NBSIR 77-1307

TOTAL PAGES: 101 TOTAL REFERENCES CITED: 28 CLASS OF DOCUMENT: (P)

ABSTRACT:

The Report examines and evaluates 13 computer programs for their potential application to the MIUS concept. These programs calculate all (or partial) combinations of: heating and cooling loads; the simulation(s) of physical systems to determine the energy requirements necessary to satisfy such loads; the prediction of optimal operation schedules and their associated costs; the accomplishment of full "life-cycle" economic analyses.

A set of criteria is presented for evaluation of this software. Information regarding the programs - obtained from user manuals and a series of seminar presentations - is systematically summarized in a standardized format using information available as of June 1974 (mainly), altho two programs are described which are currently (1977) under development. Conclusions regarding the applicability, validity and utility of the programs are reached. Recommendations are also made concerning future software development and utilization.

The Report contains (scattered) references to data sources pertinent to load calculations and utility services, including the electrical demands.

TITLE: Comparison of Computer-Predicted and Observed Energy Uses in a Multi-Family (High-Rise) Apartment Building

AUTHOR(S): J.P. Barnett; S.T. Liu

DATE OF ISSUANCE: 6/77

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 267-829]

OTHER IDENTIFICATION: NBSIR 76-1177

TOTAL PAGES: 35 TOTAL REFERENCES CITED: 12 CLASS OF DOCUMENT: (P)

ABSTRACT:

The study compares the results of two computer programs, namely NBS's Load Determination Program (NBSLD) and the American Gas Association's (E-CUBE) Program, in predicting the energy consumption of a 12-story, 118-apartment building located in Omaha, Nebraska. Results for the computed energy values are given on a monthly basis and compared with average monthly values of metered data obtained over a five year period. Close agreement (less than 7%, on an annual basis) was found between the energy consumptions predicted by the two different computer programs, as well as between the predicted values and the metered data.

Since the energy consumption for this case was closely related to the space load, the calculation of energy consumption for this building was really a test of how well the two Programs calculated space thermal load. This comparison may not be as valid for many commercial buildings where the complexity of the HVAC system performance is a major factor affecting energy consumption. The results of this study indicate that both NBSLD and the E-CUBE Programs reliably predict energy consumption for a building which is dominated by loads due to thermal transfer through its exterior shell (skin sensitive) and which also has a rather simple HVAC system. These results should, however, not be construed to mean these two programs would necessarily be as accurate for a building with a more complicated HVAC system. In the case of NBSLD, since it is only a load program, it is obvious that a new system simulation routine would have to be developed to calculate energy consumption for a different HVAC system.

TITLE: Program Document for Energy Systems Optimization Program (ESOP 2); Vol. I - Engineering Manual; Vol. II - User's Manual; Vol. III - ESOP 2 Program Listing; Vol. IV - Economic and Financial Analysis Program User's Guide*

AUTHOR(S): R.G. Hamil; S.L. Ferden

DATE OF ISSUANCE: Vol. I (3/77); Vol. II (5/77); Vol. III (6/77); Vol. IV (1/75)*

DOCUMENT PREPARED BY: Authors/Lockheed Electronics Co., Inc.; Systems and Services Division

RESPONSIBLE ORGANIZATION(S): Lockheed Electronics Co., Inc.

PROCUREMENT SOURCE; ACCESSION NO.: Vol. I [NTIS; N77-25631]

OTHER IDENTIFICATION: [JSC-12625; CPD 714; LEC-9764, for Vols. I, II & III]

*Vol. IV, by R.D. Stalling (et al), is unchanged from its prior identification as Vol. III of LEC 5041/TM 4084

TOTAL PAGES: 635 TOTAL REFERENCES CITED: 17 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This program document represents the results of a developmental study (by Lockheed Electronics Co. - Systems and Services Division) to produce a computer program which will provide energy analyses of energy conversion systems, such as MIUS.

This document is a complete revision of previous documents describing the Energy Systems Optimization Program. [The program has now been given the acronym ESOP2, rather than the previously designated ESOP.] Principle changes in the program, which are described in this document, includes: (a) modifications to the input format to allow modular inputs in specified blocks of data; (b) an optimization feature which enables the program to search automatically for the minimum value of one parameter, while varying the value of other parameters; (c) new program "option flags" for prime mover analyses; (d) inclusion of solar energy for space heating and domestic hot water.

Vol. I contains the method of analysis, description of program subroutines and a program flow chart. Vol. II contains all of the information necessary to prepare the input deck required to run an energy systems analysis using ESOP2. The inputs are divided into 14 sections such as: program flags, weather data and building parameters for orderly classification of the data. Lead card setup sheets are shown for each section for general problems, as well as specific decks for two "sample" problems. The sample problems were selected to show how the various subroutines integrate to give a total system analysis. Vol. III consists of a complete listing of ESOP2, including all subroutines used by the program; a general flowchart of the program is also provided.

TITLE: Evaluation of the Refuse Management System at the Jersey City Operation Breakthrough Site

AUTHOR(S): J.P. Overman & T.G. Statt

DATE OF ISSUANCE: 5/77

DOCUMENT PREPARED BY: Hittman Associates, Inc. (Columbia, Md.)

RESPONSIBLE ORGANIZATION(S): Municipal Environmental Research Laboratory, Office of Research and Development (EPA)

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978, 621-423/222, 1-3]; [NTIS; PB 280-551]

OTHER IDENTIFICATION: HUD-PDR-199-5 (11/78); HUD Utilities Demonstration Series Volume 3; Contract No. 68-03-0094

TOTAL PAGES: 238 TOTAL REFERENCES CITED: 25 CLASS OF DOCUMENT: (P)

ABSTRACT:

This Study evaluates the solid-waste management system at the Jersey City "Operation Breakthrough" site and assesses the economic and technical practicality of applying the system in future residential communities. This installation was the first pneumatic trash collection (PTC) system for residential refuse in the U.S.A. The annual cost for the PTC system ranged from 160 to 460% of that for conventional systems but would still have been cost-effective if it had operated at its design capacity. Over an 18 month monitoring period the PTC system was operable only 54% of the time and had a 50% probability of failure within 16 hours (or 15 cycles of operation). Following failures, probabilities of again being operable were 50 and 83% within 3.4 and 24 hours, respectively. The main transport line, programmer, discharge valves, control panel, vertical trash chutes, and compactor caused 88% of all system malfunctions, 94% of total downtime and 91% of all repair man-hours.

Design recommendations are presented that could increase system availability to about 86%. Additionally, recommendations are made for use in future residential complexes. In comparison with conventional systems, the PTC system has (as benefits): reduced labor costs; the non-appearance of rodents and vermin; and the virtual elimination of odor, litter and collection noise. Additionally, the refuse collection system was designed to be completely automatic, except for the final disposal of site refuse.

One overall recommendation is that in order for the PTC system to be most advantageous, it should be used in high-density residential communities and in other areas where there are high levels of refuse loadings. For these applications, a "debugged" PTC system could be the most economical selection and provide higher levels of service than conventional refuse collection systems.

TITLE: Design Techniques for Modular Integrated Utility Systems

AUTHOR(S): B.M. Wolfer

DATE OF ISSUANCE: 2/77

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N77-22005]

OTHER IDENTIFICATION: JSC-10747; NASA TM X-58189

TOTAL PAGES: 78 TOTAL REFERENCES CITED: 14 CLASS OF DOCUMENT: (P)

ABSTRACT:

From 1972 to 1975, NASA/JSC worked on developing MIUS design techniques. This paper describes the development of such techniques, which began with the definition of system hardware options and the selection of those most applicable to the integrated utility concept. Ground rules are delineated which provide reasonable design bounds, consistent with anticipated 1980-technology capabilities. Methods were derived for: the development of utility load profiles; the preparation of a computer program to aid in equipment selection and energy- and water-usage analyses; and for the development of cost-estimating techniques to compare MIUS with conventional utility systems and services. These techniques have been used to analyze various MIUS possibilities; for example, the variations in energy savings and costs in relation to various factors such as project type, density and size.

With regard to the design and analysis techniques, the following principal steps were indicated as prerequisite to the design of an MIUS: (a) in keeping with a ground rule to use currently available equipment, options for the various subsystems were analyzed and reduced to reciprocating engines (using either diesel fuel or natural gas) or to steam turbines for electrical-power generation; (b) compression or absorption chillers were to be used for air-conditioning; (c) incineration was to be the method for disposing of solid waste; (d) biological or physical-chemical methods were to be used in waste-water treatment; and (e) recovered heat was to be taken from power-generation and incineration processes (supplemented by boilers, if required) for space heating and domestic hot-water heating.

TITLE: (Final) Environmental (Impact) Statement of the New Community of St. Charles, Charles, County, Md.

AUTHOR(S):

DATE OF ISSUANCE: 1/77

DOCUMENT PREPARED BY: HUD/NCA (New Communities Administration)

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB-264416]

OTHER IDENTIFICATION: HUD-NCA-EIS-77/2

TOTAL PAGES: 545 TOTAL REFERENCES CITED: 50 CLASS OF DOCUMENT: (P)

ABSTRACT:
Because a typical application could contain over 50 "exhibits" and volumes of special reports and information, it is impractical to include all detailed information in the basic Environmental Statement. The list of such exhibits, reviewed in conjunction with the St. Charles New Community application for additional guarantee assistance, can be found in Appendix (A) of this document.

The environmental impact assessment procedures used in this statement are those prescribed in the U.S. Department of Housing and Urban Development "Interim Guide for Environmental Assessment", dated June 1975. The technical environmental assessment process in this guide is based upon a principle of testing for environmental impact at increasing levels of detail until a judgment can be made. The process can be viewed as a "diary approach"; i.e., the results of environmental assessments are accumulated and each Higher Level Test builds upon the findings in the previous testing level. As the process progresses, more intensive study is given to fewer environmental subcomponents. [It should also be recognized that the assessment process is as concerned with positive or beneficial consequences of project actions as with potentially adverse impacts.]

