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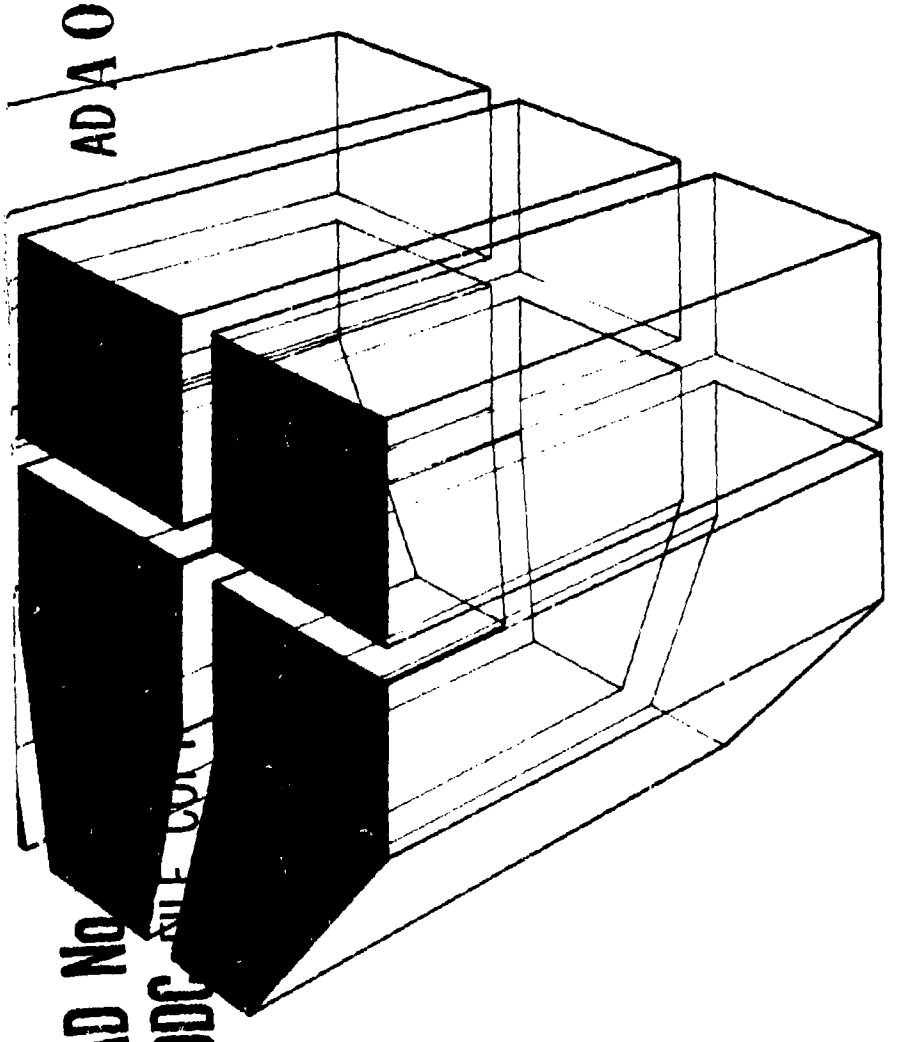
TECHNICAL REPORT P-83
August 1977
Automated Integrated Facilities System Reporting

MANAGEMENT SUMMARY: HOSPITAL EQUIPMENT MAINTENANCE SYSTEM



by
David W. Brown
Richard J. Colver

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TECHNICAL REPORT P-83
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): MANAGEMENT SUMMARY: HOSPITAL EQUIPMENT MAINTENANCE SYSTEM
5. TYPE OF REPORT & PERIOD COVERED: FINAL rept.
6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): David W. Brown, Richard J. Colver
8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
CONSTRUCTION ENGINEERING RESEARCH LABORATORY
P.O. Box 4005
Champaign, Illinois 61820

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 4A762719AT41 T1-015

11. CONTROLLING OFFICE NAME AND ADDRESS

12. REPORT DATE: August 1977
13. NUMBER OF PAGES: 50

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): 52p.

15. SECURITY CLASS. (of this report): UNCLASSIFIED
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

CERL-TR-P-83

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service
Springfield, VA 22151

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

HEMS
recurring maintenance activities
critical utility equipment

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is a management summary of the capabilities provided by the Hospital Equipment Maintenance System (HEMS) and a preview of capabilities to be provided by the Facilities Engineering Equipment Maintenance System (FEEMS), for which HEMS is an operational pilot system. When extended as a Class A Army Standard System (scheduled for FY78), FEEMS will be an integrated module of the Integrated Facilities System (IFS).

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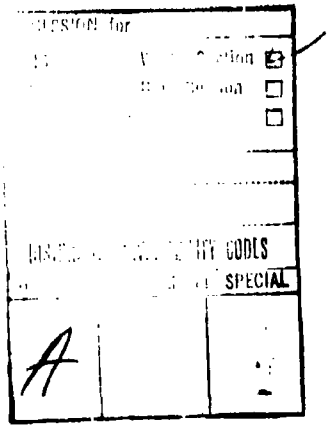
HEMS was developed for use by the installation-level Directorate of Facilities Engineering (DFAE) to support recurring maintenance activities on critical utility equipment and systems in Army hospitals and medical facilities. However, the system is equally applicable to utility systems and equipment throughout the entire installation. HEMS is designed to operate with the Integrated Facilities System (IFS) and uses several input transactions, code structures, and output documents common to IFS. To use HEMS, however, the DFAE must develop a thorough plan for recurring utilities maintenance before implementing the system.

This report provides an overview of HEMS capabilities, a brief description of its benefits, and recommendations for developing the recurring maintenance plan required for HEMS implementation. The DFAE can use this report to evaluate the potential application of HEMS to a given situation and the requirements for such an application.



FOREWORD

This research was conducted for the Directorate of Facilities Engineering, Office of the Chief of Engineers (OCE), under Project 4A762719AT41, "Design, Construction and Operations and Maintenance Technology for Military Facilities"; Task T1, "Development of Automated Procedures for Military Construction and Facility Engineering"; Work Unit 015, "Automated Integrated Facilities System Reporting"; and under U.S. Army Project Order ENG-CERL-75-6, "Hospital Equipment Maintenance System," dated 30 June 1975. The applicable QCR is 1.10.006. The OCE technical monitor was MAJ R. Riordan. The work was performed by the Facility Systems Branch (FOS), Facility Operations Division (FO), U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL.

Appreciation is expressed to the U.S. Army Training and Doctrine Command (TRADOC) Headquarters, Fort Monroe, VA; to the U.S. Army Health Service Command, San Antonio, TX; and to the Directorate of Facilities Engineering and the Management Information Systems Office at Fort Gordon, GA, for their assistance in the development and implementation of HEMS.

The study was conducted under the general supervision of Mr. R. Colver, Chief, FOS, and Mr. R. Blackmon, Chief, FO.

COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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MANAGEMENT SUMMARY: HOSPITAL EQUIPMENT MAINTENANCE SYSTEM

1 INTRODUCTION

Purpose

The purpose of this report is to provide facilities engineering and management personnel with an overview of the Hospital Equipment Maintenance System (HEMS) so that they can evaluate the potential benefits of its application within their own installation, facility, or command. Familiarity with the Army's Integrated Facilities System (IFS) and its associated procedures is necessary in understanding this report.

Background

HEMS is a semi-automated tool for monitoring and scheduling recurring maintenance activities and resources for selected utility systems and equipments. Recurring maintenance includes all schedulable maintenance not performed by dedicated operations personnel. It also encompasses all activities involving inspection, preventive maintenance, lubrication, and replacement of consumable parts, e.g., belts or filters.

HEMS provides the capability of identifying and documenting critical recurring maintenance activities for resource planning and scheduling and for automatically producing monthly work orders for activities to be completed during the next month. Feedback on work accomplished is used to analyze resource requirements and equipment performance. A history of all recurring maintenance is recorded for such analyses. Deficiency correction or repair maintenance activities are accomplished outside HEMS on an as-required rather than a scheduled basis. Historical data on deficiency correction/repair may be stored in HEMS for later analysis. HEMS provides the basis for a successful and effective recurring maintenance program and for an improvement in equipment procurement effectiveness through analysis of past equipment performance.

In July 1972, the Office of the Chief of Engineers (OCE) tasked the U.S. Army Construction Engineering Research Laboratory (CERL) with developing automated procedures for scheduling and monitoring both preventive and corrective maintenance activities of the Directorate of Facilities Engineering (DFAE) personnel on utility equipment installed in Army hospital facilities. The initial work involved collecting and analyzing maintenance data from DFAE files at Fitzsimons Army General Hospital, Denver, CO. This research showed that an established operational hospital presented such data collection problems[1] that optimal development of HEMS would be in conjunction with a hospital being constructed. This would allow the equipment data collection to be accomplished while the construction contractor was still on the job and before the Beneficial Occupancy Date (BOD).

In January 1973, OCE broadened the scope of the study to include development of a data-processing system and procedures for predicting, scheduling, and monitoring recurring maintenance activities on Army-installed equipment which would augment the current Facilities Engineering Management System (FEMS) module of the Integrated Facilities System–Increment 1 Detailed Functional Systems Requirements (IFS-1 DFSR).[2-5] The detailed functional requirements for the new system were developed by CERL in coordination with OCE's Planning and Systems Branch and with the U.S. Army Computer Systems Command (USACSC) to insure its compatibility with IFS.[6]

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[1] Thomas J. Vokac and Richard J. Colver, *Automated Scheduling of Maintenance Events: Status of Fitzsimons Hospital Study*, Technical Report A-22/AD772896 (U.S. Army Construction Engineering Research Laboratory [CERL], December 1973).

[2] *Integrated Facilities System (IFS)–Assets Accounting, Real Property Maintenance Activities, Facilities Engineering Management Information System*, GOV R-1209, Vol XVII, "Updated Detailed Functional System Requirements (DFSR)," Vol I, Chapters 1 through 5 (Office of the Chief of Engineers [OCE], 15 December 1972).

[3] *Integrated Facilities System (IFS)–Assets Accounting, Real Property Maintenance Activities, Facilities Engineering Management Information System*, GOV R-1209, Vol XVII, "Updated Detailed Functional System Requirements (DFSR)," Vol II, Annex A, B (OCE, 15 December 1972).

[4] *Integrated Facilities System (IFS) Assets Accounting, Real Property Maintenance Activities, Facilities Engineering Management Information System*, GOV R-1209, Vol XVII, "Updated Detailed Functional System Requirements (DFSR)," Vol III, Annex C, J, L (OCE, 15 December 1972) (Revised 7 March 1973).

[5] *Integrated Facilities System (IFS) Assets Accounting, Real Property Maintenance Activities, Facilities Engineering Management Information System*, GOV R-1209, Vol XVII, "Updated Detailed Functional System Requirements (DFSR)," Vol IV, Annex D, K (OCE, 15 December 1972).

[6] Richard J. Colver, *Detailed Functional Systems Requirements, Automated Integrated Facilities System Reporting*, GOV R-1209, Vol XVII, DFSR A-20 (OCE, August 1973).

The new system HEMS was developed, prototype-tested, and implemented in cooperation with the DFAE, Fort Gordon, GA, at the D. D. Eisenhower Army Medical Center during 1973-1975. The prototype test was completed in June 1975, and HEMS was officially accepted and implemented at Fort Gordon in September 1975.

CERL maintained and monitored HEMS during FY76 and was responsible for all modifications to the computer programs and for consultation on user problems.

HEMS is a Class C (command-unique) system[7] designed specifically for the U.S. Army Training and Doctrine Command (TRADOC) and Fort Gordon, GA. The system is fully documented in TRADOC Manual M18-1-B-TMY.[8-12] (This document may be obtained by contacting Headquarters, TRADOC, Directorate of Management Information Systems, Fort Monroe, VA 23651.)

Although designed to be compatible with IFS, HEMS does not directly interface with it, and therefore has not achieved the maximum potential cooperative use. HEMS, however, has no design features which would prohibit its use on the entire installation (e.g., outside of hospital facilities); however, current documentation cannot accomplish this extended use.

A new system, the Facilities Engineering Equipment Maintenance System (FEEMS), is currently being developed as a Class A Army Standard System. FEEMS, an enhancement of the successful HEMS procedures, will provide DFAEs with equal or improved capabilities. When extended (FY78), FEEMS will be an integrated module of the IFS.

Approach

The following approach was taken to provide information to the DFAE about how HEMS operates and how it can be evaluated for a specific facility. An overview of HEMS (Chapter 2) provides an explanation of the concepts necessary for understanding the system. The five maintenance management functions supported by HEMS are discussed in detail (Chapter 3), and a brief explanation of HEMS implementation is provided (Chapter 4). Finally, the management, costs, and benefits of HEMS are outlined (Chapters 5 and 6).

Mode of Technology Transfer

This study will impact TRADOC M18-1-B-TMY, Vol II, *User Procedures, Hospital Equipment Maintenance System (HEMS)* by updating information contained in that publication.

2 HEMS OVERVIEW

General Concept

HEMS was designed as a tool to provide the capability of identifying, scheduling, monitoring, recording, and analyzing recurring maintenance activities against utility systems and equipment in Army medical facilities. HEMS matches an inventory of DFAE-selected utility systems and equipment against an inventory of recurring maintenance Standard Operating Procedures (SOPs) to produce a work order containing all recurring maintenance tasks to be accomplished during a specific month. HEMS estimates work automatically. Tasks are sorted by shop, location, and maintenance frequency. The work order is scheduled to the appropriate shop as resources become available. Feedback from the shop to HEMS determines the status of the scheduled work. Tasks accomplished within the allotted time are recorded for historical analysis and rescheduled according to their frequency cycle. Tasks not accomplished within the allotted time are canceled, reported on an exception report, and rescheduled for the following month. This insures that all tasks within HEMS will continue to be scheduled until accomplished and that the same task will never appear on the same schedule twice. The status of all scheduled tasks is monitored and reported monthly.

Familiarity with the following concepts is necessary to understanding HEMS.

---

[7] *Management Information Systems: Policies, Objectives, Procedures, and Responsibilities*, AR 18-1 (Department of the Army, March 1976).

[8] *Executive Summary, Hospital Equipment Maintenance System (HEMS)*, TRADOC M18-1-B-TMY, Vol I (U.S. Army Training and Doctrine Command [TRADOC], 1 October 1975).

[9] *User Procedures, Hospital Equipment Maintenance System (HEMS)*, TRADOC M18-1-B-TMY, Vol II (TRADOC, 1 October 1975).

[10] *Operations and Scheduling, Hospital Equipment Maintenance System (HEMS)*, TRADOC M18-1-B-TMY, Vol III (TRADOC, 1 October 1975).

[11] *Systems Analysis Documentation, Hospital Equipment Maintenance System (HEMS)*, TRADOC M18-1-B-TMY, Vol V (TRADOC, 1 October 1975).

[12] *Program Documentation, Hospital Equipment Maintenance System (HEMS)*, TRADOC M18-1-B-TMY, Vol VI (TRADOC, 1 October 1975).

Recurring Maintenance Task

A recurring maintenance task is a recurring maintenance activity for a specific system or equipment (e.g., oiling the motor whose serial number is XYB11327). This is not a HEMS-unique concept but is, in fact, the key concept for any maintenance scheduling system. It is a task which first is scheduled and then assigned to a specific shop for completion at a given location and time.

