OAK RIDGE NATIONAL LABORATORY

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FOREIGN TRIP REPORT
ORNL/FTR-3839

DATE: December 17, 1990

SUBJECT: Report of Foreign Travel of Martin A. Broders, Group Leader, and Benjamin W. McConnell, Development Staff, Efficiency and Renewables Research Section, Energy Division.

TO:

FROM: Alvin W. Trivelpiece

Martin A. Broders and Benjamin W. McConnell

PURPOSE: To evaluate the overall effectiveness and energy efficiency of the Computerized Utilities Energy Monitor and Control System (CUMACS/EMCS) installed at the 26th Support Group, Headquarters, United States Army, Europe (USAREUR).

SITE VISITED: 11/26-12/7/90 26th Support Group, USAREUR, Heidelberg, Germany.
Principal Contact: Mr. Jeff Mitchell, Utilities Branch, Electronics Engineer and Mr. Juergen Bller, Chief of Utilities Division.

ABSTRACT: The travelers, representing the ORNL Energy Division, Efficiency and Renewables Research Section, conducted an in-depth evaluation of the CUMACS/EMCS installed at the 26th Support Group, USAREUR. This endeavor included an evaluation of the overall performance of this system including operations maintenance and end-user impact. System energy efficiency in terms of projected and actual energy and cost savings were analyzed. Conclusions and preliminary recommendations based on this evaluation were also formulated.

DISCLAIMER

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BACKGROUND

Under the provisions of Interagency Agreement DOE No. 1938-B090-A1 between the Department of Energy (DOE) and the United States Army Europe (USAREUR), Martin Marietta Energy Systems, Inc. (MMES) is providing technical assistance to USAREUR in the areas of computer science, information engineering, energy studies, engineering and systems development. One of the initial projects authorized under this interagency agreement calls for the "Evaluation of Utilities Energy Management and Control Systems" (UEMCS), installed at selected U. S. Army installations in Europe. The first UEMCS selected for evaluation is operated by the U. S. Army 26th Support Group in Heidelberg, Germany. This report of foreign travel summarizes the activities that occurred during a two week visit to the 26th Support Group to evaluate the overall effectiveness and energy efficiency of the CUMACS/EMCS installed at this U. S. Army installation.

SUMMARY OF ACTIVITIES

- A pre-evaluation meeting was held with Utilities Branch personnel upon arrival at the 26th Support Group, USAREUR in Heidelberg, Germany. The overall program schedule for evaluation of EMCS's at four USAREUR installations in Germany was reviewed and approved. The three (3) remaining EMCS's to be evaluated are located at USAREUR installations in the following locations:

Göppingen, Germany
Grafenwöhr, Germany
Baumholder, Germany

The overall EMCS evaluation approach was discussed and a proposed outline for a final report was presented and approved.

- The CUMACS/EMCS central control room was visited and became "home-base" for this system evaluation. The Chief of CUMACS/EMCS operations, Mr. Holger Grab, served as the travelers primary contact and host during this system evaluation. The following overview information about the CUMACS/EMCS was obtained:
 - The initial EMCS was installed in the mid 1960's and was expanded significantly in 1983 when ECIP Project No. 706 entitled "Extension of Computerized Energy Monitoring and Control System" was implemented. The construction contract for this ECIP project was awarded during March 1983 at a cost of 1,218,683 DM (approximately \$542,843). As of 1990 the CUMACS/EMCS cumulative investment cost is about \$950,000, funded primarily by the ECIP program.
 - Overall cost savings resulting from CUMACS/EMCS operation since FY-1979 are reported to be \$14,780,401. Cost savings for FY-1990 alone are reported to be \$1,488,886.
 - The current CUMACS/EMCS has the following major characteristics:

••	Buildings connected	551
••	Installations covered	11
••	Installations (future potential)	19
••	Analog sensors installed	3,781

••	Digital sensors installed	419
••	Actuators installed	1,893
••	Alarms installed	4,186
••	Status points	947
••	Total data and control points	11,226

- CUMACS/EMCS is comprised of three basic communications subsystem types:

- Low frequency power line carrier ("ripple"), simplex system
- Time division multiplex, control cable full duplex system
- FM radio controlled, half duplex system

These subsystems monitor and/or control both thermal (heating and hot water) and electrical energy systems installed at the following major Heidelberg area installations:

- Campbell Barracks (administrative)
- Mark Twain Village (family housing)
- Patrick Henry Village (family housing)
- Tompkins/Kilbourne Barracks (administrative/housing)
- Patton Barracks (administrative/housing)
- U. S. Army Hospital
- Community Support Center

- CUMACS/EMCS documentation that summarizes projected and actual energy and cost savings associated with this ECIP project was carefully analyzed. The included the following documentation:

- Form DD-1391, Military Construction Project Data Sheet (March 1980) used to justify and secure ECIP funding for this system.
- ECIP Life Cycle Cost Analysis (LCCA) Summary (July 1983) used to update ECIP project energy and cost savings projections based on actual construction contract costs.
- Projected and actual CUMACS/EMCS energy and cost savings data based on 12 years (1979-1990) of actual system operating experience.

Overall, this documentation was found to be consistent and carefully prepared. Energy and cost savings based on actual CUMACS/EMCS operating experience compare favorably with initial Form DD-1391 and ECIP-LCCA documentation projected energy and cost savings. Subject to further in-depth analysis, this project nominally has an SIR > 13, a simple payback of < 1 year, projected energy savings > 100,000 MBTU/year, and projected cost savings > \$1 million/year. Current project cost savings incorporate estimated operation and maintenance (O&M) savings, but do not include O&M costs.