Comparative Impacts of Alternative Development Actions: In an effort to summarize the "specific-impact evaluation data" presented in this Statement, a matrix was used which compared the impact of each of the examined alternatives of each examined subcomponent impact; then ratings (of A+, A, B, C, & C-) were assigned, based on criteria established in the HUD Interim Guide. The magnitudes of impact associated with each of the rankings are as follows: A+, desirable; A, acceptable; B, questionable or uncertain; C, undesirable; C-, information indicates that the project will violate a HUD standard or that of another Federal, state, or local agency. [Note: for some subcomponents, no generally accepted standards have been developed.]

The results of the comparative impact appears in Section VII of the Final Environmental Impact Statement.

TITLE: Integrated Waste Management Systems - Onsite MIUS Applications

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

DATE OF ISSUANCE: 1977

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL & HUD

PROCUREMENT SOURCE; ACCESSION NO.: [Ann Arbor Science Publishers, Inc. P.O. Box 1425, Ann Arbor, Michigan 48106]
OTHER IDENTIFICATION: "Proceedings of the Third National Conference, Individual Onsite Wastewater Systems"; 1976; pages 221-234

TOTAL PAGES: 14 TOTAL REFERENCES CITED: 10 CLASS OF DOCUMENT: (PO)

ABSTRACT:
The paper states that a MIUS may provide potable water(for drinking, bathing and cooking)from its onsite water treatment plant. The supply source may be groundwater or a surface water supply. If groundwater is used, the treatment may consist solely of disinfection, unless impurities such as iron or "hardness" must be removed. In the case of surface water sources such treatment may consist of coagulation, sedimentation, filtration and disinfection. In general, integration with other MIUS subsystems will be at a minimum if groundwater is used as the water source and at a maximum if desalination technology is required. [A number of manufacturers produce package plants which are capable of being used in MIUS but in certain parts of the USA it may be necessary to provide desalination to reduce dissolved solids; equipment for this, in the size range required by MIUS, is currently available.]

Advantages of integrating the MIUS potable water subsystem, by including onsite treatment facilities include:
a) No dependence on outside water sources; b) The need for obtaining additional land for constructing costly transmission lines is eliminated; c) The need for increased capacity at existing overloaded treatment facilities is eliminated; d) Small MIUS size increases the possibility of using groundwater sources which usually require only minimal treatment for potable use.

Several advantages of subsystem integration are common to all subsystems or generally result from use of the MIUS concept. MIUS subsystems may share operating personnel and land buildings and other site improvements that are associated with utility systems. A MIUS, using currently available technology, can provide reliable service completely independent of conventional utilities. Thus, utilities can be installed in phase with requirements of developing communities and the need for offsite transmission of services is eliminated. Because many new utility components are first proved with units small enough for direct application to MIUS, the potential to rapidly incorporate advanced technologies in MIUS is considered at least equal to and perhaps better than in conventional systems.

TITLE: Computer Program for Energy Analysis of Central Heating and Cooling Plant

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

DATE OF ISSUANCE: 9/76

DOCUMENT PREPARED BY: Authors/Lockheed Electronics Co., Inc. (Houston, Texas)

RESPONSIBLE ORGANIZATION(S): Lockheed Electronics Co., Inc.

PROCUREMENT SOURCE; ACCESSION NO.: [AIChE]

OTHER IDENTIFICATION: 11th IECEC Proceedings; pp 1726-1732 (#769298)

TOTAL PAGES: 7 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (PO)

ABSTRACT:

This program was developed to predict the performance and savings in energy and fuel at a central heating and cooling plant. The present energy distribution system consists of 5 natural-gas fueled boilers and 7 steam, turbine-driven compression chillers. In order to reduce energy consumption, replacement of several steam turbine-driven chillers by electric motor-driven chillers was considered, where electricity was either purchased or supplied by diesel-generators whose recovered heat was used to input to absorption chillers. Also, shutdown of hot well pumps, boiler feed pumps, and cooling tower fans and pumps was optionally considered. Results showed energy cost savings of nearly $2000/day using 2 electric chillers with purchased electricity and over $1500/day using 2 diesel-generators in conjunction with absorption and electric chillers.

This paper describes a computer program designed to predict the performance of a central heating and cooling facility that is more conventional than a MIUS facility. The energy distribution system at the facility was modeled in the program and the performance (including boiler fuel consumption, system thermal efficiency and energy cost) was evaluated. Two major modifications to the present system were studied: Option 2 - replacement of 2 steam turbine driven chillers with 2 electric motor driven chillers whose electricity was purchased from the local power company and Option 3 - replacement of the chillers with 2 diesel-generators, each driving an absorption and a compression electric chiller. Results showed about a 35% savings in boiler fuel, 24% in total energy, 17% in energy cost for Option 2; and 37% in boiler fuel, 29% in total energy and 14% in energy cost for Option 3.

TITLE: Evaluation of the Refuse Management Systems of the Operation Breakthrough Sites
AUTHOR(S): J.P. Overman

DATE OF ISSUANCE: 4/76

DOCUMENT PREPARED BY: Hittman Associates, Inc. (Columbia, Md.)

RESPONSIBLE ORGANIZATION(S): Municipal Environmental Research Center, Office of Research and Monitoring (EPA)
PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 260-495]; [GPO; 1977, 231-206/6191]
OTHER IDENTIFICATION: HUD-PDR-199-2 (3/77); HUD Utilities Demonstration Series Volume 2; Contract No. 68-03-0094

TOTAL PAGES: 165 TOTAL REFERENCES CITED: 9 CLASS OF DOCUMENT: (P)

ABSTRACT:
One of the provisions of HUD's (Office of Policy Development and Research) "Operation Breakthrough" (O.B.) is to evaluate refuse management systems so as to determine their economic and technical practicality for application to future projects. The nine sites examined are: Indianapolis, Kalamazoo, Macon, Memphis, St. Louis, Seattle, Sacramento, King County, WA, and Jersey City. The evaluations show that the methods employed at the Macon, Memphis, Sacramento and King County sites are the most economical and effective. The "conventional" systems consist of central containers at Macon, Memphis and Seattle and (primarily) curbside collection at King County. The Indianapolis site uses storage pens which results in low costs but also results in odors, insects and refuse scattering. The central or communal compactors at Kalamazoo are not effective or economical because of improper utilization by residents. The St. Louis system needs much modification because it is extremely costly and very ineffective. The Jersey City site utilizes a rather different system, namely Pneumatic Trash Collection, and a separate report has been prepared to assess the technical and economic performance of the system. In addition, a refuse system "user-acceptance" survey was conducted at each site and the results are documented in separate reports for each site, along with an executive summary.

The specific purpose of this Report is to present the results of evaluations of general data gathered during short visits to each site. In addition, results are presented for a four-week study of the curbside pickup of plastic bags versus standard garbage cans at the King County, Washington site. [The overall objective of the sponsor of this study was to evaluate the economics, effectiveness and feasibility of using improved solid waste collection systems in new communities. The results will be used to guide the development of larger-scale projects.

Recommendations for refuse management systems in future projects are based on the results of this Study. It is also recommended that the St. Louis site be studied and modified to reduce costs, increase system effectiveness and efficiency and to reduce environmental problems.

TITLE: Solar Energy Evaluation for Modular Integrated Utility Systems

AUTHOR(S): N.R. Hunley

DATE OF ISSUANCE: 2/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE & ACCESSION NO.: [ORNL]

OTHER IDENTIFICATION: ORNL-HUD-MIUS-13; HUD Interagency Agreement No. IAA-H-40-72

TOTAL PAGES: 38 TOTAL REFERENCES CITED: 44 CLASS OF DOCUMENT: (OF)

ABSTRACT:

The purposes of this paper are to:

1) briefly review what had been done to develop various applications of solar energy;
2) present an evaluation of those developments that have possible use in a residential MIUS and;
3) give an economic outlook for any possible MIUS uses.

The technical areas considered were: water and space heating/space cooling; refrigeration; distillation; solar engines; photochemistry; photovoltaic conversion; and thermoelectric and thermoionic conversion. Solar water heating is given most attention, along with an economic basis for determining the feasibility of its use. Environmental impacts are briefly discussed.

TITLE: Fuel Cell Technology Evaluation for MIUS Program

AUTHOR(S): I.T. Dudley

DATE OF ISSUANCE: 1/73

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE & ACCESSION NO.: [ORNL]

OTHER IDENTIFICATION: ORNL-HUD-MIUS-12; HUD Interagency Agreement No. IAA-H-40-72

TOTAL PAGES: 15 TOTAL REFERENCES CITED: 11 CLASS OF DOCUMENT: (OF)

ABSTRACT:

This report directs its attention to the concept of supplying residential and commercial buildings with electrical power from fuel cells because of such cell's potential for highly efficient fossil fuel utilization, with minimal adverse effects on the environment.

The main reaction products of fuel cells - at least those using conventional fuels and air - are carbon dioxide and water. Minor amounts of fossil pollutants (such as sulfur dioxide, nitrogen oxides, hydrocarbons and particulates) are also produced but these are negligible, in quantity, in comparison to those encountered in conventional power plants burning fossil fuels.

Fuel cell operation is duscussed (in a general way) and some typical fuel cells are listed by: operating temperature classifications; electrolytes; catalysts; oxidants; and fuels.

An evaluation of the possibilities of utilizing small, fuel cell, power plants for MIUS is included. It is concluded that although fuel cells have been developed and successfully used in spacecraft and other military applications, their physical characteristics and costs are as yet unsuited for "near-term" MIUS installations.

5. HARDWARE EVALUATION AND DEMONSTRATION REPORTS

TITLE: Performance of the Engine-Generator(s) Used in the Jersey City Total Energy Plant

AUTHOR(S): J.B. Coble; et al

DATE OF ISSUANCE: 10/76

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 264-427]

OTHER IDENTIFICATION: NBSIR 77-1207; HUD Utilities Demonstration Series Volume Eleven (3/77)

TOTAL PAGES: 21 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (P)

ABSTRACT:

Each of five (600-kilowatt rated) diesel engine-generators, due to be installed in a total energy plant for an apartment complex in Jersey City, N.J., was performance tested under NBS direction at the engine-generator vendor's plant. These tests were for acceptance of the units and also provided a basis for comparison with installed performance.