When HEMS is used, the task differs only in its origin. In most non-HEMS maintenance scheduling systems, the task is identified by initial input to the system, e.g.,

ITEM: Motor whose serial number is XYB11327
TASK: Oil; Frequency: Monthly
TASK: Check Bearings; Frequency: Quarterly
TASK: Check Brushes; Frequency: Semi-annually.

The above might represent simplified input to a typical maintenance system; however, if a user has 100 motors, all of which require the same three tasks, he/she must enter 400 input records (100 items + 3 tasks/item × 100 items). Therefore, if the user has a great deal of equipment, he/she will have an overwhelming input problem. Data maintenance is also cumbersome. For example, to change the task named OIL to a frequency of bimonthly would require the input of 200 corrected records (100 items + 100 tasks).

To alleviate this problem, HEMS contains separate files of items and activities (SOPs) which are matched by the computer to define a task. For the above example, HEMS would require 100 records to be entered in the item file, e.g.,

ITEM: Motor whose serial number is XYB11327
ITEM: Motor whose serial number is . . .

This item file is called the Select Equipment List (SEL). Likewise, HEMS would require three SOPs to be entered in the activity file, as follows:

SOP: Oil all motors monthly
SOP: Check bearings on all motors quarterly
SOP: Check brushes on all motors semi-annually.

Note the difference between the HEMS SOP and the tasks defined above. This activity file is called the Maintenance Requirements Inventory (MRI).

HEMS now can match any SOP with all appropriate records in the SEL to generate a schedulable task, e.g.,

Oil motor whose serial number is XYB11327 monthly.

All 300 tasks generated in this manner are stored in the Task File. Note that only 103 input records are required to reach this point (vs. 400 previously).

To change the oiling frequency to bimonthly, only one new record must be submitted if HEMS is used, i.e.,

SOP: Oil all motors bimonthly.

The net result of this procedure is a great reduction in resources required for initial input and ongoing maintenance of system data.

The basis of this process is a unique equipment code called the Select Equipment Identification Number (SEID). For instance, in the previous example, the SEID tells HEMS that a given item is a motor and that a given SOP applies to all motors. This allows the computer to match the MRI records with appropriate SEL records to generate tasks.

Select Equipment Identification Number (SEID)

The SEID is a unique 17-character identification number for utility equipment, which (1) identifies how the equipment is used (System Type Code), (2) identifies the equipment system (System Number), (3) defines the equipment type (Equipment Type Code), and (4) identifies the specific piece of equipment (Equipment Number). Proper assignment of the SEID provides the DFAE with a hierarchical framework by which HEMS can sort or access all equipment or tasks (see Figure 1).

The System Type Code is a standard, three-character, alphanumeric identification code that specifies the particular application of an equipment item, i.e., the type of system. Examples include heating, electrical distribution, and medical gas. Appendix A lists all System Type Codes used by HEMS. The code is considered to be standard because it is predefined by the DFAE and then validated by HEMS. Therefore, existing codes should be used when possible.

The System Number is a four-character, installation-unique, alphanumeric designation for a specific utility system. The System Number identifies the specific system in which the equipment item operates, e.g., the heating system in Building 1235 or the electrical distribution system for the NW quadrant.

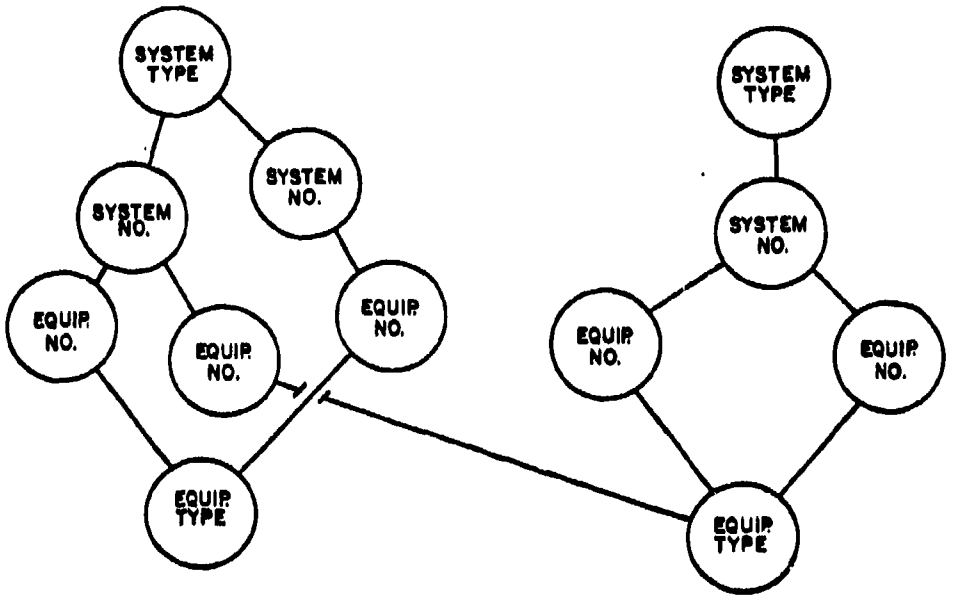


Figure 1. Hierarchical equipment identification framework.

System Type Code		Equipment Type Code		Standard
XXX	XXXX	XX	XXXXXXXX	
	System Number		Equipment Number	Installation-Unique

Figure 2. Select Equipment Identification Number.

The Equipment Type Code is a standard, two-character, alphanumeric identification code that specifies the type of equipment item, e.g., motor, pump, or electrical generator set. This code is predefined by the DFAE and validated by HEMS. Appendix B lists all Equipment Type Codes used by HEMS.

The Equipment Number is an eight-character, installation-unique, alphanumeric designation for each equipment item. After this number has been assigned, it should be displayed prominently on each equipment item to facilitate identification.

The four-part SEID is structured as shown in Figure 2.

HEMS uses the SEID in two different ways: (1) in the SEL, the full SEID identifies an equipment record; (2) an abbreviated SEID, with System Type Code and System Number only (i.e., the Equipment Type Code and Equipment Number blank) identifies a system record. Since HEMS requires each piece of equipment to belong to a defined system, a hierarchy of records is established within the SEL. The entire SEL is structured as shown in the following example:

SYS TYPE	SYS NO	EQ TYPE	EQ NO	SYS/EQ DESCRIPTION
120	121			Heating Distribution
120	121	H9	5407	Heater Unit
120	121	H9	5414	Heater Unit
120	121	R4	6105	Regulator
120	121	SF	6066	Strainer

The MRI uses the four parts of the SEID to identify the applicability of a given SOP (MRI record). For example, the SOP which requires all motors to be oiled monthly is specified by an Equipment Type Code equal to M6 (which means motor), and the remainder of the SEID is blank. This SOP then matches any SEL record having an Equipment Type of M6, regardless of the remainder of its SEID. In this manner, SOPs can be associated with equipment items (SEL records) in the six ways shown in Figure 3. HEMS can then match the MRI and SEL records to produce HEMS tasks.

Select Equipment

Select Equipment is equipment which the DFAE designates for monitoring under HEMS. This equipment must be selected carefully to include only systems and equipment which are critical to the DFAE mission and on which recurring maintenance cannot be ignored. HEMS will use the Select Equipment and associated SOPs to establish a documented and scheduled workload which can be used to justify existing resources and authorize additional resources. Based on this workload, HEMS automatically produces pre-approved, estimated work orders which go directly to the scheduler. Each work order has a limited time-frame during which work may be accomplished.

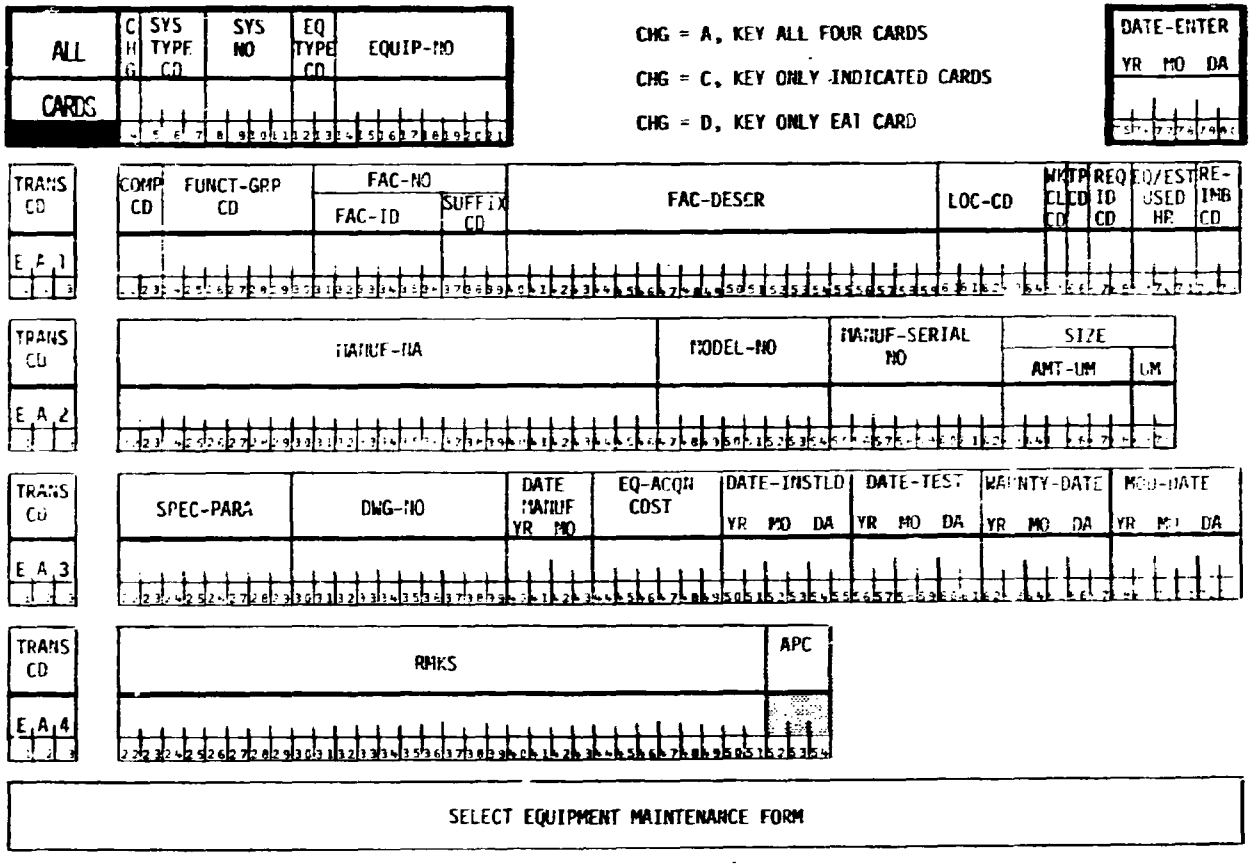
Each Select Equipment (or System) must be assigned an appropriate SEID, which becomes its identification within HEMS. Where possible, the SEID (or at least the Equipment Number) should be placed on the equipment to facilitate reference and location. SEIDs must be assigned carefully to insure consistent use of codes and numbers; SEIDs will be used by HEMS to match equipment items and SOPs and to schedule work.

Select Equipment List (SEL)

The SEL is the HEMS inventory of Select Equipment (or Systems). Each SEL record is identified by its appropriate SEID. Additional information is required for creation of each record. Figure 4 shows a blank SEL input form, which represents the contents of the SEL record. Input for each SEL record consists of the four keypunched cards shown in Figure 4. Only the information contained on the first card is required. Information contained on the last three cards should

Sys. Type	Sys. No.	Equip. Type	Equip. No.	
X				SOP for all systems of a given type
	X			SOP for a specific system
		X		SOP for all equipment of a given type
			X	SOP for a specific equipment item
X		X		SOP for all equipment of a given type used in a given type of system or application
	X	X		SOP for all equipment of a given type within a specific system

Figure 3. Association of SOPs with equipment items.



CERL Form 97
Rev 16 Sep 74

Figure 4. SEL input form.

be input only if applicable (not necessarily so for a system record), available, or desired. Information on the first card is required for HEMS operation.

SEL contents are available to the DFAE on request in several different formats (see Chapter 3).

Standard Operating Procedure (SOP) for Recurring Maintenance

SOP for recurring maintenance provides written guidance to maintenance crews concerning (1) the step-by-step procedure to be followed in performing a given maintenance task, (2) the special tools and equipment required, (3) any precautions which must be taken, (4) spare parts or supplies to be used, and (5) references to detailed drawings, designs, or instructions. The SOP also provides HEMS with a brief, coded description of the task, equipment, or system to which it applies, its frequency of occurrence, labor hour estimate, and responsible shop.

Figure 5 shows a sample SOP. Only the first page is required for HEMS operation. This form defines the HEMS maintenance requirement which can be matched with appropriate Select Equipment or Systems for scheduling. It is recommended, however, that the sections for procedures, tools, and references which follow also be generated and maintained as guidance for work crews, preferably at or near the point where maintenance will occur. Although the recommended format is optional, knowledge and observance of the contents of the form are required for an effective recurring maintenance program.

The SOP, which is designed to be cross-referenced with a central equipment maintenance library of pertinent manufacturer's instructions, parts books, and O&M guides, serves as a synopsis of the appropriate references. If additional information is required, the specific reference is identified, and the worker can easily find the document in the central library. Although this library is not required, it is highly recommended for a more effective recurring maintenance program.

Maintenance Requirements Inventory (MRI)

The MRI is the HEMS inventory of recurring maintenance requirements or SOPs and contains the first page of each SOP (see Figure 6) that the DFAE has authorized. HEMS schedules each SOP by matching MRI records with SEL records to generate schedulable tasks. HEMS then generates work orders in accordance with the specified Frequency of Maintenance.

The MRI also serves as a log of active SOPs. The contents of the MRI are available in two formats at the DFAE's request (see Maintenance Control section in Chapter 3).

Frequency of Maintenance

Frequency of Maintenance is the field on each SOP (MRI Form) which specifies how often the resulting maintenance tasks will be scheduled. This frequency may be specified as either an interval in months or operating hours, or as one to four specific months in which maintenance will be scheduled. An associated field, Frequency Unit Code, identifies the nature of the frequency by M, H, or R, respectively (see examples below).

When maintenance tasks are completed, they will be rescheduled in accordance with Frequency of Maintenance. If the task is not completed as scheduled, it will be canceled and rescheduled until it is accomplished or, as in the case of R-type maintenance, until its next occurrence.

Standard Labor Hours

Standard Labor Hours is the estimate of labor required to accomplish the maintenance requirement. This field appears on the MRI form. When a resulting maintenance task is scheduled, the Standard Labor Hours field is used to estimate the total man-hours required and the subsequent cost.

Frequency of Maintenance	Frequency Unit Code	Explanation
12	M	Schedule every 12 months
1000	H	Schedule every 1000 operating hours
02 04 08 10	R	Schedule only in February, April, August, and October of each year

STANDARD OPERATING PROCEDURES

NAME: Aerator, Ethylene Oxide Gas

MAINT-REQRMT-NO: AE10

REQRMT-SEQ-NO: 1

PAGE: 1

EB1 | A

SYS-TYPE-CD:

SYS-NO:

EQUIP-TYPE-CD: A1

EQUIP-NO:

MAINT-REQRMT-DESCR: Service Aerator

MULT-SHOP-SKILL-FLAG-CD: 1

SHOP-CD: M01

FREQ-UNIT-CD: M

FREQ-OF-MAINT: 0001

CREW SIZE: 1

LABOR-HR-STD: 50

EB2 | A

Card Columns 5-26 are the same as for the EB1 Card.