- Annual energy savings attributable to CUMACS/EMCS dropped from a high of approximately 200,000 MBTU/yr in FY 1986/87 to approximately 100,000 MBTU/yr in FY 1988/89/90. This reduction is, in major part, attributable to the installation of exterior wall and ceiling/roof insulation in all family housing, and about 45% of non family housing buildings. The

replacement of fossil fueled boilers with the more efficient hot water district heating system for space and hot water heating in buildings is also a contributing factor.

- An analysis of actual energy consumption data reveals that the largest percentage of energy consumed in family housing is for space heat and hot water heating. For example, in Patrick Henry Village, thermal energy consumption is approximately 70% compared with only 30% electrical energy consumption. Conversely, in administrative facilities the largest percentage of energy consumed is electrical energy. In Campbell Barracks, for example, approximately 70% of overall energy consumption is electrical energy, while the remaining 30% is thermal energy. The potential exists to further reduce both thermal and electrical energy consumption in both military family housing and administrative facilities. The final report of the CUMACS/EMCS evaluation will address these specific recommendations in more depth.
- The energy coordinator for the U. S. military community in Heidelberg, and the energy coordinator for Patrick Henry Village were interviewed. These interviews revealed that the CUMACS/EMCS was viewed as a very reliable system, experiencing very few end-user complaints. CUMACS/EMCS operations and maintenance personnel were reported to be very responsive if a system problem arose, and supportive of the energy coordinators overall mission.
- All facilities that were visited and under CUMACS control were found to be clean and well maintained. Some equipment which was previously serving in coal and oil boiler rooms will probably have a shorter than expected operating life. The CUMACS personnel were alerted to this possibility.
- In the present system configuration, there is very little opportunity for automation of the electrical distribution system; however, the issue of capacitor switching and control by local processor needs some additional coordination. The ORNL experience in this area was shared with the CUMACS personnel and materials from the Athens Distribution Automation Study were left for further review.
- The specific sites and facilities (buildings) visited were as follows:
 - Campbell Barracks and Mark Twain Village
 - CUMACS Center (#4), Electrical Substations (#7, #48), Typical Family Housing (#3702), District Heat Main and Auxiliary Distribution Points (#7, #3702)
 - Patrick Henry Village
 - Electrical Substation (#4749), District Heat (#4750 - old coal/oil system converted to district heat), Typical Family Housing with electric dryer control (#4713), Elementary School (#4498 - old oil boiler converted to district heat).
 - Patton Barracks
 - District Heat Center (#104) and Typical Enlisted Barracks (#103)

- U. S. Army Hospital
 - Steam Plant with "Island" Control System (#3617), Electrical Substation, Medical Gases, Vacuum System and Heating Ventilation and Air Conditioning (HVAC) (#3613), Chlorine Gas Plant (#3631H)
- Stem Kaserne
 - Oil Boiler with Fuel level alarm - FM system (#1002)
- Kilbourne Barracks
 - District Heat System (under construction #4302, #4347, #4315)
- Tompkins Barracks
 - District Heat System converted from large coal boiler (#4243), backup generation (under construction #4237)
- Future expansion of the CUMACS system to new areas will use an FM radio system which is currently on order. The control room facilities will be upgraded to a VAX computer as funds permit. The following initial observations were provided:
 - Archival of data should be done magnetically for a period longer than 14 months. The present system uses strip charts and data loggers for this purpose.
 - The central computer should be expanded to allow on-line analysis of data or a data port should be provided to link the system to a stand alone microcomputer. The present system requires hand data input for analysis on a Zenith 386 microcomputer.
 - Additional survey instruments or portable analog points would be helpful for planning of system expansion and in devising new control algorithms.

APPENDIX 1 - FULL ITINERARY

11/23/90	Departed from Knoxville, Tennessee.
11/24/90	Arrived in Heidelberg, Germany.
11/25/90	Day of Rest (weekend), Heidelberg, Germany.
11/26/90 to 12/7/90	Conducted evaluation of USAREUR, 26th Support Group, CUMACS/EMCS in Heidelberg, Germany.
12/8/90	Departed from Heidelberg, Germany, and arrived in Knoxville, Tennessee.

APPENDIX 2 - PERSONS CONTACTED

- Mr. Jeff Mitchell Electronics Engineer
HQ USAREUR, Deputy Chief of Staff Engineers
Facilities Engineering Division, Utilities Branch
Heidelberg, Germany
- Mr. Dennis Cannon Chief of Utilities and Energy
HQ USAREUR, Deputy Chief of Staff Engineers
Facilities Engineering Division, Utilities Branch
Heidelberg, Germany
- Mr. R. Gary Briggs, Jr. Program Manager, European Office
Martin Marietta Energy Systems, Inc.
Data Systems Research Division (DSRD)
Leimen, Germany
- Mr. Holger Grab Chief of CUMACS
HQ USAREUR, 26th Support Group
DEH Heidelberg, Utilities Division
Heidelberg, Germany
- Mr. Juergen Baller Chief of Utilities
HQ USAREUR, 26th Support Group
DEH Heidelberg, Utilities Division
Heidelberg, Germany
- Mr. John Doherty DOL Energy Coordinator
HQ USAREUR, U. S. Military Community Heidelberg
Directorate of Logistics
Heidelberg, Germany
- Sgt. Peter Contreras PHV Energy Coordinator
HQ USAREUR
Heidelberg, Germany

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