The engines were tested at 7 power levels, ranging from "no load" to 660 kilowatts. During the tests, fuel consumption, electrical output and jacket-water heat recovery were measured along with many other parameters. Results are reported for fuel consumption, electrical efficiency and electrical-plus-thermal efficiency; comparisons are also made with measured data from the total energy plant.

The test results indicated that the 5 units have very similar efficiencies, since the standard deviation among their values was only 0.9%. Over the 40% to 80% load range (which comprises the major part of their operating duty) average electrical efficiency ranged from 29.9 to 31.6% and the electrical-plus-thermal efficiency ranged from 54.8 to 55.3% (exhaust heat not recovered).

After 10,000 to 15,000 hours of engine running time, preliminary measured data results indicated that the engine-generator gross electrical efficiency averaged 32.4% during a period of 60% load on 3 engines. Electrical-plus-thermal efficiency, including exhaust recovery and idle engine losses, averaged 61.4% during the same period.

TITLE: Performance Characteristics of a Diesel Engine Using Low- and Medium-Energy Gases as a Fuel Supplement (Fumigation)

AUTHOR(S): L.G. Monford

DATE OF ISSUANCE: 10/76

DOCUMENT PREPARED BY: Author/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N77-14955]

OTHER IDENTIFICATION: JSC-11404; NASA TM X-58188

TOTAL PAGES: 23 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (P)

ABSTRACT:

In various MIUS studies, solid-waste incineration has been utilized to recover energy in the form of heat from the refuse. This energy is used to supplement space-conditioning requirements. Burn times may be adjusted to coincide with peak demand periods, with limited refuse storage capability. During off-seasons, little additional heat is needed; therefore, the energy-related benefits of incineration are minimal and approximately 50% of the recovered trash energy is utilized.

Of the existing techniques for extracting energy from refuse, pyrolysis appears promising for energy-related benefits because of the possibility of using the gases produced in this type of process as an alternate fuel in internal-combustion engines. [In the solid-waste pyrolysis process, fuel gas is produced by thermal decomposition of refuse in the absence of oxygen.] A test program was conducted to determine the feasibility of low- and medium-energy gas injection (fumigation) in the air intake of a diesel engine. Such an approach enables close coupling of systems and thus eliminates the need for gas heat-value upgrading, or compression. Three different premixed gases were investigated, (two derived from pyrolysis and one from an anaerobic digestor) simulating those that could be derived from refuse. The amount of each gas required to reduce diesel-fuel consumption by 5, 10, 15 and 20% was determined at each of four engine load points. These tests have shown that, without major modification, many existing engines can very efficiently utilize low-energy gas generated from solid waste for as much as 20% of normal fuel consumption. Combustion pressures were recorded during the testing but no detrimental effects on the engine were observed.

TITLE: Water Monitor System: Phase I Test Report

AUTHOR(S): R.E. Taylor; E.L. Jeffers

DATE OF ISSUANCE: 10/76

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N77-13909]

OTHER IDENTIFICATION: JSC-11020; NASA TM X-58179

TOTAL PAGES: 122 TOTAL REFERENCES CITED: 12 CLASS OF DOCUMENT: (P)

ABSTRACT:
The MIST laboratory is used for experimentation with advanced water- and waste-treatment technologies. NASA support of this integration and test program, together with other JSC studies, resulted in a project to develop an automatic water-quality monitoring/control system to ensure the safety and quality of treated wastewater.

The objective of this water monitor program is to develop a system (which includes the necessary sensors, sample collection and data acquisition and displays) to monitor in "real time" the effluent discharge from water treatment plants and to provide the data that determine the water quality. The primary objective is the demonstration - and the technology transfer to the community - of a water monitor system capable of providing a total water-quality picture including rapid microorganism detection, using NASA-developed sensor technology. This technology was demonstrated within the framework of a multiparameter (automated) real-time monitoring system that included conventional and advanced inorganic/organic systems.

Phase I of the NASA water monitor system project was concluded in Feb. 1975, with the completion of the test program on a "breadboard" configuration as described in this report. The primary overall objectives achieved during Phase I are as follows: (1) Refurbishment and augmentation of the Langley Research Center water quality monitoring system for use as a community wastewater treatment facility and water quality monitoring system; (2) Conceptualization and the initial design/development/fabrication of an advanced data acquisition system utilizing inexpensive cassette-type magnetic tape; (3) Assembly and initial demonstration of an integrated package capable of collecting the samples, sensing the respective water parameters and displaying and recording the data to provide a total water quality picture in real time; (4) Demonstration of the Phase I system approach, in an NASA wastewater treatment pilot facility, preparatory to design/fabrication of the Phase II field-demonstration water monitor system; (5) Application and evaluation of on-line, organic monitoring in a wastewater treatment facility environment; (6) Initial application and evaluation of on-line (near) real-time biological monitoring in a wastewater treatment facility environment.

TITLE: Environmental Assessment of Air Quality, Noise and Cooling Tower Drift from the Jersey City Total Energy Demonstration

AUTHOR(S): W.T. Davis (Consultant, University of Tenn. at Knoxville); J.O. Kolb (ORNL)

DATE OF ISSUANCE: July 1980

DOCUMENT PREPARED BY: Authors/ORNL (as "Contractor" to NBS)

RESPONSIBLE ORGANIZATION(S): NBS

PROCUREMENT SOURCE; ACCESSION NO.: Contact NBS (Refer to NBSGCR 80-252)

OTHER IDENTIFICATION: NBSGCR 80-252 ; NBS Purchase Order # 804523 ORNL/HUD/MIUS-52 (for internal ORNL use); HUD Utility Demonstration Series Volume Seventeen

TOTAL PAGES: 150 TOTAL REFERENCES CITED: 8 CLASS OF DOCUMENTS: (P)

ABSTRACT: This study was performed by ORNL for the Center for Building Technology of the National Bureau of Standards (NBS), the technical manager of the Utilities Demonstration Program of the Department of Housing and Urban Development (HUD). Under this program, HUD's Office of Policy Development and Research sponsored the construction and instrumentation of a T.E. plant at the "Operation Breakthrough" site at Summit Plaza in Jersey City, N.J. The purpose of the Demonstration was to provide in-depth operational information on a T.E. plant located in the residential sector. NBS began evaluating the engineering performance and economic costs of operating the Jersey City Demonstration in November 1975.

This Demonstration provided the opportunity to evaluate the dominant environmental effects resulting from "on-site" electric and thermal energy generation for 485 apartments (and an associated commercial-center and school) in the heavily developed urban area of Jersey City, N.J. This assessment covers specific effects from the operation of the T.E. plant namely: (1) air quality resulting from combustion emissions of the 600kW diesel engines and auxiliary boilers fueled with No. 2 distillate oil; (2) noise levels from the operation of the T.E. equipment; (3) cooling-tower drift from two (2,220 gpm) forced-draft cooling towers.

For the air quality study, measurements determined the combustion emission rates and (ground-level) air quality at the demonstration site. Stack analysis of NO_x, SO_2, CO, particulates and total hydrocarbons were used to characterize emisssion rates over a range of operating conditions.

Air quality was monitored for two 6-week periods, during the summer and winter of 1977. The hourly pollutant concentrations, from "background" and T.E. plant operation, were determined with four stationary sampler-units which were located 65-70 m from the exhaust stacks of the Central Equipment Building (CEB). Additionally, plume dispersion behavior was studied by using smoke-plume observations and one-hour, horizontal-concentration profile measurements. Wind direction and speed were

continuously measured at the stack exit so as to provide local micro-meteorological data.

The noise study was performed by measuring sound levels, in dB(A), within an area extending to about 60 m from the CEB. The noise survey investigated the effects on noise distribution of different wind conditions and the time of day or night and whether doors were open or closed near the diesel engines in the CEB.

In the cooling tower study, drift emission characteristics were measured to quantify the drift emission before and after cleaning of the tower interiors for the purpose of reducing fallout of large drift-droplets in the vicinity of the CEB.

The air quality study found NO_x to be the only combustion product detectable at ground level and identified the diesel engines as the major source of the NO_x. Presence of buildings taller than the exhaust stacks created a downwash of the exhaust plumes, in varying degrees, from local wind speeds above about 1.5 m/sec (3 mph). During the 6-week monitoring periods the average NO_x concentration was up to 0.05 ppm, at a distance of 65 m from the CEB; background NO_x concentrations were 0.04 to 0.08 ppm. The highest one-hour NO_x concentrations projected from observed values are less than the one-hour significant "harm level", of 2 ppm, for NO_2; therefore, no adverse human health effects are expected from the observed NO_x concentration levels.

The noise study identified the diesel engines as the major continuous noise source external to the CEB, with the engine exhaust-dilution fan being the next highest source. Under normal conditions, the maximum noise level is approximately 75 dB(A) close to the CEB; the noise level drops to 65 dB(A) - the daytime limit of the local noise ordinance for residential areas - within approximately 23 m (75 ft) of the CEB. The nighttime noise level limit of 50 dB(A) is exceeded in the Summit Plaza area from "background" noise sources alone but the T.E. demonstration area noise source does not constitute a violation of the local noise ordinance since the construction of the demonstration pre-dates the 1978 ordinance.

From the cooling tower study, the major environmental impact was found to be the nuisance effect from drift deposition resulting from dirt and debris accumulation in the tower distribution headers. However, this drift loss can be reduced to an acceptable percentage of the tower water flow rate by proper maintenance procedures. Chemical and/or biological damage from deposition of the cooling tower drift is minimized by using a (relatively) non-toxic treatment chemical for the tower water.