RMKS: need vac cleaner

APPROVAL: JKB

DATE: YR MO DA 77 04 04

MAINTENANCE REQUIREMENT INVENTORY

CERL Form 99
Rev 17 Sep 74

Figure 5. Sample SOP.

CONTINUATION SHEET

SVC AERATOR

SOP AE1Ø
SEQ. NO. 1
PAGE 2

SPECIAL TOOLS AND EQUIPMENT:

1. Vacuum cleaner

SPARE PARTS:

1. Air filters, bacteria-retentive
2. Mild detergent solution

CONTINUATION SHEET

SVC AERATOR:

SOP AE1Ø
SEQ. NO. 1
PAGE 3

PROCEDURE:

1. Turn POWER SWITCH to OFF.
2. Inspect air filter(s). Clean as required. Replace if necessary .
3. Wash surfaces, interior and exterior, and loading car. Rinse with water. Dry with cloth.

CONTINUATION SHEET

SVC AERATOR

SOP AE1Ø
SEQ. NO. 1
PAGE 4

REFERENCES:

1. 27, Ethylene Oxide Gas Aerator Equipment Manual.

Figure 5. (Cont'd.)

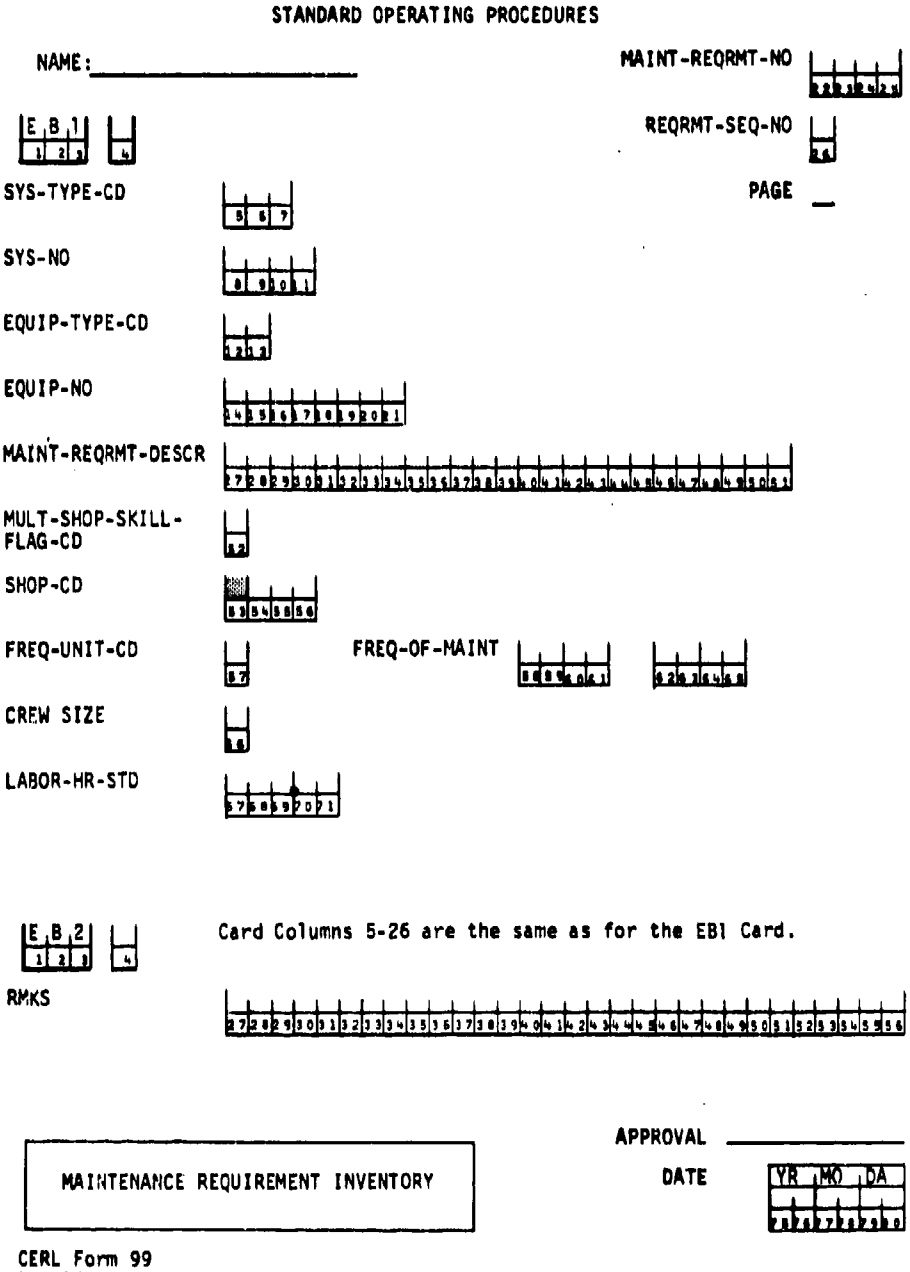


Figure 6. First page of SOP.

The Standard Labor Hours estimate represents the average time required to complete a task when it is accomplished concurrently with its usual associated tasks. This estimate includes time for material handling, coordination time, time for travel, job preparation, actual work, and craft allowances, and time for checking tools and parts in and out, if required. The estimates are not developed from tables and allowances found in the TB 420 series[13] as are estimates for repair and replacement tasks. Rather, the initial HEMS Standard Labor Hours estimate is developed from experience; periodic updates are made on the basis of HEMS historical data which represent average actual performance times for maintenance requirement tasks.

Task File

The HEMS Task File is an inventory of recurring maintenance tasks created by matching Select Equipment items with appropriate SOPs. The DFAE controls the contents of this file by making appropriate updates to the SEL and/or the MRI. The Task File is the source of HEMS work orders and the source of status information on these work orders.

Maintenance tasks are scheduled from the Task File on the basis of a maintenance interval frequency cycle calculated in months. (Note that H*-type frequencies are converted to a monthly frequency cycle using the Estimated Used Hour field on the SEL form.) This value is used to assign an initial Due Date when the task enters the Task File. The Due Date is the month in which the task will be scheduled next. Tasks are initially scheduled in the month they are input to HEMS, i.e., the Due Date is set equal to the month of input to HEMS. After the task is scheduled, the Due Date is updated in accordance with task completion:

1. If the task is completed in the allowed time interval (i.e., 1 month for monthly tasks, 2 months for bimonthly tasks, and 3 months for tasks with Frequency Cycle of 3 months or more), the Due Date is reset at a value equal to the number of months required for accomplishment plus the Frequency Cycle and rescheduled.

2. If the task is *not* completed in the allowed time interval, the Due Date is augmented by the Frequency Cycle or 3 months (whichever is less), so that the task is rescheduled the following month.

With a knowledge of this scheduling methodology, the DFAE can control his/her accomplishment of monthly tasks so that they are rescheduled at the most convenient time. In this manner, the DFAE can modify the HEMS-assigned Due Date.

HEMS Work Order

The HEMS Work Order (Figure 7) resembles other Individual Job Orders (IJO) except that it is produced by the computer. As the work order is printed, HEMS edits the contents to insure that it will satisfy all IFS requirements. In addition, HEMS concurrently produces all appropriate IFS input transactions (punch cards).

The HEMS Work Orders are produced once every month and contain all work due during the following month. One Work Order is produced for each recorded Functional Group Code, Requester ID, and Shop Code. The Work Orders are numbered in accordance with a DFAE-defined Sequence Number convention.

Phases on the HEMS Work Order are composed of all the tasks of a given Frequency Cycle (one, two, or three and more) to be performed in one location (Facility Number) during the coming month. Phase Descriptions define respective Frequency Cycles as "HEMS MAINTENANCE 1", "HEMS . . . 2", or "HEMS . . . 3". Individual tasks are identified on a separate document—the HEMS Task List (Figure 8) - which is produced with the Work Order and must accompany the Work Order as it is processed through the DFAE organization.

Each phase has an allotted interval for accomplishment according to the associated Frequency Cycles, i.e., 1, 2, or 3 months. At the end of this time, the phase is canceled and all tasks are rescheduled as if they were unaccomplished. To avoid this, the DFAE must complete the phase in its allotted time period and report it on the IFS Labor and Equipment Utilization Card (modified for HEMS) (Figure 9). If completed, the tasks in the phase will be rescheduled according to the Frequency Cycle.

HEMS Work Orders have a life of only 3 months; if unaccomplished at the end of this time, they are canceled. Any unaccomplished tasks are rescheduled on a new Work Order the following month. In this way, HEMS insures that the Work Orders do not create a backlog of recurring maintenance.

[13] *Engineered Performance Standards (EPS) Public Works Maintenance*, TB420 Series (Department of the Army, October 1972).

*H = hourly.

DATE SEP 75 WORK ORDER PAGE 7

X-TMY-009

DOC NO 01900386J FN GP CD 51SOMZ

PH CD	SHOP CD	FAC NO	COMP CD	WK CL CD	RB CD	PH DESC	R/D CD	INSP CD	UNITS EST	LAB HRS EST	LAB CST EST
01	EU1	30002A	21	K		HEMS MAINTENANCE	03	R	N	4	$ 34
02	EU1	30003A	21	K		HEMS MAINTENANCE	03	R	N	1	$ 11
03	EU1	30003M	21	K		HEMS MAINTENANCE	03	R	N	1	$ 3
04	EU1	300030	21	K		HEMS MAINTENANCE	03	R	N	1	$ 11
05	EU1	30005B	21	K		HEMS MAINTENANCE	03	R	N	1	$ 11
06	EU1	30014A	21	K		HEMS MAINTENANCE	03	R	N	1	$ 11
07	EU1	30014C	21	K		HEMS MAINTENANCE	03	R	N	1	$ 11

Figure 7. HEMS Work Order.

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TASK LIST X-TMY-006

DOC NO 01900386J SHOP ELECTRIC SHOP EU1

PH CD	FAC NO	COMP CD	LOC CD	EQ NO	EQ TYPE CD	SYS NO	SYS TYPE CD	MAINT REQ NO	MAINT REQ DESC	REQ SEQ NO	CREW SIZE	COORD FLAG	FREQ	DATE LAST COMP
01	30002A	21	1	4824	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
01	30002A	21	1	4430	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
01	30002A	21	1	4431	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
01	30002A	21	1	4432	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
01	30002A	21	1	4433	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
01	30002A	21	1	4824	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
02	30003A	21	1	4825	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
02	30003A	21	1	4435	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
02	30003A	21	1	4825	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
03	30003M	21	1	4826	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
03	30003M	21	1	4826	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
04	300030	21	2	4827	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
04	300030	21	2	4429	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
04	300030	21	2	4827	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
05	30005B	21	22	4828	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
05	30005B	21	22	4428	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
05	30005B	21	22	4828	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
06	30014A	21	1	4829	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
06	30014A	21	1	4426	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	7506
06	30014A	21	1	4829	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	
07	30014C	21	1	4830	F3	316	310	FA20	INSP ROLL AIR FLTR CNTRL	1	1		3 M	
07	30014C	21	1	4427	A2	317	310	AH20	SVC AIR HDLG UNIT	1	1		3 M	
07	30014C	21	1	4830	F3	316	310	FA30	ELECT INSP ROLL AIR FLTR	1	1		12 M	

Figure 8. HEMS Task List.

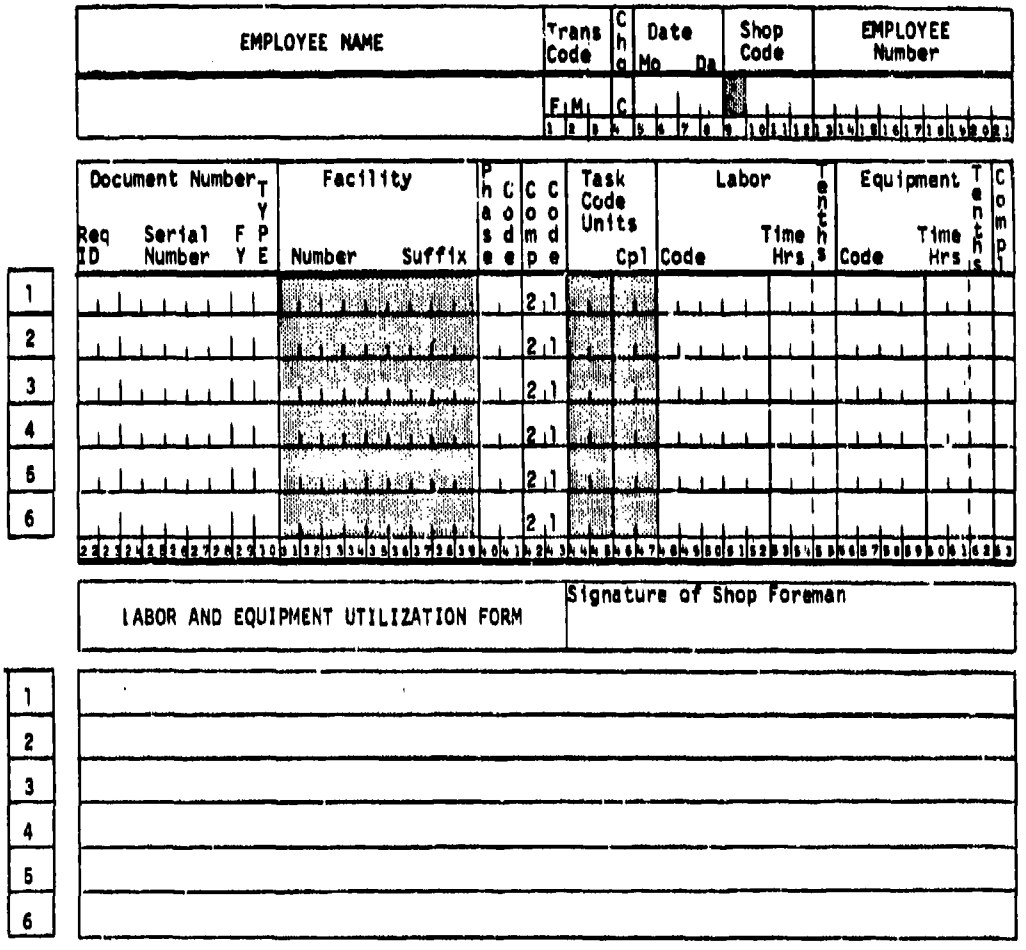

Figure 9. IFS Labor and Equipment Utilization Card (modified).

The HEMS Work Order is approved when the DFAE approves SEL and MRI inputs. Therefore, the Work Order is processed directly to the scheduler for completing at the appropriate shop as time becomes available. Unaccomplished tasks (from unaccomplished phases) are reported monthly on the HEMS unaccomplished Task List (Figure 10).

History File

The HEMS History File records a complete history of recurring maintenance on each item of Select Equipment. It also has the capability of keeping a record of selected deficiency correction/repair actions and a log of equipment operating hours (estimated or actual). The former capability requires the DFAE to input a Deficiency Correction/Repair Record (Figure 11) for each such action. The latter capability requires no input from the DFAE but instead uses estimated monthly operating hours available from HEMS; however, these estimates can be overridden by input on the HEMS Operating Hour Log (Figure 12) at the option of the DFAE.