TITLE: The Summit Plaza Total Energy Demonstration - Four Years of Operating Experience

AUTHOR(S): J.D. Ryan

DATE OF ISSUANCE: 10/79

DOCUMENT PREPARED BY: Author/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [Miller Freeman Publications; San Francisco, CA 94105]

OTHER IDENTIFICATION: Second International Total Energy Conference-Part 1 Papers, pages 4.39-4.55; Copenhagen, Denmark, Oct. 8-12, 1979

TOTAL PAGES: 17 TOTAL REFERENCES CITED: 12 CLASS OF DOCUMENTS: (PO)

ABSTRACT: This Paper summarizes the measured data and test results of HUD's T.E. demonstration project at the Summit Plaza complex in Jersey City, N.J. The demonstration site is a privately-owned, self-contained utilities plant serving the electrical, space heating/cooling and domestic hot-water needs of 486 dwelling units and their associated commercial areas plus a school and swimming pool. Operation of the plant began in January, 1974. The National Bureau of Standards monitored and collected data on the plant from start-up through October, 1978. This paper covers data for the following areas: plant component performance; electrical service reliability; economics; environmental impact.

Data is included covering: the operating thermal performance of plant components, including the diesel engine-generators; heat recovery; boilers; chillers; district heating system; etc. Areas are discussed where improved thermal performance can be obtained. Also presented are electrical service reliability data, in the form of customer service interruptions and outage causes; plant reliability is also compared with the somewhat limited data that is available for the local and national average reliability levels for utilities. Economic data is provided for initial capital costs and operation/maintenance costs. [Unit costs, for the energy commodities delivered to the site, are also calculated.]

Environmental results include stack emission, ground-level air quality and noise levels. Data on engine and boiler stack emissions cover NO_x, SO_2, CO, HC and particulates. Ground-level air quality is evaluated for NO_2 in relation to U.S. Federal Air Quality Standards and the incremental contribution of the TE plant. Noise data is assessed in terms of both the impact on residential buildings in certain areas of the site and on compliance with local noise ordinances.

TITLE: Description of the Data Acquisition and Instrumentation Systems: Jersey City Total Energy Project

AUTHOR(S): C. Bulik; et al

DATE OF ISSUANCE: 3/79

DOCUMENT PREPARED BY: Authors/NBS

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 294-926]

OTHER IDENTIFICATION: NBSIR 79-1709; HUD Utilities Demonstration Series Volume 9; Project 4626382

TOTAL PAGES: 158 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (P)

ABSTRACT:

Under HUD sponsorship, NBS gathered engineering data on an operating, diesel-powered, Total Energy (T.E.) plant; the plant supplies all the electrical power, hot water and chilled water to a 485 unit apartment/commercial building complex in Jersey City, N.J. Engineering data was continuously collected from April 1975 to December 1978, by means of a data acquisition system (DAS) which recorded the outputs from over 200 sensors located in the power plant and in the various site buildings.

The site was instrumented with 223 transducers, measuring and converting physical variables into electrical signals that were recorded on magnetic tape by the DAS. Data was recorded every five minutes, 24 hours a day, utilizing a scan of all 223 instruments in 30 seconds. The data tape reel was removed from the site periodically (about every week) and returned to NBS where it was processed on a mini-computer to produce information on the site's operation, efficiency and reliability. The rationale for a five minute sampling interval and a 30 second scanning speed is discussed in detail.

The Report describes the design and operation of the instrumentation and data acquisition systems used to monitor the T.E. plant and certain utility services to the site buildings. It also contains a description of the types, characteristics and locations of instruments used to measure the various physical variables. The capabilities and operational modes of the DAS are discussed and the major DAS components are described in detail. The report also contains a brief description of the entire site as well as instrument costs, data processing procedures and (some of) the instrumentation problems that were encountered and solved.

TITLE: Heat Transfer Performance of an Air-Cooled Tube in a Fluidized-Bed Furnace

AUTHOR(S): R.S. Holcomb

DATE OF ISSUANCE: 2/79

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1979-748-189/406]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-49; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 22 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (P)

ABSTRACT:

An ORNL program, for developing a coal-fueled MIUS, is being jointly sponsored by HUD's Office of Policy Development and Research and DoE. This (Phase II) report presents the results of certain heat transfer tests needed in the development of such a MIUS.

Heat transfer tests were conducted with an air-cooled tube in a coal-fueled, fluidized-bed furnace. An 0.5-in. tube was used and the tests were run in an 18 x 18 in. furnace, operating at atmospheric pressure and 1650°F. Results were obtained for an air flow, inside the tube, of 23 lb/hr and a mean bed particle size of 460 microns, at fluidizing velocities of 0.8 to 2.2 fps. The heat transfer coefficient from the bed to the tube wall increases from ∿40 Btu/hr-sq. ft.-°F, at a fluidizing velocity of 0.76 fps, to a value of ∿85 Btu/hr-sq. ft.-°F at a velocity of 1.6 fps; at higher velocities, the heat transfer coefficient is constant at the higher of these two values.

The following conclusions have been reached, on the basis of the heat transfer test results:

1) The assumed values of the heat transfer coefficient, for the design of the ORNL furnace, were considerably lower than those found in the tests and therefore the design is conservative; thus, the bed can operate at a lower temperature than the original design temperature.

2) The correlation in the literature for predicting the heat transfer parameter, $(Nu/Ar)^{0.22}$, yields a value that is ∿25% lower than was observed in testing.

The fluidized-bed type of furnace was selected because it has the capability of burning 1 to 5% sulfur coal in a bed of limestone (that is fluidized by the combustion air) and at the same time reducing the sulfur dioxide emissions to the same level as that for "low-sulfur" coal in a conventional furnace. [The sulfur in the coal combines with the calcium in the limestone and the spent limestone is removed with the ash. The limestone feed rate would be ∿1/3 by weight of the coal feed rate when burning high-sulfur coal.]

TITLE: A Review of Information Relevant to Tube Corrosion in a Gas-Cooled, Coal-Fired, Atmospheric-Pressure, Fluidized-Bed Furnace

AUTHOR(S): M.E. Whatley

DATE OF ISSUANCE: 11/78

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978-748-189/301]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-44; Contract No. W-7405-eng-26; Hud Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 35 TOTAL REFERENCES CITED: 16 CLASS OF DOCUMENT: (P)

ABSTRACT:

An ORNL program for developing a coal-fueled MIUS is being jointly sponsored by HUD's Office of Policy Development and Research and ERDA's Fossil Energy Branch. This publication is one of a series developed under the HUD-MIUS Program to further a particular aspect of the program goals; it is one of several topical reports covering the various aspects of the conceptual design of a coal-fueled MIUS system. This particular report is a review of information relevant to tube corrosion in a gas-cooled, coal-fired, fluidized-bed furnace.

The fluidized-bed combustion unit being developed for the coal-fired MIUS will energize a gas turbine in a Brayton cycle; the unit is characterized by a large surface area, operating at a high metal temperature and at low heat fluxes. For the generation of about 350 kW(e), 510 sq. ft. of metal surface (in the form of 560, 1/2-in., tubes) will be in contact with the bed and will operate at about 1550°F. The tube wall thickness will be about 70 mils and the tubes must be sufficiently strong to withstand the normal body forces from the fluidized bed. It is desirable for the tubes to survive at least ten years of operation, which requires penetration rates of not more than 3-5 mils/year.

A large and diverse amount of material was reviewed in a quest for definitive information relevant to tube corrosion, in hopes for guidance in selecting an optimum material. [For the most part this quest was unsuccessful, in that no basis for an optimum selection was developed.] A review was made of: conventional coal-fired, power plant boilers; turbine bucket corrosion; corrosion work, directed toward materials selection for coal gasification; and the information available from experience in the operation of other coal-fired, fluidized-bed combustors. In each case it was found that important differences between the intended application and the conditions under which the corrosion data were accumulated, make dubious the direct application of such data. Through the rationale of qualitatively analyzing the most probable mechanism for corrosion in the developing system, it was reasonably concluded that the specified attack rates will not be exceeded for several practical materials; Incoloy 800 was selected for the ORNL demonstration unit.

TITLE: Preliminary Design Technical Report: MIUS Demonstration Project St. Charles, Md. [Volume 1 (of 2); Books 1 and 2]

AUTHOR(S):

DATE OF ISSUANCE: 9/78

DOCUMENT PREPARED BY: Interstate Land Development Co., Inc. (St. Charles, Md.)

RESPONSIBLE ORGANIZATION(S): HUD (Office of Policy Development and Research)

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: Book 1: HUD-PDR-373-1 (3/79); Book 2: HUD-PDR-373 (5/79); HUD Grant No. H-2501-RG

TOTAL PAGES: 517 TOTAL REFERENCES CITED: 13 CLASS OF DOCUMENT: (P)

ABSTRACT:
As a follow-on to earlier HUD efforts in the development of a MIUS, a "grant" was awarded for a HUD/MIUS demonstration project at St. Charles, Maryland; the recipient was Interstate Land Development Company, Inc. (ILD), the developer of St. Charles Communities. One of the primary objectives of this grant was the generation of the design (including cost projections) for a MIUS which would provide reliable, energy-efficient utility services within a defined service area at St. Charles. Another primary objective was to determine whether or not a developer could receive required approvals to build/operate a MIUS, and if so, by what means.

The proposed St. Charles site has characteristics typical of high-density settlement patterns in the U.S.A. The site will contain a commercial center, surrounded by high-density residential housing. The center of the site is the proposed location of the MIUS plant. The central plant position was chosen primarily because of the necessity to distribute heat to buildings over the shortest distances possible.

Solid waste will be collected and incinerated on schedules to correspond to thermal load requirements. Most pick-up trips will be short because of the central location of the plant on site.

Electric power generated in the plant will be sold wholesale (during grid peaks) to the local electrical cooperative and at retail rates to tenants in the mall, as a "passthrough" on rents.

Geographically, the site location is ideal for a demonstration since it is an area where substantial energy use occurs in maintaining both winter and summer room comfort. Additionally, utility and fuel costs are near the median for the United States.

TITLE: Preliminary Design: Institutional Analysis Report for a HUD/MIUS Demonstration Project (at) St. Charles, Md. [Volume 2 (of 2)]
AUTHOR(S):

DATE OF ISSUANCE: 9/78

DOCUMENT PREPARED BY: Interstate Land Development Co., Inc. (St. Charles, Md.)
RESPONSIBLE ORGANIZATION(S): HUD (Office of Policy Development and Research)
PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1979, 629-555, 1-3]

OTHER IDENTIFICATION: HUD-PDR-373-2 (7/79); HUD Grant No. H-2501-RG

TOTAL PAGES:464 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (P)

ABSTRACT:
Interstate Land Development Company, Inc. (ILD) was the successful applicant for a "grant" to initiate a site-specific demonstration of the generic MIUS concept originated by HUD. The grant award was made on April 1, 1976 after an exhaustive review of proposals by land developers from throughout the U.S.A. While no demonstration occurred, a design and economic justification evolved from the effort. Both were presented in "Volume I, Preliminary Design Technical Report for a MIUS at St. Charles". As a supplement to Volume I, (this) Volume II report lists institutions identified by ILD which could impact a MIUS at a St. Charles, Maryland site.

The Report points out that the nature of the institutional impacts can be divided into three basic categories:
1) Influence on design;
2) Effect on economics;
3) Authority to build and operate.

Since the St. Charles project never entered the construction phase, the Report states that: "it will be necessary to speculate on some aspects of institutional influence and resistance". Moreover, ILD's progress - up to the point of obtaining some permits to construct - provided sufficient contacts and negotiations to give insight into the extent to which institutional factors could inspire MIUS proliferation or stiffle the concept. This report thoroughly documents experiences in dealing with authorities who could impact MIUS.

It is noted that a MIUS project would (in most cases) start at the local government level. If the county authorities, for example, reject the idea of controlled growth at a proposed location, the MIUS concept will not be a positive influence. However, MIUS can help the developer in areas where the chief objection to growth is the increased tax burden. A MIUS plant could be presented in the context of a new "clean industry" which would provide a substantial new tax base. If MIUS can also lower the cost of utilities for a public school, the package would be all the more desirable.

TITLE: Alternate Operating Conditions and Systems for the Coal-Fired Modular Integrated Utility System

AUTHOR(S): G. Samuels; W.M. Wells

DATE OF ISSUANCE: 2/78

DOCUMENT PREPARED BY: Authors/ORNL (DoE - Fossil Energy Div. of Coal Conversion and Utilization)
RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978-748-189/378]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-46; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72; ERDA Contract No. E(49-18)-1742
TOTAL PAGES: 51 TOTAL REFERENCES CITED: 24 CLASS OF DOCUMENT: (P)

ABSTRACT:

This paper analyzes the effects of varying the operating conditions, of a coal-fired closed-cycle gas turbine MIUS system, on the efficiency and cost of the plant. The merits of using an organic Rankine system for this application, either as a single cycle or in combination with the gas turbine system, is also evaluated.

It was found that the electrical efficiency and overall fuel utilization, of the reference gas turbine plant, are severely degraded by reducing the turbine inlet temperature. The electrical efficiency of the system is about 25% for a turbine inlet temperature of 1500°F and is reduced about two points for each 100°F reduction in temperature, with little change in the cost of the plant over a temperature range from 1500 to 1200°F. Reducing the turbine inlet temperature will require that the size of some components of the system be increased to maintain a given plant power output. However, the increased cost of these components is offset by cost reductions that can be realized by the use of less-expensive materials and from the use of a smaller furnace which is made feasible by the larger temperature difference between the furnace and the air in the working cycle.

A single-cycle organic Rankine system is not well suited for this application and would, at best, be very marginal. The addition of an organic Rankine secondary cycle to the gas turbine system offers the potential for significant improvements in both efficiency and cost over that of the reference gas turbine plant. Such a secondary system could add about 33% to the electrical output of the plant for an increased capital cost of only about 5%.

TITLE: Reliability Considerations for a Coal-Fired Modular Integrated Utility System

AUTHOR(S): G. Samuels

DATE OF ISSUANCE: 2/78

DOCUMENT PREPARED BY: Author/ORNL (DoE-Fossil Energy Div. of Coal Conversion and Utilization)
RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1978-748-189/380]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-45; Contract No. W-7405-eng-26; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72; ERDA Contract No. E(49-18)-1742
TOTAL PAGES: 43 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (P)

ABSTRACT:

This paper provides a statistical analysis to estimate the availability and power outage rates for a coal-fired MIUS composed of 4 to 6 parallel power modules, in which there are two modules in excess of those required to meet the system's critical load. The analysis includes estimates of the mean time between failure (MTBF) and the mean time to repair (MTTR) for the various subsystems and the effects of several methods of operation on the outage rate. Assuming an operating procedure in which excess capacity when available in "on-line", the total plant downtime for a 4 to 6 module plant is estimated to be in the range of 5 to 10 hours per year; this range of values would be expected only after a shakedown to "debug" the system and an extended operating period to establish preventive maintenance procedures. [It should be emphasized that the excess capacity requirements are based on a critical plant load and not on the peak load.]

The overall availability of a MIUS plant will depend on the availability of the individual modules, the redundancy provided and the method of operation. Compared to representative gas- or oil-fired total-energy systems, the coal-fired MIUS will probably have a lower MTBF and a longer MTTR and, consequently, a lower availability. The use of coal increases the complexity and failure modes for the plant and thus one would normally expect a greater module failure rate. The MTTR components in a coal system may not be greater than those for a gas- or oil-fired system but the longer time required to bring the module back on line should be considered part of the repair time and will thus increase the MTTR. Although the overall availability is probably somewhat less than that of a conventional system, the total plant downtime (with proper operating procedures) should be reasonable and acceptable.

TITLE: Initial Simulation and Control System Studies of the MIUS Coal-Fired Turbine Experiment

AUTHOR(S): S.J. Ball

DATE OF ISSUANCE: 2/78

DOCUMENT PREPARED BY: Author/ORNL (DoE-Fossil Energy Div. of Coal Conversion and Utilization)
RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1977-748-189/374]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-25; Contract No. W-7405-eng-26

TOTAL PAGES: 55 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (P)

ABSTRACT:

The fluidized-bed coal-fired gas turbine (CFGT) experiment is part of the MIUS program, which is jointly sponsored by HUD and ERDA (now DoE). The dynamic characteristics of the CFGT experiment are being investigated to determine the specific control system designs required to satisfy varying electrical and waste heat demands and, at the same time, to keep the temperatures and stresses of plant components within acceptable limits. The simulations indicate that the present control system design is capable of satisfactorily handling expected load transients.

Mathematical models of a proposed CFGT plant were developed to simulate each of the major plant components and the entire system of equations was solved using the CSMP (Continuous System Modeling Program) language. The purpose of this work was to investigate the inherent response characteristics of the plant and to assist in the design of the control and instrumentation systems. The objectives of the CFGT control system are to first satisfy the electrical demand and keep the fluidized-bed temperature within limits, second to satisfy the space and water-heating load requirements and third, to ensure that each plant component stays within acceptable operating limits.

A CSMP simulation is considered flexible and easy to modify, enabling the user to test various control schemes and to observe the sensitivity of the predicted response to changes in model assumptions, design features or other important factors. In the next phase of the simulation development, ORNL will incorporate more detailed plant component design data into the models and develop a scheme for handling changing demands in the heating loads, while still giving first priority to electrical demand.

TITLE: Monitoring of Combustion Emissions and Air Quality at Jersey City Total Energy Demonstration

AUTHOR(S): J.O. Kolb (ORNL); W.T. Davis (Univ. of Tenn.)

DATE OF ISSUANCE: 1/78

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL & University of Tennessee

PROCUREMENT SOURCE; ACCESSION NO.: [Information Transfer, Inc.; Suite 202, 1160 Rockville Pike; Rockville, Md. 20852]

OTHER IDENTIFICATION: "Proceedings of the 2nd National Conference and Exhibition on Technology of Energy Conservation"; Albuquerque, New Mexico; Jan. 24-27, 1978, pages 350-359

TOTAL PAGES: 10 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (PO)

ABSTRACT:

The Jersey City, N.J. Total Energy (T.E.) demonstration provided the opportunity to determine the air quality effects from on-site electric and thermal energy generation for approximately 500 apartments in a heavily developed urban atmosphere. [This demonstration is a part of the MIUS program for providing all or several of the utility services for a community.] Part of the evaluation of this T.E. demonstration is a study of the combustion emissions and air quality effects from operation of five (600kW) diesel engine generators and two auxiliary boilers, fueled with No. 2 distillate oil. This paper presents the methodology, results and conclusions of a six weeks study conducted in the summer season of 1977 by ORNL and the University of Tennessee Environmental Engineering Department. The summer monitoring effort is the initial phase of a larger study in which monitoring will be conducted during the fall/winter season of 1977.

The scope of this study was to measure and characterize the combustion emissions from the T.E. plant operation, determine the general behavior of plume dispersion from the plant and to determine the effect of the plant combustion emissions on local air quality. Background information of the loads carried by the diesel engines and auxiliary boilers in the plant (coupled with general emission characteristics) indicated that the diesel engines would be the dominant source of combustion emissions. Therefore, the major effort in emission measurement was applied to the diesel engine exhausts.

Measurements were performed to determine both the combustion emissions and ground-level air quality at the T.E. demonstration site. Stack analyses of NO_x, SO_2, CO and hydrocarbons were depended upon to characterize emissions over a range of operating conditions. Continuous wind direction and speed was also measured at the stack exit to provide local micro-meteorology. In this paper, the magnitude of the total energy plant combustion emission concentrations, (monitored out to ~350 ft. from the plant) are presented relative to the general air quality of Jersey City.