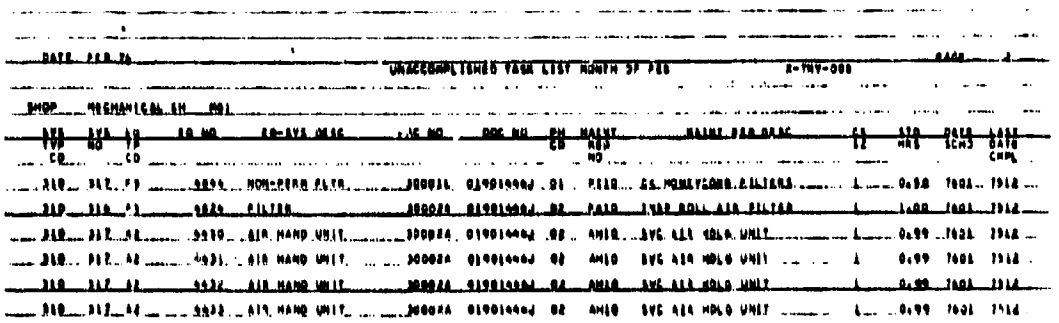

Figure 10. HEMS Unaccomplished Task List.

The DFAE cannot update the History File directly. The DFAE can, however, enter Comments (Figure 13) to the History File to log any changes or corrections desired.

The contents of the HEMS History File are available to the DFAE, on request, by the six combinations of System Type Code, System Number, Equipment Type Code, and Equipment Number shown in Figure 3. Figure 14 shows a sample output.

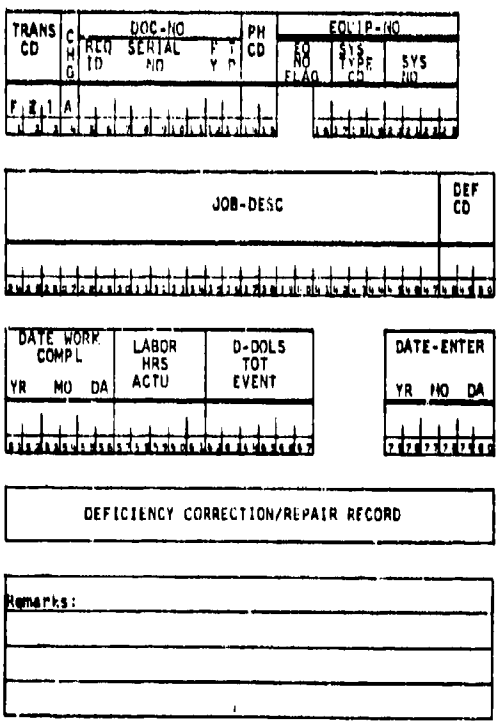

Figure 11. Deficiency Correction/Repair Record.

3 MAINTENANCE MANAGEMENT FUNCTIONS SUPPORTED BY HEMS

HEMS is designed to support the DFAE by providing a tool for identifying, scheduling, monitoring, recording, and analyzing recurring maintenance activities and resources for selected utility systems and equipment. HEMS supports five basic DFAE functions in accomplishing this objective: (1) inventory control, (2) maintenance control, (3) resource management-scheduling/processing, (4) resource management-planning, and (5) historical recordkeeping.

Inventory Control

Selected utility system and equipment inventory control is accomplished by the SEL Master Field. The SEL contains classification, identification, location, cost, and reference data on all selected equipment and systems. Data required for HEMS operation are minimized to facilitate use in an older facility where equipment identification and cost data may be difficult to obtain. Only the Select Equipment ID, certain critical categorization data, and facility number are required for HEMS operation. Additional identification and cost data may be added at the option and convenience of the DFAE. Figure 15 shows a properly prepared Select Equipment Maintenance Form with the minimum of information required for HEMS operation. Figure 16 shows a Select Equipment Maintenance Form with all information supplied.

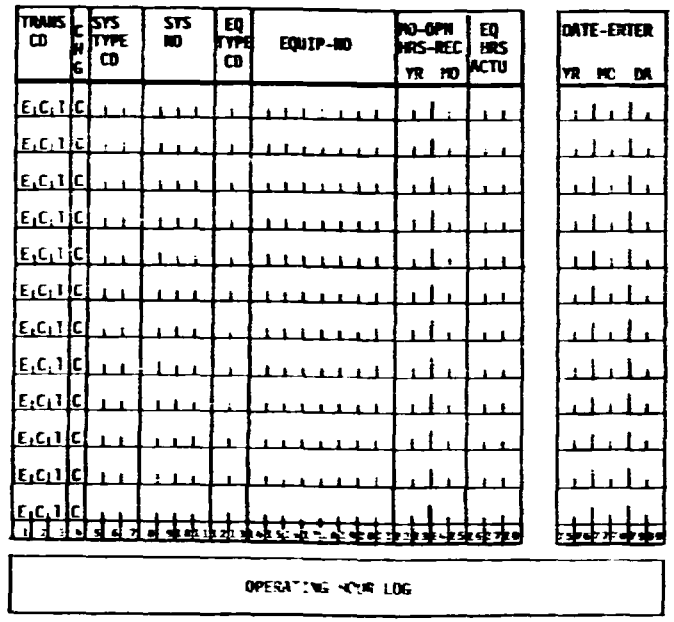

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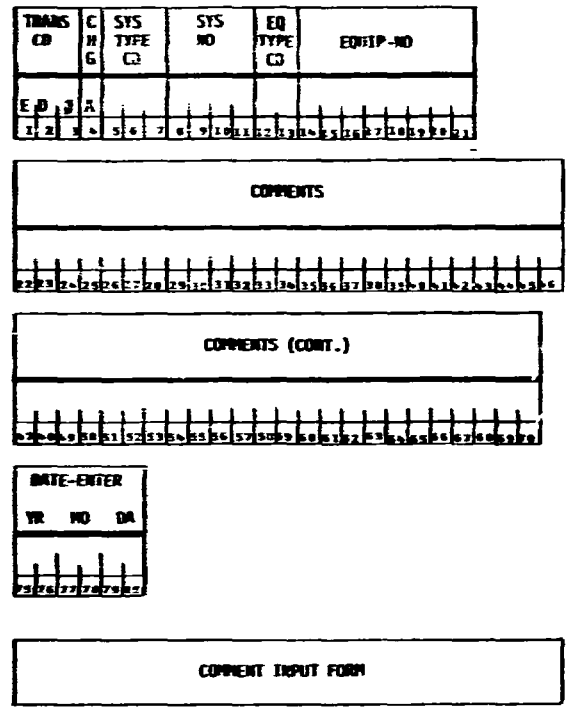
Figure 12. HEMS Operating Hour Log.



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2 Jan 75

Figure 13. HEMS Comment Input Form.

MAINTAINED EQUIPMENT ANALYSIS

X-EQK-011

SYS TYPE CD	SYS NO	EQ TYPE CD	EQ NO	FAC NO	EQ-SYS DESC	MANUF NAME	MODEL NO	AMT U/M	U/M	ACQN COST	DATE INSTL	MOD DATE	WRNTY DATE
210	211	C1	6036	30101	CHILLER	TRANE	B3JC-4	000001	EA		750101		760101

MAINT REQ NO	STD HRS	DATE SCHD	DATE COMPL	UNITS SCHD	UNITS COMPL	LABOR HRS-ACT	LABOR COST	MISC COST	DOC NO	PM CD
CA10	0.50	7508	7509	01	00	0.0	$ 0.00	$ 0.00	0190O326J	09
CA10	0.50	7507	7507	01	01	0.5	$ 3.78	$ 0.00	0190O136J	09
CA10	0.50	7509	7509	01	01	0.1	$ 1.09	$ 0.00	0190O516J	06
CA10	0.50	7510	7510	01	01	0.3	$ 2.18	$ 0.00	0190O776J	09
CA10	0.50	7511	7511	01	01	0.3	$ 2.18	$ 0.00	0190I056J	06
CA10	0.50	7512	7601	01	01	0.1	$ 1.09	$ 0.00	0190I356J	06
CA10	0.50	7601	7602	01	01	0.3	$ 2.15	$ 0.00	0190I666J	10
CA10	0.50	7602	7602	01	01	0.3	$ 2.15	$ 0.00	0190I976J	07
CA10	0.50	7603	7603	01	01	0.7	$ 6.41	$ 0.00	0190J266J	07
CA10	0.50	7604	7604	01	01	0.7	$ 6.41	$ 0.00	0190J586J	09
CA20	1.10	7507	7507	01	01	0.9	$ 7.26	$ 0.00	0190O136J	10
CA20	1.00	7603	7603	01	01	1.0	$ 8.17	$ 0.00	0190J266J	03

DATE	JOB NARR	DEFC	LABOR D-S	CMPL	CD	HRS TOTAL	ACT EVENT

EQ HRS EST AS OF 75 07 — EQUIP HRS ACTUAL

Jun	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
720	720	720	720	720	720	720	720	720	720	720	0

Figure 14. History File sample output.

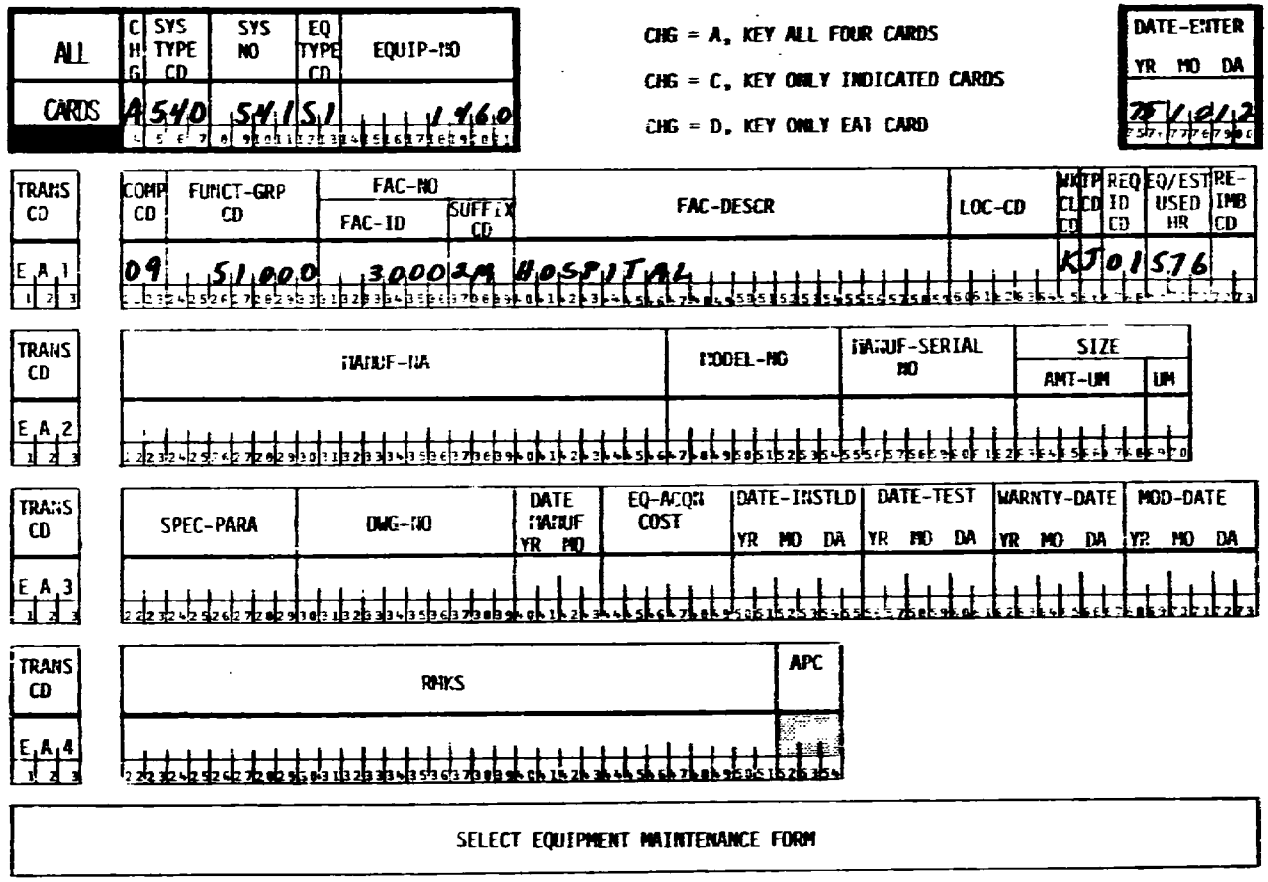

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Figure 15. Select Equipment Maintenance Form with minimum required information.

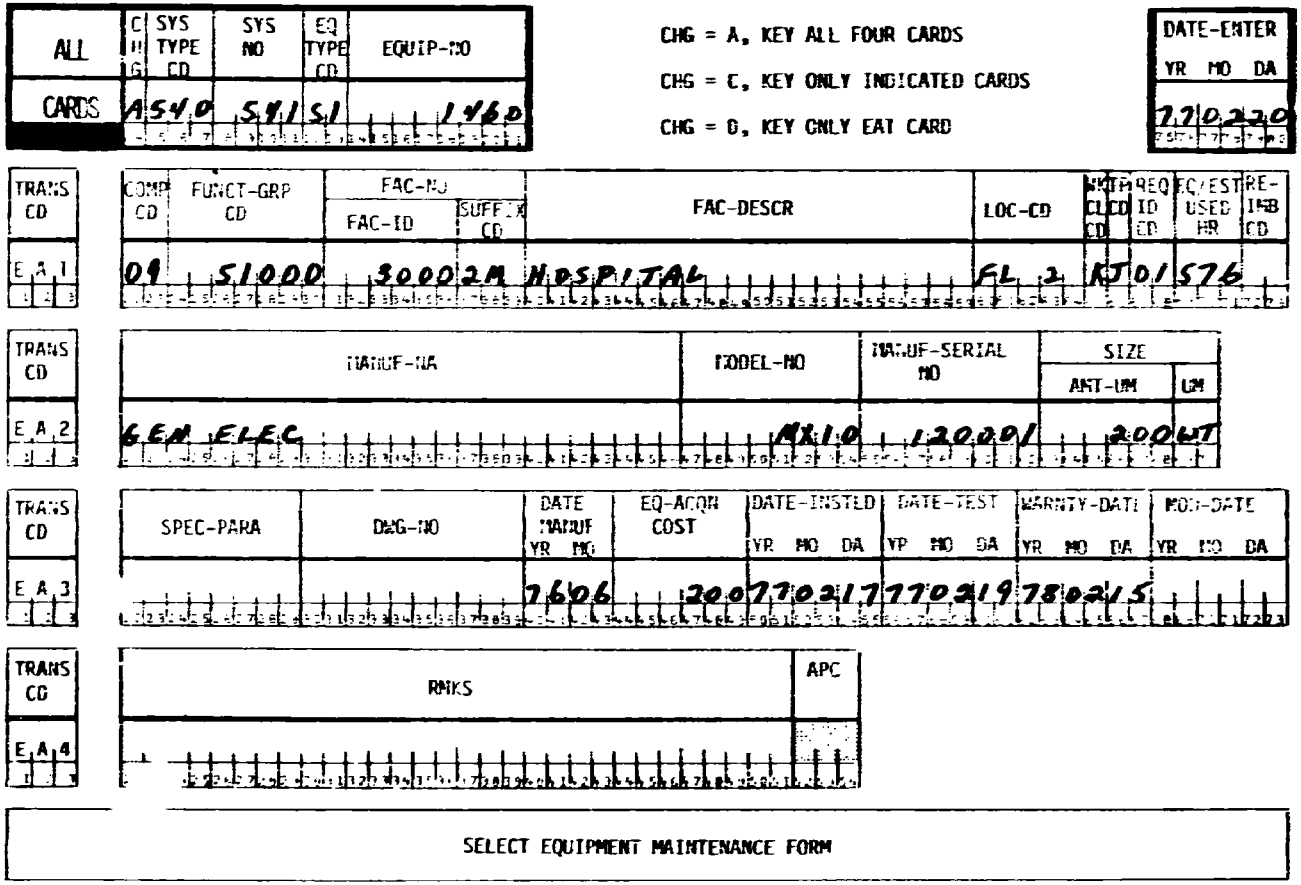

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Figure 16. Select Equipment Maintenance Form with all information.