TITLE: Design and Performance Testing of a Coal Feed and Metering System for the MIUS Fluidized-Bed Combustor

AUTHOR(S): M.E. Lackey

DATE OF ISSUANCE: 12/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: ORNL/HUD/MIUS-47; ERDA Contract No. E(49-18)-1742; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 72 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (P)

ABSTRACT:

Hundreds of "small" total energy (T.E.) systems employing diesel or gas engines have been found to be economically attractive. When shortages of gas and fuel oil began to develop in 1972, HUD asked ORNL to investigate the possibility of developing a small T.E. system that would operate with coal as the fuel. The investigation's preliminary evaluation entailed a comprehensive review of a wide variety of ways of employing coal in such systems for HUD applications. This study indicated that the most promising arrangement was obtained by coupling a closed-cycle gas turbine to a fluidized-bed coal combustion system.

In support of the MIUS Program, a full-scale coal feed and metering system was designed and experimentally evaluated under various conditions associated with the operation of a coal-fired, fluidized-bed combustor. The system employs a rotary air-lock feeder for primary metering and 3 riffles to subdivide the coal flow into 4 streams, each of which is pneumatically transported to a separate quadrant of the fluidized-bed combustor. This feeder metered the total coal flow rate with a reproducibility greater than 99%. The riffles subdivided the coal flow to give an average distribution of the flow among the four lines of $\pm$3.5% over a flow range of from 40 to 275 kg/hr corresponding to 0.2 to 1.36 of the design flow range of 200 kg/hr.

The system exhibits a decrease in the total coal feed rate of approximately 10% during the refilling of the rotary air-lock feeder supply tank. This decrease can be compensated by an increase in the rotary air-lock feeder speed of approximately 10% during refilling, followed by a return to normal speed after the filling operation has been completed.

During the course of the approximately 100 experimental runs made during this study, a total running time of over 1400 hours has been accumulated with no difficulties being experienced with either the operation of the rotary air-lock feeder or the pneumatic transport system used for feeding to the simulated fluidized-bed combustor.

TITLE: Fluidized Bed Gas Turbine Experimental Unit for MIUS Applications

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 12/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1977-748-189/320]

OTHER IDENTIFICATION: ORNL/HUD/MIUS-34 (Quarterly progress report for 1/1/76 thru 3/31/76); ERDA Contract No. E(49-18)-1742; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

TOTAL PAGES: 32 TOTAL REFERENCES CITED: 7 CLASS OF DOCUMENT: (P)

ABSTRACT:

A program for developing a coal-fueled MIUS at ORNL is jointly sponsored by HUD and ERDA (now DoE). Phase I of this program is entitled "Concept Preliminary Evaluation" and deals with the various ways coal (and coal-derived) fuels might be employed in a MIUS system. Phase II deals with the development of a firm conceptual design and cost estimate for the construction of a system for test and evaluation.

Prime priority was given to the preparation of bid packages for procurement of long lead-time items. Bids were requested on the longest lead time item, the "Incoloy 800"tubing, and the order was placed. Discussions with four boiler manufacturers have indicated that they are interested in bidding on the furnace; a bid package for the furnace has been prepared and will be sent out when funds are available.

The AiResearch study under subcontract strongly favors "closed cycle" vs "open cycle" operation in a MIUS system and indicates that their existing model 831-200 engine can be modified for use in a closed cycle system, the main change required being in the shaft oil seal. Coal dispersion rates were measured in the 4 foot square cold-flow test facility. The coal dispersion rate was poor for incipient fluidization of the bed but was satisfactory at the minimum design air flow rate and was still better at higher air flows.

Bench tests of the coal metering and feed equipment indicate that the vibratory feed system can be adjusted to give good division of the coal feed into 4 nearly equal streams, at any given coal feed rate, but wide variations in the flow rates develop as the coal feed rate is changed. The flow divider device, on the other hand, splits the coal feed into 4 streams with a flow rate for each which is within less than $\pm$5% of the mean for the entire coal flow rate of interest; further, this excellent performance is repeatable day after day.

TITLE: Atmospheric Fluidized Bed Combustion Technology Test Unit for Industrial Cogeneration Plants

AUTHOR(S): A.P. Fraas; R.S. Holcomb

DATE OF ISSUANCE: 12/77

DOCUMENT PREPARED BY: Authors

RESPONSIBLE ORGANIZATION(S): ORNL

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; Conf-771219-1] & [The Mitre Corporation; 1820 Dolley Madison Blvd., McLean, VA. 22101]

OTHER IDENTIFICATION: "Proceedings of the 5th International Conference on Fluidized Bed Combustion"; Washington, D.C., Dec. 12-14, 1977; Vol. 3, pages 55-71

TOTAL PAGES: 17 TOTAL REFERENCES CITED: 6 CLASS OF DOCUMENT: (PO)

ABSTRACT:

Fluidized bed combustion represents a very promising method for using a wide range of coals (to replace oil and natural gas as fuels for industrial plants) within acceptable emission standards. The total quantity of coal that will have to be burned to produce process heat and electricity for industry can be substantially reduced if coal-fired cogeneration systems are employed in industrial plants to provide both electricity and process heat. The gas turbine is very well suited for such cogeneration systems since it has a higher ratio of electric power output to exhaust heat load and also has a higher exhaust gas temperature availability. A fluidized bed coal combustor, heating air to a high temperature inside tubes immersed in the bed, is an attractive system for supplying clean air to drive a gas turbine for industrial cogeneration plants.

A program for DoE is underway at ORNL to assess the potential application of gas turbine cogeneration systems and to investigate the technology required for them. The program, entitled the Coal Combustor for Cogeneration (CCC) Program, is directed at the study of systems in the size range from 5 MW(e) to 50 MW(e).

The Test Unit Program, discussed in this paper, will develop the technology for a fluidized bed coal combustion system to provide a source of high temperature air for process heating and gas turbine power generation in industrial plants. The conceptual design of the Technology Test Unit has been completed. The 6 foot square combustor has a bed depth of 2 feet and has been designed for atmospheric pressure and 1650°F, to produce a heat output of about 5 million Btu per hour. Development and testing have been conducted in the areas of fluidization, heat transfer, tube corrosion and coal feeding. New results on heat transfer, tube corrosion and coal feeding are presented in this paper. [A number of furnace companies were invited to submit their own designs for the combustor unit, from which designs a final selection will be made.]

TITLE: Exhaust Emission Evaluation of Three Caterpillar Tractor (D-398) Diesel-Electric Sets

AUTHOR(S): C.E. Kitsen; R.S. Egdall

DATE OF ISSUANCE: 11/77

DOCUMENT PREPARED BY: Authors/York Research Corp. (Stamford, Conn.)

RESPONSIBLE ORGANIZATION(S): York Research Corp. (for NBS)

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; PB 276-102]

OTHER IDENTIFICATION: GCR 77-104; HUD Utilities Demonstration Series Volume Fourteen; Contract: 2-35932/Grant: YRC Job No. Y-7881

TOTAL PAGES: 69 TOTAL REFERENCES CITED: 4 CLASS OF DOCUMENT: (P)

ABSTRACT:

York Research Corp. was contracted by NBS to perform gaseous and particulate emissions testing on 3 (600 kW-rated) diesel-generator sets; these engines were purchased for installation at the HUD Total Energy Demonstration Plant in Jersey City, N.J. The emissions testing was part of a comprehensive performance test program conducted for HUD. The test program was undertaken with the objective of providing baseline data to compare with installed engine performance data to be collected by NBS under actual field operating conditions during a 2 to 3 year demonstration program.

Each unit's exhaust was tested at varying loads for oxides of nitrogen, carbon monoxide, vaporous hydrocarbons (HC) and particulate matter. Test Methods are outlined in the report.

The emissions testing was conducted at varying operating loads which included 0%, 20%, 40%, 59%, 79%, 100% and 110%. [These engines were designed to provide the dual functions of electric generation and heat supply through exhaust heat exchangers.] Water jacket cooling water temperatures were maintained at two levels, depending on engine load; i.e., $\leq$ 200°F at loads of 100% and 110%, and $\leq$ 228°F at 79% and below.

The text of the report indicates that the reliability of the data resulting from this test program may,in some cases, have been adversely affected by non-standard measurement techniques and in other cases by deviations from recommended procedures. However, these data are considered to be good approximations of the true emission values.

TITLE: Fluidized Bed Gas Turbine Experimental Unit for MIUS Applications

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 11/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: ORNL/HUD/MIUS-33 (Quarterly progress report for 10/1/75 thru 12/31/75); ERDA Contract No. E(49-18)-1742; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

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

ABSTRACT:

A program for developing a coal-fueled MIUS at ORNL is jointly sponsored by HUD and ERDA (now DoE). Phase I of this program is entitled "Concept Preliminary Evaluation" and deals with the various ways coal (and coal-derived) fuels might be employed in a MIUS system. Phase II deals with the development of a firm conceptual design and cost estimate for the construction of a system for test and evaluation.

During this quarter authorization was obtained from HUD and ERDA to proceed with Phase III of the program, i.e., the detail design and construction initially using the funds that remain after the Phase II work.

Detail design work was initiated. Discussions with vendors proceeded, based on the Phase II layout drawings. Several modifications were made in detailed elements of the furnace design to simplify fabrication. A study contract with AiResearch was arranged and they are examining the problems involved in adapting one of their engines to operate with a fluidized bed heat source.

Cold-flow tests were started to investigate the rate of dispersion of coal injected into the 4 foot square bed through the coal feed ports. The "Iron Fireman" stoker was installed and its bench testing was initiated.

TITLE: Fluidized Bed Gas Turbine Experimental Unit for MIUS Applications

AUTHOR(S): A.P. Fraas

DATE OF ISSUANCE: 11/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: ORNL/HUD/MIUS-32 (Quarterly progress report for 7/1/75 thru 9/30/75); ERDA Contract No. E(49-18)-1742; HUD Interagency Agreement No. IAA-H-40-72 ERDA 40-333-72

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

ABSTRACT:

A program for developing a coal-fueled MIUS at ORNL is jointly sponsored by HUD and ERDA (now DoE). Phase I of this program is entitled "Concept Preliminary Evaluation" and deals with the various ways coal (and coal-derived) fuels might be employed in a MIUS system. Phase II deals with the development of a firm conceptual design and cost estimate for the construction of a system for test and evaluation.