Four SEL input data fields are edited by HEMS in accordance with edit tables supplied by the DFAE: System Type Code, Equipment Type Code, Functional Group Code, and Requester ID Code. Fields are edited for valid values contained in Tables 1, 2, 3, and 4, shown in Figures 17 through 20, respectively. Table inputs are made on forms shown in the figures. Tables are maintained in punch card form so that entries may be added, removed, or changed as desired by the DFAE.

The DFAE controls the select equipment inventory by adding to, deleting from, and updating the SEL. Contents may be reviewed on one or more of five SEL optional outputs:

1. System Type List Report
2. System Number List Report
3. Maintained Equipment Type List Report
4. Maintained Equipment Number List Report
5. Maintained Equipment by Facilities Report

The SEL reports are requested only on an as-required basis by the DFAE for checking the inventory. Each report presents the inventory by sorting either by one of the SEID subfields or by facility numbers. A current copy of each report should be obtained at least annually or when major revisions are made to the SEL. The following paragraphs describe each report.

System Type List Report

The HEMS System Type List Report is sorted by the System Type Code and then by corresponding System Number. The equipments associated with each system are also provided by Equipment Type Code and Equipment Number. The report includes abbreviated inventory data from SEL records such as the Location, Work Class Code, Type Code, Requestor ID, and Facility Number. This report controls the systems and the assigned System Type Codes used in HEMS. Figure 21 provides an example of this report.

System Number List Report

The HEMS System Number List Report is sorted by the System Number and then the corresponding System Type Code. It provides the system description but no inventory data. This report is designed to control the installation-unique System Numbers and associated descriptions used in HEMS to prevent duplications. Figure 22 provides an example of this report.

Maintained Equipment Type List Report

The HEMS Maintained Equipment Type List Report is sorted by the SEID starting with the Equipment Type Code, then the System Type Code, the System Number, and finally the Equipment Number. The Maintained Equipment Type List Report is the master control report for the SEL. This report provides all the inventory data entered in the SEL, thus establishing a complete inventory source for HEMS. It may also be used to monitor use of HEMS Equipment Type Codes. Figure 23 provides an example of this report.

Maintained Equipment Number List Report

The HEMS Maintained Equipment Number List Report is sorted by the SEID, starting with the Equipment Number, then the Equipment Type Code, the System Number, and finally the System Type Code. The Maintained Equipment Number List Report provides only the Equipment Name, Facility Number, and Location Code for each piece of equipment. This report may be used to monitor the Equipment Numbers assigned by the DFAE to avoid duplication. Figure 24 provides an example of this report.

Maintained Equipment by Facilities Report

The HEMS Maintained Equipment by Facilities Report is sorted by Facility Number and provides a listing of Select Systems and Equipments within each facility. This report contains the SEL records by SEID for each Facility Number and includes the Equipment/System Description and Location Code and provides locational control for the DFAE. Figure 25 provides an example of this report.

Maintenance Control

HEMS controls recurring maintenance activities through the MRI Master File. This file enables the DFAE to monitor the active Recurring Maintenance SOPs. The MRI contains maintenance description, responsible shop, frequency, crew size, and labor hour standard data from the SOP.

Input to the MRI comes from the first page of the SOP the MRI Form. Figure 26 shows a properly completed MRI Form. To insure complete control over the selected HEMS maintenance requirements, the DFAE must establish a policy whereby each SOP is entered into the MRI and each MRI Form has an associated SOP.

Each SOP (and subsequent MRI record) is uniquely identified by an MRI Number. This field is comprised of a unique Maintenance Requirement Number and a

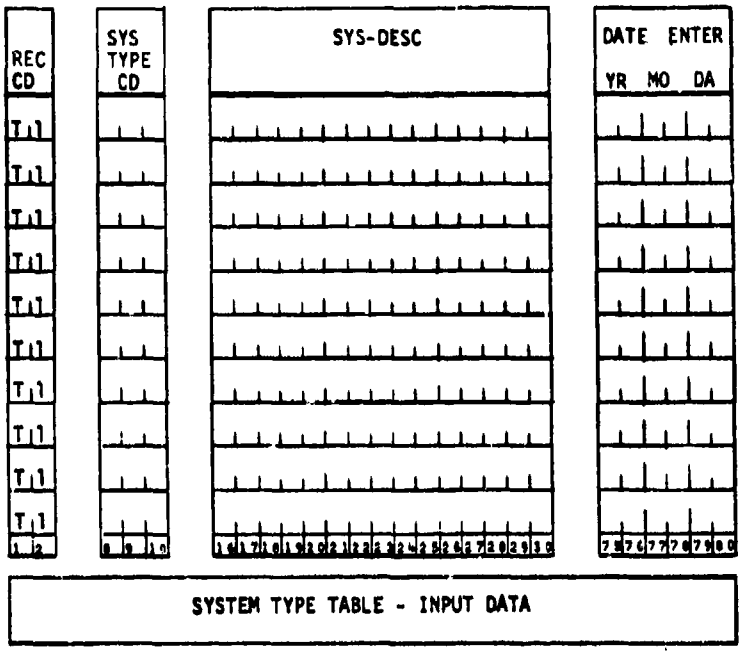

Figure 17. System Type Code.

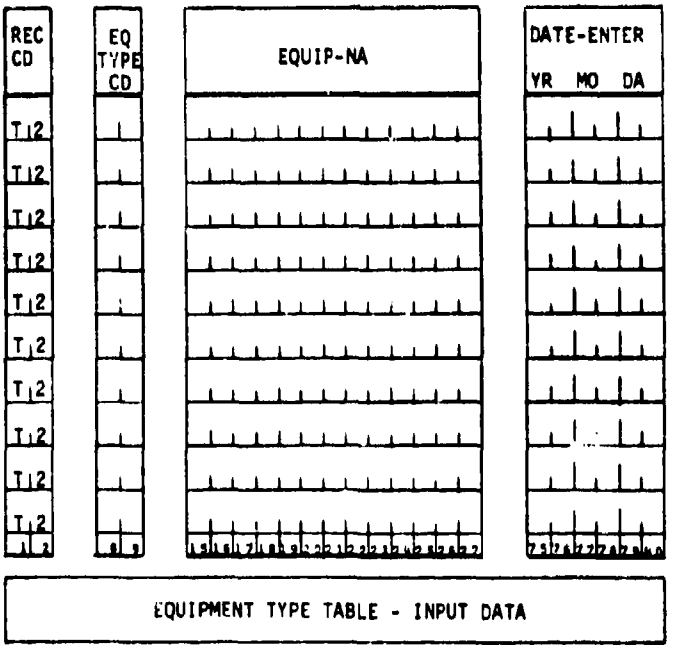

Figure 18. Equipment Type Code.

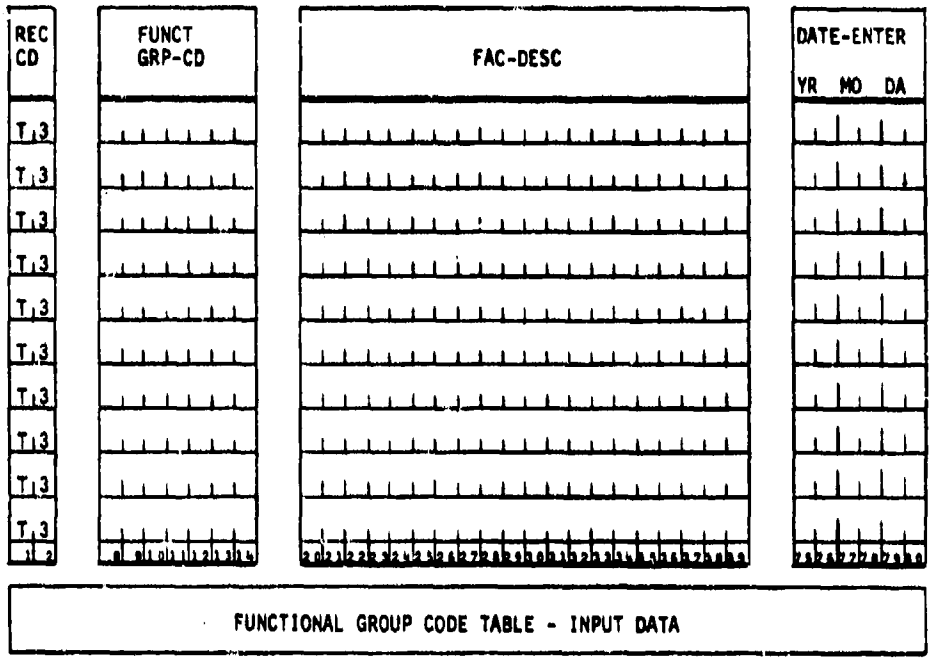

Figure 19. Functional Group Code.

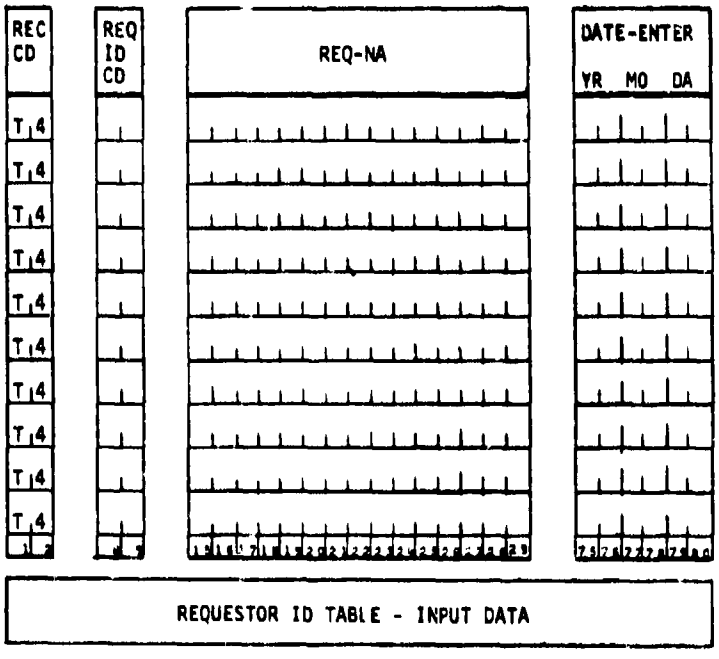

Figure 20. Requester ID Code.

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SYSTEM TYPE LIST X-TMY-301

SYS TYPE CD	SYS NO	SYS DESCR	EQ TYPE CD	EQ NO	EQ NAME	LOC CD	WK CL CD	TYPE CD	REQ ID CD	FAC NO	REMARKS	DATE ENT
A10	A1A	STRUCTURAL										760116
			L6	8014	LOCKS		K	J	01	30014		
			L6	8015	LOCKS		K	J	01	301		
A10	A1D	STRUCTURAL										760116
			L6	8019	LOCKS		K	J	01	319		
A10	A11	STRUCTURAL										760116
			L6	8001	LOCKS		K	J	01	30001		
A10	A13	STRUCTURAL										760116
			L6	8003	LOCKS		K	J	01	30003		
A10	A1E	HEAT GENERATION										750715
			D2	6052	DEARATOR		K	J	01	30103		
			G1	6110	GAGE		K	J	01	30102		
			W4	6053	WATER SOFTEN		K	J	01	30101		

Figure 21. System Type List Report.

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SYSTEM NUMBER LIST X-TNY-002

SYS NO	SYS TYPE CD	SYS DESC
651	650	EQUIP MAIN
652	650	EQUIP MAIN
653	650	EQUIP MAIN
662	660	EQUIP EMERGENCY
663	660	EQUIP EMERGENCY
671	670	EQUIP WAS GARB
672	670	EQUIP WAS GARB
681	680	EQUIP INT TRANS
682	680	EQUIP INT TRANS
683	680	EQUIP INT TRANS
684	680	EQUIP INT TRANS
686	680	EQUIP INT TRANS
691	690	EQUIP SPECIALZD
692	690	EQUIP SPECIALZD
712	710	WATER TREATMENT
713	710	WATER TREATMENT
715	710	WATER TREATMENT
911	910	STP GENERATION

Figure 22. System Number List Report.

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EQ TYPE CD	SYS TYPE	SYS NO	EQ NO	SYS DESC	EQ NAME	COMP	FN GP CD	FAC NO	FAC DESC	LOC CD	MK CD	T C	PRO ID CD
				MANUF	MOD NO	MANUF SER NO	AMT OF U/M	U/M	SPEC PARA	DWG NO			EQ ES USED HRS
				DATE MANUF	ACQN COST	DATE INSTL	DATE MOD	DATE TEST	DATE WRNTY	REMARKS			DATE EXT
SI	540	541	1351	ELECT INTERIOR	SWITCH	09	51SOPO	33001F	HOSPITAL 1ST FL		K	J	01
				ARROW HART				000018	EA				576
					750101			760401					75061
SI	540	541	1357	ELECT INTERIOR	SWITCH	09	51SOPO	33001E	HOSPITAL 1ST FL		K	J	01
				ARROW HART				000015	EA				576
					750101			760401					75061
SI	540	541	1363	ELECT INTERIOR	SWITCH	09	51SOPO	33001D	HOSPITAL 1ST FL		K	J	01
				ARROW HART				000079	EA				576
					750101			760401					75061
SI	540	541	1370	ELECT INTERIOR	SWITCH	09	51SOPO	33001C	HOSPITAL 1ST FL		K	J	01
				ARROW HART				000071	EA				576
					750101			760401					75061
SI	540	541	1372	ELECT INTERIOR	SWITCH	09	51SOPO	33001B	HOSPITAL 1ST FL		K	J	01
				ARROW HART				000063	EA				576
					750101			760401					75061

Figure 23. Maintained Equipment Type List Report.

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MAINTAINED EQUIPMENT NUMBER LIST

X-TMY-G06

EQ NO	EQ TYPE CD	SYS NO	SYS TYPE CD	EQ NAME	FAC NO	LOC CD
e027	PT	114	210	PUMP	30102	
e028	PT	114	210	PUMP	30102	
e029	PT	114	210	PUMP	30102	
e030	PT	215	210	PUMP	30102	
e031	PT	215	210	PUMP	30102	
e032	PT	215	210	PUMP	30102	
e033	PT	512	510	PUMP	30101	BSMNT
e034	PT	512	510	PUMP	30101	
e035	CI	211	210	CHILLER	30101	
e036	CI	211	210	CHILLER	30101	
e037	CI	214	210	CHILLER	30101	
e038	CH	211	210	COOL TOWER	301OUT	OUTSD
e039	CH	211	210	COOL TOWER	301OUT	OUTSD
e040	CH	211	210	COOL TOWER	301OUT	OUTSD
e041	CH	211	210	COOL TOWER	301OUT	OUTSD
e042	BT	911	910	BOILER	30101	
e043	BT	911	910	BOILER	30101	
e044	BT	911	910	BOILER	30101	
e045	SK	116	110	STEAM TURBINE	30101	
e046	SK	115	110	STEAM TURBINE	30101	
e047	H9	121	120	HEATER UNIT	30102	
e048	H9	121	120	HEATER UNIT	30101	GENR4

Figure 24. Maintained Equipment Number List Report.

DATE FEB 86 PAGE 82

MAINTAINED EQUIPMENT BY FACILITIES REPORT X-THV-013

FAC NO	FN GP CD	FAC DESC	SYS TYPE CD	SYS NO	EQ TYPE CD	EQ NO	EQ/SYS DESC	LOC CD
3198	72SOMV	MEDICAL BARRACKS	120	121	H9	5414	HEATER UNIT	STG
			230	231	G3	5417	GRILL SUPPLY	
			230	231	G4	5418	GRILL RETURN	
			230	231	T3	5415	THERMOSTAT	
			310	317	A2	5419	AIR HAND UNIT	ORDLY
			310	318	G6	5420	GRILL EXHAUST	
			450	451	FA	5416	FOUNTAIN	ORDLY
319C	72SOMV	MEDICAL BARRACKS	120	121	H9	5421	HEATER UNIT	STG
			230	231	G3	5424	GRILL SUPPLY	
			230	231	G4	5425	GRILL RETURN	
			230	231	T8	5422	THERMOSTAT	
			310	317	A2	5426	AIR HAND UNIT	ORDLY
			310	318	G6	5427	GRILL EXHAUST	
			450	451	FA	5423	FOUNTAIN	ORDLY
3190	72SOMV	MEDICAL BARRACKS	120	121	H9	5428	HEATER UNIT	STG
			230	231	G3	5431	GRILL SUPPLY	
			230	231	G4	5432	GRILL RETURN	
			230	231	T8	5429	THERMOSTAT	
			310	317	A2	5433	AIR HAND UNIT	ORDLY
			310	318	G6	5434	GRILL EXHAUST	
			450	451	FA	5430	FOUNTAIN	ORDLY
315E	72S169	MEDICAL BARRACKS	230	231	G3	5436	GRILL SUPPLY	

Figure 25. Maintained Equipment by Facilities Report.

STANDARD OPERATING PROCEDURES

NAME: Breaker, Vacuum

MAINT-REQRMT-NO: 0 V L 0

EB1 | A

REQRMT-SEQ-NO: 1

SYS-TYPE-CD: 4 S 0

PAGE: 2

SYS-NO:

EQUIP-TYPE-CD: 5 7

EQUIP-NO:

MAINT-REQRMT-DESCR: SVC VAC BREAKER

MULT-SHOP-SKILL-FLAG-CD: 1

SHOP-CD: M 0 2

FREQ-UNIT-CD: M

FREQ-OF-MAINT: 0 0 1 2

CREW SIZE: 1

LABOR-HR-STD: 2 0

EB2 | A

Card Columns 5-26 are the same as for the EB1 Card.

RMKS

APPROVAL: BB

DATE: YR 75 MO 04 DA 15

MAINTENANCE REQUIREMENT INVENTORY

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Figure 26. Completed MRI Form.

Requirement Sequence Number. The former identifies a specific SOP or set of SOPs to be performed together. The latter defines precedence or relationship such as when SOPs are to be performed serially (in sequential order) or concurrently by different shops. Requirement Sequence Number can be used where there is more than one MRI Form on the same SOP.

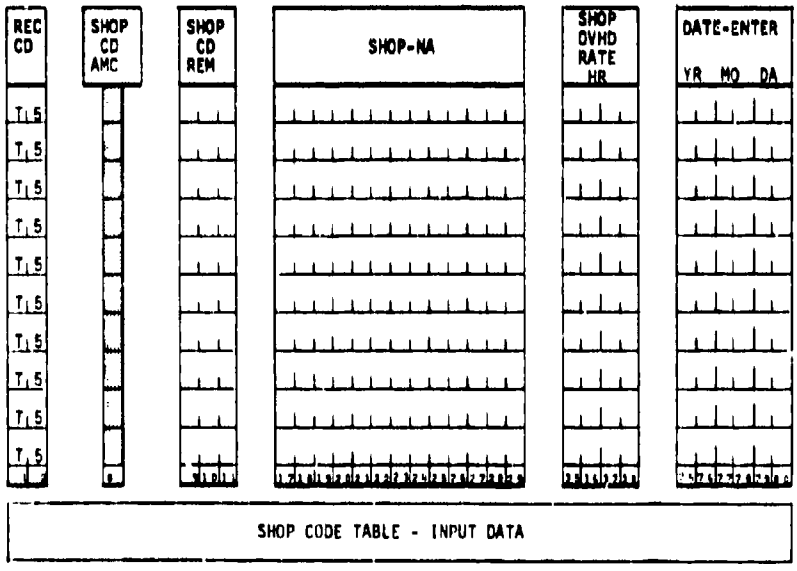
MRI input data fields for System Type Code and Equipment Type Code are edited using Tables 1 and 2 of Figure 17 and 18, as with similar SEL input fields. This insures appropriate matches between the SEL and the MRI. Shop Codes are also edited. The DFAE inputs valid codes using Table 5 in Figure 27. Maintenance of this table is identical to that for Tables 1 through 4 of Figures 17 through 20.

The DFAE controls the select maintenance requirements by adding to, deleting from, and updating the MRI. Contents may be reviewed on one of two optional MRI outputs: (1) Requirements List Report, or (2) Requirements List by Maintenance Requirement Number Report.

The MRI reports are requested as required by the DFAE to check the inventory. Each report presents the inventory through sorting by unique MRI Number or by the associated SEID. A current copy of each report should be obtained at least annually or when major revisions are made to the MRI. Each report is described below.

Requirements List Report

The HEMS Requirement List Report displays the complete contents of the MRI by the appropriate SEID. The records are sorted and listed by Equipment Type Code, Equipment Number, System Type Code, System Number, and MRI Number. System maintenance records will have blank Equipment Type Codes and Equipment Numbers, and will therefore appear first in the Requirements List Report. This report is the master control listing for the MRI, since it is a complete listing of all the MRI input data. It facilitates checking the SOP input and the SEIDs used to match the MRI with the SEL. Figure 28 provides an example of this report.



CERL Form 100E
Rev 13 Sep 74

Figure 27. Shop Code Input.

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EQ TYPE CD	SYS TYPE CD	SYS NO	EQ NO	MAINT REQ NO	MAINT REQ DESC	REQ SEQ NO	FREQ
				MULT SHOP CD	SHOP CD	CREW SIZE	STD HRS	DATE ENT	REMARKS
	530	534		LE10	SVC EME LIGHTING SYSTEM	1	M00030000
				1	E01	1	00400	751016	BATTERY OPERATED
	530	534		LE20	SVC EME LIGHTING SYSTEM	1	M00120000
				1	E01	1	00400	751016	BATTERY OPERATED
	540	54A		CL10	INSPECT AND TEST CLOCKS	1	M00010000
				1	E01	1	02400	750615	
	540	546		AS10	INSP OXYGEN ALARM SYSTEM	1	M00010000
				1	E01	2	01600	750615	
	540	546		AS30	INSP OXYGEN ALARM SYSTEM	1	M00120000
				1	E01	2	01600	750615	
	540	545		AS10	INSP VACUUM ALARM SYSTEM	1	M00010000
				1	E01	2	01600	750615	
	540	545		AS30	INSP VACUUM ALARM SYSTEM	1	M00120000
				1	E01	2	01600	750615	

Figure 28. Requirements List Report.

Requirements List by Maintenance Requirement Number Report

The HEMS Requirements List by Maintenance Requirement Number Report is sorted by Maintenance Requirement Number and then by Requirement Sequence Number. This report contains only the Maintenance Requirement Description and SEID shown on the SOP and may be used as an index of SOPs and a reference guide to the MRI Numbers currently in use. Careful review will insure that duplicate numbers are not assigned. Figure 29 provides an example of this report.

Resource Management-Scheduling/Processing

HEMS Resource Management-Scheduling/Processing is accomplished monthly through the Task Master File. The Task File contains all recurring maintenance tasks with their current Due Dates. HEMS Work Orders and Task Lists are produced monthly from the Task File (see Figures 7 and 8).

The HEMS Work Orders will be scheduled to the shops with the other non-HEMS workload requirements which the DFAE must accomplish. The DFAE assigns the priorities and determines which work orders will be accomplished, based on available resources. Unlike other work orders, the HEMS Work Order has a limited life. Each task on a Work Order must be accomplished in its allotted time interval, or it is canceled and rescheduled. This eliminates a backlog of HEMS work. Cancellation is accomplished by phase (a grouping of tasks), depending on the Frequency Cycle of Phase Tasks.

When a task is scheduled in a Work Order Phase, it cannot appear on another Work Order until the original Work Order Phase is completed or canceled. The Task File accounting, which identifies any active task (one appearing in an active Work Order Phase) with the appropriate Work Order Document Number and Phase Code, insures that this process is accomplished. This accounting process also allows HEMS to trace and recover resource expenditures (man-hours, equipment hours, and materials) against the task.

DFAE personnel report resource expenditures on Labor and Equipment Utilization Forms (see Figure 9) and Material Issue Forms (see Figure 30). Both are designed in the same form as the appropriate IFS counterpart. Resources are reported by Work Order Phase and recorded in the IFS Job Master File (FMJ). HEMS retrieves these data, matches them against the appropriate tasks in the Task File, and prorates the expended resources on the basis of an individual task's Labor Hour Standards for historical purposes. The man-hours are thus converted to dollars by applying effective shop rates maintained in Table 5 of Figure 27. Likewise, equipment hours are converted to dollars using an additional DFAE-maintained table (Table 6 of Figure 31). Table 6 is also used to edit Labor and Equipment Utilization Form input.

Resource Management-Planning

HEMS supports resource management-planning by providing three different reflections of HEMS workload: (1) Unaccomplished Task List Report, (2) HEMS Status Report, and (3) Yearly Workload Projection Report.

These reports do not require special input, because they are generated from data contained in HEMS. The reports are influenced by changes in the SEL, MRI, and the resource expenditure information submitted against Work Order Phases. The first two are generated monthly; the third is requested when desired by the DFAE.

Unaccomplished Task List Report

The HEMS Unaccomplished Task List Report (see Figure 10) lists all tasks scheduled by HEMS but not completed within the designated time interval. This provides the DFAE with a review of actual performance against the established recurring maintenance workload. The Unaccomplished Task List Report provides the tasks which were canceled for a specific month for each shop. The listing includes the SEID, Equipment/System Description, Facility Number, Maintenance Requirement Number and Description, Crew Size, Standard Hours, Date Scheduled, and the Last Date Completed.

HEMS records completion of tasks by phase. If a phase has not been completed, then all tasks within that phase will be listed as unaccomplished. The DFAE must therefore check the Unaccomplished Task List and remove tasks which were actually accomplished. The remaining unaccomplished tasks are the workload by shop which was not accomplished due to lack of available resources. If the same tasks remain unaccomplished consistently, the DFAE should have the equipment checked and serviced immediately or have the frequency changed to a more appropriate cycle. The workload which cannot be accomplished in each shop is documented on the Unaccomplished Task List Report and will provide the DFAE with potential justification for seeking additional resources.

DATE FEB 76 — REQUIREMENTS LIST BY MAINTENANCE REQUIREMENT NUMBER — X-TMY-013 — PAGE 27

MAINT REQ NO	REQ SEQ NO	MAINT REQ DESCR	EQ TYPE CD	SYS TYPE CD	SYS NO	EQ NO
VV30	1	SVC GATE VALVES	V3	120	41B	
VV30	1	SVC BOILER GLOBE VALVE	V3	120	416	
VV30	1	SVC CHECK VALVE	V3	120	417	
VV30	1	SVC FOS EMERG SHUT-OFF VA	V3	120	42A	
VV30	1	SVC BLR PRESSURE RELIEF V	V3	120	473	
VV30	1	SVC FOS SAFETY VALVE	V3	120	479	
WA10	1	CHECK WASHING MACHINES	W1	650	652	
WA20	1	CHECK WASHING MACHINES	W1	650	652	
WC10	1	INSPECT WATER CLOSET	W2	450		
WK10	1	SVC REL CLN PRE-RNSE SPRA	K2	620	62H	
WK10	1	SVC GLASS WASHER	K2	620	62G	
WK10	1	SVC DISHWASHER	K2	620	62F	
WK10	1	SVC POT & PAN WASHER	K2	620	6AS	
WK20	1	SVC POT & PAN WASHER	K2	620	6AS	
WK20	1	SVC DISHWASHER	K2	620	62F	
WK20	1	SVC GLASS WASHER	K2	620	62G	
WK20	1	SVC REL CLN PRE-RNSE SPRA	K2	620	62H	
WK30	1	SVC GLASS WASHER	K2	620	62G	

Figure 29. Requirements List by Maintenance Requirements Number Report.

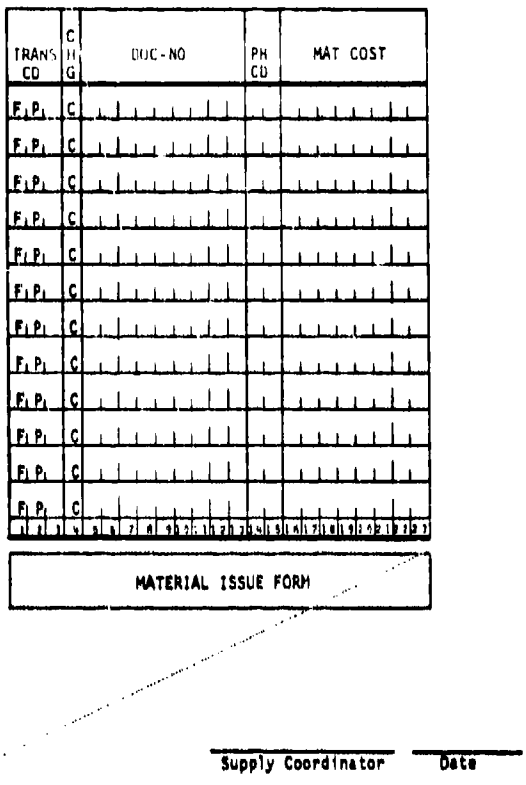

Figure 30. Material Issue Form.

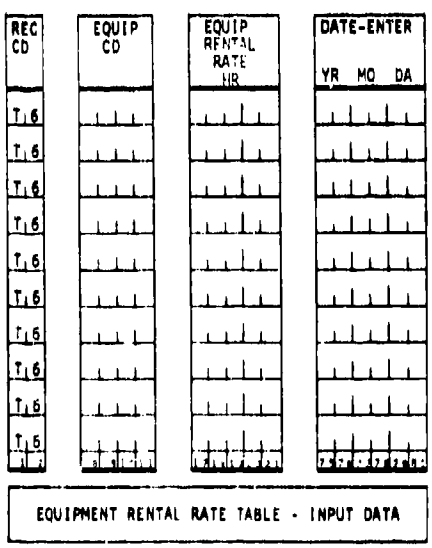

Figure 31. Equipment Rental Rate Table.

HEMS Status Report

The HEMS Status Report (Figure 32) provides the DFAE with a review of all HEMS work currently scheduled to the shops. The HEMS work is identified for each shop by appropriate Document Number and Phase Code. The report divides the scheduled work into the following four categories for each shop and includes the Document Number, Phase Code, Date Scheduled, Estimated Labor Hours, Actual Labor Hours, and the Total Cost:

1. The New Work Order Phases section lists the work for a specific shop for the current month. This is a complete listing of the new HEMS Work Order Phases to be accomplished.