During this quarter, the second of the Phase II effort, there was an intensive effort to complete the conceptual design and cost estimate of an experimental coal-fired, closed-cycle gas turbine having an electrical output of about 325 kW(e). [The conceptual design includes the directly related auxiliaries required for a MIUS application.] This effort entailed extensive contacts with potential vendors of the principal items of equipment required. A set of 10 topical reports covering this work was drafted and submitted for review, with a request for authorization to begin work on Phase III. These draft reports delineate the proposed design and present analyses and data from bench tests to validate the choice of conditions and proportions chosen.

TITLE: Dynamics and Control Studies of a MIUS Coal-Fired Gas Turbine Experiment

AUTHOR(S): S.J. Ball

DATE OF ISSUANCE: 9/77

DOCUMENT PREPARED BY: Author/ORNL

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; CONF-770939-1]

OTHER IDENTIFICATION: Contract W-7405-ENG-26; paper is from "Power Plant Dynamics, Control and Testing Symposium" held at Knoxville, Tenn. (Sept. 7, 1977)

TOTAL PAGES: 20 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (PO)

ABSTRACT:

Mathematical models of a proposed coal-fired gas turbine (CFGT) plant were developed to simulate each of the major plant components; the entire system of equations was solved using the CSMP ("Continuous System Modeling Program") language. The purpose of this work was to investigate the inherent response characteristics of the plant and to assist in the design of the control and instrumentation systems. The objectives of the CFGT control system are: first, to satisfy the electrical demand while keeping the fluidized bed temperature within limits; second, to satisfy the space and water-heating load requirements; third, to ensure that plant component temperatures stay within acceptable operating limits. The study reported in this paper was based on a preliminary plant design; future work will use more detailed simulations that incorporate updated plant component designs and piping layouts. Also a scheme will be developed for handling changing demands in the heating loads, while still giving first priority to electrical demand.

Based on the present simulation, the CFGT experiment can be controlled satisfactorily with the control system design as described in the paper, or with minor variations. The design can handle "turbine trips" and "load transients" (small steps and ramps) that are much faster than most load changes expected in a typical MIUS application.

TITLE: Study of Lyndon B. Johnson Space Center Utility Systems

AUTHOR(S): T.E. Redding; W.C. Huber

DATE OF ISSUANCE: 6/77

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.:

OTHER IDENTIFICATION: JSC-11651; NASA TM-58196

TOTAL PAGES: 127 TOTAL REFERENCES CITED: 13 CLASS OF DOCUMENT: (P)

ABSTRACT:

The purpose of this report is to document the results of the NASA/JSC integrated utility system (IUS) in-house study. This study was aimed toward definition and analysis of potential energy-saving utility system modifications for the JSC. The study was initiated in mid-Jan. 1975 as a result of JSC management's interest in pursuing facility energy savings, in addition to the approximately 25% already achieved through the energy loads reduction program.

The objective of the study effort was to define, analyze, and document potential energy-saving utility system modifications that would serve as a basis for a statement of work to obtain a preliminary engineering report for the most desirable design concepts. [Similar studies have been previously conducted at JSC; however, they either addressed only specific item modifications or they were conducted under entirely different guidelines and constraints.]

This report begins with a discussion of the existing JSC utility system, which was used as the baseline for comparisons with modification options. This discussion is followed by a listing of study guidelines and a detailed description and analysis of the individual options. Appendix A (of the report) consists of a description and discussion of a computer program developed to analyze energy flow and equipment performance in the JSC Central Heating and Cooling Plant. Appendix B deals with the results of a computer analysis of JSC buildings to determine heating and cooling load as functions of ambient weather conditions, occupancy, operating equipment, etc., and also considers the results of modifications designed to reduce these loads.

A section of this report summarizes certain aspects of T.E. and MIUS, as they relate to this study.

TITLE: MIUS Integration and Subsystem Test (MIST) Data System

AUTHOR(S): L.M. Pringle; J.W. Goebel (General Electric)

DATE OF ISSUANCE: 4/77

DOCUMENT PREPARED BY: Authors/NASA-JSC/General Electric Co./Hamilton Standard Div. of United Technologies Corp.
RESPONSIBLE ORGANIZATION(S): NASA-JSC

PROCUREMENT SOURCE; ACCESSION NO.: [GPO; 1977-771.015/1441]; [NTIS; N77-28037]
OTHER IDENTIFICATION: JSC-11871; NASA TM X-58201

TOTAL PAGES: 194 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (P)

ABSTRACT:

This report presenta a historical survey of the development of a data system for use in testing the integrated subsystems of a MIUS. The MIST data system is reviewed from its conception through its checkout and operation as the controlling portion of the MIST facility. The efforts of the author and support contractors in designing, procuring, installing and operating the system are described. The main text does not contain design details but the appendixes are detailed analysis reports that serve as the basis for the MIST data system design.

The MIST data system was intended to provide a real-time monitoring and control function that would allow for complete evaluation of the performance of the mechanical and electrical subsystems, as well as control the operation of the various components of the system. In addition to the aforementioned capabilities, the MIST data system provides computerized control of test operations such that minimum manpower is necessary to set up, operate and shut-down subsystems during test periods.

Because of the basic features of the MIST data system - and because it is comprised of commercially available equipment - its application to other facilities is direct. Instrumentation found in conventional utility plants or industrial complexes interfaces readily with the remote-data-gathering units. Should there be a greater or lesser number of a specific type of measurement (e.g., thermocouples), the units can be configured accordingly. Additionally, the monitoring, alarm, display, recording and logging functions are available to be used for performance evaluation purposes.

TITLE: Final Report: Design and Installation (of) Total Energy Plant-Central Equipment Building Summit Plaza Apartments "Operation Breakthrough Site"; Jersey City, New Jersey

AUTHOR(S):

DATE OF ISSUANCE: 2/77

DOCUMENT PREPARED BY: Gamze-Korobkin-Caloger, Inc. (Chicago, Ill.)

RESPONSIBLE ORGANIZATION(S): Gamze-Korobkin-Caloger, Inc.

PROCUREMENT SOURCE; ACCESSION NO.: [HUD, Office of Policy Development and Research]

OTHER IDENTIFICATION: HUD Utilities Demonstration Series Volume Twelve

TOTAL PAGES: 119 TOTAL REFERENCES CITED: 8 CLASS OF DOCUMENT: (P)

ABSTRACT:

This report deals with the design of a 3000 kW total energy (T.E.) plant serving an aggregate of residential, commercial and institutional buildings at the "Operation Breakthrough" site at Jersey City, N.J. The site receives all power, lighting, space heating, space cooling and heat for domestic hot water from its on-site power plant. In addition, trash collection for the apartments, school and commercial buildings is achieved by means of a pneumatic trash collection system (PTC) which conveys garbage and other trash from these buildings to the power plant, through an underground piping system.

The T.E. concept is a viable one when the life-cycle costs of the system is sufficiently lower than alternative methods of providing thermal and electrical loads. That is, the added initial investment and ongoing maintenance costs associated with the total energy system should be justified by a corresponding reduction in energy consumption. When fuel and power are purchased from outside sources, problems of peak loads and load diversity are generally not a critical factor in the design. However, when all thermal and electrical loads are served from a T.E. plant, peak loads and diversity are paramount considerations in determining whether T.E. will be economically viable.

Careful coordination of all phases of the entire project design is necessary to ensure that a T.E. installation will be successful in all aspects. Under the guidelines established by HUD, there were many parties involved, each having a responsibility for a portion of the overall design and/or construction. Recommendations are included in the report to: improve the coordination among the efforts of all parties; eliminate wasted effort and overdesign; and optimize the T.E. plant design.

TITLE: Instrumentation Control and Data Management for the MIST Facility

AUTHOR(S): V.A. Celino

DATE OF ISSUANCE: 1977

DOCUMENT PREPARED BY: Author/Hamilton Standard (Division of United Technologies)

RESPONSIBLE ORGANIZATION(S): Hamilton Standard

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N78-22134/8WE]

OTHER IDENTIFICATION: JSC-13957; NASA-CR-151708

TOTAL PAGES: 128 TOTAL REFERENCES CITED: 2 CLASS OF DOCUMENT: (P)

ABSTRACT:

The purpose of the MIST has been to evaluate overall performance benefits of various configurations of utilities integration concepts. Testing of the original MIST set-up had demonstrated its technical value to the overall MIUS program but the limitations of manual data gathering, reduction and control imposed a severe limitation for effective utilization. As a result, the MIST was retrofitted with complete instrumentation and automated data gathering and control. This system has proven itself efficient, convenient and reliable in providing data for evaluation of subsystems and systems performance in MIST testing to date.

Because of the basic features of the MIST data system and because it utilizes commercially available equipment, the data system and the methodology of its implementation are directly applicable to other facilities where system evaluation is required. The conventional instrumentation interfaces readily with the remote data gathering units (and the data system's monitoring, alarm, display, recording and logging functions) to satisfy the needs for complete performance analysis. It is the purposes of this document to: record the methodology by which the successful implementation was accomplished; emphasize the requirement to include a thorough instrumentation and control task early in the system design stages; suggest means by which such an installation could be duplicated.

A critical step necessary for the successful operation and evaluation of the MIST (or any MIUS installation) is a thorough system level analysis of the proposed installation, performed at the start of the design effort. Virtually all of the functions performed by the system require some sort of automatic control to regulate the operation of the function, as well as feedback of operational data to evaluate the level of performance. In order to accomplish this, it is necessary to project all anticipated parameters of interest together with the projected sensitivity of each measurement.