2. The In-Process Work Order Phases section lists the Work Order Phases which have been previously generated by HEMS but have not yet been completed or canceled. This listing will help the DFAE identify work which must be given a higher priority in order to accomplish it before it is canceled. This work is at least 1 month old.

3. The Completed Work Order Phases section lists the Work Order Phases performed and completed during the past month by each shop.

4. The Canceled Work Order Phases section lists the Work Order Phases which were not completed in the allotted time interval.

Yearly Workload Projection Report

The HEMS Yearly Workload Projection Report (see Figure 33) is an optional report which must be requested by the DFAE and provides the total projected HEMS workload. The DFAE should request this report quarterly or when the SEL or MRI are changed significantly.

The Yearly Workload Projection Report presents the HEMS workload in terms of estimated standard hours for each month during the year specified by the DFAE. The projection is produced for each shop by using the Standard Labor Hour estimates from the MRI and the schedules currently found in the Task File. The DFAE may examine this report to see how the HEMS workload will be scheduled if all work is accomplished during its scheduled month. The hours scheduled for each month can be compared to the man-hours available to perform the work in each shop. The work overloads and underloads may be adjusted by shifting scheduled work to the following month for actual accomplishment.

DATE SEP 75 PAGE 8

HEMS WORKORDER PHASE
HEMS STATUS REPORT

X-TMY-012

SHOP ELECTRIC SHOP E01

DOC NO	PH CD	DATE SCHED	LABOR HRS EST	LABOR HRS ACTU	TOTAL COST
THE FOLLOWING WORKORDER PHASES ARE NEW:					
01900506J	02	7509	0.1		
01900506J	03	7509	4.0		
01900516J	01	7509	3.0		
01900516J	02	7509	3.0		
THE FOLLOWING WORKORDER PHASES ARE IN PROCESS:					
01900216J	03	7508	3.0		
01900216J	05	7508	3.0		
01900216J	08	7508	3.0		
01900216J	10	7508	3.0		
THE FOLLOWING WORKORDER PHASES HAVE BEEN COMPLETED:					
01900216J	02	7508	7.5	13.0	$101.27
01900216J	04	7508	2.5	8.0	$ 62.32
01900216J	05	7508	4.5	10.0	$ 77.90
01900216J	18	7508	2.5	5.0	$ 38.95
THE FOLLOWING WORKORDER PHASES HAVE BEEN CANCELLED:					
01900325J	02	7506	88.0	0.0	$ 0.00
01900325J	04	7506	151.4	0.0	$ 0.00

Figure 32. HEMS Status Report.

Because of the nature of the HEMS rescheduling routines (Date Completed plus the Frequency Cycle), the shifts in workload will be reflected in future projections.

Historical Recordkeeping

The History Master File provides historical recordkeeping containing records of recurring maintenance, deficiency correction/repair activities, and operating hours for each item of select equipment. Inputs are provided internally by HEMS and externally by the DFAE.

History Input

Recurring maintenance (HEMS maintenance) records are generated from the HEMS resource management process. The History File contains a record for each accomplishment of a HEMS task, including MRI Number, Labor Hour Standard, Date Scheduled, Date Completed, Actual Labor Hours, Labor Cost, Miscellaneous Cost (equipment and supplies), Document Number, and Phase Code. Also included is a count of times scheduled.

Deficiency correction/repair (non-HEMS) activities against a Select Equipment may be entered at the discretion of the DFAE on a Deficiency Correction/Repair Record Form (see Figure 11). Each record reports a single event, including Date Completed, Narrative, Deficiency Code, Actual Labor Hours, Deficiency Dollars for the Total Event, Document Number, and Phase Code.

DATE SEP 75 YEARLY WORKLOAD PROJECTION (STD. HRS.) PAGE 2

FROM 7509 TO 7608

X-TMY-007

		JUL	AUG	SEP	OCT	NOV	DEC
SHOP MECHANICAL SH	M01	159	784	88	147	114	85
SHOP PLUMBING SHOP	M02	176	98	9	216	18	36
SHOP OPERATORS	M03	14	8	11	32	8	8
SHOP PIPEFITTERS	M04	4	20	2	10	10	2

FROM 7509 TO 7608

X-TMY-007

		JAN	FEB	MAR	APR	MAY	JUN	TOTAL STD HRS
SHOP MECHANICAL SH	M01	149	234	88	146	115	85	2,194
SHOP PLUMBING SHOP	M02	176	63	9	216	15	47	1,079
SHOP OPERATORS	M03	14	8	9	18	8	8	146
SHOP PIPEFITTERS	M04	4	15	2	12	8	3	92

Figure 33. Yearly Workload Projection Report.

Equipment operating hours are recorded for each Select Equipment. The recorded value is the estimated amount on the SEL Form, unless overridden by the DFAE. The overriding is accomplished by the input of an Operating Hour Log (Figure 12) for a given month. When available, this input is also used to convert H-type maintenance frequencies to a monthly Frequency Cycle.

Finally, since the History File is not updated in the usual manner (add, change, delete), the DFAE must be able to note both changes in select equipment identification and errors in the data entry. This capability is provided by the HEMS Comment Input Form (Figure 13). Comments entered in this manner will always be retrieved with the appropriate select equipment information to inform the reader that changes have occurred.

History Reporting

The History File records are available to the DFAE on the HEMS Maintained Equipment Analysis Report. This report by specified SEID is requested by card input; the DFAE must complete a punch card form the Maintained Equipment Analysis Match Command Form (Figure 34).

The DFAE then can choose from the following seven parameters which indicate the equipment histories to be retrieved:

1. Parameter "1" indicates a request for a specific SEID. The History File records will be provided for only the maintained systems or maintained equipment whose SEID is requested.

2 Parameter "2" indicates a request for all of the History File records.

3. Parameter "3" indicates a request for the records of all maintained systems having a particular System Type Code

4. Parameter "4" indicates a request for all the history records for maintained systems having a specified System Number.

5. Parameter "5" indicates a request for all the history records having a specified Equipment Type Code.

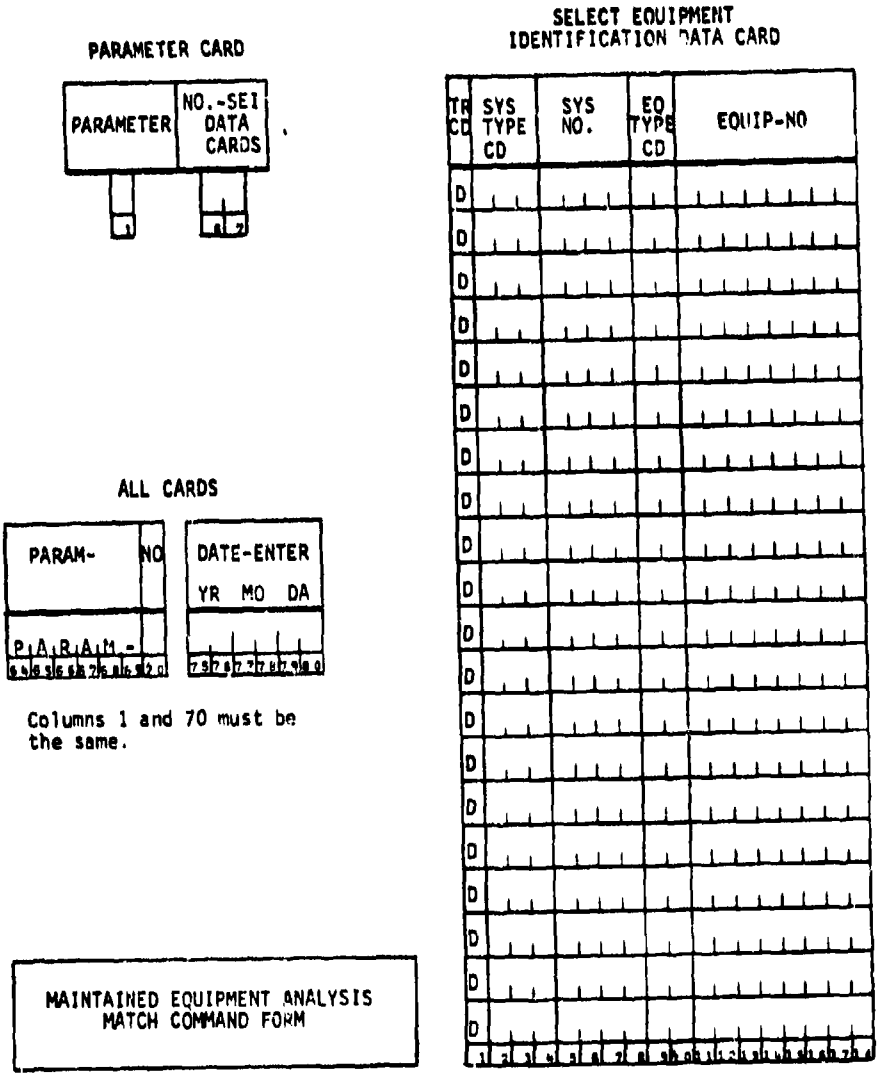

Figure 34. Maintained Equipment Analysis Match Command Form.

6. Parameter "6" indicates a request for records having a specified System Type Code in combination with a specified Equipment Type Code.

7. Parameter "7" indicates a request for equipment records having a specified System Number in combination with a specified Equipment Type Code.

The DFAE may choose one or more of these parameters to obtain the History File records which are to be reported. The entire History File should be obtained at least once annually by requesting Parameter "2." However, since the entire History File can be quite large, the other parameters should be used throughout the year to obtain, as required, only those records which are desired.

The HEMS Maintained Equipment Analysis Report provides a complete report of all records for each requested select equipment or system. Records are reported in the following order:

1. SEL extract including SEID, Facility Number, Equipment/System Description, Manufacturer's Name, Model Number, Unit of Measure and Amount, Acquisition Cost, Date Installed, Modification Date, and Warranty Date.

2. DFAE input comments in chronological order.

3. HEMS maintenance tasks in Date Completed and MRI Number order.

4 Deficiency correction/repair activities in Date Completed order.

5. Equipment operating hours.

Figure 14 provides an example of the Maintained Equipment Analysis Report.

4 HEMS IMPLEMENTATION

General

HEMS has been designed as a stand-alone automated DFAE tool which can be used in conjunction with IFS. The DFAE is responsible for maintaining the functional aspects of the system. The Installation Management Information System Office (MISO) operates the system and provides a satisfactory level of responsiveness to DFAE needs. This chapter describes both DFAE and MISO responsibilities and the procedures required to interface HEMS with IFS.

DFAE Responsibilities

Establishing the Select Equipment Inventory

The DFAE must decide how HEMS will be used. HEMS can be applied to either one complex facility at the installation, such as the hospital, or to an unlimited number of facilities. The DFAE must weigh the benefits and requirements for automating recurring maintenance activities resource management for each facility on the installation against what he/she considers to be a manageable and justifiable recurring maintenance workload. HEMS is designed as a tool for maintaining complex facilities that contain critical utility systems or equipment; it may be used for any utility system or equipment requiring recurring maintenance. The DFAE should code his/her HEMS data in accordance with IFS instructions and with consideration for the whole installation; however, HEMS should be established for the most critical facilities first, with other facilities added later as experience with HEMS procedures is gained.

After the DFAE determines the facilities to be included in HEMS, he/she must decide what systems and equipment will be selected and monitored. The SEL may contain only those critical items which must not fail or all the items requiring recurring maintenance. Establishing the equipment inventory for each facility will require substantial effort, which is additional reason to limit the number of facilities initially included in HEMS and to establish a phased program to add additional desired facilities. The systems/equipment within a given facility may also be added in phases, from the most to the least critical. This will help to implement HEMS for the desired facilities as soon as possible. It should be noted that all equipment may be put in HEMS to provide complete inventory control. This will make the SEL very large, but will not necessarily affect the remainder of HEMS, since the size of HEMS' output is also a function of SOPs established.

Establishing HEMS SOPs

The DFAE must prepare SOPs for the recurring maintenance activities to be monitored under HEMS. Some SOPs may already exist; these will have to be modified in format, and possibly content, to meet HEMS requirements. It is recommended that the DFAE obtain available SOPs from installations already using HEMS as a starting point. HEMS can be implemented only if a minimum of critical maintenance activities are defined. Additional SOPs can be added later.

Establishing the HEMS Coding Structure

Prior to establishing either the SEL or the MRI, the DFAE must consider the impact of the coding structure on the scheduling and reporting of the HEMS workload. The coding structure required by IFS is a good starting point. From here, the DFAE must decide how to schedule recurring maintenance, which is primarily a function of Facility Suffix Code, Equipment Number, System Number, and Shop Code.

The Facility Suffix Code can be used to identify sections, floors, or rooms within a given Building Number. Building Number and Facility Suffix Code are used together to identify the Facility Number. This field must be properly defined to insure that proper Select Equipment control can be established without violating established IFS rules. It should also be remembered that the Facility Number is used to establish the HEMS Work Order Phase and therefore should be defined as the limited location to which the DFAE desires to schedule a maintenance crew.

Equipment Number is an installation-unique identification for utility systems equipment. This number may also be used to identify a group of similar equipment, if desired. This simplifies the SEL but may compound the MRI, since each group of similar equipment which has a different number of equipment items will require a different estimate (Labor Hour Standard) and therefore different MRI Forms. Note that the same SOP may have more than one MRI Form associated with it. Furthermore, aggregation of individual equipment items will affect the level of detail available in the HEMS History File and the ease of entering such items as deficiency correction/repair maintenance and operating hours. Location of equipment within a Facility Number Location may also be hindered by this aggregation. Note that all equipment numbering is done within a specified Equipment Type Code.

The System Number is an installation-unique identification for utility systems. It may be used to define general types of systems within a given System Type Code, indicate location within a facility, or a combination of both. Again, the choice may affect the level of HEMS history detail, the ease of scheduling, or the ease of SOP preparation. Careful use of the System and Equipment Numbers can greatly enhance the DFAE's control of the HEMS workload.

Appendices A and B provide System and Equipment Type Codes, respectively. These are standard codes to be used for all installations. Since there may be omissions, limited additions can be made to each list; however, care should be taken to insure that these codes are not used for installation-unique identification. Additions should be coordinated with other HEMS users.

Finally, assignment of the Shop Code should follow guidelines set forth in IFS. Deviations, where allowed, can affect both the number of MRI Forms required and the level of detail in Work Order Phase identification. If the DFAE can define the Shop Code in greater detail, he/she may be able to more effectively use the Requirement Sequence Number on the MRI Form; however, this will tend to increase the size of the MRI. On the other hand, loss of detail in Shop Code identification may conflict with IFS and cause problems in determining effective shop rates.

These primary codes define the basic HEMS coding structure and have the greatest impact on the degree to which HEMS can provide a tool for accomplishing recurring utility maintenance in the manner chosen by the DFAE. This coding structure must be established prior to any SEL or MRI entries being completed. Although the HEMS workload can eventually be defined, a change in the basic coding structure due to unforeseen identification problems or a change in maintenance philosophy can cause numerous problems and many wasted man-hours; HEMS implementation is definitely an example of initial planning being most beneficial.

MISO Responsibilities

HEMS is comprised of 27 ANSI COBOL programs written for the U.S. Army Computer Systems Command Base Operations Computer Configuration (IBM 360-30/40/50, 128K, DOS). All master files are stored on magnetic tape, and no more than two tape drives are required at one time. All output is spooled for later printing.

HEMS is operational once per month, with a run-time of 1.5 to 3 hours, depending on the number of optional reports requested by the DFAE. HEMS runs are made in the middle of each month at approximately 30-day intervals, as specified by the DFAE. Two-day turnaround for run-time is requested of MISO.

HEMS has adequate editing to prevent reruns. Reruns requested by the DFAE will be accomplished only when MISO time is available. Likewise, optional reports requested at times other than the normal cycle will be run only when time is available.

HEMS Status

HEMS is a Class C system under AR 18-1, approved only for operation at the TRADOC installation at Fort Gordon, GA. The system is currently supported and maintained on a reimbursable basis by CERL, P.O. Box 4005, Champaign, IL, 61820. The applicable point of contact is Mr. David W. Brown, Facility Systems Branch, Facility Operations Division, CERL, commercial telephone (217) 352-6511 (FTS: 958-7221).

Installations that want to use HEMS should contact the Directorate of Management Information Systems, U.S. Army Training and Doctrine Command, Fort Monroe, VA, 23651, ATTN: Ms. Bonnie Lackey, telephone (804) 727-4115 (AUTOVON: 680-4115). HEMS documentation in the form of TRADOC Manual 18-1-B-TMY is available from this source.

5 MANAGEMENT INITIATIVES

HEMS is an automated management tool designed to identify, monitor, and analyze the recurring maintenance workload. With HEMS, the DFAE can manage the recurring maintenance program which best fits the installation's facilities and maintenance resources.

HEMS provides the DFAE with the framework to establish a program to both reduce planning time and increase the capability of monitoring and analyzing the maintenance activities. Depending on how extensive the recurring maintenance program is, the DFAE should be able to provide more reliable and safe facilities while increasing productivity and reducing overall costs.

The DFAE will use HEMS as an automatic control for scheduling recurring maintenance activities. When the correct maintenance is performed at the correct time, the equipment becomes more reliable, since both the frequency and the amount of downtime and replacement are reduced. Emergency work and major repairs can be reduced substantially when shop personnel are effectively used to service and repair equipment on a scheduled basis.

The following sections discuss management initiatives which will insure maximum use of HEMS capabilities.

Definition of HEMS Workload

The DFAE should approach HEMS workload definition with the idea of documenting formerly undocumented maintenance requirements. Realizing that additional resources are scarce or nonexistent and that deficiency correction/repair maintenance is of highest priority, the DFAE must define only that workload which is critical to mission reliability and personnel safety. HEMS will provide IIO-type visibility to the defined workload and documentation of DFAE performance against the defined schedules.

After having defined the HEMS coding structure (see Chapter 4), the DFAE must select and document the SOPs which will provide critical inspections, replacements, and service to select utility systems and equipments. Care must be taken to assign proper identification and sequencing to both Select Equipments and SOPs. Initial estimates of Labor Hour Standards should be based on experience and can be updated from collected data as the system is used.

The means of accomplishing the workload is extremely important. Once defined, the workload (SEL and SOPs) should be reviewed and approved by the DFAE. Approval of individual HEMS Work Orders will not be required, since their contents are completely controlled by the contents of the SEL and MRI Master Files. When the workload is approved, the DFAE should commit his/her resources to its performance. The workload may increase or decrease over time, but it must always reflect the DFAE's definition of critical and therefore high-priority activities, if HEMS is to remain an effective tool.

HEMS Analyst

The key to effective use of HEMS capabilities is the ongoing management of the HEMS workload. The effort required for this job will vary according to the workload's size and nature. It is best if this task is performed by one individual who can monitor and coordinate the entire recurring maintenance program supported by HEMS. This provides decisionmaking and review with a continuity and cohesion not provided by a segmented group of individuals.

Responsibilities of the HEMS analyst should include maintenance of the SEL and MRI Master Files, maintenance of HEMS SOPs and the central reference library, assignment of installation-unique identification numbers, review of planning and status reports, analysis of equipment and resource performance, and review of system feedback from work crews and supply. These activities will help insure that HEMS will continue to operate effectively and without problems. The analyst should be involved in initial HEMS workload definition activities.

Numbering Select Equipment

The HEMS System and Equipment Numbers are installation-unique identifiers which can be used to physically tag and identify installation utility systems and equipment. These greatly facilitate location of specific equipment, familiarity with HEMS coding requirements, and control of the equipment inventory.

Control of SOPs

Effectiveness of HEMS SOPs can be greatly increased by locating copies of pertinent SOPs at or near the maintenance activity. This will complicate SOP maintenance but should increase work crew effectiveness. When changes are made to SOPs, the central (master) SOP book can include a list of locations of these distributed copies to facilitate recording of changes in them.

Care must be taken to insure that all MRI Forms have associated SOPs, and vice versa. Lack of proper control can result in an incomplete HEMS workload, the lack of a ready reference for work crews, and the possibility of critical work remaining undone.

If possible, the SOP should be cross-referenced to key manufacturer literature in a central library located near the master SOP. This facilitates quick and direct reference to operating and assembly instructions, spare parts information, and repair information not necessarily contained in the SOP.

Planning Maintenance

Since HEMS is a recurring maintenance system, SOPs and scheduled tasks do not cover deficiency correction and repair work. However, HEMS does periodically get a work crew to a critical utility location to inspect and assess the current condition of the Select Equipment. When deficiency or repair requirements are identified, there should be a procedure for generating a deficiency correction or repair work order. If the work crew is properly equipped and skilled and the requirement is an emergency, the correction can be made immediately and reported later. If the crew cannot make the correction or if it can be postponed, it should be scheduled as a planned correction action. Effective use of planned maintenance will reduce equipment downtime and replacement as well as the number of emergency service calls.

Scheduling HEMS Maintenance

Although monthly HEMS Work Orders are produced automatically, the DFAE retains control over the basic schedule by controlling when the work is accomplished and when new requirements are added to the HEMS workload.

Recall that HEMS tasks are rescheduled by adding the Frequency Cycle to the month the work was accomplished. This means that the DFAE can shift workload by delaying accomplishment; however, note that delaying accomplishment for more than 1 or 2 months may cause task cancellation. HEMS will then reschedule the work for the month following the cancellation and list the associated tasks on the Unaccomplished Task List. Also note that HEMS tasks cannot be shifted individually; only the Work Order Phase can be delayed, which shifts the schedule on all tasks in that phase.

New tasks added to the HEMS workload will be scheduled for the month immediately following their addition. If their accomplishment must be delayed, their addition to the workload should also be delayed.

Once a reasonable and workable schedule of tasks has been established, the DFAE should strive to maintain it. HEMS has built-in flexibility for up to 2 months of delay; however, such delay will affect the future schedule. To maintain the schedule, the DFAE must insure that work is accomplished in the scheduled month by assigning it a sufficiently high priority to receive resources. If this cannot be done, the scheduler must insure that work is accomplished in the allotted time interval and thus not canceled and reported on the Unaccomplished Task List. To do this, the scheduler must insure that any monthly phases (HEMS . . . 01) on the given month's Work Orders, bimonthly phases (HEMS . . . 02) on the previous month's Work Orders, and quarterly phases (HEMS . . . 03) on Work Orders 2 months old receive sufficient priority to be accomplished in the current month. Review and coordination of HEMS resource management planning documents (see Chapter 3) can greatly facilitate this process. Review and use of these reports insures that the HEMS analyst can level workload, assure accurate estimates, and maintain direct control of the HEMS workload.

6 HEMS BENEFITS AND COSTS

General

The primary benefit of HEMS is its capability to define, document, and program critical recurring equipment maintenance activities, which will be reflected in an appropriate adjustment of manpower authorization and an increase in customer satisfaction. With an effective recurring maintenance program, a DFAE

should be able to reduce utility equipment failure and downtime by identifying and correcting problems on a planned basis before they occur or are identified by a dissatisfied customer. This "planned" maintenance concept will facilitate improved scheduling and tend to decrease the amount of overtime required for emergency utility activities.

Secondary benefits of the system include the capability to analyze equipment performance through the History File, and the ability to reference drawings and specifications and locate specific equipment items through the inventory of Select Systems and Equipments.

Operating Experience

HEMS has been operational at Fort Gordon, GA, since September 1975. The system was implemented at a new hospital (D. D. Eisenhower Army Medical Center) and therefore did not replace an existing system. Consequently, no directly observed cost or benefit data are available; however, the following benefits and costs observations have been made by personnel at Fort Gordon after approximately 12 months of HEMS operation.

Benefits

1. HEMS is a formal system which provides the capability for planning and scheduling critical recurring maintenance well in advance of need. Current systems do not function because the maintenance staff is kept too busy responding to emergencies to take time for routine planning, scheduling, and record keeping.

2. HEMS provides the capability to switch from a "break and fix" policy to a planned inspection and repair policy based on planned maintenance. Users feel that with HEMS, approximately 80 to 90 percent of the deficiency correction/repair effort can be accomplished as planned maintenance before breakdown, whereas formerly, approximately 95 percent of all maintenance was accomplished after breakdown. The result is a much higher level of customer satisfaction and a higher level of workforce productivity. This level of planned maintenance has not yet been achieved at Fort Gordon.

3. HEMS provides feedback not previously available to the DFAE, which enables him/her to estimate equipment service life and abandonment criteria and to make repair/replace decisions. The result is an increased capability to plan and document workload and increase workforce productivity.

Costs

The following is a simple case study of the Fort Gordon HEMS operation after approximately 12 months:

1. Number of select systems and equipments: 1956

2. Number of maintenance requirements monitored (equal to or greater than number of SOPs): 445

3. Number of derived recurring maintenance tasks: 2519

4. Man-months to define and load data: 6 @ $1,250 = $7,500

5. Monthly keypunching requirement: 3 to 4 man-hours @ $4 = $12 to $16

6. Monthly computer run-time (IBM 360-40, BASEOPS): 1 1/2 hours @ $75 = $112.50

7. Monthly reproduction time: 3 hours @ $30 = $90

In addition, Fort Gordon employs a service order clerk approximately one-third time to oversee the HEMS operation.

7 SUMMARY AND CONCLUSIONS

This report provides information for a DFAE to use in evaluating the applicability of HEMS for a particular installation. Included is an explanation of the concepts necessary for understanding the system (Chapter 2), a detailed discussion of the five maintenance management functions supported by HEMS (Chapter 3), a brief explanation of the system implementation (Chapter 4), and an outline of the management, costs, and benefits of the system (Chapters 5 and 6).

In 12 months of operation at Fort Gordon, GA, HEMS provided direct benefits and increased capabilities to the DFAE, including the capability for planning and scheduling critical recurring maintenance, the capability of having a planned inspection and repair policy, and the capability of estimating equipment service life and abandonment criteria (p 90). The applicability of HEMS to other installations must be evaluated on a case-by-case basis, using the information presented in this report. To make HEMS an effective tool for managing critical utility system and equipment recurring maintenance activities, care must be taken to insure proper workload definition and coordination (Chapter 4).

APPENDIX A:

SYSTEM TYPE CODES USED BY HEMS

System Type Code	System Type
100	Heating Systems (not a valid system type)
110	Heating Generation
120	Heating Distribution
130	Heating Controls
200	Air-Conditioning Systems (not a valid system-type)
210	Chilled Water Generation
220	Chilled Water Distribution
230	Air-Conditioning Components
300	Ventilation Systems (not a valid system type)
310	Ventilating
400	Plumbing (not a valid system type)
410	Plumbing, Water
420	Plumbing, Medical Gas
430	Plumbing, Sewage and Waste
440	Plumbing, Fuel
450	Plumbing, Fixtures
460	Plumbing, Controls
470	Plumbing, Steam
500	Electrical Systems (not a valid system type)
510	Electrical Generation
520	Electrical Distribution
530	Lighting
540	Electrical Interior
600	General Equipment (not a valid system type)
610	Equipment, Communication
620	Equipment, Food Service
630	Equipment, Laboratory
640	Equipment, Shop
650	Equipment, Maintenance
660	Equipment, Emergency
670	Equipment, Waste and Garbage
680	Equipment, Internal Transportation
690	Equipment, Specialized
700	Treatment (not a valid system type)
710	Water Treatment
720	Sewage Treatment
800	Storage Systems (not a valid system type)
810	Water Storage
820	Fuel Storage
910	Steam Generation
920	Improved Grounds

APPENDIX B:

EQUIPMENT TYPE CODES USED BY HEMS

EQUIP CODE	EQUIPMENT NAME
A1	Aerator
A2	Air Handling Unit
A3	Alarm
A4	Annunciator
A5	Air Separator
B1	Ballast
B2	Bath
B3	Battery
B4	Battery Charger
B5	Blower
B6	Boiler
B7	Bubbler–Swimming Pool
C1	Cabinet, Warming (Food Service)
C2	Cable
C3	Capacitator
C4	Chemical Additive Equipment
C5	Chlorinator
C6	Circuit Breaker
C7	Clock
C8	Cock
C9	Coil
CA	Combustion Chamber
CB	Compressor
CC	Condenser
CD	Connector
CE	Control Panel
CF	Cooler
CG	Cooling Tower
CH	Chiller
CI	Counter
CJ	Counter, Dietary
CK	Counter, Medicine
D1	Damper
D2	Deaerator
D3	Dimmer
D4	Disposer
D5	Drain
D6	Dryer
D7	Duct
D8	Dumbwaiter
DA	Dust Collector
DB	Door
E1	Elevator
E2	Extinguisher
F1	Fan
F2	Faucet
F3	Filter
F4	Food Preparation Equipment
F5	Food Serving Equipment
F6	Food Storage Equipment
F7	Fountain
F8	Furnace
G1	Gage
G2	Generator
G3	Grill
G4	Grounding Equipment
H1	Heat Exchanger
H2	Hoist
H3	Hood
H4	Humidifier
H5	H-V Unit
H6	Hydrant
H7	Hydrochlorinator
H8	Heater Unit
H9	Humidistat
I1	Incinerator
I2	Irrigation Equipment
I3	Ice Maker
K1	Kitchen-Washing Equipment
L1	Lamp
L2	Lighting Fixture
L3	Lighting Exterior
L4	Line Isolation Monitor
M1	Manhole
M2	Measuring Instrument
M3	Medical Gas
M4	Meter
M5	Motor (less than 1 hp)
M6	Motor (1-5 hp)
M7	Motor (greater than 5 hp)
M8	Muffler
M9	Mains
MA	Mixing Box
MB	Manometer
MC	Motor Control Center

EQUIP CODE	EQUIPMENT NAME
P1	Pipe and Accessories
P2	Pipe Insulation
P3	Pneumatic Tube
P4	Pool - Swimming
P5	Power Lines
P6	Pump
P7	Pump, Circulating
P8	Panelboard
R1	Raceway
R2	Radiator
R3	Refrigeration Equipment
R4	Regulator
R5	Reservoir
R6	Retriever
R7	Refrigerated Room
R8	Receptacle
R9	Register
S1	Scale
S2	Shower
S3	Signal
S4	Sink: Lavatory
S5	Special Security and Disbursement Door
S6	Sprinkler Equipment
S7	Steam Separator
S8	Starter Magnetic
S9	Strainer
SA	Substation
SB	Switch
SC	Sterilizer
SD	Steam Turbine
T1	Tank
T2	Thermometer
T3	Transformer
T4	Trap
T5	Trayveyor, Conveyor
T6	Thermostat
T7	Troffer Light
U1	Urinal
V1	Vacuum Breaker
V2	Vacuum Cleaner
V3	Valve
V4	Vent
V5	Vacuum Pump
W1	Washer
W2	Water Closet
W3	Water Heater
W4	Water Softener
W5	Water Still

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