The appendix of this Report provides the technical data required for computerized control and/or monitoring of the selected MIST subsystems. The philosophy used in the preparation of the appendix is to provide the computer with the capability to start and stop equipment, verify system configurations, control simulated loads and monitor data. This capability includes all control room functions except: (1) engine stop, start and control and (2) water management and solid-waste management. The capability to shed automatic computer control was also to be provided; such capability allows for manual operations or direct computer input for the operation of each control element.

TITLE: NASA Water Monitor System for Community Applications

AUTHOR(S): R.E. Taylor (NASA); E. Jeffers (Boeing)

DATE OF ISSUANCE: 12/76

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

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [AWWA Catalog No. 20136; Conference Proceedings]
OTHER IDENTIFICATION: Paper No. (3A-1); "American Water Works Ass'n. Water Technology Conference"; San Diego, Calif., Dec. 6-7, 1976

TOTAL PAGES: 20 TOTAL REFERENCES CITED: 13 CLASS OF DOCUMENT: (PO)

ABSTRACT:
Testing of the MIUS concept has been performed at NASA/JSC in Houston, Texas. The MIST (MIUS Integration and Subsystems Test) laboratory has been built at the JSC and is being used for experimentation with advanced concepts, including water and waste treatment technologies. The NASA support of this integration and test program, together with other JSC supporting studies, resulted in a project to develop an automated water quality monitoring and control system to insure the safety and quality of treated wastewater, so as to permit its reuse (for non-potable purposes) in systems such as the MIUS.

NASA has undertaken to develop an automatic WMS (Water Monitor System) that can assure conformance to projected high effluent-quality standards and increase the potential for reclamation and reuse of water. The system includes the necessary sensors, sample collection system and a data acquisition and display system to monitor (in "real" or "near-real time") the discharges from water or wastewater treatment plants and provide the data which determines the quality of the water. Water parameters monitored by the system include: general microorganism detection, utilizing automated chemiluminescence and bioluminescence techniques; automated total coliform and fecal coliform detection, by sensing evolved metabolic hydrogen; total organic carbon; total oxygen demand; residual chlorine; chloride; hardness; pH; turbidity; conductivity; ammonia; nitrate; total nitrogen; sodium; dissolved oxygen; and temperature. Other advanced techniques applied in the NASA/WMS, of potential benefit to water laboratory personnel and water/wastewater system practitioners, include: computer-controlled sample collection and processing of on-line samples; computer-controlled standardization of sensors; computerized data acquisition, formatting, plotting and "hard-copy" report generation.

This paper briefly describes the project objectives, elements of the system, the automated biological sensor systems, adaptibility of the design to remote monitoring applications and the current status of the project.

TITLE: MIUS Integration and Subsystems Test Program

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

DATE OF ISSUANCE: 12/76

DOCUMENT PREPARED BY: Authors/NASA-JSC

RESPONSIBLE ORGANIZATION(S):

PROCUREMENT SOURCE; ACCESSION NO.: [NTIS; N77-26027]

OTHER IDENTIFICATION: JSC-11402; NASA TM X-58187

TOTAL PAGES: 152 TOTAL REFERENCES CITED: 1 CLASS OF DOCUMENT: (P)

ABSTRACT:
NASA/JSC, through its USPO, undertook the MIST Program in support of the conceptual design work associated with the MIUS Program sponsored by HUD. This program was intended to develop and demonstrate the technical, economic and institutional advantages of integrating the systems for providing all or several of the utility services for a community.

The MIST Program is the test verification of the MIUS design concepts. On a small scale, tests of full-size MIUS designs can be run to verify designs before full-scale deployment. The test program was a multiphase operation. Its initial goal was to establish the performance characteristics of the elements that make up the facility and to compare them to manufacturers' data. After the operation envelope was clarified, fully integrated tests were conducted with the use of load profiles characteristic of different types of user facilities and weather conditions; this was an attempt to demonstrate the capability of the subsystems to function in a long-term integrated fashion, to examine the overall energy balance and polluting byproducts produced and to compare the test results with the conventional utility service experience. [The demonstrated ability to simulate important system variables on a small scale and to thusly prove out design concepts at low cost was shown to have valid application to the urban sector.]

Results of the integrated tests were highly encouraging. Total plant efficiencies ranged from 57 to 65%, an approximate doubling of the figures associated with conventional systems. Reduction of total input energy also results in fewer emissions.

An analysis of the results of the tests leads to the conclusion that the technical goals of the MIUS Program are feasible; i.e., provision of utility services can be achieved by integrated systems with a reduction of prime energy consumption and a reduction in environmental impact. In the area of economics, it can be concluded that an automated control system can operate the plant with a minimum manpower level. No other firm conclusions in the economic sphere can be drawn from the experience gained from this program.

TITLE: MIST Test Requirements Document

AUTHOR(S): G.C. Shows; T. Reese

DATE OF ISSUANCE: 5/74

DOCUMENT PREPARED BY: NASA-JSC/USPO

RESPONSIBLE ORGANIZATION(S):

REFERENCE SOURCE & ACCESSION NO.: [NASA-JSC/USPO]

OTHER IDENTIFICATION:

TOTAL PAGES: 287 TOTAL REFERENCES CITED: CLASS OF DOCUMENT: (OF)

ABSTRACT:

The primary purpose of this document is to define the key issues which have been identified in the MIUS Conceptual design studies and to describe the MIST equipment to be tested and the test operations to be employed to resolve these key issues. The document describes the general plan and outline for the initial, six-month, MIST test program and served as the guide for the preparation of testing procedures, data recordings and data reduction.

MIUS key design issues, that has been identified as of 5/74, are described in the report. The objective of these descriptions and their related discussions was to identify the specific problems in each area and to also identify the hardware, instrumentation and operations required to resolve said problems.

TITLE: Program Plan for the MIUS Integration and Subsystems Test (MIST) Program

AUTHOR(S): F. A. Keune

DATE OF ISSUANCE: 7/73

DOCUMENT PREPARED BY: Hamilton Standard Division (United Aircraft Co.)

RESPONSIBLE ORGANIZATION(S): NASA-JSC

REFERENCE SOURCE & ACCESSION NO.: [NASA-JSC]

OTHER IDENTIFICATION: NASA Contract No. NAS 9-13458

TOTAL PAGES: 143 TOTAL REFERENCES CITED: 5 CLASS OF DOCUMENT: (OF)

ABSTRACT:

The primary objective of the program discussed in this report is to produce a "test-bed" MIUS (acronym: MIST) which can deliver the data necessary to adequately support the design requirements of a "full-scale" MIUS. The test-bed has to be both flexible and versatile to accommodate alternate subsystems so as to simulate a variety of test conditions.

Toward this end, MIST must be: a) inexpensive, when compared to a MIUS demonstration project; b) technically sound, i.e., configured to adequately address key MIUS technical issues; c) designed for changes and growth; d) configured with simplicity; and e) having visual appeal to attract the attention of visitors.

The document presents program logic and a work breakdown structure as well as schedule and task descriptions for the MIST Program.

6. COMPOSITE SUBJECT INDEX FOR SP-489 AND THIS SUPPLEMENT

NOTES FOR COMPOSITE SUBJECT INDEX WHICH FOLLOWS

1) This Index covers all abstracts from NBS SP-489 (issued August 1977) plus those from this document.

2) Pagination of the abstracted reports in this document is a continuation of that begun in the original document: NBS SP-489. The page numbers of abstracted reports in NBS SP-489 range from 9 to 149; pages in this document range from 151 to 244.

3) Herein, the numbers following the 65 primary index entries refer to page numbers in NBS SP-489 plus those in this volume. There is no conflict in the numbering system since the page numbers in this supplement continue from those in NBS SP-489, whose last Abstract is on page 149. [Note: If an Abstract covers two pages, its entry number is the first page of said Abstract.]

4) Primary index entries are cross-indexed to other primary entries, as appears helpful.

5) Secondary index entries (i.e., those which have no page numbers associated with them) are appropriately cross-referenced to one or more primary entries.

6) Since about 80 percent of the Abstracts deal directly (or in a significant secondary fashion) with one or more of the variegated aspects of MIUS, it was not deemed helpful to include what would have been a lengthy list of MIUS subcategories.

COMPOSITE SUBJECT CLASSIFICATION INDEX

NBS-114A (REV. 2-8C)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET (See instructions)	1. PUBLICATION OR REPORT NO. NBS SP 489 Suppl. 1	2. Performing Organ. Report No.	3. Publication Date August 1982

4. TITLE AND SUBTITLE

Abstracted Reports and Articles of the HUD Modular Integrated Utility Systems (MIUS) Program , Supplement 1

5. AUTHOR(S)

M. H. Nimmo and B. Reznek, Editors

6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

7. Contract/Grant No.

8. Type of Report & Period Covered

supplemental/updating

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP)

Building Technology Division
Office of Policy Development and Research
Department of Housing and Urban Development
Washington, DC 20410

10. SUPPLEMENTARY NOTES

Library of Congress Catalog Card Number: 82-600571

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This document provides an additional listing of reports and articles relating to the HUD-MIUS Program. Reports published and selected since the issuance of NBS SP-489 are listed. Also included, for the sake of completeness, are some earlier reports which had not been included in the original NBS SP-489. Both NBS SP-489 and this document are required for full coverage. The entry for each report contains an abstract and other pertinent information, including procurement sources and procedures. Reports are grouped by four general subject categories: Program/Concept Description; Systems Analysis; Technology Evaluation; and Hardware Evaluation & Demonstration. The reports are further classified into three publication/availability categories: government publications (Published Reports); non-government publications and articles (Outside Publications); and "informal" reports and data (Open-File Reports). An overall subject index has been included which covers both NBS SP-489 and this document.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Abstracted reports and articles; coal-fired MIUS; comparison studies; concept background of MIUS; conservation of energy; energy analysis; HUD/MIUS Program; HVAC systems; performance analysis; solid waste; total energy; utility systems.

13. AVAILABILITY

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